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Classification: 1st

CHAPTER 1

SURVEYS

1.1. PERSON TRIP SURVEY

The Person Trip Survey shows up the socioeconomic data and the moving pattern of the RMB-Belem Metropolitan Area population. This survey was supplemented by two other surveys which are Screen Line¹ and Cordon Line².

As for the system procedure, the RMB - Belem Metropolitan Area was sub-divided into 100 traffic zones. The outside of the Study Area was divided into 4 external zones, representing areas of access by roads zone 68 (Castanhal and Santa Izabel do Para) and zone 69 (all the others), by river (zone 70) and by air (zone 71). The total number of traffic zone is 104 (FIGURE 1.1-1). The definition of these traffic zone was done according to the configuration of zone limits used in PDTU/1991 "The Masterplan Study on Urban Transport in Belem in the Federative Republic of Brazil (1991, JICA)". A few traffic zones defined in 1990, which had quite different occupancy during this period, were broken down to preserve the concept of homogeneity of occupancy.

The Person Trip Survey was made through home interviews in 7,000 households in the Study Area from May 24th to June 30th, 2000. The interviewers visited target household to ask and register socioeconomic characteristics, household information and person trip information of all household members about their previous day movement. These interviews were implemented from Tuesday to Saturday.



Foto: Ozeas Santos

FIGURE 1.1-2 Scene of Person Trip Survey

The total number of residences that were interviewed represents 2.02% of the total number of households in the RMB according to IBGE - "Instituto Brasileiro de Geografia e Estatística" counting in 1996 in the Study Area in RMB. This total reaches 32,467 persons. This sample was done in each traffic zone of the RMB map at random.

¹ This survey focus comparison and adjustment between the total number of trips in Screen Line and the origin and destination of Person Trip Survey.

² This survey focus to complement the Person Trip Survey data with those related to the external origin of the Study.

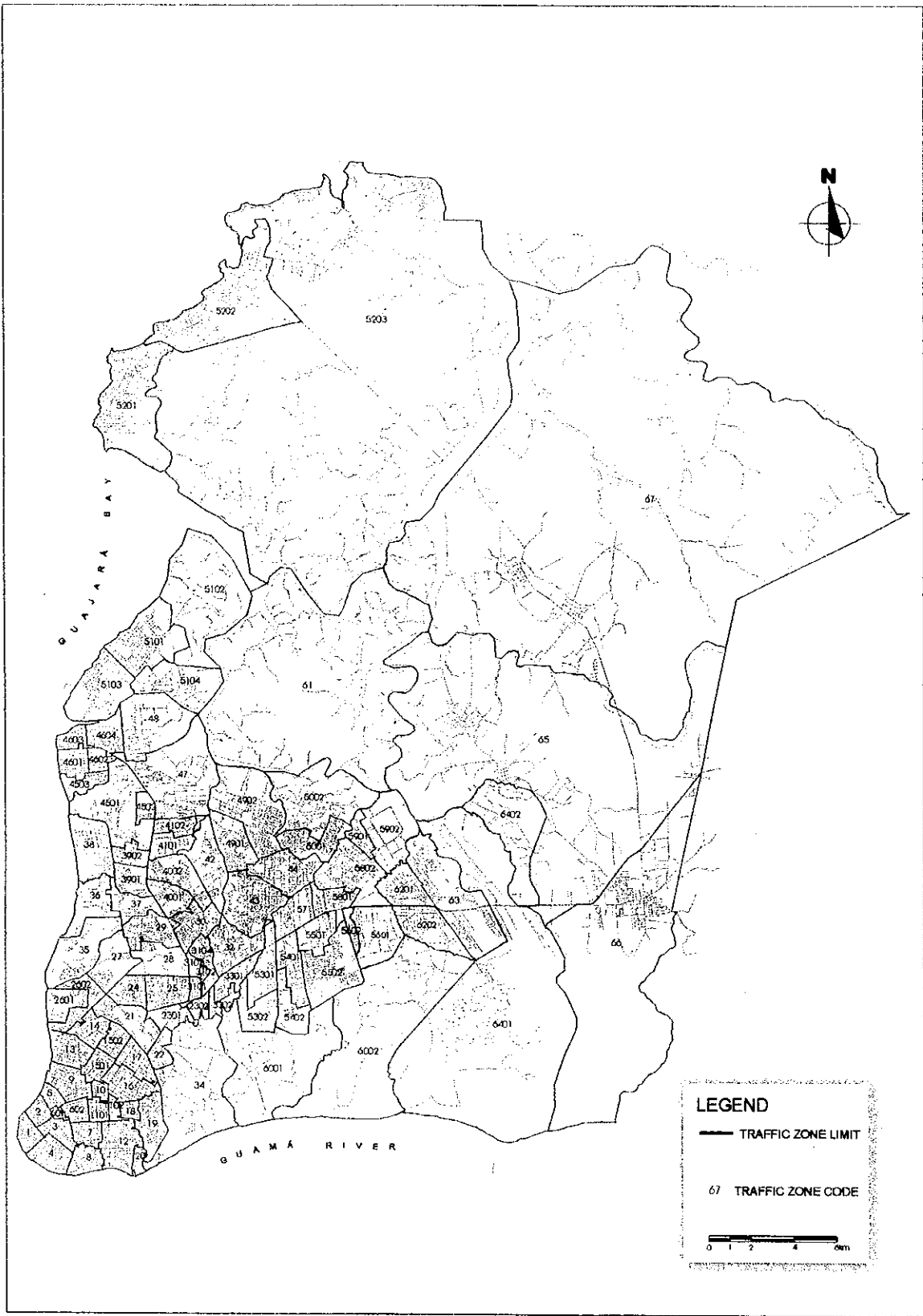


FIGURE 1.1-1 - Traffic Zones - RMB

The Person Trip Survey questionnaire is composed of three parts:

- a) Residence characteristics;
- b) Residents social economic data;
- c) Person Trip data.

The RMB 100 internal traffic zones were grouped into 19 macro zones (FIGURE 1.1-3) with the purpose of comparing the results of PDTU/1991 with PDTU/2001. The relation of traffic zone and its macro zones is shown in TABLE 1.1-1 and FIGURE 1.1-4.

TABLE 1.1-1 – Zone Conversion Table between PDTU/1991 and PDTU/2001

Macro Zone	Traffic Zone	
	1990	2000
Centro	1, 2, 3, 4, 5, 601, 602	1, 2, 3, 4, 5, 601, 602
Guama	7, 8, 12, 19, 20	7, 8, 12, 19, 20
Sacramenta	9, 13, 14, 1501, 1502	9, 13, 14, 1501, 1502
Marco	10, 1101, 1102, 16, 17, 18	10, 1101, 1102, 16, 17, 18
Marambaia	21, 22, 2301, 2302, 24, 25, 28, 3101	21, 22, 2301, 2302, 24, 25, 28, 3101, 3102
Aeroporto	2601, 2602, 27, 35	2601, 2602, 27, 35
Embrapa	34	34
Guanabara	3102, 32, 33	3103, 3104, 32, 3301, 3302
Bengui	29, 30, 37, 3901, 3902, 4001, 4002, 4101, 4102, 42	29, 30, 37, 3901, 3902, 4001, 4002, 4101, 4102
Pratinha	36, 38	36, 38
Icoaraci	4501, 4502, 4601, 4602, 4603, 4604, 47, 48	4501, 4502, 4503, 4601, 4602, 4603, 4604, 47, 48
Cidade Nova	42; 43, 44, 49, 50	42; 43, 44, 4901, 4902, 5001, 5002
Julia Seffer	53, 54, 5501, 5502, 57	5301, 5302, 5401, 5402, 5501, 5502, 57
Ananindeua	56, 5801, 5802, 59, 62	5601, 5602, 5801, 5802, 5901, 5902, 6201, 6202
Aura	60	6001, 6002
Outeiro	5101, 5102	5101, 5102, 5103, 5104
Ilhas	61	61
Mosqueiro	5201, 5202, 5203	5201, 5202, 5203
Marituba, Benevides e Sta. Barbara do Para	63, 64	63, 6401, 6402, 65, 66, 67
Externa		68, 69, 70, 71

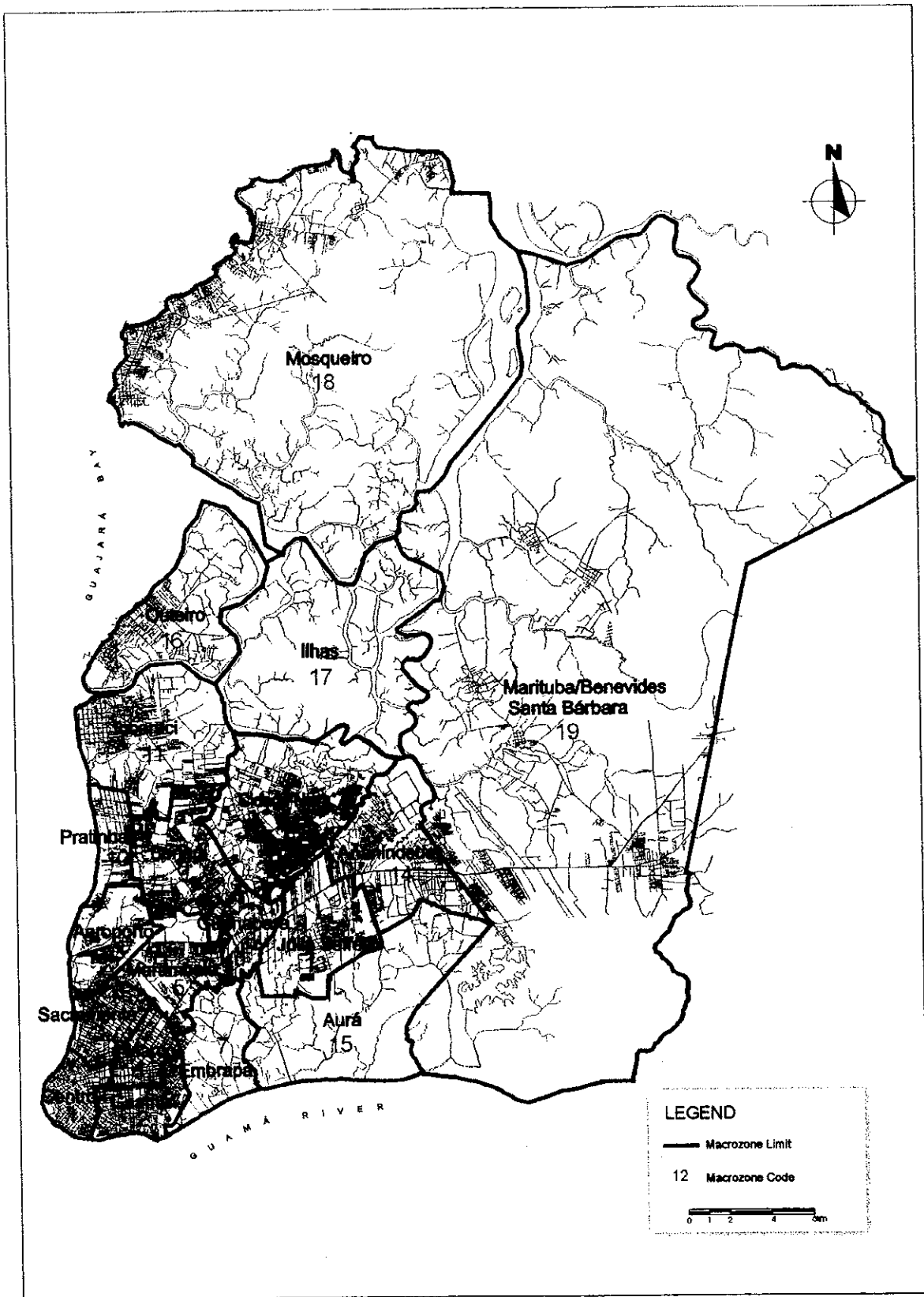


FIGURE 1.1-3 - Belém Metropolitan Area Macrozones

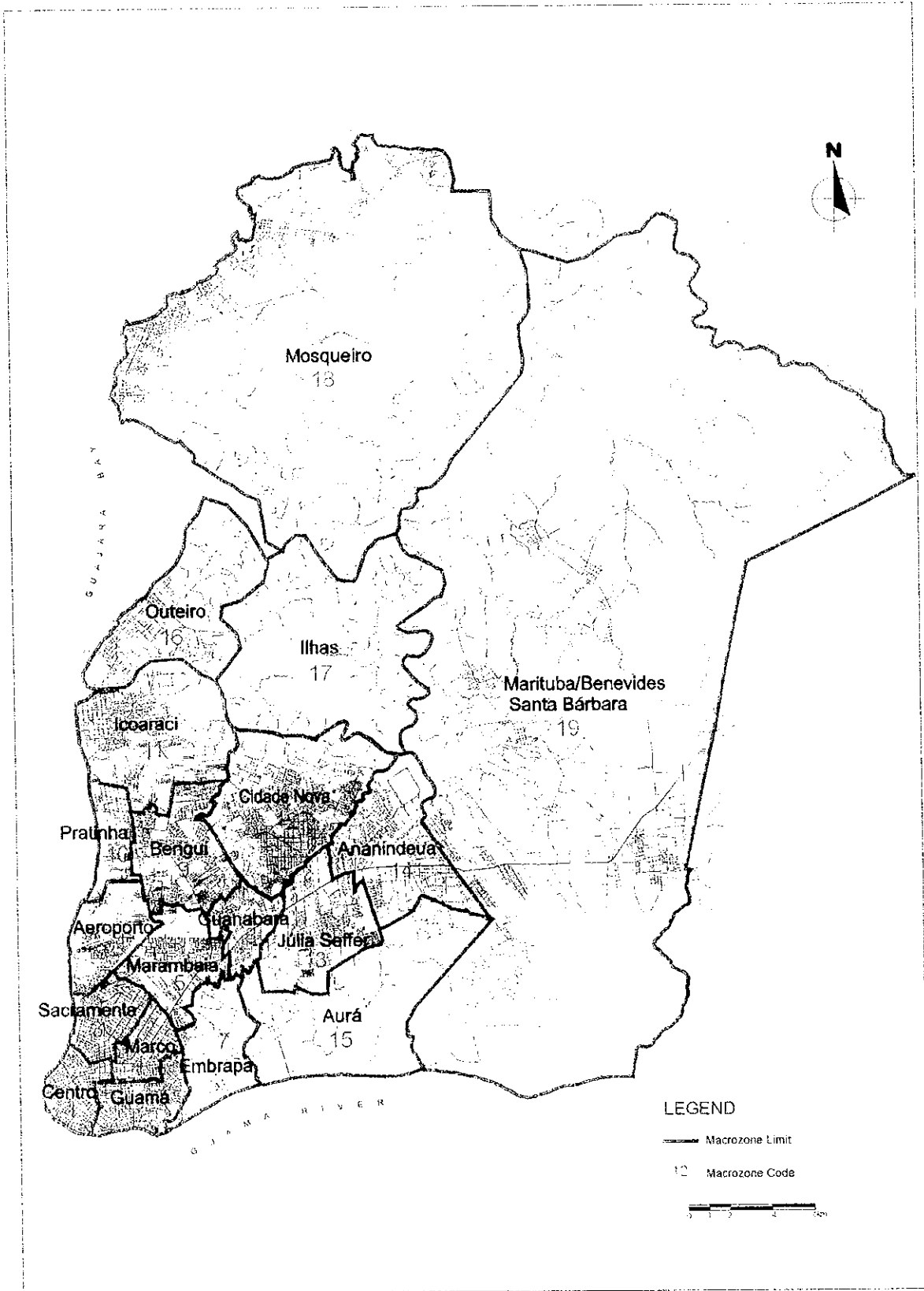


FIGURE 1.1-3 - Belém Metropolitan Area Macrozones

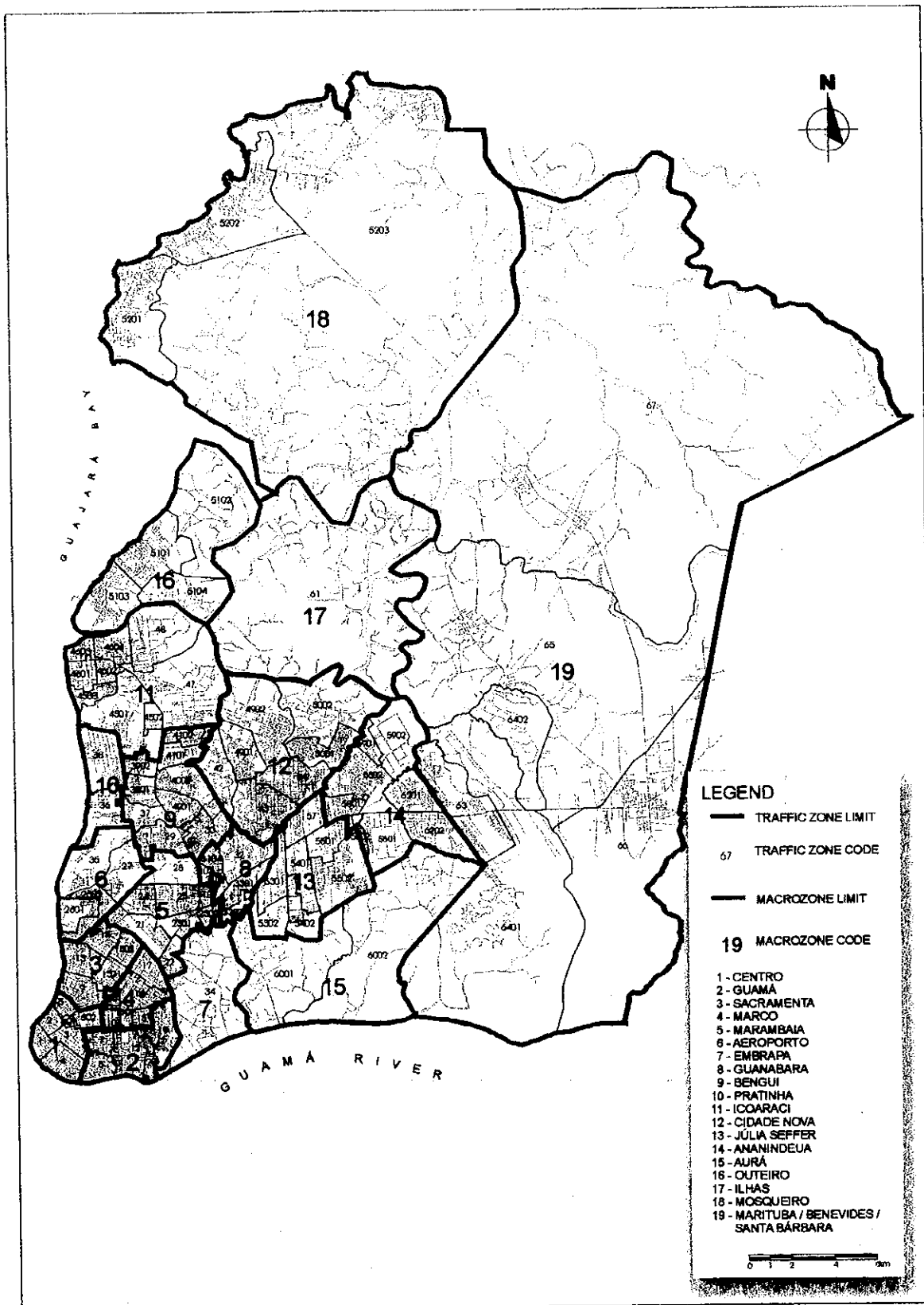


FIGURE 1.1-4 - Traffic Zones and Macrozones - RMB

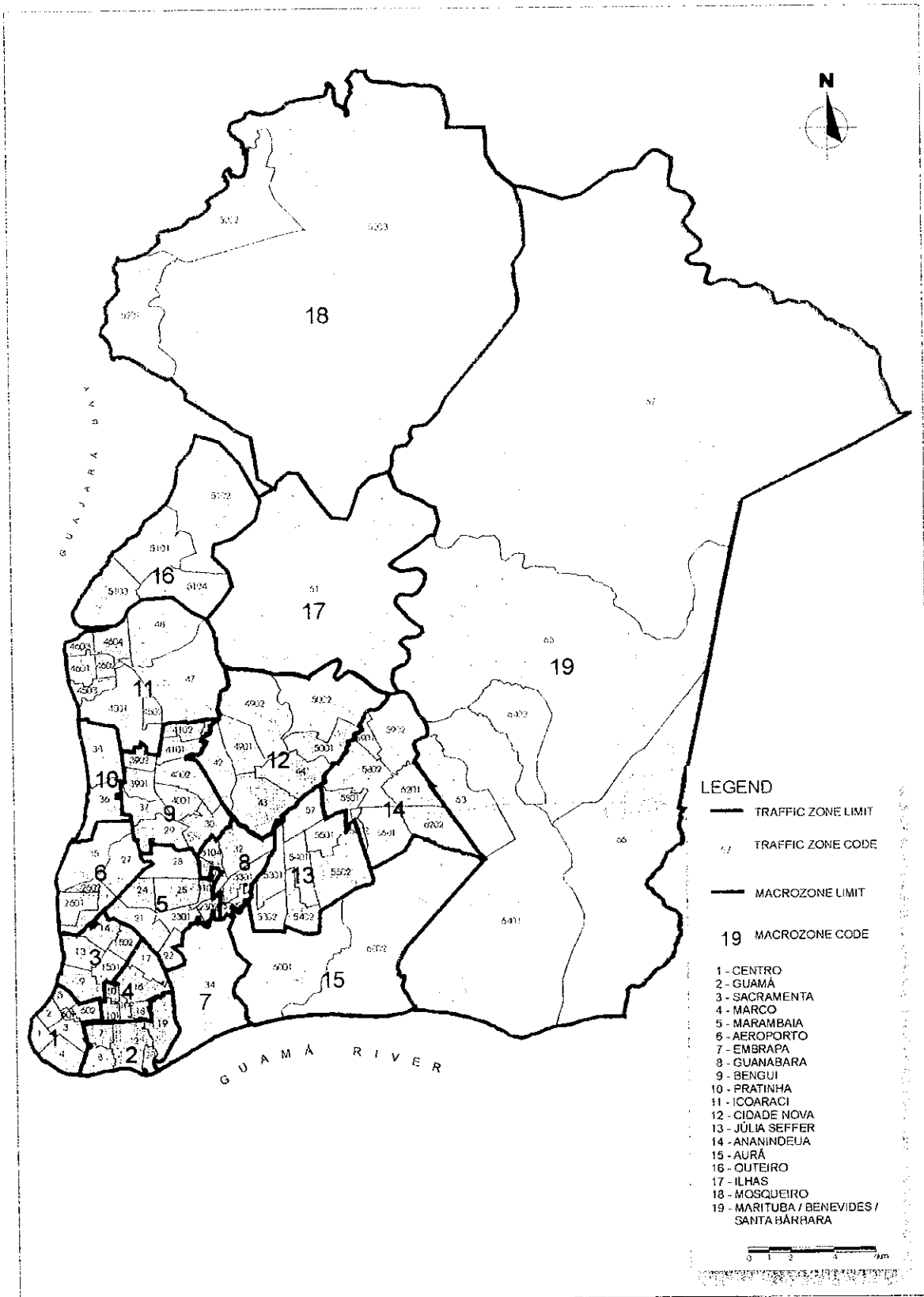


FIGURE 1.1-4 - Traffic Zones and Macrozones - RMB

1.1.1. SOCIOECONOMIC CHARACTERISTICS

The current population and occupation data of Study Area/2000 are shown in TABLE 1.1-2. The estimated number of inhabitant is 1,782,395. This data indicates an increase annual rate of 2.3% in comparison to the estimated number in PDTU/1991, which was of 1,419,224 inhabitants.

TABLE 1.1-2 – Demography and Occupation in Study Area

Item	Quantity	%
Total Population	1,782,395 inh.	100.0
Male	821,684 inh.	46.1
Female	960,711 inh.	53.9
Number of Households	7,000 inh.	
Occupation	1,782,394 inh.	100.0
Work	515,114 inh.	28.9
Primary Industry	8,015 inh.	1.6*
Secondary Industry	37,606 inh.	7.3*
Tertiary Industry	469,493 inh.	91.1*
Student	548,727 inh.	30.8
Housewife	187,589 inh.	10.5
Others**	530,965 inh.	29.8

* Related to a number of persons with "work" as occupation

FIGURE 1.1-5 shows the composition of the population by age and sex. The female population (53.9%) is larger than male (46.1%). The age composition shows that 71.3% are under 40 years old. The major concentration occurs among 15 and 19 years old (12.8%), 20 and 24 years old (11.5%). Such composition did not show significant changes in comparison to the data obtained in 1990.

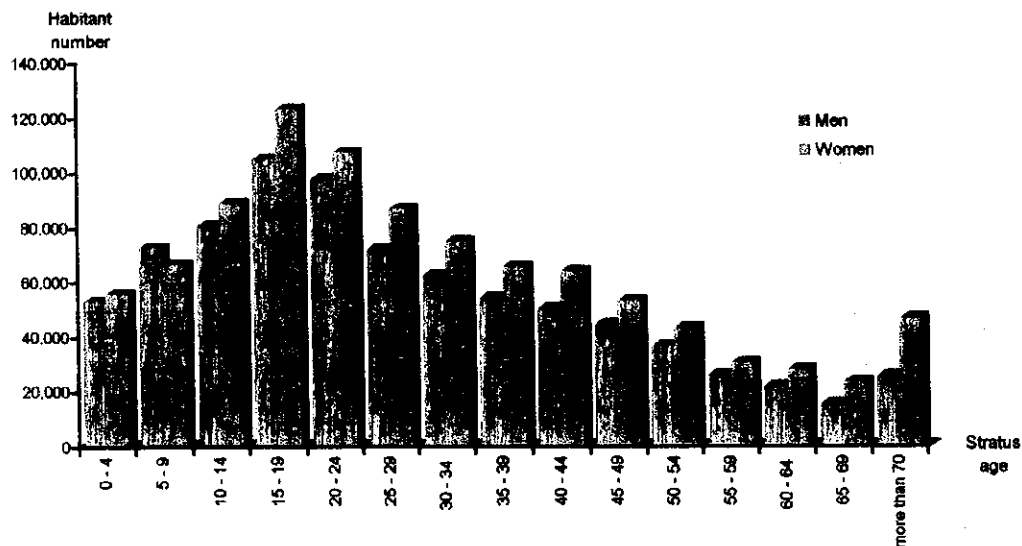


FIGURE 1.1-5 – Population Composition by Age and Sex

The RMB population distribution by occupation is shown in FIGURE 1.1-6. It is observed that the occupation percentage in "work" (32.0%) and "study" (31.0%) are very close and their sum is over 60.0% of the total. Only the "housewife" function was considered to be the "household" occupation and as for "others" included people that were "retired", "unemployed" and persons who never had a job.

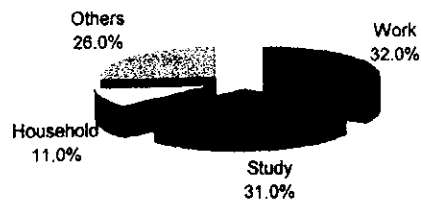


FIGURE 1.1-6 – Population Distribution by Occupation in RMB

FIGURE 1.1-7 the tertiary industry (91.1%) is much larger than the other industries. This analysis indicates the characteristics of Belem as metropolis of Para state. Most of workers are under tertiary sector. In fact, the Person Trip Survey stands out the bakery sector and others as commercial business (shown PDTU/1991).

In 1990 the tertiary industry represented 82.4% while the secondary industry 16.1%. The primary industry showed no significant changes.

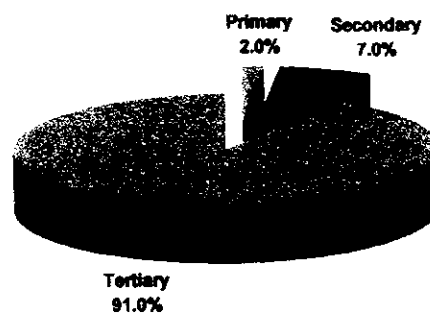


FIGURE 1.1-7 – Distribution of Population by Economic Activity in RMB

TABLE 1.1-3 shows that only 32.7% of the population work on primary, secondary and tertiary industry being the male sex the majority. The activities, which are represented more significantly, are "student" (30.8%), "private service" (10.6%), and "housewife" (10.5%). The "unemployment" rate obtained in the Person Trip Survey is 7.2% and the "retired" rate 8.9%.

TABLE 1.1-3 – Population Distribution by Occupation and Sex in RMB

Occupation	Quantity			%		
	Men	Women	Total	Men	Women	Total
Agriculture	6,258	1,757	8,015	0.4	0.1	0.5
Industrial	11,364	4,886	16,250	0.6	0.3	0.9
Civil Construction	20,258	1,098	21,356	1.1	0.1	1.2
Trade	92,285	68,184	160,469	5.2	3.8	9.0
Transport and Communication	23,881	4,392	28,273	1.3	0.2	1.6
Services	105,350	84,269	189,619	5.9	4.7	10.6
Public Administration	47,817	43,315	91,132	2.7	2.4	5.1
Others Activities	35,904	32,061	67,965	2.0	1.8	3.8
Unemployment	70,160	57,589	127,749	3.9	3.2	7.2
Student	258,907	289,820	548,727	14.5	16.3	30.8
Retired	64,725	93,822	158,547	3.6	5.3	8.9
Housewife	2,141	185,448	187,589	0.1	10.4	10.5
Never worked	82,398	94,306	176,704	4.6	5.3	9.9
TOTAL	821,448	960,947	1,782,395	46.1	53.9	100.0

TABLE 1.1-4 shows that Guama (14.6%), Cidade Nova (10.6%), Sacramento (10.2%) and Central Area (10.0%) are macro zones which have the major employment percentage of home based people, while the major employment percentage of non home based are find in macro zones located in 1.^a Legua³, Central Area (24.4%), Marco (11.2%) and Sacramento (10.3%). In the Expansion Area the macro zones which are responsible for the highest rates are Cidade Nova (6.0%) and Icoaraci (5.5%). These data showed the employment concentration in 1.^a Legua.

TABLE 1.1-4 – Population Distribution by Home Based and Non Home Based Areas and Macro Zone

Macro Zone	Home Based					Non Home Based				
	Primary	Secondary	Tertiary	Total	%	Primary	Secondary	Tertiary	Total	%
Central Area	604	3,129	47,872	51,605	10.0	1,208	4,721	119,789	125,718	24.4
Guama	1,043	4,447	69,886	75,376	14.6	659	3,459	44,633	48,750	9.5
Sacramento	549	2,745	49,299	52,593	10.2	494	3,239	49,134	52,867	10.3
Marco	384	2,525	39,802	42,711	8.3	329	2,910	54,679	57,918	11.2
Marambaia	604	3,568	41,778	45,950	8.9	110	3,294	37,276	40,680	7.9
Aeroporto	55	1,702	15,152	16,909	3.3	0	933	11,584	12,517	2.4
Embrapa	0	55	549	604	0.1	329	274	3,294	3,898	0.8
Guanabara	0	1,372	18,830	20,203	3.9	55	1,976	15,262	17,293	3.4
Bengui	549	3,788	41,833	46,170	9.0	110	2,855	21,959	24,924	4.8
Pratinha	274	384	5,709	6,368	1.2	714	769	4,996	6,478	1.3
Icoaraci	1,372	4,008	26,626	32,006	6.2	769	3,623	23,991	28,383	5.5
Cidade Nova	439	3,294	50,836	54,569	10.6	439	2,031	28,437	30,908	6.0
Julia Seffer	0	1,208	11,474	12,682	2.5	0	659	8,015	8,674	1.7
Ananindeua	659	2,855	22,893	26,406	5.1	769	3,184	20,312	24,265	4.7
Aura	0	165	494	659	0.1	0	110	165	274	0.1
Outeiro	0	220	4,282	4,502	0.9	0	494	4,117	4,611	0.9
Islands	0	0	0	0	0.0	0	0	0	0	0.0
Mosqueiro	165	439	5,270	5,874	1.1	165	659	5,160	5,984	1.2
Marituba, Benevides, Sta. Barbara	1,318	1,702	16,908	19,927	3.9	933	1,098	12,079	14,110	2.7
Externa	0	0	0	0	0.0	933	1,318	4,611	6,862	1.3
Total	8,015	37,606	469,493	515,114	100.0	8,015	37,606	469,493	515,114	100.0

³ 1.^a Legua Patrimonial – delimited area in 6.6km radius that coincide with Dr. Freitas Ave./Perimetral Ave.

FIGURE 1.1-8 presents the employment number of primary industry in home based and non-home based by the macro zone. The macro zones in Central Area (1) and Externa (20) and Marituba, Benevides, Sta. Barbara do Para (19), present the majority employment quantities in non-home based. This economic sector has no expressive quantity in RMB - Belem Metropolitan Area. The macro zones Guama (2), Icoaraci (11), Marituba, Benevides, Santa Barbara do Para (19) have the majority employment quantity on home based.

In comparison with data between PDTU/1991 and this Study, the employment numbers do not indicate the remarkable increase, but the employment geographical distribution considerably expands into all RMB.

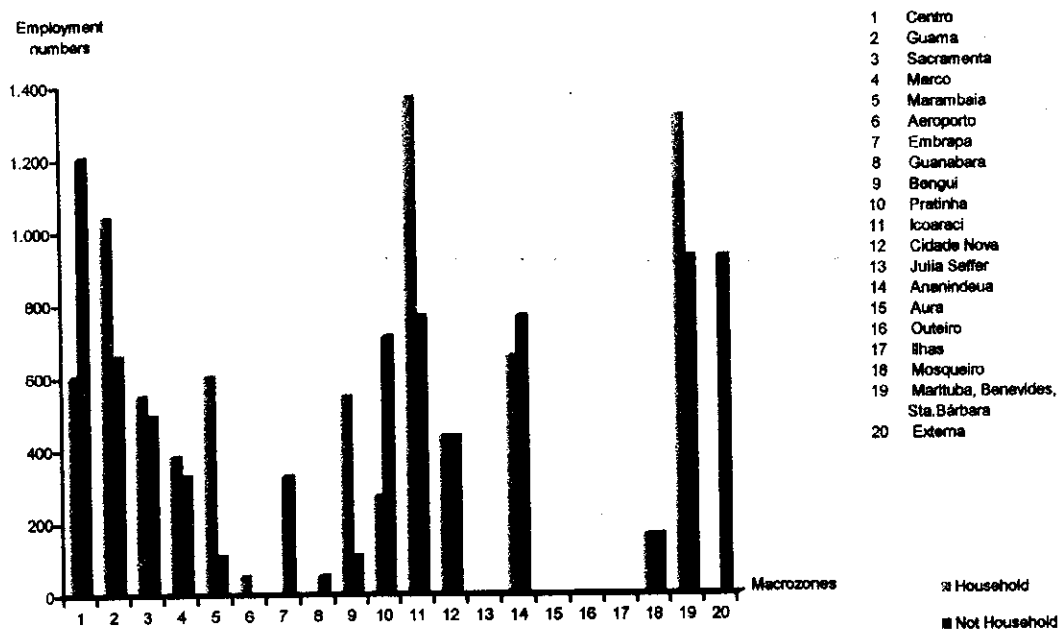


FIGURE 1.1-8 – Employment Number of Primary Activity by Macro Zone

As secondary industry employment (FIGURE 1.1-9), the distribution has a similarity between the home based and non home based. The macro zone Central Area (1) stands out on non home based employment and the macro zones Guama (2), Icoaraci (11), and Bengui (9) on home based employment.

Comparing the data between PDTU/1991 and this Study, there is a significant reduction on their absolute values. The spatial distribution is more equitable as on primary industry.

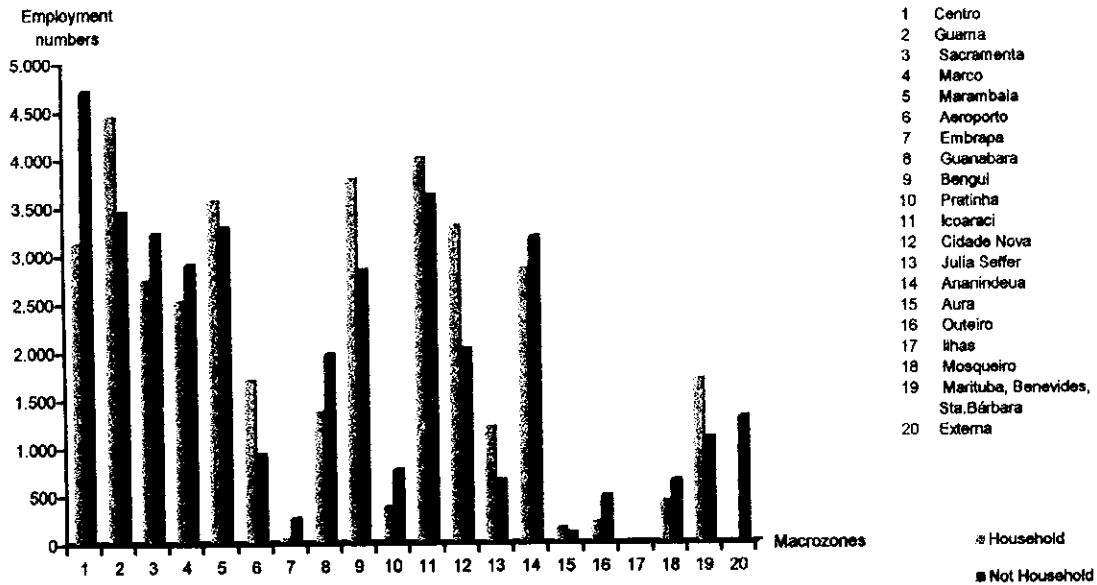


FIGURE 1.1-9 – Employment Number of Secondary Activity by Macro Zone

For the tertiary industry (FIGURE 1.1-10) the macro zone Central Area (1) aggregates most of employment numbers, around 120,000. The macro zone Marco (4) with 50,000 employment ranks the second place. For the home based the macro zones Guama (2) and Cidade Nova (12) concentrate the largest employment numbers of tertiary industry.

On last decade, the tertiary industry presented the largest increase in 15.35%. However, there is a small retraction on non-home based employment in macro zone Central Area (1) from 130,000 to 120,000 and drastic increase of home based employment in macro zones of Cidade Nova (12) 56.62%, Bengui (9) 38.71%, and Ananindeua (14) 81.96%.

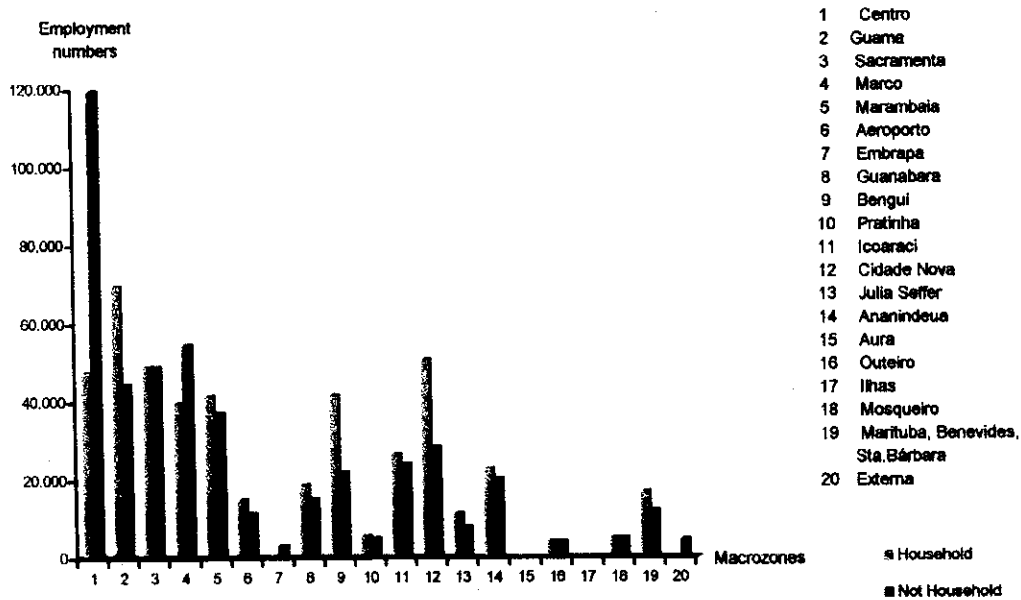


FIGURE 1.1-10 – Employment Number of Tertiary Activity by Macro Zone

In order to compare the data of PDTU/1991 with that of this study, the income level used on this study is based on the same income level of PDTU/1991 adjusted by the "Suma Economic, July/2000⁴".

FIGURE 1.1-11 shows the household number distribution per income level. It is observed that the majority of household is within R\$106,00 to R\$1.260,00 (80.4%) income level. The level from R\$421,00 to R\$630,00 (19.3%) and from R\$211,00 to R\$315,00 (15.7%) present two of the biggest share. Adding the interim level from R\$316,00 to R\$420,00 (12.3%) to the previous 2 levels, they correspond to 50.0% of all RMB households.

In comparison to the PDTU/1991 and this Study, the household distribution per stratum income does not show significant change. The level from R\$421,00 to R\$630,00 holds the major participation.

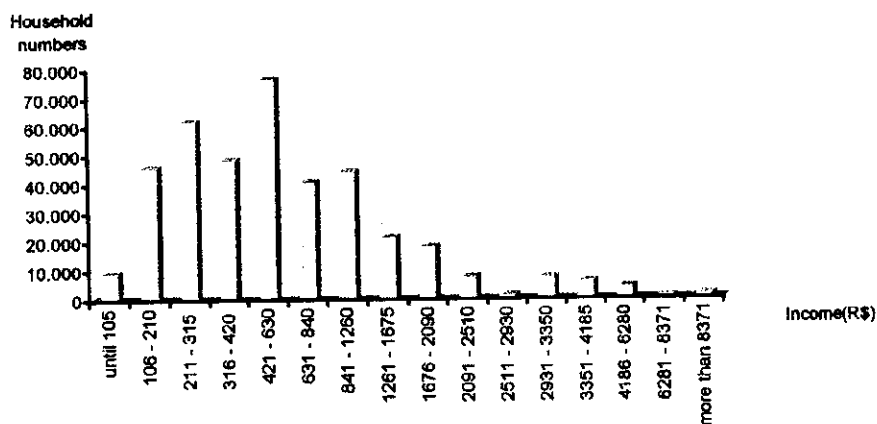


FIGURE 1.1-11 – Household numbers by Income Rank

TABLE 1.1-5 presents numbers of motorized household, the vehicle property, and the household average income per macro zone. The macro zones Central Area (15.4%), Sacramento (13.1%), Marco (12.3%), Guama (11.5%) and Marambaia (11.2%), located in 1.^a Legua, are those which present the major household index. Comparing the total number of vehicles with the average income of household there is a relation between them.

⁴ Actualization Table – General Price Index - FGV – (Base: July 2000 = 1.00)

TABLE 1.1-5-- Motorized Household Numbers, Vehicle Property and Household Average Income

Macro Zone	Quantity of Household				Quantity of Vehicles			Household Income Average (in reais)
	Non Motorized	Motorized	Total	%	Car	Motorcycle	Total	
Central Area	20,257	12,052	32,309	15.4	14,712	566	15,278	1,669.72
Guama	44,588	8,997	53,585	11.5	8,940	340	9,280	768.30
Sacramenta	30,612	10,185	40,797	13.1	9,619	509	10,129	957.31
Marco	17,937	9,619	27,556	12.3	11,204	453	11,656	1,434.64
Marambaia	25,859	8,771	34,629	11.2	8,601	340	8,940	923.52
Aeroporto	11,769	2,094	13,863	2.7	1,641	226	1,867	646.26
Embrapa	283	113	396	0.1	57	57	113	350.00
Guanabara	13,920	2,320	16,240	3.0	2,150	57	2,207	698.51
Bengui	31,291	4,696	35,987	6.0	4,414	340	4,753	654.46
Pratinha	4,923	736	5,658	0.9	679	57	736	509.76
Icoaraci	23,652	4,244	27,896	5.4	3,225	736	3,961	645.91
Cidade Nova	37,968	8,544	46,512	10.9	7,073	792	7,865	713.50
Julia Seffer	10,808	1,019	11,826	1.3	962	113	1,075	600.17
Ananindeua	18,673	2,207	20,879	2.8	1,754	283	2,037	559.13
Aura	509	226	736	0.3	113	57	170	251.54
Outeiro	3,678	226	3,904	0.3	113	57	170	443.87
Islands	0	0	0	0.0	0	0	0	0
Mosqueiro	4,244	679	4,923	0.9	396	170	566	593.61
Marituba, Benevides, Sta. Barbara	17,088	1,301	18,390	1.7	1,358	113	1,471	452.31
Total	318,058	78,029	396,088	100.0	77,011	5,262	82,273	

FIGURE 1.1-12 shows the percentage distribution of vehicle property by income level. The non-motorized household number decreases with the income growth. The motorcycle percentage is larger in lower income and decreases as the income grows. To automobile the contrary occurs. Its percentage increases as the income average grows, and two of the last tables with income show that majority household owns with more than one vehicle.

Comparing the PDTU/1991 with this study, the percentage distribution of vehicle property by income level presents similar data. The only difference is that the data presents significant change of percentage with more than one vehicle per household in two highest income levels.

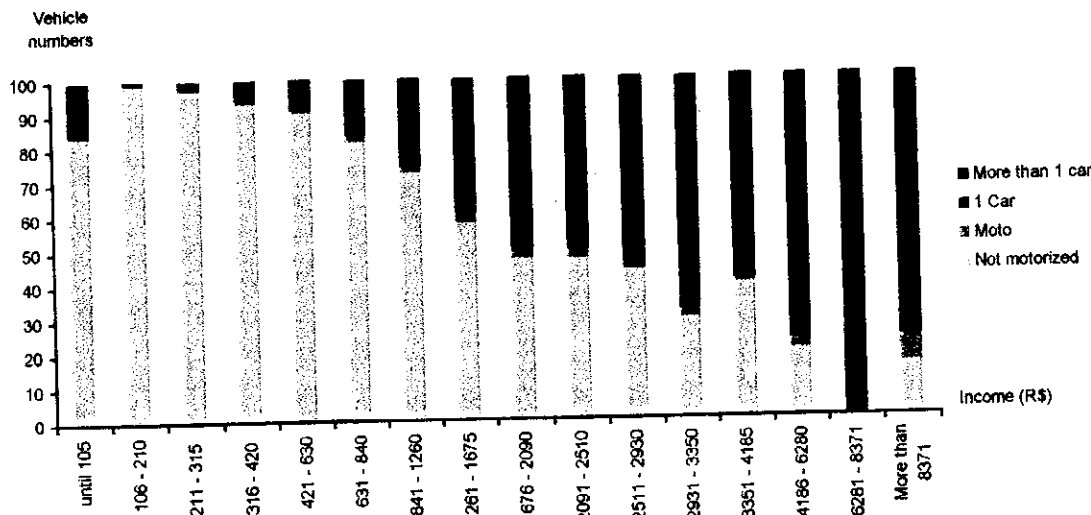


FIGURE 1.1-12 – Percentage of Vehicle Property by Income Rank

FIGURE 1.1-13 represents the vehicle property index per income level. Here the non-motorized household curve decreases and the motorized household curve increases. On income level from R\$2.091,00 to R\$2.930,00 the two curves cross showing that the percentage of motorized and non-motorized households is equal.

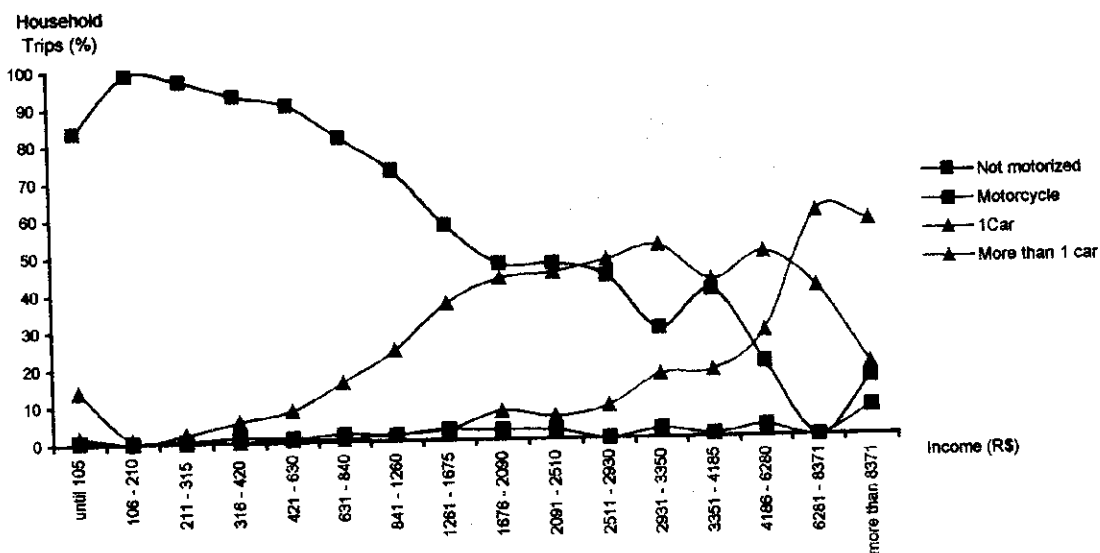


FIGURE 1.1-13 – Percentage of Household per Vehicles Property by Income Rank

1.1.2. TRIP CHARACTERISTICS

FIGURE 1.1-14 shows that the largest number of effective trips is "to home" the main purpose (45.0%), justified that the residence return required for all trips; follows by purposes "work" (16.0%) and "study" (15.0%). On "others" (23.0%) are aggregate trips as "shopping's", "leisure", "health", "personal matter", "transfer" and "others". The "business" trips (1.0%) do not present a significant percentage comparing with others.

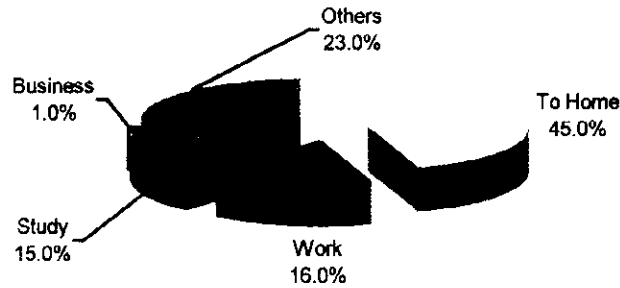


FIGURE 1.1-14 – Trip Composition Purposes by all Modes

FIGURE 1.1-15 excludes trips by "boat", "bicycle" and "walking", and also shows that the "to home" purpose still predominate over "others", with 43.0%. In these cases there is an increase of 4.0% on trips numbers to "work" purpose and a decrease of 4.0% to "study". It can be emphasized the importance of the "study" purpose by non motorized trips.

Comparing the PDTU/1991 and PDTU/2001 data, the trip distribution by purpose, considering for all modes and excluding the "boat", "bicycle", and "walking" modes, do not present significant differences, because it had only an increase of 5.0% on "to home" and decrease of 5.0% on "business". The other purposes do not present differences more than 2.0%.

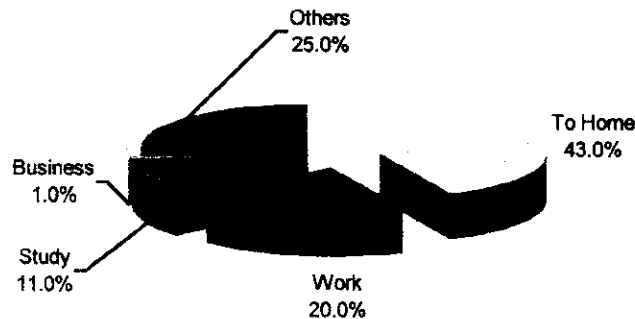


FIGURE 1.1-15 – Trip Composition Purposes Excluding "Boat", "Bicycle" and "Walking" Modes

Analyzing trips by mode (FIGURE 1.1-16) can be concluded that "bus" (44.6%), "walking" (34.6%); "car" (21.1%) and "bicycle" (7.6%) modes are responsible for most of the trips. The others by "taxi", "truck", and "boat" are summed up only 1.1% of the total. It can be emphasized that by "bicycle" are more than the total trips of "taxi", "truck" and "boat" together.

Comparing existing data obtained in 1990, "bus" mode suffers a decrease of 8.9% in modal division, and the "bicycle and walking" modes had an increment of 12.9%. These changes shows the significant lost on the demand by bus reveling the different trips quality in the last 10 years.

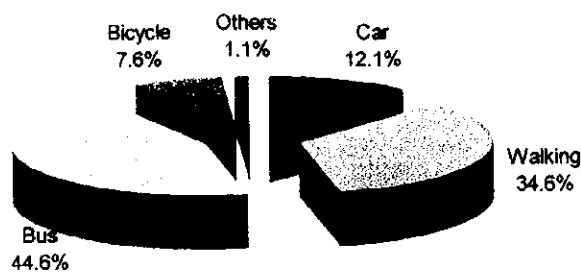


FIGURE 1.1-16 – Trip Composition Modes by all Purposes

As for the motorized modes excluding "bicycle", "walking" and "boat" modes (FIGURE 1.1-17), the "bus" mode is more accounts around 76.0% of total trips. The total trips of "bus" and "car" (20.52%) reach almost 97.0%.

Comparing moving of motorized vehicle between 1990 and 2000 reveals that the "bus" mode keep the 75.0% of participation. The "car" mode had a little increase of 2.0%, from 18.0% to 20.52%; the "truck" mode had a decrease around 4.0% and the others modes reduced lower than 1.0%.

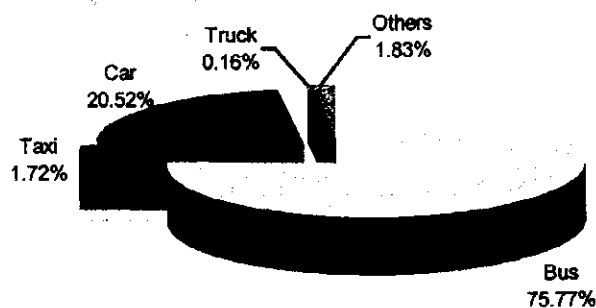


FIGURE 1.1-17 – Trip Composition Modes Excluding "Boat", "Bicycle" and "Walking"

FIGURE 1.1-18 shows the predominance of "bus" mode over other motorized trips for all purposes except "business". The "bicycle / walking" mode is more expressive on trips to "study" and "to home". The "car" mode is significant on trips to "business" e "work" purposes.

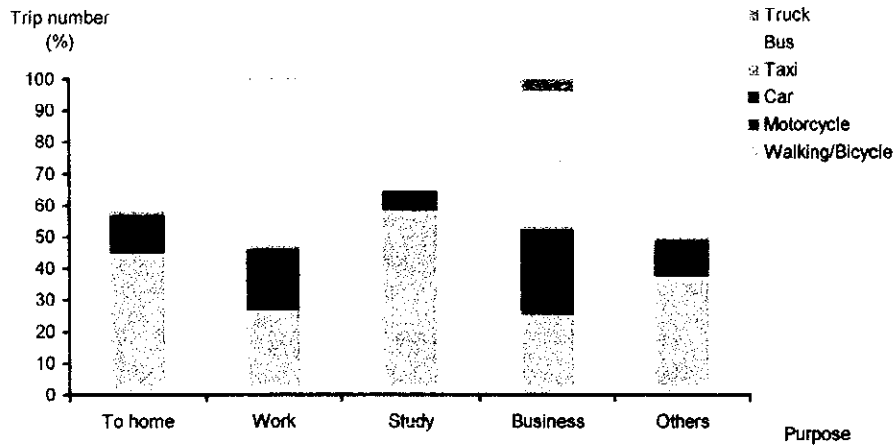


FIGURE 1.1-18 – Trip Composition Mode by Purpose

On FIGURE 1.1-19 observes that “motorcycle”, “car”, “taxi”, and “bus” mode have similar percentage distribution of “to home” and “work” purposes around 50.0% and 25.0% respectively. For others purposes occurs high variations. The trips by “walking / bicycle” mode are remarkable on “study” purpose and “truck” mode presented high trips percentage of “business” purpose.

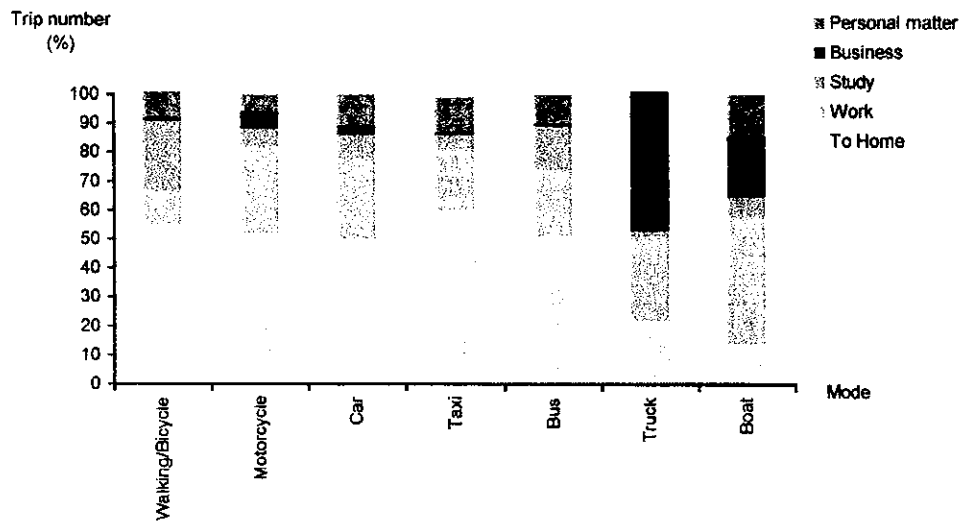


FIGURE 1.1-19 – Trip Percentage Purpose by Mode

Comparing the trip purposes between the data of PDTU/1991 and PDTU/2001 (FIGURE 1.1-20), only the “to home” and “others” purposes increase. The “to home” purpose presented a significant increase (from 40.0% to 45.0%). The “business” purpose presented a more notable decrease (from 4.7% to 1.0%).

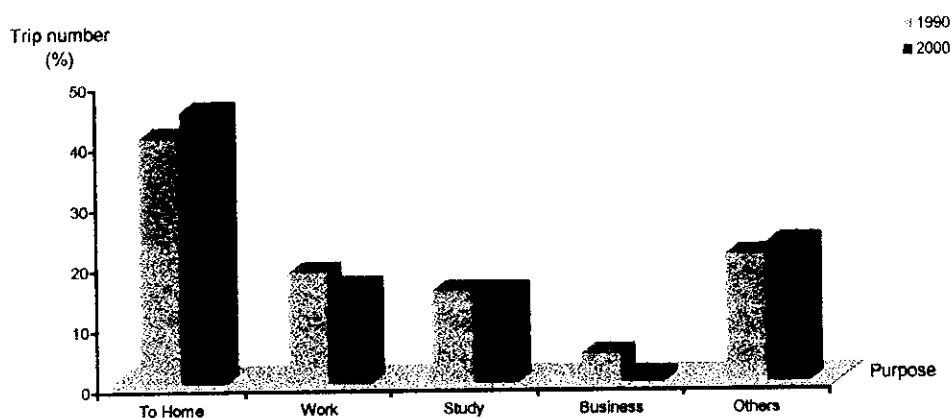


FIGURE 1.1-20 – Trip Percentage by Purpose – 1990 and 2000

Comparing the data between PDTU/1991 and PDTU/2001 (FIGURE 1.1-21), the "to home" trip mode becomes more expressive, increasing from 37.4% to 43.0% (excluding "boat", "walking / bicycle" modes). Trips by "study" purpose that in the prior figure showed a decrease between the years 1990 and 2000 suffer little growth, around of 1.0% - increase trip numbers for this purpose occurred effectively on motorized modes.

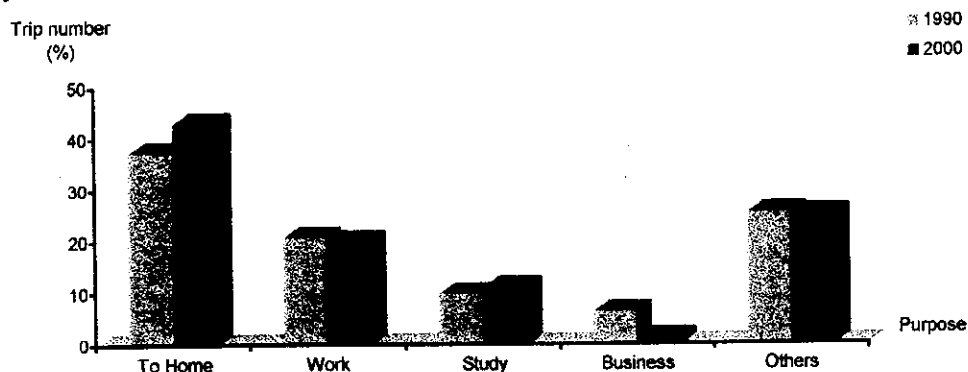


FIGURE 1.1-21 – Trip Percentage by Purpose Excluding "Boat", "Bicycle" and "Walking" Modes – 1990 and 2000

FIGURE 1.1-22 shows the comparison of trip modes to 1990 and 2000, where the participation of "walking / bicycle" mode trips increase considerably – from 30.0% to 42.0%. The "car" mode present decreases from 12.7% to 12.1%. The "bus" mode presents the highest decrease on trips, from 53.5% to 44.6%. Those data show the transfer of demand from "bus" mode to "walking" and "bicycle" modes.

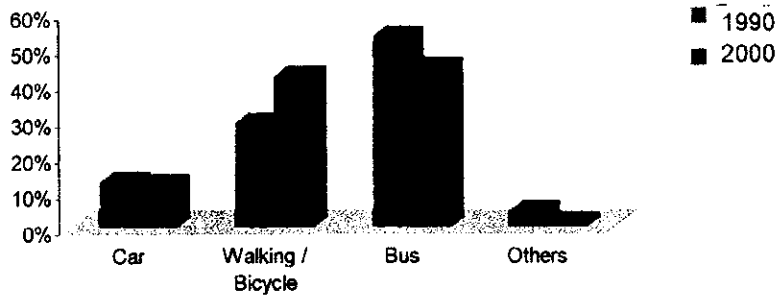


FIGURE 1.1-22 – Trip Percentage by Mode – 1990 and 2000

Between motorized modes (FIGURE 1.1-23), the "bus" mode shows similar participation in both two years, around 75.0%. The "car" mode increases from 18.0% to 20.52% and the others modes decrease lower than 3.0%.

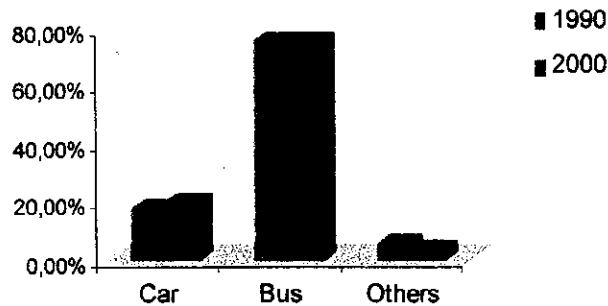


FIGURE 1.1-23 – Trip Percentage by Mode Excluding "Boat", "Bicycle" and "Walking" Modes – 1990 and 2000

FIGURES 1.1-24, 1.1-25, and 1.1-26 show the trip distribution patterns from the origin and destination data in the Person Trip Survey by applying to of the desire lines charts which are based on the macro zones. These lines show the similar trip patterns to concentrate to macro zones 1, 2, 3, and 4, on 1.^a Legua from among peripheral districts. The origin and destination matrixes are shown in ANNEX A.

The desired lines movement by "bus" mode (FIGURE 1.1-25) and for all modes (FIGURE 1.1-24) are similar on extension, direction, and flow intensity. When excluded "bus" and "walking" modes, other modes (FIGURE 1.1-26) do not show similarity, which indicates strong predominance on trips by bus.

The macro zones Central Area (1), Guama (2), Marco (3), and Sacramento (4), that constitute 1.^a Legua, has great numbers of trips. These trips decrease gradually along the distances between pairs of origin and destinations increase.

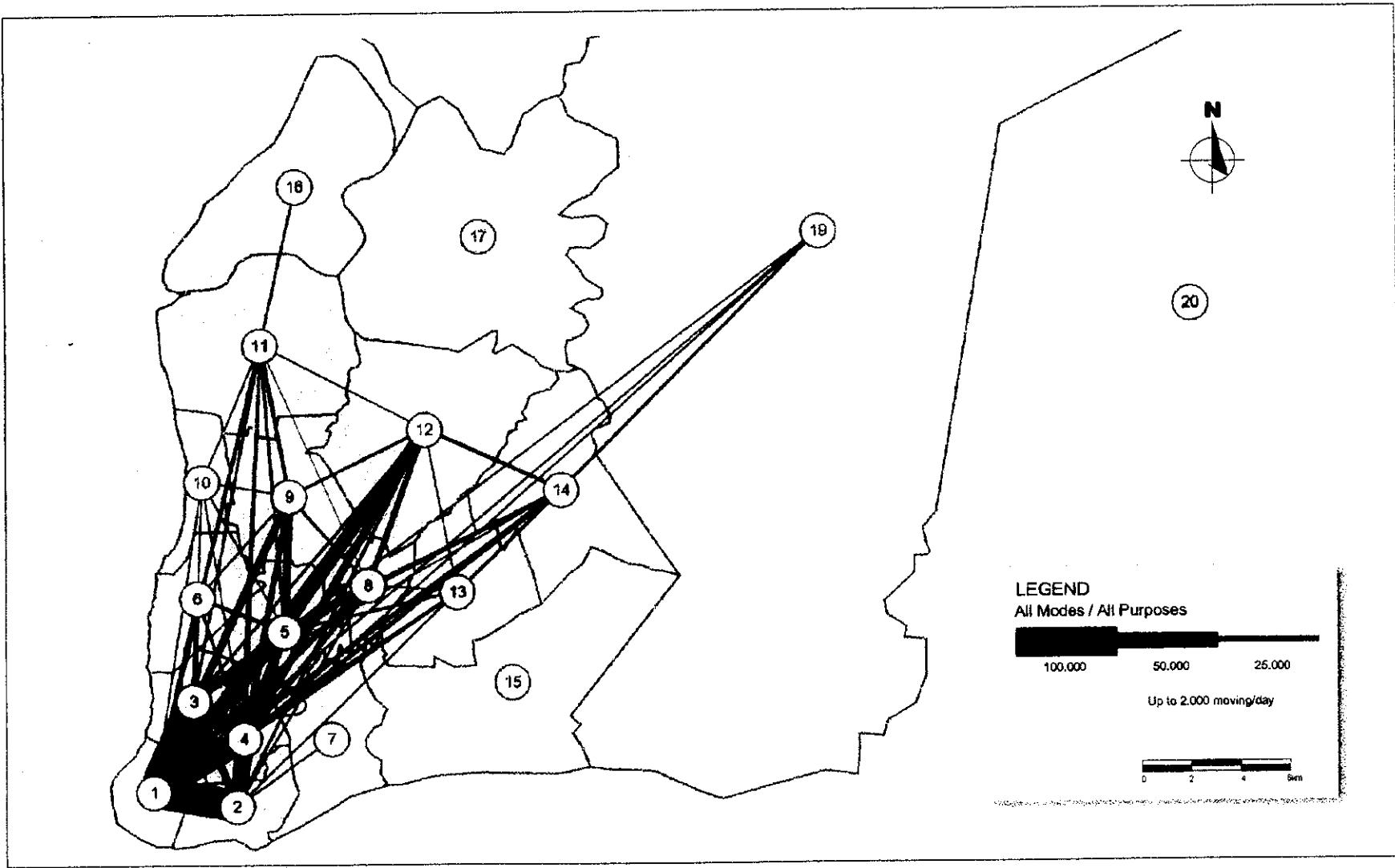


FIGURE 1.1-24 - Desire Lines - All Modes / All Purposes

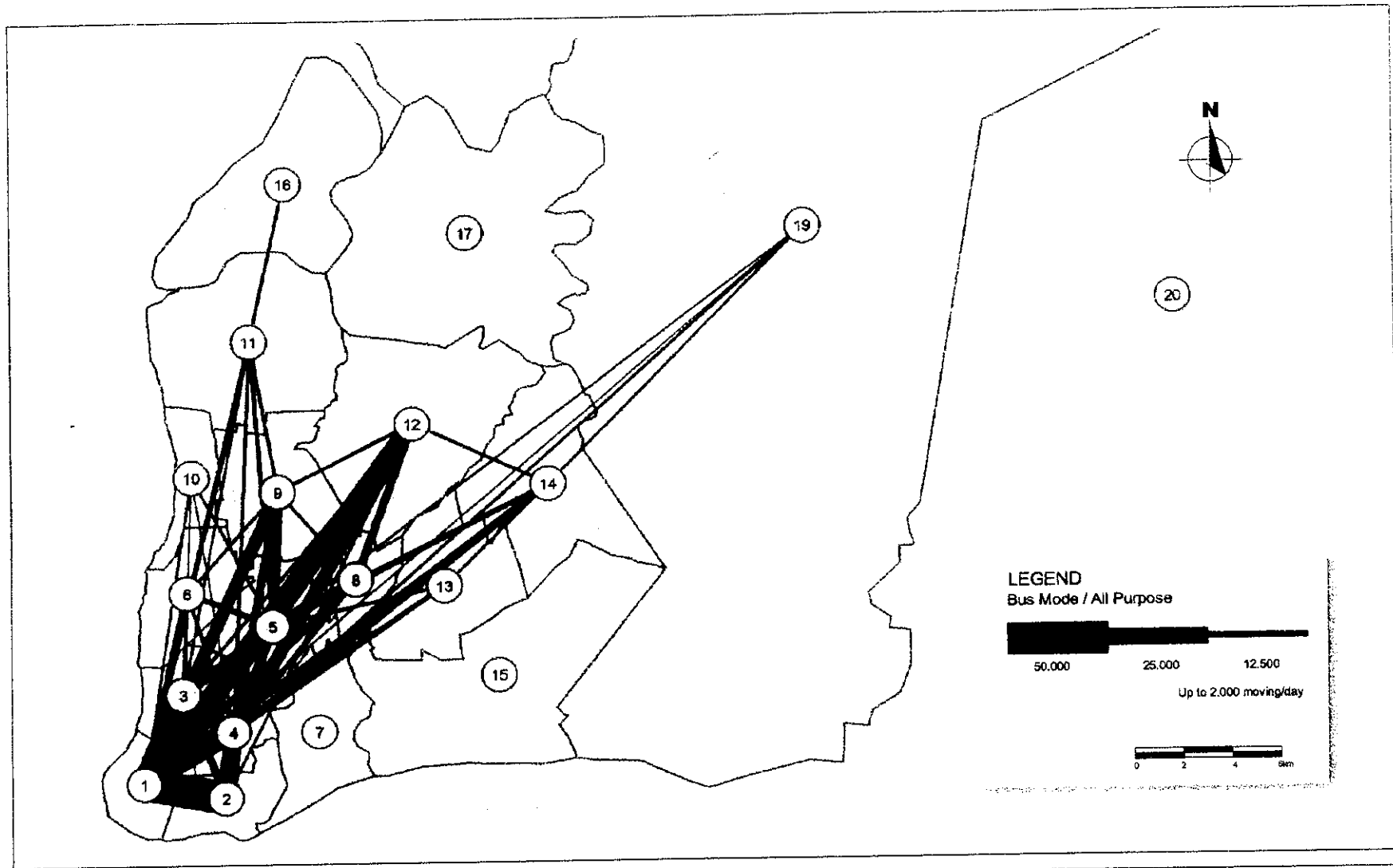


FIGURE 1.1-25 - Desire Lines - Bus Mode / All Purposes

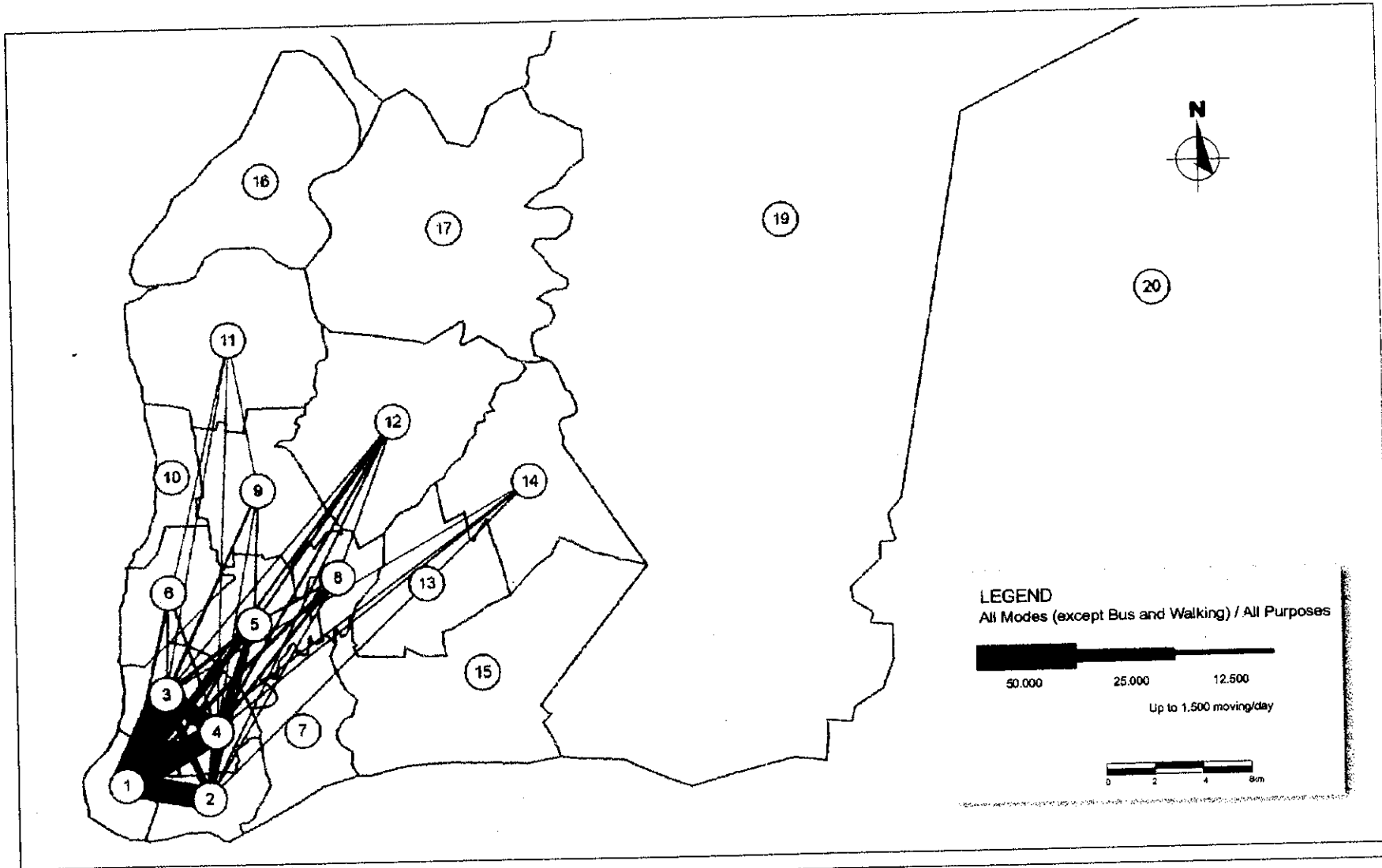


FIGURE 1.1-26 - Desire Lines -All Modes (except Bus and Walking) / All Purposes

In FIGURE 1.1-24 the desired lines shows that besides the aspects mentioned before, the macrozones Cidade Nova (12) and Bengui (9), although located away from 1.^a Legua, exchange a significant number of trips with several central macro zones and lower volume with other peripheral zones.

In desire lines shown in FIGURE 1.1-25 long distance trips and large big intensity of flows are remarkable in the macro zones Cidade Nova (12) and Bengui (9). The data indicate the need of analysis on the capacity and operational model of the current system, which serves those areas.

FIGURE 1.1-26 is much different from the others with the considerable reduction on trip change as a distance increase from 1.^a Légua, indicating the private vehicle property reduction of resident in the suburban zones in RMB.

1.2. CORDON LINE

The Cordon Line survey was done to complement the Person Trip Survey data and especially the origin trips from outside the RMB. The survey was carried out through interviews from September 27th to October 4th on trips by road, river, and air.

Eight locations were chosen for the survey, as shown in TABLE 1.2-1 and FIGURE 1.2-2.

TABLE 1.2-1 – Cordon Line Point Localization

Code	Localization
1	Rod. BR-316, km 30
2	Val-de-Caes Airport International
3	Icoaraci Port
4	CDP Passenger Terminal
5	Foca Port
6	Jaruma Port
7	Arapari Port
8	Brilhante Port

On BR-316 road it was also done a classified volume counting and a vehicle occupation rate survey in a sample of 14.5% of the total number of vehicles. The Cordon-Line was carried out from 5:00 a.m. to 7:00 p.m. with the support of the Federal Road Patrol (FIGURE 1.2-1).

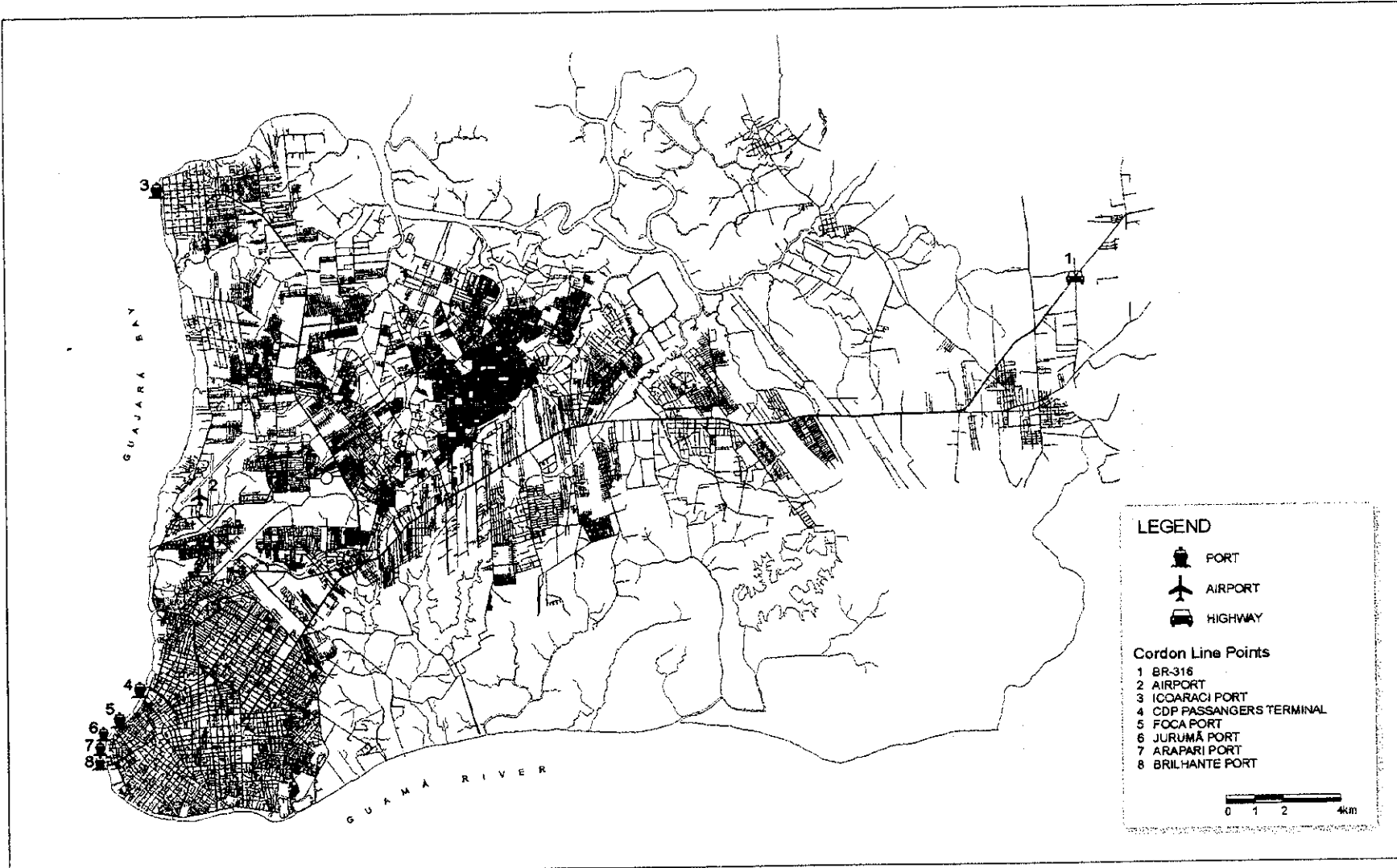


FIGURE 1.2-1 - Cordon Line's Points Surveyed



FIGURE 1.2-2 – Scene of Cordon Line Survey on BR-316 Road

The sampling rate of the interviews related to the total number of passengers who crossed *Cordon Line* were of approximately 15.0% on BR-316, 20.0% in the ports and 22.0% at Val-de-Cães International Airport.

The surveyed ports were chosen because they have the most significant number considering the passenger flow along the river shore, and were indicated by the Port Authorities of Para and Amapa.

TABLE 1.2-2 shows the number of passengers/day, vehicles/day on dual way traffic and average occupation rate by mode on BR-316. The highest passenger volume is the "car" mode (44.1%) followed by "truck" (30.9%).

TABLE 1.2-2 – Average Occupation Rate on BR-316

Mode	Vehicles/day		Passenger/day		Average Occupation Rate
	Quantity	%	Quantity	%	
Car	6,192	59.3	17,967	44.1	2.90
Minibus	568	5.4	5,112	12.5	9.00
Bus	457	4.4	11,882	29.1	26.00
Truck	3,228	14.3	5,810	30.9	1.80
Total	10,445	100	40,772	100.0	-

The total trips in RMB Cordon Line and the Cordon Line data for the years of 1990 and 2000 are shown in (FIGURE 1.2-3) and TABLES 1.2-3 and 1.2-4. The data shows an increase of 13.0% for the external – external movement in Cordon Line and 15.0% for the external – internal movement. The absolute values of these movements confirm their small participation (around 1.0%) related to the total number of movements within the Study Area. This fact has already been observed in PDTU/1991.

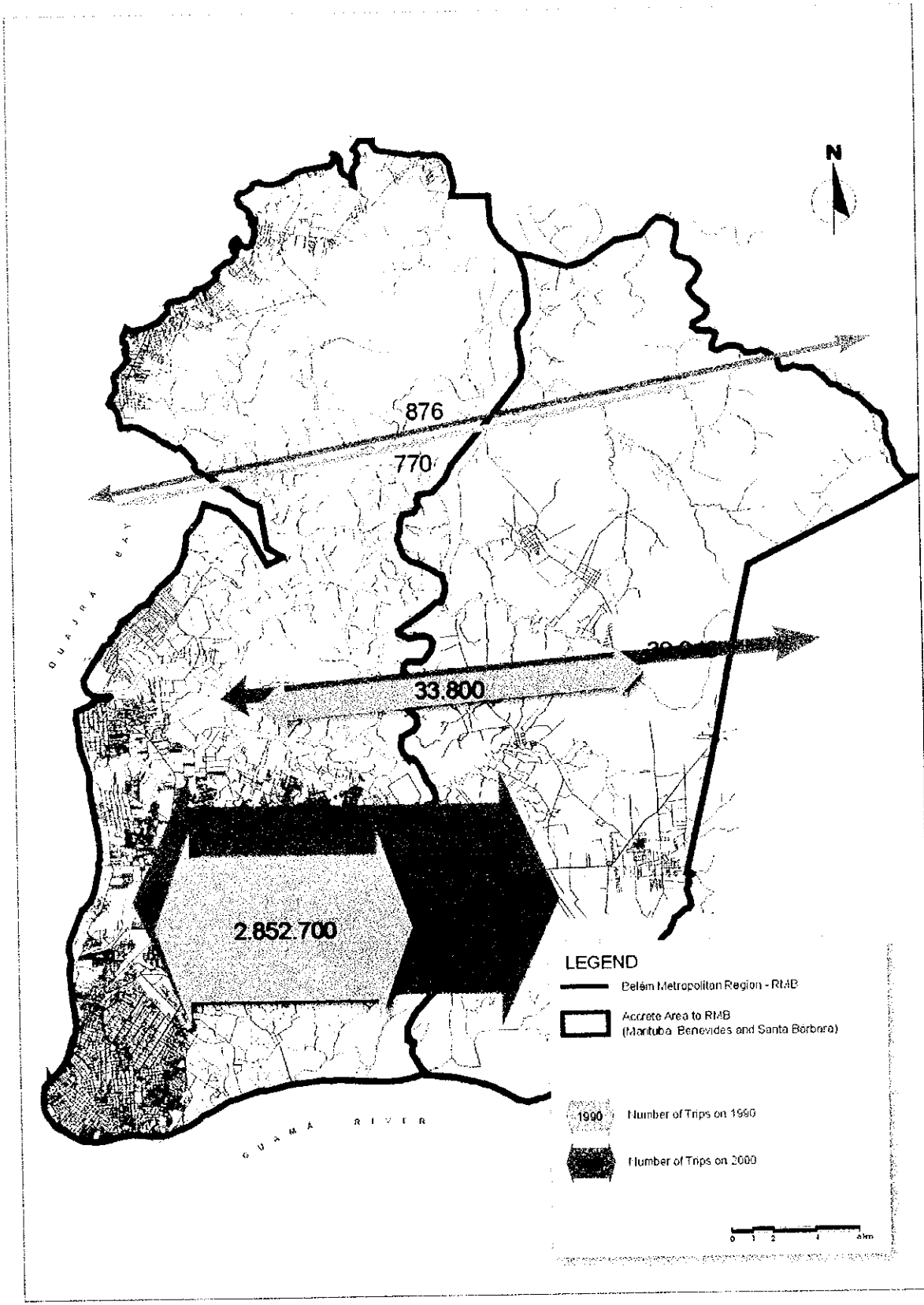


FIGURE 1.2-3 - RMB Trips and Cordon Line Results - 1990 and 2000

TABLE 1.2-3 – Trips Synthesis of Person Trip Survey and Cordon Line – 1990 / 2000

Types of Trip	1990		2000	
	Number of Trips	%	Number of Trips	%
Internal – Internal	2,852,700	98.8	3,640,356	98.9
Internal – External	33,800	1.2	39,046	1.1
External – External	770	0.0	876	0.0
Total	2,887,270	100.0	3,680,278	100.0

TABLE 1.2-4 – Trips Synthesis of Person Trip Survey and Cordon Line – 1990 / 2000 excluding "Boat", "Bicycle" and "Walking" Modes

Types of Trips	1990		2000	
	Number of Trips	%	Number of Trips	%
Internal – Internal	2,011,245	98.3	2,525,108	98.5
Internal – External	33,329	1.6	37,171	1.5
External – External	717	0.0	827	0.0
Total	2,045,291	100.0	2,157,225	100.0

The Study Area internal trips presented a growth about 28.0% in comparison to PDTU/1991 which shows increase in the number of trips per inhabitant, considering, in this decade, the population increasing is 28.0%.

FIGURE 1.2-4 shows the percentage distribution of trip purposes generated from the outside to the inside of RMB obtained from the eight counting points of Cordon Line. In this figure "leisure", "health" and "shopping" purposes were counted as "personal matters". The "work" purpose represents the majority of trips: 45.2%. These trips as well as the trips of the "study" purpose show daily frequency, which cause greater impact on the metropolitan transport system. In Cordon Line, the "to home" purpose has lower participation (20.9%) comparing to the Person Trip Survey since the non home based trips are more frequent.

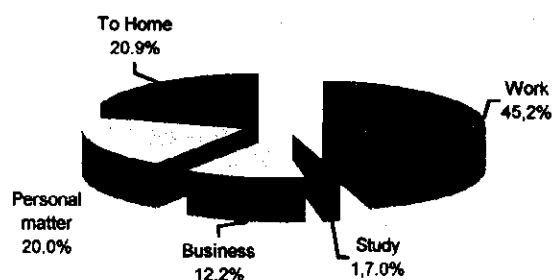


FIGURE 1.2-4 – Trip Composition by Purposes (External – Internal) Cordon Line Survey

The mode of trips surveyed in Cordon Line (FIGURE 1.2-5) presents the percentage by transport mode used in RMB outside of the Study Area. Thus, the "car" and "bus" mode presented the highest percentage: 36.7% and 31.9% respectively. Following, trips by "truck" and "minibus": 12.8% and 10.8%, respectively. The highest participation of "car", "bus", "truck", and "minibus" mode is due to the significant number of trips registered in the counting point on BR-316 Road.

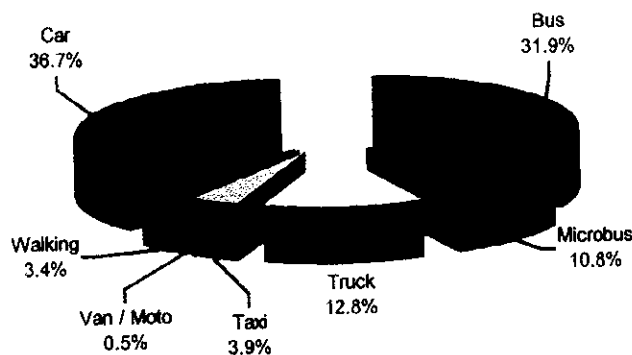


FIGURE 1.2-5 – Trip Composition by (External – Internal) on Cordon Line Survey

1.3. SCREEN LINE

The main purpose of this survey was to evaluate and adjust the trip data obtained from the Person Trip Survey through the comparison of the total number of trips crossing the Screen Line with the information obtained in the Person Trip Survey.

Due to the extension of the tertiary industry on the last ten years (farther Screen Line defined in 1990), a second Screen Line on Dr. Freitas Avenue was considered.

The Screen Line survey was done in 21 intersections, as showed on TABLE 1.3-1 and illustrated in FIGURE 1.3-1. Eighteen of these points are the same location as those in the Screen Line counted in PDTU/1991. The other three are located in the second Screen Line. Besides the counting of traffic flow, the survey counted the visual occupancy of the vehicles to obtain the volume of passengers that cross the Screen Line.

In Screen Line 1, the possibility of double vehicles counting (private and taxis) occurs because the looping and parking space. It was also done origin and destination survey per registration of number of car.



FIGURE 1.3-1 - Screen Line's Points Surveyed

TABLE 1.3-1 – Screen Line Localization

Code	Localization	Direction
1	Marechal Hermes Ave	Inbound
2	Municipalidade St.	Outbound
3	Gaspar Viana St.	Inbound
4	Senador Manoel Barata	Outbound
5	Tiradentes St.	Inbound
6	Boaventura da Silva St.	Outbound
7	Gov. Jose Malcher Ave	Inbound
8	Nazare Ave	Outbound
9	Braz de Aguiar Ave	Inbound
10	Gentil Bittencourt Ave	Outbound
11	Conselheiro Furtado Ave	Inbound
12	Mundurucus St.	Outbound
13	Pariquis St.	Inbound
14	Eng. Fernando Guilhon St.	Dual way
15	Padre Eutiquio St.	Inbound
16	Apinages St.	Outbound
17	Roberto Camelier Ave	Dual way
18	Bernardo Sayao Ave	Dual way
19	Almirante Barroso Ave	Dual way
20	Pedro Alvares Cabral Ave	Dual way
21	Arthur Bernardes Road	Dual way

The results obtained from the Screen Line survey pointed out that the traffic volume on dual ways is of approximately 50,000 vehicles/day. The average/day rate occupancy per mode to each Screen is shown in FIGURE 1.3-2. The number of people is much larger in Screen 2, confirming the boarding and alighting survey data, since the more busses come closer to the center, less is the occupancy rate.

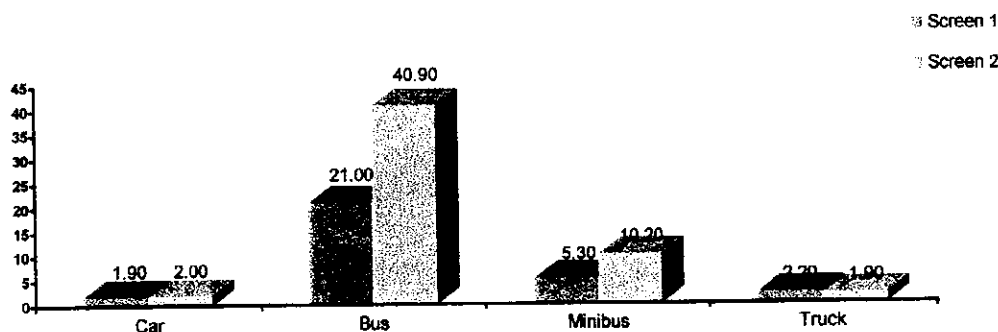


FIGURE 1.3-2 – Average Occupancy by Mode on Screen Line 1 and 2

The results of “car” and “taxi” license plate survey showed that about 16.0% of their vehicles crossed on the Screen 1 are counted twice. This percentage was subtracted from the first volume obtained on the Screen.

FIGURE 1.3-3 shows the total number of people that crossed Screen Line 1 and 2 in “bus” and “car+taxi” modes. According to this FIGURE there is an inversion in numbers of people that crossed Screen Line 1 and 2 in “bus” and “car+taxi” modes. The number of people is higher in the “bus” mode in the Screen 2 Survey. In Screen 1 Survey the highest number is in “car+taxi” mode. The volume of bus passengers who got off on Dr.Freitas Ave. and Quintino Bocaiuva St can explain this fact. In addition to that, there are more trips by “car” mode on 1.^a Legua, between Dr. Freitas Ave. and Quintino Bocaiuva Street.

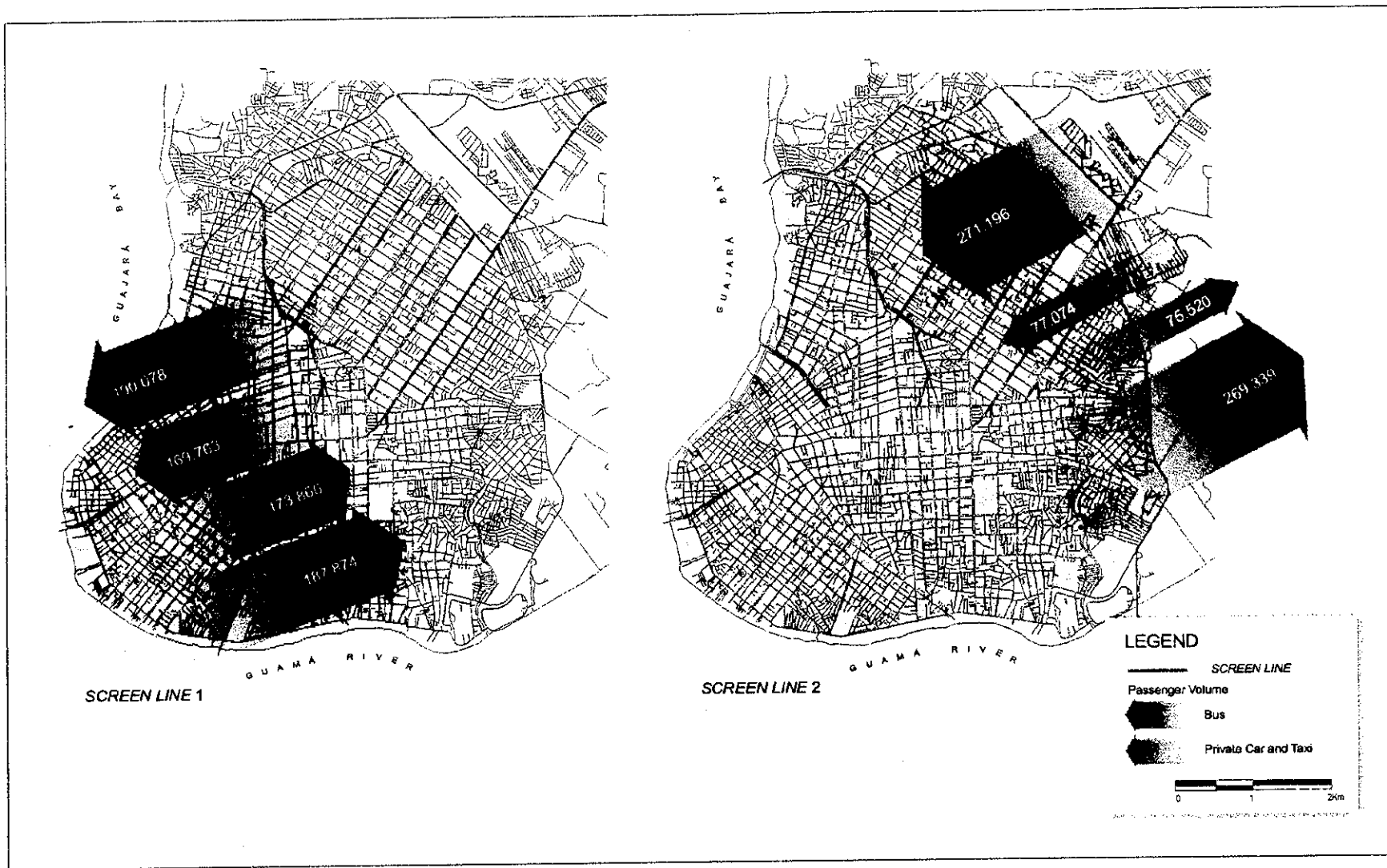


FIGURE 1.3-3 - Screen Line's 1 and 2 Person Counting

1.4. BUS BOARDING AND ALIGHTING SURVEY

This survey purpose are as the followings:

- a) To identify the bus stop in the public transport used by higher passengers volume;
- b) To identify the passenger volumes by bus line ;
- c) To identify the conditions of bus system in the peak hours;
- d) To identify the round operation hour and average operational speed;
- e) To identify other operational characteristics.

The Belem Metropolitan Area public transport system has 147 conventional lines that come from 81 terminals and 27 minibuses selective lines. There are around 1,800 bus stops along the public transport network. The conventional system has approximately 1,750 vehicles that carry out 12,723 trips/day, transporting about 1,450,000 passengers/day (ANNEX B).

The public transport system on 1.^a Legua and its surroundings has a compact network that converges on central area (FIGURE 1.4-1). In this area, only Terra Firme, part of Guama and Sacramento district have areas with no public transport. In other areas, the public transport network converges on BR - 316 and Augusto Montenegro corridors (FIGURE 1.4-2) because of road discontinuity. The figures above also show that public transport and selective networks run in the same areas. The Reduto and Campina districts have a selective system network.

After analyzing the operational data of minibuses, it was observed that the current demand represents only 3.0% of the total number of passengers from the conventional system. Because of that, no survey on "Boarding and Alighting" was carried out on minibuses. The trips made by this mode will be analyzed from the data of the Person Trip Survey.

The bus boarding and alighting survey was done in 144 conventional lines from September 20th to October 4th, 2000 from 6:00 a.m. to 7:00 p.m. (FIGURE 1.4-3). The number of passengers getting in and off in each bus stop along the itineraries was taken into count. The sample of trips that were surveyed corresponds to 12.0% of the total number of trips made.

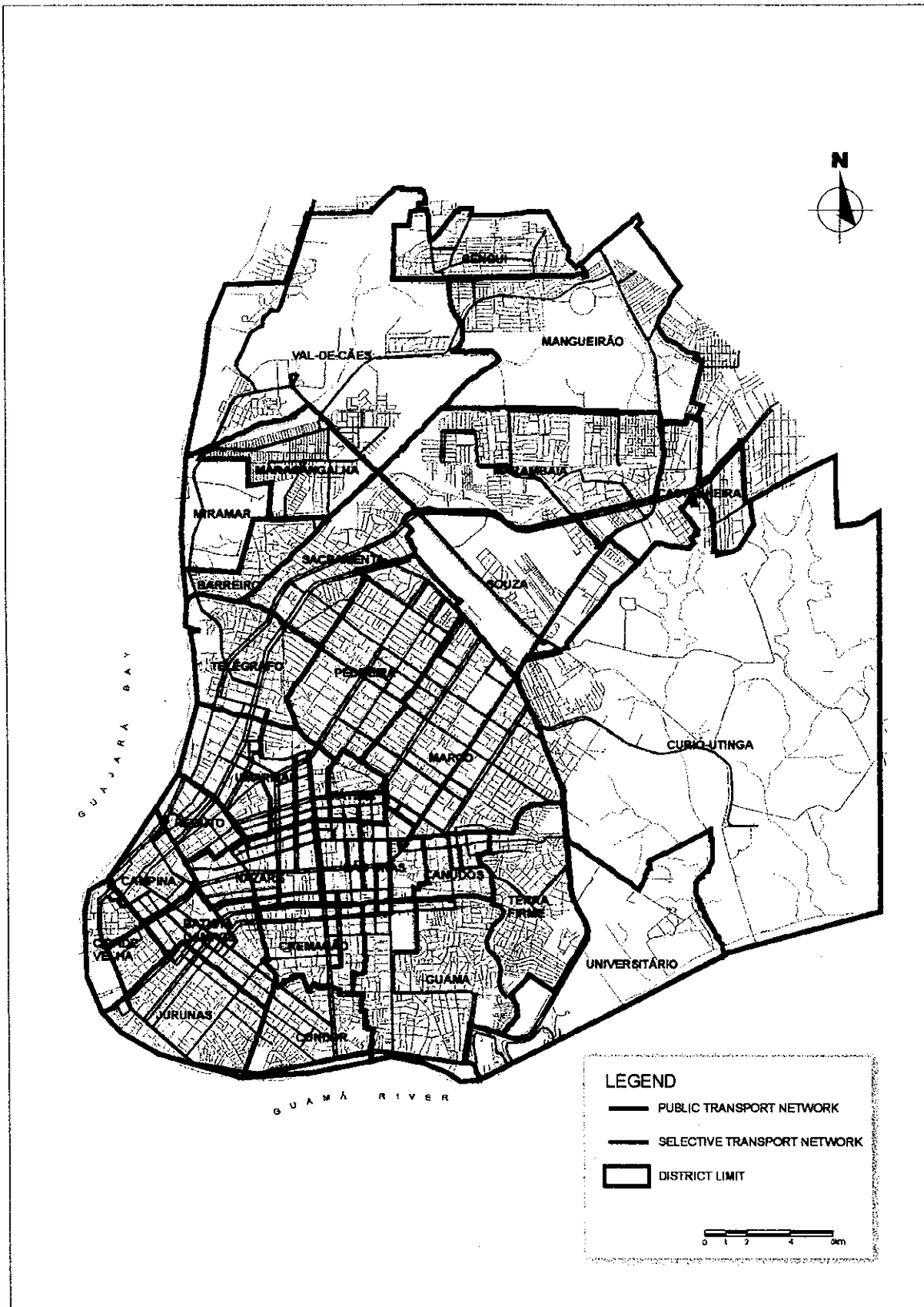


FIGURE 1.4-1 - Public Transport Network - 1ª. Léguas and Surrounding

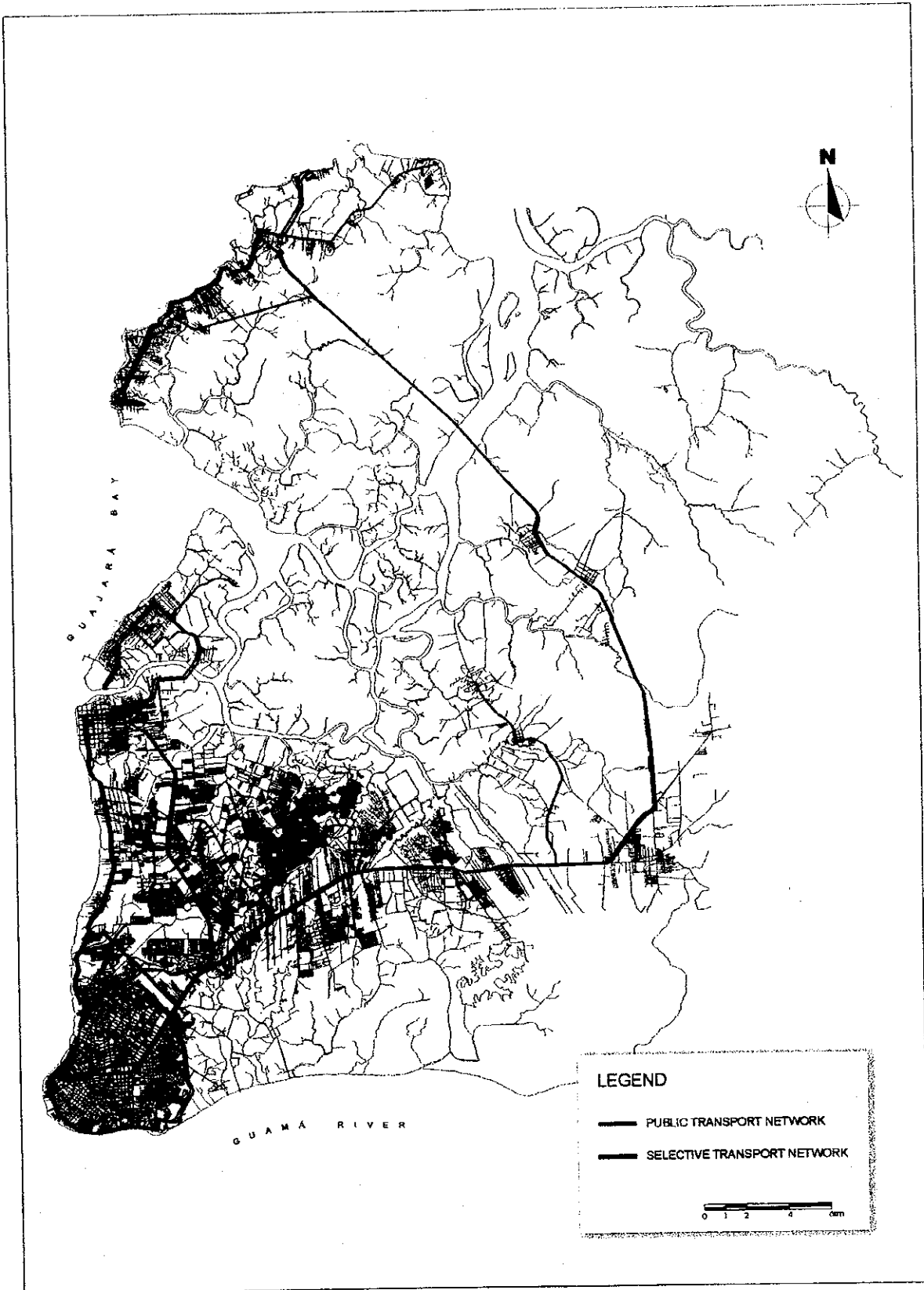


FIGURE 1.4-2 - Public Transport Network - RMB



FIGURE 1.4-3: Scene of the Bus Boarding and Alighting Survey

The total daily number of passenger based on the expansion of data from the boarding and alighting survey is 1,448,301 passengers.

FIGURE 1.4-4 shows the daily loading of passengers from the public transport system per link and direction in the main metropolitan corridors and the boarding and alighting volume in areas of greater demand. On the way to district-center, loading increases as it gets close to Entroncamento, where intersects Almirante Barroso Avenue, Tavares Bastos Avenue and Julio Cesar Avenue. The highest number is of 200,000 passengers/day. From this point on, the loading decreases towards the Central Area, culminating in 60,000 passengers/day.

The survey shows a notably inferior usage of buses that come from São Braz to the Central Area. In fact, 80 lines cross the Almirante Barroso Ave. considered the most crowded area. The number decreases to 68 lines on Assis de Vasconcelos Ave. The demand decreases 70.0% from São Braz and the supply decreases only 15.0%.

The boarding and alighting at Entroncamento, Sao Braz and Central Area (FIGURE 1.4-4) result from the sum of the points located in and around these areas, which were divided in district-center and center-district way. The amount shows the Central Area as a point of larger demand for renewal, which registers around 40,000 passenger getting on and off in each direction. Secondly, the area of São Braz with a number that ranges from 25,000 and 30,000 passenger in each direction. Finally, Entroncamento with a varying from 10,000 to 14,000 passenger/way.

FIGURE 1.4-5 shows the system loading in the morning peak time identified from 6:15 a.m. to 7:15 p.m. Similar data is noticed all day long with a few quantity difference among the number of passengers who come from Almirante Barroso Ave. between Tavares Bastos and Julio Cesar Avenues. The rate in this area is around 38,000 passengers/hour in each day. In Central Area recorded 7,000 passengers/hour in each day.

In order to study the potentiality of integration terminals in a near future, the number of passengers per hour in each way was also taken into count. In the following areas: BR-316 Road next to Entroncamento and Alça Viaria – 3,300 passengers and BR-316 Road with Coqueiro Road – 12,000 passengers, Augusto Montenegro Road with Bengui Street with 11,700 passengers; and Entroncamento, considering the volumes coming from BR-316 and Augusto Montenegro Roads, with around 43,000 passengers.

Another relevant aspect observed in the boarding and alighting survey was the number of boarding passengers who take advantage of free tickets. Those represent 22.7% of the total number of passengers/day. It can be considered high because this free service reflects directly in the fare of paying passengers.

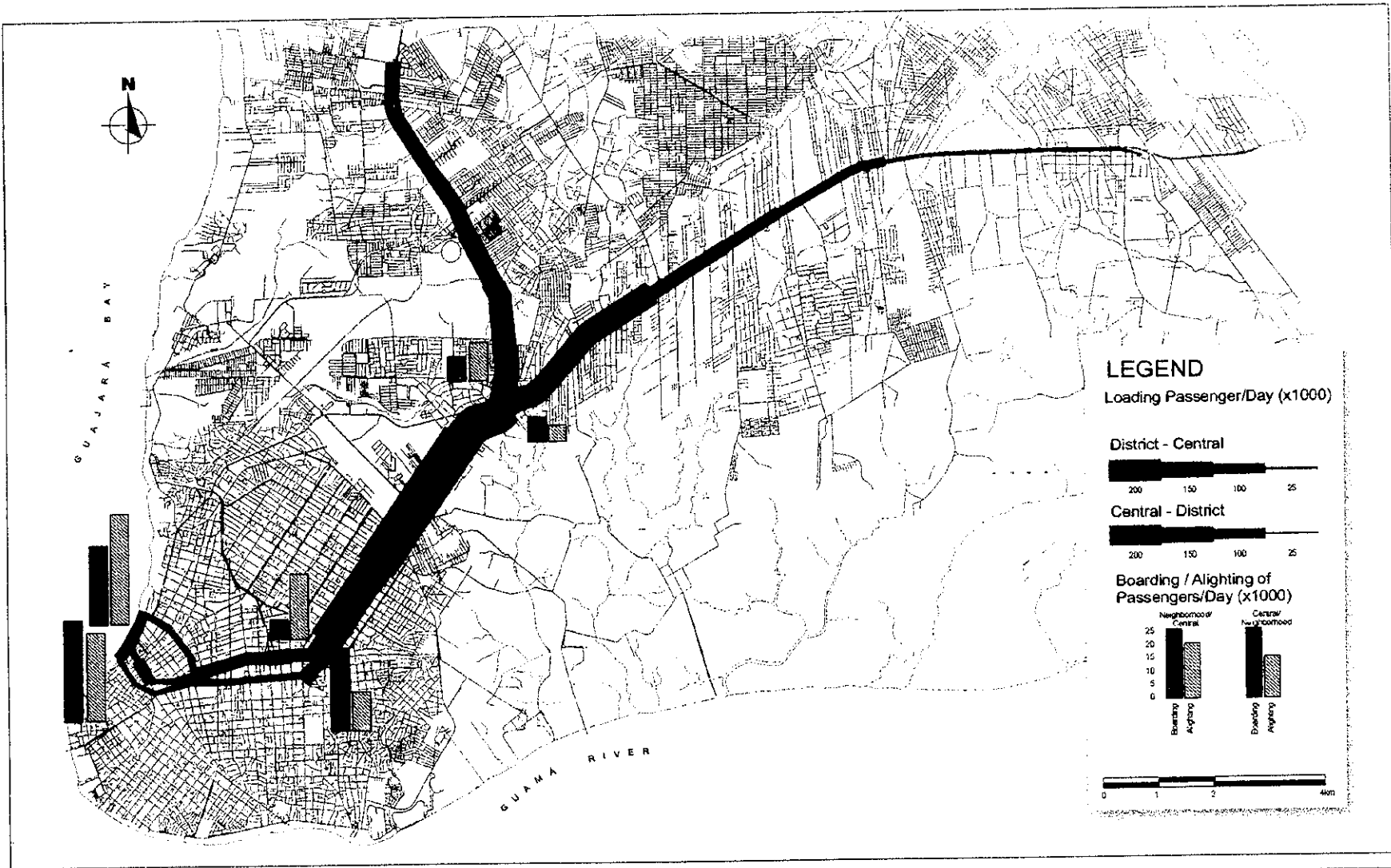


FIGURE 1.4-4 - Public Transport - Loading by Link - 24 hours

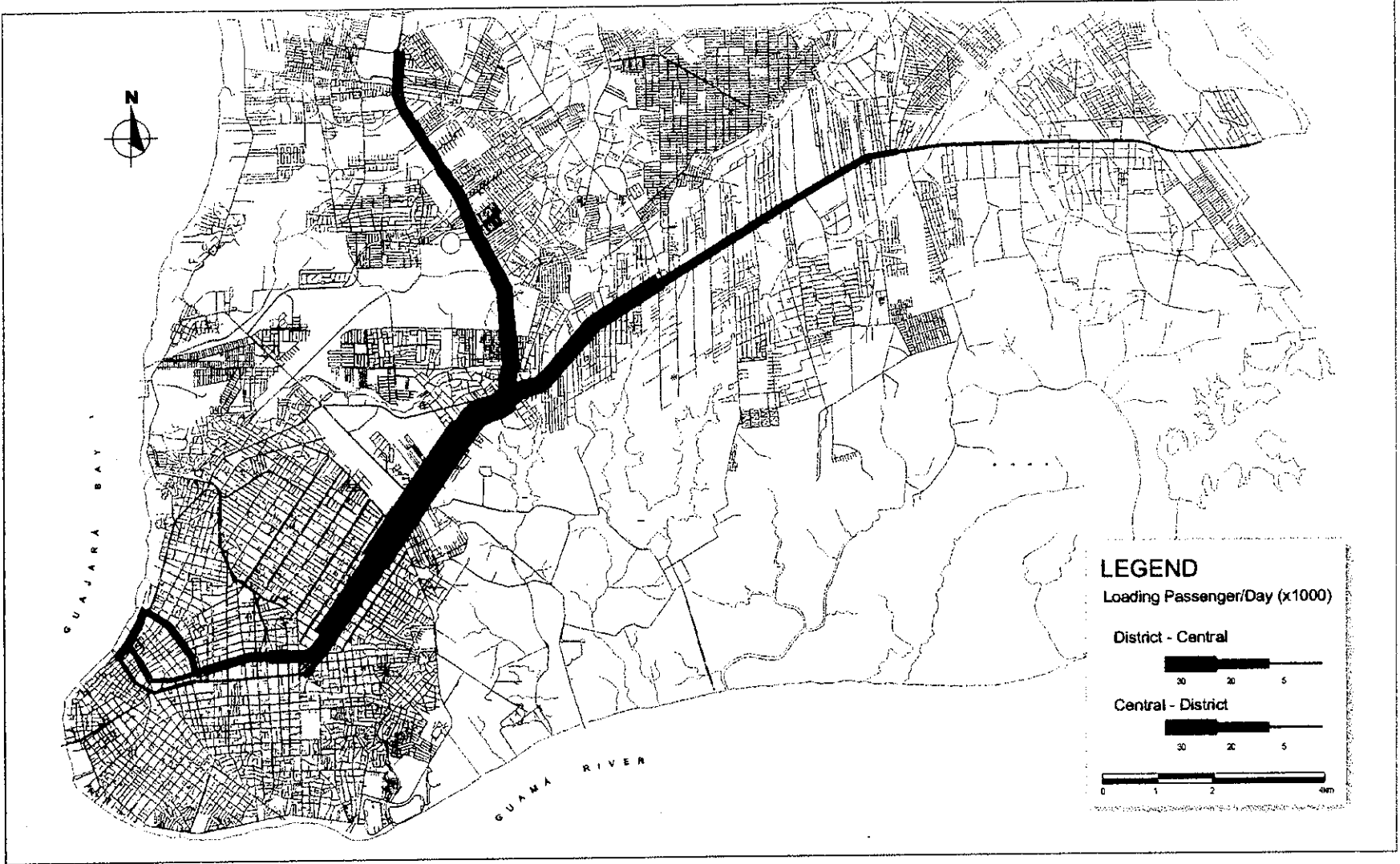


FIGURE 1.4-5 - Public Transport - Loading by Section - Morning Peak Hour

1.5 TRAFFIC VOLUME

The volume counting selected from traffic was done from October 26th to November 6th 2000, in 25 intersections and 10 sections located in the main Belem Metropolitan Area traffic corridors (FIGURE 1.5-1). The volume counting in intersections was done in two periods of three hours each (from 6:00 a.m. to 9:00 a.m. and 5:00 p.m. to 8:00 p.m.). In these sections, the counting was done during 24 hours beginning at 6:00 a.m. and ending the next day at the same time.

The purpose of this survey was to obtain the amount of traffic during peak time, as well as daily volume in the main intersections and sections of the RMB-Belem Metropolitan Area. Later on, the data will enable to analyze the capacity of system roads.

The vehicles were classified into four groups: "car/van", "minibus", "bus" and "truck" for vehicle conversion to "passenger car unit (PCU)". TABLE 1.5-1 shows PCU.

TABLE 1.5-1 – PCU by Vehicle Type

Type	Equivalence Factors
Car and Van	1.00
Minibus	1.30
Bus	2.25
Truck	2.50

The results of the counting volume survey in 11 intersections located in the main corridor are presented in FIGURES 1.5-2 to 1.5-12. The other intersections are presented in ANNEX C.

The intersections from 01 to 07 (FIGURES 1.5-2 to 1.5-8) situated along Almirante Barroso Ave. present low volume on its crossroads. There are not variations between morning and afternoon peak hour. Traffic volume in these intersections reaches 4,000 pcu/hour.

In the Central Area ring, represented by intersections 10, 11 and 12 (FIGURES 1.5-9 to 1.5-11), the traffic volume is of approximately 4,000 pcu/hour. It has homogeneous distribution among several movements except in intersection 10, where Boulevard Castilhos França movement reaches 2,000 pcu/hour in the morning peak hour. On Marechal Hermes - Presidente Vargas the movement if of 400 vehicles.

The intersection 18 (FIGURE 1.5-12) presented the volume of 2,500 pcu/hour in every 15 min in the district - center way. The greatest volume reached 1,000 vehicles/hour in the center-district way. In the afternoon peak hour, the volume is similar: around 1,500 pcu/hour.

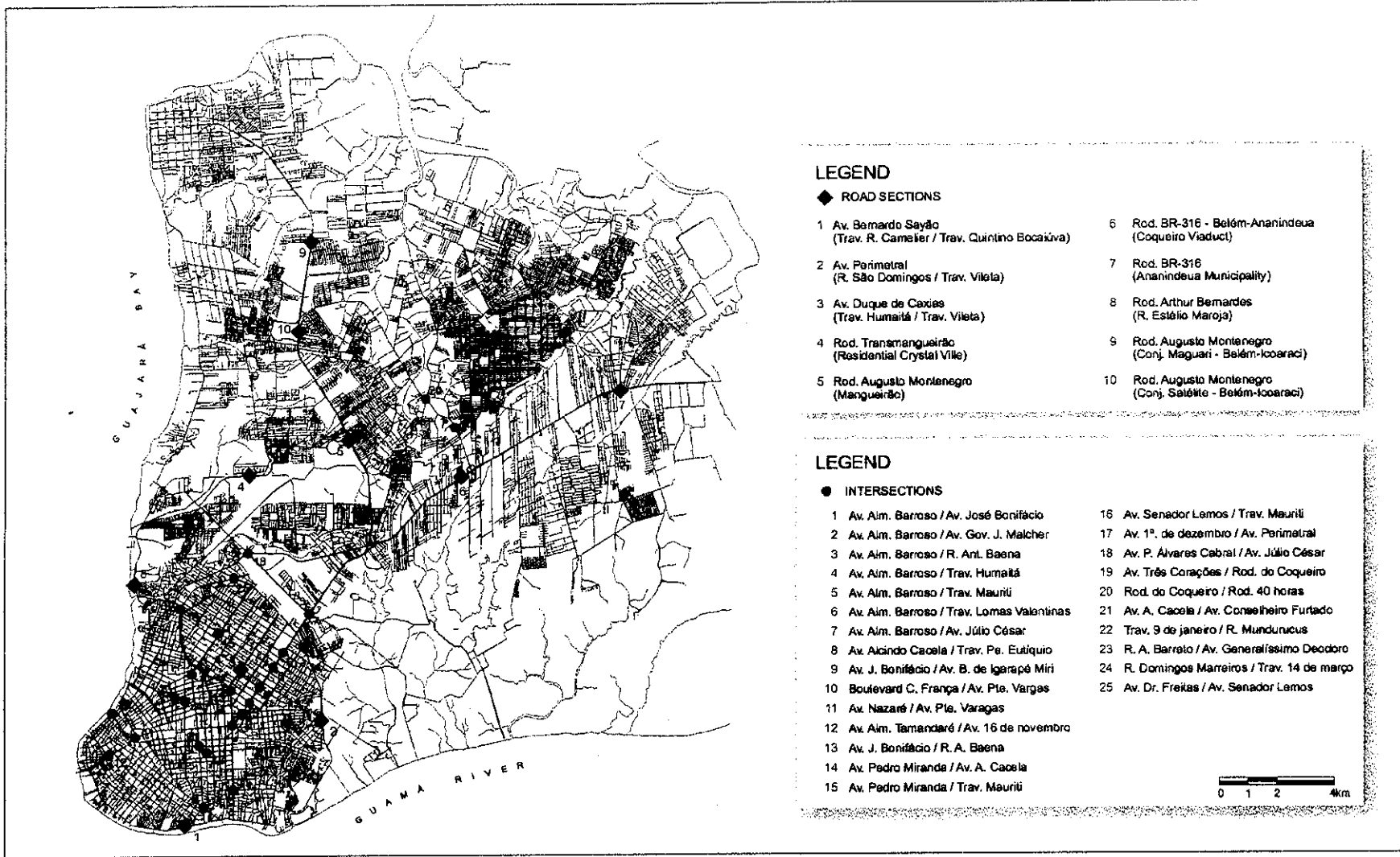


FIGURE 1.5-1 - Roads Intersections and Sections Surveyed

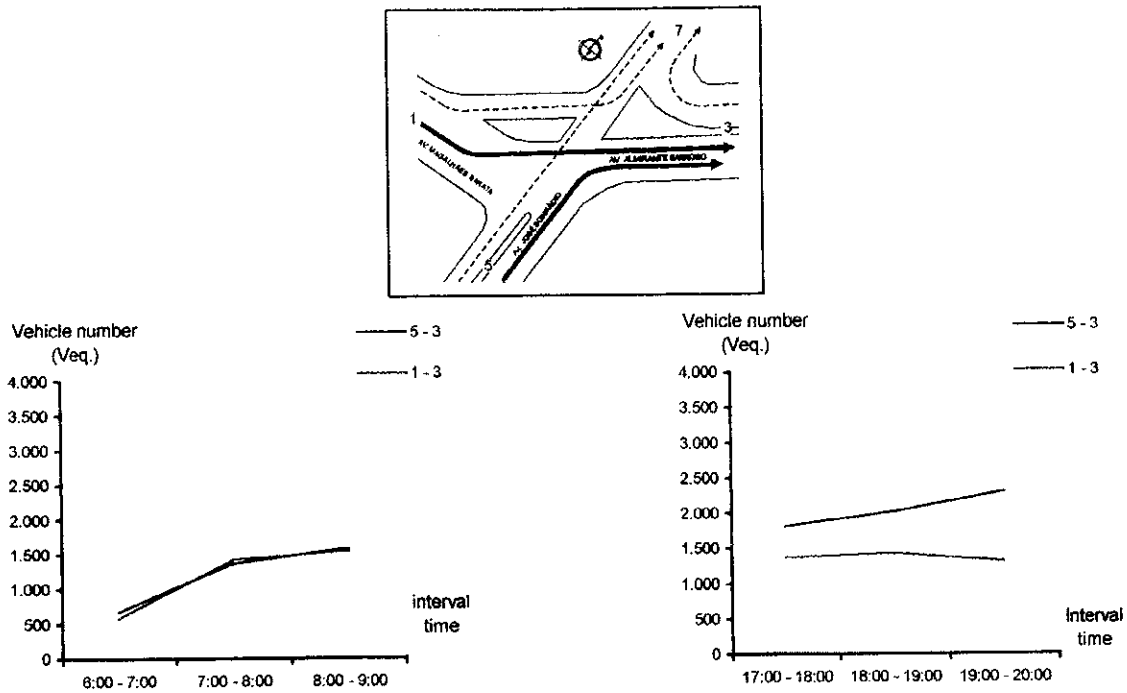


FIGURE 1.5-2 – Hour Fluctuation of Vehicles – Intersection 01

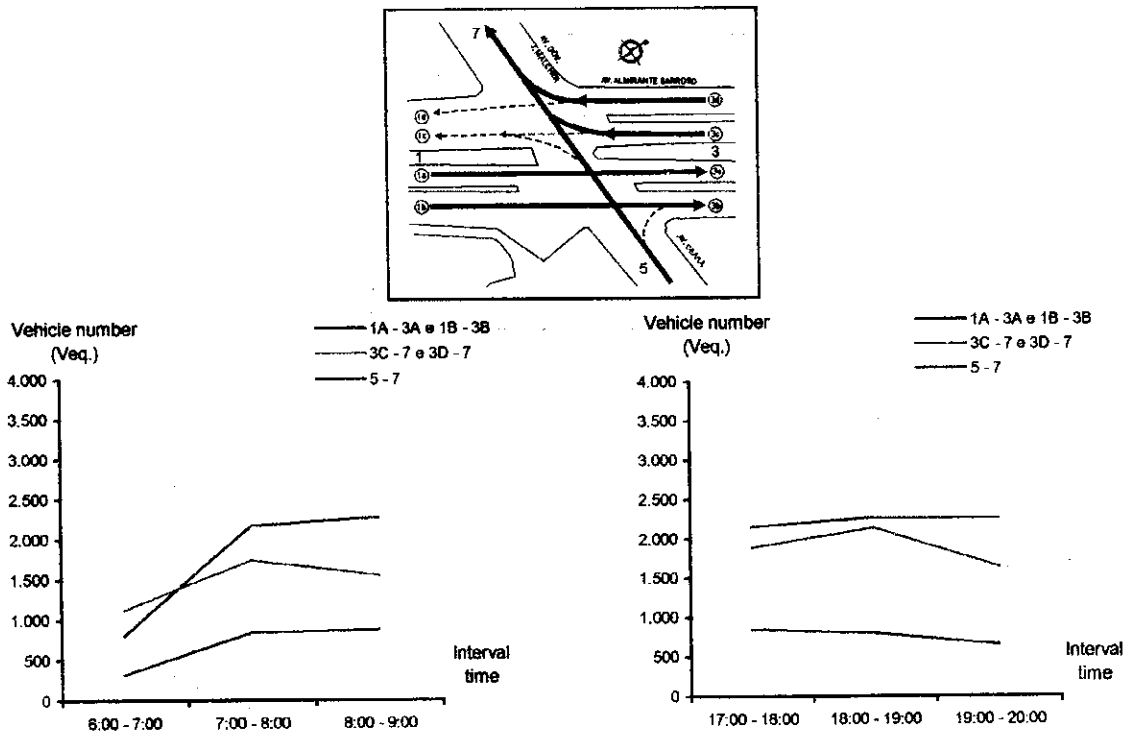


FIGURE 1.5-3 – Hour Fluctuation of Vehicles – Intersection 02

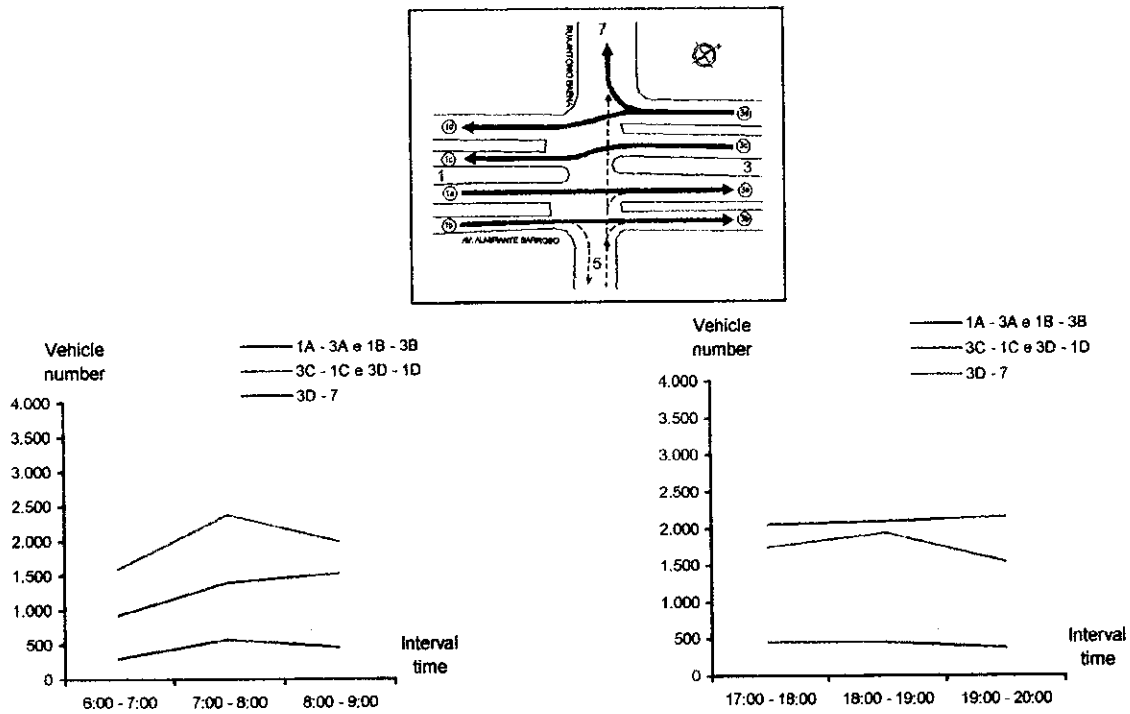


FIGURE 1.5-4 - Hour Fluctuation of Vehicles - Intersection 03

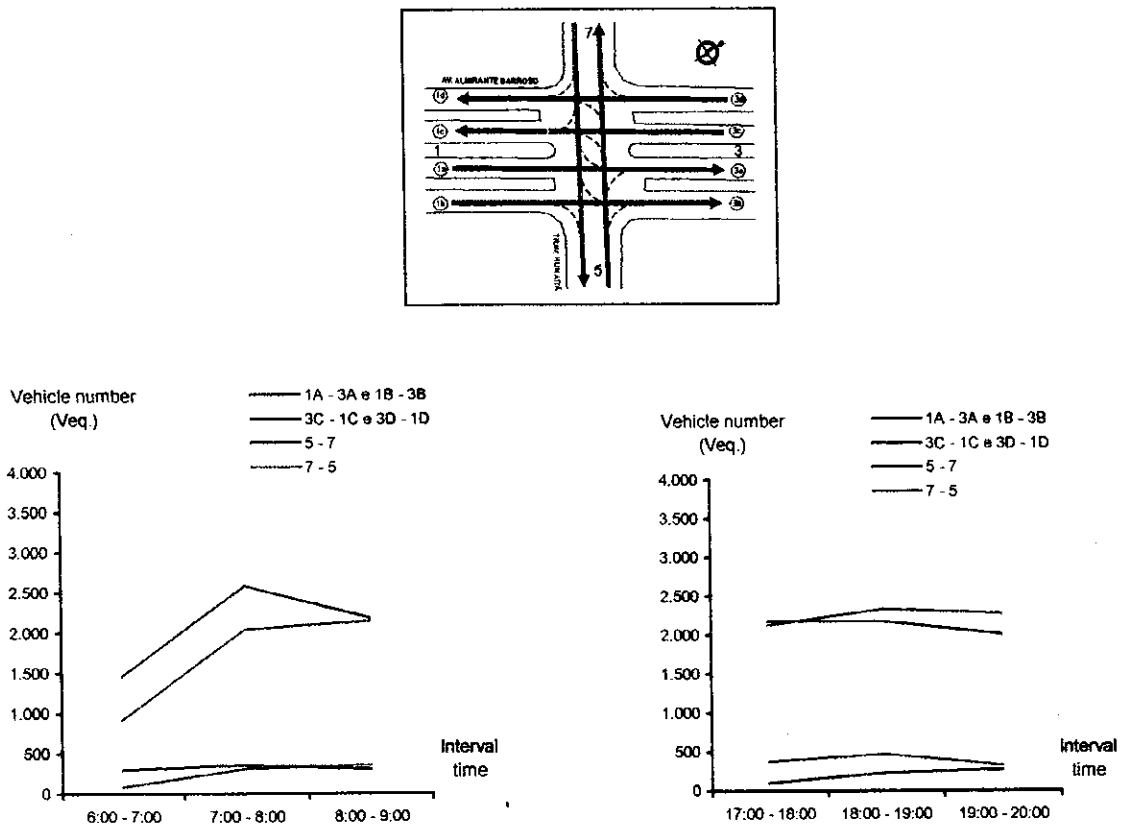


FIGURE 1.5-5 - Hour Fluctuation of Vehicles - Intersection 04

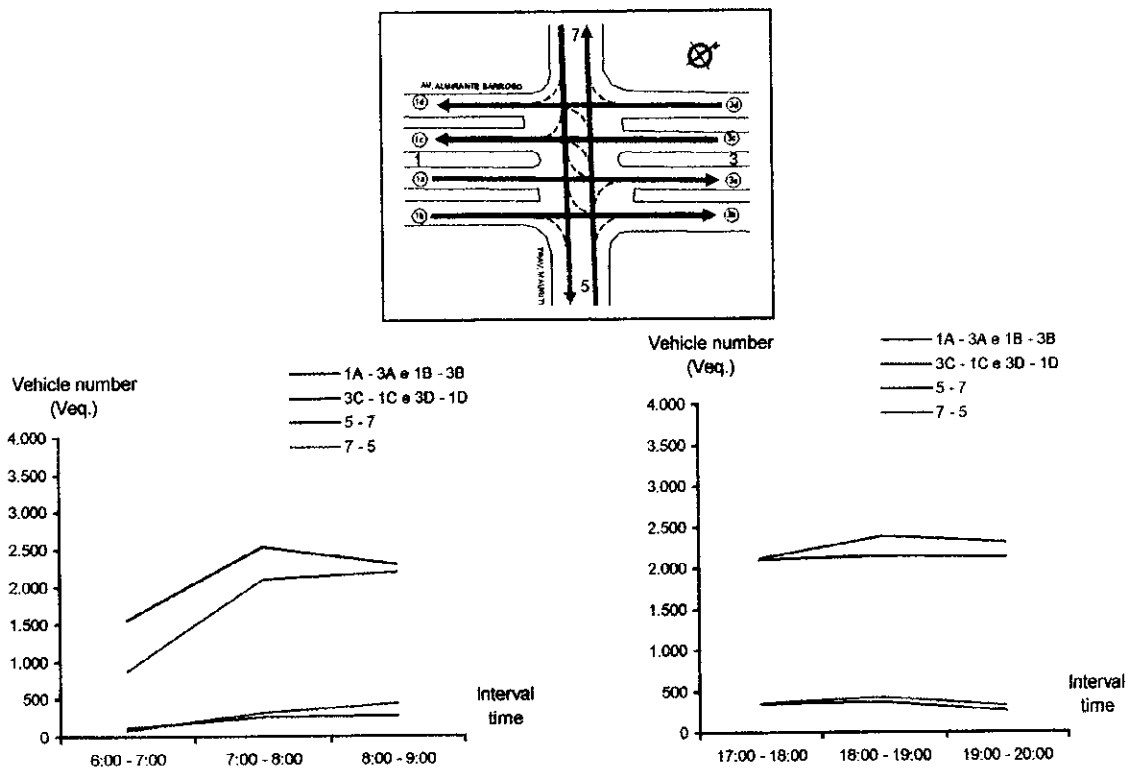


FIGURE 1.5-6 – Hour Fluctuation of Vehicles – Intersection 05

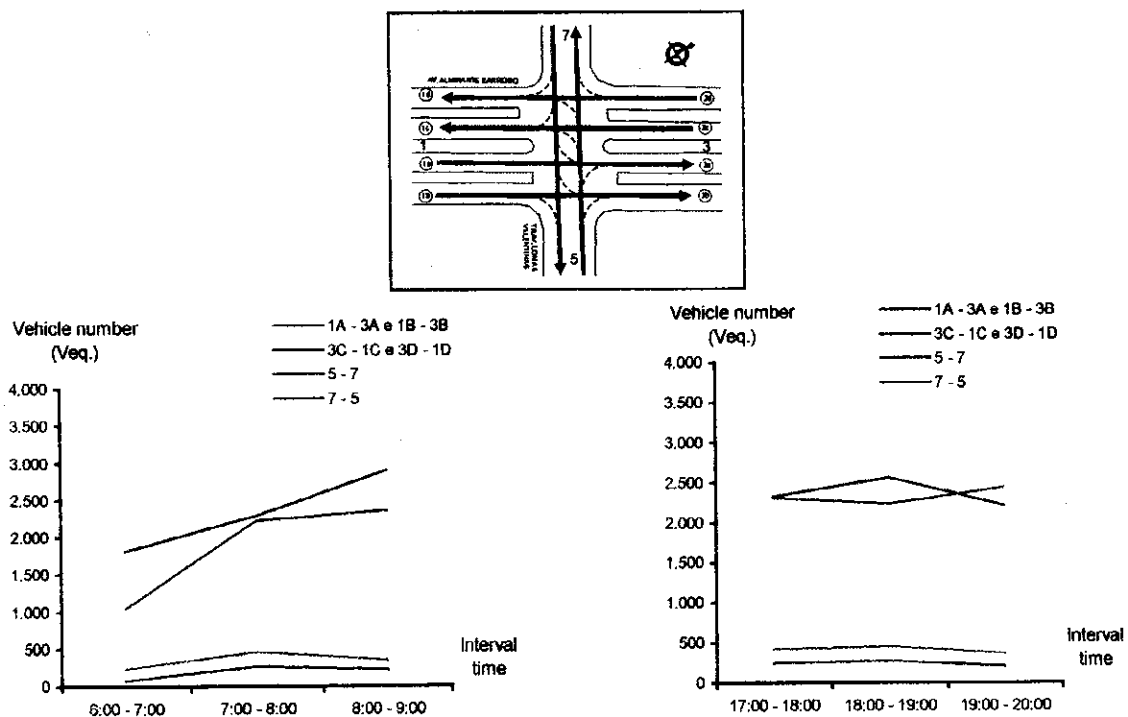


FIGURE 1.5-7 – Hour Fluctuation of Vehicles – Intersection 06

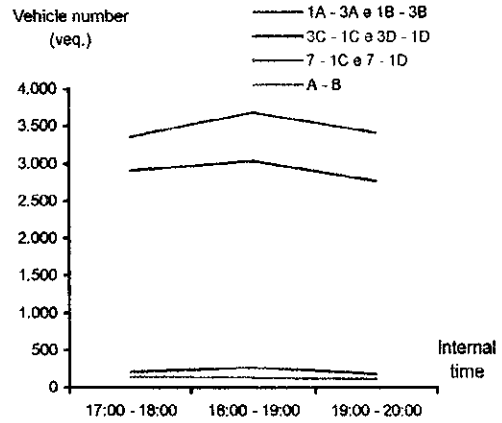
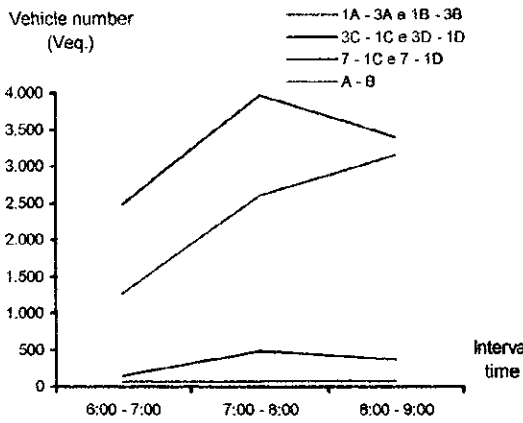
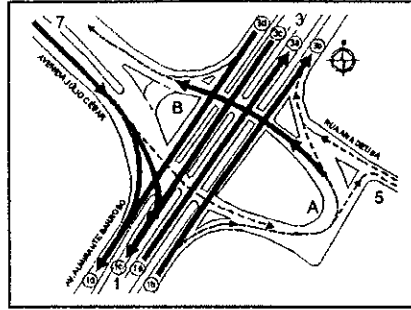


FIGURE 1.5-8 – Hour Fluctuation of Vehicles – Intersection 07

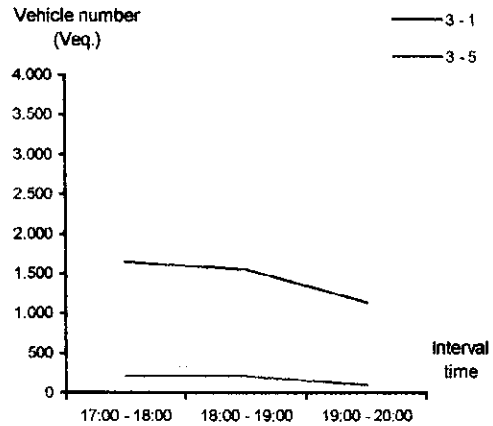
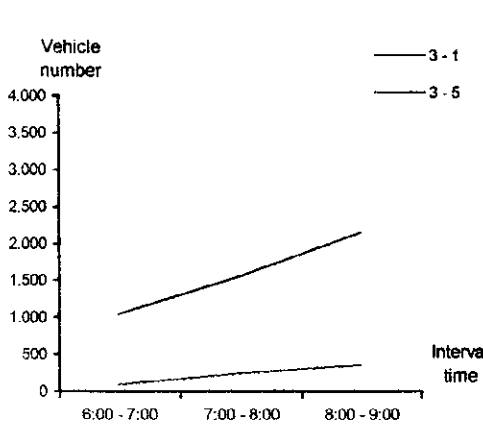
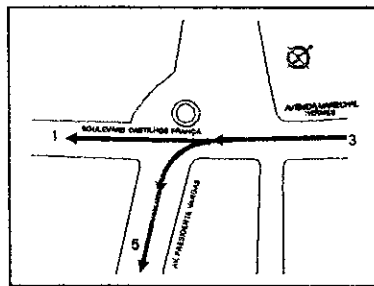


FIGURE 1.5-9 – Hour Fluctuation of Vehicles – Intersection 10

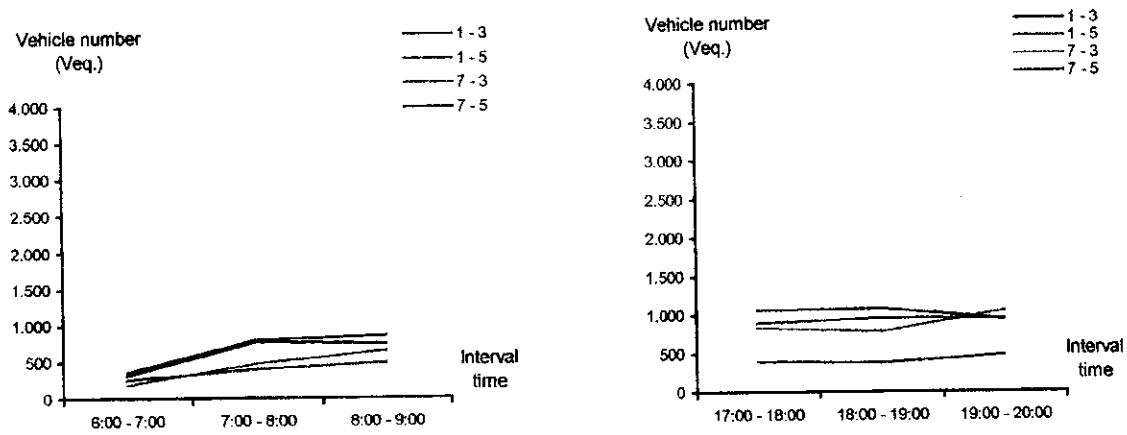
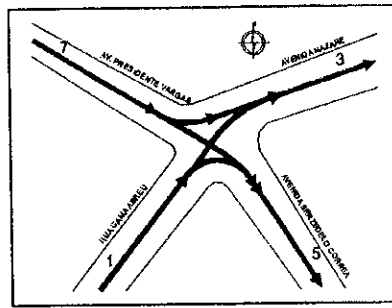


FIGURE 1.5-10 – Hour Fluctuation of Vehicles – Intersection 11

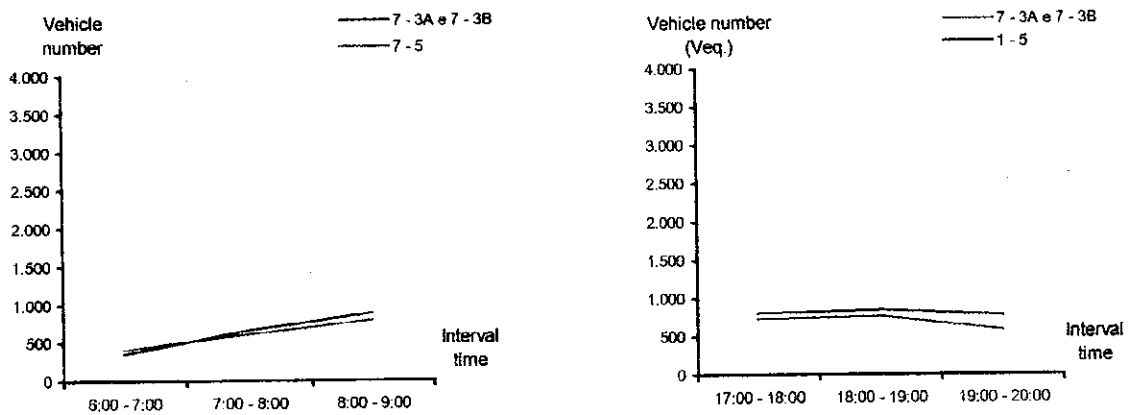
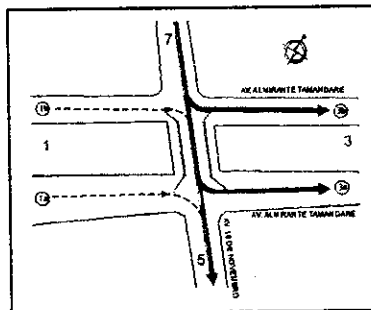


FIGURE 1.5-11 – Hour Fluctuation of Vehicles – Intersection 12

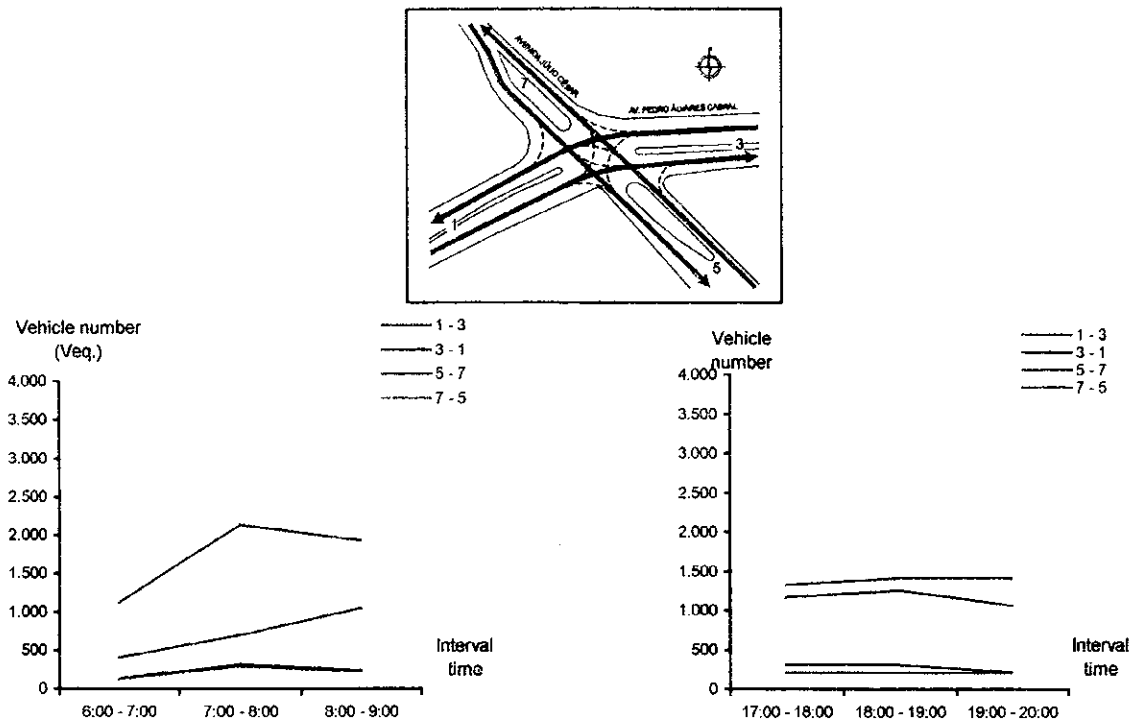


FIGURE 1.5-12 – Hour Fluctuation of Vehicles – Intersection 18

FIGURE 1.5-13 shows the results of the volume counting at the main segments of BR-316, Augusto Montenegro and Arthur Bernardes roads and Bernardo Sayão and Perimetral Avenues, and the results at the others points are in the ANNEX D.

BR-316 road records the largest volumes with approximately 6,500 vehicles/hr in the dual-ways in the peak hours during from 8:30 to 9:30 am and 6:15 to 7:15 pm. In this road, the traffic volume is higher than 5,000 vehicle/hr during from 6:30 to 7:30 am. Augusto Montenegro ranks the second higher with average volumes between 4,000 and 5,000 vehicles/hr. Bernardo Sayão, Perimetral and Arthur Bernardes Avenues present lower volumes between 500 and 1,000 vehicles/hr in the same period.

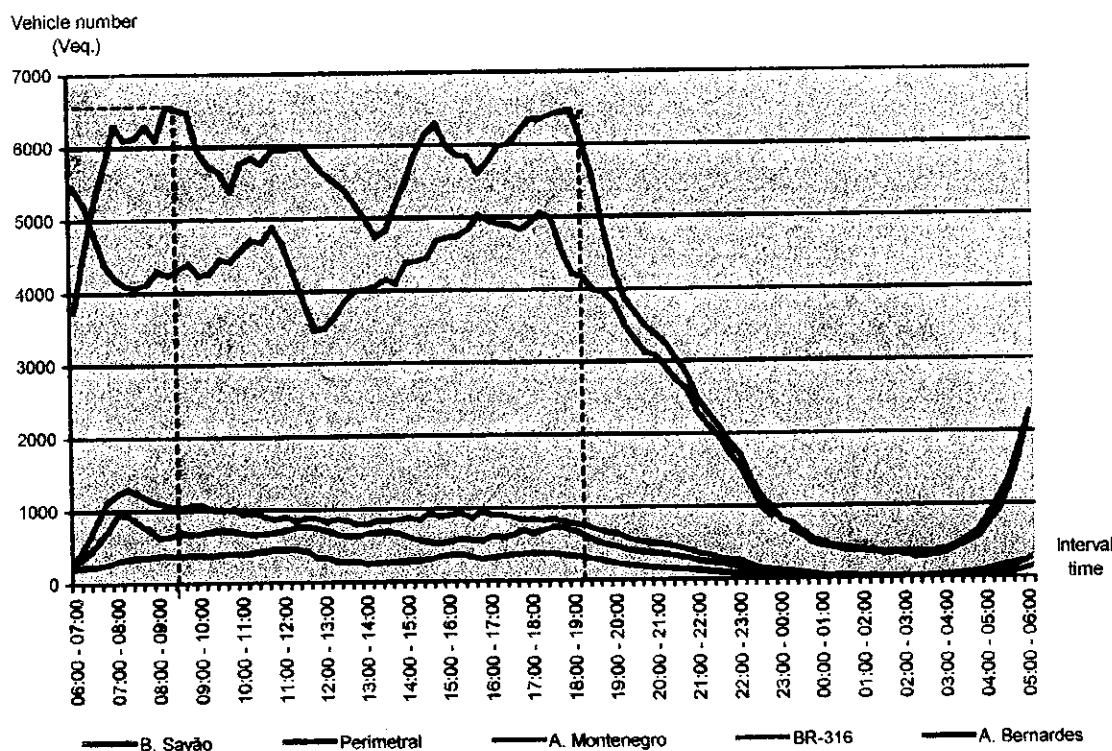


FIGURE 1.5-13 – Roadside Traffic Count Result

1.6. TRAVEL TIMES (VELOCITY - DECELERATION)

Nine main road routes in RMB-Belem Metropolitan Area were selected to measure the velocity and deceleration as shown in FIGURE 1.6-1, which include important arterial and/or collector roads.

It was done with a survey car during 6:00am to 9:30am in the morning and 5:00 am to 8:30pm in the afternoon from August 29th to 31 and September 1st to 4th. The measuring is carried out at two times on each route during two days and totals up to 8 times per route. The purpose is to know the average velocity and the deceleration causes by road segment on the nine selected routes.

The time and following factors of deceleration were recorded at the exactly moment when the survey car decelerated:

- Bus stop;
- Pavement conditions;
- Traffic lights;
- Traffic accidents;
- Road constructions;
- Traffic jam.

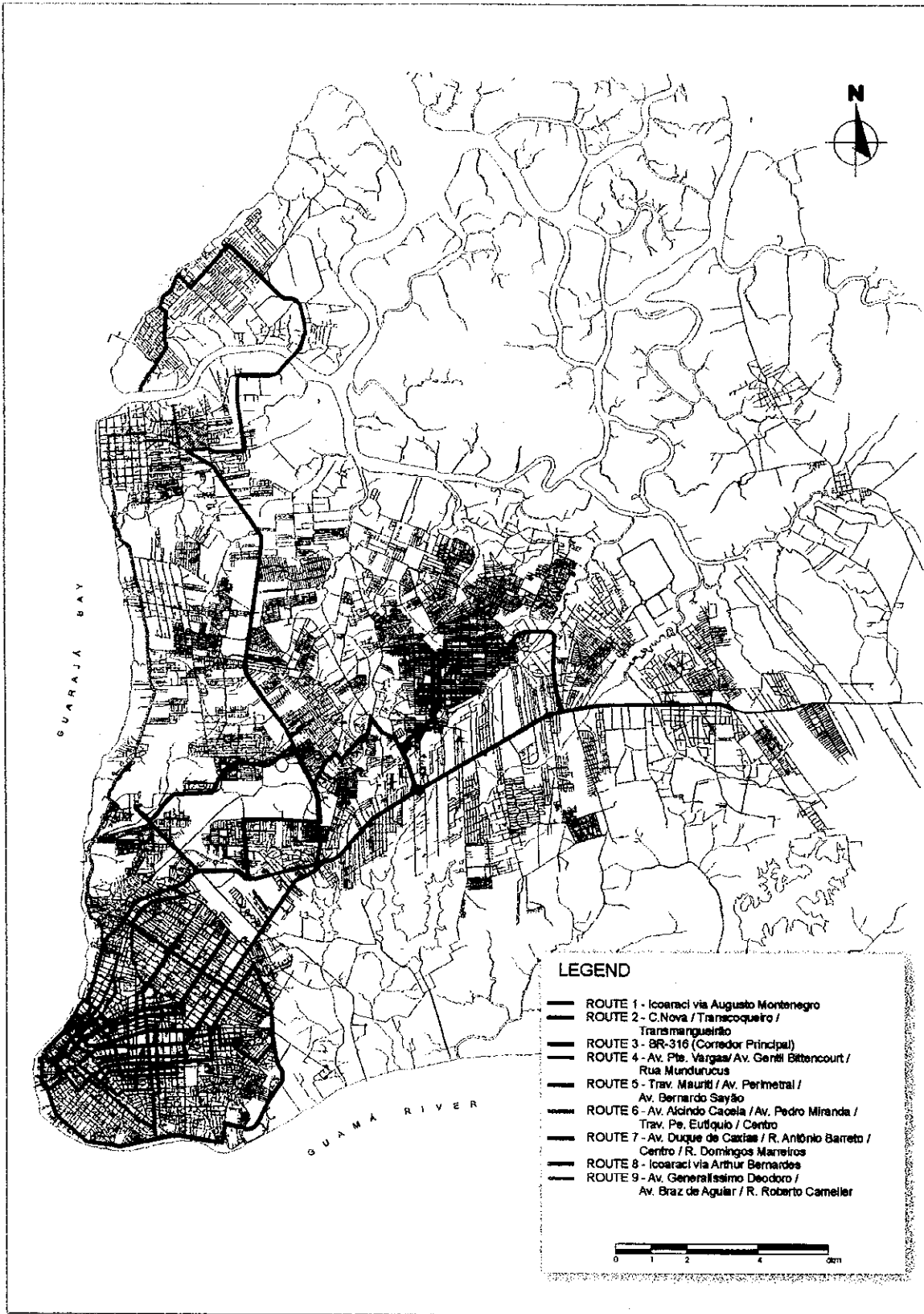


FIGURE 1.6-1 - Routes Trip Time Survey (Velocity and Delay)

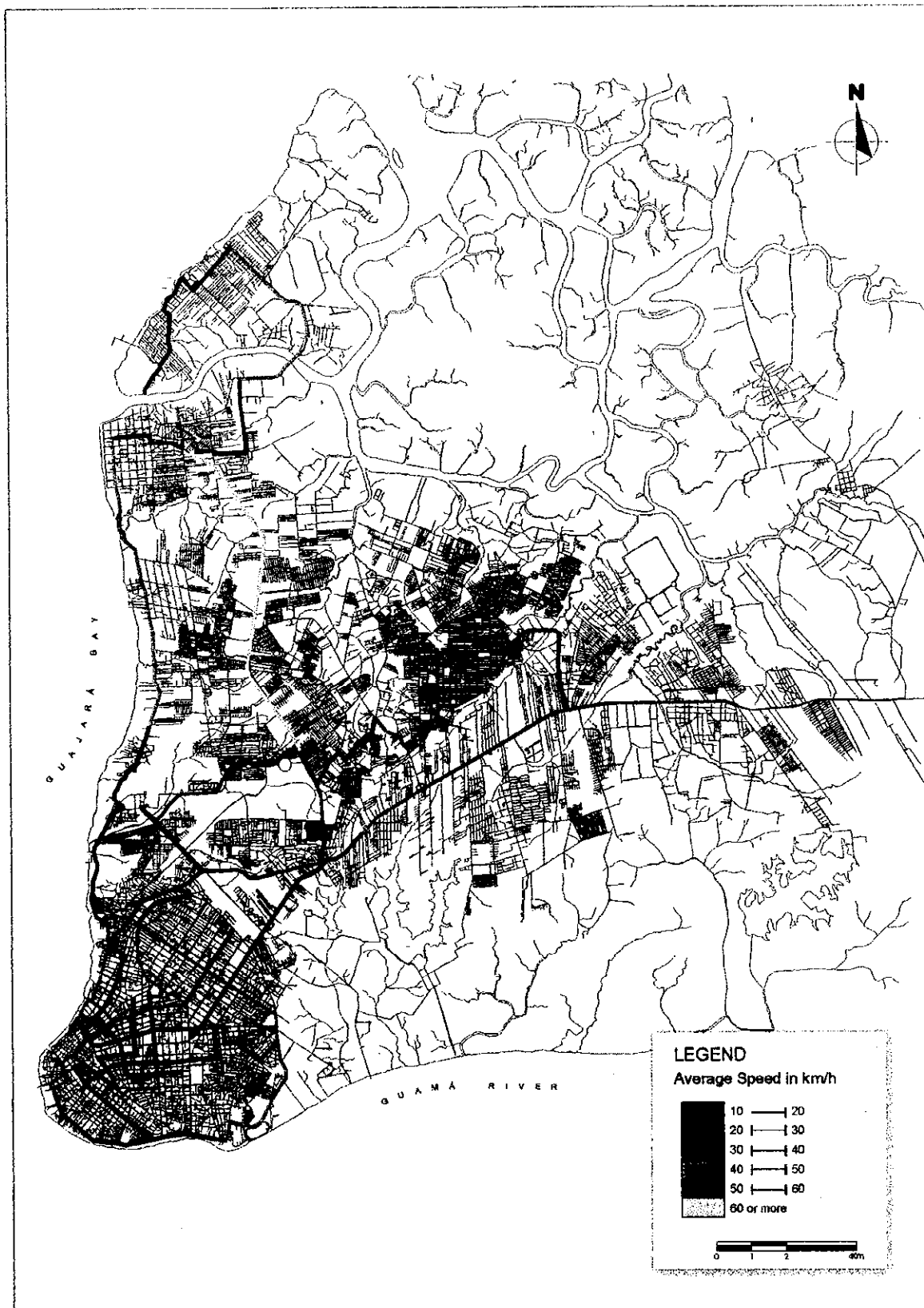


FIGURE 1.6-2 - Average Velocity by Link on Way District-Center - Morning Peak

FIGURE 1.6-2 shows the average velocities by segment surveyed in the morning peak hour in the inbound direction. On the 1a Legua, the average velocity is lower between 10 to 30 km/h, especially near to Central Area. The roads in the periphery areas as Cidade Nova residential, Transcoqueiro Road, Maguari Road, and some Icoaraci roads also record low velocity.

FIGURES 1.6-3 to 1.6-12 show the most detailed analysis of the average velocity per segment as well as deceleration factors observed on main road routes. ANNEX 05 – (Synthesis Road Trip Time Survey -Velocity and Deceleration) shows the described numerical segments.

In route 1 (FIGURE 1.6-3) the higher velocity occurs on Augusto Montenegro Road, going down next to Pedro Alvares Cabral Avenue. The lower velocity occurs in Pedro Alvares Cabral Avenue next to Tavares Bastos Avenue, certainly provoked by retention in crossing these roads.

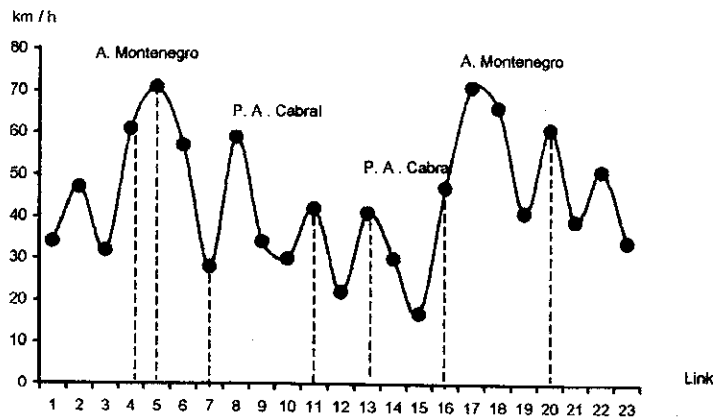


FIGURE 1.6-3 – Average Velocity per Section on Route 1

FIGURE 1.6-4 shows that the main factors of the deceleration on Route 1 are the pavement conditions, traffic lights, and traffic jam. The area which showed highest deceleration percentage related to pavement and traffic light conditions in this route is next to central area.

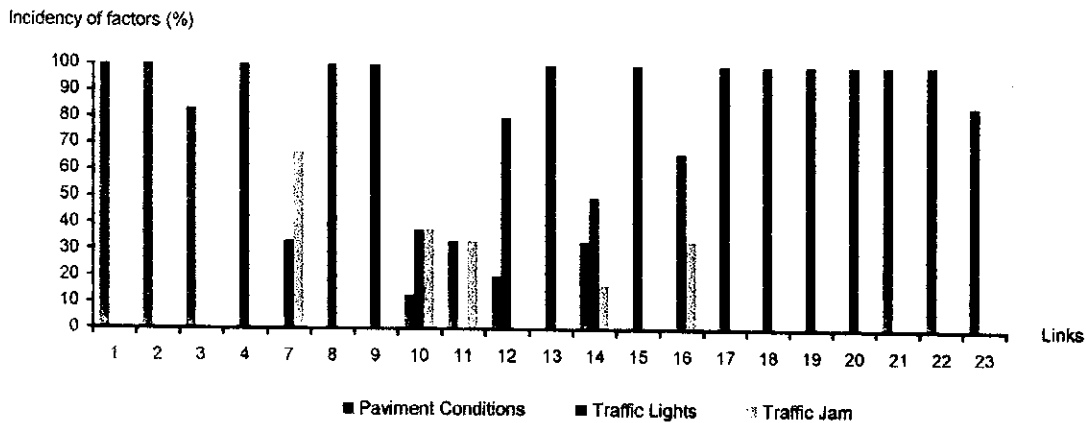


FIGURE 1.6-4 – Percentage Distribution of Delay Factors per Section on Route 1

The velocities obtained in Route 3 (FIGURE 1.6-5) shows the reduction next to Entroncamento, reaching the lowest velocity in Central Area. On BR-316 Road the velocity increase as it get far from Entroncamento in direction to Pirelli Road. This route was considered the most important among the surveyed routes because encloses the total main corridor.

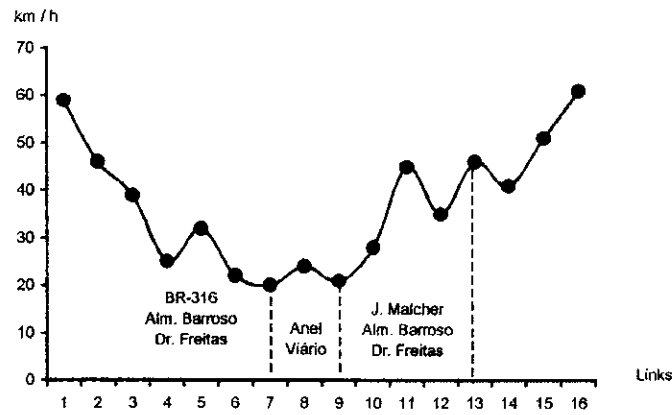


FIGURE 1.6-5 – Average Velocity per Section on Route 3

As for deceleration factors FIGURE 1.6-6 shows that only traffic lights and traffic jam were relevant in this route. The stop time provoked by the traffic lights was predominant in their total represented in some sections (3,7,9,11,12). At the beginning and final sections of route (1 and 16) the total of stop time is due to traffic jams since there is no traffic lights.

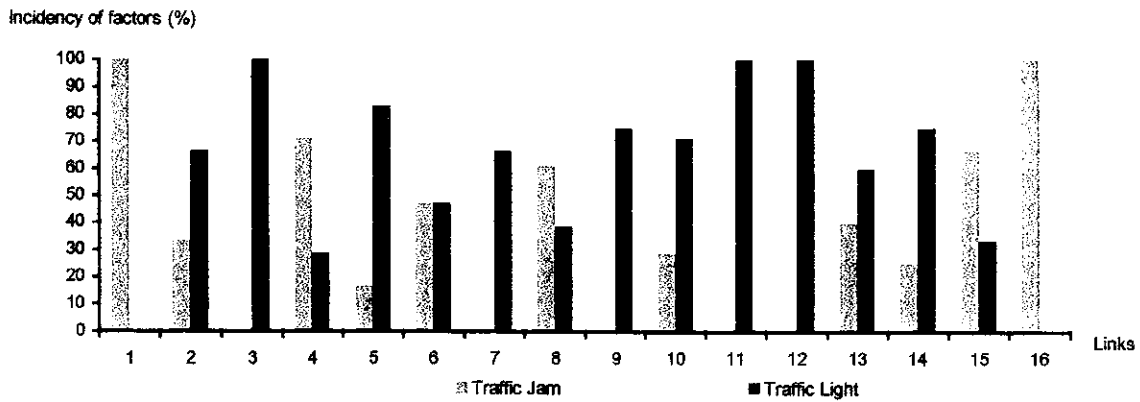


FIGURE 1.6-6 – Percentage Distribution of Delay Factors per Section on Route 3

The roads of the Route 4 are located in 1.^a Legua. It is observed the homogeneity in velocities (FIGURE 1.6-7), excluding the section on Conselheiro Furtado Ave. (next to Padre Eutiquio St.) and Quintino Bocaiuva St. (next to the main corridors) which presents velocity decrease to 11km/h.

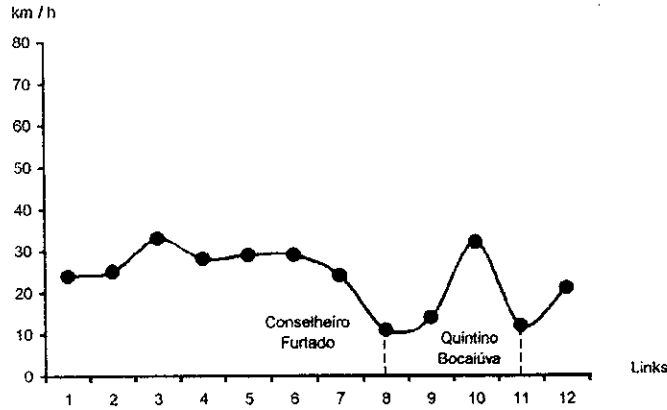


FIGURE 1.6-7- Average Velocity per Section on Route 4

Referring to delay factors (FIGURE 1.6-8) a predominance of the stop time on traffic lights is observed mainly on starting points (1 to 5) along Presidente Vargas, Gentil Bittencourt and 1.^o de Dezembro avenues. From this point on there is a decrease in numbers of traffic lights and traffic jams occur more frequently.

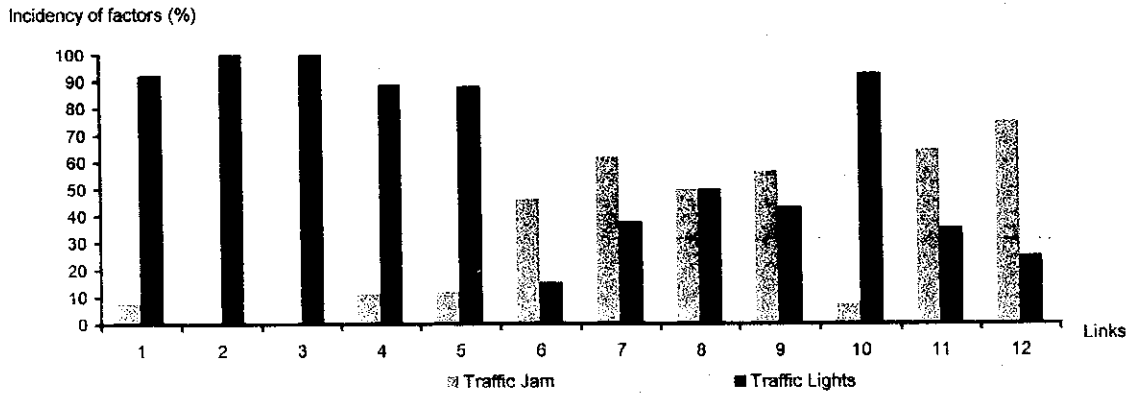


FIGURE 1.6-8- Percentage Distribution of Delay Factors per Section on Route 4

The Route 5 is composed by two road groups: Senador Lemos Avenue / Mauriti St. and Perimetral Ave. / Bernardo Sayao Ave. In both the velocity was not high (FIGURE 1.6-9). This is due to localization of these groups in 1.a Legua with intense land use.

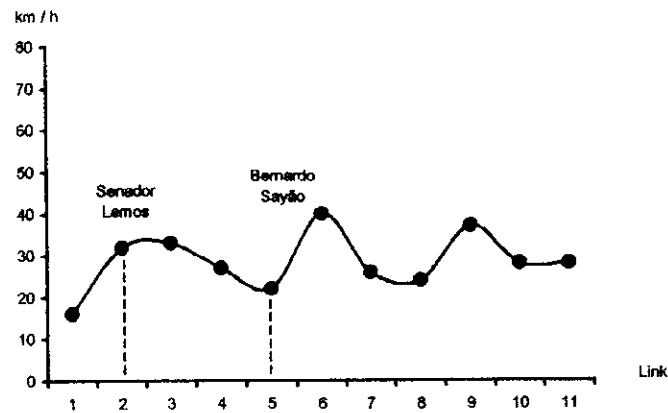


FIGURE 1.6-9 – Average Velocity per Section on Route 5

The Route 7 is composed by 1.a Legua roads so the data do not reach high velocities (FIGURE 1.6-10). The highest velocities obtained happened on Antonio Barreto St. and Duque de Caxias Ave. and the lowest in Central Area roads. The velocities obtained are relatively high because the survey was done before the major traffic jam time.

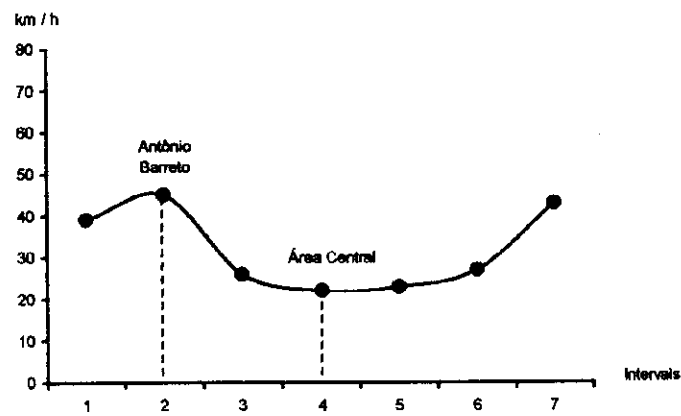


FIGURE 1.6-10 – Average Velocity per Section on Route 7

The velocities in route 8 do not present much variation (FIGURE 1.6-11), reaching the lowest points in the way back from Central Area, on Visconde de Souza Franco Ave. and Jerônimo Pimentel St.

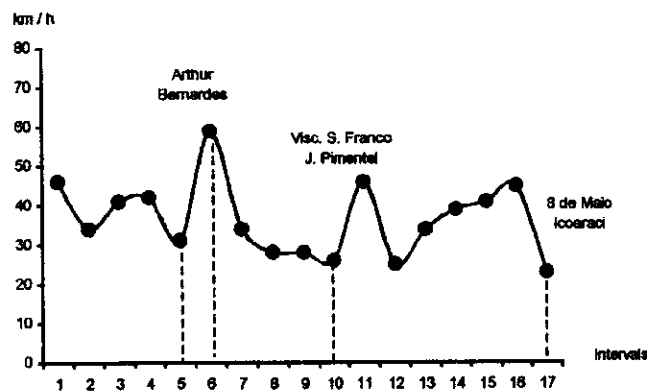


FIGURE 1.6-11 – Average Velocity per Section - Route 8

The roads that compose Route 9 are next to Central Area that is why the velocities are not high, reaching the lowest level on Generalíssimo Deodoro Av. before Braz de Aguiar Ave. (FIGURE 1.6-12).

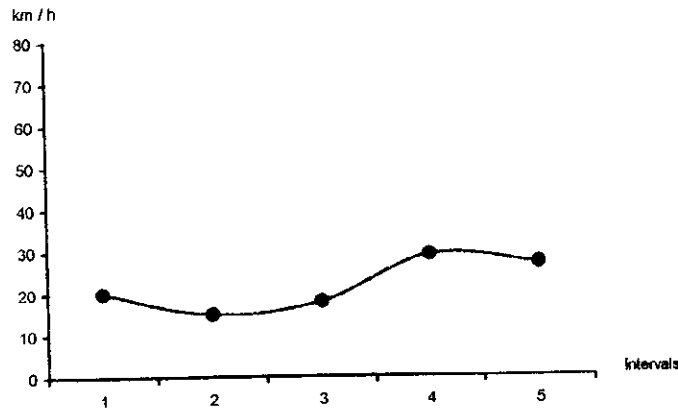


FIGURE 1.6-12 – Average Velocity per Section - Route 9

1.7. PARKING DOWNTOWN

The Central Area that is part of Batista Campos and Nazare district is the central business district such as commercial and business services surrounded by Historical Center. All trip modes attract in this place in RMB - Belem Metropolitan Region. The parking survey was done to obtain private vehicle parking demand and the average parking time.

The parking survey was carried out on the following five parking spots in the Central Area (FIGURE 1.7-1).

- Ver-o-Peso
- Comercio
- Republica Square;
- Iguatemi Shopping; and
- Braz de Aguiar.

These parts were divided into 28 routes to facilitate the collection data. The parking survey had been done for two days to each part between 9:30am to 11:30am in August 16th, 17th, and 21st to 24th, 2000.

FIGURES 1.7-2 to 1.7-11 shows the average occupation rates and distribution of average parking duration time against a stratum of 30min in the morning and afternoon peak hours.

Part 01 – Ver-o-Peso Area (market area)

The part 01 (FIGURE 1.7-2 and 1.7-3) is observed that the number of parked vehicles is considerably higher in the morning when parking demand exceeds the parking capacity. The demand reaches approximately 110.0% of the capacity, if taking into account an illegal -parking vehicle of 10.0%. In the afternoon this occupation ratio gets lower to less than half of the capacity after the intense morning activities in Ver-o-Peso.

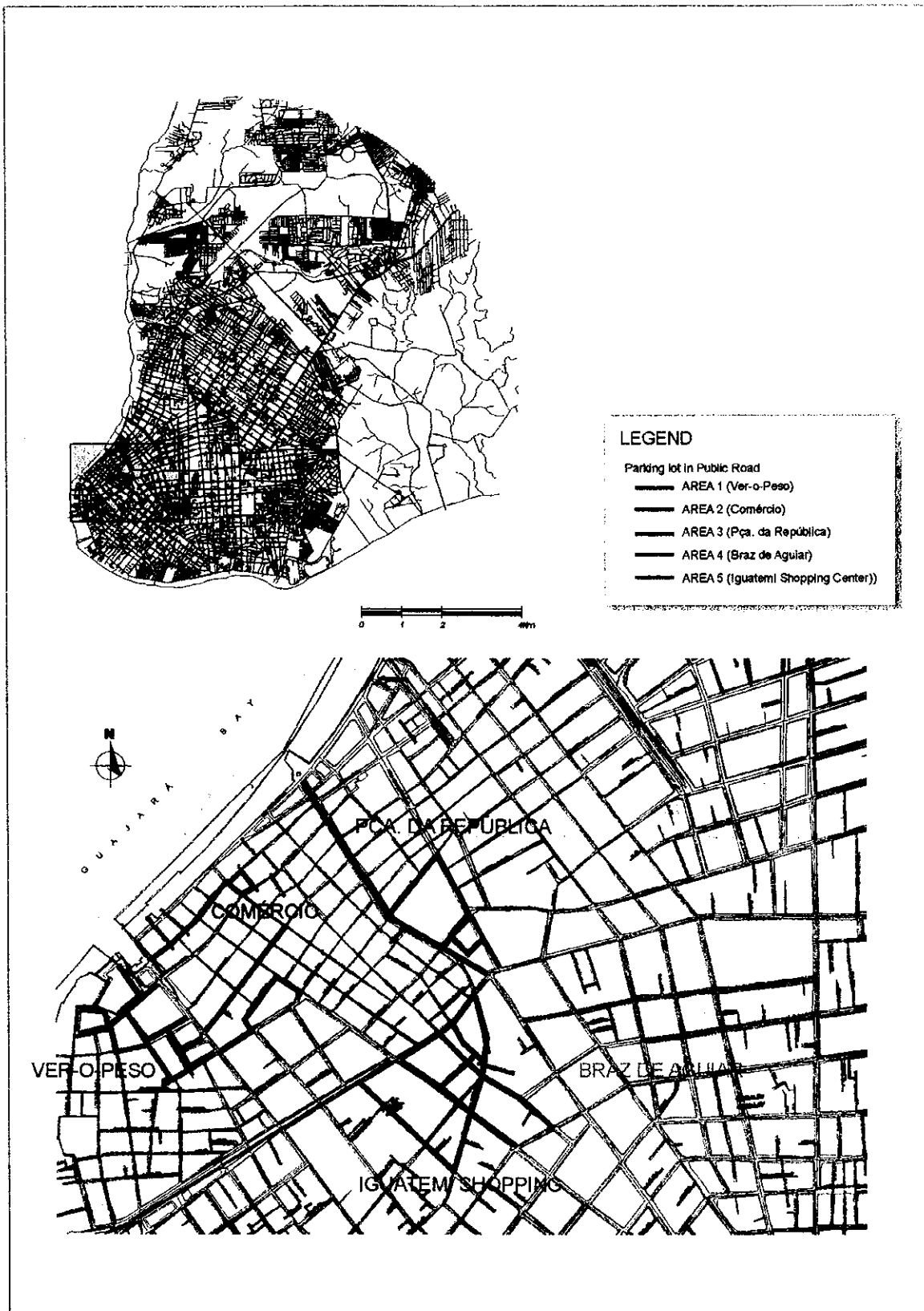


FIGURE 1.7-1 - Parking in-Street Surveyed

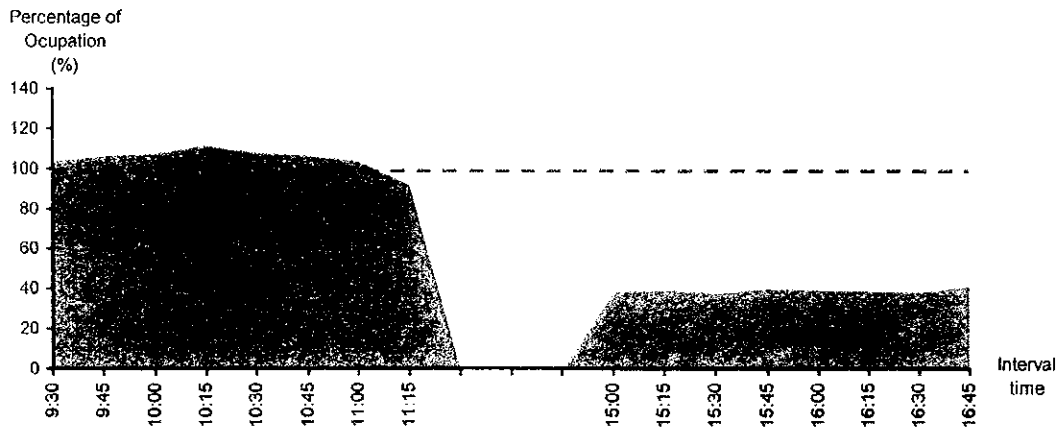


FIGURE 1.7-2 – Average Occupancy Rate - Part 01 – Ver-o-Peso Area

As can be seen in FIGURE 1.7-3, 70.0% of parked vehicles in the morning and afternoon periods take within one hour duration for short time activities such as shopping, business, and personnel matters.



FIGURE 1.7-3 – Occupancy Percentage - Part 01 – Ver-o-Peso Area

Part 02 –Downtown Area

In this part (FIGURES 1.7-4, 1.7-5) it is observed an average occupation rate up to 100.0% for both periods (morning and afternoon), and the major rate (123.0%) occurs in morning peaks at 11:15am. It is also observed that as in Part 01 the occupation rates are over its capacity indicating lack of parking place to attend the local demand.

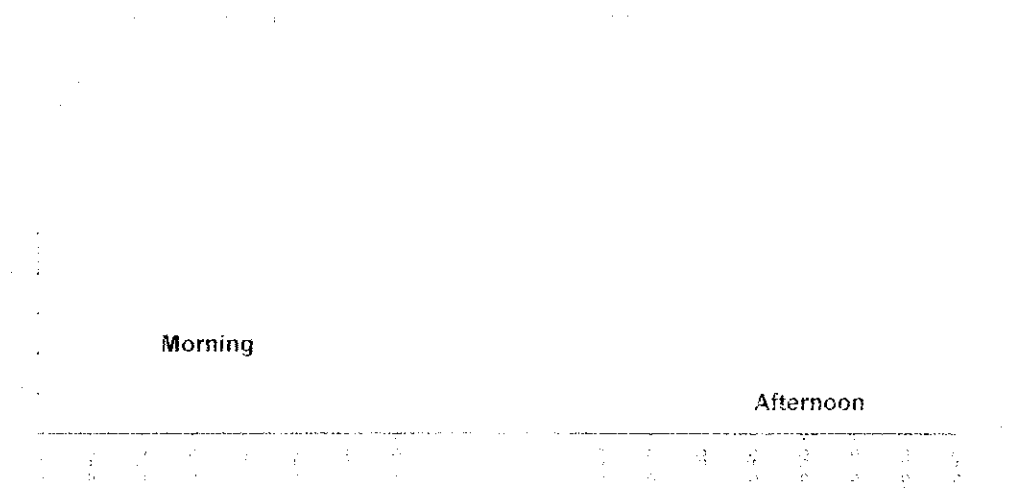


Figure 1: Average number of people in the queue (Y-axis) versus Time (X-axis) for Morning and Afternoon

The graph shows the average number of people in the queue during the morning and afternoon. The morning peak occurs at 10:00 with 100 people, and the afternoon peak occurs at 1:00 with 100 people. The queue length is zero during the rest of the day.

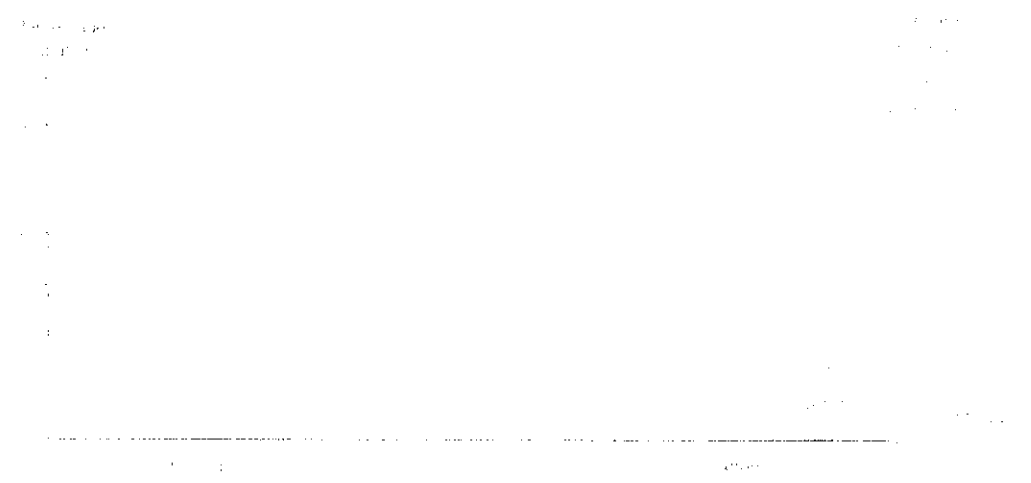


Figure 2: Average number of people in the queue (Y-axis) versus Time (X-axis) for Morning and Afternoon

The graph shows the average number of people in the queue during the morning and afternoon. The morning peak occurs at 10:00 with 100 people, and the afternoon peak occurs at 1:00 with 100 people. The queue length is zero during the rest of the day.

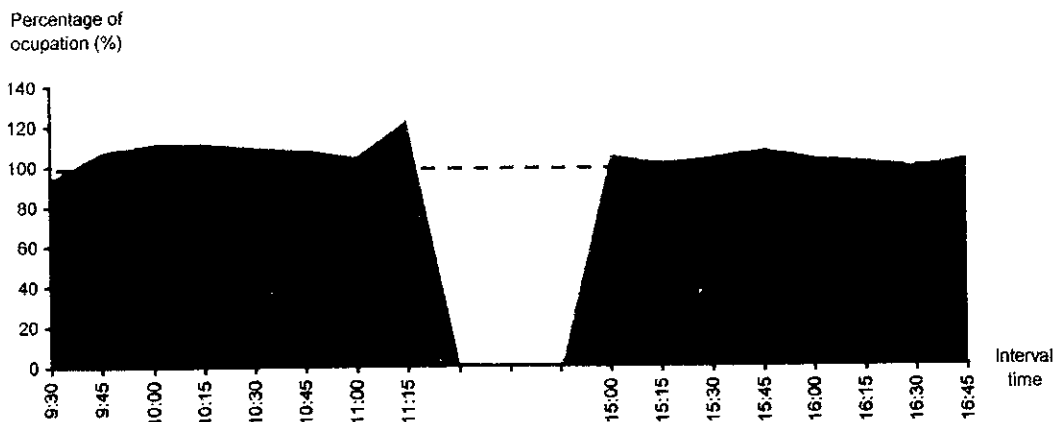


FIGURE 1.7-4 – Average Occupancy Rate - Area 02 – Downtown Area

Referring to the average occupancy time, there are similarities between morning and afternoon movement, presenting small variations from zero to one hour (FIGURE 1.7-5). This part also showed a higher percentage of parked vehicles on interval of 90min or more toward Part 01 –Ver-o-Peso Area.

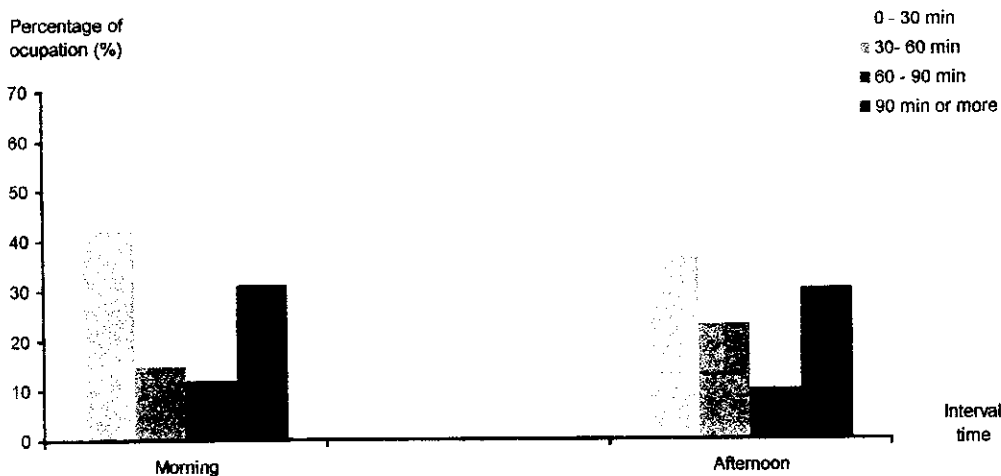
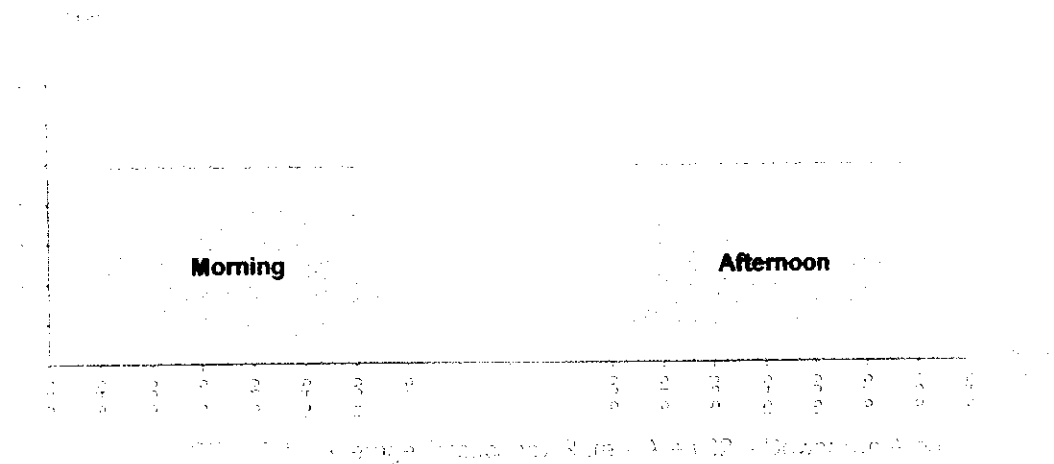


FIGURE 1.7-5 – Occupancy Percentage - Area 02 – Downtown Area

Part 03 – Praça da Republica Area

FIGURE 1.7-6 shows the average occupation rate of Praça da Republica Area. On morning period the rates are slightly superior to 100.0% in some schedule. On afternoon period these rates have little decrease though the occupancy is very close to the maximum capacity of this part.



Regarding the average occupancy rate, there are similarities between morning and afternoon movement, peaking and waning from zero to one hour (FIGURE 1 (b)). This plot also showed a high percentage of parked vehicles on a level of 0.80 or more toward the 21-Verde Plaza Area.

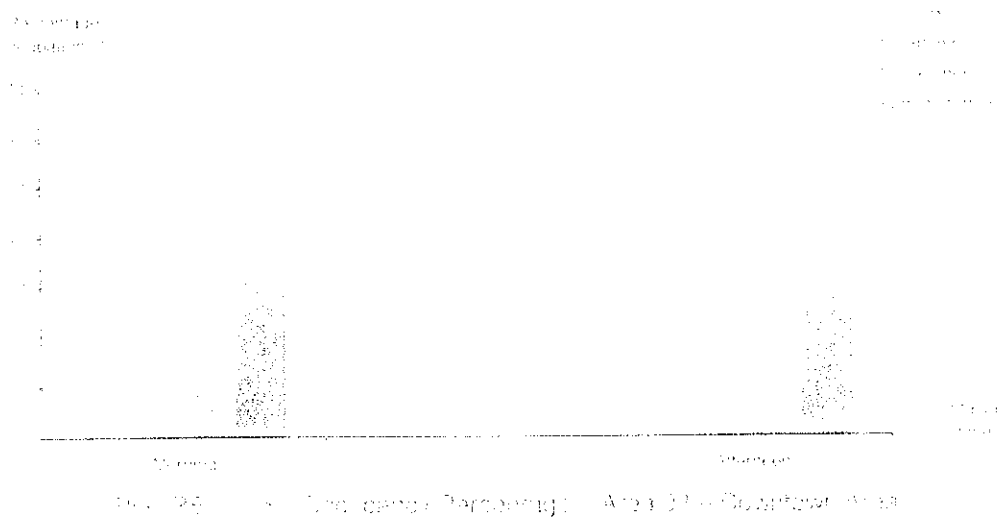


FIGURE 2. Area 21 - Quadrant Area

FIGURE 1 (a) shows the average occupancy rate of Plaza 14 República Area. On morning period, no taxis are sighted, superior to 100% in some sectors. On afternoon, about 70% of taxis, due to the decrease through the time, and is 40% close to the maximum capacity of 100%.

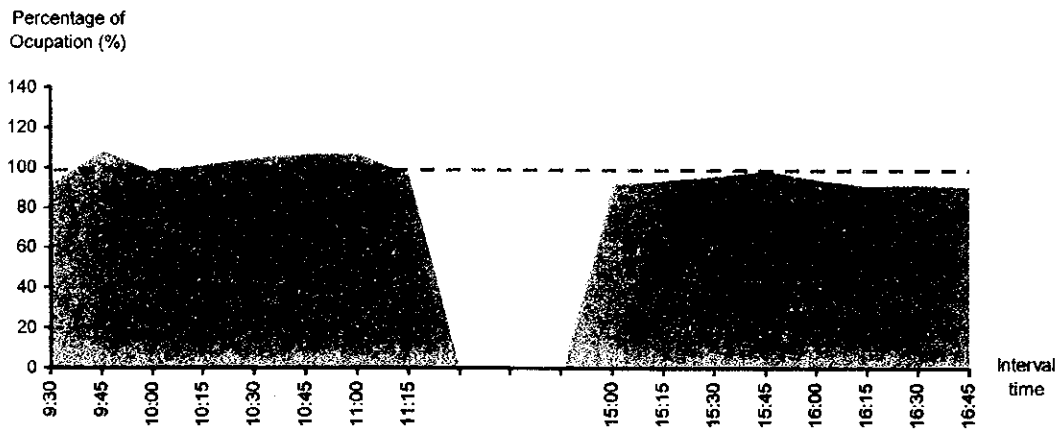


FIGURE 1.7-6 – Average Occupancy Rate - Area 03 – Praça da Republica Area

Referring to average permanence time (FIGURE 1.7-7) , the vehicles on morning period (around 50.0%) stay until 30min and around 30.0% stay 90min or more. In the afternoons there is a little reduction to 40.0% for vehicles that park up to 30min, and an increase on other permanence time.

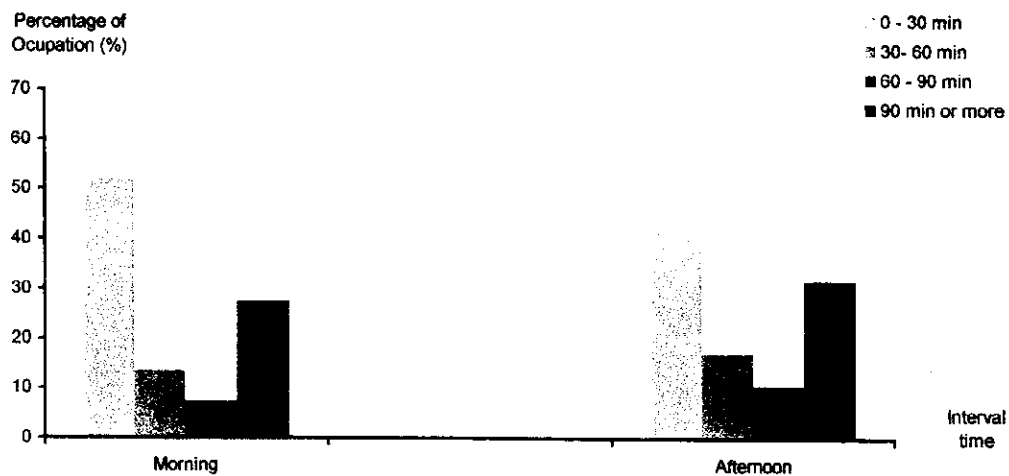


FIGURE 1.7-7 – Occupancy Percentage - Area 03- Praça da Republica Area

Part 04 –Braz de Aguiar Area

Part 04 (FIGURE 1.7-8), shows that the average occupation rates vary between 70.0% and 90.0% and is little higher on morning period where the highest rates is from 10:00 a.m. to 10:45 a.m. (90.0%) On afternoon period these rates decrease reaching the average level of 80.0%. The lower level reached for this part was of 71.0% at 11:15 a.m.

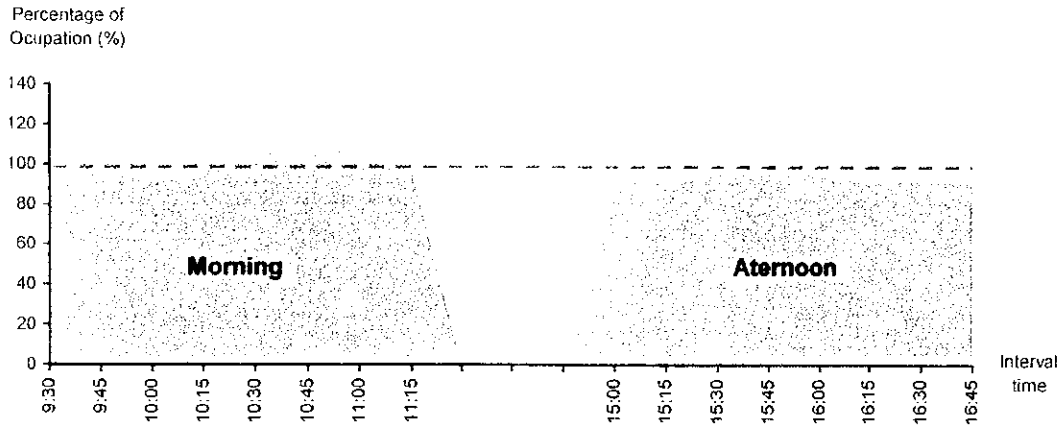


FIGURE 1.7-6 – Average Occupancy Rate - Area 03 – Praça da Republica Area

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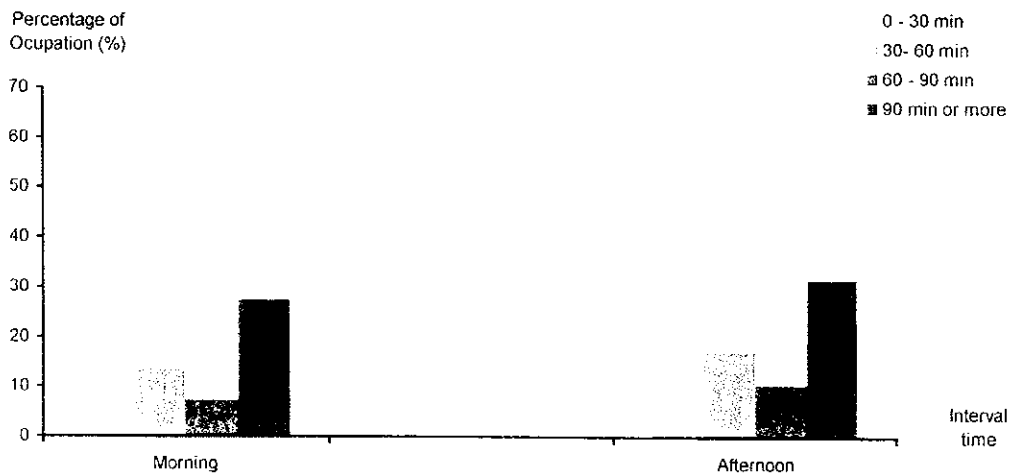


FIGURE 1.7-7 – Occupancy Percentage - Area 03– Praça da Republica Area

Part 04 –Braz de Aguiar Area

Part 04 (FIGURE 1.7-8), shows that the average occupation rates vary between 70.0% and 90.0% and is little higher on morning period where the highest rates is from 10:00 a.m. to 10:45 a.m. (90.0%) On afternoon period these rates decrease reaching the average level of 80.0%. The lower level reached for this part was of 71.0% at 11:15 a.m.

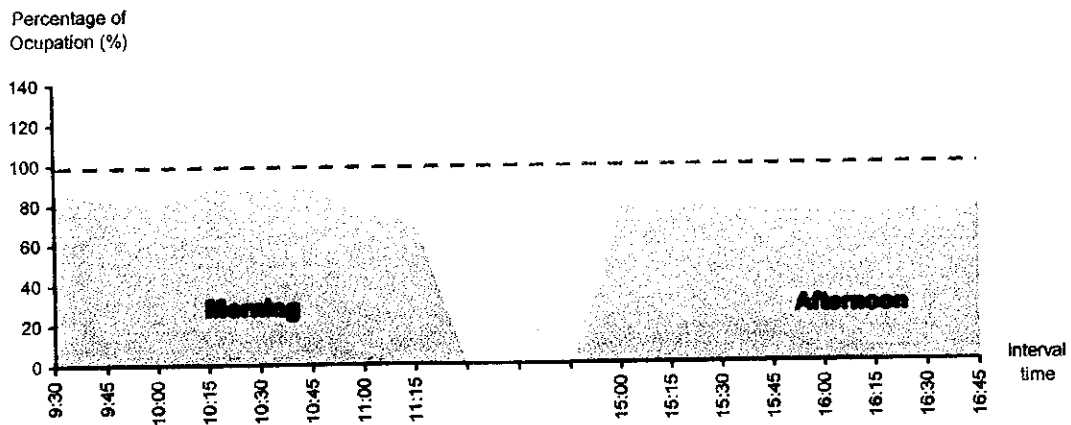


FIGURE 1.7-8 – Average Occupancy Rate - Area 04 – Braz de Aguiar Area

There is similarity between morning and afternoon period referring to average occupancy time (FIGURE 1.7-9) both periods indicate 55.0% of vehicles stay until 30 min. showing a high rotation.

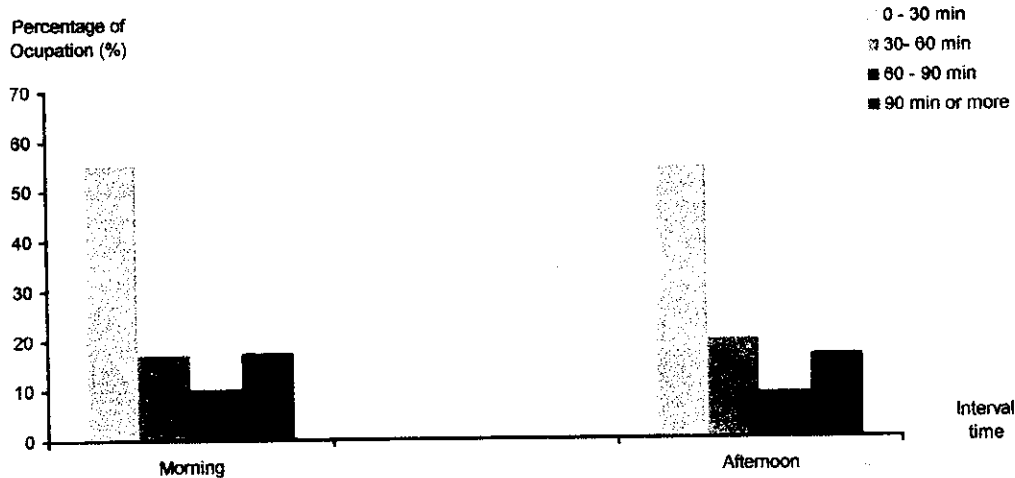


FIGURE 1.7-9 – Occupancy Percentage - Area 04 – Braz de Aguiar Area

Part 05 –Shopping Iguatemi Area

FIGURE 1.7-10 shows that the average occupation rate in this area is slightly higher on morning period with maximum level of 86.0% at 9:30 a.m. when Shopping Iguatemi is still closed. On afternoon period these rates are lower reaching the minimum level of 61.5% of occupancy from 3:30 p.m. to 3:45 p.m. This figure also shows parking capacity to absorb more cars that probably occurs due to free parking in Shopping Iguatemi.

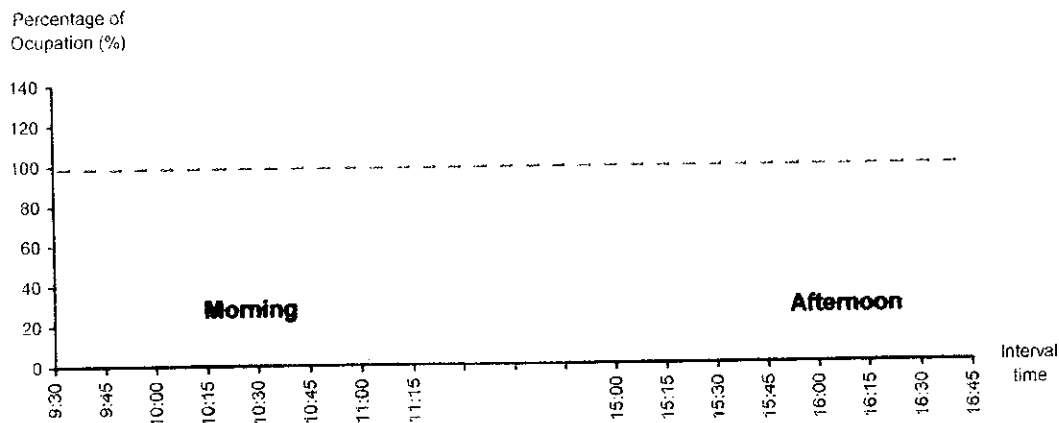


FIGURE 1.7-8 – Average Occupancy Rate - Area 04 – Braz de Aguiar Area

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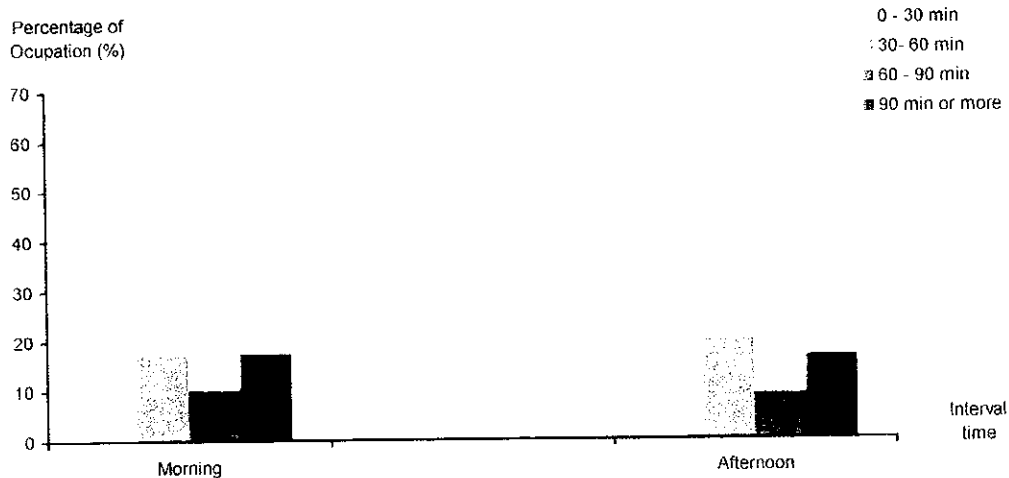


FIGURE 1.7-9 – Occupancy Percentage - Area 04 – Braz de Aguiar Area

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