6 TRANSPORT DEMAND CONTEXT

6.1 Transportation Demand Model

Based on the conventional four-step model, future traffic demand in Metro Manila was projected. Considering its traffic characteristics, the forecast model was constructed separately for car-owning and noncar-owning household, since the mobility of the former is higher than the latter. The model structure should also reflect the projected future growth of car ownership, the demand forecast procedure of which is shown in Figure 6.1. In the MMUTIS Study Area, the principal determinant of modal share is car ownership regardless of trip length and destination, hence the trip-end modal split model was adopted in Step 2. However, as railway network is developed and modal shift from private to public transport is expected in the future, demand conversion model was incorporated in Step 4. The Study Area was divided into 171 zones, 94 of which are in Metro Manila and 77 in the adjoining areas. There are 10 zones in the external areas, which include the NAIA and the North Pier.

Figure 6.1
Transport Demand Forecast Procedure

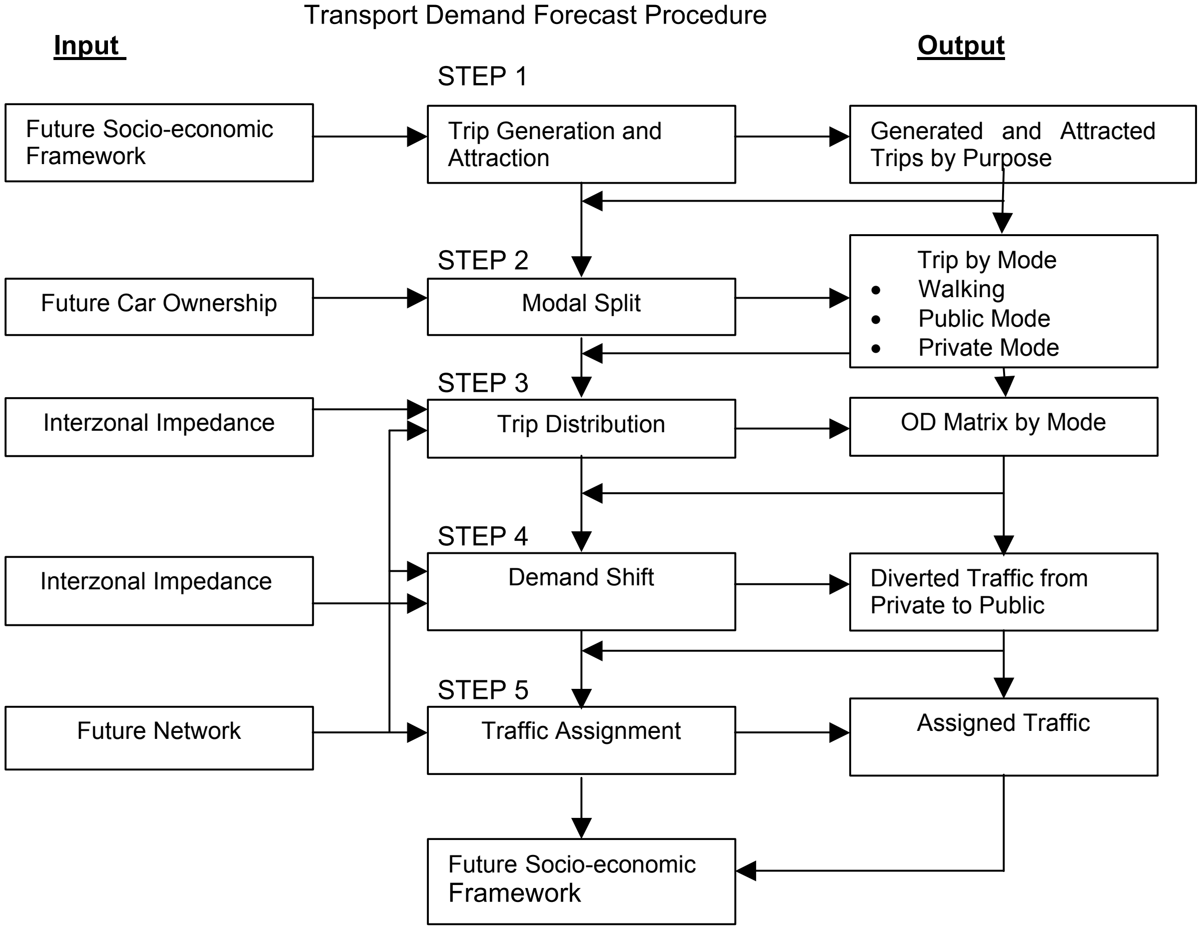
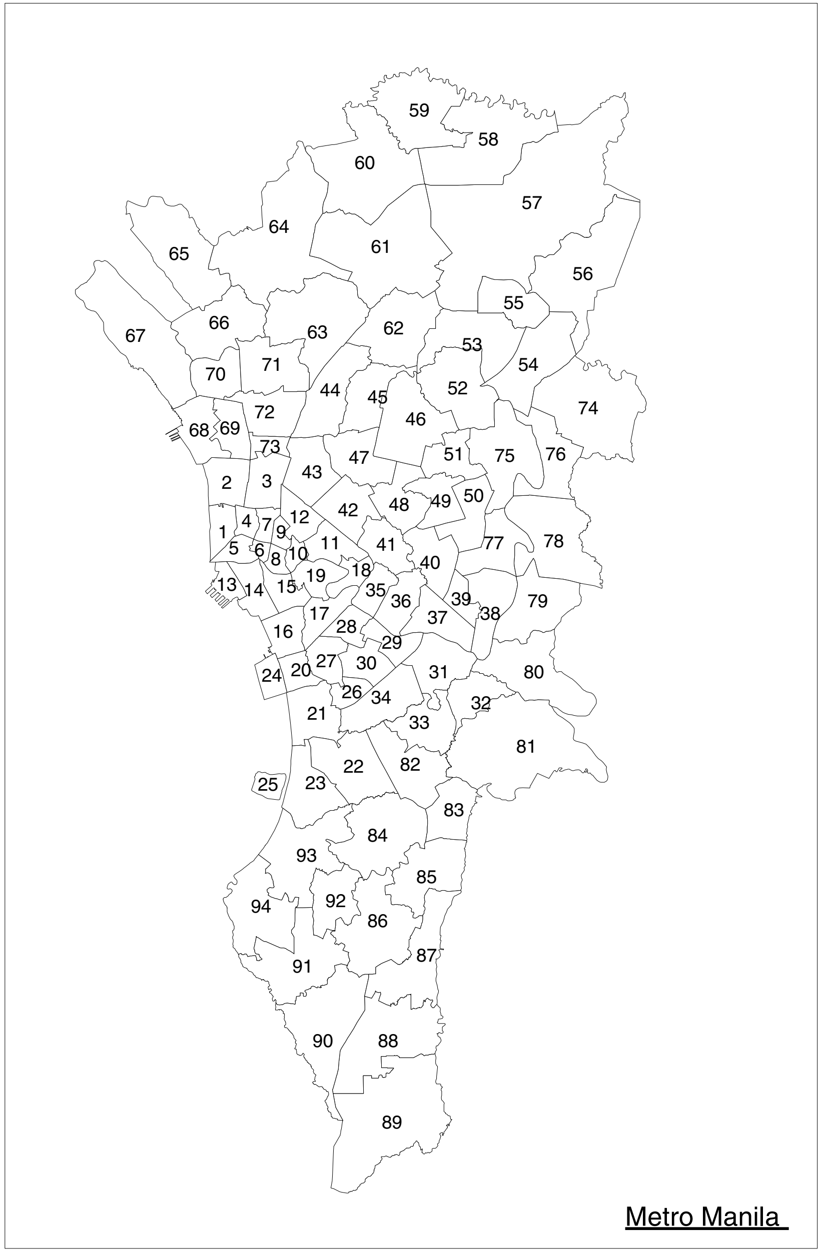
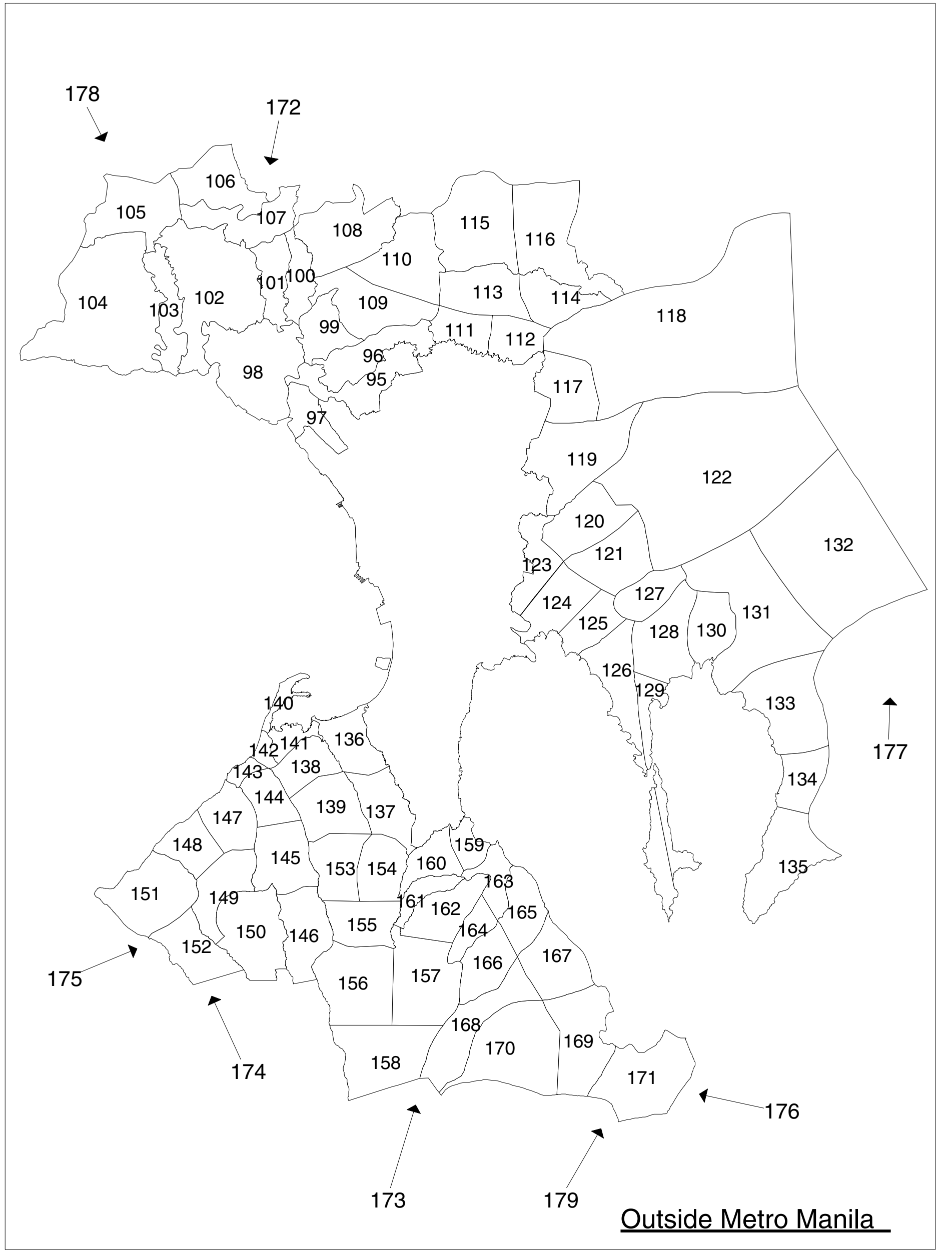


Figure 6.2
Zoning Map





Step 1: Trip Generation/Attraction Model

A linear regression model was developed by trip purpose, by car ownership and by trip generation/attraction, as follows:

Generation $G_i = \sum a_k x_{ki} + C$
Attraction $A_j = \sum b_k x_{kj} + D$

Where,
x_{ki} : Explanatory Variable of Zone i
x_{1i} : Population
x_{2i} : Workers at workplace
x_{3i} : Workers at residence
x_{4i} : Car-owning population
x_{5i} : Noncar-owning population
x_{6i} : Pupils/students at school
x_{7i} : Tertiary workers at residence
x_{8i} : Tertiary workers at workplace

a_k, b_k : Parameter
C, D : Constant

Car ownership was taken into account due to the difference in trip production rate and the future increase in car ownership. For "business" and "private" purposes, home-based and nonhome-based trips were segregated, and different models were constructed. In selecting explanatory variables, correlation matrices were prepared and investigated beforehand. Model parameters for trip generation/attraction are shown in Table 6.1

Table 6.1
Generation/Attraction Model

(Noncar Owner)

Trip Purpose	Linear Regression Model		F Value	Multiple Correlation Coefficient
To-home	$G_i = 0.5860 \times x_{1i} + 0.6310 \times x_{2i}$	– 5362.3	731.6	0.9471
	$A_j = 1.8520 \times x_{3j}$	– 1802.4	433.7	0.8483
To-work	$G_i = 0.6900 \times x_{3i}$	– 1630.3	540.9	0.8735
	$A_j = 0.8510 \times x_{2j}$	– 4665.5	2459.2	0.9673
To-school	$G_i = 0.3230 \times x_{5i}$	+ 1587.3	358.9	0.8261
	$A_j = 0.4870 \times x_{6j}$	+ 5413.9	933.0	0.9205
Business	$G_i = 0.1130 \times x_{3i}$	– 214.7	172.5	0.7128
(home-based)	$A_j = 0.0510 \times x_{1j} + 0.0100 \times x_{2j}$	– 799.3	94.0	0.7278
(nonhome-based)	$G_i = 0.1620 \times x_{2i}$	– 425.1	375.9	0.8329
	$A_j = 0.1760 \times x_{2j}$	– 897.5	403.5	0.8440.
Private	$G_i = 0.0170 \times x_{5i} + 0.4620 \times x_{3i}$	– 1663.0	133.5	0.7844
(home-based)	$A_j = 0.3130 \times x_{5j}$	– 4861.1	342.4	0.8190
(nonhome-based)	$G_i = 0.0700 \times x_{5i}$	– 1359.6	127.4	0.6589
	$A_j = 0.1330 \times x_{2j}$	– 1447.8	85.3	0.5850

(Car Owner)

Trip Purpose	Linear Regression Model		F Value	Multiple Correlation Coefficient
To-home	$G_i = 0.7870 \times x_{2I}$	– 3167.1	719.9	0.9004
	$G_i = 0.0170 \times x_{5I} + 0.4970 \times x_{3j}$	– 460.9	96.4	0.7351
To-work	$A_j = 0.3130 \times x_{5j} + 0.1250 \times x_{3j}$	– 131.9	133.1	0.7885
	$A_j = 0.5180 \times x_{8j}$	– 4369.4	712.9	0.9006
To-school	$G_i = 0.2750 \times x_{4i}$	+ 2875.9	82.4	0.5807
	$A_j = 0.2250 \times x_{6j}$	+ 396.7	439.5	0.8555
Business	$G_i = 0.0790 \times x_{3i}$	– 105.1	84.9	0.5962
(home-based)	$A_j = 0.0690 \times x_{2j}$	– 293.8	296.0	0.8066
(nonhome-based)	$G_i = 0.1210 \times x_{8i}$	– 762.4	760.8	0.9110
	$A_j = 0.0960 \times x_{2j}$	– 1046.5	456.6	0.8619
Private	$G_i = 0.2460 \times x_{4i}$	– 211.3	96.4	0.6097
(home-based)	$A_j = 0.2270 \times x_{2j}$	– 1109.3	542.9	0.8751
(nonhome-based)	$G_i = 0.1220 \times x_{2i}$	– 1576.7	415.4	0.8625
	$A_j = 0.1260 \times x_{2j}$	– 1692.0	336.1	0.8315

Step 2: Modal Split Model

Firstly, the number of pedestrian or walk trips was estimated by zone and purpose assuming that the share remains unchanged in the future. Then, the number of trips by private mode was estimated by zone and trip purpose based on the rate of car-owning households. The rest is the number of trips by public mode. The result is presented in Table 6.2.

Table 6.2
Modal Split Model

Trip Purpose	Mean Walk Trip Rate	Private Mode Split		
		Coefficient	Constant C	Multiple Correlation
To-home	(0.2211)	0.4604	6.157	0.738
To-work	(0.1574)	0.3953	11.872	0.596
To-school	(0.3063)	0.6545	-1.3894	0.755
Business	(0.0894)	0.5193	23.064	0.407
Private	(0.2115)	0.4874	11.012	0.587

Where,

Walk Trips: $G(W)_i = W_{Gi} G_i$
W_{Gi} : Walk Rate of zone i
G_i : Trip Generation of Zone i

Trips by Private Mode: $G(PR)_i = (aX_i = c) G_i *0.01$
X_I : Car-owning Household Rate (%)

Trips by Public Mode: $G(PU)_i = G_i - G_i (W) – G(PR)_i$

Step 3: Trip Distribution Model

The trip distribution model has two types, i,e., intrazonal and interzonal.

Intrazonal Trip Distribution Model: After formulating the trip generation/ attraction model, the intrazonal trip model can be based on the result of the person-trip surveys as shown in Table 6.3.

Table 6.3
Intrazonal Trip Model

Trip Purpose	Mode	Coefficient			Multiple Correlation Coefficient
		α	β	c	
To-home	Walk	0.4686	10.714	0.0039	0.941
	Public	0.1743	12123	0.0043	0.904
	Private	0.3817	0.9059	0.0141	0.901
To-work	Walk	0.5487	1.0314	0.0055	0.944
	Public	1.0164	0.2135	0.0174	0.830
	Private	0.4700	0.4429	0.6124	0.680
To-school	Walk	0.8662	0.5416	0.0188	0.929
	Public	1.2669	0.2783	0.0019	0.930
	Private	0.7113	0.4377	0.0857	0.905
Business	Walk	0.5611	0.6122	0.2104	0.951
	Public	1.0043	0.1388	0.0852	0.863
	Private	0.5146	0.5776	0.0751	0.781
Private	Walk	0.9239	0.3726	0.0623	0.953
	Public	0.8930	0.3481	0.0273	0.876
	Private	0.8389	0.4044	0.0288	0.876

Where, $Tii = c \times G_i^{\alpha} \times A_i^{\beta}$

Tii : Intrazonal Trips of Zone i
G_i : Trip Generation
Ai : Trip Attraction of Zone i
α,β : Parameter
c : Constant

Interzonal Trip Distribution Model: After preempting the intrazonal trips by a separate model, a Voorhees-type gravity model was developed (distribution of generated traffic in proportion to the share of attracted traffic discounted by interzonal impedance). This is presented in Table 6.4.

Table 6.4
Trip Distribution Model

Trip Purpose	Mode	β	Correlation Coefficient
To-home	Walk Public Private	0.1236 0.8232 0.4904	0.55 0.79 0.89
To-work	Walk Public Private	0.1253 0.9839 0.7309	0.63 0.93 0.92
To-school	Walk Public Private	0.0924 0.8948 0.6017	0.65 0.81 0.88
Business	Walk Public Private	0.6017 0.7722 0.3828	0.84 0.84 0.79
Private	Walk Public Private	0.2110 1.0322 0.5575	0.55 0.92 0.89

Where, $T_{ij}= G_i * (A_j/D^{\beta}_{ij})/(A_{\kappa}/D^{\beta}_{ik})$

T_{ij} : Trips from zone i to zone *j*
G_i : Trip generation of zone *i*
A_j : Trip attraction of zone *j*
D_{ij}: Interzonal impedance between zone *i* and zone *j*
β : Parameter

The models above do not show satisfactory correlation due to a variety of geographical, social and economic interrelations that cannot be well explained by statistical formula. This model introduces an adjustment factor K_{ij} defined as follows:

$$K_{ij} = T_{ij}/\hat{T}_{ij}$$

Where, T_{ij} : Actual number of trips between zones *i* and *j* (1996)
$\hat{T}_{ij}$: Theoretically calculated number of trips between zones *i* and *j* (1996)

If this adjustment factor is directly applied to the calculated values for the future, it will omit the socio-economic changes that will take place. Thus, it was readjusted so that the adjustment rate becomes one half of that for 2015. It is expressed as follows:

$$2015\ K_{ij} = \{1996\ K_{ij} - 1\} \times 0.5 + 1.0$$

Step 4: Demand Shift Model

Some users of private cars or utility vehicles will transfer to public mode when reliable and comfortable railway service becomes available. To estimate this demand shift, a conversion model was developed based on the result of a MMUTIS survey on the "willingness-to-pay" attitude of people.

Table 6.5
Parameters of Conversion Model from Private to Public Mode

Parameter	Coefficient
α	0.0408
β	0.0392
γ	2.35

Note: $P = \dfrac{1}{1 + \mathrm{Exp}(\alpha\Delta t + \beta\Delta C + \gamma)}$

Where, Δt : Travel time differences in minutes (public mode-private mode)
ΔC: Travel cost differences in pesos (public mode-private mode)
α,β,γ : Parameters

Step 5: Traffic Assignment Model

Two types of models were adopted for traffic assignment, as follows:

- Highway-type assignment for private and public modes
- Transit assignment for public mode and highway-type assignment for private mode

Highway-type Assignment for Private and Public Modes

This model applies conventional incremental assignment algorithm to both public and private modes. The algorithm is simple, and many examinations are possible. During the MMUTIS period, almost all the discussions about traffic assignment were based on this model. Following are its remarkable descriptions:

1) Railway links were closed when private trips were assigned, while expressway links were not used for assigning public trips (excluding existing expressway).
2) Tolls for expressways were assumed to be ₱ 4/km except for R10/C3.
3) It was assumed that R10-C3 was toll-free, considering the traffic flow of trucks in the Port Area. For more details, refer to the section on economic evaluation.
4) Public transport fares were assumed the same for all public modes.

Transit Assignment for Public Mode and Highway-type Assignment for Private Mode

This model consists of two parts: transit assignment for public trips and highway-type assignment for private trips. To discuss the public transportation system in detail, transit assignment should be introduced before completing the formulation of the road and railway network. Developed by the JICA, it is a model that assigns trips to a fixed route like railway, bus and other public transportation. Since the fare system affects the result of this model, the fares were first determined to maximize fare revenue of each line (Table 6.6). The result is then transferred into preload data for the highway-type assignment.

Figure 6.3
Transit Assignment and Highway-type Assignment

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Table 6.6
Setting of Speed and Fare for Each Mode

Mode	Speed (km/h)	Passenger Capacity	Fare (P)
Aircon Bus	20	60	$L \leq 4$: 10 $L > 4$: $10 + 0.48 \times (L - 4)$
Ordinary Bus	20	70	$L \leq 4$: 10 $L > 4$: $10 + 0.48 \times (L - 4)$
Minibus	20	30	$L \leq 4$: 10 $L > 4$: $10 + 0.48 \times (L - 4)$
Jeepney	9	18	$L \leq 4$: 10 $L > 4$: $10 + 0.48 \times (L - 4)$
PNR	15	50	$2.5 + 0.5 \times L$
Railway	30 35 40 50	1500	Each line has its own fare system.

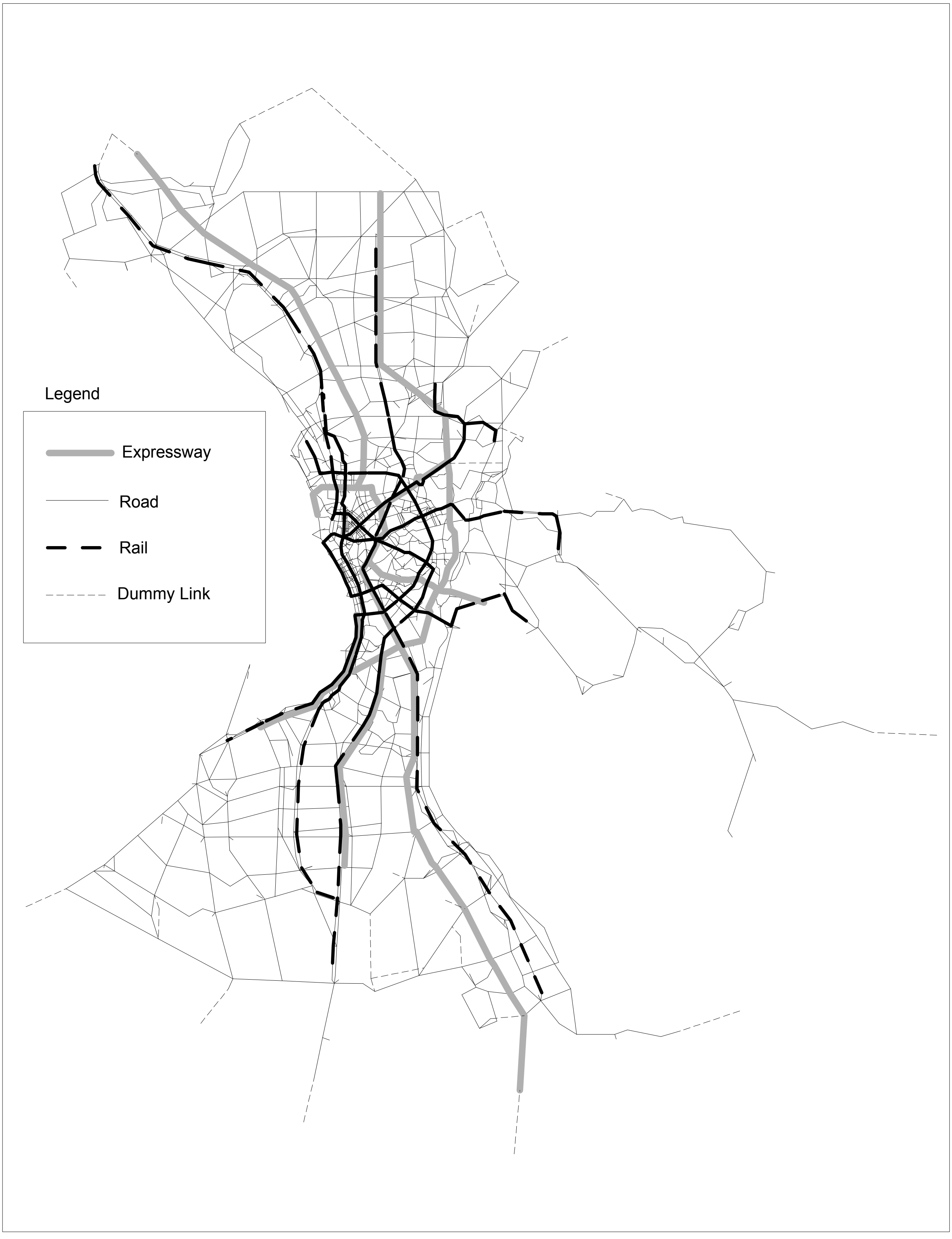
Time Value

Time values adopted in these models are the following:

Table 6.7
Time Value (₱/hour)

	1996	2005	2015
Private Mode	74.4	101.2	123.5
Public Mode	60.0	81.6	99.6
Growth Rate (1996: = 1.00)	1.00	1.36	1.66

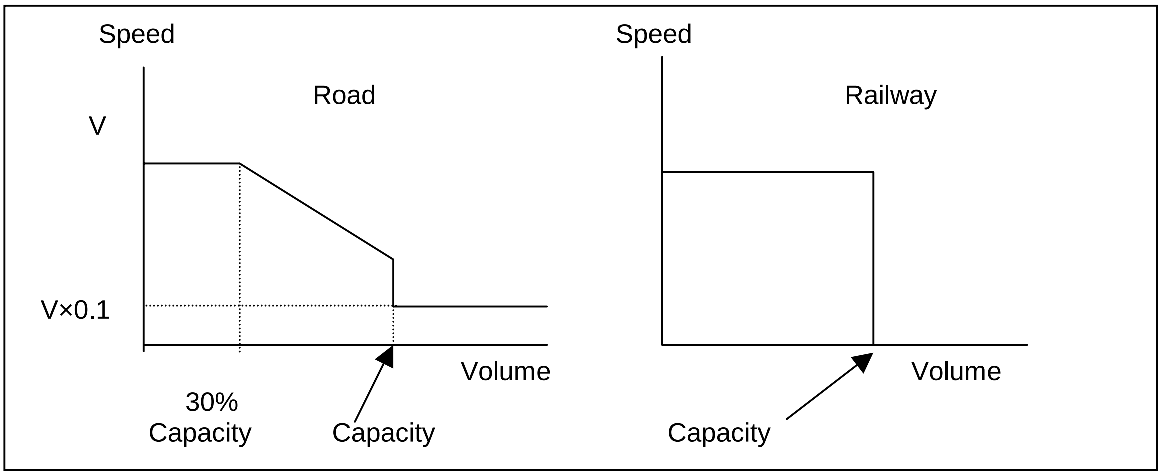
Figure 6.4
MMUTIS Network for Traffic Assignment



Link Attributes

Two types of QV formula are adopted in these models as shown in Figure 6.5. Every road shares the same type and each type has two factors: initial speed and capacity. Initial speed is determined by road classification and number of lanes. Capacity specifications include the number of lanes, width of carriageway, lateral clearance, existence of sidewalk, peak hour ratio, and location.

Figure 6.5
Speed-Flow Relationship Used in the MMUTIS

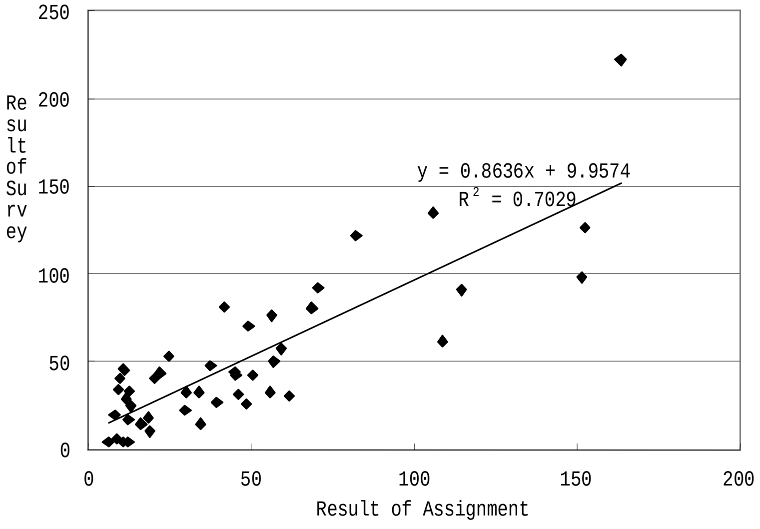


Source: MMUTIS Study Team

Calibration of the Model

To calibrate the model, traffic flow in 1996 was estimated by adopting an assignment model to 1996's OD (origin-destination) table and comparing it with the data from the screenline/cordonline survey. The result is a multiple correlation coefficient of 0.70.

Figure 6.6
Correlation between Survey and Model



Source: MMUTIS Study Team

6.2 Future Demand

This section describes the estimated traffic demand based on Scenario II (as this scenario is considered to be the most realistic and where traffic load is the second largest next to Scenario I). The characteristics of the future demand are as follows:

1) Growth of Trips by Purpose

According to the 1996 MMUTIS person-trip survey, the total number of trips in the Study Area was estimated at 30.2 million including walk trips. In 2015, this will grow to 54.5 million (1.80 times), while population growth is estimated at 1.58 times more than the present.

Table 6.8
Growth of Trips by Purpose

Purpose	1996 ('000)		2015 ('000)		2015/1996	
	Incl. Walk	Excl. Walk	Incl. Walk	Excl. Walk	Incl. Walk	Excl. Walk
To-home	13,898	10,824	24,216	19,157	1.72	1.77
To-work	4,873	4,100	8,946	7,557	1.84	1.84
To-school	4,977	3,449	8,865	6,348	1.78	1.84
Business	2,011	1,828	3,987	3,717	1.98	2.03
Private	4,432	3,483	8,451	6,910	1.91	1.98
TOTAL	30,191	23,684	54,465	43,689	1.80	1.84

Source: MMUTIS Study Team

2) Growth of Trips by Mode

The share of pedestrian trips will slightly decrease from 22% to 20%. Excluding pedestrian trips, the share of public transportation will decrease from 78% in 1996 to 66% in 2015.

If average occupancy per PCU is calculated by mode at an average measured by PCU-km per vehicle type, the result is 1.9 for private mode (car, UV, and truck) and 14.9 for public mode (16.0 excluding tricycle). Based on these figures, the 12% increase in the share of private mode will push up the total traffic volume by about 35%.

Table 6.9
Trip Composition by Mode

	1996				2015			
	Walk	Public Mode	Private Mode	Total	Walk	Public Mode	Private Mode	Total
Trips ('000)	6,507	18,452	5,233	30,191	10,776	28,930	14,759	54,465
Composition w/ Walking (%)	21.6	61.1	17.3	100.0	19.8	53.1	27.1	100.0
Composition w/o Walking (%)	-	77.9	22.1	100.0	-	66.2	33.8	100.0

Source: MMUTIS Study Team

3) Growth of Trips by Zone

Changes in trip generation from 1996 to 2015 are shown in Figure 6.7. It shows that trip generation will increase in most of the zones, higher outside Metro Manila and lower inside due to the outward expansion of population and employment, among other factors.

4) OD Table

OD tables were prepared by trip purpose (to-home, to-work, to-school, business, private) and by mode of transport (walk, public, private). Original tables with a 390-zone system were integrated with 181- and 37-zone systems (trips related outside the Study Area were added up in Zone no. 33).

5) Trip Length

At present, the average trip length in the Study Area is 11 km, excluding pedestrian and intrazonal trips based on the 171-zone system. Average trip length for public and private modes is 10.2 km and 13.2 km, respectively, reflecting the difference in mobility. In 2015, when the urban area has expanded, the average trip length will reach 15.4 km, 1.40 times longer than the present (Figure 6.8).

6) Trip Distribution

Figure 6.9 shows the changes in trip distribution from 1980 to 1996 and 2015. In 1980, trips were concentrated in the central part of Metro Manila inside EDSA. In 1996, it has extended to the suburbs in the north, south and east. In the latter two particularly, trips are crossing Metro Manila boundary. This pattern will be further remarkable in 2015. The northern part of Cavite and Laguna will become busy urban areas, coupled with the development in the north. As a result, the north-south (N-S) urban axis will be imminent.

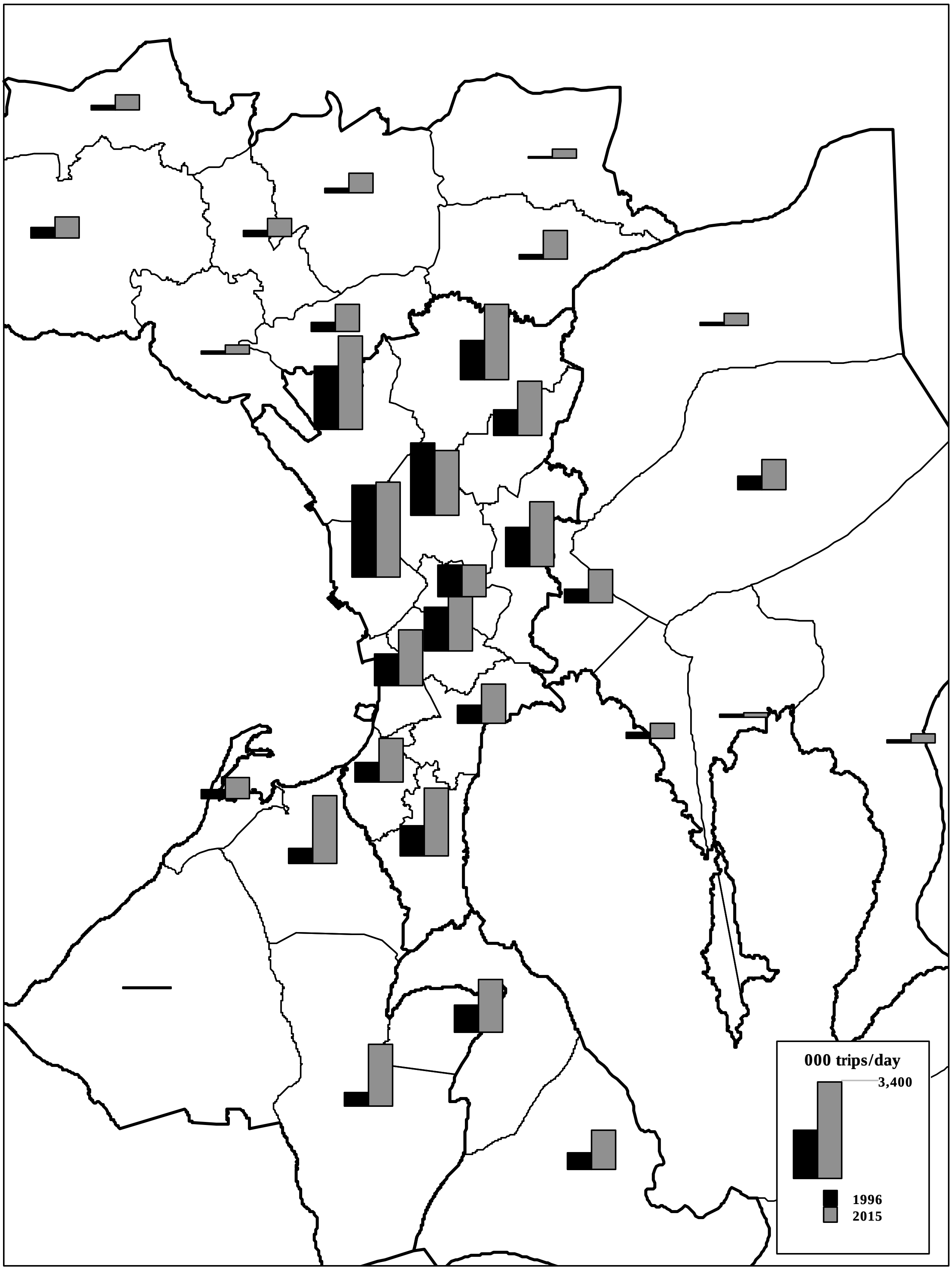
7) Traffic Volume

There are three major factors that will contribute to the increase in traffic load on roads in the future, to wit:

- Population 1.58 times
- Relative increase in private mode 1.35 times
- Increase in average trip length 1.40 times

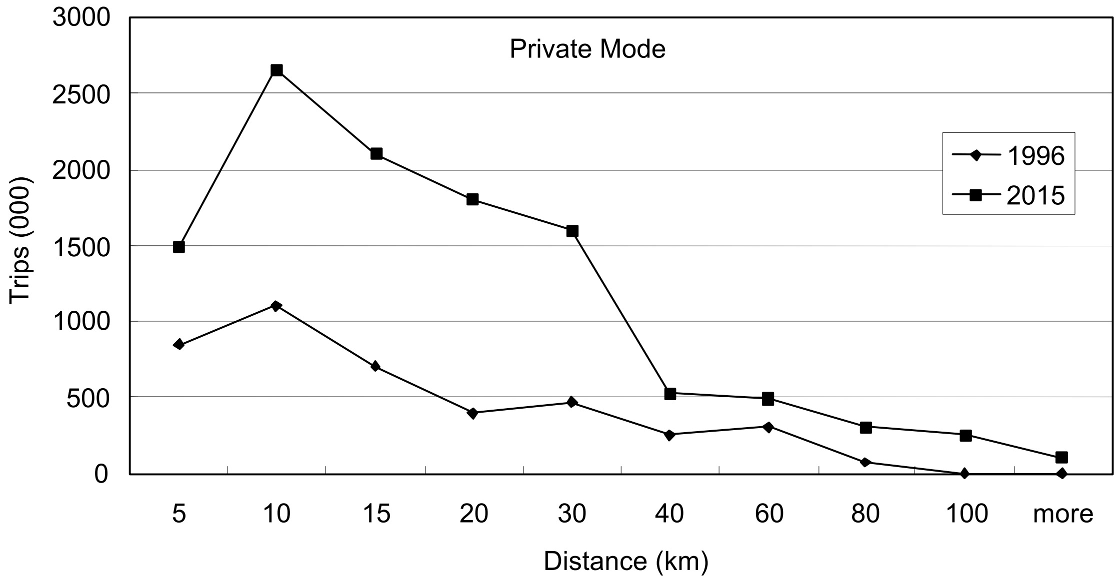
The combined effect of these three factors is about 3.0 times more than the present traffic volume. It is impossible, however, to enhance the current arterial road network to accommodate the predicted increase. To avoid the chronic paralysis of the road network, it is imperative to reform the urban structure and construct efficient mass transit systems.

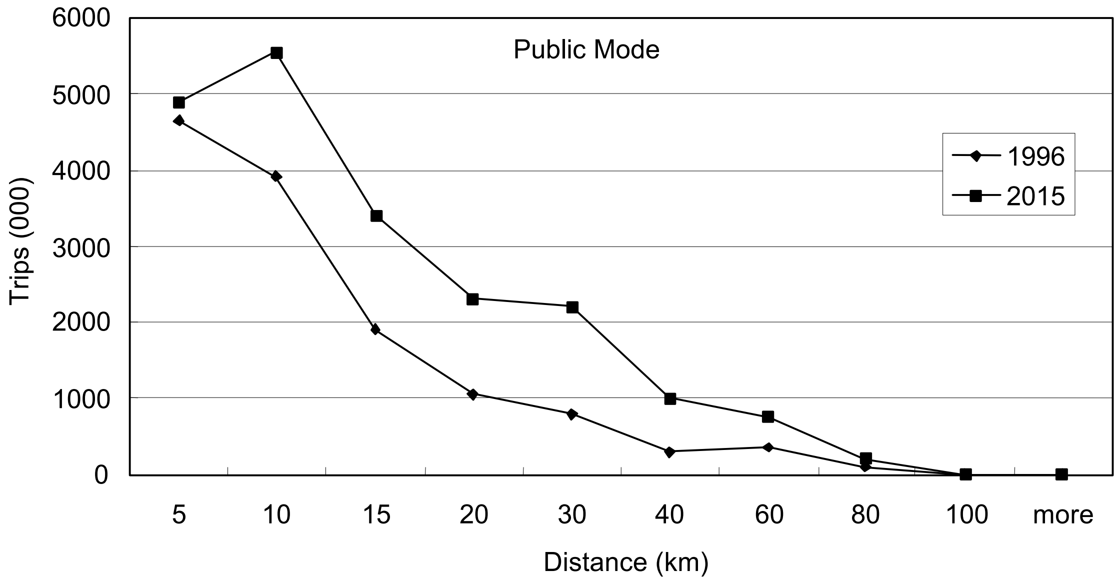
Figure 6.7
Increase in Trip Generation, 1996-2015 (Scenario 2)



Source: MMUTIS Study Team

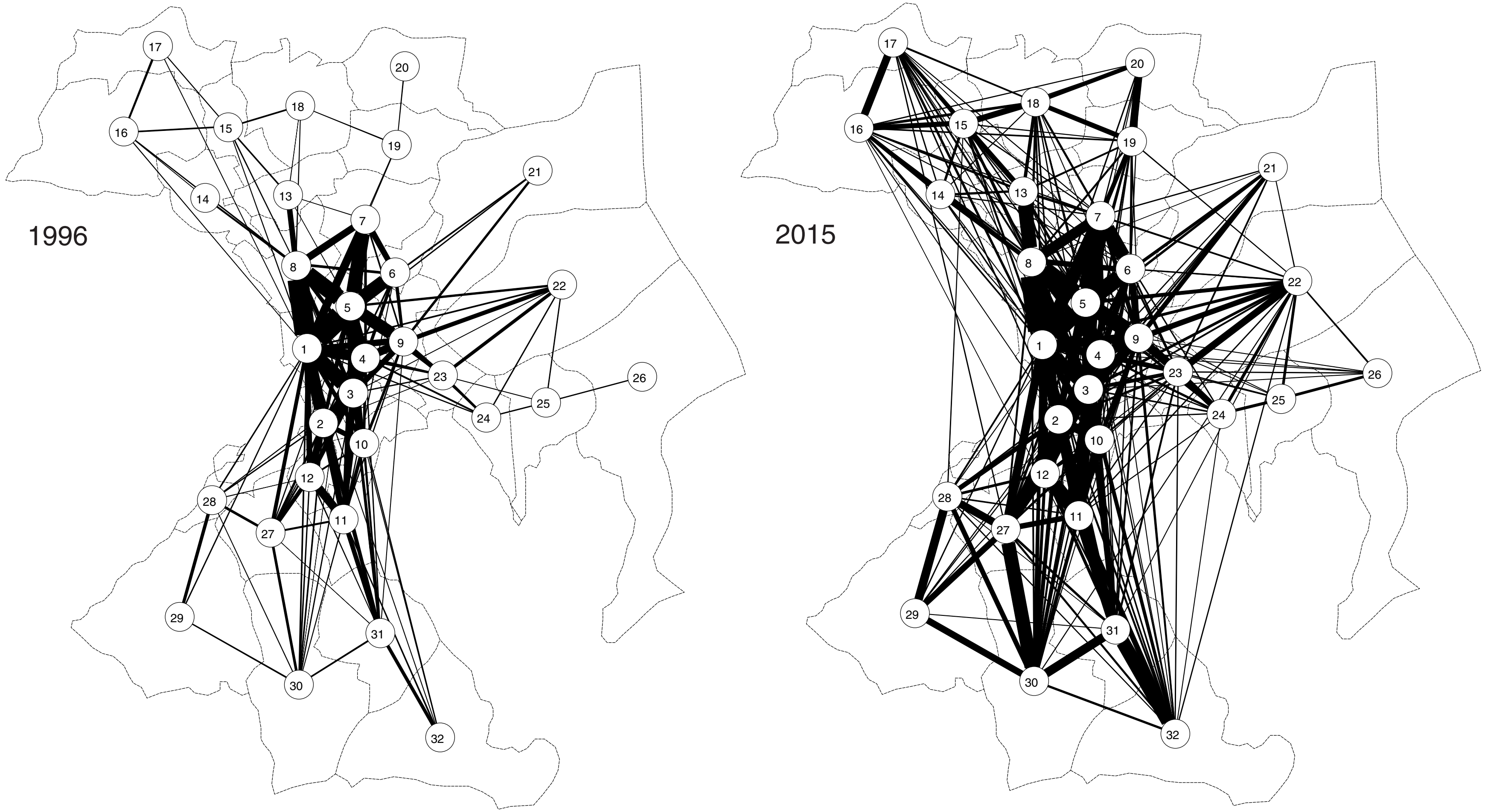
Figure 6.8
Number of Trips by Trip Length





Source: MMUTIS Study Team

Figure 6.9
Increase in Trip Generation, 1996-2015 (Scenario 2)



6.3 Assessment of Demand-Supply Balance

6.3.1 Methodology

Purpose of Analysis

The following are the two purposes of this analysis:

- To clarify the planning direction and priority by identifying the areas or corridors where demand-supply gaps are very huge.
- To provide the basis with which the performance of the proposed networks is compared and evaluated.

Definition of Corridors and Areas for Analysis

Figure 6.10 and Table 6.10 identify the corridors for analysis, together with mini-screenlines while Figure 6.11 pinpoints the areas (zones) for traffic analysis.

Table 6.10
Definition of Corridors and Mini-Screenlines

Corridor	Mini-Screenline	Existing Major Roads
Cavite Coastal	IS1	Coastal Road Quirino Avenue
	OS1	Bacoor bypass
	OS2	Aguinaldo Highway
Laguna	IS2	South Superhighway
	OS3	South Superhighway
Rizal	IE 1	J.P. Rizal Shaw Boulevard Ortigas Avenue
	IE 2	Aurora Boulevard
	OE	Marcos Highway Ortigas Avenue
Northeast	INE	Commonwealth Avenue
	ONE	E. Rodriguez Highway
North Plateau	IN 1	Quirino Highway Mindanao Avenue.
	ON 1	Quirino Highway
North Coastal	IN 2	North Luzon Expressway
	IN 3	McArthur Highway
	ON 2	North Luzon Expressway McArthur Highway
EDSA	Kamuning-Kamias (KK)	EDSA
	Guadalupe (GLP)	EDSA
	SSH	EDSA

Figure 6.10
Location of Corridors and Screenlines for Traffic Assignment

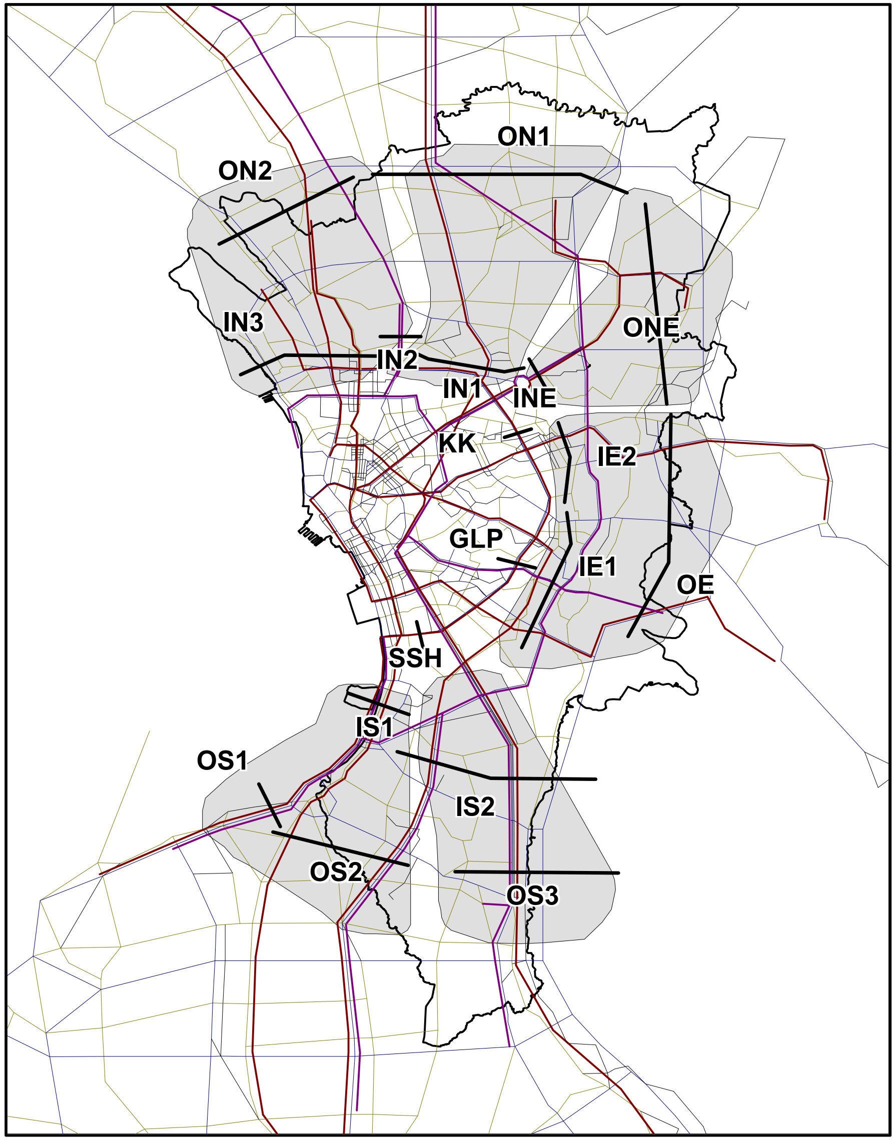
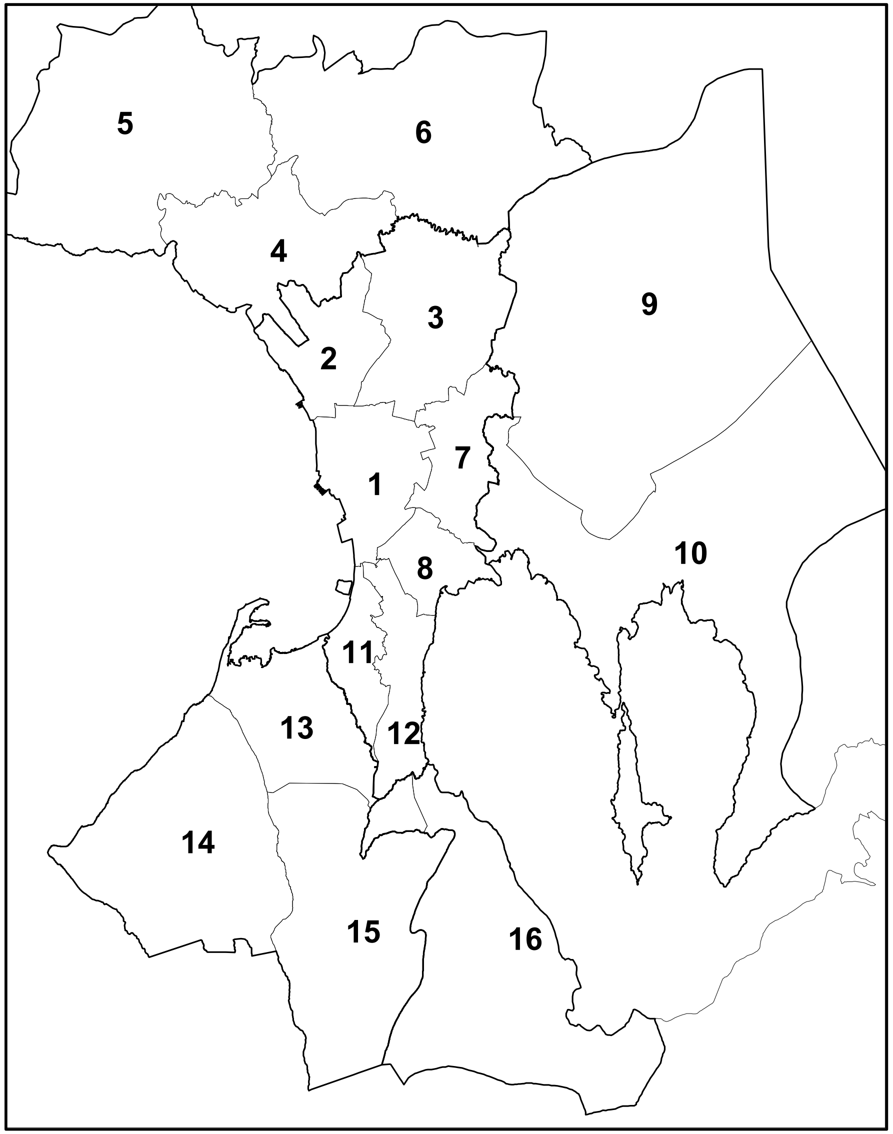


Figure 6.11
Area Classification of the Study Area for Traffic Assessment



6.3.2 Assessment of "Do-nothing" Situation

Although the do-nothing situation (i.e., no additional transport infrastructure will be provided until the year 2015) is hypothetical, it is useful to know what the situation would be if nothing is done. Figure 6.12 shows the results of the traffic assignment on the following two cases:

- 1996 OD matrix on 1996 road network
- 2015 OD matrix (Scenario 2) on 1996 road network

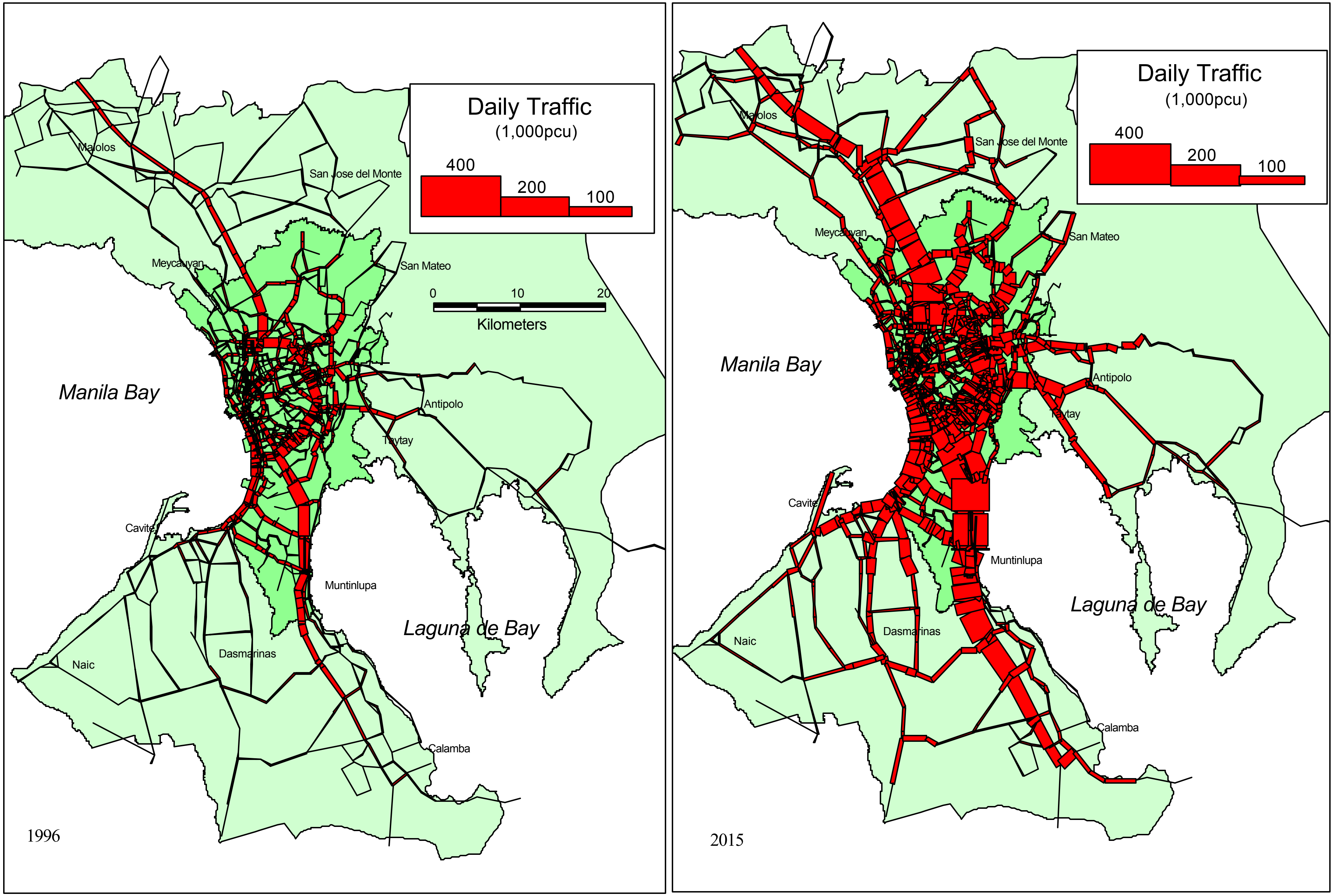
Area Analysis

The first case (simulation of the existing situation) shows an average volume/capacity ratio (VCR) at 0.7. Road sections with a VCR below 1.0 are located in some areas, particularly within EDSA and peripheral areas. The second case (the 2015 OD on 1996 roads) shows an average VCR at 2.3, showing an extremely congested situation.

Table 6.11
Volume/Capacity Ratio of Roads by Area
Do-nothing Situation, 2015

Zone No.	Area	Capacity		Assigned		VCR	
		PCU × km (Million)	Ratio to 1996	PCU × km (Million)	Ratio to 1996		(1996)
1	W/in EDSA	10.4	1.0	17.8	2.1	1.7	0.8
2	MMNorth1	3.2	1.0	7.4	2.7	2.3	0.8
3	MMNorth2	5.5	1.0	12.5	2.6	2.3	0.9
4	OutNorth3	1.5	1.0	6.3	4.3	4.2	1.0
5	OutNorth4	3.3	1.0	6.2	3.8	1.8	0.5
6	OutNorth5	1.2	1.0	4.3	5.9	3.5	0.6
7	MMEast1	3.7	1.0	7.4	2.4	2.0	0.8
8	MMEast2	2.1	1.0	4.6	2.6	2.1	0.8
9	OutEast3	1.0	1.0	3.3	3.7	3.4	0.9
10	OutEast4	2.4	1.0	5.9	3.6	2.5	0.7
11	MMSouth1	2.7	1.0	6.0	2.8	2.2	0.8
12	MMSouth2	4.7	1.0	12.8	3.2	2.7	0.9
13	OutSouth3	1.3	1.0	6.6	4.5	5.1	1.1
14	OutSouth4	1.5	1.0	2.5	3.9	1.7	0.4
15	OutSouth5	1.9	1.0	6.1	4.2	3.2	0.8
16	OutSouth6	5.2	1.0	6.7	4.5	1.3	0.3
	TOTAL	51.6	1.0	116.2	3.0	2.3	0.7

Figure 6.12
Assigned Traffic Volume in a Do-nothing Scenario



Corridor Analysis

Table 6.12, showing passenger demand by radial corridor, indicates the approach to formulate a road and railway network. Since the demand for public transportation will amount to over a million person trips, except in the North Plateau corridor, providing mass transit system in each corridor is necessary. The data also reveal that traffic load on each radial corridor is so congested that it might be inevitable to provide circulate corridors outside EDSA. These new corridors would disperse traffic demand and change the structure of traffic flow.

Table 6.12
Passenger Demand by Radial Corridor, 2015 (million persons/day)

Corridor	EDSA ←→ Outer EDSA			Metro Manila ←→ Outer Area		
	Public	Private	Total	Public	Private	Total
Cavite Coastal	1.7	0.8	2.5	1.3	0.7	2.0
Laguna	1.2	1.1	2.3	1.1	1.1	2.2
Rizal	2.3	1.4	3.7	1.2	0.8	2.0
Northeast	1.1	0.2	1.3	0.2	0.6	0.8
North Plateau	0.8	0.4	1.2	1.0	0.4	1.4
North Coastal	2.3	1.1	3.5	1.4	0.8	2.2

Figure 6.13 shows the estimated traffic volume on the screenlines for 1996 and 2015. The increase is remarkable on those set at Metro Manila boundary. On those just outside EDSA, the increase is moderate at about two to three times higher, though the volume is large. In the south and north (IS2, IN2), the growth is enormous, at about three. On and within EDSA, the growth is less than two times.

Tables 6.13 and 6.14 show the results of assignment on each corridor in 1996, while Tables 6.15 and 6.16 show those in a do-nothing situation in 2015. In such a situation, the most serious congestion is expected on radial corridors outside EDSA, with a VCR of more than three. Even after the completion of the railway project on EDSA, Aurora Boulevard, Commonwealth and Quirino avenues and the elevated toll road, or Skyway, on the South Luzon Expressway, the current levels of service cannot be maintained due to the tremendous growth in traffic demand. Traffic congestion will still worsen if no drastic countermeasures are taken, such as providing mass rapid transit and expressway, and other TDM measures.

Figure 6.13
Traffic Increase on Mini-Screenlines in 1996-2015

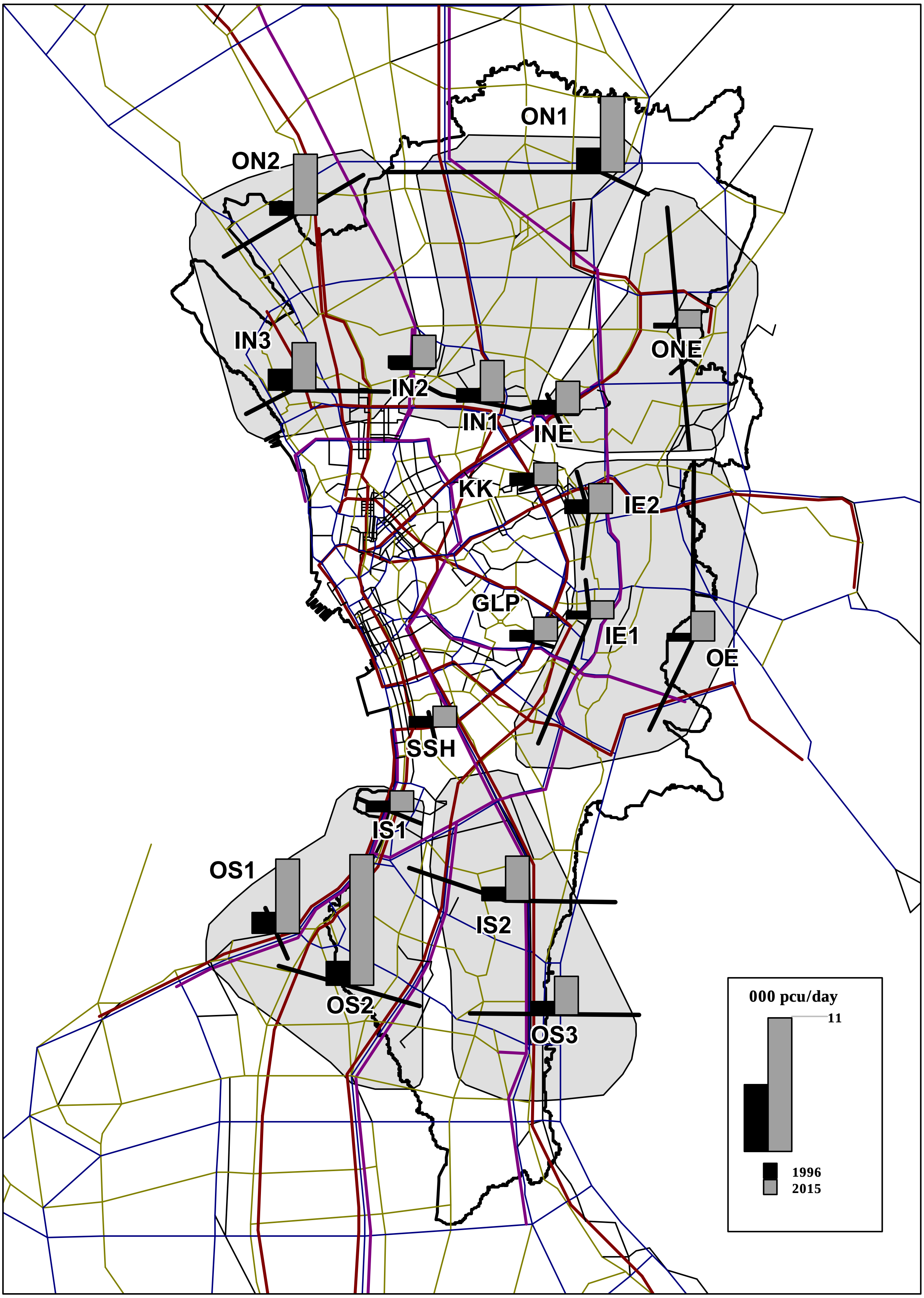


Table 6.13
Transport Capacity and Required Capacity Across Mini-Screenlines by Corridor, 1996

Corridor/ Mini-Screenline		Transport Capacity				Required Capacity				VCR of Roads
		Rail[1)] (No. of lanes)	Road (000 PCUs/day)			Rail[1)] (No. of lanes)	Road (000PCUs/day)			
			Highway	Express-way	Total		Highway	Express-way	Total	
Cavite Coastal	IS1	-	270	-	270	-	214	-	214	0.8
	OS1	-	25	-	25	-	42	-	42	1.6
	OS2	-	27	-	27	-	52	-	52	1.9
Laguna	IS2	-	179	-	179	-	205	-	205	1.1
	OS3	-	191	-	191	-	206	-	206	1.1
Rizal	IE1	-	272	-	272	-	191	-	191	0.7
	IE2	-	152	-	152	-	166	-	166	1.1
	OE	-	201	-	201	-	124	-	124	0.6
North-east	INE	-	77	-	77	-	89	-	89	1.2
	ONE	-	95	-	95	-	41	-	41	0.4
North Plateau	IN1	-	82	-	82	-	95	-	95	1.1
	ON1	-	47	-	47	-	95	-	95	2.0
North Coastal	IN2	-	0	148	148	-	0	152	152	1.0
	IN3	-	79	-	79	-	126	-	126	1.6
	ON2	-	98	-	98	-	113	-	113	1.2
EDSA	KK	-	156	-	156	-	158	-	158	1.0
	GLP	-	185	-	185	-	165	-	165	0.9
	SSH	-	156	-	156	-	134	-	134	0.9

Table 6.14
Assessment of Demand Magnitude by Corridor/Mini-Screenline, 1996

Corridor/ Mini-Screenline		Demand				Required Capacity				VCR on Roads
		Rail	Road (000 pax/day)			Rail[1)] (No. of lanes)	Road (000PCUs/day)			
			Public	Private	Total		Public	Private	Total	
Cavite Coastal	IS1	-	780	313	1094	-	48	165	214	0.8
	OS1	-	324	41	366	-	20	22	42	1.6
	OS2	-	191	77	268	-	11	40	52	1.9
Laguna	IS2	-	552	324	877	-	34	170	205	1.1
	OS3	-	566	325	892	-	35	171	206	1.1
Rizal	IE1	-	726	277	1004	-	45	146	191	0.7
	IE2	-	566	248	815	-	35	130	166	1.1
	OE	-	555	170	726	-	34	89	124	0.6
North East	INE	-	584	101	685	-	36	53	89	1.2
	ONE	-	89	68	157	-	5	35	41	0.4
North Plateau	IN1	-	414	131	545	-	25	69	95	1.1
	ON1	-	582	111	693	-	36	58	95	2.0
North Coastal	IN2	-	708	205	914	-	44	107	152	1.0
	IN3	-	655	162	817	-	40	85	126	1.6
	ON2	-	507	156	663	-	31	82	113	1.2
EDSA	KK	-	948	189	1137	-	59	99	158	1.0
	GLP	-	847	214	1061	-	52	112	165	0.9
	SSH	-	517	193	710	-	32	101	134	0.9

1/ Railway capacity was assumed to be 850,000 passengers a day in both directions at any cross-section.

Table 6.15
Transport Capacity and Required Capacity Across Mini-Screenlines by Corridor
Do-nothing Situation, 2015

Corridor/ Mini-Screenline		Transport Capacity				Required Capacity				VCR on Roads
		Rail[1)] (No. of lanes)	Road (000 PCU/day)			Rail[1)] (No. of lanes)	Road (000PCU/day)			
			Highway	Express-way	Total		Highway	Express-way	Total	
Cavite Coastal	IS1	-	270	-	270	-	549	-	549	2.0
	OS1	-	25	-	25	-	158	-	158	6.1
	OS2	-	27	-	27	-	289	-	289	10.6
Laguna	IS2	-	179	-	179	-	654	-	654	3.6
	OS3	-	191	-	191	-	630	-	630	3.3
Rizal	IE1	-	272	-	272	-	438	-	438	1.6
	IE2	-	152	-	152	-	396	-	396	2.6
	OE	-	201	-	201	-	473	-	473	2.4
North East	INE	-	77	-	77	-	231	-	231	3.0
	ONE	-	95	-	95	-	145	-	145	1.5
North Plateau	IN1	-	82	-	82	-	286	-	286	3.5
	ON1	-	47	-	47	-	297	-	297	6.3
North Coastal	IN2	-	0	148	148	-	0	421	421	2.9
	IN3	-	79	-	79	-	310	-	310	3.9
	ON2	-	98	-	98	-	511	-	511	5.2
EDSA	KK	-	156	-	156	-	347	-	347	2.2
	GLP	-	185	-	185	-	424	-	424	2.3
	SSH	-	156	-	156	-	301	-	301	1.9

Table 6.16
Assessment of Demand Magnitude by Corridor/Mini-Screenline, Do-nothing Situation, 2015

Corridor/ Mini-Screenline		Demand				Required Capacity				VCR on Roads
		Rail	Road (000 pax/day)			Rail[1)] (No. of lanes)	Road (000PCUs/day)			
			Public	Private	Total		Public	Private	Total	
Cavite Coastal	IS1	-	1676	845	2522	-	104	444	549	2.0
	OS1	-	808	204	1013	-	50	107	158	6.1
	OS2	-	532	486	1018	-	33	255	289	10.6
Laguna	IS2	35	1128	1109	2238	-	70	584	654	3.6
	OS3	22	1126	1064	2191	-	70	560	630	3.3
Rizal	IE1	-	1408	665	2074	-	88	350	438	1.6
	IE2	-	891	648	1539	-	55	341	396	2.6
	OE	-	1204	756	1961	-	75	398	473	2.4
North-east	INE	-	1058	313	1371	-	66	165	231	3.0
	ONE	-	241	246	488	-	15	129	145	1.5
North Plateau	IN1	-	765	453	1219	-	47	238	286	3.5
	ON1	-	970	449	1420	-	60	236	297	6.3
North Coastal	IN2	-	1424	632	2056	-	89	332	421	2.9
	IN3	-	901	483	1384	-	56	254	310	3.9
	ON2	-	1401	805	2206	-	87	423	511	5.2
EDSA	KK	-	1751	452	2204	-	109	238	347	2.2
	GLP	-	1679	607	2287	-	104	319	424	2.3
	SSH	-	1036	448	1485	-	64	236	301	1.9

1/ Railway capacity was assumed to be 850,000 passengers a day in both directions at any cross-section.

6.3.3 Assessment of "Do-committed" Situation

This case will assess the traffic situation in 2015 when committed projects shown in Table 6.17 would have been completed. This situation is considered as the *without-case* for evaluating MMUTIS projects.

Table 6.17
Committed Projects in the Study Area

Sector	Name	Section
Expressway	Skyway I	Buendia-Bicutan
Arterial Road	C5 Missing Link (1)	P.Tuazon-B. Serrano
	C5 Missing Link (2)	South Luzon Expressway-Roxas Blvd.
Railway	MRT 2	Recto-Santolan
	MRT 3	Taft/EDSA-Caloocan
	North Rail	Meycauayan-Caloocan

The result is shown in Tables 6.18-6.20. Under the do-committed case, no significant improvement can be expected, while under the do-nothing case the average VCR has slightly gone down from 2.3 to 2.2.

Table 6.18
Volume/Capacity Ratio of Roads by Area, Do-committed Case, 2015

Zone No.	Area	Capacity		Assigned		VCR
		PCU × km (Million)	Ratio to 1996	PCU × km (Million)	Ratio to 1996	
1	W/in EDSA	10.6	1.0	17.1	2.0	1.6
2	MMNorth1	3.2	1.0	7.1	2.6	2.2
3	MMNorth2	5.5	1.0	12.2	2.6	2.2
4	OutNorth3	1.5	1.0	6.3	4.3	4.2
5	OutNorth4	3.3	1.0	6.2	3.8	1.8
6	OutNorth5	1.2	1.0	4.3	5.9	3.5
7	MMEast1	3.8	1.0	7.2	2.3	1.9
8	MMEast2	2.5	1.2	4.5	2.5	1.8
9	OutEast3	1.0	1.0	3.3	3.7	3.4
10	OutEast4	2.4	1.0	5.8	3.5	2.5
11	MMSouth1	3.0	1.1	5.9	2.7	1.9
12	MMSouth2	5.5	1.2	13.0	3.2	2.4
13	OutSouth3	1.3	1.0	6.6	4.6	5.2
14	OutSouth4	1.5	1.0	2.5	3.9	1.7
15	OutSouth5	1.9	1.0	6.1	4.2	3.2
16	OutSouth6	5.2	1.0	6.7	4.5	1.3
	Total	53.6	1.0	114.9	3.0	2.1

Table 6.19
Transport Capacity and Required Capacity Across Mini-Screenlines by Corridor
Do-committed Situation, 2015

Corridor/ Mini-Screenline		Transport Capacity				Required Capacity				VCR of Roads
		Rail[1)] (No. of lanes)	Road (000 PCUs/day)			Rail[1)] (No. of lanes)	Road (000PCUs/day)			
			Highway	Express way	Total		Highway	Express way	Total	
Cavite Coastal	IS1	-	270	-	270	-	460	-	460	1.7
	OS1	-	25	-	25	-	158	-	158	6.1
	OS2	-	27	-	27	-	288	-	288	10.6
Laguna	IS2	-	179	-	179	-	651	-	651	3.6
	OS3	-	191	-	191	-	614	-	614	3.2
Rizal	IE1	-	272	-	272	-	419	-	419	1.5
	IE2	1.0	152	-	152	0.4	366	-	366	2.4
	OE	-	201	-	201	-	473	-	473	2.4
North-east	INE	-	77	-	77	-	210	-	210	2.7
	ONE	-	95	-	95	-	144	-	144	1.5
North Plateau	IN1	-	82	-	82	-	289	-	289	3.5
	ON1	-	47	-	47	-	296	-	296	6.3
North Coastal	IN2	-	0	148	148	-	0	396	396	2.7
	IN3	1.0	79	-	79	0.4	307	-	307	3.9
	ON2	-	98	-	98	-	496	-	496	5.0
EDSA	KK	2.0	156	-	156	1.0	283	-	283	1.8
	GLP	2.0	185	-	185	1.2	377	-	377	2.0
	SSH	2.0	156	-	156	0.6	242	-	242	1.6

Table 6.20
Assessment of Demand Magnitude by Corridor/Mini-Screenline, Do-committed Situation, 2015

Corridor/ Mini-Screenline		Demand				Required Capacity				VCR of Roads
		Rail	Road (000 pax/day)			Rail[1)] (No. of lanes)	Road (000PCUs/day)			
			Public	Private	Total		Public	Private	Total	
Cavite Coastal	IS1	-	1505	695	2201	-	94	366	460	1.7
	OS1	-	809	204	1014	-	50	107	158	6.1
	OS2	-	530	484	1014	-	33	254	288	10.6
Laguna	IS2	-	1166	1100	2267	-	72	578	651	3.6
	OS3	-	1138	1031	2170	-	71	543	614	3.2
Rizal	IE1	-	1384	633	2018	-	86	333	419	1.5
	IE2	369	575	628	1203	0.4	35	330	366	2.4
	OE	-	1204	756	1961	-	75	398	473	2.4
North-east	INE	-	1071	273	1345	-	66	143	210	2.7
	ONE	-	241	246	488	-	15	129	144	1.5
North Plateau	IN1	-	769	458	1227	-	48	241	289	3.5
	ON1	-	966	447	1414	-	60	235	296	6.3
North Coastal	IN2	-	1338	594	1933	-	83	313	396	2.7
	IN3	337	675	503	1179	0.4	42	265	307	3.9
	ON2	-	1133	808	1942	-	70	425	496	5.0
EDSA	KK	881	1194	397	1591	1.0	74	209	283	1.8
	GLP	1033	845	617	1463	1.2	52	324	377	2.0
	SSH	489	571	393	964	0.6	35	206	242	1.6

1/ Railway capacity was assumed to be 850,000 passengers a day in both directions at any cross-section.

7 FORMULATION OF A MASTER PLAN

7.1 Approach

A drastic approach is necessary to solve the many problems facing Metro Manila's transport sector and to manage the process of change. To develop a practical transport strategy for Metro Manila, the following issues must be considered:

1) Transport networks require a hierarchy of facilities if they are to operate efficiently. The MRT/LRT, rail systems and busways should generally form the core network, with road-based transit acting as feeder. It is also necessary to identify the primary roads, which usually comprise expressways or divided at-grade roads with relatively high capacities.

2) Transport can be a major catalyst in spearheading urban development. Key requirements are developmental roads at urban peripheries. When constructed ahead of actual massive developments, they are both easier to construct and much cheaper, too.

3) Metro Manila still maintains a high level of public transport modal share compared to other Asian cities that have lost their attractiveness in the 1980s. Before Manilans drop their riding habits, the public transport system should be improved and competitive services provided.

4) Fully segregated MRT systems must be the core system. When they are extended to the suburbs, their revenues do not tend to cover the capital costs. MRT systems thus cannot be a catalyst for new development areas if financial constraints are severe and unless there are integrated urban developments and effective feeder services.

5) It is very important that access to the central business district (CBD) is maintained and enhanced. It plays a most crucial part in Philippine economy and is central to future national prosperity. The CBD requires both a good MRT and road access system.

6) It is very important that access to the NAIA and Port Area be made available. Currently, it is not and improvement is necessary.

Substrategy

There are basically two substrategies in drawing up a Master Plan:

Transport Strategy: This is to develop consensus on an implementable, fundable, 'good' Plan that includes:

1)	Mega Projects	:	Control the chaotic proliferation of mega projects
2)	Public Transport	:	Improve the efficiency and responsiveness of public transport
3)	Traffic Management/ Safety	:	Maximize the network's passenger capacity, improve passenger and pedestrian safety and safeguard the local environment

4)	PNR	:	Develop a sustainable strategy for rail operations
5)	Developmental Roads	:	Construct new roads ahead of urbanization in the peripheries of existing urban areas
6)	Secondary Roads	:	Improve network capacity by improving the existing network's connectivity and capacity
7)	Air Pollution	:	Reduce the harmful effects of traffic-related air pollution
8)	Airport /Port Access	:	Develop consensus for an airport/port strategy for the Greater Capital Region and provide effective access

Development/Management Strategy: This will develop an effective institutional framework and includes:

1)	Development Strategy	:	Define the necessary context for sectoral planning, planning by LGUs and enforcement
2)	Institutional Change	:	Improve the effectiveness of metropolitan institutions
3)	Strengthening of the MMDA	:	Strengthen the MMDA to realize its full powers and to enable it to carry out metropolitan multimodal planning
4)	Private Sector Participation	:	Improve the effectiveness of the BOT/PFI process

Transport Priority

Transport priorities are clear. They are:

1) Implementation of low-cost management measures: traffic management and engineering, small terminals, bus and jeepney priorities
2) Construction of secondary roads: missing links and major improvement of existing roads
3) Removal of bottlenecks on the existing network through grade separation, local widening, etc.
4) Construction of new roads and major improvement on existing roads in the existing and emerging urban areas
5) Construction of PFI MRT systems and busways
6) Construction of PFI expressways

The Focus

The focus needs to be on:

1) Improving public transport, on which most depend and will continue to depend
2) Integrating public transport modes
3) Integrating transport modes
4) Integrating transport and land development
5) Guiding Metro Manila's development in the north and south
6) Providing accessibility to Metro Manila's major national assets – the NAIA and Port Area

7.2 Constraints and Opportunities

Constraints

There are four major constraints that influence transport strategy:

1) Institutional effectiveness: The most important factor, this concerns the government's ability to set strategy, determine priorities, allocate resources accordingly, and ensure implementation and integration of projects with the rest of the transport system.

2) Acquisition of land, environmental permissions, etc., to construct infrastructure in the city: The ability to acquire the above-mentioned items shows a facet of institutional effectiveness.

3) Committed projects: There are many projects with varying levels of commitment. Whether these projects are indeed 'committed' for funding or not has a major impact on transport strategy.

4) Funding: Public funding for the transport sector is limited and unstable. The estimated amount needed is about US$ 4 to 10 billion over 20 years, or US$ 200-500 million a year. Private funding (through BOT and similar schemes) is considered a supplement. There are however other potential sources such as increased vehicle registration tax, fuel tax, and other forms of user charges.

Opportunities

On the other hand, there are four major opportunities:

1) Public/Private venture partnership
2) Integration of transport development with city planning
3) Gradual shift of existing land use to a more public transport-based city structure using rail mass transit as the core
4) Future introduction/expansion of TDM measures to manage demand and increase funding sources

7.3 Funding and Affordability

7.3.1 Current Transportation Spending

Public Sector: Infrastructure spending has been increasing over time, not only in absolute terms, but also as a percentage of the gross national product (GNP) and total national government spending. It has also been increasing as a percentage of capital spending. However, this has not been a steady trend. While capital spending has fluctuated to around 3% of the GNP throughout the period, there has been a marked shift in emphasis toward spending on infrastructure since 1993. Since that year the annual rate increased from around 40% to 60-70% of capital spending and almost double as a percentage of the GNP and government spending.

Private Sector: Only since 1995 has private sector funding played a major role in transportation infrastructure development in the Study Area. There are four major projects which are using private funds under the BOT scheme to finance their construction and operation. These are the Skyway project, connecting the South Luzon Expressway (SLE or South Superhighway) to downtown Manila, the MRT Line 3 along EDSA, the Cavite Expressway, and the Southern Tagalog Expressway. Because of these projects, private investment in transportation in the Study Area will increase from ₱ 771 million in 1995 to almost ₱ 12 billion in 1998. The total amount of spending on land transportation in the country and the Study Area is summarized in the following tables:

Table 7.1
Total Spending on Land Transportation Infrastructure and Vehicles
in the Philippines (1996, Million Pesos)

Year	NG		GOCC		LGU		Public		Private		Total	
	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.
1989	5,500	1,110	1	131	1,999	n/a	7,500	1,241	3,870	2,969	11,370	4,210
1990	8,500	1,210	15	152	2,029	n/a	10,544	1,362	4,496	3,688	15,040	5,051
1991	8,000	1,367	30	190	1,660	n/a	9,690	1,557	7,551	4,906	17,241	6,463
1992	13,537	1,593	265	224	0	n/a	13,802	1,817	8,504	6,526	22,306	8,343
1993	10,523	1,719	227	191	0	n/a	10,750	1,910	8,472	7,913	19,222	9,823
1994	14,351	1,827	274	182	0	n/a	14,625	2,009	10,255	9,430	24,880	11,439
1995	13,683	3,312	647	194	190	n/a	14,520	3,506	7,669	11,067	22,189	14,573
1996	21,985	3,552	703	235	0	n/a	22,688	3,787	11,699	12,538	34,387	16,325
1997	25,227	3,576	11,748	278	1,106	n/a	38,081	3,854	19,179	14,474	57,260	18,328
1998	28,539	3,696	10,694	290	1,672	n/a	40,905	3,986	21,260	16,188	62,165	20,174

Source: Annual BESF, MMUTIS estimation

Table 7.2
Spending on Land Transportation Infrastructure and Vehicles
in the Study Area (1996, Million Peso)

Year	NG		GOCC		LGU		Public		Private		Total	
	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.	Invest.	Maint.
1989	407	n/a	1	115	380	n/a	788	n/a	1,575	1,053	2,362	n/a
1990	572	n/a	15	135	391	n/a	978	n/a	1,590	1,299	2,569	n/a
1991	597	n/a	30	170	325	n/a	952	n/a	4,106	1,880	5,058	n/a
1992	2,671	105	265	208	0	n/a	2,936	313	1,969	2,386	4,905	2,699
1993	1,967	170	116	175	0	n/a	2,083	345	4,758	3,095	6,840	3,440
1994	2,196	207	184	158	0	n/a	2,380	365	4,027	3,696	6,407	4,061
1995	1,765	339	445	172	40	n/a	2,249	511	3,319	4,320	5,568	4,831
1996	2,322	327	512	198	0	n/a	2,834	525	7,390	4,910	10,224	5,435
1997	5,228	296	11,497	227	239	n/a	16,964	523	14,193	5,693	31,157	6,216
1998	4,968	294	10,484	240	367	n/a	15,818	534	15,674	6,391	31,492	6,925

Source: Annual BESF, MMUTIS estimation

7.3.2 Future Trends in Transportation Spending

During the last few years the proportion of annual infrastructure spending devoted to land transportation projects has varied between 30% and 60% and between 30% and 50% during the Ramos administration. The proportion has been steadily declining over time, from 50% for the 1987-1992 period to 43.3% for 1993-1998 and only 42.5% for the period since 1994. Relative to the GNP, spending increased as a greater proportion of the budget has gone to infrastructure in recent years.

It has been assumed that the level of land transportation spending relative to infrastructure spending is inversely related to economic growth, i.e., it will be lower in high-growth periods as more funds are made available to other infrastructure projects. Future rates have been adopted, as follows: 45% in the low-growth scenario, 42.5% in the medium growth and 40% in the high growth. These assumptions are summarized in Table 7.3.

Table 7.3
Assumptions Underlying the National Land Transport Budget

Scenario	Low Growth	Medium Growth	High Growth
Annual GNP % Growth Rate	4.0	5.5 1/	7.0 2/
Annual Budget as % of the GNP	19.0	21.0	23.0
Infrastructure Spending as % of Budget	10.0	12.0	14.0
Land Transport Spending as % of Infrastructure	45.0	42.5	40.0

Source: MMUTIS Study Team
1/ declining to 4.0% between 2006 and 2010
2/ declining to 4.0% between 2006 and 2015

These assumptions at the national level produce a very wide range of forecasts shown in Table 7.4. The figures appear to be substantial sums, particularly when compared to past levels of expenditure. However, the cost of some of the projects currently in the pipeline for the Study Area, particularly elevated expressways and mass transits, is also high. Private funding for the Skyway and MRT 3 are equivalent to more than ₱ 1 billion/km, while the multiarticulated LRV favored in Manila are ₱ 25-30 million each.

Table 7.4
Best Estimate Budget Envelope by Growth Scenario (1996, Million Pesos)

Scenario	1999-2004	2005-2010	2011-2020
Low Growth	42,554	55,441	131,431
Medium Growth	56,165	78,557	188,508
High Growth	71,158	107,978	274,113

Source: MMUTIS Study Team

7.3.3 Revised Estimate of Fund Availability

The economic crisis may be expected to affect the budget envelope in five ways:

1) The government transport infrastructure budget will be smaller, due to reduced economic growth and increased priorities for social spending in the short term.
2) Project costs will increase in peso terms, due to the depreciation of the currency.
3) The weak property market undermines prospects for projects to be supported by property deals.
4) Traffic and revenues will be lower than they would be due to lower economic growth and incomes.
5) The private sector may be more cautious in entering into BOT projects, since many private entrepreneurs have been badly hit by the crisis.

The public sector budget is shown in Table 7.5 analyzed as follows:

1) About US$ 4-10 billion over 22 years or US$ 180-45 million a year with private sector funding (for BOT and similar projects) to supplement the budget.
2) This is one-quarter to one-third lower than previously estimated (the result of lower growth, change in government priorities and peso depreciation). The estimates are as follows:

Table 7.5
Revised Estimate of Public Sector Funding
for Metro Manila's Transport Sector

(US$ billion)

Scenario		1999-2004	2005-2010	2011-2020	Total 1999-2020
Low Growth	Total	0.6	1.0	2.4	40
	(Per year	0.10	0.17	0.24	0.18)
Medium Growth	Total	1.0	15	3.5	6.0
	(Per year	0.17	0.25	0.35	0.27)
High Growth	Total	1.6	2.4	6.0	10.0
	(Per year	0.27	0.40	0.60	0.45)

Source: MMUTIS Study Team

7.3.4 Public and Private Sector Funding

Contrary to general belief, few BOT land transport projects anywhere are financially viable for a private concessionaire; those that are are usually estuarial crossing and tunnels. No MRT system in the world is known to be financially viable. Hence in Metro Manila, all BOT projects are likely to require joint public and private funding. This is important because BOT projects, often thought to be the easy funding option, in fact often require substantial public investments (or guarantees, which amounts to the same thing).

In the Philippines, there are as yet no operational BOT land transport projects. Based on international experience, particularly in Asia, there is a need to determine – for each major category of infrastructure – the percentage of the capital cost that the public sector is likely to shoulder. This amount needs to compete for available public sector funds, alongside other management and low-cost expenditures mentioned earlier. The estimates are as follows:

Table 7.6
Proportion of Major Project Expenditures
Funded by the Public and Private Sectors

Infrastructure	% Public	% Private
MRT Systems		
Busway	75	25
At-grade MRT/LRT	25	75
Elevated MRT/LRT	60	40
Underground MRT/LRT	90	10
Highways		
At-grade Expressway	35	65
Elevated Expressway	50	50
Primary Arterial Road	100	-
Secondary Arterial Highway	58	-

Source: MMUTIS Study Team
Note: The following qualifications apply to the table:
1 The figures are averages and the figure for individual projects will vary with conditions.
2 The figures assume that the MRT/road network is "well structured". If the network is too dense, not well aligned, or not well integrated with the rest of the transport system, the revenue potential will be much reduced, and public-sector funding will increase. This is a particular problem with MRT systems. A factor is therefore applied to the required public funding for each network that will reflect the extent to which it should be "well structured".

BOT projects are often a two-edged sword: They hold the promise of substantial private sector funding, provided the essential public sector funding is also available, without which few projects can materialize.

7.4 "Do-maximum" Network

7.4.1 Planning Considerations

The Do-maximum Network Plan, which best complied with the desired future urban structure of the Study Area, was prepared to assess the level of infrastructure needed to improve the traffic situation and maintain adequate service level in the future. Based on the do-nothing and do-minimum/committed situations, the future transport demand is so enormous that roads alone would not be sufficient; a substantial mass rail transit network should be provided. This Plan is composed of the following:

1) At-grade primary arterial roads
2) At-grade secondary arterial roads
3) Elevated expressways
4) Mass rail transit

In formulating the Plan, the existing network structure was basically maintained but redefined so that the outer areas are adequately integrated with Metro Manila. The Plan was prepared based on available topographic maps (with 1/10,000 and 1/50,000 scale) and taking into account other actual physical conditions.

7.4.2 Road Network

The Plan includes at-grade primary and secondary arterial roads and expressways. Major considerations given in formulating it are as follows:

At-grade Primary Arterial Road Network (see Figure 7.1)

The current radial-circumferential primary road system should be expanded to cover and integrate the fast-growing outer areas. The development of arterial roads here is very critical and should have at least six lanes with adequate curbside traffic control facilities.

At-grade Secondary Arterial Road Network (see Figure 7.2)

The primary road network will be complemented by a set of secondary arterial roads composed of:

1) Existing roads which are readily available;
2) Existing roads that need improvement or consent of relevant organizations for public use (e.g. subdivision roads); and,
3) New roads

Urban Expressway Network (see Figure 7.3)

Urban expressways will form the backbone of the metropolis. In addition to the N-S expressway axis composed of the North Luzon Expressway (NLE), Skyway (I, II, III) and SLE, an additional N-S axis is proposed with the construction of an elevated expressway over C5 which will be extended to the south. It will be connected with the east-west expressways on the north, middle and south portions of the axis. The concept is to absorb major traffic flow to/from major traffic-generating sources, such as Makati, Ortigas, Cubao, and Manila, by expressways.

With the above, the future basic road network of the Study Area will be composed of 265 km of expressways, 792 km of primary arterial roads and 878 km of secondary arterial roads (see Table 7.7). The cost is approximately US$ 14 billion. The size of the Plan is summarized in Table 7.8.

Table 7.7
Summary of Future Road System

		Length (km)		
		M. Manila	Outer Areas	Total
Expressway	Existing [1/]	34.0	49.0	83.0
	Ongoing Skyway 1	9.3	-	9.3
	MMUTIS Proposal	144.8	28.0	172.8
	Subtotal	188.1	77.0	265.1
Primary Arterial Road	Existing	211.3	-	211.3
	Ongoing/committed [2/]	7.5	-	7.5
	MMUTIS Proposal	113.2	459.9	573.1
	Subtotal	332.0	459.9	791.9
Secondary Arterial Road	Existing	307.3	21.0	328.3
	MMUTIS Proposal (Existing)	2.0	298.3	300.3
	MMUTIS Proposal (New)	93.1	156.5	249.6
	Subtotal	402.4	475.8	878.2
Total		922.5	1,012.7	1,935.2

Source: MMUTIS Study Team
1/ Sections of NLE and SLE located in the Study Area.
2/ C-5 missing links (P. Tuazon-B. Serrano, SLE-Roxas Blvd.).

Table 7.8
Size of the Network Plan

(km)

	M. Manila		Outer Areas		Total		
	Existing	New	Existing	New	Existing	New	Total
Expressway	34.0	154.1	49.0	28.0	83.0	182.1	265.1
Primary Road	211.3	120.7	-	459.9	211.3	580.6	791.9
Secondary Road	307.3	95.1	21.0	454.8	328.3	549.9	878.2
Total	552.6	369.9	70.0	942.7	622.6	1,312.6	1,935.2

Source: MMUTIS Study Team

Figure 7.1
Primary Arterial Road Network

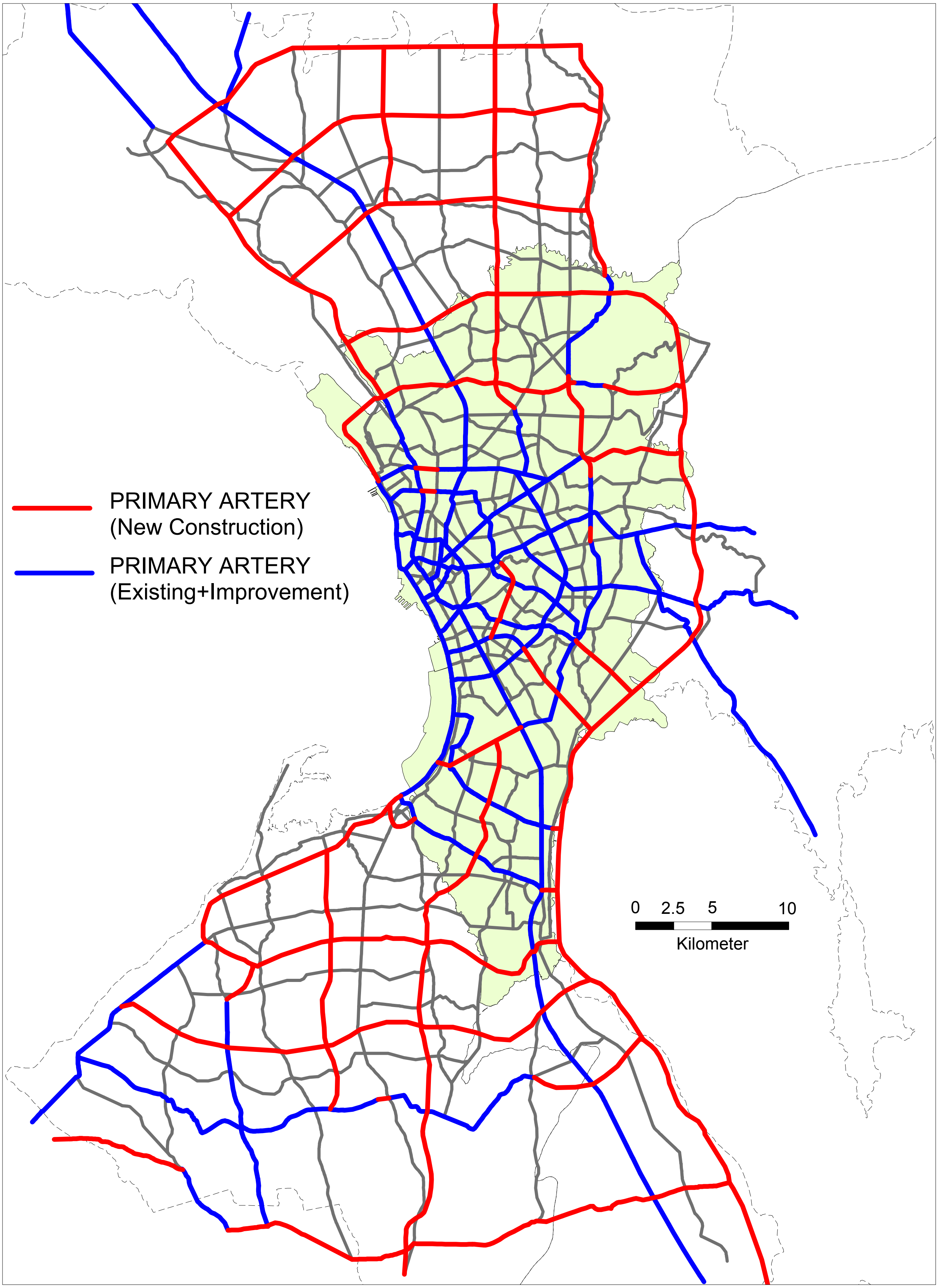


Figure 7.2
Secondary Arterial Road Network

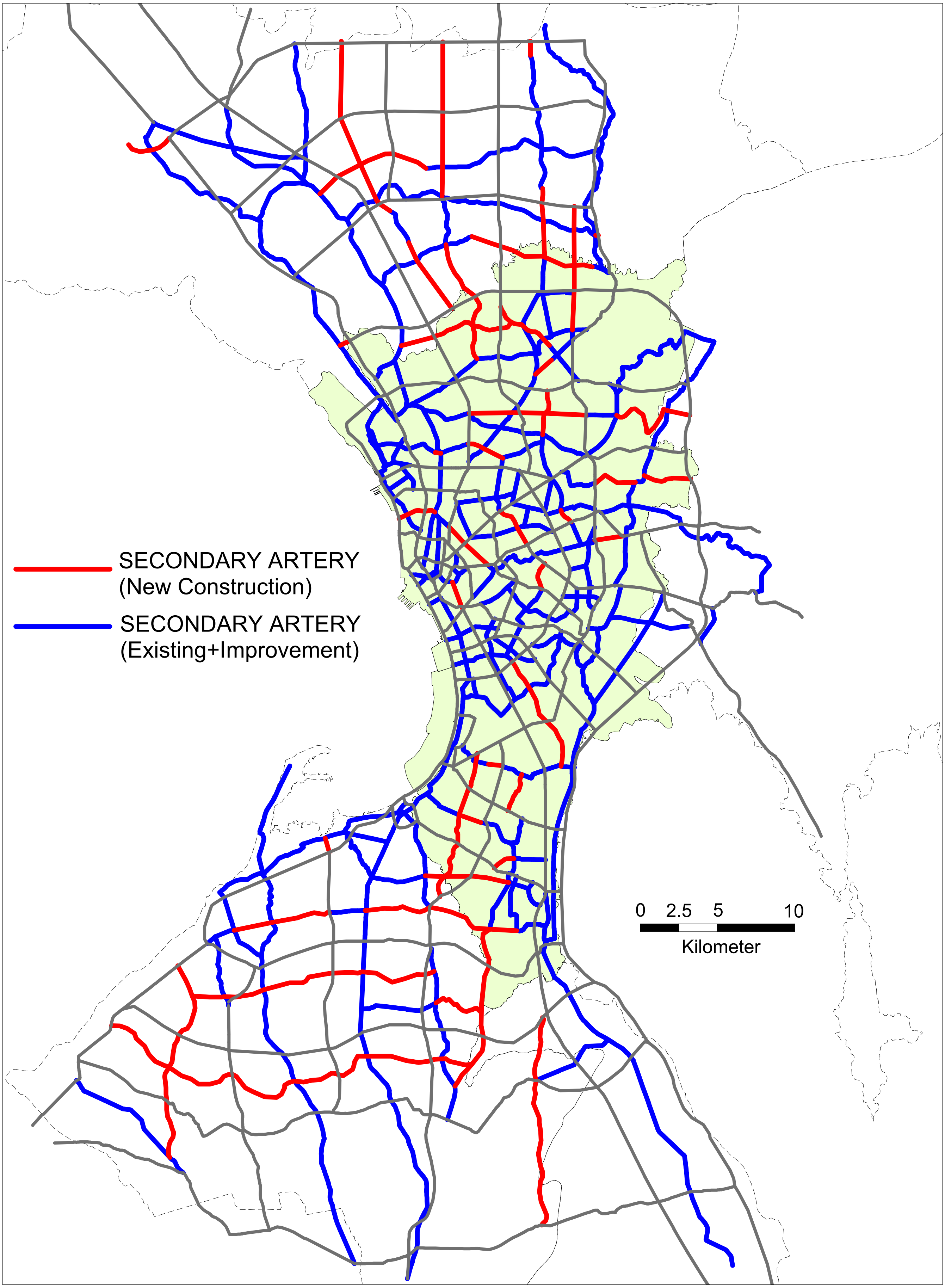
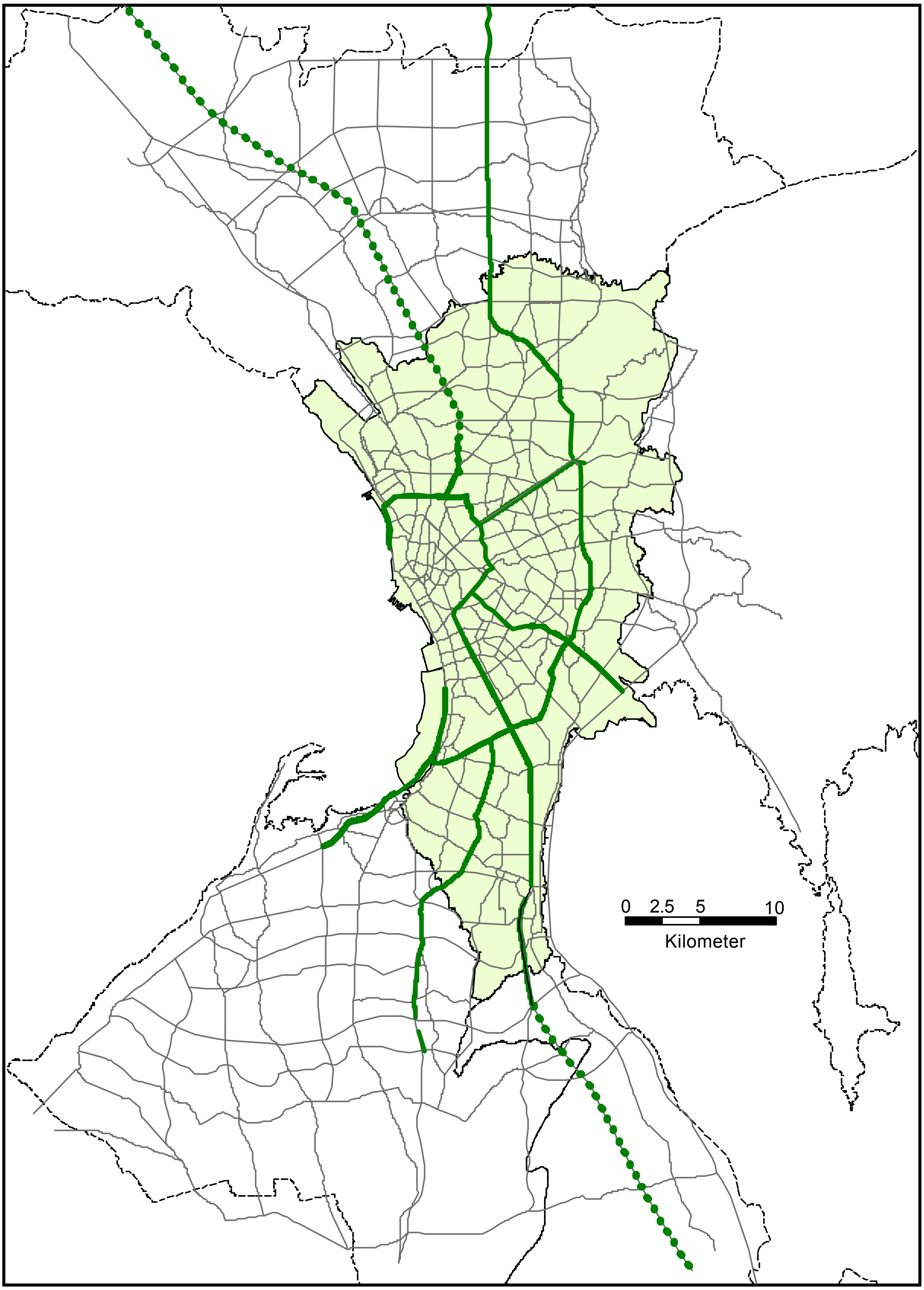


Figure 7.3
Expressway Network



7.4.3 Urban Rail Network

The main planning principle is to provide a strong north-south axis with the North Rail and its extension together with the MCX and its extension. Underground use is worth considering for medium- to long-term planning. The urban rail network will have a total of 346 km, including the existing LRT Line 1 (14.5 km) and the ongoing Line 2 (14 km) and Line 3 (16.8 km), as shown in Table 7.9 and Figure 7.4. The proposed network will be as follows:

Line 1: The line will extend to Dasmariñas, Cavite in the south (30 km elevated).

Line 2: The line will extend to Antipolo in the east (12 km elevated) and to the west across Line 1 to the Port Area from where the line passes along Roxas Boulevard and Buendia to link Makati and Fort Bonifacio (17 km underground). Then the line will further lead to Binangonan in the east (20 km elevated/at-grade).

Line 3: The line will extend to Navotas and Obando (16 km elevated) in the north across Line 1 and PNR. The line in the south will extend to the reclamation area across Line 1 and further extend to Kawit (15 km elevated/at-grade) in the south.

Line 4: The line will extend to San Mateo in the north via a branch line. In the city center, instead of terminating on Recto Avenue, it can take over the extension portion of Line 2.

North Rail and Extension: A suburban commuter service will be provided between Malolos and Caloocan (30 km at-grade). From there, the line links Fort Bonifacio (20 km underground) and extends to General Trias in the south (25 km underground/elevated/at-grade).

MCX and Extension: A suburban commuter service will link Calamba with Alabang (28 km at-grade) from where the line will be elevated up to Paco (42 km). The line will then proceed toward the north across EDSA (11 km underground) and further extend northward to San Jose del Monte (18 km elevated).

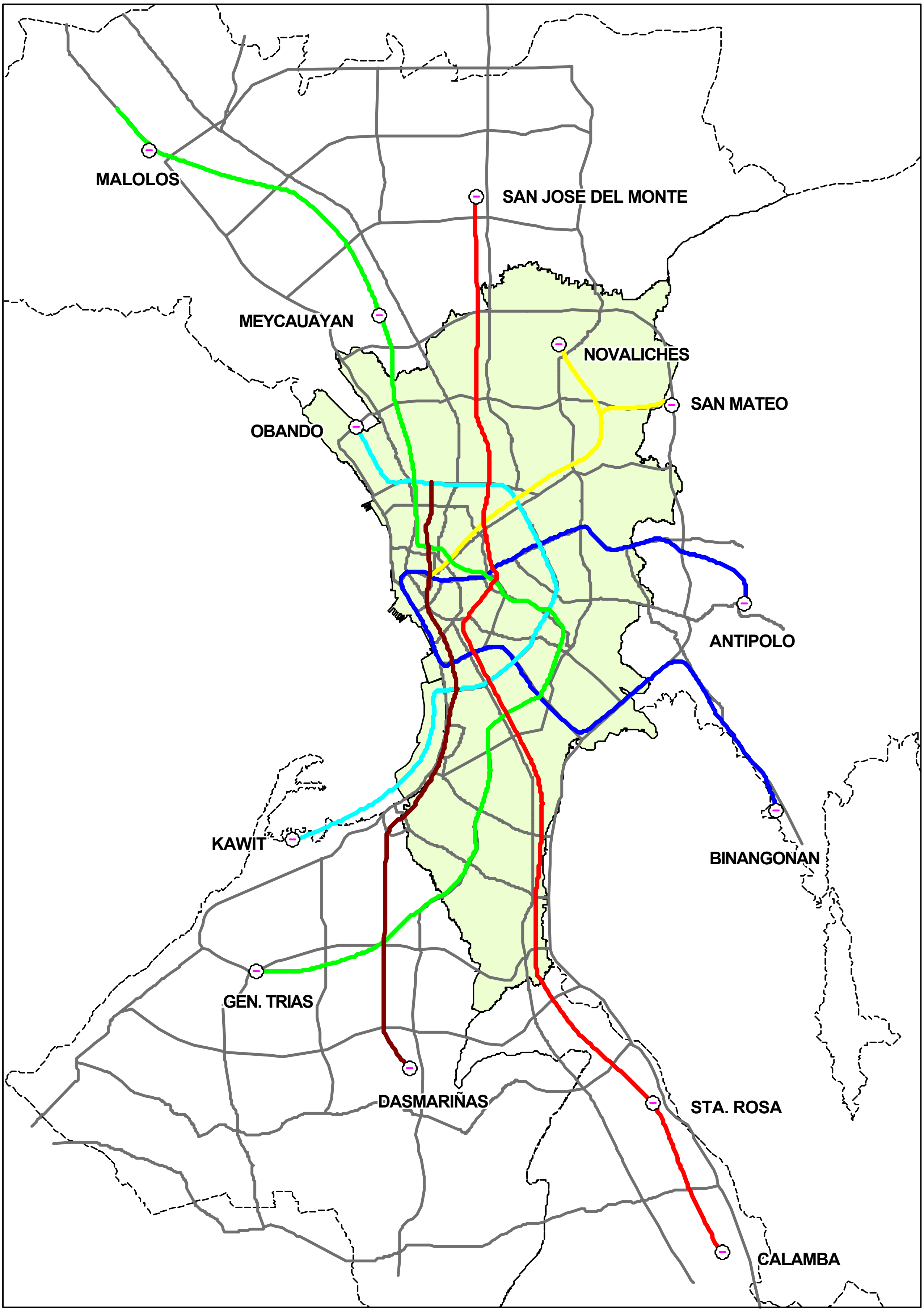
A summary of the above-mentioned LRT/MRT lines is given in Table 7.9.

Table 7.9
LRT/MRT Busway Profile

Line	Route Length (km)	No. of Stations	Speed (kph)	Time (min)
Line 1 and Extension				
Existing (Monumento-Baclaran)	14.5	18	30-35	24-29
S. Extension (Dasmariñas)	28.7	17	30-35	50-60
Subtotal	43.2	35	-	54-89
Line 2 and Extension				
E. Extension (Antipolo)	12.0	8	32-37	20-22
Existing (Recto-Santolan)1/	14.0	10	32-37	23-26
S. Extension (Fort-Bonifacio)	16.9	15	32-37	60-69
S. E. Extension (Binangonan)	19.8	10	32-37	60-69
Subtotal	62.7	43	-	103-117
Line 3 and Extension				
N.W. Extension (Obando)	16.3	4	30-35	12-Nov
Existing1/	16.8	16	30-35	29-34
S. Extension (Kawit)	15	7	30-35	26-34
Subtotal	48.1	27	-	66-76
Line 4 and Extension				
Main Line (Recto-Novaliches)	22.8	23	32-37	37-43
E. Extension (San Mateo)	6.2	3	32-37	10-12
Subtotal	29	26	-	47-55
North Rail and Extension				
North (Malolos)	30.5	13	40-45	40-45
Middle (Caloocan-Fort Bonifacio)	19.5	12	40-45	37-43
South (Dasmariñas)	24.5	15	37-43	34-40
Subtotal	74.5	40	-	111-128
MCX and Extension				
North (San Jose del Monte)	18.1	12	37-43	25-29
Middle (EDSA-Paco)	10.7	7	40-45	16-15
South I (Alabang)	22.1	9	40-45	29-33
South II (Calamba)	28.3	7	43-48	35-40
Subtotal	79.2	35	-	105-117
TOTAL	346.2	-	-	-

Source: MMUTIS Study Team
1/ Under construction

Figure 7.4
LRT/MRT/Busway



7.4.4 Assessment of Network Performance

The proposed network was planned taking into account the expected traffic demand in the year 2015. Comprising rail, expressways and at-grade roads, it will be utilized in a relatively balanced manner. Although it would have a large transport capacity, as shown in Table 7.10, its VCR would be in the range of 0.8 to 1.5, only slightly better than the present one due to the expected big increase in traffic demand. However, the network's overall service level would be acceptable, and demand distribution among different corridors and modes would be well balanced.

The results of these traffic assignment exercises indicate that urban developments need to be more strongly guided toward the north. The current trend gives strong pressure on the south and east where a capacity increase that is more than the proposed network's would be practically difficult. Urban expansion toward the east is discouraged due to environmental reasons.

Table 7.10
Volume/Capacity Ratio of Roads by Area
Do-maximum Case, 2015

Zone No.	Area	Capacity		Assigned		VCR
		PCU × km (Million)	Ratio to 1996	PCU × km (Million)	Ratio to 1996	
1	W/in EDSA	14.5	1.4	14.1	1.7	1.0
2	MMNorth1	7.6	2.4	6.2	2.3	0.8
3	MMNorth2	16.4	3.0	13.0	2.8	0.8
4	OutNorth3	8.7	5.8	5.3	3.6	0.6
5	OutNorth4	8.3	2.5	5.2	3.2	0.6
6	OutNorth5	15.3	12.6	5.2	7.1	0.3
7	MMEast1	7.6	2.0	6.9	2.2	0.9
8	MMEast2	5.7	2.7	5.8	3.2	1.0
9	OutEast3	1.5	1.6	3.1	3.5	2.0
10	OutEast4	3.6	1.5	5.6	3.4	1.6
11	MMSouth1	7.5	2.8	5.5	2.6	0.7
12	MMSouth2	11.2	2.4	10.0	2.5	0.9
13	OutSouth3	10.7	8.3	6.7	4.6	0.6
14	OutSouth4	18.4	12.0	2.6	4.0	0.1
15	OutSouth5	11.9	6.3	5.1	3.5	0.4
16	OutSouth6	10.4	2.0	6.8	4.5	0.6
Total		159.4	3.1	107.1	2.8	0.7

Figure 7.5
Traffic Volume and VCR of Highways, Do-maximum Case, 2015

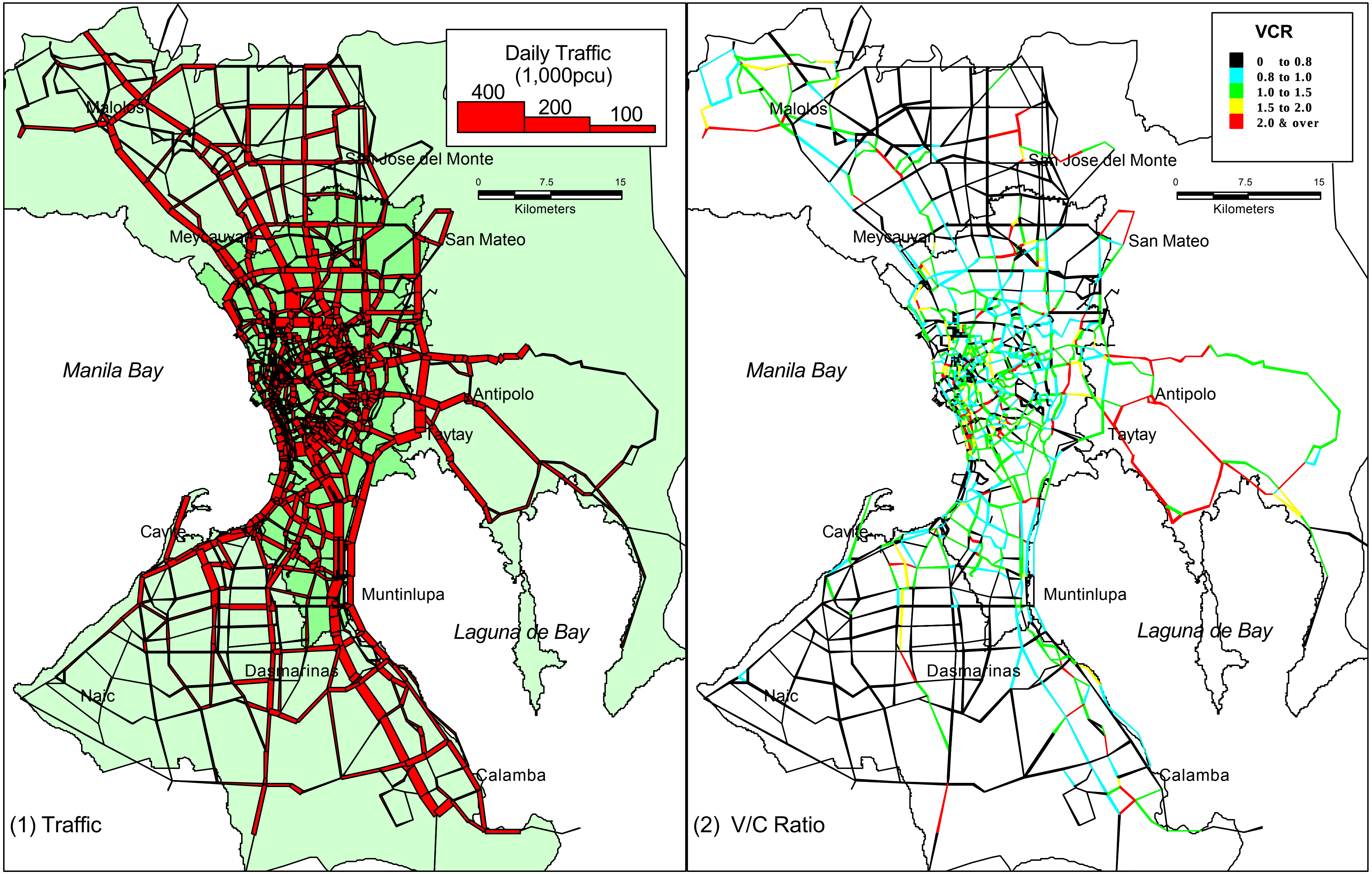
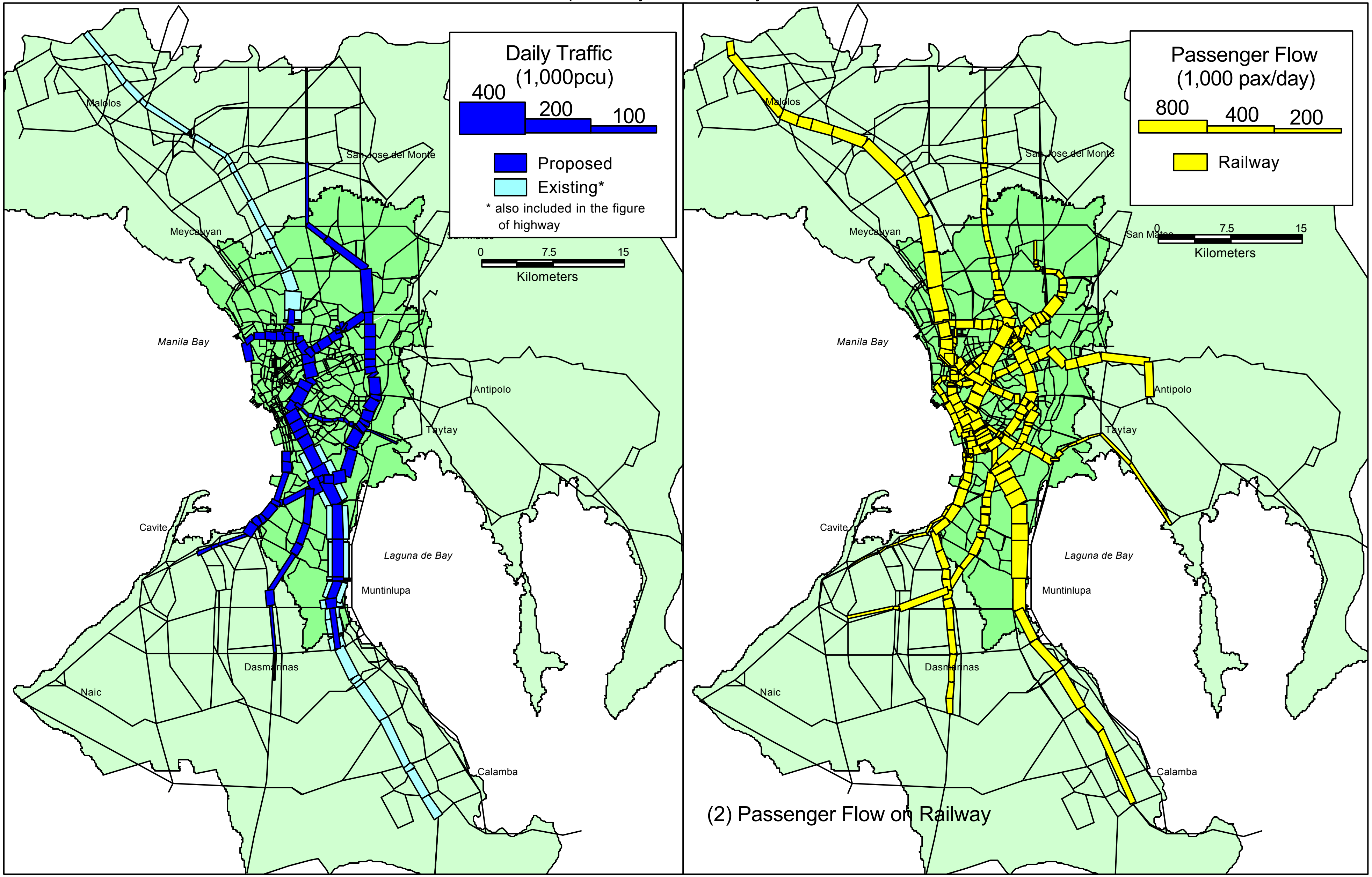


Figure 7.6
Traffic Volume on Expressways and Railways, Do-maximum Case, 2015



(2) Passenger Flow on Railway

Table 7.11
Transport Capacity and Required Capacity Across Mini-Screenlines by Corridor
Do-maximum Case, 2015

Corridor/ Mini-Screenline		Transport Capacity				Required Capacity				VCR on Roads
		Rail[1/] (No. of lanes)	Road (000 PCUs/day)			Rail[1/] (No. of lanes)	Road (000PCUs/day)			
			Highway	Express-way	Total		Highway	Express-way	Total	
Cavite Coastal	IS1	2.0	270	148	418	1.0	219	91	310	0.7
	OS1	1.0	187	148	335	0.1	148	52	200	0.6
	OS2	2.0	258	148	406	1.0	185	75	261	0.6
Laguna	IS2	2.0	469	296	765	1.8	459	248	708	0.9
	OS3	1.0	368	148	516	1.2	361	143	505	1.0
Rizal	IE1	1.0	362	148	510	0.5	372	43	415	0.8
	IE2	1.0	218	-	218	0.8	249	-	249	1.1
	OE	2.0	381	148	529	0.9	349	29	379	0.7
North-east	INE	1.0	77	148	225	0.9	76	118	194	0.9
	ONE	1.0	370	-	370	0.1	218	-	218	0.6
North Plateau	IN1	1.0	253	-	253	0.9	235	-	235	0.9
	ON1	1.0	389	148	537	0.4	282	57	340	0.6
North Coastal	IN2	-	-	296	296	-	-	222	222	0.8
	IN3	2.0	310	-	310	1.1	320	-	320	1.0
	ON2	0.0	358	-	358	0.0	335	-	335	0.9
EDSA	KK	2.0	156	-	156	0.8	160	-	160	1.0
	GLP	2.0	185	-	185	0.7	181	-	181	1.0
	SSH	2.0	156	-	156	0.6	178	-	178	1.1

Table 7.12
Assessment of Demand Magnitude by Corridor/Mini-Screenline
Do-maximum Case, 2015

Corridor/ Mini-Screenline		Transport Capacity				Required Capacity				VCR on Roads
		Rail	Road (000 pax/day)			Rail[1/] (No. of lanes)	Road (000PCUs/day)			
			Public	Private	Total		Public	Private	Total	
Cavite Coastal	IS1	812	286	556	843	1.0	17	292	310	0.7
	OS1	126	237	352	590	0.1	14	185	200	0.6
	OS2	828	2	495	498	1.0	-	261	261	0.6
Laguna	IS2	1529	67	1338	1405	1.8	4	704	708	0.9
	OS3	1028	45	954	999	1.2	2	502	505	1.0
Rizal	IE1	447	469	733	1203	0.5	29	385	415	0.8
	IE2	684	455	420	875	0.8	28	221	249	1.1
	OE	752	290	686	977	0.9	18	361	379	0.7
North-east	INE	800	230	342	572	0.9	14	180	194	0.9
	ONE	48	233	387	620	0.1	14	203	218	0.6
North Plateau	IN1	722	323	408	732	0.9	20	215	235	0.9
	ON1	301	752	556	1308	0.4	47	293	340	0.6
North Coastal	IN2	-	437	371	808	-	27	195	222	0.8
	IN3	933	540	544	1084	1.1	33	286	320	1.0
	ON2	-	310	601	911	-	19	316	335	0.9
EDSA	KK	694	460	250	711	0.8	28	132	160	1.0
	GLP	576	246	316	562	0.7	15	166	181	1.0
	SSH	476	456	285	741	0.6	28	150	178	1.1

1/ Capacity of railway was assumed to be 850,000 passenger per day for both directions at any cross-section.

7.4.5 Investment Cost of "Do-maximum" Network

The total cost of the do-maximum network requires about US$ 30 billion or roughly US$ 20 billion of public sector share, twice the possible amount estimated under the high-growth scenario. This clearly indicates that the future network development for the Study Area will be hampered by serious financial constraints.

Table 7.13
Investment Cost of Do-maximum Network

	Total Cost[1/] ($ billion)	Cost for Gov't[1/]		
		%	($ billion)	(₱ billion)
Urban Rails	16.0	63	10.1	354
Artery Roads	5.0	100	5.0	175
Secondary Roads	2.3	100	2.3	81
Expressways	7.2	40	2.9	100
Total	30.5	67	20.3	7.0

Source: MMUTIS Study Team,
1/ Estimated by the MMUTIS

In addition to the above, the budget for management and low-cost improvements is also necessary. Traffic management/engineering, small terminals and local roads – all these require continuous investment. The MMURTRIP project includes components comprising low-cost management measures and secondary roads that may cost about US$ 150 million. When extended to other corridors this may increase to US$ 250 million. Assuming a similar project is started every Plan period, the cost over 22 years would be about US$ 1,000 million. In addition, assuming that removing bottlenecks on the existing network through grade-separation and local widening, among others, would cost US$ 10 million each and two are constructed every year for 22 years, the cost would be about US$ 500 million. The total cost would then be about US$ 1,500 million to be committed to these relatively low-cost but high-impact projects.