The treatment types are as follows:

1) Adaptation
2) Conservation
3) Development

For each combination of the above-mentioned classifications, detailed regulations, -for example, the upper limit of number of stories- are determined. Figure 2.2-2 is a summary of the land use regulation map, classified by land use category. Table 2.2-1 shows the area of each designated use zone by Ward. Of 49,217.3 ha of the Study Area, 28,396.2 ha (57.7%) are designated as the above-mentioned use zones.

The areas of the category "Others" in Santa Fe, Los Martires and La Candelaria, which together total 720.4 ha, are of the central part of the city originally designated as "Multipurpose-use zone" or other use zones. DAPD made blank recently, intending to designate a special use zone for the conservation and rehabilitation of the buildings and blocks of historical importance.

The area of land which has development potential is, therefore, 20,100.7 ha. This figure is obtained by subtracting 720.4 ha from 20,821.1 ha, i.e., the total area of "Others". Some parts of the non designated land are already urbanized by various development activities and squatters.

Table 2.2-1 Use Zoning in 1995

No. and name of Ward	Special residential zone	General residential zone	Institutional zone	Industrial zone	Multipurpose-use-zone	Metropolitan service facil. zone	Metropolitan green zone	Others	Total (ha)
1 Usaquen	1,621.3	981.1	168.3	0.0	152.1	0.0	108.3	1,307.9	4,339.0
2 Chapinero	598.3	148.0	0.0	0.0	311.8	0.0	4.1	365.0	1,427.2
3 Santa Fe	51.0	89.3	4.9	0.0	57.9	0.0	0.0	553.7	756.8
4 San Cristobal	0.0	1,326.2	0.0	0.0	161.2	0.0	22.4	158.8	1,668.6
5 Usme	0.0	934.7	3.7	0.0	38.9	0.0	0.0	3,250.8	4,228.1
6 Tunjuelito	0.0	534.7	256.6	94.1	77.2	0.0	86.6	0.0	1,049.2
7 Bosa	0.0	647.4	0.0	77.5	53.3	54.9	0.0	1,552.5	2,385.6
8 Kennedy	0.0	2,088.3	0.0	235.9	42.2	60.8	62.3	1,275.3	3,764.8
9 Fontibon	0.8	792.5	0.0	656.9	175.5	702.2	4.4	923.9	3,266.2
10 Engativa	114.4	1,719.7	92.7	247.5	362.3	0.0	111.0	795.4	3,443.0
11 Suba	1,675.1	1,685.4	62.8	174.5	346.7	0.0	259.1	5,411.6	9,615.2
12 Barrios unidos	230.1	484.2	55.7	0.0	284.0	0.0	144.4	0.0	1,198.4
13 Teusaquillo	287.7	263.5	238.9	0.0	380.9	0.0	180.6	0.0	1,351.6
14 Los Martires	42.1	15.7	0.0	0.0	466.0	0.0	19.5	109.0	652.3
15 Antonio Narino	0.0	0.0	0.0	0.0	472.8	10.2	0.0	0.0	483.0
16 Puente Aranda	23.4	911.5	0.0	706.9	79.6	0.0	8.4	0.0	1,729.8
17 La Candelaria	54.7	0.0	27.5	0.0	55.5	0.0	0.0	57.7	195.4
18 Rafael Uribe	0.0	488.9	43.6	60.5	378.6	0.0	7.1	0.0	978.7
19 Ciudad Bolivar	0.0	1,357.9	52.3	214.7	0.0	0.0	0.0	5,059.5	6,684.4
Study Area Total	4,698.9	14,469.0	1,007.0	2,478.5	3,896.5	828.1	1,018.2	20,821.1	49,217.3

As for the land use regulations in the surrounding municipalities, there are two types of land use plan maps. One is for the whole administrative area, and the other for the urban area. The former designates zones for ecological protection, agriculture, mining, industry, recreation and the urban area within the jurisdiction of the municipality. The latter designates zones for residence, commerce, industry and recreation within the urban area. Figure 2.2-3 shows an outline of land use regulations of municipalities where related information was obtained through visits to them.

2.2.3 Existing Development Projects

There are many housing and commercial center development projects being implemented by the private sector. However, not many of these projects are large-scale or important. The most important one is the Ciudad Salitre. This project (organized and financed by the BCH) is located in Zone 82 (Teusaquillo Ward), with the planned number of houses of 20,000 (population of about 80,000 people) and the

expected employment of more than 100,000 people. At present construction work is going on, and apartment houses completed in some parts of the project site are being sold and rented. According to the development plan, all construction will be finished by the year 2000.

Other important housing projects planned by DAPD are Tintal Norte, Tintal Sur and Ciudad Bolivar. These projects intend to supply low-cost houses with public utilities by acquiring land in squatter areas by giving merits to landowners for the rise of land price. This development measure is expected to function as a useful method for supplying new houses to low-income classes and improving the environment of squatter residential areas. In the economic activities, the Zona Franca will play an important role. The implementation schedule and the planning scale, however, are not yet clear. The location is along Avenida Centenario in Zone 51 (Fontibon Ward). Though located outside the Study Area, an industrial estate project in Cota and an ambitious land use plan of Chia should be taken into account.

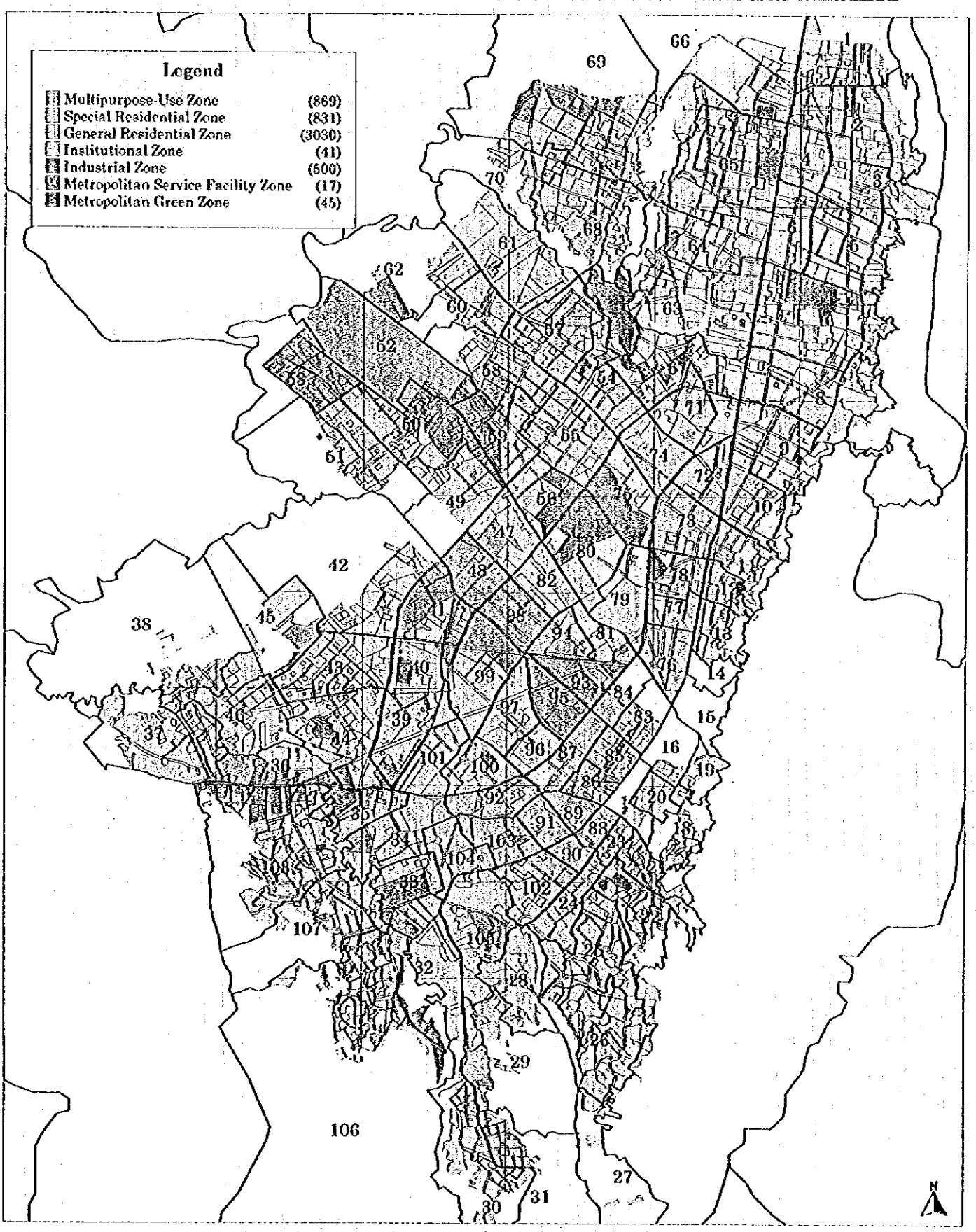


Figure 2.2-2 Land Use Regulation for Bogota

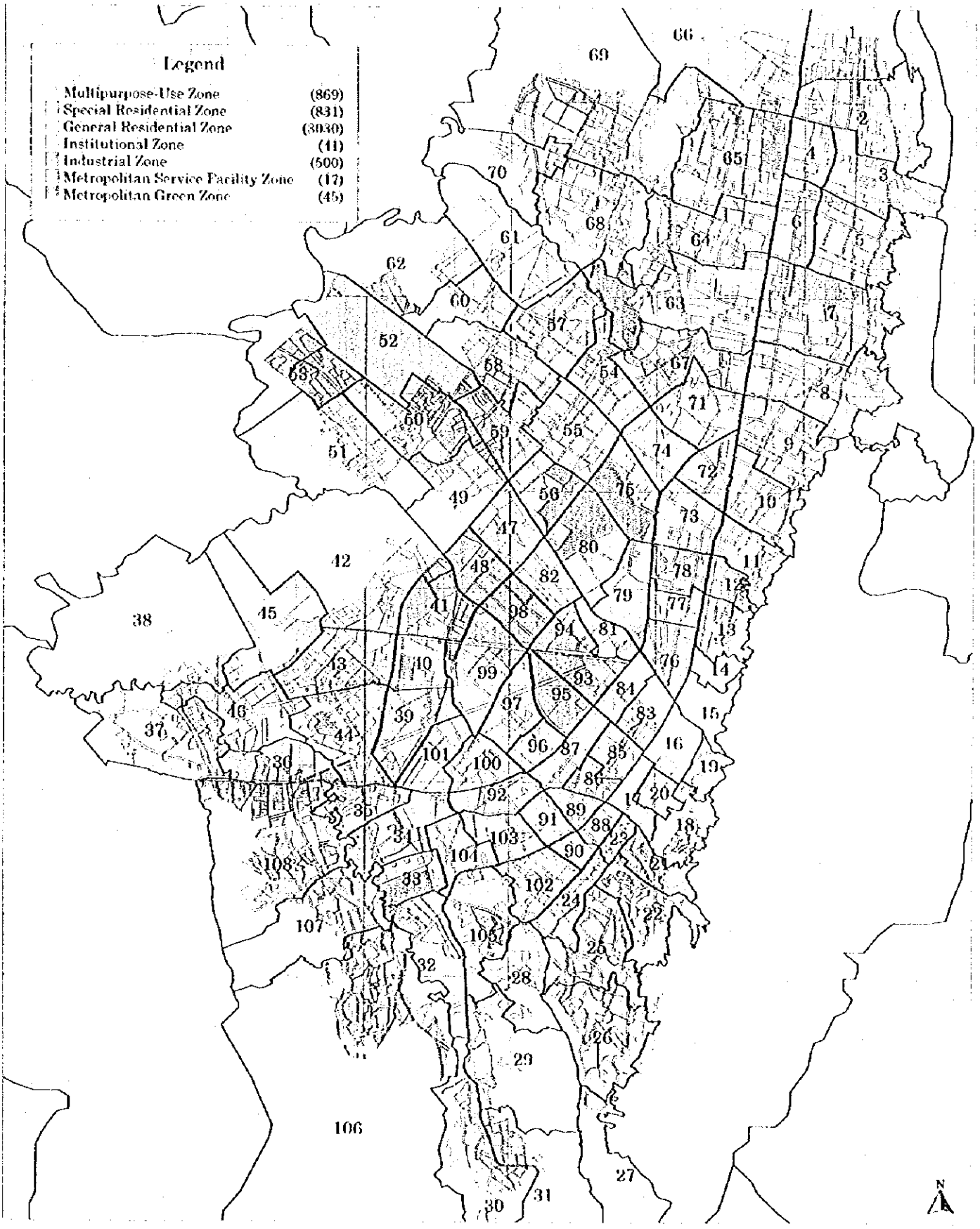


Figure 2.2-2 Land Use Regulation for Bogota

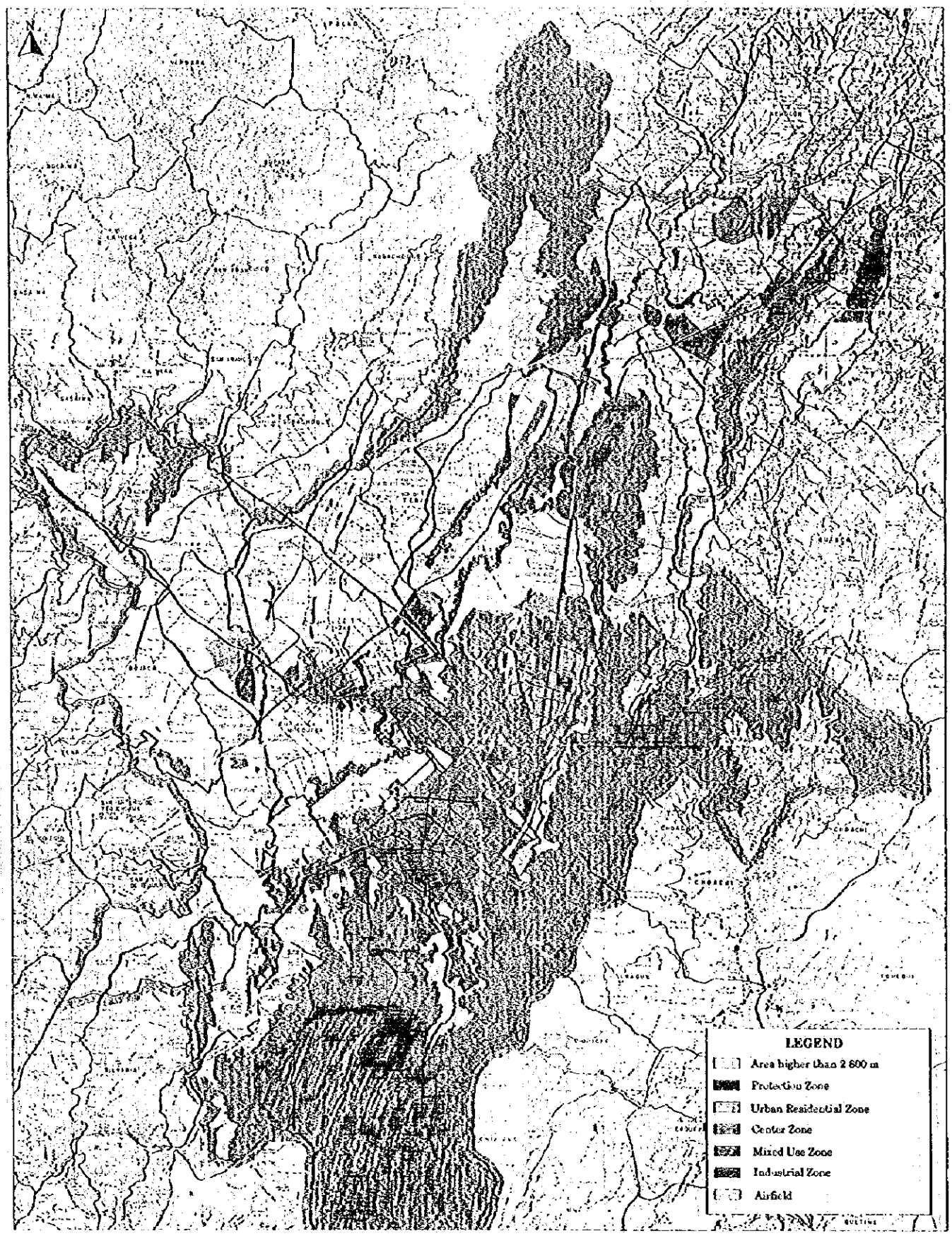


Figure 2.2-3 Land Use Regulation for Surrounding Municipalities

2.3 Population and Employment Distribution

2.3.1 Population Distribution

Table 2.3-1 shows the population distribution in the Study Area in 1995. These populations by zone are obtained using the following process:

1) The estimation of population of each Ward by DAPD
   a) JICA estimation (including Sumapaz): 6,025,000
   b) Old DAPD estimation : 5,509,578
   c) Correction factor : 1.0936=6,025,000/5,509,578
   d) Application of 1.0936 to old estimated population of each Ward
2) The estimation of populations of 108 traffic zones by Study Team
   a) Calculation of numbers of households by zone (Precensus Data)
   b) Distribution of population of each Ward to included zones proportionally to numbers of households of each zone

The most populated zone is Zone 37 with a population of 158,990 (population density: 248.0 persons per hectare), followed by Zone 106 with a population of 155,938 (population density: 31.6 persons per hectare). Zones with a population of 0 are Zones 48 and 52. The former is a complete industrial zone, while the latter is the airport. Zone 82, where Ciudad Salitre is planned and now under construction, has a population of only 72.

The central part of the Study Area, composed of Santa Fe (Zones 14-18, population 147,959), Candelaria (Zones 19 and 20, population 29,321) and Los Martires (Zones 83-87, population 129,800) has a population of 307,080, which makes up 5.1% of the total population.

The second ring of the old urban area, composed of Chapinero (Zones 9-13, population 173,437), Barrios Unidos (Zones 71-75, population 236,698), Teusaquillo (Zones 76-82, population 166,388), Puente Aranda (Zones 93-101, population 385,188), Tunjuelito (Zones 32-35, population 219,585), Rafael Uribe (Zones 102-105, population 330,567), Antonio Narino (Zones 88-92, population 158,016) and San Cristobal (Zones 21-26, population 405,833) has a total population of 2,075,712, which makes up 34.6% of the total population.

The third suburban area, composed of Usaquen (Zones 1-8, population 415,006), Suba (Zones 63-70, population 544,637), Engativa (Zones 54-62, population 834,563), Fontibon (Zones 47-53, population 317,100), Kennedy (Zones 39-46, population 660,692), Bosa (Zones 36-38, population 265,706), Ciudad Bolivar (Zones 106-108, population 362,424) and Usme (Zones 27-31, population 212,080) has a total population of 3,612,208, which makes up 60.3% of the total population.

The central area and the second ring are almost fully urbanized, with the exception of Zone 82 (Ciudad Salitre), and no great population increase can be expected in future. On the other hand, the suburban area already has a great population, but it still has a vast amount of land which can be developed. Therefore, most of the future increases in population will be absorbed in this area, with the greatest absorption in Suba.

Table 2.3-1 (1) Population Distribution in 1995 (Traffic Zone)

Ward no	Zone no	Area of Zone (ha)	Population	Density (p/ha)
1	1	1,382.62	41,961	30.3
1	2	564.49	21,985	38.9
1	3	358.72	69,223	193.0
1	4	175.16	34,115	194.8
1	5	414.58	83,647	201.8
1	6	221.49	33,413	150.9
1	7	659.95	84,628	128.2
1	8	561.94	46,034	81.9
2	9	635.07	47,797	75.3
2	10	299.12	43,073	144.0
2	11	209.28	34,356	164.2
2	12	103.60	20,570	198.6
2	13	180.05	27,641	153.5
3	14	89.20	4,520	50.7
3	15	166.48	21,922	131.7
3	16	170.13	29,717	174.7
3	17	114.38	30,230	264.3
3	18	216.64	61,570	284.2
17	19	102.03	11,402	111.8
17	20	93.43	17,919	191.8
4	21	158.56	18,291	115.4
4	22	341.19	50,309	147.5
4	23	59.23	13,935	235.3
4	24	177.31	59,315	334.5
4	25	411.33	149,564	363.6
4	26	520.95	114,419	219.6
5	27	490.28	10,748	21.9
5	28	308.90	50,867	164.7
5	29	725.96	29,929	41.2
5	30	1,994.68	74,730	37.5
5	31	708.18	45,806	64.7
6	32	365.81	60,268	164.8
6	33	177.45	25,157	141.8
6	34	315.99	83,648	264.7
6	35	189.91	50,512	266.0
7	36	250.13	38,498	153.9
7	37	641.20	158,990	248.0
7	38	1,494.33	68,218	45.7
8	39	301.30	73,378	243.5
8	40	186.85	32,143	172.0
8	41	252.91	14,777	58.4
8	42	1,261.27	64,720	51.3
8	43	382.62	118,291	309.2
8	44	432.11	93,304	215.9
8	45	563.57	116,372	206.5
8	46	384.12	147,707	384.5
9	47	224.89	16,551	73.6
9	48	189.14	0	0.0
9	49	413.76	58,105	140.4
9	50	444.32	104,253	234.6
9	51	785.41	104,230	132.7
9	52	692.03	0	0.0
9	53	516.73	33,961	65.7
10	54	271.51	87,474	322.2
10	55	355.31	139,439	392.4
10	56	218.41	11,055	50.6
10	57	367.55	142,641	388.1
10	58	381.69	106,584	279.2
10	59	282.36	56,073	198.6
10	60	259.73	88,490	340.7
10	61	608.06	152,169	250.3
10	62	698.27	50,638	72.5
11	63	742.46	84,780	114.2
11	64	535.65	65,749	122.7
11	65	646.62	43,492	67.3
11	66	3,872.00	27,218	7.0
11	67	408.22	41,758	102.3
11	68	632.38	139,970	221.3
11	69	2,346.55	75,062	32.0
11	70	431.27	66,608	154.4
12	71	293.32	50,660	172.7
12	72	173.53	38,302	220.7
12	73	238.87	50,741	212.4
12	74	208.44	73,218	351.3
12	75	284.32	23,737	83.6
13	76	189.98	32,578	171.5
13	77	115.63	30,501	263.8
13	78	156.03	26,291	168.5
13	79	243.01	26,327	108.3
13	80	362.22	26,666	73.6
13	81	120.64	23,953	198.5
13	82	164.24	72	0.4
14	83	153.20	30,139	196.7
14	84	121.07	16,803	138.8
14	85	125.10	20,318	162.4
14	86	87.69	25,673	292.8
14	87	165.23	36,865	223.1
15	88	69.48	25,912	372.9
15	89	82.54	31,433	380.8
15	90	63.65	18,797	295.3
15	91	105.84	34,194	323.1
15	92	161.63	47,680	295.0
16	93	161.79	3,197	19.8
16	94	133.12	10,274	77.2
16	95	177.84	3,513	19.8
16	96	106.14	39,099	368.4
16	97	206.25	68,564	332.4
16	98	181.38	6,988	38.5
16	99	374.39	110,911	296.2
16	100	181.85	64,456	354.4
16	101	207.05	78,186	377.6
18	102	223.36	65,461	293.1
18	103	171.91	61,564	358.1
18	104	182.96	69,834	381.7
18	105	400.43	133,708	333.9
19	106	4,942.45	155,938	31.6
19	107	653.46	74,136	113.5
19	108	1,088.39	132,350	121.6
	Total	49,217.25	5,995,000	121.8

Table 2.3-1 (2) Population Distribution in 1995 (Ward)

No.& name of Ward	Area of Ward (ha)	Population	Density (p/ha)
1 Usaquen	4,339.0	415,006	95.6
2 Chapinnero	1,427.1	173,437	121.5
3 Santa Fe	756.8	147,959	195.5
4 San Cristobol	1,668.6	405,833	243.2
5 Usme	4,228.0	212,080	50.2
6 Tunjuelito	1,049.2	219,585	209.3
7 Bosa	2,385.7	265,706	111.4
8 Kennedy	3,764.8	660,692	175.5
9 Fontibon	3,266.3	317,100	97.1
10 Engativa	3,442.9	834,563	242.4
11 Suba	9,615.2	544,637	56.6
12 Barrios Unidos	1,198.5	236,698	197.5
13 Teusaquillo	1,351.8	166,388	123.1
14 Los Martires	652.3	129,800	199.0
15 Antonio Narino	483.1	158,016	327.1
16 Puente Aranda	1,729.8	385,188	222.7
17 La Candelaria	195.5	29,321	150.0
18 Rafael Uribe	978.7	330,567	337.8
19 Ciudad Bolivar	6,684.3	362,424	54.2
Study Area Total	49,217.3	5,995,000	121.8

2.3.2 Employment Distribution

As described in 2.1.5, 2,365,700 employees live in the Study Area. A total of 2,274,500 people work inside the Study Area, and 91,200 people work outside. On the other hand, 97,600 people come into the Study Area from the outer area to work. According to the balance, therefore, the Study Area attracts a few more employees than the outer area.

As a result, the total number of employees working inside the Study Area is 2,372,100 people in 1995. From the standpoint of the economic sector, the employees in the primary and secondary sectors commute out more from the Study Area and those in the tertiary sector commute in more from the outer area (see Table 2.3-2).

Table 2.3-2 Employees by Living and Working Places

Living place	Economic sector	Working place		
		Study Area	Outer area	Total
Study Area	Primary	16,800	10,900	27,700
	Secondary	549,400	24,000	573,400
	Tertiary	1,708,300	56,300	1,764,600
	Total	2,274,500	91,200	2,365,700
Outer area	Primary	700		
	Secondary	23,200		
	Tertiary	73,700		
	Total	97,600		
Total	Primary	17,500		
	Secondary	572,600		
	Tertiary	1,782,000		
	Total	2,372,100		

Table 2.3-3 shows the numbers of employees commuting to outside the Study Area by zone. A considerable number of employees in the primary sector go out to the municipalities of Bogota Metropolitan Area, especially to Madrid, Funza and Cota. The main works should be related to floriculture, a sector which is prospering in the area. For the secondary and tertiary sectors, Chia and Soacha attract many people.

Table 2.3-3 Employees Commuting to outside the Study Area

Zone no. & name	Primary	Secondary	Tertiary	Total
109 Sumapaz	0	0	0	0
110 Cota	1,035	235	3,038	4,308
111 Chia	891	3,794	9,353	14,038
112 Funza	1,058	1,502	3,601	6,161
113 Mosquera	567	2,433	2,905	5,905
114 Sibate	165	1,200	1,737	3,102
115 Soacha	536	4,837	7,990	13,363
116 Bojaca	76	41	99	216
117 Cajica	0	655	1,056	1,711
118 Facatativa	655	934	2,136	3,725
119 Gachancipa	0	62	265	327
120 La Calera	166	794	2,574	3,534
121 Madrid	1,518	1,230	3,388	6,136
122 Sopo	510	520	1,734	2,764
123 Tabio	131	205	76	412
124 Tenjo	328	72	521	921
125 Tocancipa	117	665	648	1,430
126 Zipaquira	347	721	3,379	4,447
Municip. in BMA	8,100	19,900	44,500	72,500
127 North	387	283	2,414	3,084
128 Rionegro	0	0	81	81
129 Subachoque	742	448	855	2,045
130 Villeta	93	512	1,533	2,138
131 Tequendama	735	1,539	2,730	5,004
132 Fusagasuga	0	197	195	392
133 Caqueza	745	726	3,430	4,901
134 Fomeque	0	289	125	414
135 Guasca	98	106	437	641
Outside BMA	2,800	4,100	11,800	18,700
Total	10,900	24,000	56,300	91,200

On the other hand, Table 2.3-4 shows the numbers of employees by zone coming into the Study Area from outside. Main zones which attract laborers of the outer area are

Zones 16, 35, 37, 47 and 85. Zone 16 is the Central Business District (CBD) of Bogota, so it especially attracts employees in the tertiary sector. Zone 35 is composed of an industrial zone and multipurpose-use zone, and is located along Autopista del Sur. Therefore, many people come from Soacha and other municipalities along this highway. Zone 37 is the urban area of Bosa located along Autopista del Sur, and is close to Soacha. Thus, this zone also attracts employees from the area, as mentioned for Zone 35. The Bus Terminal is located in Zone 47. Inter-municipal and inter-departamental bus routes concentrate in the zone. Zone 85 is the central part of Los Martires, and is close to the Central Station.

Table 2.3-5 shows employment distribution in the Study Area as a comparison between the number of employees on living place basis and that on working place basis for each zone. The core of employment is remarkably Zone 16, which has a working population of 192,843 people.

The ratio of the number of employees on working place basis to that on living place basis (hereinafter referred to as W/L ratio) indicates a degree of job opportunity. If the ratio of a zone is 1, the zone can be regarded as self-sufficient in employment. Although some people in those zones go out for work to other zones, the same number of people come into the zone.

The W/L ratio of Zone 16 is 14.94, which shows a very high concentration of jobs in the zone. The W/L ratio of Zone 82 is 191.63. At present, this zone is under construction for Ciudad Salitre and few people live there. The W/L ratios of Zones 93, 95 and 98 are also very high. These zones are fully developed industrial zones and the number of residents is comparatively small. For Zones 48 and 52, it is impossible to obtain a W/L ratio since there are no residents. The former is a complete industrial zone, and the latter is the airport Eldorado.

Other than the above-mentioned zones, a belt of zones from Zone 9 to Zone 15 (Chapinero and Santa Fe); Zone 20 of Candelaria; Zones 83, 84, and 85 of Los Martires; and Zones 76 and 77 of Teusaquillo are all job centers.

Most of the W/L ratios of zones belonging to suburban areas like Bosa, Suba and Kennedy are below 1.00. This means that these zones are residential areas, and many employees living there commute to the job centers.

Table 2.3-4 Employees Commuting from outside the Study Area

Ward no.	Zone no.	Primary	Secondary	Tertiary	Total
1	1	62	323	878	1,263
1	2	0	197	393	590
1	3	0	25	112	138
1	4	5	97	224	326
1	5	2	81	257	340
1	6	0	44	98	142
1	7	13	381	1,284	1,678
1	8	9	128	355	491
2	9	9	315	1,140	1,464
2	10	33	557	2,527	3,117
2	11	12	247	1,094	1,353
2	12	2	107	518	627
2	13	10	202	1,190	1,402
3	14	0	9	34	43
3	15	7	108	759	874
3	16	45	1,184	7,902	9,131
3	17	1	64	351	416
3	18	6	77	153	236
17	19	13	54	312	379
17	20	2	116	891	1,009
4	21	0	0	0	0
4	22	0	13	33	46
4	23	0	69	196	265
4	24	0	83	388	471
4	25	3	93	172	267
4	26	0	5	7	12
5	27	0	2	5	7
5	28	0	33	140	173
5	29	0	0	0	0
5	30	2	29	65	96
5	31	0	43	82	125
6	32	0	232	409	641
6	33	0	67	625	692
6	34	0	70	236	306
6	35	37	2,288	4,861	7,186
7	36	31	708	1,164	1,903
7	37	62	1,675	3,408	5,145
7	38	0	0	0	0
8	39	2	212	336	550
8	40	0	65	122	187
8	41	0	129	182	311
8	42	1	30	91	122
8	43	7	208	1,106	1,322
8	44	1	66	161	227
8	45	22	490	1,390	1,901
8	46	0	71	329	400
9	47	0	1,119	3,881	5,000
9	48	0	40	39	79
9	49	2	23	67	92
9	50	16	734	1,813	2,563
9	51	4	130	238	372
9	52	19	50	598	667
9	53	0	40	72	112
10	54	19	246	507	772
10	55	0	71	144	216
10	56	5	67	258	330
10	57	0	41	118	159
10	58	6	206	434	647
10	59	0	7	18	25
10	60	0	43	110	153
10	61	3	111	327	441
10	62	0	146	594	740
11	63	10	92	299	401
11	64	1	22	82	104
11	65	1	59	162	223
11	66	11	133	403	547
11	67	0	27	93	120
11	68	1	41	80	122
11	69	43	528	1,036	1,607
11	70	0	8	16	24
12	71	1	89	284	375
12	72	10	203	639	852
12	73	3	601	1,310	1,914
12	74	7	412	1,092	1,511
12	75	0	37	82	119
13	76	7	228	1,215	1,450
13	77	32	645	3,313	3,990
13	78	0	102	456	558
13	79	2	23	208	232
13	80	0	151	910	1,061
13	81	0	108	293	401
13	82	4	39	79	122
14	83	20	653	2,465	3,138
14	84	29	937	3,105	4,072
14	85	0	999	4,806	5,805
14	86	0	36	58	94
14	87	2	297	1,001	1,300
15	88	0	1	3	4
15	89	0	0	0	0
15	90	3	55	177	236
15	91	0	124	314	438
15	92	4	268	394	666
16	93	5	185	255	445
16	94	2	71	143	215
16	95	0	205	491	696
16	96	0	5	18	23
16	97	0	8	47	56
16	98	0	565	834	1,399
16	99	0	191	315	506
16	100	0	23	106	129
16	101	6	100	159	265
18	102	0	75	279	354
18	103	1	8	20	29
18	104	4	68	177	249
18	105	0	15	31	46
19	106	1	43	92	136
19	107	0	40	134	174
19	108	16	610	1,025	1,650
	Total	700	23,200	73,700	97,600

Table 2.3-5 (1) Employment Distribution (Traffic Zone) in 1995

Ward no.	Zone no.	No. of employed persons		Ratio
		Living place	Working place	W/L
1	1	16,565	15,197	0.92
1	2	7,121	16,356	2.30
1	3	29,434	16,554	0.56
1	4	16,232	12,551	0.77
1	5	36,385	26,439	0.73
1	6	14,133	16,767	1.19
1	7	38,664	68,764	1.78
1	8	21,652	48,235	2.23
2	9	26,935	74,629	2.77
2	10	20,485	82,620	4.03
2	11	15,258	62,496	4.10
2	12	7,657	41,202	5.38
2	13	10,783	41,115	3.81
3	14	2,670	22,481	8.42
3	15	8,156	42,756	5.24
3	16	12,904	192,843	14.94
3	17	10,905	27,048	2.48
3	18	22,305	4,885	0.22
17	19	4,626	6,570	1.42
17	20	7,070	27,001	3.82
4	21	7,055	2,657	0.38
4	22	18,531	5,983	0.32
4	23	6,803	4,271	0.63
4	24	22,933	16,552	0.72
4	25	52,591	9,603	0.18
4	26	40,002	9,164	0.23
5	27	3,037	877	0.29
5	28	19,153	4,232	0.22
5	29	9,379	2,295	0.24
5	30	24,950	8,528	0.34
5	31	15,824	4,938	0.31
6	32	23,462	12,147	0.52
6	33	10,933	6,115	0.56
6	34	31,314	10,106	0.32
6	35	21,578	24,469	1.13
7	36	13,783	8,208	0.60
7	37	54,820	27,890	0.51
7	38	20,255	4,911	0.24
8	39	30,017	21,996	0.73
8	40	11,672	10,271	0.88
8	41	6,015	8,189	1.36
8	42	24,612	14,208	0.58
8	43	47,048	33,973	0.72
8	44	37,782	16,186	0.43
8	45	41,571	23,237	0.56
8	46	54,115	13,666	0.25
9	47	7,273	15,946	2.19
9	48	0	10,751	
9	49	24,417	18,994	0.78
9	50	42,043	23,893	0.57
9	51	37,950	36,237	0.95
9	52	0	21,390	
9	53	13,047	5,196	0.40
10	54	35,522	25,193	0.71
10	55	58,356	30,998	0.53
10	56	4,882	11,829	2.42
10	57	58,762	25,624	0.44
10	58	42,960	25,521	0.59
10	59	21,472	13,873	0.65
10	60	33,378	10,641	0.32
10	61	63,568	20,193	0.32
10	62	19,470	6,572	0.34
11	63	37,950	30,812	0.81
11	64	29,318	12,892	0.44
11	65	17,086	9,740	0.57
11	66	11,378	8,300	0.73
11	67	19,469	20,949	1.08
11	68	53,224	22,558	0.42
11	69	28,775	14,119	0.49
11	70	25,579	8,709	0.34
12	71	21,522	23,561	1.09
12	72	15,456	18,942	1.23
12	73	18,682	39,438	2.11
12	74	30,166	24,475	0.81
12	75	11,177	12,661	1.13
13	76	13,711	40,123	2.93
13	77	11,007	25,991	2.36
13	78	12,603	24,134	1.91
13	79	10,663	12,584	1.18
13	80	10,815	36,285	3.36
13	81	9,942	12,651	1.27
13	82	31	5,941	191.63
14	83	11,536	30,161	2.61
14	84	6,301	52,617	8.35
14	85	8,038	24,961	3.11
14	86	12,415	8,970	0.72
14	87	15,947	32,943	2.07
15	88	9,759	7,090	0.73
15	89	12,696	6,636	0.52
15	90	7,365	5,831	0.79
15	91	12,686	18,290	1.44
15	92	19,876	15,101	0.76
16	93	1,230	25,081	20.39
16	94	4,669	9,039	1.94
16	95	1,679	29,866	17.79
16	96	15,730	10,096	0.64
16	97	32,128	13,642	0.42
16	98	3,395	34,963	10.30
16	99	45,726	56,071	1.23
16	100	25,276	8,049	0.32
16	101	34,675	21,569	0.62
18	102	25,708	15,687	0.61
18	103	24,974	13,388	0.54
18	104	24,842	11,791	0.47
18	105	49,662	13,958	0.28
19	106	54,041	16,481	0.30
19	107	28,964	6,948	0.24
19	108	45,553	23,977	0.53
	Total	2,365,700	2,372,100	1.00

Table 2.3-5 (2) Employment Distribution (Ward) in 1995

No. & name of Ward	No. of employed persons by living place				No. of employed persons by working place				Ratio
	Primary	Secondary	Tertiary	Total(A)	Primary	Secondary	Tertiary	Total(B)	W/L
1 Usaquen	2,393	32,022	145,771	180,186	2,592	55,669	162,602	220,863	1.23
2 Chapinero	1,324	12,198	67,596	81,118	2,438	55,198	244,426	302,062	3.72
3 Santa Fe	339	16,541	40,060	56,940	1,563	40,870	247,581	290,014	5.09
4 San Cristobal	1,284	49,890	96,741	147,915	265	13,686	34,280	48,231	0.33
5 Usme	296	21,418	50,629	72,343	380	5,941	14,549	20,870	0.29
6 Tunjuelito	739	24,554	61,994	87,287	133	15,039	37,665	52,837	0.61
7 Bosa	1,014	27,968	59,876	88,858	602	14,401	26,006	41,009	0.46
8 Kennedy	1,915	59,269	191,648	252,832	671	37,408	103,647	141,726	0.56
9 Fontibon	2,444	33,377	88,909	124,730	1,528	36,656	94,223	132,407	1.06
10 Engativa	4,048	73,611	260,711	338,370	1,375	48,641	120,428	170,444	0.50
11 Suba	4,208	55,913	162,658	222,779	1,693	34,163	92,223	128,079	0.57
12 Barrios Unidos	504	19,521	76,978	97,003	485	33,165	85,426	119,076	1.23
13 Teusaquillo	1,804	11,136	55,832	68,772	718	26,631	130,360	157,709	2.29
14 Los Martires	200	10,498	43,539	54,237	656	33,629	115,364	149,649	2.76
15 Antonio Narino	702	12,173	49,507	62,382	281	15,914	36,754	52,949	0.85
16 Puente Aranda	2,422	37,061	125,025	164,508	1,053	71,155	136,166	208,374	1.27
17 La Candelaria	80	2,355	9,261	11,696	283	4,041	29,247	33,571	2.87
18 Rafael Uribe	1,039	32,877	91,270	125,186	465	14,713	39,646	54,824	0.44
19 Ciudad Bolivar	945	41,018	86,595	128,558	319	15,680	31,407	47,406	0.37
Study Area total	27,700	573,400	1,764,600	2,365,700	17,500	572,600	1,782,000	2,372,100	1.00

CHAPTER 3
Person Trip Characteristics

3. PERSON TRIP CHARACTERISTICS

3.1 Introduction

In the Study, traffic surveys were planned and carried out to obtain detailed information on travel characteristics. The surveys aimed to collect new comprehensive trip information and socioeconomic data. The following various types of traffic surveys were carried out in the Study.

a) Person Trip Survey
b) Cordon Line Survey
c) Screen Line Survey
d) Traffic Volume Counts
e) Airport Passenger OD Survey
f) Company Interview Survey
g) Travel Time Survey

The major traffic survey is the Person Trip Survey by which comprehensive trip information and socioeconomic data in the Study area are collected. As the Person Trip Survey only covers the residents of the Study Area on a sampling basis, it is supplemented by a number of surveys such as Cordon Line and Screen Line Surveys.

3.2 Survey to be Conducted

3.2.1 Person Trip Survey

The purpose of the Person Trip Survey is to obtain detailed information on travel characteristics of residents in the Study Area. The survey covers the movement of a person in terms of trip purpose, origin and destination as well as departure and arrival times, etc. It also covers household characteristics including occupation, income and vehicle ownership, etc. The database of Person Trip Survey provided the following output:

a) Socioeconomic characteristics of residents and transport users
b) Trip generation / attraction in person trip level
c) Distribution and flow of person trips

The Person Trip Survey was conducted through home interviews in which interviewers directly visited homes selected from Manzana which indicates a group of buildings surrounded by streets on four sides,(on random sampling basis). A random sample data of 15, 518 households (73,724 persons interviewed), was collected from the Study area.

The Person Trip Survey began in the beginning of August, 1995 and was completed by the end of November, 1995 including preparation to data punching and checking. Figure 3.2-1 and Figure 3.2-2 show zoning map inside and outside the study area.

3.2.2 Cordon Line Survey

Cordon Line Survey consists of roadside interviews and traffic volume counts which are conducted simultaneously at the cordon line survey stations. The roadside interview is done to obtain O-D data of vehicles and passengers, including those not registered or residing inside the Study Area but traveling to/from the Study Area. Traffic volume count at the cordon line stations has two objectives. One is to supplement the ordinary traffic volume data, while the other is to obtain expansion

factors. Trips of which the origin and destination are outside the city of Bogota are also obtained from this survey. Survey locations are shown in Figure 3.2-3.

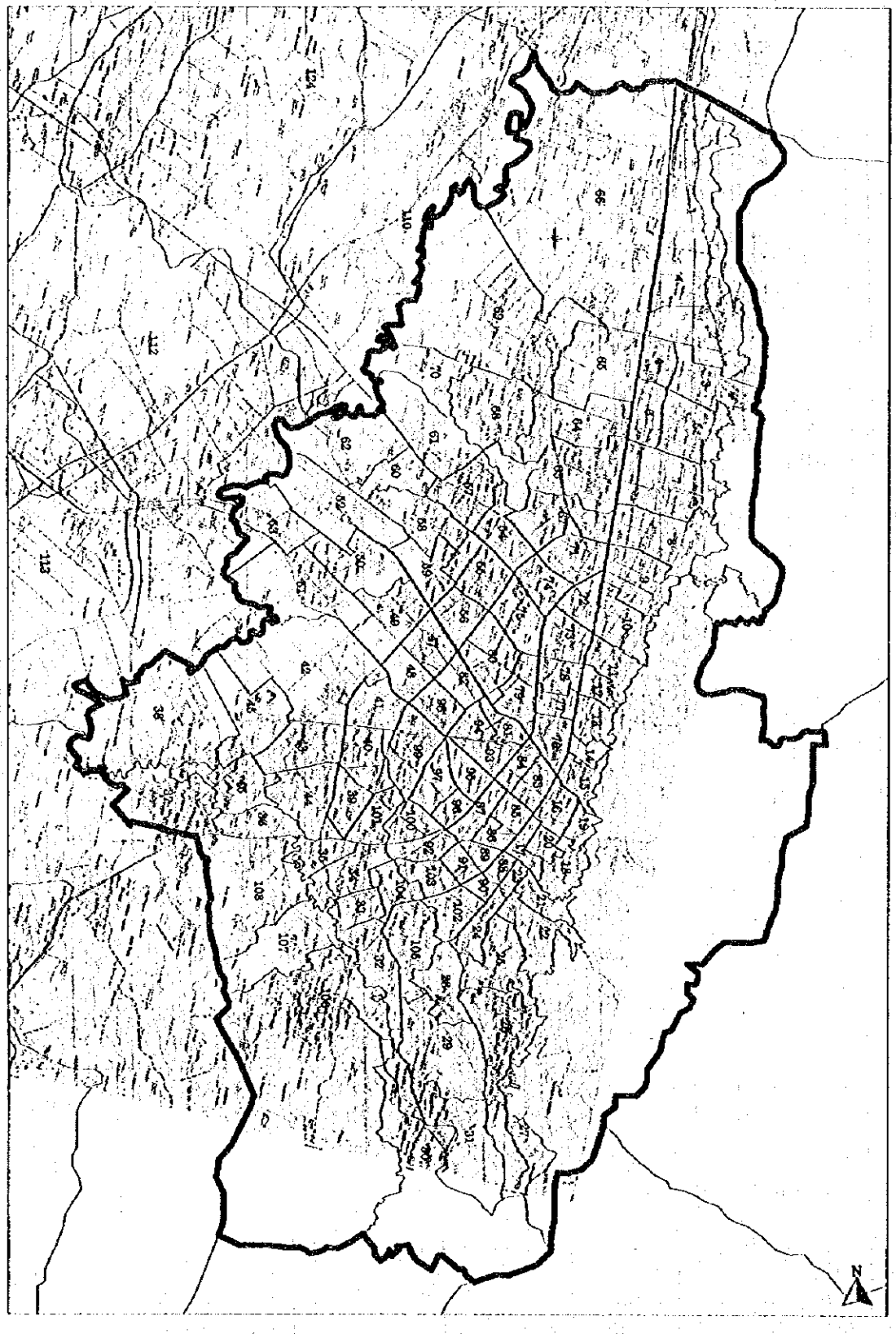


Figure 3.2-1 Zoning Map inside the Study Area

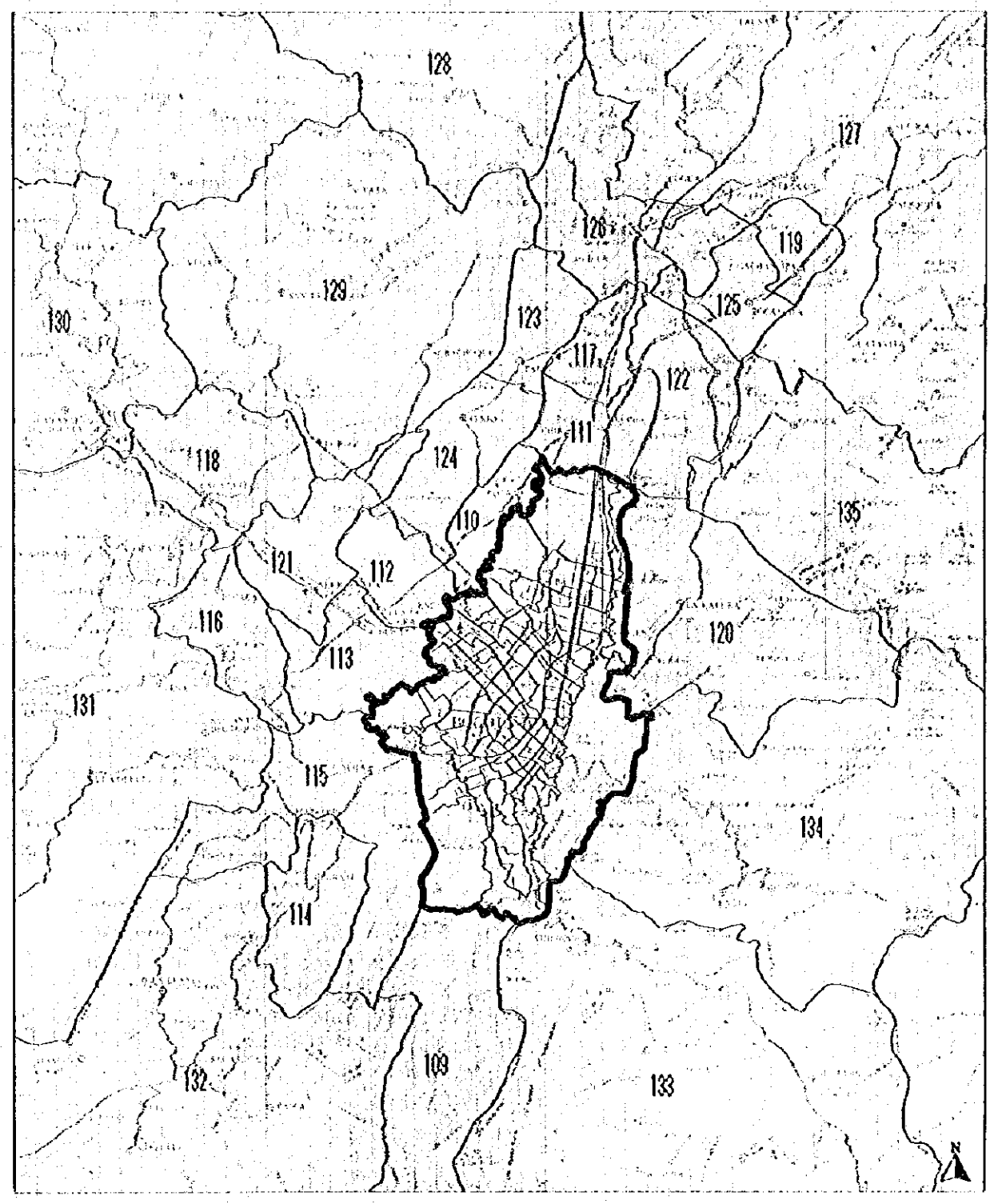


Figure 3.2-2 Zoning Map outside the Study Area

3.2.3 Screen Line Survey

The Screen Line Survey has two objectives. One is to supplement traffic volume data, the other is to confirm the accuracy of the OD data obtained from the Person Trip Survey by comparing traffic volume data counted by Screen Line Survey and the expanded OD trips supposed to cross the screen line. Survey locations are shown in Figure 3.2-3.

3.2.4 Traffic Volume Counts at Selected Intersections and on Road Sections

Traffic Volume Count was carried out for understanding the traffic conditions on major roads. Since there are many major roads in Bogota, it is impossible to count traffic volume on every major road. Therefore, the purpose of the survey is to update the existing traffic data on the roads and to supply traffic data on roads where no count data exists. The counting locations were on major roads and at major intersections between the major roads.

3.2.5 Airport Passenger OD Survey

Travel characteristics of passenger dwelling outside Bogota and in foreign counties from/to Bogota International/Domestic Airport were not obtained from the Person Trip Survey. In order to obtain trip characteristics of airport passengers, an Airport Passenger OD Survey was conducted. From the survey, trips made by airport passengers which come to and from the inside of the Study Area are obtained.

3.2.6 Company Interview Survey

The objectives of the Company Survey is to obtain trip information on goods vehicles, especially heavy trucks, as well as the cargo trip production ratio. The trip information regarding trucks was not sufficiently obtained from the Person Trip Survey.

The companies interviewed were selected by a random sampling method from a company list. Major factories are concentrated in some industrial zones, especially 25 major factories located in the Santa Monica industrial zone. The total number of companies interviewed was 50. Twenty companies were selected from the Santa Monica zone, and the remaining samples were chosen from other areas.

3.2.7 Travel Time Survey

The Travel Time Survey was carried out to evaluate the conditions of traffic congestion on major roads as well as the service level of roads. The Travel Time Survey was carried out along every major road during the morning, afternoon, and evening hours and measured by using a test car. The travel time was recorded in terms of passing time at every intersection, as well as reasons for waiting at intersections (categorized into 8 types as shown below) was filled out in the survey form. This information was sought to explain the cause of traffic congestion.

a) Waiting for traffic signal change
b) Traffic accident
c) Slow-moving buses or buses conflict near bus stops
d) Over-saturated congestion with traffic spill back due to bottleneck
e) Traffic merging from side roads without traffic signal light
f) Influence of cars turning to the left
g) Reduction of road width

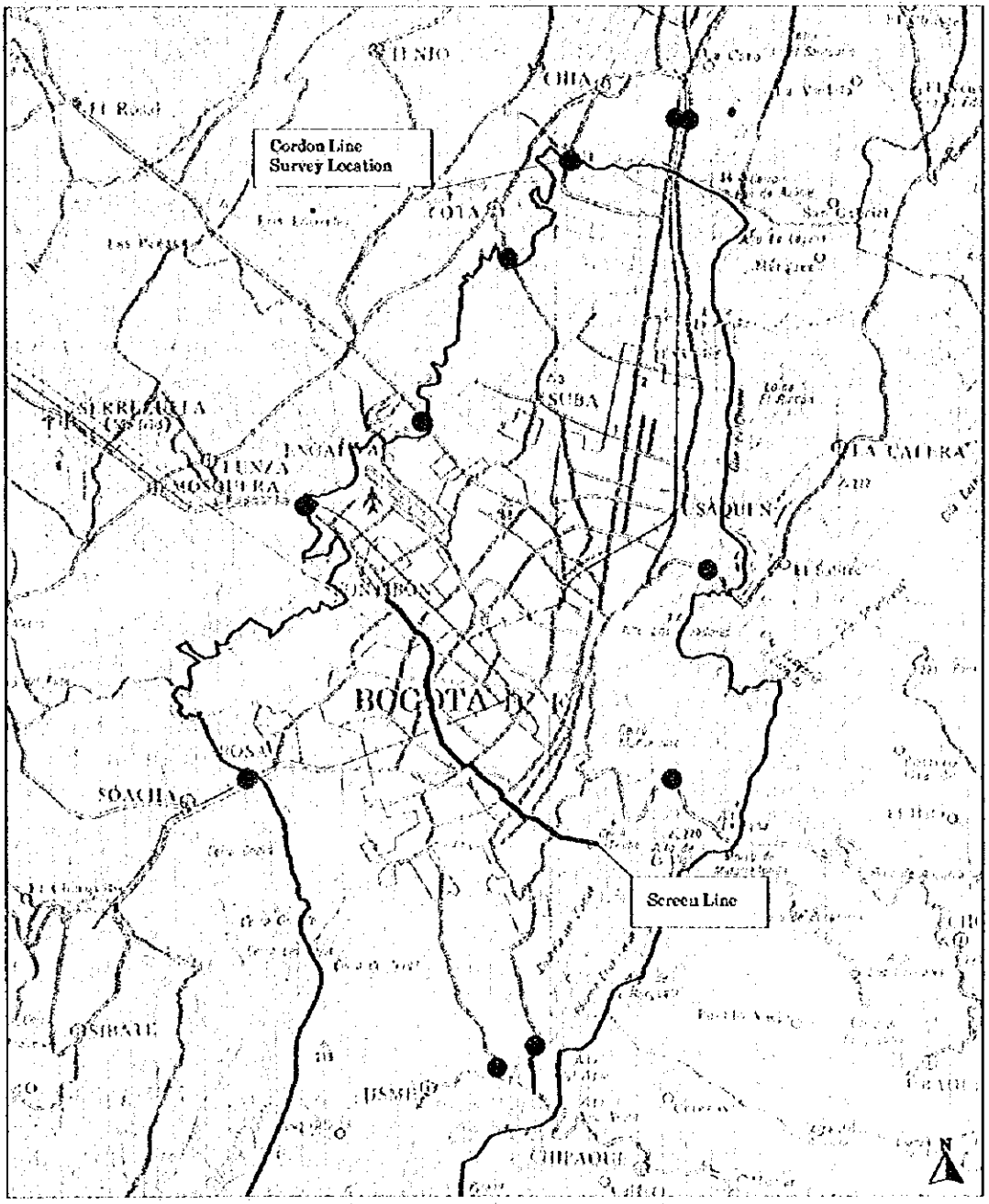


Figure 3.2-3 Survey Locations of Cordon Line and Screen Line Surveys

3.3 Person Trip Characteristics

Since the Person Trip Survey data was obtained on a random sampling basis, the collected survey data needs to be expanded to show real values reflecting the actual population. Data processing is done in many steps from the expansion of survey data to the screen line check.

In this section, households and their trip characteristics were analyzed based on the Person Trip Survey data. These analyzed data were also used for travel demand mode shown in Chapter 9.

3.3.1 Data Processing

Data checking was conducted manually and by microcomputers simultaneously during the field survey. For mistakes detected in the data check process, interviewer revisited those households to correct the questionnaire.

After the completion of the field survey, a secondary check with microcomputer, especially for logical examination, was made mainly for the relationships between occupation and trip purpose, home based or non-home based trip and purpose, arriving time and departure time, etc. Through those processes, the collected samples became available for data analysis. Expansion of the Person Trip Survey data, which was on a random sampling basis was made by traffic zone based on the 1995 population shown in Chapter 2.3.

3.3.2 Total Number of Trips

(1) Total Number of Trips

The total number of trips per day in the Study Area in 1995 is approximately 14.9 million, of which 14.6 million trips are made by residents in the Study Area, and 298 thousand are by non-residents. Since trips by residents in the Study Area have a 98% share, it seems to indicate that the Study Area is closed from the view point of traffic. Summarized in Figure 3.3-1 is trips of residents and non-residents according to internal and external trips.

Out of the total trips made by residents, 14.6 million trips, equivalent to 98 % of the total, are made within the Study Area. On the other hand, 321 thousand trips (2%) travel through the boundary of the Study Area. As for the non-residents, 98% of the total are trips between internal and external places of the Study Area, and the remaining (2%) are external- external trips.

(2) Trip Composition by Purpose

As can be seen from Figure 3.3-2, which shows the trip purposes made by all modes, the composition of "to home" trip purpose is highest (45%), followed by 20% for "to work", 15% for "to school", 14% for "private" and 6% for "business". On the other hand, Figure 3.3-3 shows the composition of purpose by mode of road transportation (excluding walking and bicycle). As seen, the share of "to work" and "business" trips increase, while the other purpose trips somewhat decrease.

Almost half of the trips are "to home" which means that there are many home-based trips, and that there are many outgoing trips with one destination.

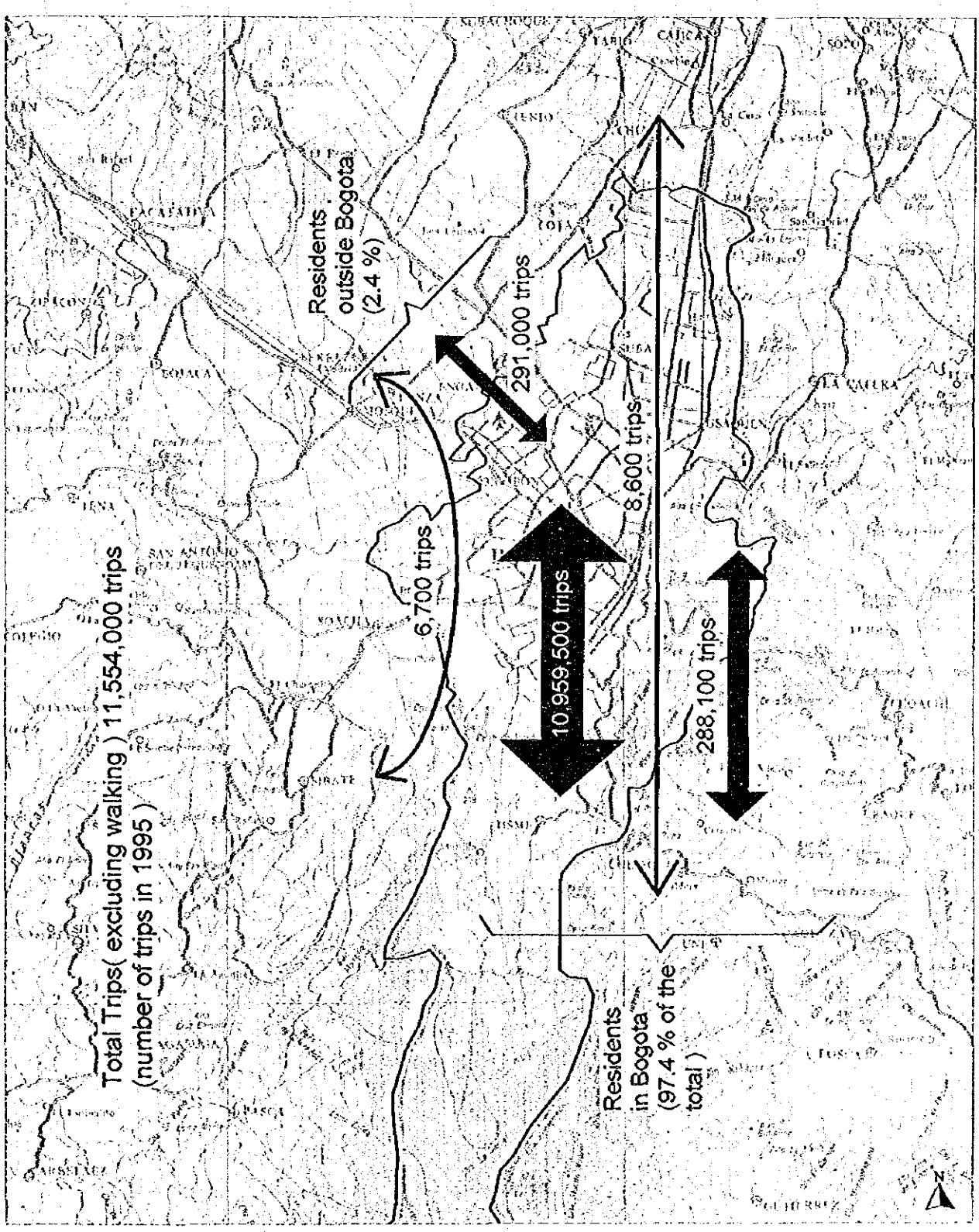


Figure 3.3-1 Total Number of Trips in the Study Area

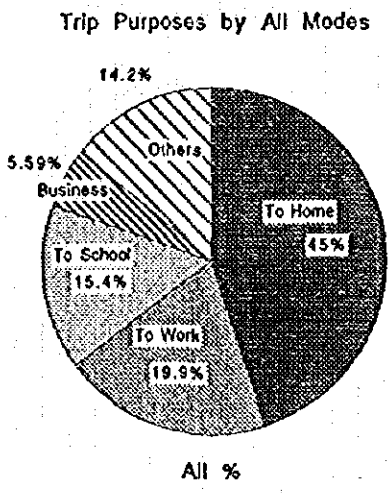


Figure 3.3-2 Composition of Trip Purposes (All Mode)

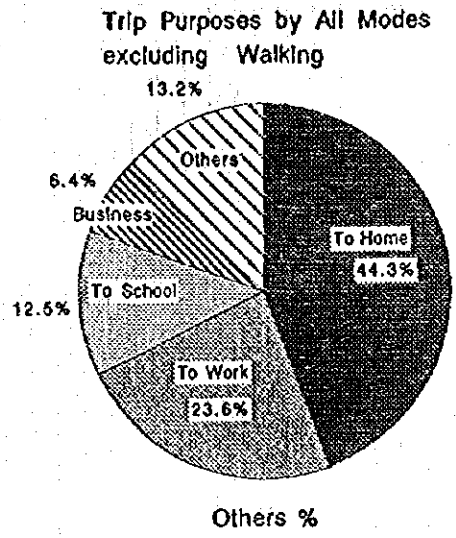


Figure 3.3-3 Composition of Trip Purposes *(Excluding Walking and Bicycle)*

(3) Trip Composition by Mode

Trip modes are summarized in Figure 3.3-4. The figure shows a breakdown of all trips in a day. As can be seen, about 15% are car, bus 56%, taxi 4%, truck 3%, walking and bicycle 23%. The share by motorcycle is as low as 0.4%. As for the trip composition of road transportation excluding walking and bicycle (refer to Figure 3.3-5), bus transport (72%) is predominant over others.

As for the ratio of private and public transport to all modes excluding walking, approximately 80% are public transport including bus and taxi, and the remaining 20% are private.

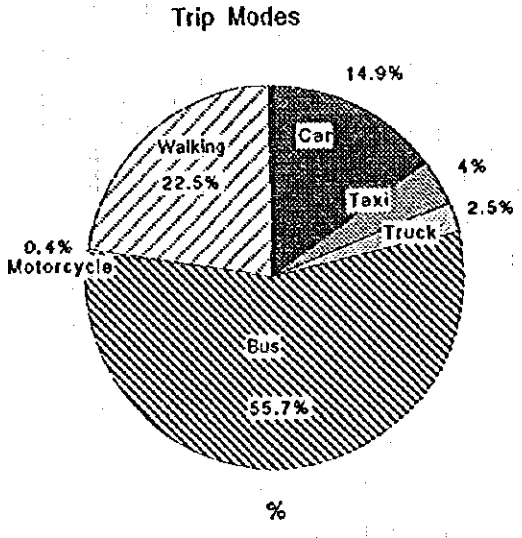


Figure 3.3-4 Composition of Modes (All Mode)

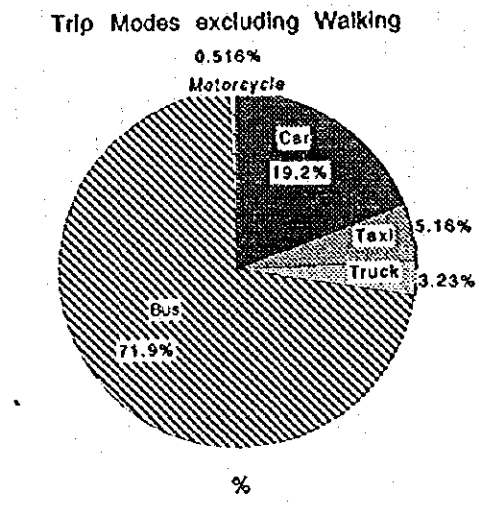


Figure 3.3-5 Composition of Modes *(Excluding Walking and Bicycle)*

3.3.3 Trip Production Rate

The concept of trip production rate in terms of number of trips per person (5 years or above) in a day, involves two facets: one is the gross rate which is for all the persons not related to whether a trip is made or not, and the other is net rate which is only for

the person who make a trip. In this report, gross rate excluding walking and bicycle modes is taken as the trip production rate taking into account the making of a travel demand model.

(1) Trip Production Rate by Age Group and by Sex

The trip production rate (excluding walking and bicycle) by sex is 2.38 for male, and 1.66 for female as shown in Table 3.3-1, which shows the trip production rate by age group and by sex. As for the trip production by age group, the males between aged 30 and 54 years old exceed 3.0, while the females (20- 34 years) stand at 2.0 - 2.3, (these figures are considerably higher than that of other age groups of females).

Table 3.3-1 Trip Production Rate by Sex and Age

Age Rank	Male	Female	Total
5 - 9	0.72	0.73	0.73
10 - 14	1.22	1.29	1.25
15 - 19	2.03	1.89	1.96
20 - 24	2.90	2.33	2.61
25 - 29	2.88	2.09	2.47
30 - 34	3.05	2.08	2.54
35 - 39	3.28	1.93	2.55
40 - 44	3.17	1.74	2.39
45 - 49	3.20	1.66	2.36
50 - 54	3.02	1.41	2.15
55 - 59	2.75	1.24	1.97
60 - 64	2.35	0.97	1.61
65 - 69	2.13	0.83	1.49
70 - 74	1.81	0.64	1.22
75 -	1.09	0.36	0.68
Total	2.38	1.66	2.01

(2) Trip Production Rate by Occupation and by Purpose

Trip production rate by occupation is shown in Figure 3.3-6. The production rate for workers in tertiary industries exclusive of "community" is roughly 3.0 - 4.0 trips per day. On the other hand, workers in the secondary industries have a slightly low rate (2.7-2.9).

As for the production rate by purpose according to occupation, the composition of trip purpose is similar to the occupation excluding "trading" and "transportation" workers. The business purpose trip in these industries is predominant in comparison to other occupations.

(3) Trip Production Rate by Household Income Level

Figure 3.3-7 shows the trip production rate by household income level. As can be seen, the higher the household income level is, the higher the trip production rate is. The composition of purpose shows that the every trip purpose increases in proportion to the income level.

(4) Trip Production Rate Vehicle Ownership

Figure 3.3-8 compares trip production rate by motorized and non-motorized households classified into 3 categories; non-car owning, 1 car owning, and multi-car owning. The trip production rate is 2.43 for car owning household and 2.75 for households owning multi-cars, while it is 1.78 for non-motorized household. This shows that the trip production rate is closely related to whether or not a household owns a car. As for the mode composition of trip production rate as shown in Figure 3.3-9, it is quite different for motorized and non-motorized households. The non-motorized households show a high share of bus transportation, while for motorized household, it is lower.

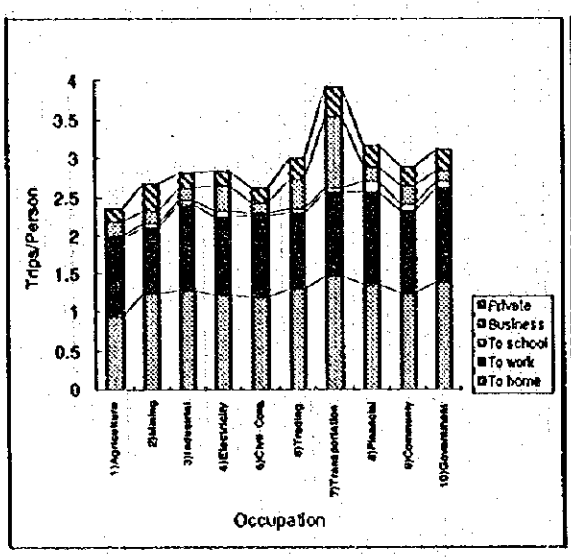


Figure 3.3-6 Trip Production Rate by Occupation

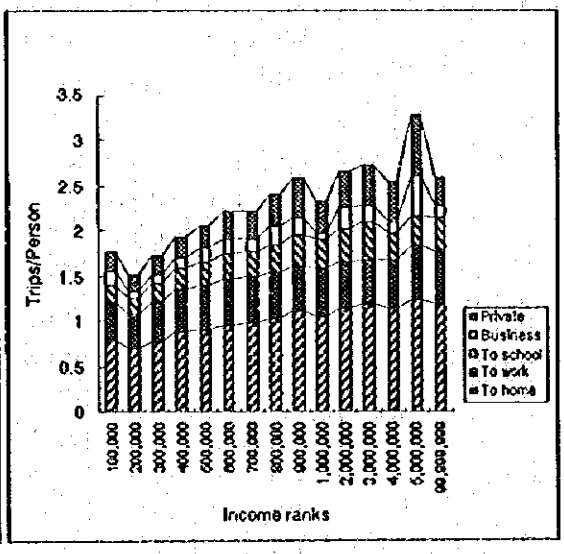


Figure 3.3-7 Trip Production Rate by Household Income Levels

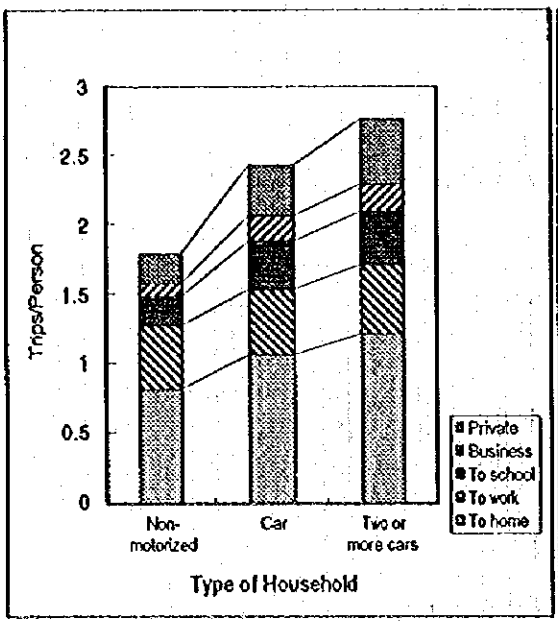


Figure 3.3-8 Trip Production Rate by Vehicle Ownership

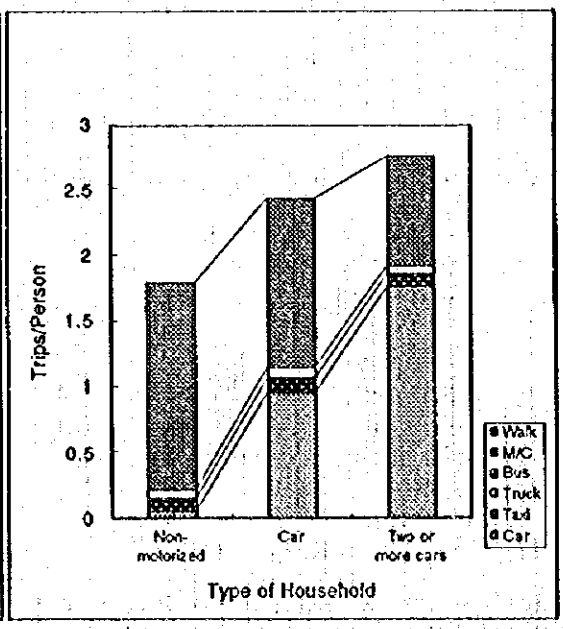


Figure 3.3-9 Trip Production Rate by Vehicle Ownership and by Mode

3.3.4 Trip Generation and Attraction

(1) Trip Generation and Attraction by Purpose and Zone

Trip generation and attraction according to the integrated zone are shown in Figure 3.3-10 which shows figures of all purposes excluding "to home" purpose. Looking at an integrated zone whose numbers of generation and attraction trips are higher, both of those of zone No.6 stand at approximately 1.2 million. The zones with other large numbers of generation and attraction trips are 11 and 15.

As for the "to work" trip purpose shown in Figure 3.3-10, trip attraction in zones No.5, 6 is dramatically higher than the others, while trip generation is considerably lower than the average rate. This is because these zones are business activity centers and there are many workers concentrated in these zones. The "business" and "private" purpose trips are the same as that of the "to work" trips.

(2) Trip Generation and Attraction by Mode

Figure 3.3-11 show trip generation and attraction by zone and transport mode in which the mode is classified into 2 groups: car (including taxi and truck) and bus. The zones in which the car in the trip generation and attraction is higher are 2, 3, 4, 5, 6, 15 and 17. On the other hand, the highest zone of public transportation (bus) is zone No. 6, 11, 15 and 24.

(3) Hourly Trip Generation by Purpose

The hourly number of trips by transport mode are shown in Figure 3.3-12 and Figure 3.3-13, which show the hourly fluctuation of trips and the departure time. As can be seen, the morning and evening peak hour ratios are approximately 14% and 10%, which occur between 6:00 a.m. and 7:00 a.m., and between 5:00 p.m. and 6:00 p.m., respectively. At noon, the generation trips also rise due to return.

The peak hour percentage for "to work" trip rises by 30% in the morning from 6:00 a.m. and 7:00 a.m. The "to school" trip fluctuation indicates the same pattern as that of "to work". The peak hour ratio of "to school" is 15% at 7:00 - 8:00 a.m., in contrast to 30% in the "to work". The "to home" trip peak occurs twice: from 12:00 a.m. to 13:00 a.m. and 6:00 p.m. to 7:00 p.m. The "business" trip starts around 6:00 a.m. and ends around 4:00 p.m.

(4) Hourly Trip Generation by Mode

The hourly number of trips by transport mode are shown in Figure 3.3-14 and Figure 3.3-15. These figures show the hourly trip distribution under "departure time". As seen, the trip patterns of hourly distribution by mode are nearly the same throughout the day, except at noon which is the peak period of walking occurs in comparison with that of bus and car.

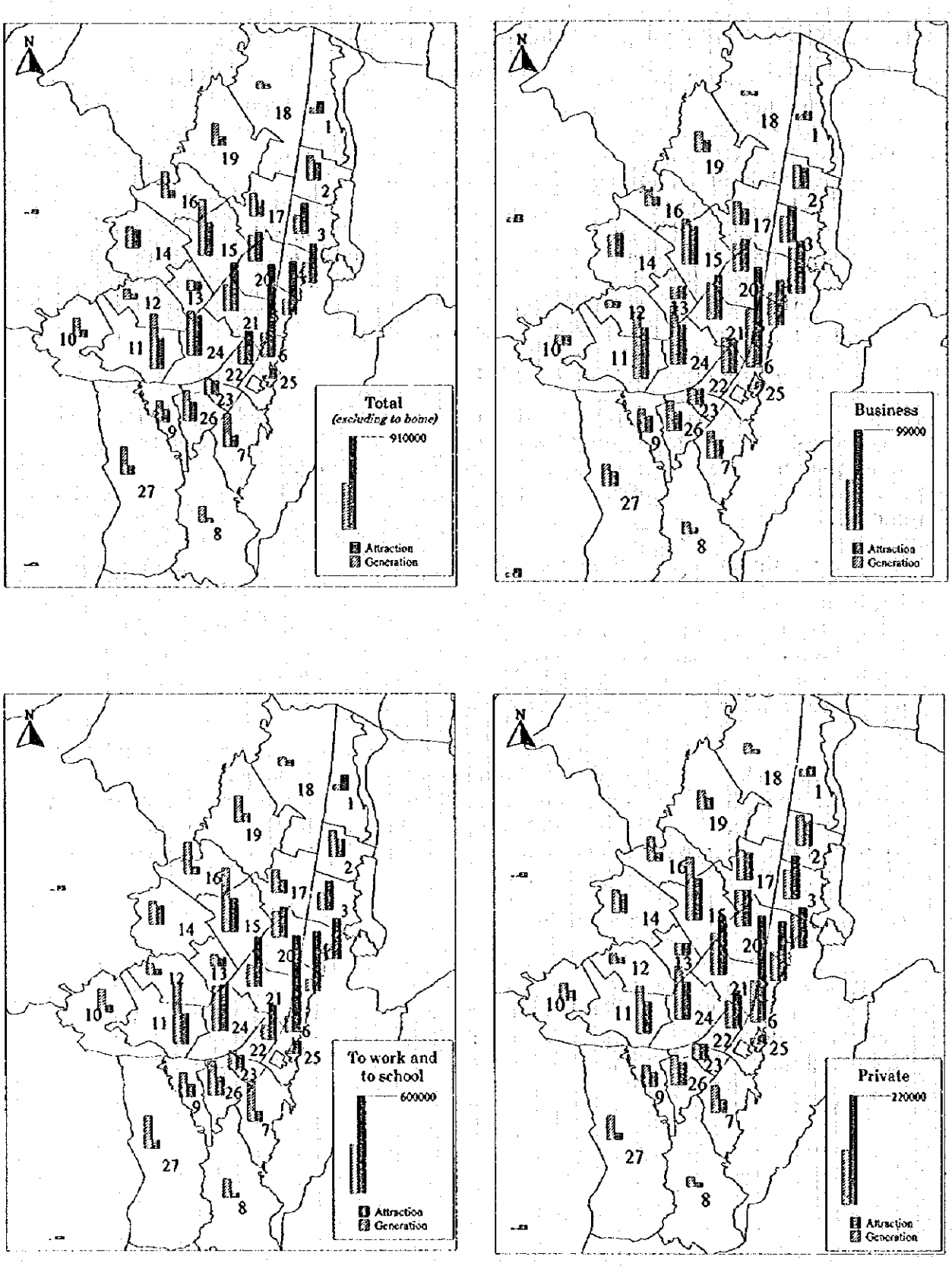


Figure 3.3-10 Trip Generation and Attraction

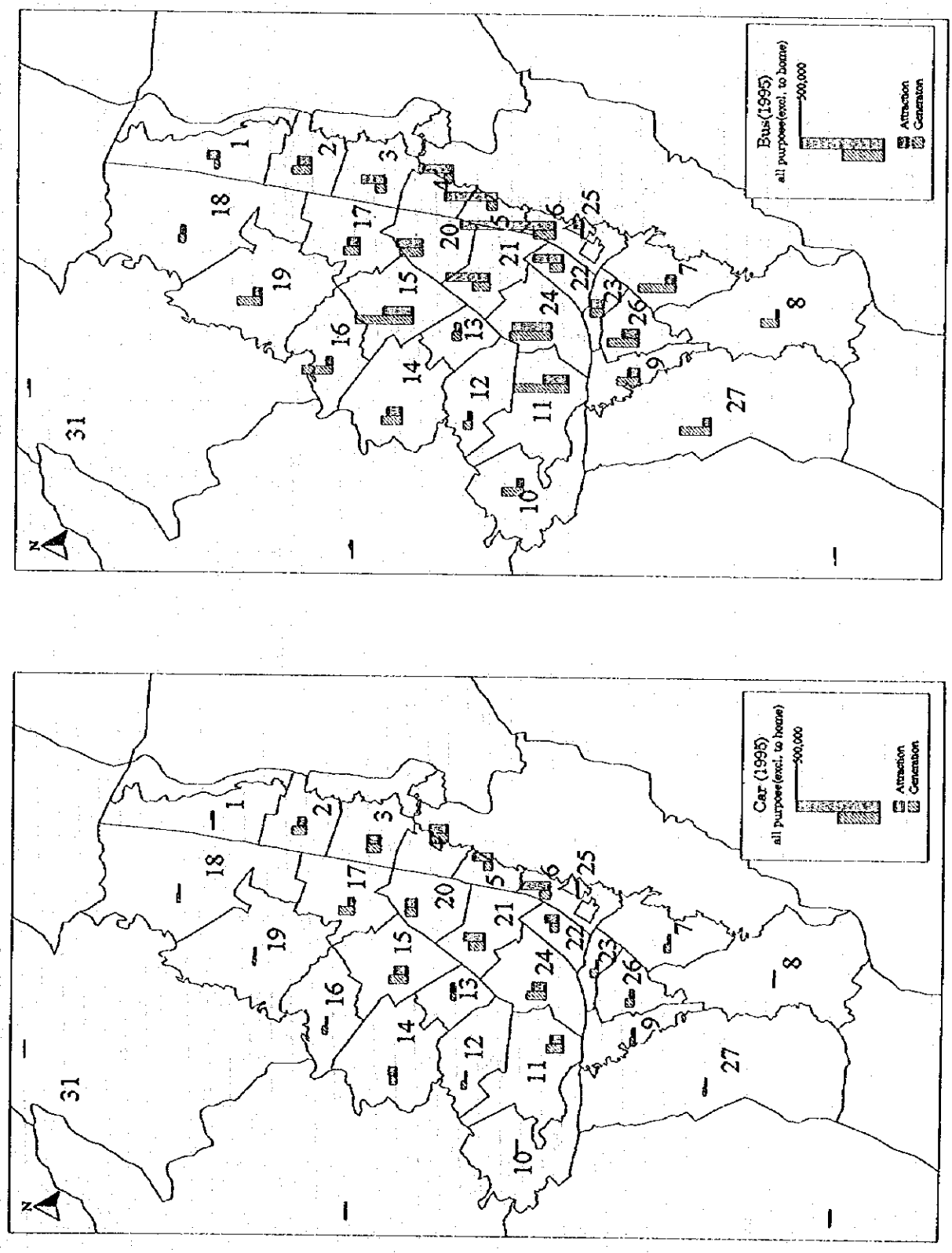


Figure 3.3-11 Trip Generation and Attraction by Mode

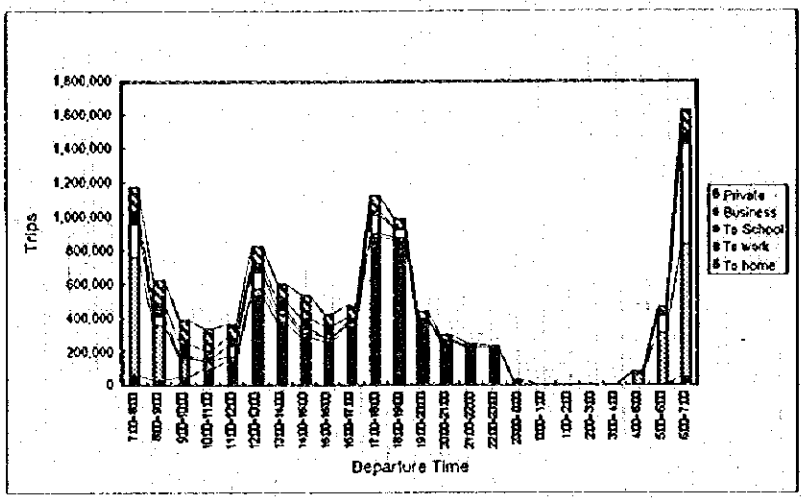


Figure 3.3-12 Hourly Trip Distribution by Purpose

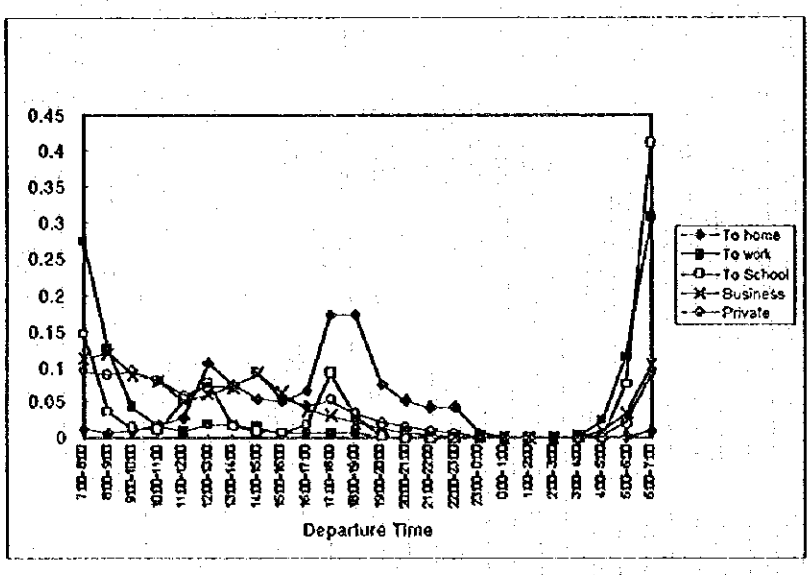


Figure 3.3-13 Hourly Trip Distribution Ratio by Purpose

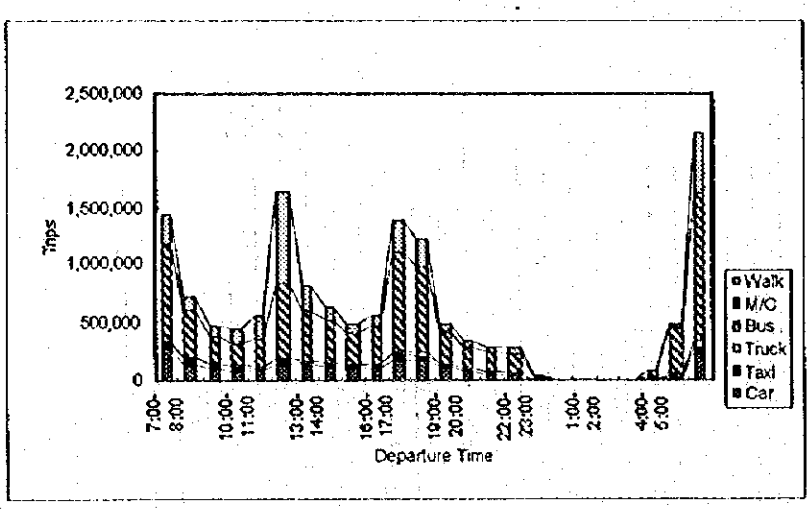


Figure 3.3-14 Hourly Trip Distribution by Mode

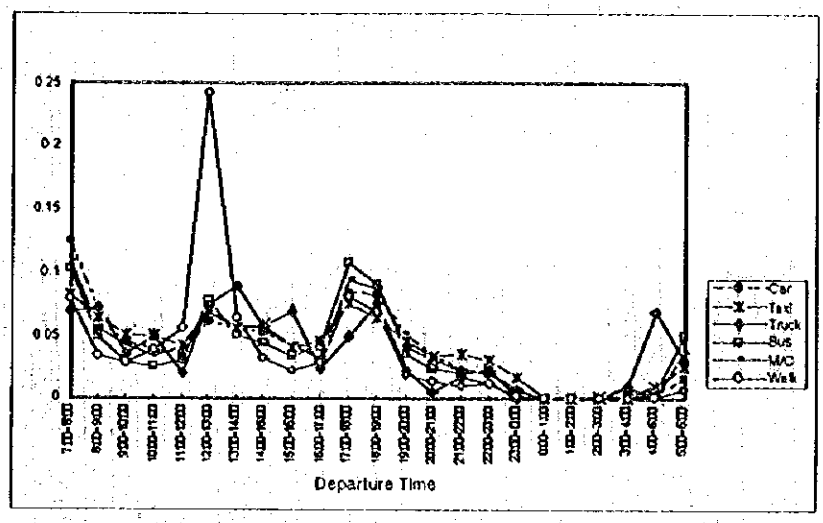


Figure 3.3-15 Hourly Trip Distribution Ratio by Mode

3.3.5 Trip Distribution

(1) Trip Distribution by Motorized / Non-Motorized and by Purpose

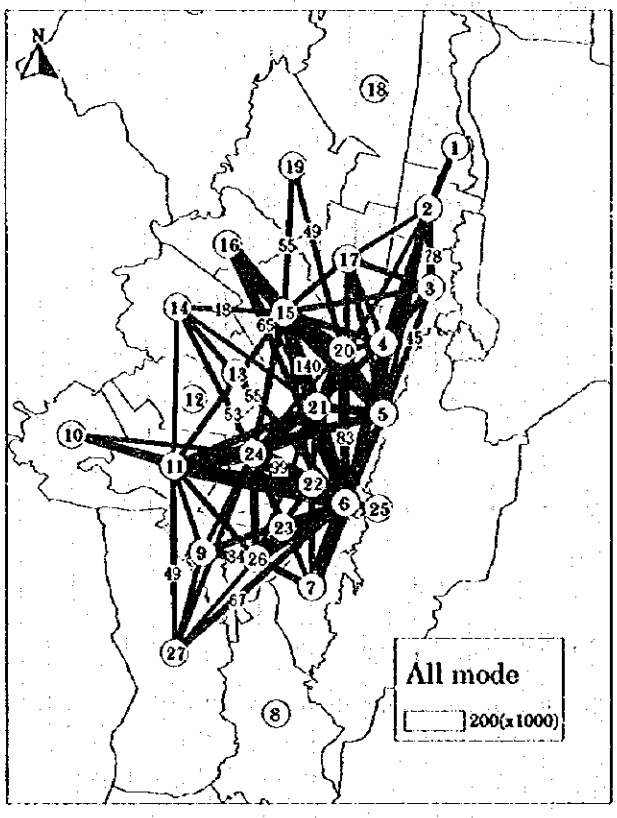
Trip distribution by all modes and purposes is shown in Figure 3.3-16 by desire line charts. In this figure, the two-directional movement between each pair of zone blocks is drawn by a straight line whose width is proportional to the number of trips between zone blocks. As can be seen, there are large movements between the central area which is composed of zones 5, and 6, and its surrounding residential area composed of zones 1, 2, 3, 11, 15, 17, and 24. In conclusion, strong desire lines are drawn to zones 5 and 6 from every place.

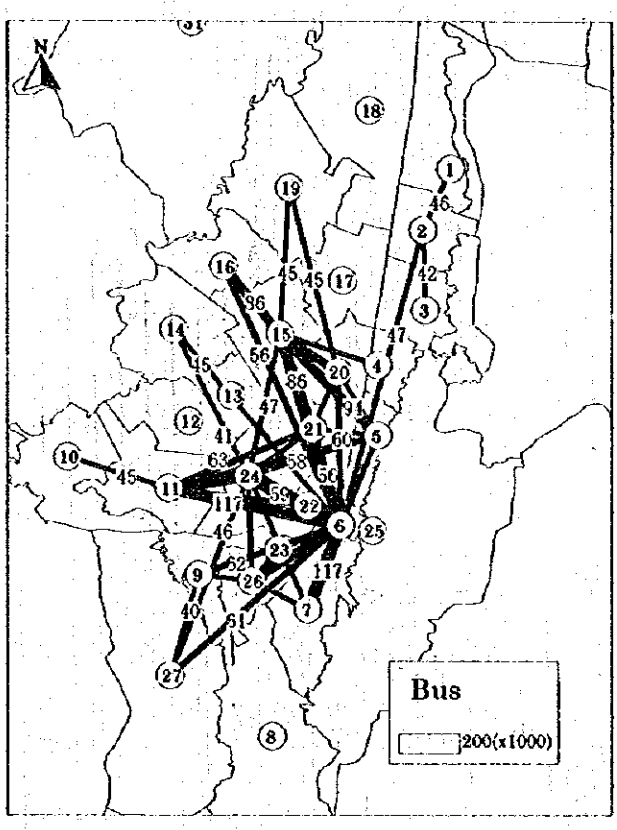
The desire lines by purpose appear in Figure 3.3-17 which is classified into motorized and non-motorized households. The desire line for "to work" trips shows that there is heavy traffic between the business area (Zones 5 and 6) and every other area. The desire lines for the motorized households are concentrated the northern area, in contrast to the southern area of the non-motorized household. The "to school" trips also show the same desire pattern as that of the "to work" desire line. These "to school" trips can be considered as movement of high school or higher level students, since a large part of the primary and secondary school pupils attend on foot (short distance trip) and are probably excluded from this figure due to the movements within the integrated zone.

The "private/other" trips show that in the motorized households, the trips were concentrated in the northern area: zones 2, 3, 4, 5 and 6, are noticeable, while the non-motorized area has strong desire lines between the business/ commercial areas (Zones No. 5 and 6) and the southern area.

(2) Trip Distribution by Mode

The desire lines by mode are shown in Figure 3.3-16. As can be seen, the bus trips cover the whole Study Area with heavy traffic, while the car desire lines connect between the central area (Zones 5 and 6) and the northern area (Zones 1,2, 3, 17 and 20) with strong desire line. The bus trip distribution covers mainly the southern part of the Study Area, while the car trips are mainly in the northern part.





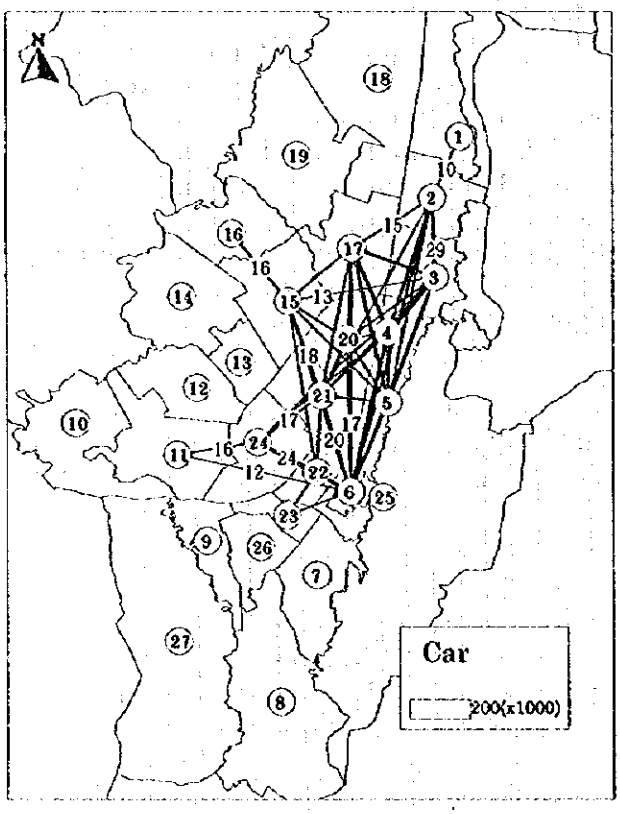


Figure 3.3-16 Trip Distribution by Modes

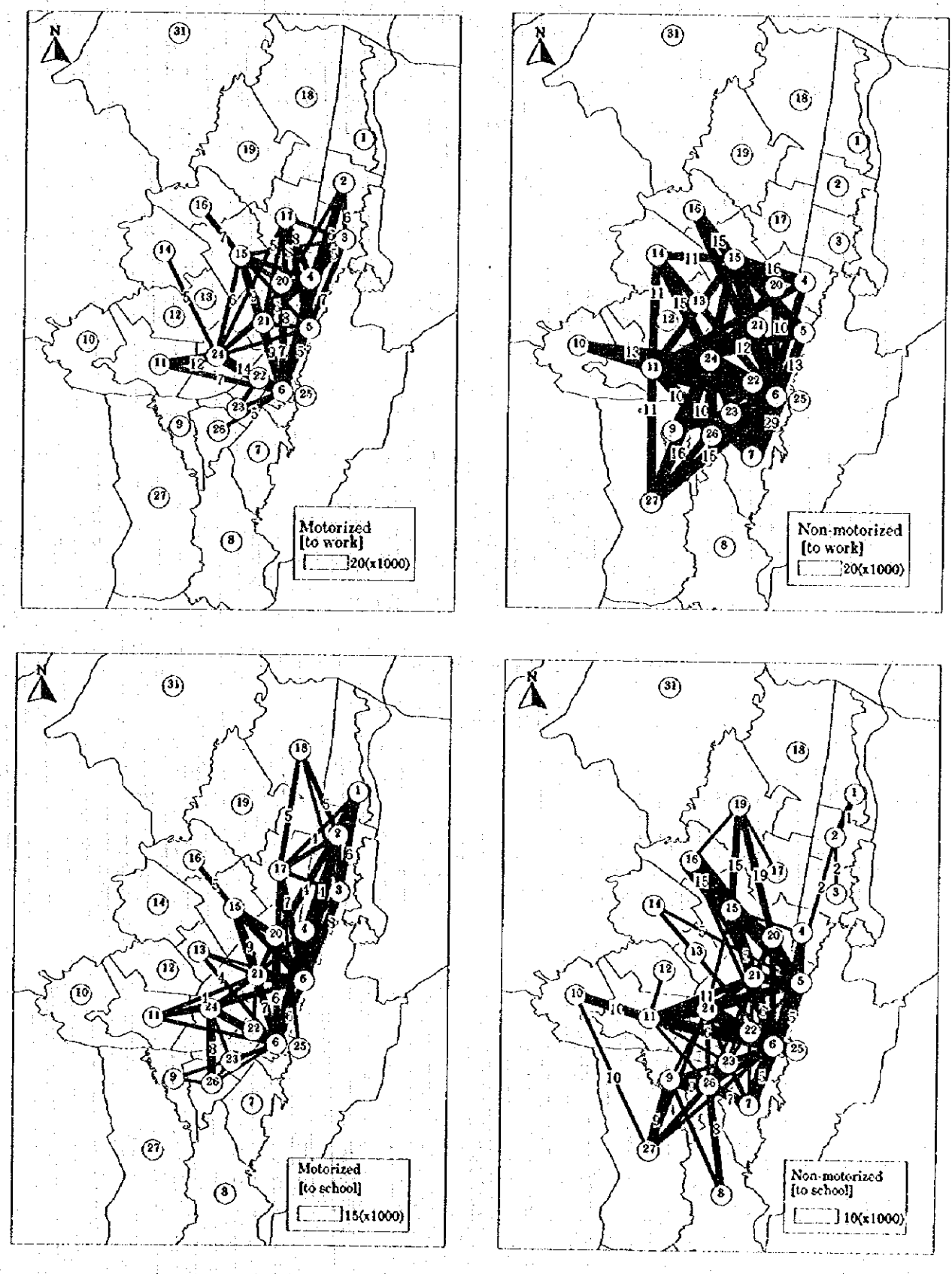


Figure 3.3-17 Trip Distribution by Motorized / Non-Motorized and By Purpose

(3) Travel Time by Purpose

Travel time distribution by purpose is shown in Figure 3.3-18. The travel times of the "to work" trips have three significant lengths: around 20 -25 minutes, 35 minutes and 70 minutes. The "business" and "private" trip times also show similar patterns as that of "to work" trips. Approximately 80% of the their total trips have the travel time within 60 minutes. On the other hand, the travel time of "to school" has a peak around 15-20 minutes. Its accumulative percentage, however, reaches 50% by 45 minutes, in contrast to 36% for the "to work".

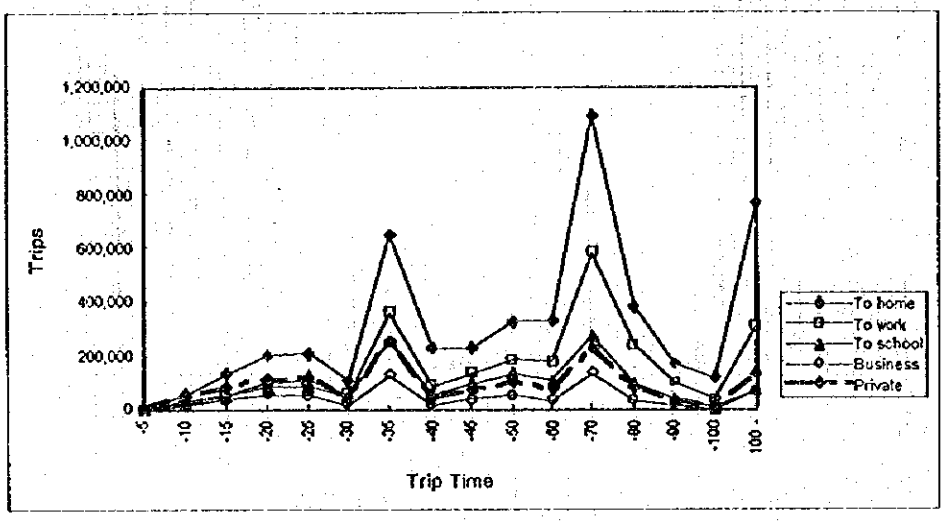


Figure 3.3-18 Travel Time by Purpose

3.3.6 Modal Share of Trip by Purpose and by Mode

The trip composition of modes according to trip purpose is shown in Figure 3.3-19. The share of "to work" trips by bus accounts for about 70%, and "to school" trips were predominantly on foot at 37%. The "business" trip is by car and bus at 28% and 34%, respectively. The trip composition of purpose by mode is also shown in Figure 3.3-20. Car, taxi and bus are used for trips with the purpose of "to work", "private" and "to home", while walking has relatively high percentage of "to school", compared to car and bus.

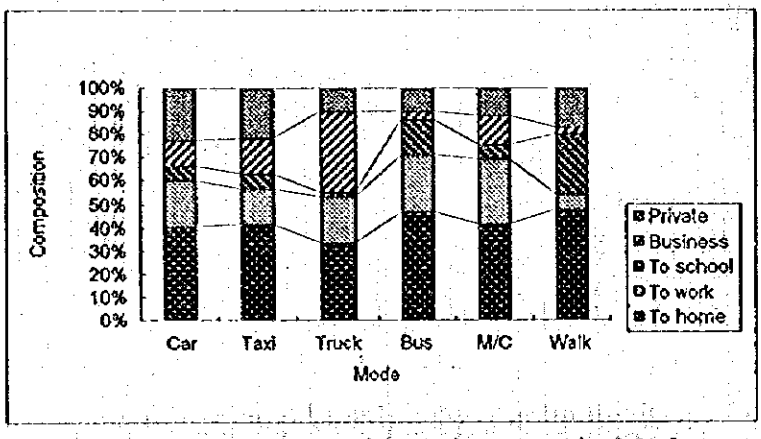


Figure 3.3-19 Composition of Purpose by Mode

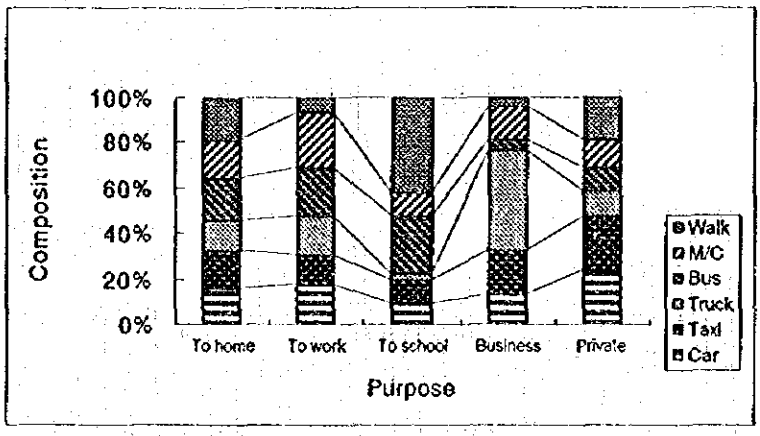


Figure 3.3-20 Composition of Modes by Purpose

3.3.7 Household Trip Characteristics

(1) Modal Share by Motorized Household

The trip composition of mode used by non-motorized and motorized households is shown in Figure 3.3-21. In this figure, the motorized household is classified into 3 categories: non-car owning, 1 car owning and multi-car owning. The car owning household mainly uses a car (1 car owning : 33% of the total modes, and multi-car : 59%) and bus (the former : 45 %, and the latter : 28%), while the transportation of non-motorized household is supported by bus (88 % of the total modes exclusive of walking).

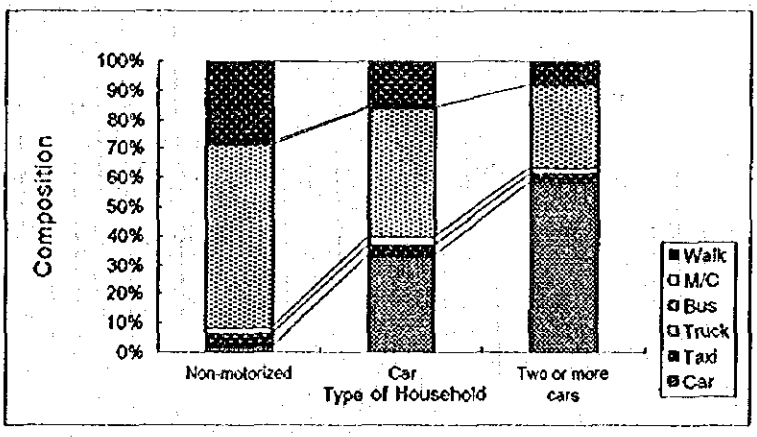


Figure 3.3-21 Trip Composition of Mode by Motorized and Non-Motorized Households

(2) Trip Composition of Mode by Household Income Level

The trip composition rate of mode by household income level is shown in Figure 3.3-22. The relationship between travel mode used and income level is found from this figure which shows the composition of transport mode on the Y-axis against monthly income on the X-axis. The higher the household income level is, the higher the share of car is, and the lower the walking share is. As for bus, the middle income levels between 200,000 Peso and 500,000 Peso are higher than the others. This trend is based on the relationship between household income and car ownership.

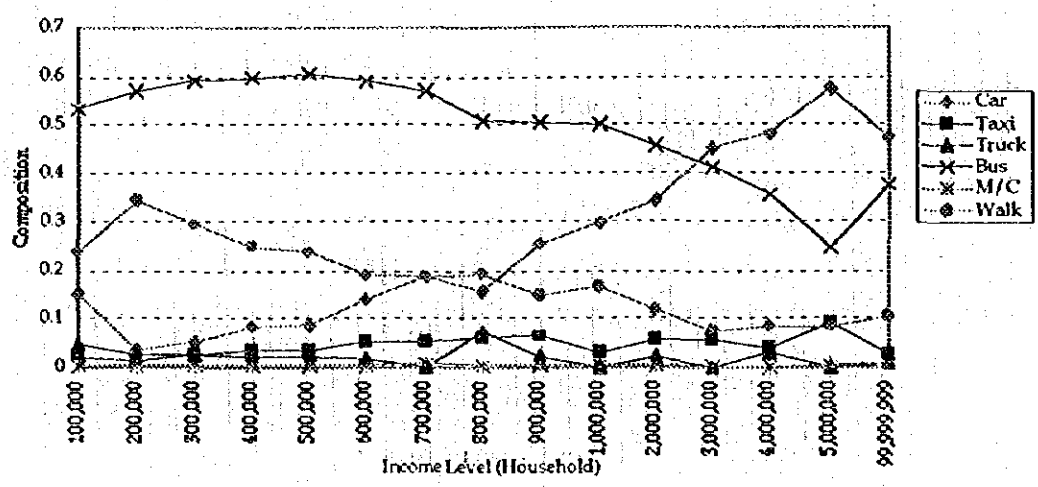


Figure 3.3-22 Trip Composition of Modes by Income Level

3.3.8 Car Ownership

(1) Car Ownership by Registered Place

The characteristics of car ownership in Bogota, such as registered place, type of ownership, etc., are revealed by the PT survey data. Table 3.3-2 shows car ownership by registered place and type of ownership. The total number of passenger cars owned in Bogota is approximately 500,000, of which approximately 33% are registered outside Bogota by residents dwelling in Bogota. This means that 33% of the cars are used inside Bogota, but registered outside of Bogota. The figures for cars estimated from PT survey are very close to the number of registered cars in Bogota according to the STT's statistical data.

The figures in exclude the vehicles owned by a company or the government but privately used. It is because the interviewers visited private houses, not company or government offices. Therefore, the figures are slightly lower than that in actual use.

Table 3.3-2 Car Ownership by Registered Place according to Type of Ownership

	Registered Place				
	In Bogota		Outside		Total
	Vehicles	(%)	Vehicles	(%)	Vehicles
Privately Owned	322,896	67%	159,876	33%	482,772
Officially Owned	9,830	66%	5,145	34%	14,975
Total	332,726	67%	165,021	33%	497,747

(2) Motorized Households and Car Ownership by Zone

The percentage of motorized households who own a car is approximately 30% of the total as shown in Table 3.3-3. The figures for motorcycle (32,000) are much lower than that of cars. On the other hand, the number of families owning bicycles is high at approximately 410,000 bicycles. These bicycles are mainly used for recreation and sports.

The high percentage districts of motorized households are Usaquen (No. 1) and Chapinero (No. 2), followed by Teusaquillo (No. 13) and Suba (No. 11). These districts

are also high in monthly average household income. Figure 3.3-23 shows the average household income level against the motorized household ratio by district. According to this figure, the higher the average income level by district is, the higher the motorized household ratio is.

Table 3.3-3 Motorized Households and Car Ownership by District

District No.	Number of Households			Motorized Ratio	Number of Vehicles			Average Household Income
	Non-Motorized	Motorized Households	Total		Car	Motorcycles	Bicycle	
1	35,539	54,565	90,104	0.606	83,084	2,019	27,164	787,609
2	12,720	31,618	44,338	0.713	51,243	710	8,645	1,029,622
3	27,629	4,361	31,990	0.136	4,894	905	8,574	375,207
4	74,355	9,077	83,432	0.109	10,397	1,945	21,445	284,541
5	39,398	2,736	42,134	0.065	2,850	1,093	6,991	247,310
6	38,323	9,253	47,576	0.194	9,704	1,070	17,777	377,920
7	49,314	5,691	55,005	0.103	6,619	1,212	13,209	282,922
8	103,968	31,699	135,667	0.234	34,185	3,846	42,164	367,862
9	45,790	22,480	68,270	0.329	28,679	2,156	33,887	502,806
10	132,832	47,918	180,750	0.265	55,826	3,899	73,024	432,050
11	70,283	48,432	118,715	0.408	71,148	2,506	40,058	613,235
12	32,268	20,239	52,507	0.385	26,494	1,878	14,012	668,255
13	15,229	21,489	36,718	0.585	29,717	500	10,969	852,529
14	18,036	10,202	28,238	0.361	13,281	1,072	7,497	487,599
15	19,495	12,918	32,413	0.399	15,584	962	8,127	419,129
16	55,578	28,316	83,894	0.338	33,798	2,709	34,332	503,382
17	5,359	650	6,009	0.108	650	81	971	326,636
18	58,552	11,216	69,768	0.161	12,815	2,010	22,086	324,663
19	66,564	6,200	72,764	0.085	6,779	1,626	16,500	251,785
Total	901,232	379,060	1,280,292	0.296	497,747	32,199	407,432	476,735

Note : Motorized Household refers to car ownership.

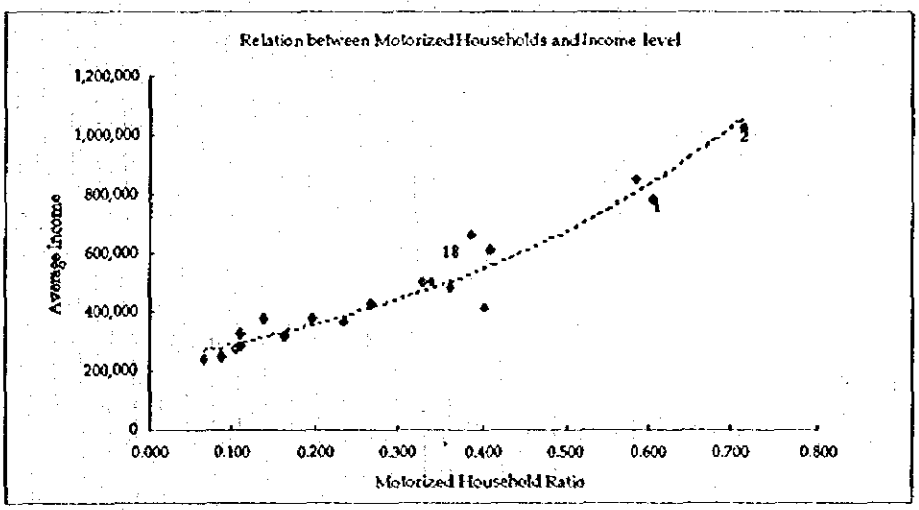


Figure 3.3-23 Relationship between Motorized Households and Income Level

(3) Household Income and Motorized Households

The accumulative percentage of car ownership categorized into non-car, one car, and multiple cars by monthly household income level is shown in Figure 3.3-24 and the percentage of ownership for the income level according to the same category is shown

in Figure 3.3-25. As seen from these figures, the composition rate of non-motorized households decrease, while motorized households increase as per the increase in income level.

The distribution of motorized households who own one car has a crest between 1 million to 2 million pesos, while the multiple car households increase accordingly with the increase of income level.

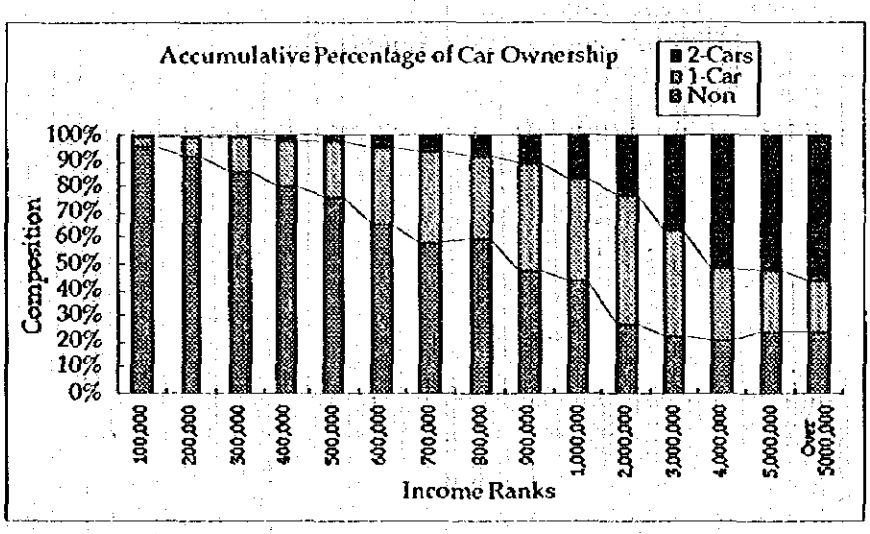


Figure 3.3-24 Accumulative Percentage of Car Ownership

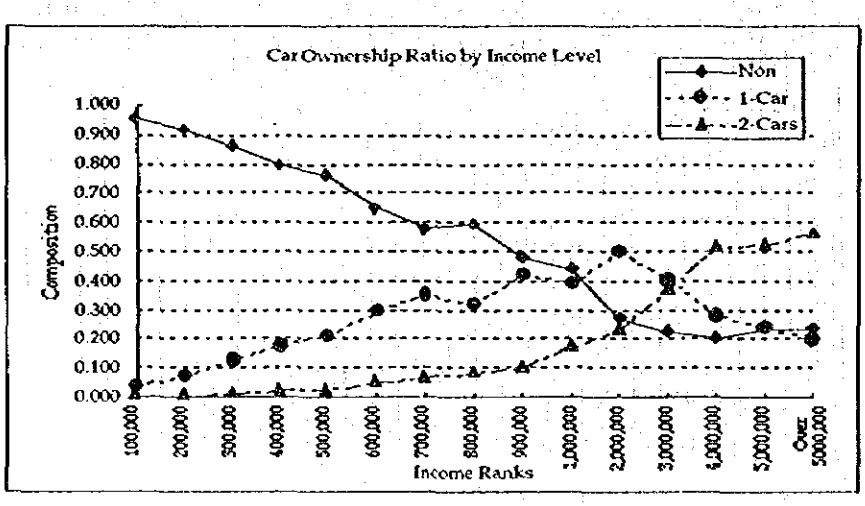


Figure 3.3-25 Car Ownership Ratio by Income Level

CHAPTER 4
Road Facility Conditions and Traffic Characteristics

4. ROAD FACILITY CONDITIONS AND TRAFFIC CHARACTERISTICS

The existing road facility conditions are examined based on the results of the field reconnaissance surveys conducted, analysis of data collected, and full discussion with Colombian counterparts during the period from July to December 1995. At the same time, various traffic and transport surveys such as cordon line, screen line, traffic volume count, intersection traffic volume count, and travel speed surveys were conducted by the Study Team. Based on the results of the above-mentioned surveys, the existing traffic characteristics of the Study Area were analyzed.

4.1 Road Facility Conditions

4.1.1 Existing Road Network

(1) Trunk Road Network in Colombia

The major cities of Colombia which have a population of over 500,000 are Bogota (6,000,000), Medellin(1,700,000), Cali(1,700,000), Barranquilla(1,100,000), Cartagena (750,000) and Cucuta(500,00).

Barranquilla and Cartagena are located on the coastal area, and the other three cities are located in the mountainous areas.

The trunk road network in Colombia is formed by two longitudinal trunk roads and three lateral trunk roads. Two trunk roads, National Road No. 25 and No. 45 a pass through the center of Colombia as the longitudinal trunk road network (direction from south to north), and National Road No. 25 is connected to Ecuador as an international road.

The National Road No. 90 passes through Cartagena, Baranquilla and also connects to Venazuela as an international road. The National Road No. 25 connects Sincelejo, Medellin and Cali. The National Road No. 45 connects Santa Marta, Bogota and Neiva. Three trunk roads, National Road No. 40, No. 50 and No. 60, are located at the center of Colombia as the lateral trunk road network (direction from east to west).

(2) Trunk Road Network in the Metropolitan Area of Bogota

There are four (4) trunk roads connected to Bogota as the radial road network of Bogota. The four National Roads connecting Bogota and other cities are as follows;

a) National Road No. 55 (Bogota to Tunja and Cucuta)
b) National Road No. 45A
c) National Road No. 50 (Bogota to Manizales)
d) National Road No. 40 (Bogota to Villavicencio)

The urbanized area of Bogota is 15 km (east-west direction) by 30 km (south- north direction) longs, and is located between a mountainous area (east side of the city) and Rio Bogota (south, west side of the city).

The trunk road network in Bogota is formed by three (3) ring roads and seven (7) radial roads as shown in Figure 4.1-1 and Figure 4.1-2. The name of the ring and radial roads in Bogota are as follows:

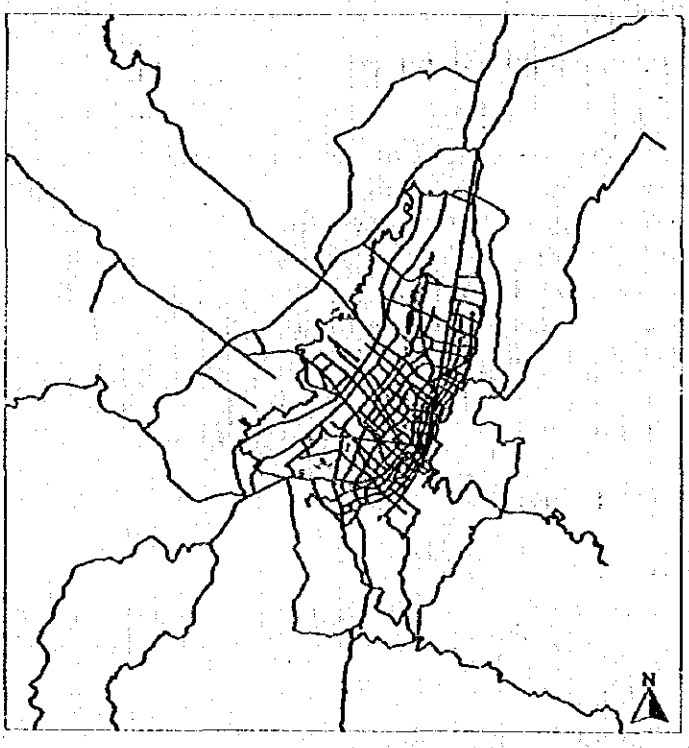


Figure 4.1-1 Road Network in Bogota City and Surrounding Area

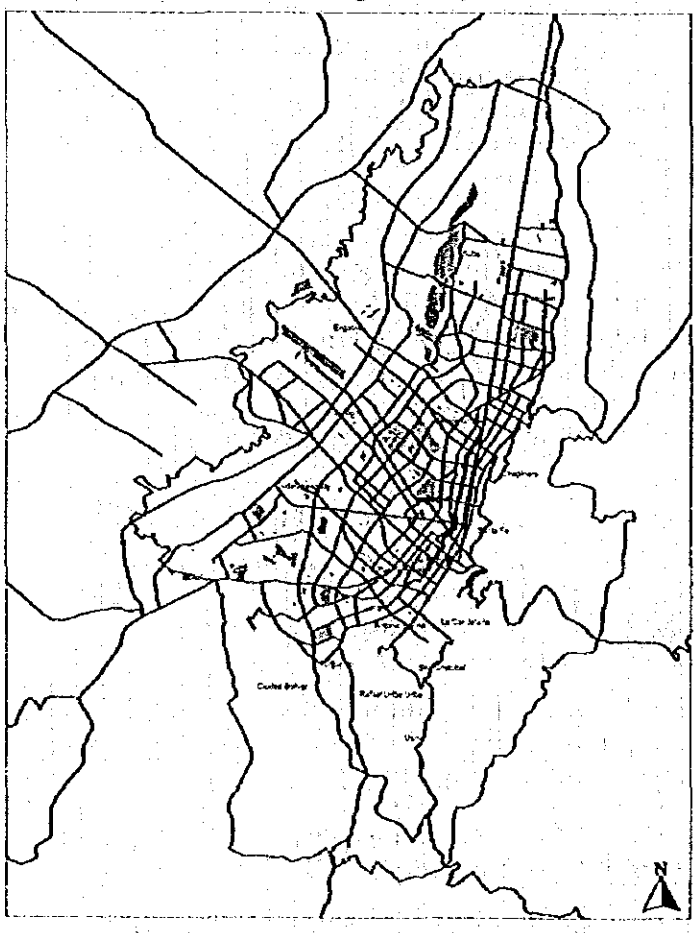


Figure 4.1-2 Road Network in Bogota City

1) Name of Ring Road

a) Avenida Ciudad de Quito (V-1 road)
b) Avenida del Congreso (V-2 road)
c) Avenida Boyaca (V-1 road)

2) Name of Radial Road

a) Autopista del Norute (V-0 road)
b) Autopista del Sur (V-1 road)
c) Avenida Villavicencio (V-2 road)
d) Avenida del Americas (V-0 road)
e) Aotopista El Dorado (V-0 road)
f) Autopista Medellin (V-1 road)
g) Avenida Suba (V-2 road)

However, some parts of the road segments on the ring roads and the radial roads have not been completed yet. Therefore, the trunk road network in Bogota is not formulated as a complete ring and radial road network pattern.

The secondary roads have been developing in accordance with the progress of housing and industrial developments. The secondary road network in the urbanized area of Bogota is formed as a grid road pattern.

The road network of V-0, V-1, V-2, and V-3 were identified by the Acuerdo 2, 1980, and some parts of the road network were adjusted by the Acuerdo 6, 1992. However, many roads have not been constructed yet.

4.1.2 Road Classification and Cross Section

(1) Functional Road Classification

The functional road classification was stated in Acuerdo 2, 1980 of Bogota. According to the Acuerdo, a road is classified into two (2) types of roads; arterial roads and local roads. Arterial roads are classified into seven (7) types of roads, and the local roads are classified into eight (8) types of roads. The width of the typical cross section of each road type is shown in Table 4.1-1, and the typical cross section of the arterial roads are illustrated in Figure 4.1-3.

Table 4.1-1 Width Of Cross Section Elements

Classification (Type of Road)	R.O.W (m)	Lane Width (m)	No. of Lanes
Arterial Road			
V-0	100	3.50(H), 3.50(L)	6(H)+6(L)=12
V-1	60	3.75(H), 3.33(L)	4(H)+6(L)=10
V-1P	60	- ,3.33(L)	- 6(L)= 6
V-2	40	- ,3.33(L)	- 6(L)= 6
V-3	30	- ,3.00(L)	- 6(L)= 6
V-3E	25	- ,3.75(L)	- 4(L)= 4
V-3R	18	- ,3.00(L)	- 4(L)= 4
Local Road			
V-4	25	- ,3.75(L)	- 4(L)= 4
V-4A	22	- ,5.00(L)	- 2(L)= 2
V-5	18	- ,5.00(L)	- 2(L)= 2
V-6	16	- ,4.50(L)	- 2(L)= 2
V-7	13	- ,3.50(L)	- 2(L)= 2
V-8	10	- ,3.00(L)	- 2(L)= 2
V-9	8	- ,3.00(L)	- 1(L)= 1
V-9E	6	- ,2.00(L)	- 1(L)= 1

Note; (H); High-Speed Lane
(L); Low-Speed Lane

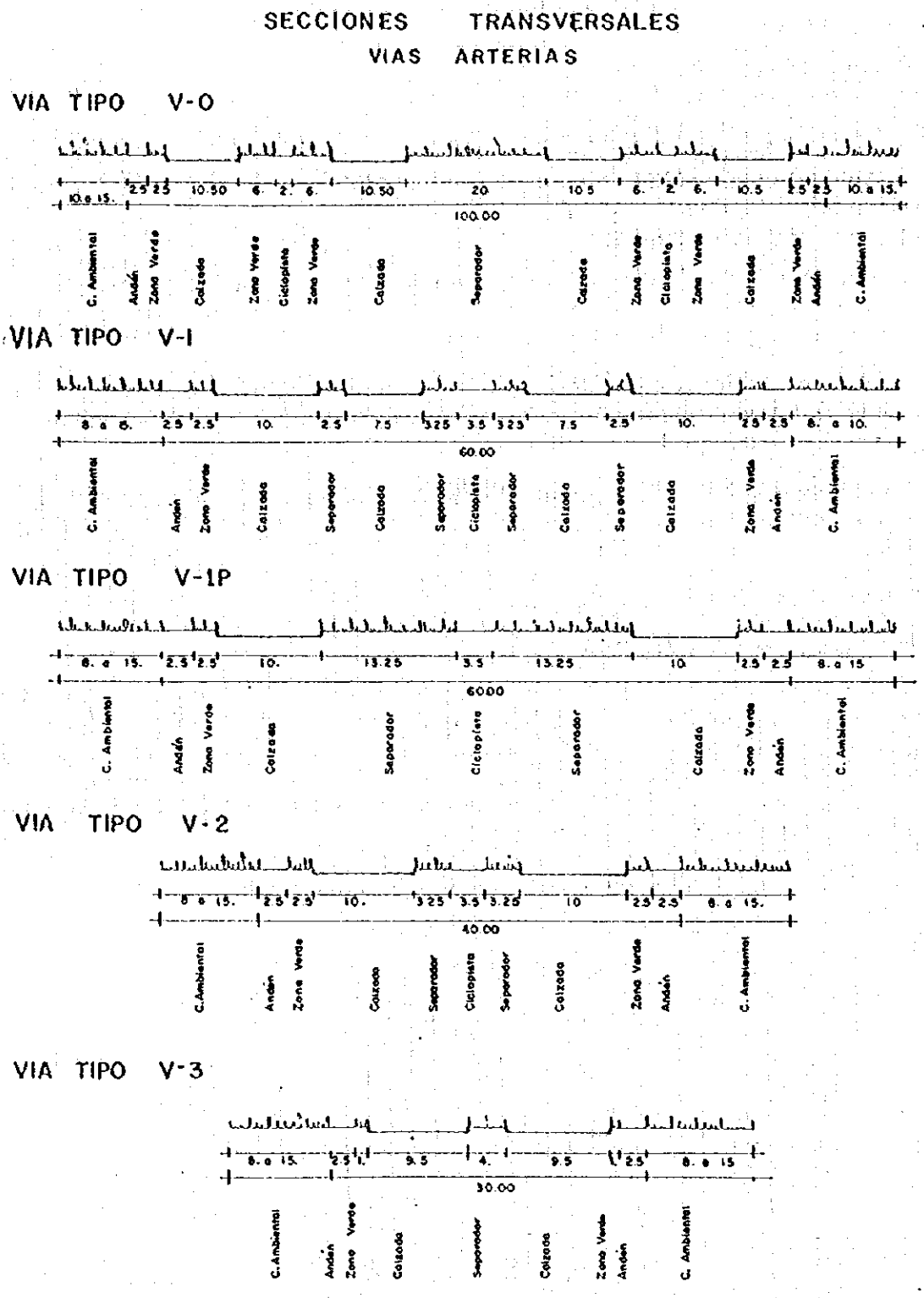


Figure 4.1-3 Typical Cross Section on Existing Arterial Road

The existing roads of each type have been constructed with the specified in the Acuerdo 2, 1980. Some parts of the road segnients are not completed yet, but the trunk roads have been constructed gradually based on the road network of the Acuerdo 2, 1980.

(2) Road Maintenance and Construction Classification

Bogota is responsible for the construction and maintenance of all the roads in the city. The roads in Bogota have been mainly constructed by IDU, and the maintenance of these roads has been mainly conducted by SOP. The construction and maintenance of roads which are located outside the city are under the responsibility of Ministry of Transport (MOT).

4.1.3 Road Structure Conditions

(1) Alignment Conditions

The horizontal and vertical alignments of the existing roads have been maintained in good condition relative to the geometric design standards since Bogota is located on almost flat terrain.

(2) Cross Section Conditions

The cross sections of V-0 and V-1 roads have the high-speed lane (2 to 3 lanes) and low -speed lane (3 lanes), and V-2 and V-3 roads have 6-lane dual carriageway with a 10.0- to 5.0-meter medium divider as shown in the Chapter 4.1-2.

However, there is no space for preparation of shoulders on both sides of the carriageway of the high and low speed lanes. The shoulder space can be used for construction of drainage facilities and maintenance of lateral clearance for keeping the traffic safety. The trunk roads should maintain shoulders on both carriageways to decrease the traffic accidents, to keep the lateral clearance and to maintain comfortable driving.

(3) Grade-Separated Intersection

There are many grade-separated intersections in Bogota. Many intersections where the trunk roads cross are developed as grade-separated intersections, however, there are many at-grade intersections at the place where the intersections between the trunk road exits. Grade-separated intersections are constructed in various types such as diamond, semi cloverleaf and full cloverleaf types as interchanges. Among them, the diamond-type interchange is the most popular. At present, about 39 grade-separated intersections are constructed in Bogota, and many other grade-separated intersections are planned. The numbers of grade-separated intersections on the individual roads are as follows, and the locations of the existing grade-separated intersections are illustrated in Figure 4.1-4.

a) Autopista el Dorado 5 Intersections
b) Avenida las Americas 5 Intersections
c) Autopista Norte 6 Intersections
d) Autopista Sur 3 Intersections
e) Avenida Quito 10 Intersections
f) Avenida Congreso 5 Intersections
g) Avenida Boyaca 3 Intersections
h) Avenida Caracas 1 Intersection
i) Avenida 7a 1 Intersection

Intersections other than those mentioned above are signalized or unsignalized

intersections. The Institute of Urban Development (IDU) has been planning to develop four (4) grade-separated intersections on the Autopista Sur. They will be constructed by the year 1998.

In December 1995, the construction of a new grade-separated intersection between Avenida Boyaca and Avenida Esperanza (Calle 39) will be completed. The bridge length is about 334 meters, with a 29-meter cross section. The total construction cost is estimated to be 4,376 million pesos at the 1995 rate.

(4) Road Pavement Conditions

Generally, the pavement conditions of the existing roads are very poor. There are many pot holes on the almost all the existing roads even on the trunk roads in Bogota. This is one of the cause to decreasing road traffic capacity and increasing traffic accidents. Nighttime driving is especially dangerous. There are many sag and crest points on the existing road surface. These sag and crest points may occur at the road segments which are constructed on the soft soil foundation. The main reasons for the poor pavement conditions are as follows;

a) Poor maintenance of road surface and roadbed
b) Poor maintenance of drainage facilities

(5) Road-Side Drainage Conditions

Bogota is developed on almost flat terrain. Therefore, the maintenance and control of the road-side drainage systems are comparatively difficult.

There are three(3) rivers or canals in Bogota which flow from the north to the south, and five (5) rivers or canals flowing from the east to the west. These rivers and canals are maintained for the runoff treatments from the road side drainage.

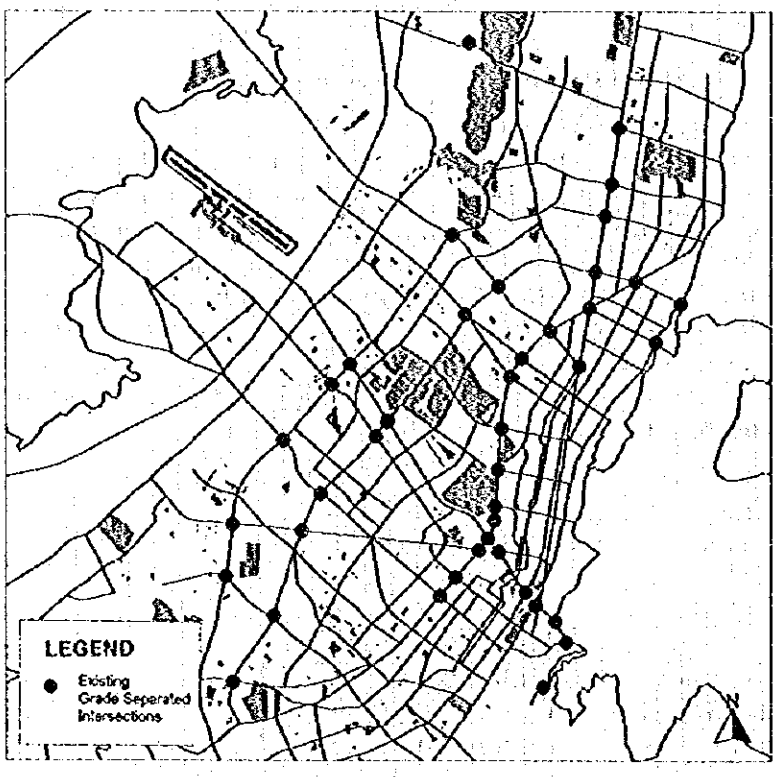


Figure 4.1-4 The Locations of Existing Grade-Separated Intersections

The drainage facility conditions of almost all the roads which are located in Bogota are very poor. When it rains heavily, many parts of road segment are completely submerged in by the rainwater, and this is one of the causes of the traffic congestion. The main problems of the road-side drainage facility systems in Bogota are as follows:

1) Poor Maintenance of Drainage Facilities

Almost all the inlets of catch-basins located along the roadside are filled with the mud, sand, and waste, and cannot function.

2) No Drainage Facilities

Generally, drainage facilities located on the shoulders such as L-type gutters or U-type gutters should be constructed to collect the rainwater and to lead the water to the catch-basin. However, there are no drainage facilities in almost all the existing roads in Bogota.

3) Miss Location or Arrangement of Catch-basin

There are many catch-basins along the roads located in the east-west direction (Calle), however, there are few catch-basins along the roads located in the north-west direction (Carrera, Avenida). Generally, the catch-basins should be installed at the lowest points on the road segments, but, it can be observed that some catch-basins are located at the high points of the road segments.

4) Catch-basin with No Functional Inlet Shapes

There are three(3) types of inlet shapes along the existing roads. Type-1 : the holes of inlet are located both at the end of the carriageway and under the edge of sidewalks. Type-2 : the holes of inlet are located only at the end of carriageway. Type-3 : the holes of inlet are located only under the edge of the sidewalks. The type-1 is the most functional inlet shape. Type-2 and type-3 are installed on almost all of existing roads. The holes of the type-2 and type-3 cannot function when heavy rain falls.

5) Poor Construction Materials for Catch-basin

There are many catch-basins destroyed along the roads. It may be caused by heavy vehicles and poor quality of the catch-basins.

4.1.4 Problems and Issues for Road Facilities

(1) Road Facility Problems

1) Incomplete Trunk Road Network

The trunk road network in Bogota is generally formed by ring and radial road network patterns, but, there are some missing links. The trunk road should be connected accordance with the road classification or road hierarchy, and should be formed with the complete links taking into account the transport operations and traffic safety. Those missing links of trunk road will be required to be constructed as soon as possible.

2) Shortage of Numbers of Road

The roads have been developed gradually keeping pace with the developing of urban activities, however, the development of the road construction could not catch up with the increment of the traffic volume. The actual traffic volume on trunk roads has been exceeding the road capacity, and traffic congestion occurs at many places in Bogota. It

will be required that new roads be constructed, or that improvement of the existing roads be implemented.

3) No shoulder Space on the Road

There are no shoulder space on the surface of the road. The functions of shoulder are very important for preparation of drainage facilities, space for emergency car stop, increment of the road capacity and the traffic safety. It is required that the shoulders be constructed on both sides of the carriageway.

4) Poor Maintenance

The maintenance of existing roads is very poor, especially for pavement and drainage facilities. Poor maintenance is decreasing the capacity and increasing the traffic accidents. It is required that the road maintenance be implemented periodically.

(2) Issues of Road Facilities

In order to solve the problems of existing road facilities as well as to prepare the future road development plan, the following issues of road facilities are pointed out.

1) Importance of Education

It is very important to improve the existing road facility conditions. The most important matter is to educate drivers and pedestrians to respect and keep traffic regulations and good manners.

2) Creation of High-Quality Road Facilities

Bogota is the capital, and largest city of Colombia, as well as the political, economic and cultural centers. The development of road and transport facilities should be maintained as a representative of Colombia.

3) Preservation of Good Urban Environmental Conditions

Bogota has been maintaining a good urban environmental perspective. For an example, some trunk roads have good plantation (road side trees) on both road sides or at the space of central reservation. The development of road projects should be maintained in harmony with good urban environmental aspects.

4.2 Current Road Traffic Characteristic

4.2.1 Traffic Characteristic

(1) Traffic Volume in Bogota Urban Area

Table 4.2-1 shows the two-way 12-hour traffic volumes on major roads. Traffic volumes are in the range of 153,000 and 21,000 passenger car unit (PCU). The highest volume of 153,000 is observed on Avenida Quito, which runs from the north to the south of the city. Other higher volumes are seen on the arterial roads in the urban city as follows; Autopista del Norte, Avenida 7a, Avenida del Las Americas, Transversal 23, Autopista el Dorado, Avenida Boyaca, Avenida 68, Avenida Suba, Autopista del Sur and Avenida 1 de Mayo. These volumes range from 128,100 to 50,500 PCU/day.

The traffic volumes on major radial roads running from Centro to north, south and east are as follows: Avenida 7a: 116,300-24,200; Avenida 13- Avenida Caracas: 45,600-24,300; Avenida Suba: 61,600-33,400; Autopista Medellin: 47,000-31,400; Autopista el Dorado: 82,600-54,200; Avenida Centenario: 47,700-31,600; Avenida de las Americas: 96,100-21,100; Avenida 1a de Mayo: 50,500-31,400; and Autopista del Sur: 61,300-35,800. On the other hand, traffic volumes on major ring roads which circumscribe the city center, i.e., Avenida 68 and Avenida Boyaca, are 68,500-52,000, 74,600-47,000, respectively.

Table 4.2-1 Traffic Volume on Major Roads (1995)

Unit : PCU for dual-way

Road	Range of Traffic Volume		
	12 Hour	Peak Hour	
		7:00-8:00	17:00-18:00 18:00-19:00
Avenida Quito	153,000 - 52,700	13,800 - 4,100	15,100 - 4,000
Autopista Del Norte	128,100 - 86,500	9,700 - 6,400	15,300 - 8,500
Avenida 7	116,300 - 24,200	9,700 - 2,200	7,800 - 2,700
Avenida Del Las Americas	96,100 - 21,100	9,300 - 1,900	8,600 - 2,400
Transversal 23	83,300 -	6,700 -	6,200 -
Autopista El Dorado	82,600 - 54,200	9,100 - 4,900	5,000 - 4,800
Avenida Boyaca	74,600 - 47,000	7,400 - 4,800	6,900 - 5,500
Avenida 68	68,500 - 52,000	6,800 - 4,700	6,400 - 4,800
Avenida Suba	61,600 - 33,400	4,700 - 2,800	3,100 - 2,500
Autopista Del Sur	61,300 - 35,800	5,600 - 3,400	5,800 - 2,900
Avenida 1 De Mayo	50,500 - 31,400	4,000 - 2,600	4,300 - 3,400
Avenida Centenario	47,700 - 31,600	4,800 - 2,800	3,800 - 3,100
Autopista Medellin	47,000 - 31,400	5,000 - 2,800	4,200 - 3,000
Avenida Cirucunvalar	46,000 - 32,500	4,100 - 2,900	-
Avenida Caracas	45,600 - 35,800	5,100 - 2,700	4,900 - 3,900
Avenida 19	44,000 - 37,300	3,600 - 3,100	3,200 - 2,900
Avenida 10	41,800 - 29,200	3,800 - 2,600	3,200 - 3,000
Avenida 15	40,200 - 34,700	3,600 - 2,400	3,300 - 2,900
Carrera 13	30,500 - 24,200	2,200 - 2,000	2,000 - 1,500

Thus, it can be seen that the roads with heavy traffic volume converge are on the area surrounded by Avenida 7a, Autopista del Norte, Avenida Quito, Avenida 30 and Autopista del Sur. Within the area that constitutes the city's business and commercial center mentioned above, an especially substantial volume of traffic is concentrated on Avenida 7a, Autopista del Norte and Avenida Quito running from north to south.

Table 4.2-1 also gives two-way traffic volumes on major roads during the morning and evening peak hours. Two-way traffic volumes (PCU/day) on major arterial roads in the Study Area range approximately between 13,800 and 1,900 during the morning peak hour (7:00-8:00), and 15,300-1,500 during the evening peak hour (17:00-19:00). The peak hour volume per lane of area above mentioned is observed high between 1,910 and 340. Further details are discussed below.

1) Morning Peak Hour

During the morning peak hour on major radial roads, Autopista del Norte shows the heaviest traffic volume at about 9,700-6,400 PCU/day. Other higher volumes are seen on the Avenida 7a, and Avenida del las Americas, and Autopista el Dorado. The volumes are 9,700-2,200, 9,300-1,900, 9,100-4,900, respectively. Traffic volumes on major ring roads which circumscribe the city center, Avenida Quito, Avenida Boyaca and Avenida 68, are 13,800-4,100, 7,400-4,800, 6,800-4,700 respectively. Two-way peak hour volumes on arterial roads serving the city center range between 1,620 and 370, indicating a condition of saturation.

2) Evening Peak Hour

During the evening peak hour on major radial roads, Autopista del Norte shows the heaviest traffic volume at about 15,300-8,500. The other high-volume roads are as follows: Avenida del las Americas: 8,600-2,400; Avenida 7a: 7,800-2,700; Autopista del Sur: 5,800-2,900. Traffic volumes on major ring roads are seen as follows: Avenida Quito: 15,100-4,000; Avenida Boyaca: 6,900-5,500; Avenida 68: 6,400-4,800. Two-way peak hour volumes on arterial roads serving the city center range between 1,900 and 15,000, indicating a condition of saturation.

(2) Screen line Traffic Volume

The two-way traffic volumes at the each point ranges between 96,100 and 1,900 PCU. High traffic volumes cross on Avenida de las Americas (S-16), Avenida Boyaca (S-17) ,Avenida 68 (S-15) and Avenida Caracas (S-6). The two-way 12-hour traffic volumes on these four survey points are 96,100, 71,500, 67,100 and 43,800, respectively. The total traffic volumes of these four bridges is 278,500, equivalent to 49.3% of the total screen line traffic volume.

The two-way traffic volumes at the morning peak hour (7:00-8:00) ranges between 9,300 and 200; the total traffic volumes in the inbound direction show 34,000, while 20,200 is observed in the outbound direction. During the evening peak hour (17:00-19:00), the two-way traffic volume ranges between 11,100 and 100; the total traffic volume in the inbound direction shows 21,400, while 31,400 is observed in the outbound direction.

(3) Cordon Line Traffic Volume

The highest volume of 52,600 is observed on Autopista del Sur (C-6). The next highest volumes are seen on Avenida Centenario (C-6) and Autopista del Norte (C-2). These volumes are 43,000 and 36,900, respectively. Figure 4.2-1 shows the traffic volume passing the cordon line classified into five traffic corridors (Northern part, Northwestern part, Southwestern part, Southeastern part, and Eastern part). The traffic volume bound to the Northern part and Northwestern part shows the highest figure, equivalent to about 32% of the total cordon line traffic volume. The volumes of other parts are shown as follows; the Southwestern bound direction (about 30%) and the Eastern bound direction (4%) and Southeastern bound direction (2%).

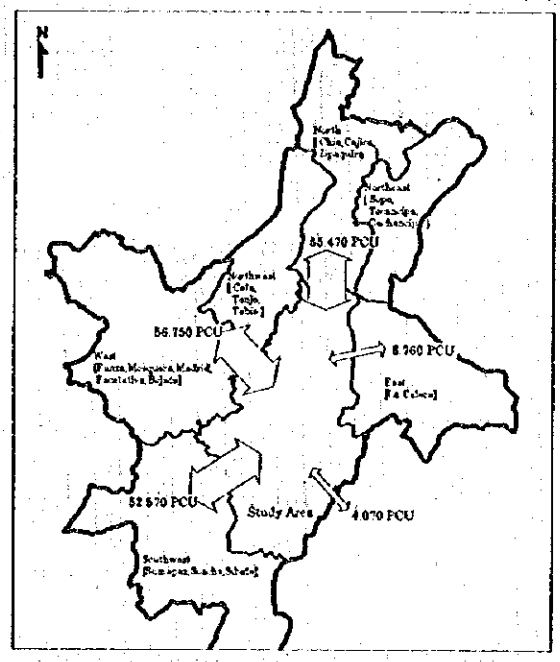


Figure 4.2-1 Traffic Volume on Cordon Line

(4) Hourly Fluctuation

The fluctuation patterns in three peak hours are during 7:00-9:00 in the morning, 11:00-14:00 in the midday, and 17:00-19:00 in the evening. Especially large fluctuations are seen in the midday peak hour due to changes in traffic congestion that occurs during business hours.

The morning peak hour occurs during 6:00-7:00 in the southern area surrounded by Autopista del Sur, Avenida 1a Hortua and Avenida 7a; during 7:00-8:00 in the northeastern area of commercial/business areas and the western area of Avenida Caracas running from the north to the south; while the evening peak hours simultaneously occur during 17:00-19:00 in the whole city.

The morning and evening peak rates of hourly traffic to 12-hour traffic on main locations of screen line /cordon line are shown as follows: on Avenida Caracas (northern/southern cross sections), Avenida 68 and Avenida Boyaca on screen line, in the morning peak hour these peak rates show 7.2%, 8.9% and 11.8%, while in the evening peak hour, 9.2%, 8.7%, and 9.0%, respectively. On Autopista del Norte, Avenida Centenario, Autopista del Sur and Avenida Villavcencio on cordon line, in the morning peak hour the peak rates show 8.1%, 8.2%, 9.1% and 14.9%, and in the evening peak hour 8.8%, 7.2%, 8.3% and 10.0%, respectively.

The ratios of daytime to nighttime volume on the cordon line and the screen line are as follows: the ratio on the cordon line ranges between 1.26 and 1.40 except 1.97 at Avenida Villevicencio and on the screen line it ranges between 1.24 and 1.43.

(5) Vehicular Type Composition

The characteristics of the vehicular type composition on the screen and cordon lines are described as below.

1) On the screen line

The shares of each vehicular type on the screen line during 12-hours are as follows: the cars, 16-54%, the taxis, 13-37%, the trucks, 6-35%, the buses, 1-26%, the busetas, 1-29%

and the colectivos, 0-9%. Especially at the screen line stations on Carrera 60 (S-14) and Carrera 34 (S-11), the cars show a high share at 25-27%, while the share of the bus group is high at the stations on Carrera 6 E (S-1), 58%, and Avenida 10 (S-5), 42%; and the share on Avenida Caracas (S-6) shows 28%.

During morning peak hour, the shares of trucks at the stations from Carerra 1 (S-1) to Carerra 34 (S-11) range approximately between 3 and 10%. The shares are low due to the restriction on the entry of heavy trucks during peak hours inside the ring road Avenida Quito.

2) On the cordon line

The shares of each vehicular type on the cordon line during 12-hours are as follows: the cars, 34-75%, the taxis, 2-9%, the trucks, 9-47%, the buses, 1-9%, the busetas, 0-2%, and the colectivos, 2-24%. Especially at the cordon line stations on Autopista del Norte (C-2) and Autopista Medellin (C-5), the cars have the high share at 72-75%, while the share of the bus group is slightly higher at the stations on Autopista del Sur (C-7), 32%, and Via Choachi (C-10), 25%.

Of the total volume on cordon line, the share of cars in the north-bound direction is high at 23%. The north-bound and northwest-bound directions each have a high share of trucks at 9%, while the share of the bus group in southwestern-bound direction is about 7%. Its figure is higher than in other directions.

In the morning peak hour, the share of cars at the station on Autopista Medellin (C-5) is high at 76%, and the station on Autopista del Sur (C-7) has the highest share of bus group at 35%.

4.2.2 Travel Speed

(1) Status of Travel Speed

Figure 4.2-2 shows the current travel speed by each road segment between intersections on the major roads during the morning peak hour, the midday peak hour and the evening peak hour. The characteristics of travel speed by periods are shown below.

1) Morning Peak Hour

The road segments with travel speed of 10 km/h or less, indicating heavy congestion, are concentrated on major radial roads in Centro and the northern business/ commercial area surrounded by Avenida 7a, Avenida 147, Autopista Del Norte, Avenida Boyaca, Avenida Quito and Autopista del Sur. These heavily congested roads are as follows: Avenida 7a (Section Avenida 127 - Calle72), Avenida Caracas (Section Avenida 72 - Calle 63, Calle 26-Calle 13), Avenida 19 (Section Avenida 147-Avenida 127), Avenida 81 (Section Avenida Quito-Avenida Caracas), Avenida Quito (Section Calle13-Avenida Boyaca), Avenida 68 (Section Avenida Suba-Avenida 7a) and Avenida Centenario (Section Avenida Quito-Avenida 7a). On the other hand, the road segments with the same travel speed as above congested area are seen in the areas where a major roads crosses the Avenida 68 and Avenida Boyaca. These sections are located on Autopista del Sur, Avenida 1a de Mayo and Avenida Suba.

Therefore, the business/commercial area surrounded by Avenida Caracas, Avenida 7a and Avenida Quito is heavily congested to an especially high degree. The area by Avenida 7a, Avenida 147, Autopista del Norte , Avenida Boyaca, Avenida Quito and Autopista del Sur covering approximately 100 km2 is heavily congested in Bogota.

2) Midday Peak Hour

In the area surrounded by Avenida 7a, Avenida 127, Autopista del Norte , Avenida Quito and Avenida 27 S with travel speed of 10 km/h or less, traffic for business purposes is concentrated being the city's business and commercial center. Therefore, the especially congested segments are as follows: Avenida 7 (Section Calle 72-Calle 45), Carrera 11 (Section Avenida 92-Calle 72), Avenida 15 (Section Avenida 94-Calle 85), Avenida Caracas (Section Avenida 78-Calle 34, Calle 26-Calle 6), Carrera 13 (Section Calle 68-Calle 34), Carrera 24 (Section Avenida 78-Calle 63) and Avenida 10 (Section Calle 26-Calle 6). In addition, low travel speeds are observed in the vicinity of the intersections Avenida 68-Calle 72, Avenida Boyaca-Calle 72, Avenida Boyaca - Autopista El Dorado, Avenida Boyaca-Avenida 1a de Mayo. The area surrounded by Avenida 7a, Avenida 127, Autopista del Norte , Avenida Quito and Avenida 27 S covering approximately 60 km2 is heavily congested.

3) Evening Peak Hour

The segments with low travel speed in the evening peak hour are more or less the same as those in the morning peak hour. The congested area, however, expands further northward and westward than that of the morning, and, moreover, the traffic is highly dense. Thus, the especially congested segments are located on almost all major roads in area surrounded by Avenida 7a , Avenida 127 , Autopista del Norte , Avenida Quito, Autopista Del Sur and Avenida 1a de Mayo. The area covering approximately 110 km2 centering on Avenida 7a, Avenida Caracas and Avenida Quito is heavily congested.

(2) Main Causes of Traffic Congestion on Major Roads

The travel time of each segment, the frequency of stops and their causes were recorded in the travel time survey to find out what causes the traffic congestion on the major roads. The principal causes of traffic congestion on major roads are classified into 7 types as shown below. The traffic congestion on major roads is aggravated on road segments and at intersections by aggregating several causes such as traffic spill-back and slow-moving buses/busetas conflicts near bus stops during peak hour.

a) Waiting for traffic signal change
b) Traffic accident
c) Slow-moving buses/busetas conflicts near bus stops
d) Over-saturated congestion with traffic spill-back due to bottlenecks
e) Traffic merging from side roads without traffic signal lights
f) Influence of cars turning to the left
g) Reduction of road width

Figure 4.2-3 shows the main causes of traffic congestion on major roads. The main causes on congested segments with travel speeds of 10 km/h or less during peak hour are shown below.

On major roads surrounded by Avenida 7a, Avenida 127 , Autopista del Norte , Avenida Quito , Autopista del Sur and Avenida 1 de Mayo, serious traffic congestion is caused by over-saturated congestion with traffic spill-back due to bottlenecks, slow-moving buses/busetas conflict near bus stops, and traffic merging from side roads without traffic signal lights.

These bottlenecks causing over-saturated congestion with traffic spill-back are seen on main intersections of Avenida 7a, Avenida Caracas, Avenida 13, Avenida Quito, Avenida 19, Avenida 15, Carrera 11, Avenida 68 and Avenida 72. They have about 25 intersections. Of 25 intersections surveyed, all the intersections between Avenida 19-

Calle 134, Avenida 19-Calle 127, Avenida Boyaca-Avenida Suba, Avenida 19-Avenida Boyaca, Avenida 7a-Calle 85, Avenida Caracas-Avenida 78, Calle 68-Carrera 78 and Avenida 10-Calle 19 show a saturation degree of more than 1.0. The value ranges between 1.37 to 1.04, indicating that these intersections are oversaturated.

The congested segments caused by slow-moving buses/busetas conflict near bus stops are seen on most of the major roads. The serious locations are on sub-arterial roads such as Carrera 11, Avenida 15, Carrera 24 and Avenida 10, all of which are located either in the northern business/commercial area or Centro. The other bus conflict locations are observed in the vicinity of the main intersections on Avenida 68, Avenida Boyaca Avenida Quito and Autopista del Sur.

The traffic merging from side roads without traffic signal lights is seen on the sub-arterial roads. These roads are seen in business/commercial area of the northeastern city and a partial areas of the southern center. The remarkable roads are as follows: Carrera 11, Avenida 15, Avenida 19 and Calle 72.

The side roads on Avenida Caracas shows traffic congestion due to waiting for traffic signal changes, because of the priority signal phase for Avenida Caracas. The heavily congested segments caused by reduction of road width are observed on Carrera 11 between Calle 82 and Calle 72.

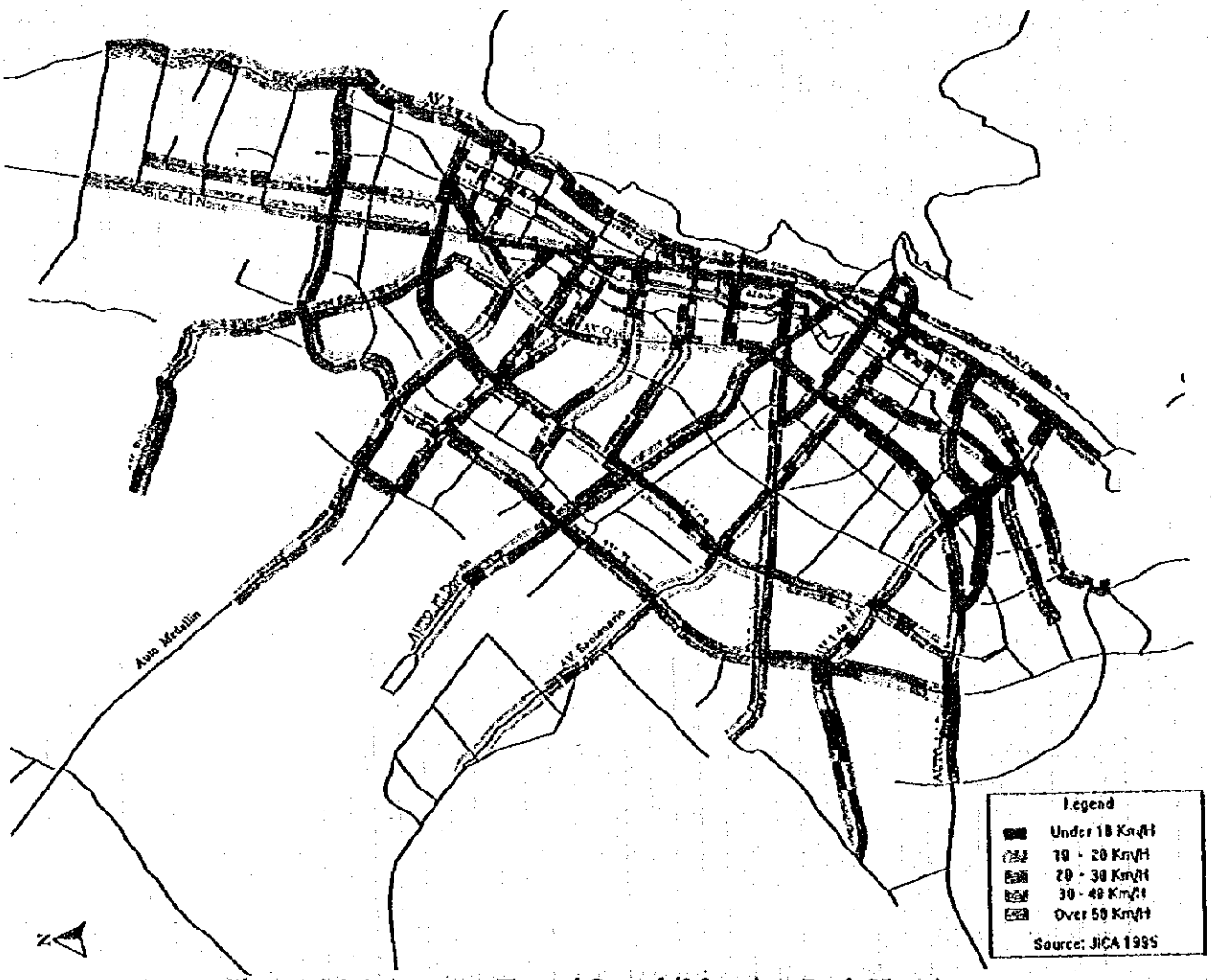


Figure 4.2-2 Average Travel Speed (Morning Peak Hour)

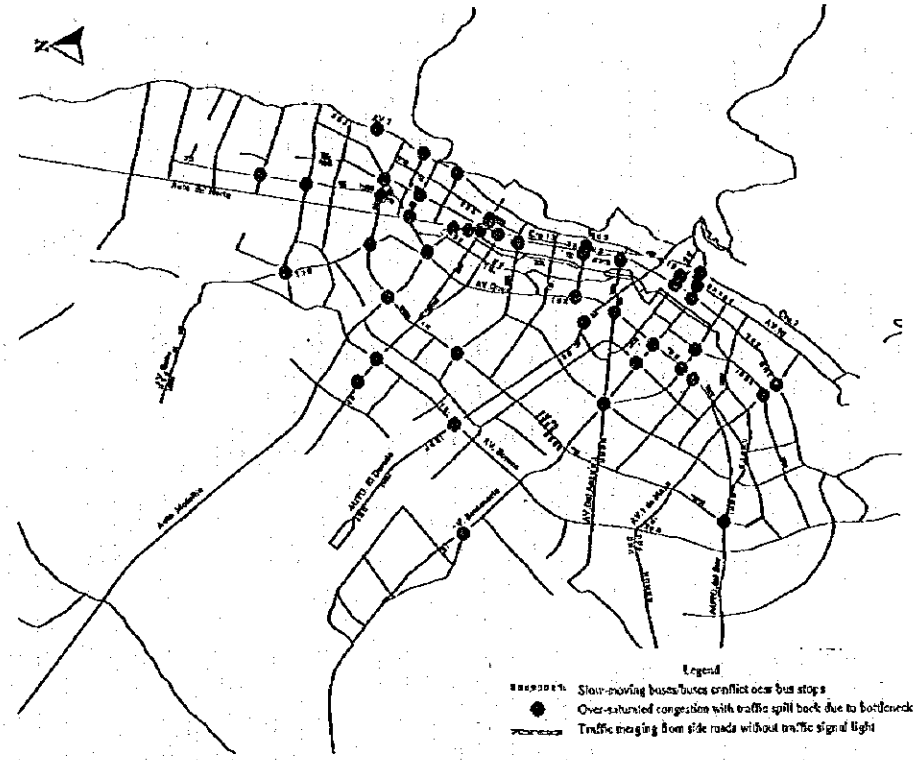


Figure 4.2-3 Main Causes for Traffic Congestion on Major Roads

4.2.3 Traffic Accidents

(1) Number of Accidents

Table 4.2-2 shows the number of traffic accidents that occurred in Bogota during the past 10 years (1985 - 1994). As seen in Table 4.2-2, a downward trend is observed in 1991, but the number of accidents increases gradually over the following years until 1994. Traffic accidents during the past decade since 1985 increases about 1.3 times. However, the number of accidents per vehicle registered declined during the 10 years, apparently indicating the effectiveness of traffic safety measures.

Table 4.2-2 Yearly Traffic Accidents in Bogota

Year	Number of Accidents			Number of Registered Veh.
	Fatal Ac.	Others	Total	
1985	4,739	24,101	28,840	273,649
1986	4,249	20,251	24,500	288,900
1987	4,707	26,540	31,247	306,633
1988	4,831	29,512	34,343	327,164
1989	5,008	29,704	34,712	343,484
1990	4,466	35,963	40,429	357,474
1991	4,492	27,501	31,993	372,273
1992	-	-	-	392,181
1993	-	-	34,870	442,128
1994	5,279	30,916	36,195	489,244

(2) Accident Analysis

1) Traffic Accidents by Vehicle Type

The number of traffic accidents by vehicle type in 1994 in Bogota is shown as follows:

Of the total number of fatal accidents caused by 4-wheeled vehicles, approximately 67% were cars, 10% trucks and 23% buses.

2) Traffic Accident Types

Of the total fatal accidents, a 89% are vehicle-to-vehicle accidents, while 9% involved pedestrians.

3) High Incidence Locations

The high-accident locations are within the area surrounded by Avenida 7a, Avenida 100, Avenida 68 and Avenida Centenario. The locations with high accident rates are in the city center, and the areas on southern Avenida Quito (Avenida 30), Avenida 68, Avenida 7a, Avenida Caracas, Autopista Medellin and Avenida Centenario, are particularly remarkable. While the intersections with high accident rates are shown as follows: Autopista el Dorado-Avenida Boyaca: 163 accidents; Avenida Boyaca-Calle 39: 141 accidents; Avenida 68-Autopista Medellin: 132 accidents; Avenida100-Cra.15: 128 accidents; Avenida Boyaca-Calle 12: 115 accidents; Avenida 68-Avenida 63: 107 accidents; and Avenida68-Calle72: 106 accidents. The existing recording sheet of accidents does not classify the accident types such as collision and violation types. Therefore, the detailed accident analysis is difficult. However, according to several traffic accident diagrams and visual observations on roads, the qualitative analysis of accident causes concludes that:

At most signalized intersections, the occurrence of sideswipe collisions and rear-end collisions are high. This is seemingly mainly due to indistinct stop lines and lane markings which drivers tend to pass, and drivers' disregarding traffic lights. At the approach, drivers do not follow the lane marks, do make sudden and frequent lane changes without notice, and jump queues and block intersections. Bus drivers' behavior is habitually loading and unloading passengers at intersections and in middle lanes.

CHAPTER 5
Public Transport Conditions

5. PUBLIC TRANSPORT CONDITIONS

5.1 General

The urban public transport service operates under the jurisdiction of STT of Bogota. The transport enterprises are in charge of the public transport service for passengers and mixed:

1) Passengers mode: transport that allows exclusive mobilization of passengers under different kinds of vehicles.

2) Mixed mode: Transport service which allows simultaneous mobilization of passengers and cargo (boxes, bundles and packages) in buses and busetas properly licensed in which they charge additionally depending on the type and quantity of the cargo.

Among passengers mode, there are different service levels such as:

1) Ejecutivo: Service that is made by relatively new buses or busetas with certain comfortableness. No standing passengers are allowed. Inside this category, there are different levels of service by type, model and comfort of the vehicle:
   a) Bus ejecutivo: Vehicles of less than 7 years of age
   b) Bus super ejecutivo: Vehicles of less than 5 years of age
   c) Buseta ejecutiva Vehicles of less than 7 years of age
   d) Buseta super ejecutiva: Vehicles of less than 5 years of age
2) Corriente: Service of buses and busetas of different types and models which allow standing passengers without exceeding authorized capacity. There are different levels of service depending on vehicle model, affecting the fare.

3) Taxi Colectivo or Microbus: They are vehicle of regular service with an average capacity of 13 passengers.

4) Taxi: regular taxi-cab with the capacity of four passengers

Nowadays, there is a seemingly an excessive supply of public transport. There are 631 authorized routes that cover the city. The service is provided by an inadequate lot of vehicles, because 18.6% of the vehicles are older than 20 years. Contributing to pollution and danger on the roads. 10.3% of the vehicles are colectivos that have low capacity and congest traffic.

Public transport does not have any governmental subsidy and is organized by private enterprises.

5.2 Administration of Public Transport

5.2.1 Organizational Structure

(1) Organization

The Public Transport Unit (UTP) in STT has jurisdiction over public transport administration in Bogota. UTP is composed of four divisions; Transport Legalization Division, Route Division, Cost and Tariff Division and Transport Company Division and under the last division, there are two sections. Under the UTP chief, there is a data

processing group named Geo-related Information System Group(SIG). Figure 5.2-1 shows the organization of UTP.

In connection with the Avenida Caracas Trunk Bus project, the Inter-institutional Transport Group (GIT) was created to coordinate the project in a comprehensive way, consisting of DAPD, STT, IDU, ETB, SISE and UNDP.

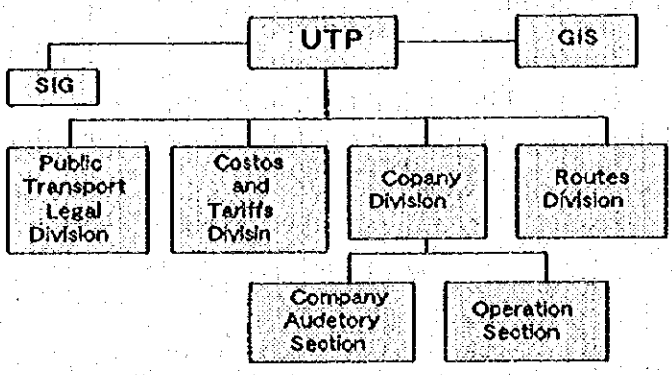


Figure 5.2-1 Organization of Public Transport Unit (UTP)

Personnel and staff of each entity is as follows:

a) UTP: one director
b) Public Transport Legal Division: one chief and four lawyers
c) Costs and Tariffs Division: one chief and two engineers
d) Routes Division: one chief and seven engineers
e) Company Division: one chief
   - Company Auditory Section: one chief and six professionals
   - Operation Section: one chief

(2) Functions of STT in Public Transport Administration

1) Functions

Functions of each division are specified in Decree 265, 1991, of which the main functions are as follows:

a) UTP

- To supervise, coordinate, regulate and control the operation of public transport in Bogota.
- To prepare for the Secretary, the plans of assignment, modification or cancellation of routes to transport companies in Bogota.
- To watch and investigate violations against public transport regulations

b) Public Transport Legal Division

- To apply the valid regulations to public transport vehicles under jurisdiction of Bogota.
- To judge the judicial cases in the private sector in accordance with regulations
- To check and formalize regulations and acts prepared by each Division.
- To promote the administrative investigation of different companies, concerning public transport services in accordance with the regulations
- To participate in judicial advice program for related agencies.
- To participate as an arbitrator in the conflicts among sauce members and drivers in public transport companies.

c) Costs and Tariffs Division

- To maintain the tariff system of public transport updated, under the instruction of the Subsecretariat of Planning.
- To investigate possible variations of transport costs for the calculation of tariffs

d) Routes Division

- To conduct a study for the assignment, modification or cancellation of public transport routes.
- To propose alternative routes to meet demand (to public transport companies) following recommendation by the Subsecretariat of Planning.
- To determine the number of terminals to provide efficient services to handle demand.
- To maintain route inventories.
- To attend route requests from the public sector or local communities.

e) Companies Division

- To control the issuance of licenses for public transport companies.
- To supervise the updating of the inventory of public transport companies.

f) Company Auditory Section

- To implement periodic inspections of public transport companies, to know their organization, function, operation and complaints about the regulations.

g) Operation Section

- To review and evaluate the studies in the past on the constitution of public transport companies in different modes.
- To evaluate and classify the companies and to register them.

h) SIG

- To use the information database as necessary to determine the actual situation
- To create a database for route systems in accordance with the requirements of the Routes Division
- To develop, revise and manage a digital map.
- To coordinate and establish an interchange procedure of graphic information on each entity.

2) Monitoring of Bus Operation

STT has no specific program for monitoring public transport and no specific points are designated for route control. Troncal Caracas Project tried to build such a program for strategic control points. However, it is not functioning yet.

The Subsecretariat of Planning in STT tried another monitor program to count the traffic volume on specific streets or junctions. Local solutions were then implemented, but these were only local studies prior to local projects.

For route restructuring, the Routes Division made a survey on two consecutive days in July 1995, visiting the terminal to check the actual service of each route, the origin and the destination, the route alignment, service frequency and the authorization of the route. The results of this survey will be analyzed also in this Master Plan Study.

5.2.2 Public Transport Policy

STT promulgates several decrees and resolutions every year, to regulate public transport service. Important ones in recent years are shown below. By those decrees, it is apparent that STT's policies put the emphasis on: (1) Renewal of bus fleets by urging replacement

with fare incentive, (2) Decrease in use of small-size buses, (3) Suspension of authorization of new companies and new routes until the route reconstruction plan is prepared, and (4) Restriction of over-supply.

1) Decreto 568 September 1993

To authorize only bus and buseta type vehicles to operate mass public transport for passengers in regular and executive levels , if they acconiplish the following requirements:

a) The new vehicle that is going to be registered must have equipment and gadgets that assure minimum contamination
b) The new vehicle must transport a minimum of 40 or 28 passengers for bus or buseta, respectively
c) The new vehicle must have advanced steering.
d) The vehicles must be the model of the incorporation year.
e) To suspend new authorizations of operation to new transportation urban companies. It will not be possible to expand authorized maximum capacity to companies already operating.

2) Decreto 612 October 1993

Not to allow any more entrance for public service of vehicles of microbus type. Reduce by 50% transport capacity available for vehicles of microbus type. Maximum authorized transport capacity cannot be given to companies already in service. To suspend authorization of new companies

3) Decreto 853 , December 1993

To give exceptions to vehicles for public transport. To authorize only for replacement of: bus or buseta to bus, bus or buseta to buseta and microbus or buseta to microbus.

4) Decreto 716 November 1994

To suspend new authorizations of taxis, because there are too many already. To suspend authorizations of new urban taxi companies.

5) Resolution 255, October 1994

To suspend authorization of new routes for public transport or modifications to the existing ones that would uses Avenida Caracas.

6) Resolution 080 April 28 1995

Temporarily to suspend (3 months) the authorization and modification of routes, considering the bad quality of the service for passengers until they get the routes restructuring plan prepared by the Routes Division of STT.

7) Decree 018 & 019 January 1995

Differential fares are established for current service levels, providing alternatives for low income users and encouraging investment in new vehicles; to guarantee a more efficient and safer transport.

Set a progressive fare increase by a maximum of 18%, according to national policies and fares for ejecutivo, superejecutivo and microbus (free within a specified range).

8) 105 law, December 1995

Maximum use life is 20 years. Authorities may suspend vehicle increases, submitting to removal of a vehicles more than 20 years old. Old vehicles must be removed from service before:

a) June 30 1995 1970 and older
b) December 31 1996 1974 and older
c) June 30 1999 1978 and older
d) December 31 2001 more than 20 years.
e) After 2002 all vehicles more than 20 years old must be removed.

Vehicle life may be extended by 10 additional years only once in the life time if they area properly transformed, according to Ministry of transportation regulation to be defined. Companies must provide periodically to the owners vehicle reposition programs and must provide and regulate funds for such reposition.

To transform a vehicle, the engine and transmission must be replaced by new ones and the body must be updated. Only one transformation is allowed during the vehicle lifetime. Vehicles from 1968 to 1973 may be changed to private service, if they fulfill the requirements.

5.3 Demand for Public Transport

As stated in Chapter 3, approximately 11.2 million trips are made daily in the Study Area, excluding trips by walking, according to the results of Person Trip Survey conducted on September to October, 1995. Out of these trips, 8.3 million trips (71,9%) are made by public transport and 5.2% by taxi.

Average trip length of bus passengers is estimated at 9.2 km which will become longer as the expansion of the City in the future.

In the O-D structure of bus passengers trips, significant movement is observed between the central business district (CBD; Centro to Chapinero) and the western area (Suba, Kennedy, Bosa) and also between CBD and the southern area (Uribe, Usme, Tunjuelito).