5.5 Alternatives Evaluation and Conclusion

5.5.1 Traffic Demand Forecast

In Chapter 3, future land use plan and changes in socio-economic characteristics were considered, and the modal split among the means of public transport and the car was forecast. In this Sub-Chapter, traffic demand on each mode under each Alternative is forecast based on said forecast result and under transportation policy. The result of this demand forecast will offer the most basic data for evaluating the Alternative Plans.

(1) Forecast Process

The major mode of public transport which each of Alternative Plans rely upon is:

Alternative A: Railroad (to be introduced)

Alternative B: Bus (to be introduced)

Alternative C: PUJ

Rail-transit and bus system are not presently used in Davao City as the means of urban transportation. Therefore, it is believed difficult to forecast the traffic demand on mass transit based on the analysis of the existing traffic facts. Here, the peculiar features of mass transit (regularity, rapidity, low price) and the modal role sharing shown below are taken into consideration in forecasting traffic demand for each mode under each Alternative Plan. The process of this forecasting is shown in Figure 5.14.

i) PUJ

It is assumed that the PUJ, now serving short and medium distance travel demand, will have the role of serving short trip demand within each block (with the tricycle serving very small ranges, and the AC being replaced by PUJ in the future).

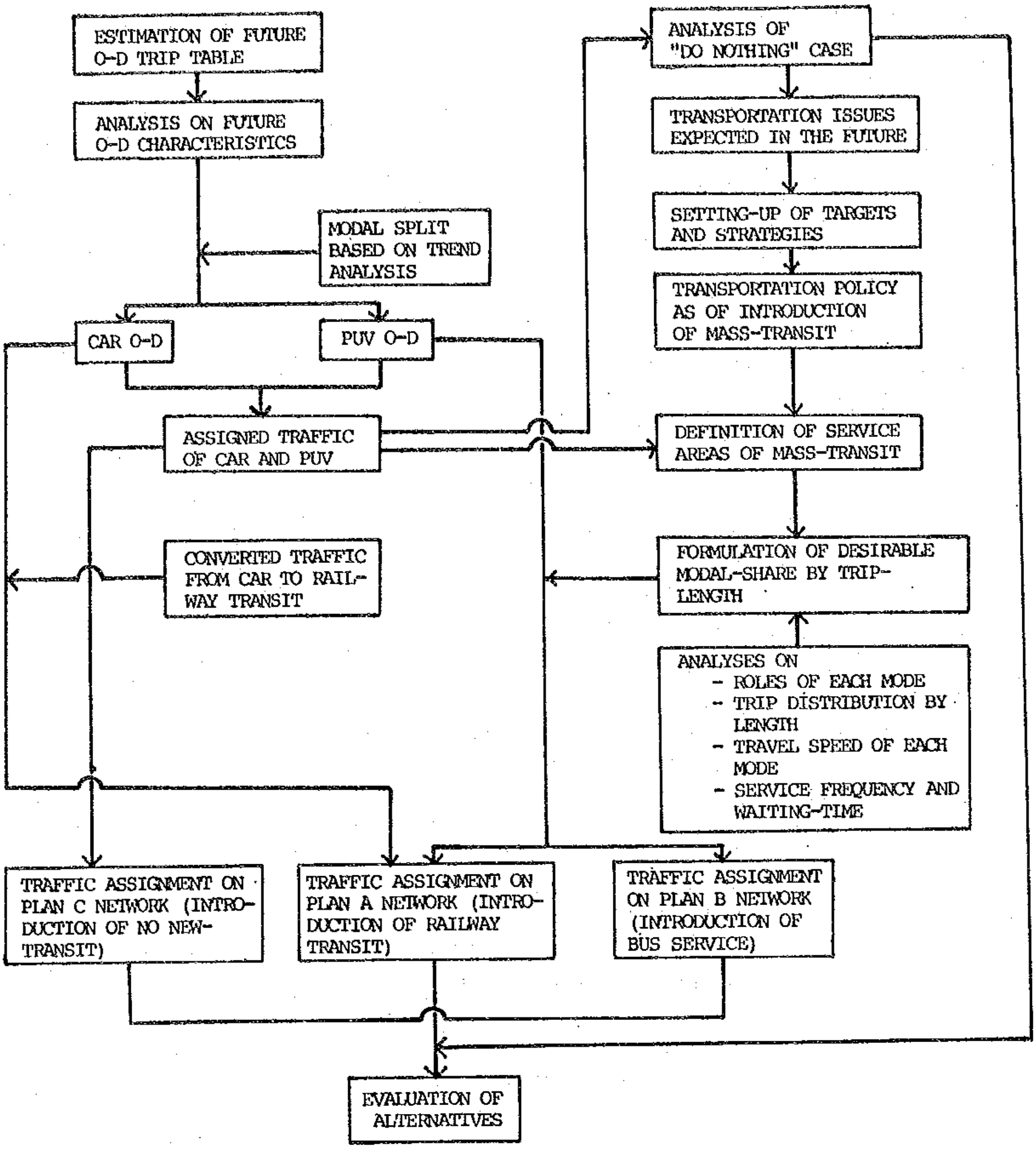


Figure 5.14 Procedure of Traffic Forecasting and Evaluation of Alternatives

ii) Bus System

Buses, now serving long distance travel demand between cities, will chiefly serve medium distance travel demand in each block and between neighboring blocks as the means of feeder service to complement inter-block medium and long distance trunk service to be performed either by bus or railroad (with provincial buses serving wide area traffic demand as present).

iii) Railroad

Rail-transit is to serve chiefly medium and long distance inter-block travel demand within the Project Area.

(2) Demand Forecast by Mode

i) Modal Share

As a result of studying the items listed below, the modal share by distance ranges have been arrived at for each Alternative, as presented in Figure 5.15.

- Relationship between trip distance and modal role
- Travel speed by modes
- Sphere of influence of major PUV truck routes and feeder service structure
- Service frequency and waiting time
- Modal splits experienced in other cities

Modal splits under Alternative A and B can be forecast from this Figure 5.15. The modal shares of the taxi and the PUJ are left unchanged under Alternatives A and B, as they will play the same roles under them.

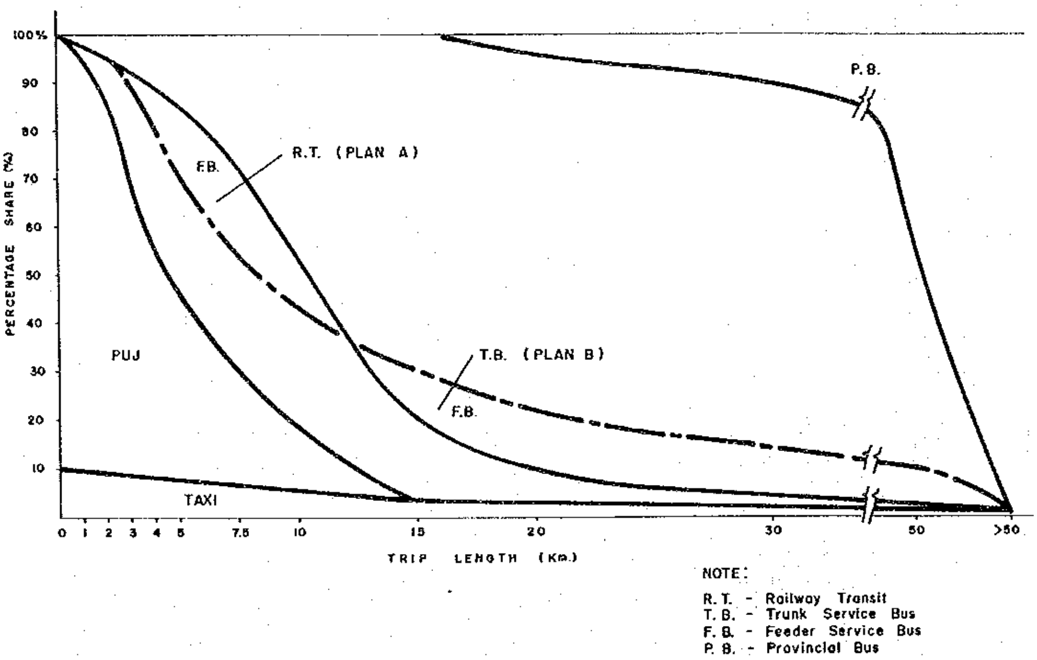


Figure 5.15 Modal Share of Public Transport Modes

ii) Car Rail-transit Demand Shift

Assuming, through car parking characteristics, that, of the total car trips, commuter trips (to office, school) which require a prolonged (4 hours or more) parking will be attracted to rail-transit when introduce, in consideration of the latter's advantage (regularity, rapidity, amenity, and so forth), it is estimated that under Alternative A, approximately 19% of total car trips, or about 73,000 trips, must be added to the modal of rail-transit estimated under the PUV modal shares shown by Figure 5.15.

iii) Forecast Result

The results of forecast of modal split by the Alternatives are presented in Figure 5.16 and Table 5.5. A traffic (excluding walking and bicycles) increase of about 3.2 times is indicated for the year 2000. Demand increases by modes are naturally different from one Alternative to another: for car and trucks, 3.1 times under Alternative A against 3.7 times under Alternatives B and C. Little difference is indicated for PUVs, however: 3.2 times under Alternatives B and C. Translated into the number of trips, the demand increase of 300,000 to 370,000 trips is indicated for cars and trucks, and twice as much, or 600,000 to 660,000 trips for PUV.

Also, presented in Figure 5.17 is person trip desire lines by rail-transit which will offer trunk service. Block pairs between which demand is strong are listed below, which shows that rail-transit is preferred for relatively long trips:

Poblacion (Block IV) – Panacan (Block II)

Poblacion (Block IV) – Toril (Block VI)

Poblacion (Block IV) – Talomo (Block V)

The person trip desire line for bus service, drawn for Alternative B, is presented in Figure 5.18. Because the lines have been drawn basically for trunk service, they reveal similar behavior as did the lines for rail-transit.

Table 5.5 Traffic Volume by Mode and by Alternative

		1979	2000 Plan – A	2000 Plan – B	2000 Plan – C
Car/Truck		118 (28.3)	398 (30.0) ((3.3))	436 (32.9) ((3.7))	436 (32.9) ((3.7))
PUV	R.T.	– –	235 (17.7)	– –	– –
	BUS	10 (2.4)	264 (19.9)	491 (37.0)	144 (10.8)
	PUJ AC TRICYCLE	271 (64.8)	382 (28.8)	352 (26.4)	712 (53.7)
	TAXI, PU	19 (4.5)	48 (3.6)	48 (3.6)	34 (2.6)
	SUB-TOTAL	300 (71.7)	929 (70.0) ((3.1))	890 (67.1) ((3.0))	890 (67.1) ((3.0))
	TOTAL	418 (100)	1,327 (100) ((3.2))	1,327 (100) ((3.2))	1,327 (100) ((3.2))

Note: Upper : Number of Person Trips (x 1000 P. T.)
Under : ( ) share (%)
(( )) Growth rate of Traffic Volume (2000/1979)

(1) Status Quo

(2) Plan – A Introduction of Railway and Bus System

(3) Plan – B Introduction of Bus System

(4) Plan – C Based on the current mode

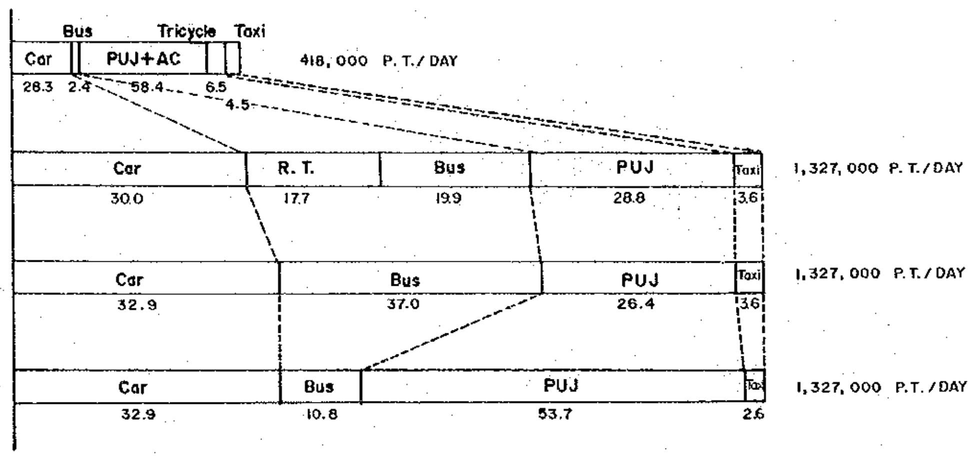


Figure 5.16 Modal Shares by Alternative

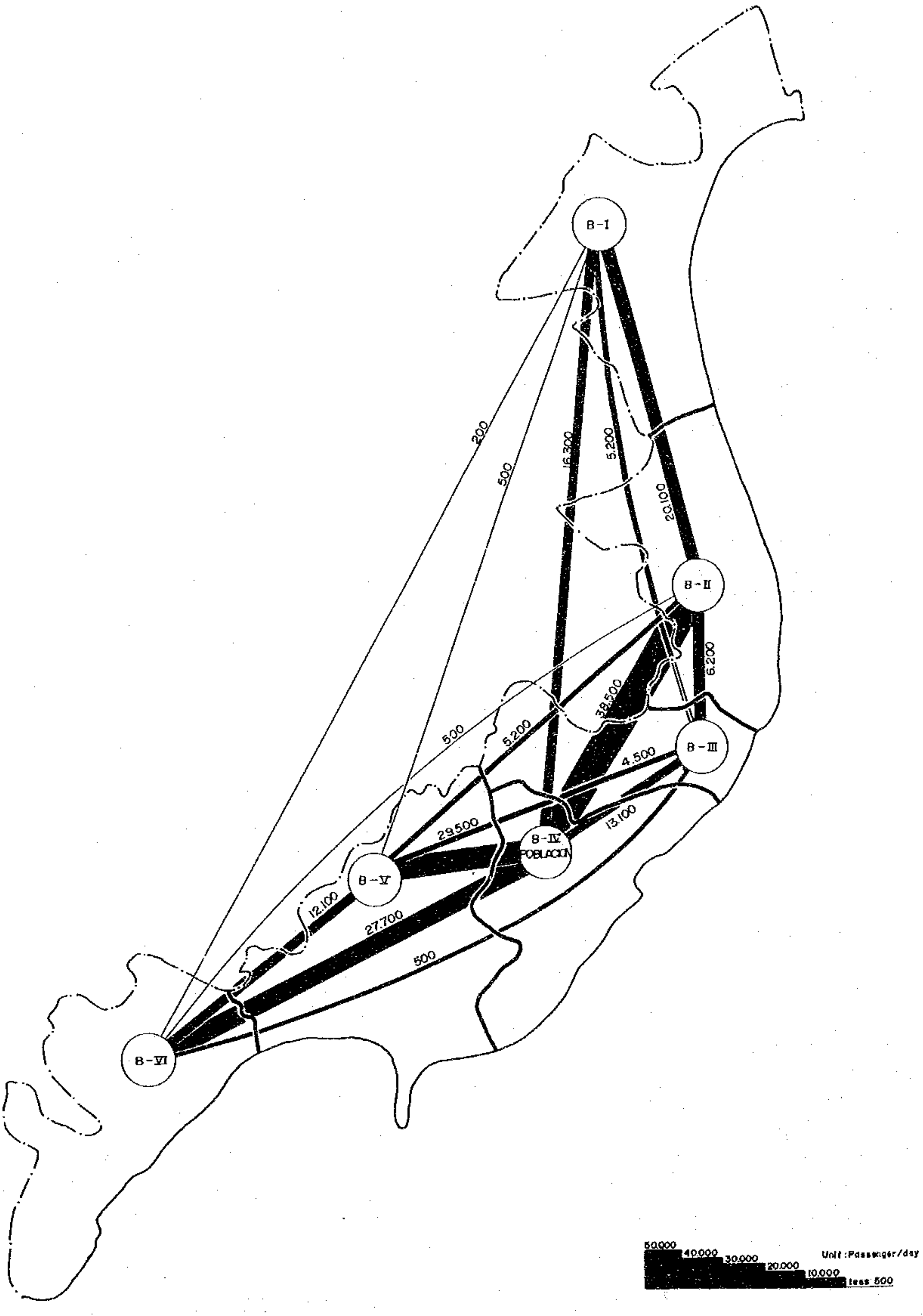


Figure 5.17 Person Trip Desire Line of Rail Transit, 2000 (Plan–A)

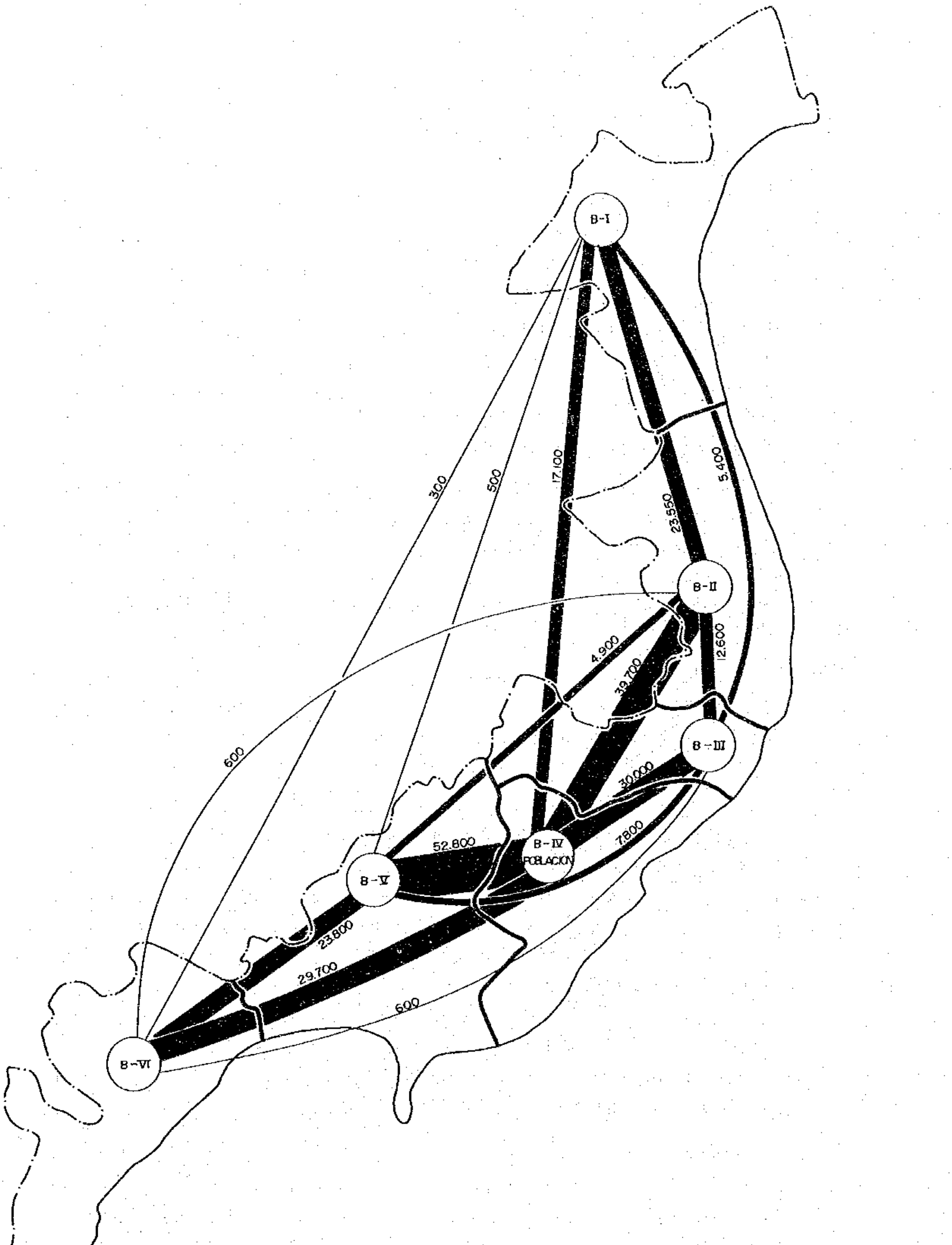


Figure 5.18 Person Trip Desire Line of City Bus, 2000 (Plan—B)

(3) Traffic Assignment

The volume of traffic forecast under each of the Alternatives is now assigned to the respective road network, through an ordinarily used method: first, it is assumed that people utilizing public transport (rail-transit, bus, PUJ) flow on the shortest route to achieve the shortest travel time, then, assigned in addition to this volume of traffic is car and truck traffic taking into consideration relationship between travel speed and traffic volume (in other words, the shortest route changes as traffic volume increases).

The total traffic volume (PCU/day) assigned under each of the Alternatives is shown in Figures 5.19 through 5.21. The result of distribution under "do nothing case", which offers a common base of comparison, is shown in Figure 5.22, which shows a relatively even assigned traffic volume on almost every road (with traffic overflooded on one route flowing to other routes) but a situation seriously aggravating urban functions and traffic environment with as many as 60,000 PCU/day flowing on 2-lane roads, as pointed out under Sub-Chapter 5.2.

It is judged that the traffic flow indicated by the assigned traffic volumes under each of the Alternatives as presented in Figure 5.19 through 5.21 is generally coherent with the transport network pattern of Figure 5.6 and the road network proposed in Figure 5.7. These Alternatives are to be evaluated based on this assigned traffic volume and economic, traffic functional, and policy considerations.

Under either of the Alternatives, a maximum traffic volume of 40,000 to 50,000 PCU/day is estimated to concentrate on McArthur Highway, E. Quirino Avenue, and R. Castillo St. These roads constitute the important route which is given the role of spine of the transport network pattern.

On the other hand, a traffic volume of 16,000 to 30,000 PCU/day and 15,000 to 20,000 PCU/day are respectively estimated for North Diversion Road (Panacan-Bunawan) to be newly built on the west of Davao-Agusan Road and Coastal Road (Poblacion-Toril) to extend from Poblacion toward south, and the substantial traffic volumes thus estimated prove the importance of these roads. A traffic of 10,000 to 30,000 PCU/day is estimated under each of the Alternatives for Ring Road to be formed with the extension of J.P. Laurel Avenue until connected with Coastal Road. Under Alternatives B and C, the straight extension of J.P. Laurel Avenue for connection with Diversion Road (by a tunnel) will expectedly result in the diversion of 10,000 to 13,000 PCU/day from McArthur Highway for the substantial mitigation of congestion on the latter.

Traffic demand on the representative mode of public transport proposed by each of the Alternatives is shown in Figures 5.23 through 5.25 Travel demand for rail-transit shown in Figure 5.23, increases toward Poblacion from both north and south, and reaches a maximum of about 97,000 person trip/day. Conversely, the demand gradually slackens off toward north and south away from Poblacion and dwindles to about 40,000 person trips/day after Panacan (north) and Talomo (south). This behavior should be borne in mind in the operation of railroad. Demand on bus, shown in Figure 5.24, is strongest on E. Quirino Avenue at about

9,000 PCU/day, followed by Davao-Cotabato Road, Buhangin Road, and Diversion Road. This trend is also true with demand on the PUJ, shown in Figure 5.25.

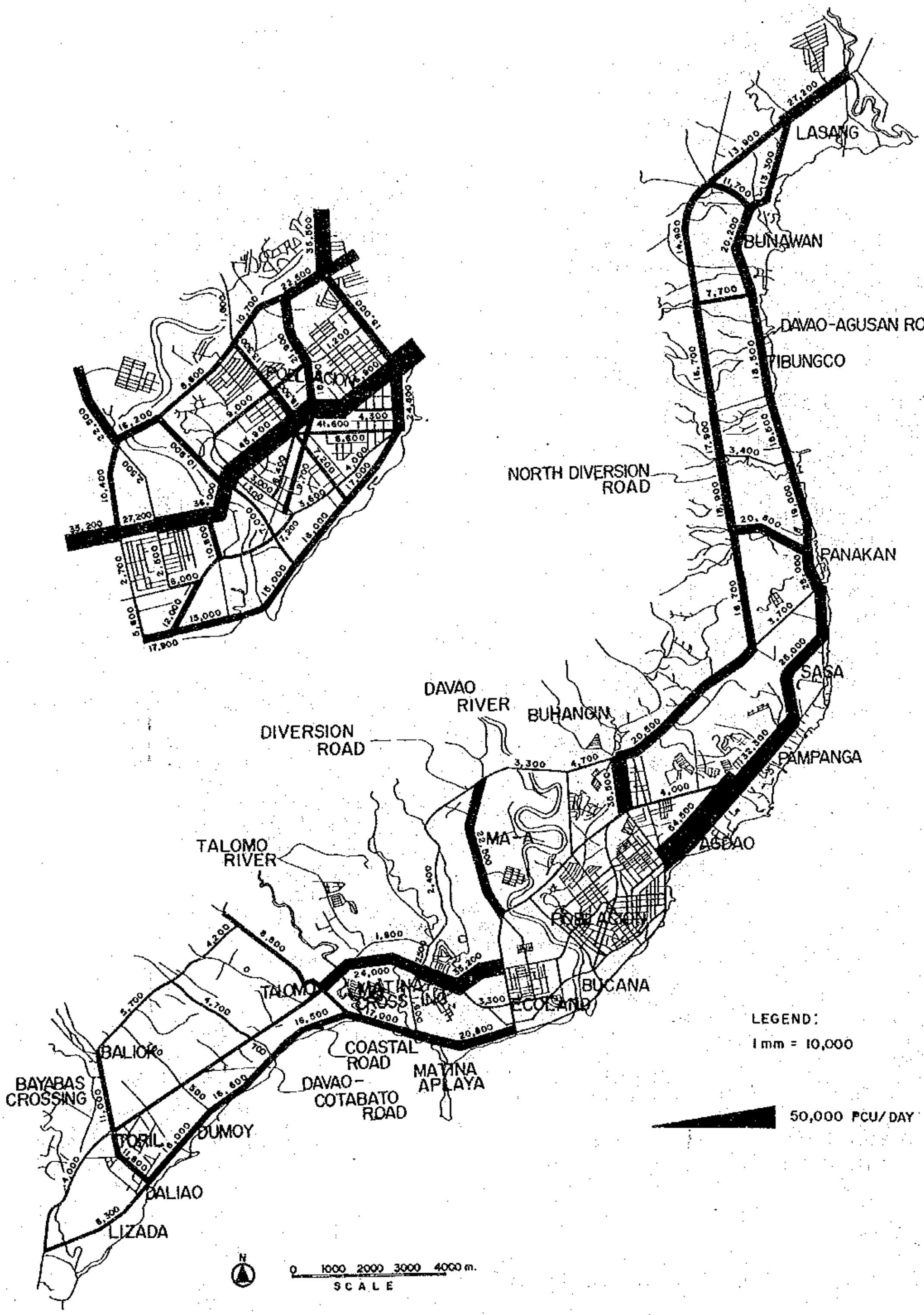


Figure 5.19 Traffic Volume in Plan A, 2000

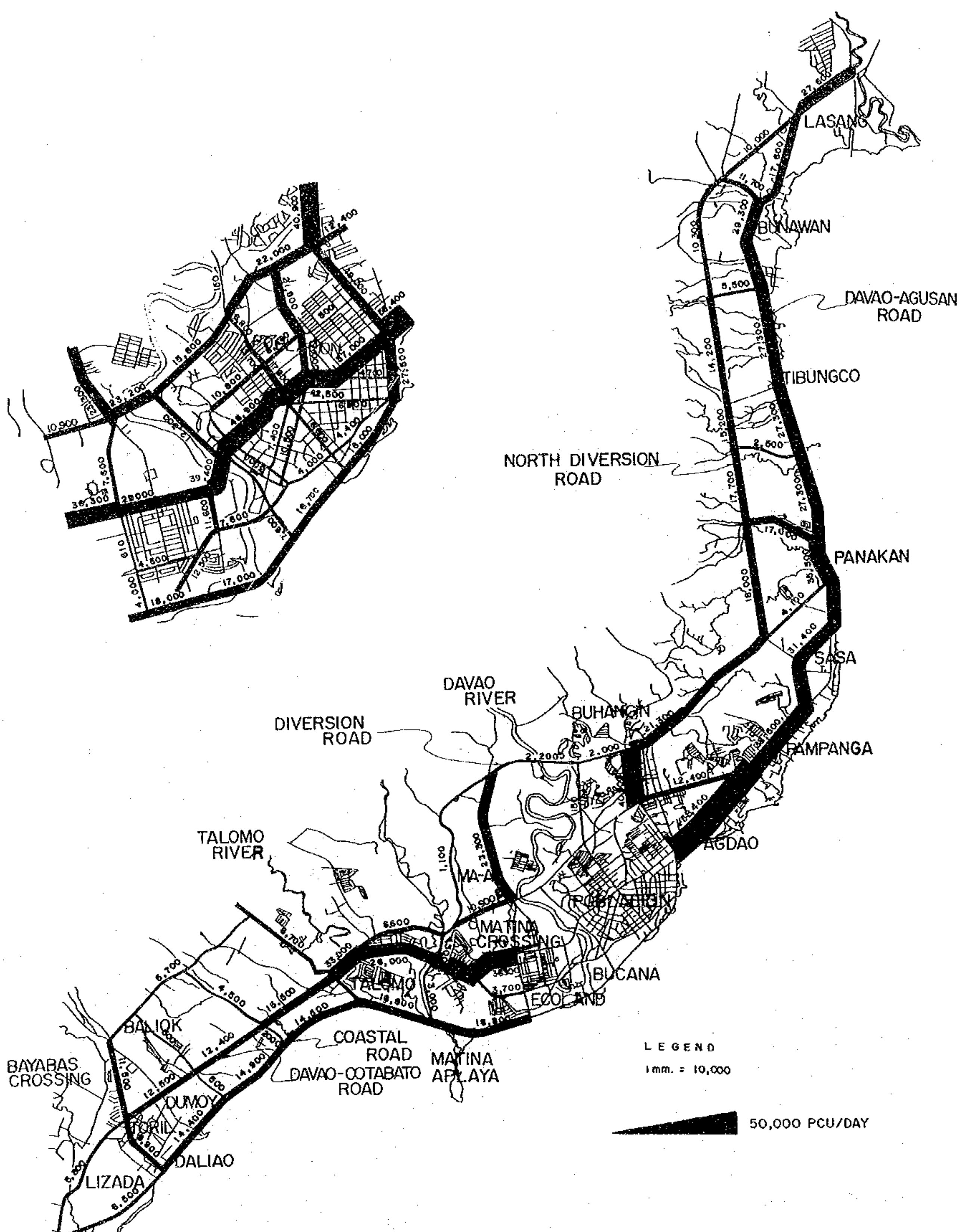


Figure 5.20 Traffic Volume in Plan B, 2000

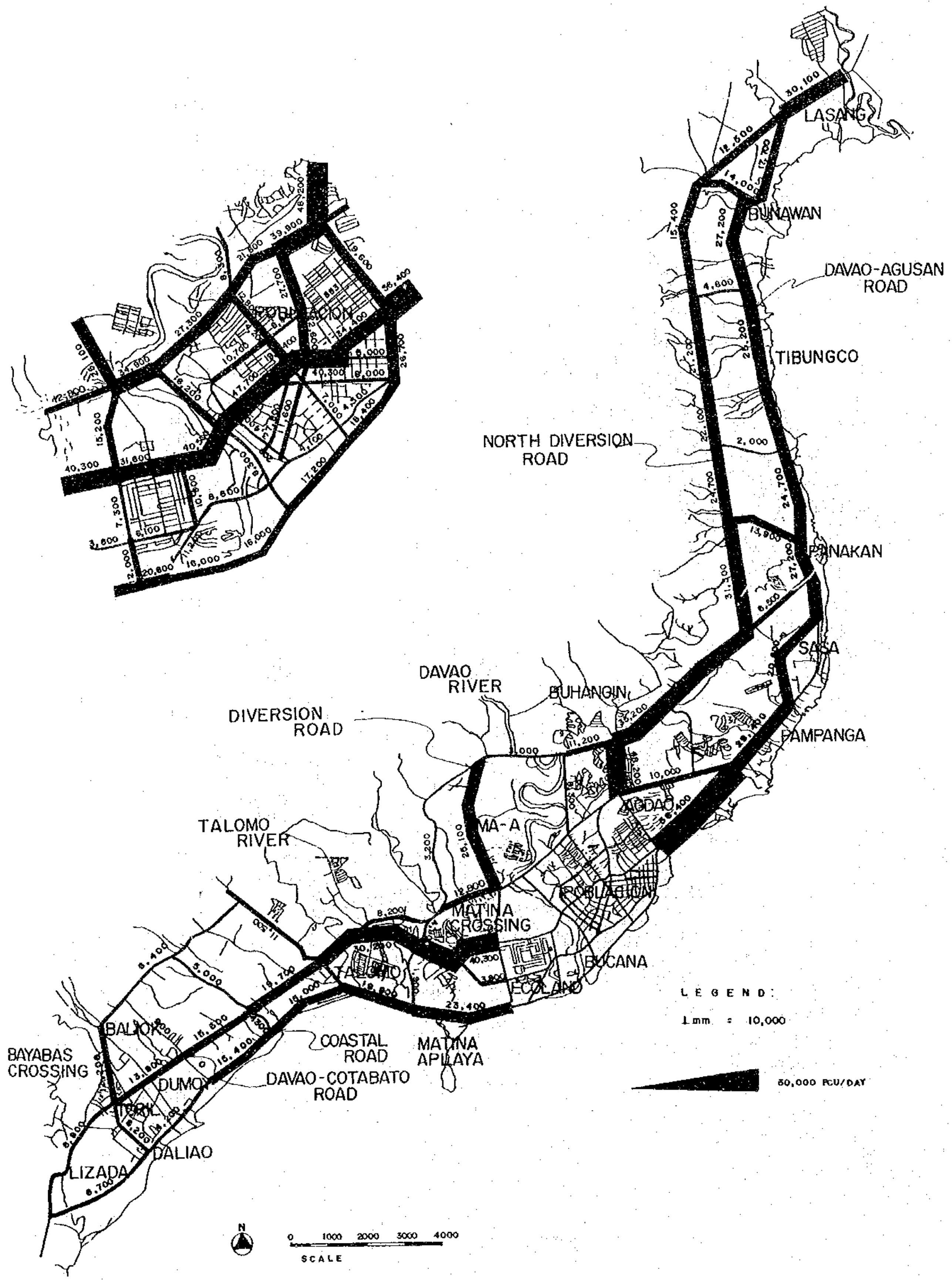


Figure 5.21 Traffic Volume in Plan C, 2000

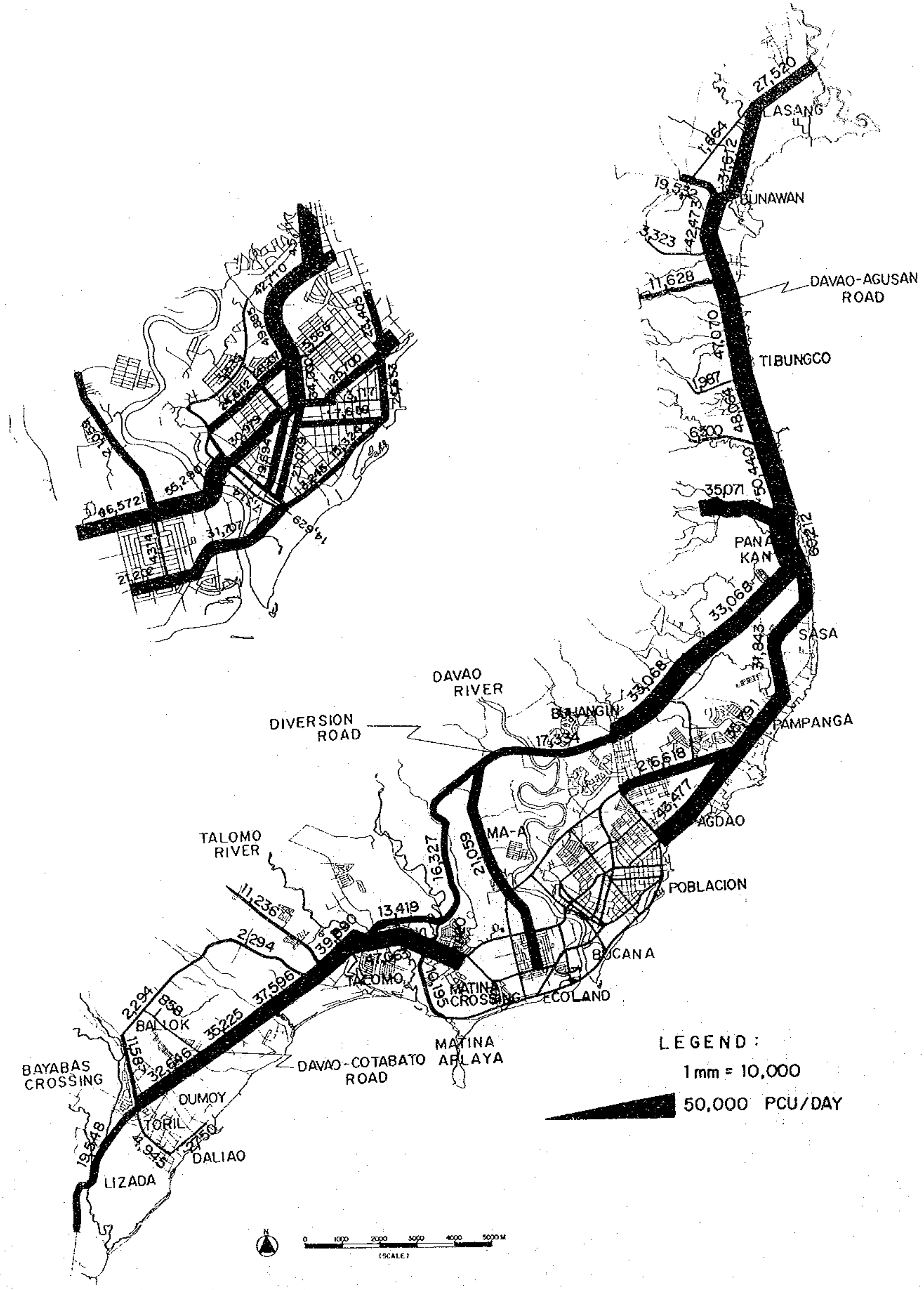


Figure 5.22 Traffic Volume in Do Nothing Case, 2000

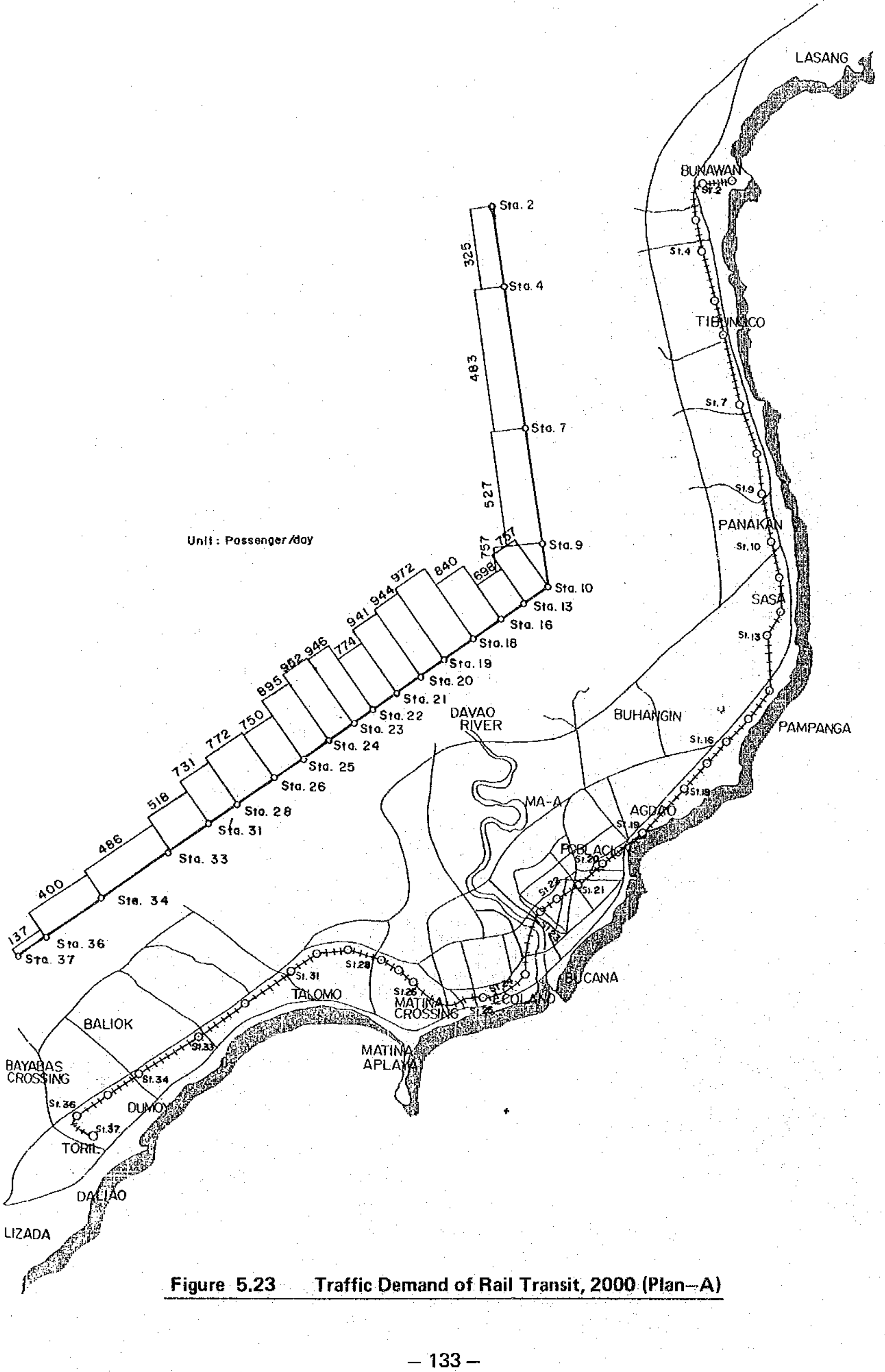


Figure 5.23 Traffic Demand of Rail Transit, 2000 (Plan–A)

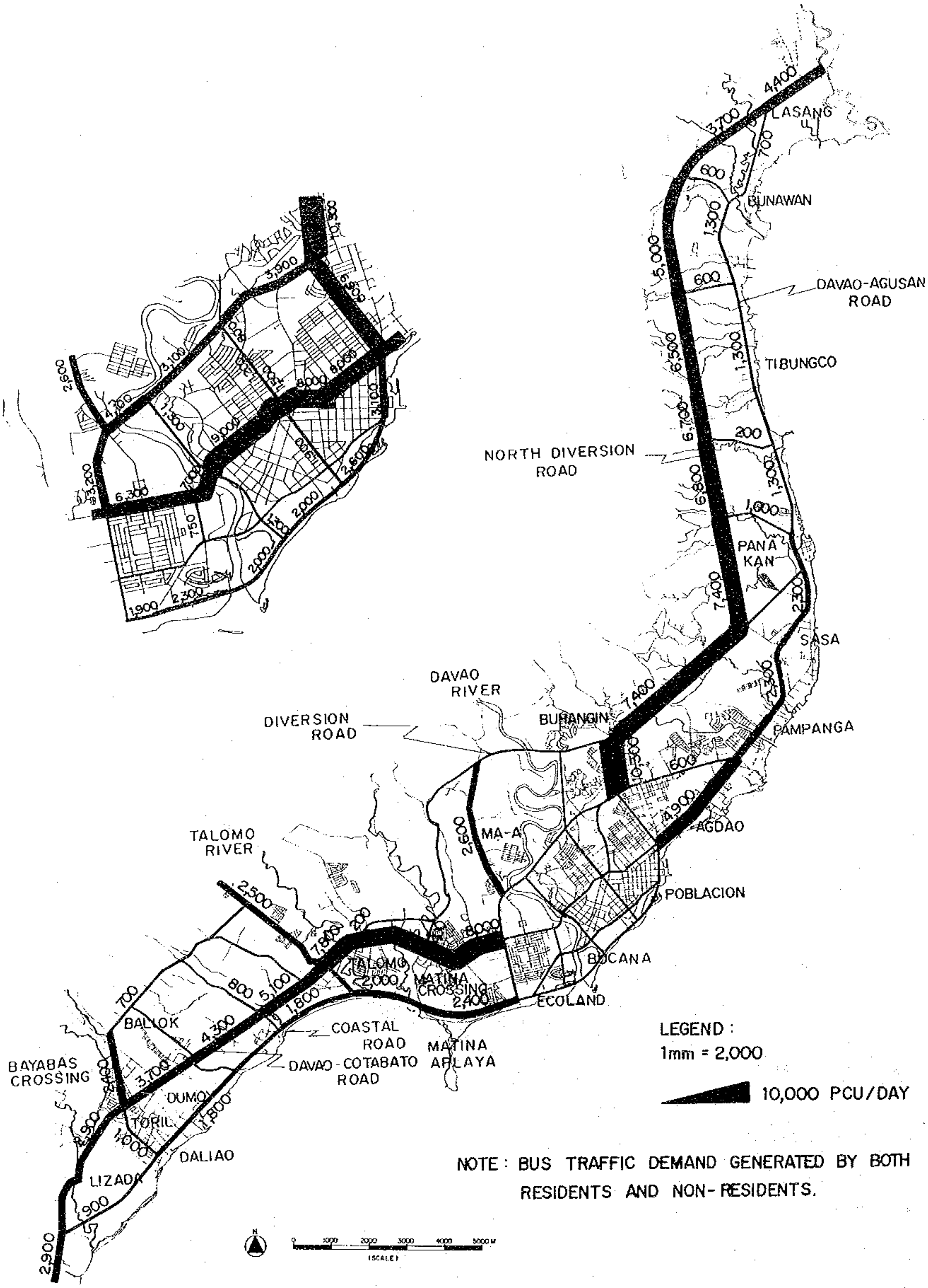


Figure 5.24 Traffic Demand of Bus, 2000 (Plan–B)

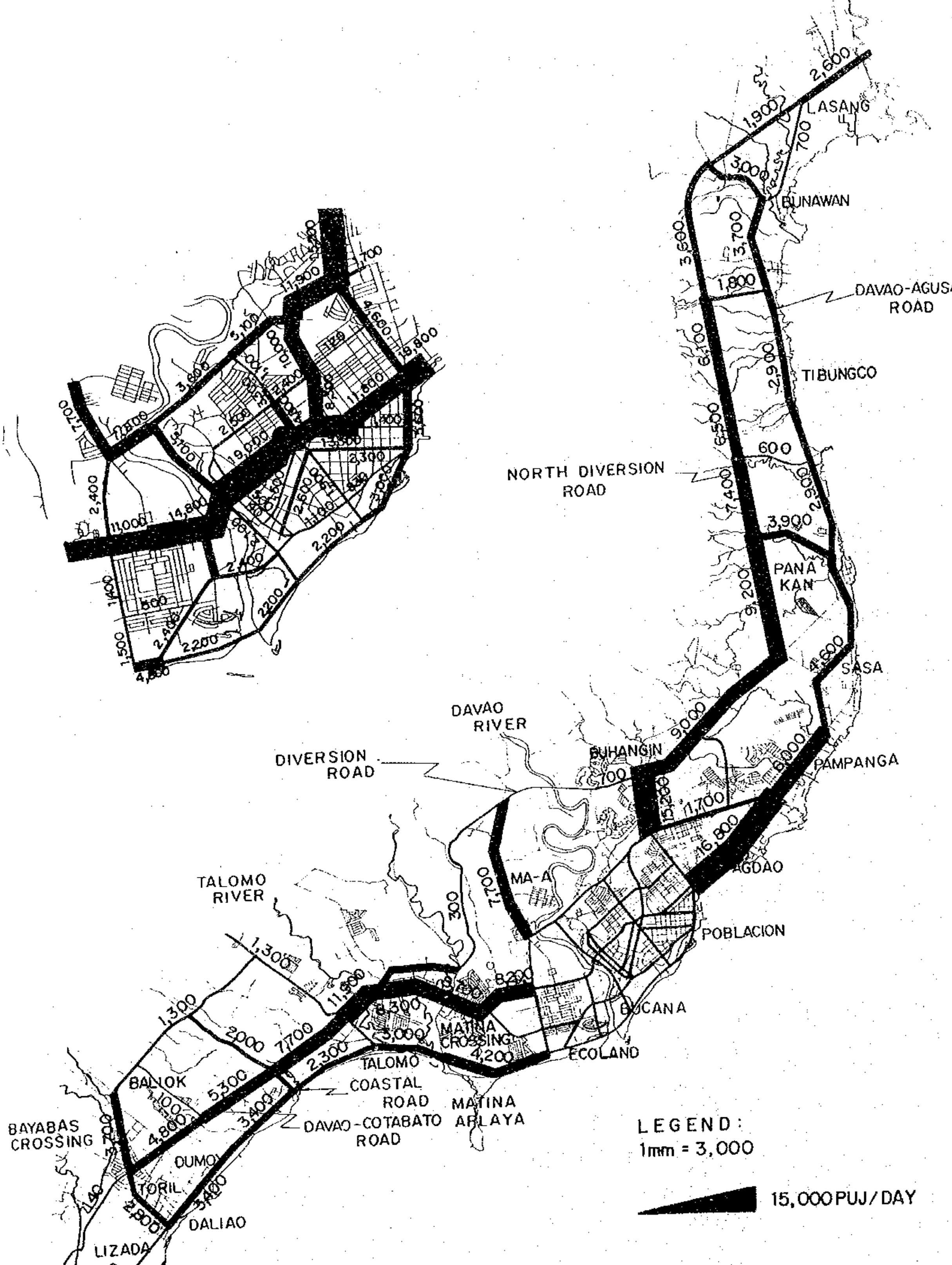


Figure 5.25 Traffic Demand of PUJ, 2000 (Plan–C)

Table 5.6 shows the number of person trips crossing Davao River by modes. Of the approximate total of 300,000 person trips/day, about 27% is served by car and the remaining 73% by modes of public transport under Alternative A, while, under Alternatives B and C, about 31% is served by car and the remaining 69% by modes of public transport.

Table 5.6 Person Trips by Mode crossing Davao River

	Mode	Plan–A	Plan–B	Plan–C
Person Trips (x 100 PT)	Car	734	923	923
	Railway	952	–	–
	Bus	817	1,450	270
	PUJ	343	473	1,634
	Pu	97	97	116
	Total	2,943	2,943	2,943
Modal Share (%)	Car	24.9	314	31.4
	Railway	32.3	–	–
	Bus	27.8	49.2	9.2
	PUJ	11.7	16.1	55.5
	PU	3.3	3.1	3.9
	Total	100.0	100.0	100.0

5.5.2 Comparative Evaluation of Alternatives

1) Evaluation Concept

The proposed three Alternative Plans are evaluated through three steps:

a. Comparison of Alternative Characteristics

The Alternative characteristics are studied and compared in terms of such indicators as passenger-kilometer, passenger-hour, vehicle-kilometer, vehicle-hour, and so forth.

b. Economic Efficiency Assessment

The annual average costs and benefits in the year 2000 are compared, disregarding project implementation schedule. The benefit is calculated as the total of savings in vehicle operating cost and passenger time cost.

c. Economic Efficiency Change Induced by Energy Cost Increase

A sensitivity analysis is done to estimate the effect on benefit, under each Alternative, of rise in energy cost, which substantially affects vehicle operating cost.

2) Alternative Characteristics

Table 5.7 compares the characteristics of Alternatives in terms of various indicator values as arrived at by assigning traffic demand in 2000 to the transport network of each Alternative. The values vary largely from one Alternative to another, due chiefly to:

Difference in the transport network
Difference in the operational characteristics of primary mode of public transport

Differences in per-vehicle passenger capacity of major modes of public transport (railroad and bus under Alternative A, the bus under Alternative B, and the PUJ under Alternative C, in the number of passenger per PCU, in route structure, in operation speed, and in other characteristics determine the shape of transport network and the volume of construction work needed for realization of the network, which in turn, determines traffic distribution.

Passenger-Kilometers (aggregate travel distance) is an important indicator directly quantifying the total volume of traffic demand. This value is greater under Alternative A than under Alternatives B and C, due to the access trip which must be made to a railroad station under Alternative A. On the other hand, Alternative A shows a relatively good value of passenger-hours (aggregate travel time) due to the rapidity of railroad service-better than Alternative C and as good as Alternative B. In anyway, all Alternatives will be a substantial improvement over the "do nothing case". It may be said that the effect of Alternatives is better reflected on reduction in travel time than on reduction in travel distance.

Unlike passenger-kilometers and passenger-hours, which show the volume of transportation demand, vehicle-kilometers (aggregate vehicle travel distance) and vehicle-hours, (aggregate vehicle travel time) show the volume of supply – or, how much of total transportation capabilities are available to meet the people's demand for travel. These supply values vary depending on the average number of passengers on each vehicle (occupancy rate) and the average operation rate of the vehicle used for the calculation of the value. The values presented in Table 5.7 assume the same occupancy and operation rates as present. Because of the presence of railroad, the vehicle-kilometer and vehicle-hour values of the bus and the PUJ are relatively low under Alternative A. Such values of the car is also low under Alternative A, due to the assumption that demand will shift from car to railroad. It is characterized that the vehicle-hour value of the bus is high under Alternative B and that of the PUJ is high under Alternative C.

Another important indicator is average volume/capacity ratio. The average volume/capacity ratios of 0.53, 0.51, and 0.47 indicated under Alternatives A, B, and C, respectively, similarly represent a substantial improvement in traffic flow from the ratio of 1.86 indicated in the "do nothing case". The distribution of the ratios, presented in Figure 5.26, indicates that almost all road sections show a ratio of only 1.0 or less under Alternatives A, B, and C, whereas, in the "do nothing case", bottleneck sections with 2.0 or higher ratio are ubiquitous.

As a conclusion, it is asserted that all Alternatives can cope with the future traffic demand.

Table 5.7 Major Characteristics of Alternatives, 2000

		Plan A	Plan B	Plan C	Do-Nothing Case
Passenger-Kms.	(000/day)	9,499	9,114	9,016	9,516
Passenger-Hrs.	(000/day)	315	365	377	905
Vehicle-Kms. by Mode (000/day)	Car	854	995	997	1,075
	Jeep	384	447	448	483
	P.U. Taxi	311	316	271	293
	PUJ	151	118	564	595
	Bus	128	222	54	54
	Truck	252	279	279	301
	Railway	17	—	—	—
Vehicle-Hours by Mode (000/day)	Car	26	30	29	69
	Jeep	11	13	13	31
	P.U. Taxi	10	10	9	19
	PUJ	9	7	28	68
	Bus	5	9	2	5
	Truck	11	12	11	28
	Railway	1	—	—	—
Average Volume/Capacity Ratio		0.53	0.51	0.47	1.86
Overall Road Capacity of the Project Area (PCU x 000 km.)		4,394	5,061	5,854	1,645
Total length of Road sections with 10,000 or more PCU's/day (Kms.)		93.9	108.8	113.4	97.5
Total length of Road Sections with 40,000 or more PCU's/day (kms.)		3.2	5.0	5.9	22.1
Total length of Road Sections with 1.0 more v/c ratio (kms.)		47.8	30.1	21.1	92.1
Total length of Road Sections with 1.5 or more v/c ratio (kms.)		5.8	5.4	2.2	69.8

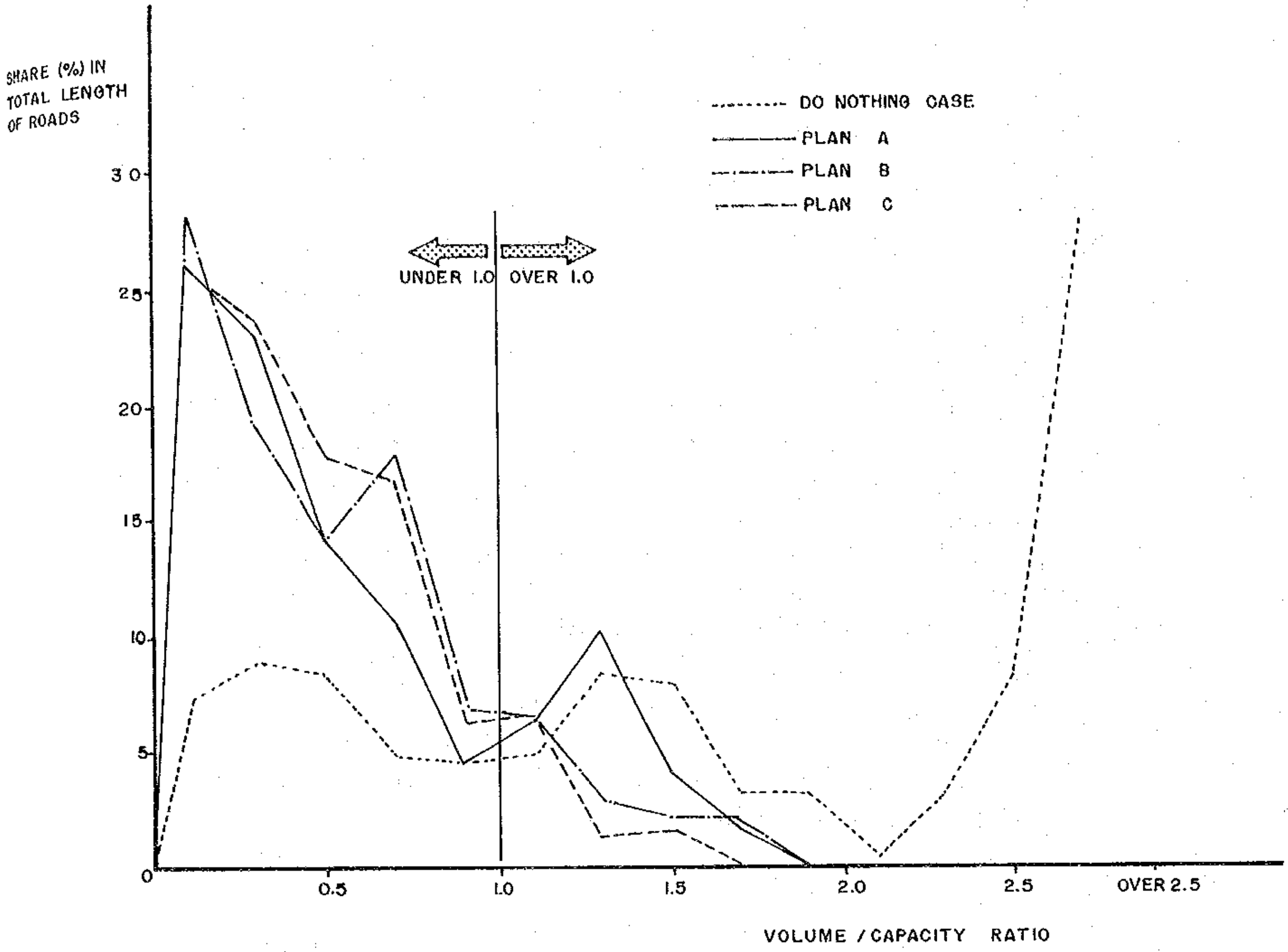


Figure 5.26 Distribution of Volume/Capacity Ratios

3) Economic Efficiency

The amounts of initial investments and repair/maintenance expenses under the Alternatives are listed in Table 5.8. Because the investment time-table is not specified yet for any of the Alternatives, the initial investment has been converted into average annual cost, added to which is average annual repair/maintenance cost in arriving at average annual total cost. Cost of railroad cars is included in the operating expense.

The economic benefit of each Alternative, on the other hand, is quantified in terms of saving in the following two costs:

Vehicle operating cost
Passenger time cost

Here, the "saving" is the amount by which total cost under each of the Alternative is less than the total cost in "do nothing case." The total cost is the total of the three products arrived at by multiplying the vehicle-kilometer, vehicle-hour, and passenger-hour values obtained from the traffic assignment under each Alternative by vehicle operating cost (distance-proportioned), vehicle operating cost (time-proportioned), and passenger time cost, respectively. The unit costs used for this calculation are listed in Tables 5.9 and 5.10 and the basis of the unit costs are explained in detail in Volume IV 3.7.

Total operating cost and saving from the "do nothing case" have been computed for each Alternative for the year 2000, using the values of these two Tables. The result i s shown in Table 5.11. The railroad operating cost has been estimated with the Metro Manila Light Rail Transit data as reference.

Table 5.8 Summary of Economic Cost

(P Million)

	Plan A	Plan B	Plan C
INITIAL COST			
Road			
A. New Construction	258.9	340.9	419.0
B. Improvement	251.2	355.2	395.6
C. Land Acquisition/ compensation	339.0	460.6	500.0
Sub-Total (A + B + C)	849.1	1,156.7	1,314.6
Rail Transit			
D. Civil Work	493.9	–	–
E. Electro Mechanical Equipment	241.7	–	–
F. Land Acquisition/ compensation	56.4	–	–
Sub-Total (C + E + F)	792.0	–	–
TOTAL	1,641.1	1,156.7	1,314.6
ANNUALIZATION OF INITIAL COST			
Depreciation[1/]			
$\frac{1}{20}$ (A + B + D + E)	62.3	34.8	40.7
Capital Opportunity Cost (Total Initial Cost x 0.15 x ½)	123.1	86.8	98.6
TOTAL	185.4	121.6	139.3
MAINTENANCE COST PER ANNUM			
For Roads	6.5	6.9	7.2
For RT (1% of D & E)	7.4	–	–
TOTAL	13.9	6.9	7.2
TOTAL ANNUAL COST	199.3	128.5	146.5

*Note: Annual maintenance cost of roads in "Do-Nothing Case" is estimated at ₱ 8.5 M/Year

Note[1/] Depreciation period is assumed 20 years considering the present railway situation in the Philippines.

Table 5.9 Economic Vehicle Operating Cost, Davao, 1980

Cost Item	Car	Jeep	P.U. Taxi	Jeepney & Auto Calesa	Bus	Truck
RUNNING COST (₱ /vehicle/km)						
Fuel	0.319	0.383	0.255	0.351	0.559	0.606
Lubricant Oil	0.005	0.008	0.004	0.007	0.023	0.023
Tire	0.026	0.028	0.029	0.051	0.109	0.113
Maintenance (Spare Parts	0.069	0.087	0.021	0.021	0.170	0.201
Maintenance (labour)	0.041	0.052	0.028	0.035	0.039	0.058
Depreciation (Distance)	0.147	0.075	0.120	0.086	0.226	0.156
TOTAL	0.597	0.633	0.457	0.580	1.126	1.157
FIXED COST (₱ /vehicle/hour)						
Depreciation (Time)	1.030	0.404	0.318	0.302	1.605	1.398
Capital Opportunity Cost	1.579	1.350	0.495	0.795	4.430	3.758
Crew Cost	1.200	1.600	2.700	2.600	6.800	5.700
Overhead & Motor Vehicle Fee	0.360	0.380	1.210	1.840	8.510	6.040
Insurance	0.460	0.460	0.460	0.810	1.000	0.890
TOTAL	4.629	4.294	5.183	6.347	21.805	17.786

Source: Estimated Based on the Highway Planning Manual, Volume 4, PPDO, MPWH

Table 5.10 Passenger Time Cost, Davao, 1980

(₱/hour)

Type of Passenger/Driver	At Work	To/From Work	Other Purposes
Car/Jeep Driver (Owner)	10.35	5.18	0
Car/Jeep Passenger	4.14	2.07	0
P.U. Taxi Passenger	4.14	2.07	0
Jeepney/Auto Calesa Passenger	2.07	1.04	0
Bus Passenger	2.61	1.31	0
Truck Passenger	1.55	0.78	0

Source: Estimated Based on the Highway Planning Manual, Vol. 4, PPDO, MPWH

Table 5.11 Calculation of Economic Benefits (Savings) for the Year 2000

(₱ million/year)

	Do-Nothing Case	Plan A	Plan B	Plan C
ROAD				
Vehicle Operating Cost	1,250.7	729.7	864.4	868.4
Passenger Time Cost	333.6	97.6	147.4	139.2
Sub-Total	1,584.3	827.3	1,011.8	1,007.6
RAIL TRANSIT 1/				
Maintenance (1% of Rolling Stock)	–	3.7	–	–
Labour	–	15.2	–	–
Material	–	10.6	–	–
Power	–	16.4	–	–
Overhead	–	4.6	–	–
Depreciation (Rolling Stock over 20 years)	–	18.4	–	–
Capital Opportunity Cost (Rolling Stock cost x 0.15 x ½)	–	34.4	–	–
(Sub-Total)	–	103.3	–	–
Passenger Time Cost	–	41.0	–	–
Sub-Total	–	144.3	–	–
TOTAL	1,584.3	971.6	1,011.8	1,007.6
SAVINGS	–	612.7	572.5	576.7

1/ Worked out based on the Metro Manila LRT data.

The Alternative Plans are compared in Table 5.12, using the respective cost (annual average) and benefit (in the year 2000) as calculated in the above.

Table 5.12 **Comparison of the Economic Benefit of the Year 2000 and the Annualized Cost**

	Plan A	Plan B	Plan C
Benefit in 2000 (₱ Million)	612.7	572.5	576.7
Annualized Cost (₱ Million)	190.8	120.0	138.0
Ratio	3.2	4.8	4.2

The above comparison of benefit in terms of saving and the annualized cost does not give the exact benefit/cost ratio used in ordinary economic evaluation, namely, the discounted cash flow analysis which cann't be pursued at this stage without any investment schedule for each Alternative Plan. However, it will give a significant information for assessing the economic justification of each Alternative and for comparing the Alternatives for their relative desirability. Given this qualification, it is observed that all of these three Alternatives are economically feasible; the economic efficiency is particularly high of Alternative B, which provides for the introduction of buses as trunk service mode.

4) Sensitivity to Energy Cost

Energy cost has been rising in the recent years, due to rapid oil price hikes. Here, the effect of an assumed average real 5% annual fuel cost increases on the above benefit-cost comparison is studied, with everything else constant. Yearly 5% increases will accumulate to a 2.65 times increase in 20 years.

Table 5.13 **Influence of the Rise of Fuel Cost on Economic Efficiency of Alternative Plans**

	Plan A	Plan B	Plan C
Benefit in 2000 (₱ Million)	775.9	645.9	618.8
Annualized Cost (₱ Million)	190.8	120.0	138.0
Ratio	4.1	5.4	4.5

As a result, it has been confirmed that all the Alternative Plans are feasible even if fuel cost will continue to increase by real annual rate of 5%. Rather, the importance and urgency of traffic improvement becomes even greater when fuel cost increases.

5) Conclusion

(1) The results of economic analyses of Alternatives A, B, and C, are all favorable and indicate that they are all feasible. Alternative B is generally more advantageous than A and C, but by a small margin.

(2) In comparison with Alternative B, Alternative C shows little greater benefit relative to substantially greater cost. Reliance only on the PUJ for public transport will not only require the greatest amount of construction cost in developing the required infrastructure, but also will involve a high level of fuel consumption for operation. Therefore, Alternative C may be ruled out at this stage.

(3) The relative economic efficiency of Alternative A is the lowest of all Alternatives. The completion of a railroad system may still be premature in the year 2000, because, while the railroad construction expenses are huge, demand expected in 2000 will not be strong enough to support it. Nevertheless, the ruling out of Alternative A based only on the foregoing analysis may not be wise, because:

a. If traffic demand will rise beyond prediction, the benefit of Alternative A will soon become greater than the benefits of Alternatives B and C.

b. Railroad has advantages over road transportation in that it offers faster service on regular basis with energy efficiency and little environmental pollution.

c. Railroad is being introduced as the means of urban transport in large cities of advanced nations and in the capitals of developing nations; transition to post-car society is an international trend of today.

(4) Sooner or later, depending on the pace of progress in regional development in Davao, the advancement of road construction, traffic demand increase trend after the year 2000, oil price increases, and other conditions, time will certainly come when the introduction of railroad system in the Project Area will be feasible and necessary. Therefore, efforts should be made for the development of a transport system which will make it easy for the introduction of railroad whenever the need arises.

(5) The road network to be completed by the year 2000 under Alternative B tends to be somewhat excessive. Particularly if railroad is to be introduced at some future time, it will be an over-investment.

(6) In view of the foregoing, the road network of Alternative A is recommended, provided that, without railroad, there will be some links with an inadequate capacity; cross section traffic capacity insufficiency is feared to result particularly between Bunawan and Panacan in the Northern Area and in the vicinity of the airport. Therefore, the adjustment of the road network toward that under Alternative B will be necessary.

(7) At the future time for the review of the Master Plan, the concept of railroad introduction should be carefully re-evaluated in the light of the effect which will have been felt by then of bus service introduction, achievement in regional development in Davao City, and the trend of oil prices, as well as the degree of demand mitigation on the car effected by the Metro Manila LRT and its transportation efficiency and operational success/failure.

CHAPTER 6 ROAD NETWORK MASTERPLAN

Tables and Figures

CHAPTER 6

ROAD NETWORK MASTERPLAN

6.1 Basic Policy

6.1.1 Road Network Formation Concept

Of the alternative transportation networks compared and analyzed in the preceding Chapter, the road network of Alternative Plan A is to be modified into the final one to be recommended. Therefore, the same four objectives are adhered to:

(1) The formation of a road network which will support future socio-economic development

(2) Achievement of convenience, safety, and amenity

(3) Formation of a traffic system with potentials for future development

(4) Formulation of a realistic plan which can be implemented

More practically, the basic concept which underlay the plan formulation process was:

(1) The road network to be developed must have a traffic capacity not less than the forecast future traffic volume

(2) Trunk roads must be distributed with suitable intervals (ordinarily 1.0 to 1.5 kilometers) between them, while the shape of network be made as simple as possible.

(3) The existing roads are to be utilized as practically as possible.

(4) In the downtown CBD area, the urban image is to be exalted by the establishment of a wide boulevard with rich vegetation, while exclusive pedestrian streets are to be established for the separation of carriageways and pedestrian walks.

(5) Ties and communications must be enhanced between the Project Area and its hinterland, while avoiding the entry into the downtown area of large cargo vehicles utilized in goods distribution.

(6) With the transitions of the major mode of public transport from the PUJ to the city bus and from the city bus to the rail-transit in mind, care and contrivance must be used so as to facilitate such transitions in the future, while avoiding investments which may become wasteful after each transition.

(7) Care must be used so as to contain the total investment within the amount of available investment fund as estimated in 5.2.3.

(8) For areas where the construction of road is anticipated to be technically difficult and for sections where land acquisition is anticipated to be difficult, alternatives are to be formulated and studied.

6.1.2 Composition of Chapter 6

This Chapter is one of the most important parts of this Plan, establishing the basic policy of road development in the Project Area toward the year 2000 and the method of traffic management in Poblacion and areas around it. The composition of this important Chapter is as follows:

Shown first in 6.2 will be the road network to be developed under the long term plan (by the year 2000) and that under the medium range plan (by 1990). together with the explanation of the roles of major roads, design standards, and standard road cross sections, as well as the justification of the road network by the result of traffic assignment.

Then, in 6.3., the development standard and the necessary development extension of roads other than trunk roads will be discussed. The amounts of investment necessary for the development of trunk roads and other roads are presented in 6.2.3. and 6.3.2, respectively.

In 6.4., technical and land acquisition difficulties expected in the process of the construction of new, and the upgrading/improvement of the existing, roads will be brought into focus, and solutions or alternative plans will be suggested.

Lastly, in 6.5., a guideline will be laid for traffic management and parking space development in CBD. In consideration that the alteration of traffic management system in response to changes in traffic situation is relatively easy, only basic policy will be shown, rather than making excessively detailed discussion. The major target year for this planning is set at the year 1990.

6.2 Trunk Road Network Plan

6.2.1 General

The three Alternative Plans have been analyzed based on various transportation indicators and evaluated for their economy and transportation policy compatibility. As a result, it has been concluded that an eclectic plan for phased transition from the bus (Alternative B) to the railroad (Alternative A) is to be recommended. Under this eclectic plan, the bus is to be introduced as the chief mode of public transport and, during the period up to the year 2000, efforts are to be made for the development, without over-investment, of a road network which will facilitate the eventual (after 2000) introduction of rail-transit. Accordingly, the road network of Alternative A is used for this recommended Plan with modifications as discussed hereunder.

The transportation demand per Alternative B (the demand when bus service is introduced) is assigned on the road network of Alternative A, and thus demand and supply (capacity) are compared and any over/under-supply is assessed for each road section. As a result, the road network shown in Figure 6.1 has been selected for recommendation. In arriving at this network, the basic policy of road network structuring discussed in Chapter 6.1. is adhered to.

6.2.2 Long Term Trunk Road Network

1) Road Network Structure and Road Function

The recommended road network to be completed by the long term target year of 2000 is shown in terms of project scale in Figure 6.2. This road network shows a ladder shape pattern and is generally coherent with the transport network pattern and the road network concept formulated in Chapter 5.1. The component major trunk roads and their functions are as follows:

i) Ring Road

Ring Road is to be created around Poblacion/Ecoland area with the aim of distributing traffic entering into this area and detouring through traffic, thereby achieving the mitigation of traffic congestion and the improvement of traffic environment in the area. Ring Road will consist of upgrading of R. Garcia Street, Dacudao Avenue and Ecoland Road and new construction of J.P. Laurel Extension, New Ma-a Bridge, Ma-a Road Extension, and Coastal Road for a total length of approximately 14.9 kilometers.

ii) Six-Lane Road

Davao-Agusan Road/Davao-Cotabato Road is an important major route as a "shaft" of the ladder shape road network in the Project Area attracting a highest traffic concentration in the Area. Therefore, it is to be upgraded to a 4-lane road throughout the entire extension of the route. Of this, the section where severe traffic congestion is expected, namely, R. Castillo Street, Lapu-lapu Street, E. Quirino Avenue, and McArthur Highway for a total length of about 10.5 kilometers, is to be further expanded to a 6-lane road to achieve a high level of bus service and bus transportation efficiency. Of the six lanes, two will be designated exclusive bus lanes.

Davao-Agusan Road/Davao-Cotabato Road (Bunawan-Toril) will be the route of, and provide land for the future rail-transit as discussed in Sub-Chapter 5.5. Therefore. the cross section of this road is to be that which will facilitate the railroad track construction; in the urban area of Poblacion, elevated track is to be used and, in other areas, track is to be built utilizing the middle strip center median of road's right-of-way. The development of a traffic core is planned for Boy Scout Area, where this 6-lane road will pass through and where bus and PUJ terminals are concentrated. The traffic system of the future is to be developed around this traffic core.

iii) M. Roxas Avenue

The development of a modern CBD which will become the "central nerve system" of Davao City has been recommended on the axis of M. Roxas Avenue, which is located literally in the middle of Poblacion, and in the area surrounded by M. Mabini Extension and E. Jacinto Street. With this in mind, M. Roxas Avenue is to be upgraded to a 4-lane road by 1990, utilizing the existing 50-meter right-of-way and aiming to stimulate the development of this area. Furthermore, it is recommended that in about the year 2000, when the development of this CBD will have been completed. this road be converted from a motor vehicle road to an exclusive pedestrian avenue – a space for people's enjoyment in this newly developed symbol zone of Davao City. Essential at this time will be the development of M. Mabini Extension and E. Jacinto Street, which exist in parallel to M. Roxas Avenue, so as to create routes alternative to the latter.

iv) Coastal Road

Poblacion and Bucana district are to be connected with each other by land with the reclamation of land from Magsaysay Park to Bolton Bridge, aiming at the stimulation of Bucana district development. A Coastal Road is to be constructed along the shore of Bucana Island. Coastal Road will not only be essential to said development but also will constitute a part of Ring Road in Poblacion area and a part of the "ladder shaft" of the road network in area between Talomo and Toril.

SIR project is underway in Piapi area on Bucana Island, and, therefore, coordination is necessary for the installation of Coastal Road. When the acquisition of land for Coastal Road is proven difficult, it will be necessary that land for the road be made available through land reclamation and other work along the coastal line.

v) North Diversion Road (Panacan-Bunawan)

In order to meet traffic demand in the Project Area extending north to south, a ladder shaped road network has been designed. In Northern Area (Panacan-Bunawan), the existing Davao-Agusan Road and North Diversion Road (Panacan-Bunawan) which is to be newly constructed on the west of and in parallel to the former, will function as the "shafts" of the ladder shaped road network. In Southern Area (Ecoland-Toril), the existing Davao-Cotabato Road and Coastal Road to run in parallel to the former will be the "shafts". The distribution of these roads aims not only to expand road capacity to meet the expanding demand, but also to provide a road network which will offer greater safety in emergency situations.

vi) Bunawan-Calinan Road

In order to enhance ties between the coastal area and the inland area of Davao City, the construction of a road between Bunawan and Calinan, where the development of agro-based industries is recommended, is planned in addition to the existing Davao-Bukidnon Road. Bunawan-Calinan Road, when completed, will not only offer a shortest route to connect Calinan area with coastal industrial area and port facilities, but will also open an alternative to the existing road (Davao-Bukidnon Road), thereby improving the safety of the area in emergency.

vii) Matters of Caution

In planning, care should be used so as that the geographical location of each road project and road alignment be studied in detail in view of possible topographical constraints and coordination with other projects.
Examples are:

- J.P. Laurel Extension and New Ma-a Bridge
(in view of topography)
- Coastal Road on the right side coast of Davao River
(coordination with SIR)

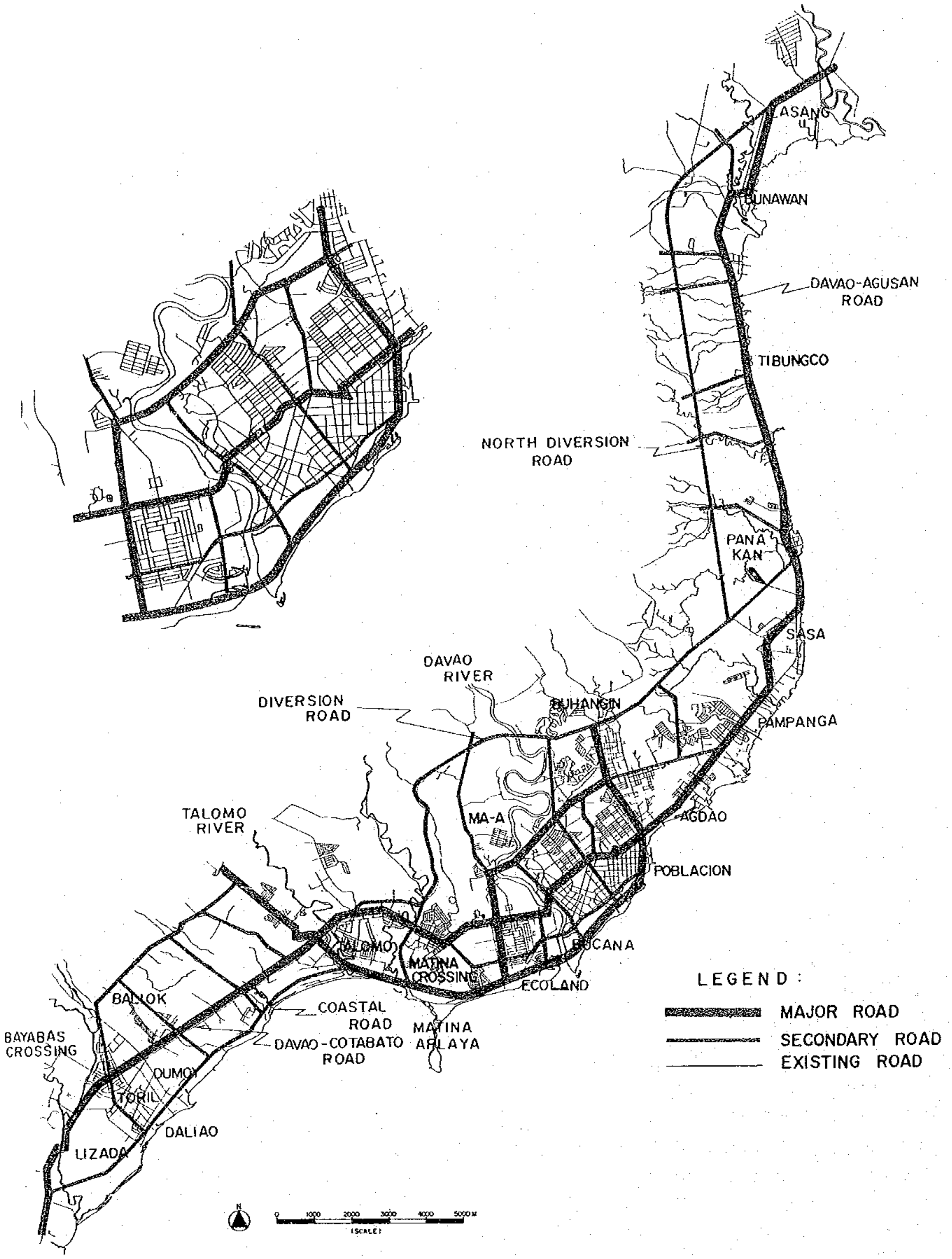


Figure 6.1 Proposed Road Network

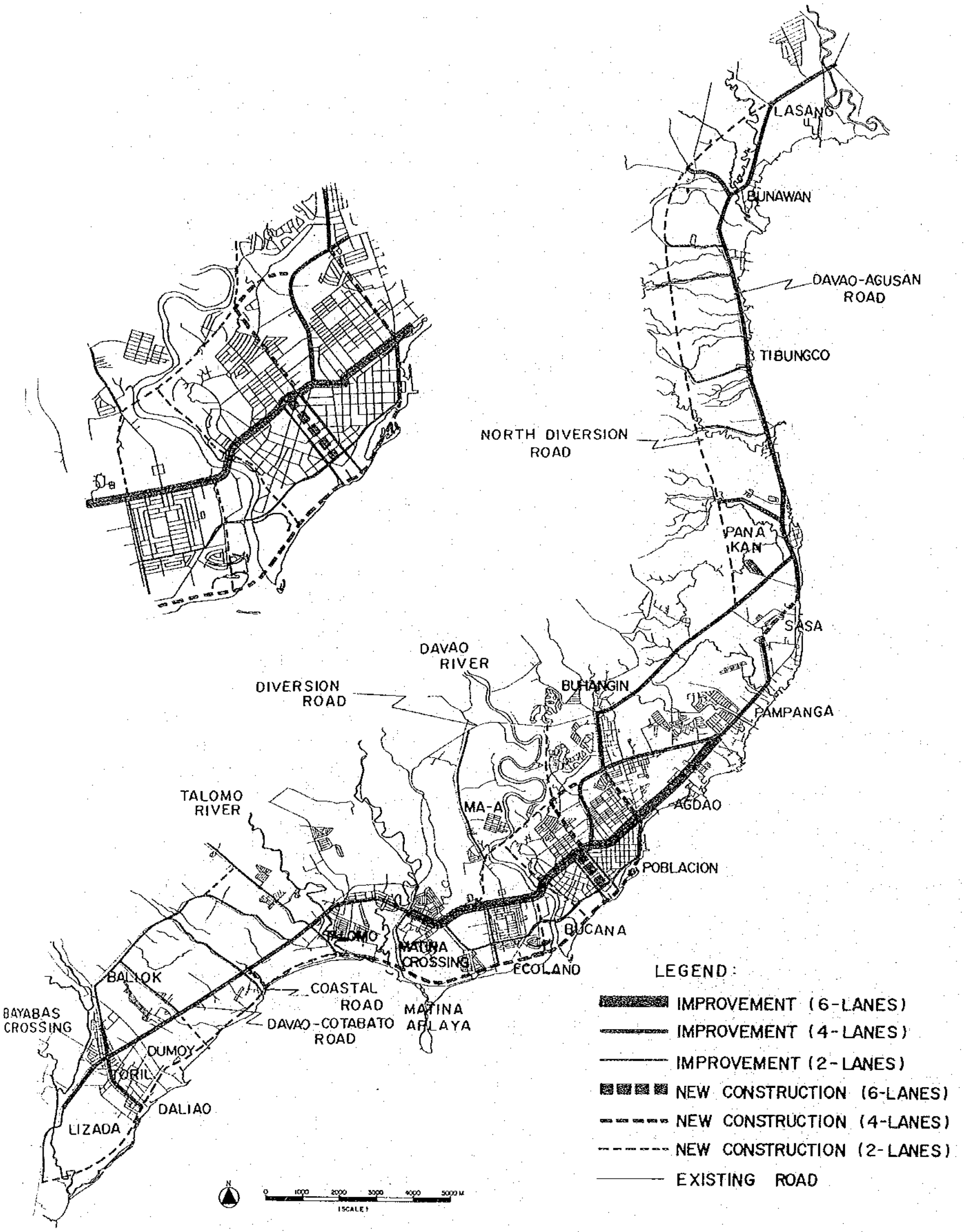


Figure 6.2 Road Network Masterplan, 2000

2) Road Design Standard and Cross Section

Urban roads have been constructed so far in the Philippines according to design standards adopted separately for individual roads, without a unified set of design standards for universal application. Roads, component parts of an integral road network, must be designed with a systematic and organic harmony with each other under unified standards of universal application, if they are to properly perform their functions for the best performance of the network as a whole. Therefore, it will be essential that road standards, which will reflect the Masterplan philosophy will be established and that each road be constructed and upgraded/improved in accordance with such standards.

Thus, road design standards have been developed through the study and review of each step followed in the process of the Masterplan formulation . The following were borne in mind in developing these standards, which are presented in Table 6.1.

(1) The establishment of a set of road design standards in conformity with the hierarchial functional levels of road: The existing road network of Poblacion is structured with roads designed by similar standards with a consequence of disorderly flow of motor vehicles on any road. To assure orderly flow of traffic, proper level of function must be achieved by each road according to proper design standard.

(2) The separation of carriageway and pedestrian walk: Sidewalk should be established as much as possible, in order not only to promote pedestrian safety but also for the expansion of traffic capacity of road.

(3) Installation of center median strip: A center median strip should be installed on major roads in order that fatal collision accidents be prevented from occurring by the separation of traffic flowing opposite directions. In Poblacion, where insufficient intervals (often less than 200 meters) between intersections are causes for reduced road capacity and increased traffic accidents, continuous center median should be created, thereby making it physically impossible for traffic from minor roads to proceed straight across a trunk road or to turn left onto a trunk road; by allowing such traffic to make only right turn onto a trunk road, the number of intersections will be reduced for greater intervals between them.

(4) Establishment of a halting lane: A halting lane should be established on urban roads where loading and unloading of passengers and commodities are required frequently. For instance, of the wide 7-meter carriageway (each direction) of E. Quirino Avenue, only one lane can be used due to the traffic blocking by vehicles stopping at the curb. The use of both two lanes will become possible, when a halting lane is installed by expanding the road carriageway width by 1.5 or 2.0 meters.

Table 6.1 Design Standard

Road Classification	Design Speed (KPH)	No. of Lanes	Width of Lane (m)	Halt Lane/ Shoulder (m)	Center Median Strip (m)	Side-Walk (m)	Right of Way (m)	Inter-Section	Minimum Horizontal Radius (m)	Maximum Vertical Grade (%)
Major Road										
Intra-City	50-60	4-6	3.25	1.5-6.5	2.0 or	4.0	30-50	Signal Control	150-200	5-6
Inter-City	60 or more	2-4	3.50	1.25 or more	1.75	—	30	Signal Control	200	5
Secondary Road	40-50	2-4	3.00	1.5-2.5	—	3.5	20-25	Signal Control	100-150	6-7
Collector Road	30-40	2	3.00	1.5-2.5	—	3.0	15-18	—	65-100	7-8
Local Road	30	2	3.00	0-1.0	—	3.0	6-12	—	65	8

Standard road cross sections are presented in Figure 6.3 , of which a) is the standard cross section of 6-lane road, whose outer lanes (one for each direction) near sidewalks will be designated exclusive bus lanes, and the center median will provide the space where piers can be errected to support elevated railroad tracks. When the elevated tracks are to be constructed, two center lanes (near the center median) can be utilized as work area, with the remaining four lanes constantly opened for use by motor traffic. The cross section of Davao-Agusan Road is shown in Figure 6.3 b) which will give the flexibility of utilizing the wide center median either as railroad track land or as exclusive bus lanes. That of Davao-Cotabato Road is shown in Figure 6.3 c), which, when railroad track is built on its center median, will be used as a 2-lane road. In this case, Coastal Road will have to be upgraded to a 4-lane road.

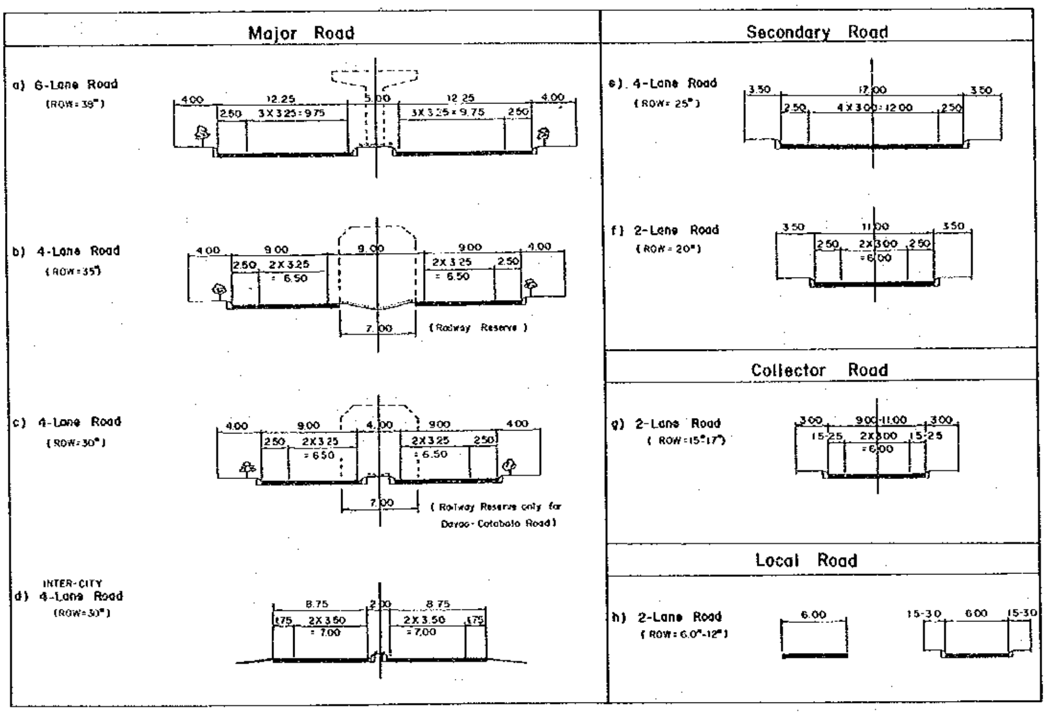


Figure 6.3 Standard Road Cross-Section

3) Traffic Demand and Improvement Effects

The long term road network must be able to fully accommodate the expanding traffic demand in the future. The result of assignment of traffic demand, the bus as the chief mode of public transport in the year 2000, to the long term road network is shown in Figure 6.4.

Such demand is strong on Davao-Agusan Road and Davao-Cotabato Road, both of which traverse the Project Area from north to south, with the traffic volume of 22,000 PCU/day and 19,000 to 29,000 PCU/day, respectively, which are enough to justify a 4-lane road. North Diversion Road (Panacan-Bunawan) and Coastal Road (Talomo-Toril), which will be constructed in parallel to said two major roads and which will constitute parts of the ladder shaped road network, are believed to perform their functions at least in terms of the volume of traffic – predicted demand on them being 6,000 to 16,000 PCU/day and 10,000 to 12,000 PCU/day, respectively.

Suggesting the importance of Ring Road around Poblacion/Ecoland, estimated traffic volume is also substantial on roads which form parts of Ring Road: 13,000 to 18,000 PCU/day on J.P. Laurel Extension, and 16,000 to 25,000 PCU/day on Coastal Road.

The greatest traffic volume in the Project Area, 29,000 to 55,000 PCU/day, is estimated for R. Castillo Street and McArthur Highway, which traverse this Ring Road from north to south. About 10-kilometer section of this route. where traffic will be particularly heavy is to be upgraded to a 6-lane road, with two of the six lanes used as exclusive bus lanes. These bus lanes should be administered carefully in view of the heavy traffic.

Table 6.2 presents important traffic indicators compiled based on the result of traffic assignment. The implementation of the Masterplan would result in substantial reductions of both passenger-kilometer and passenger-hour values. particularly by an impressive 60% in the case of the latter. The congestion ratio of "do nothing case" is estimated at 1.9 whereas, a substantial improvement is indicated by the average congestion ratio of 0.5 under the Masterplan.

While the total length of road sections where congestion ratio is 1.0 or higher is about 92 kilometers on the "do nothing case," such is only 15 kilometers, and in no section does the excess of 1.0 estimated for parts of Diversion Road (in the vicinity of Panacan) and E. Quirino Avenue should mean a little traffic handling problem, because alternative roads are available. It is judged that the Masterplan will fully accommodate the future traffic demand.

Table 6.2 Major Indicators of Masterplan

	Do Nothing Case	Masterplan (Year 2000)
Passenger-kms	9,516,000	9,075,000
Passenger-Hours	905,000	373,000
Overall Road Capacity of the Project Area (PCU x km)	1,645,000	4,991,000
Total Length of Road Sections with 10,000 or more PCU's/day (kms.)	97.5	87.2
Average Volume/Capacity Ratio	1.86	0.48
Total Length of Road Sections with 1.0 or more v/c ratio (kms.)	92.1	14.8

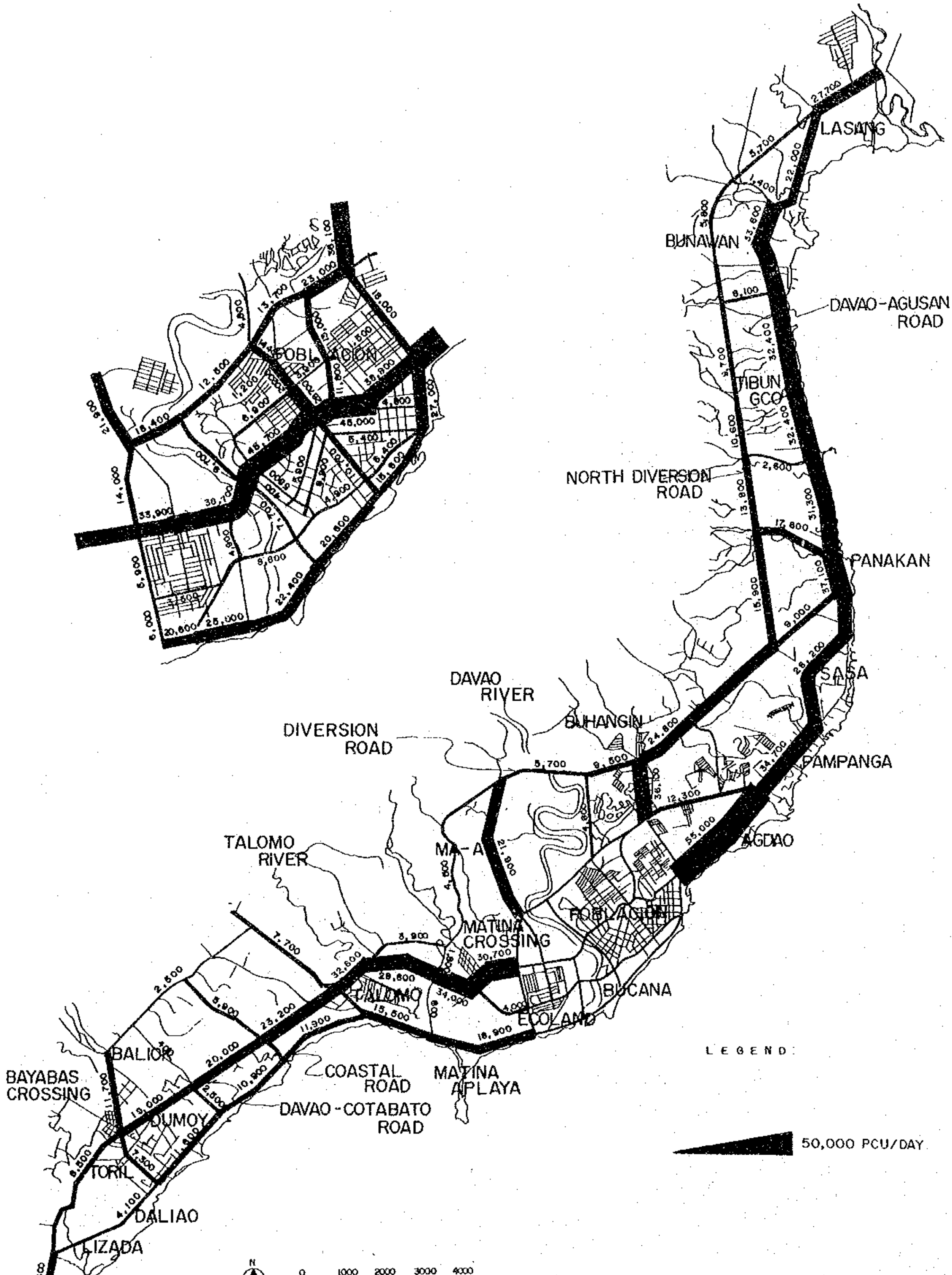


Figure 6.4 Traffic Volume Year 2000 (Masterplan)

6.2.3 Medium Term Road Network

1) Road Network Structure and Function

Medium term road network — which is to consist of the products of road projects which will be completed by 1990 in accordance with the project schedule discussed in Chapter 8— is presented in Figure 6.5 in terms of the project scale. Of all the road projects for the completion of the long term road network, those which will have been completed by the midpoint target year of 1990 will be as follows:

Ring Road

Of component roads of Ring Road, J.P. Laurel Extension and New Ma-a Bridge will be completed by 1990. In lieu of Coastal Road, which will also become a part of Ring Road but will not be completed by 1990 due to incompletion of land reclamation work at Bucana Bridge and Bucana Island, M. Quezon Boulevard and Bolton Road, which are located on the west of Coastal Road, will be used to temporarily form a ring road.

Davao-Agusan Road-McArthur Highway Upgrading

Of the entire extension of Davao-Agusan Road/Davao-Cotabato Road a route of prime importance in the Project Area now and in the future — which is to be widened to a 4-lane, the widening of a 30 -kilometer section from Bunawan to Talomo will be completed by 1990, the remainder (Talomo-Toril), where a smaller traffic volume is estimated, being scheduled for completion after 1990. Also, the upgrading of a part of this route to a 6-lane boulevard with the installation of exclusive bus lanes is scheduled for after 1990, when the bus service will be in full operation.

M. Roxas Avenue Development

Utilizing the existing 50-meter right-of-way width, M. Roxas Avenue is to be upgraded to a 4-lane road by 1990 in order to stimulate the devleopment of a new CBD along this avenue by the year 2000. At the same time, E. Jacinto Street is to be improved into a major east-west road connecting M. Quezon Boulevard, E. Quirino Avenue, and J.P. Laurel Extension. M. Mabini Extension, which runs in parallel to M. Roxas Avenue, is to start functioning as an access road connecting M. Quezon Boulevard and E. Quirino Avenue by the year 2000, when M. Roxas Avenue will be closed to motor vehicles and dedicated to pedestrian traffic.

In addition to the above, priority emphasis will be placed on the development of roads in and near Poblacion where a heavy traffic is expected to concentrate, such as J.P. Laurel Avenue, Buhangin Road (upgrading to 4-lane), M. Quezon Boulevard, Bolton Road, and Ma-a Road. In addition, Daliao-Lubogan Road in Toril and the Old National Highway (GBBC-Lubogan Road) are to be worked on in order to support land use.

2) Demand on Medium Term Trunk Road Network

In 1990, the transition of primary mode of public transport from the PUJ to the bus will be in process. Road traffic demand in this situation is assigned to the medium term road network in Figure 6.6.

The road network in 1990 will not yet show the complete ladder shaped pattern

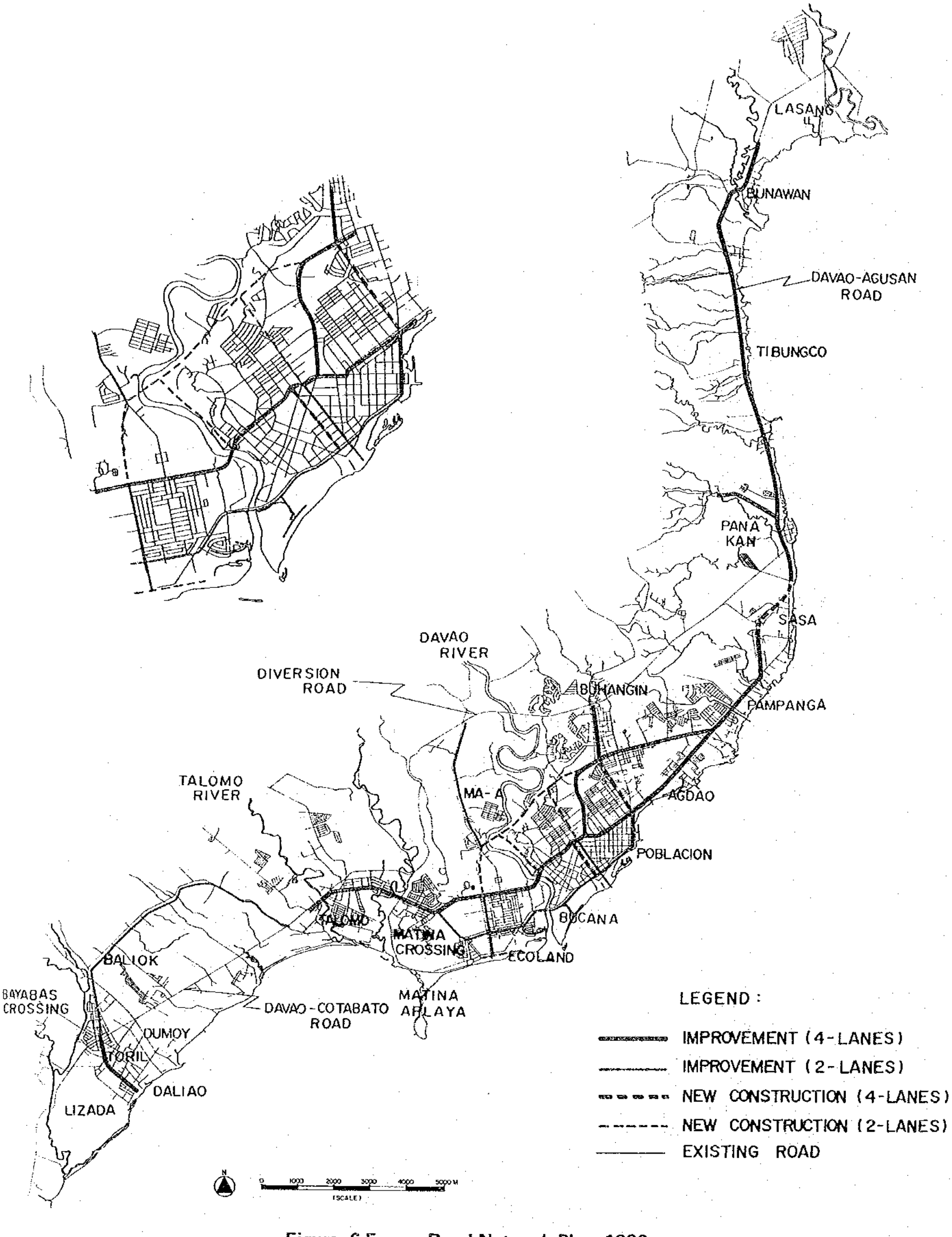


Figure 6.5 Road Network Plan, 1990

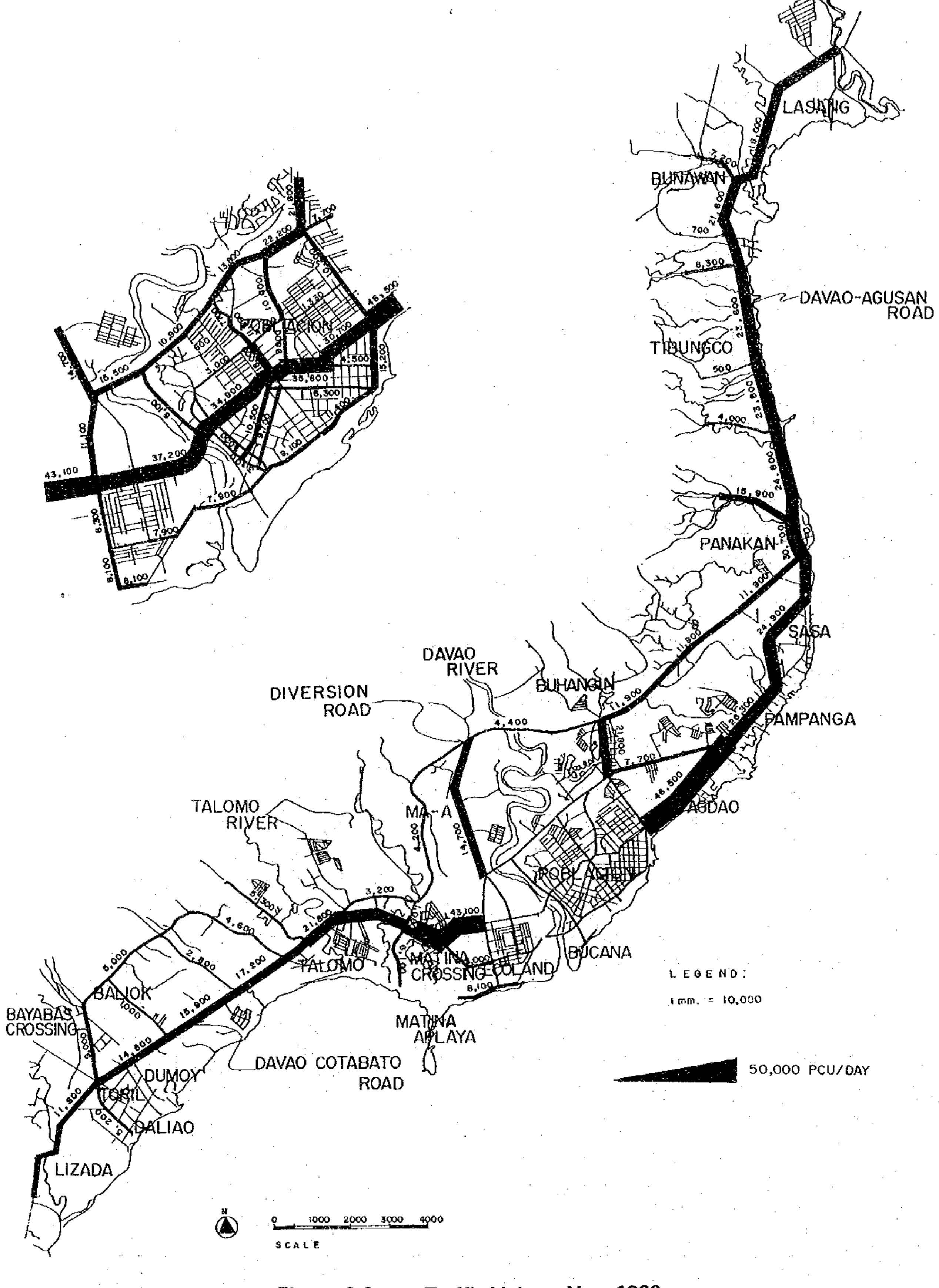


Figure 6.6 Traffic Volume Year 1990

of the long term road network, and traffic demand in the Project Area extending from north to south will still depend on two major roads: Davao-Agusan Road and Davao-Cotabato Road. On these roads, the volume of traffic is estimated to be from 18,000 to 26,000 PCU/day and 15,000 to 22,000 PCU/day, respectively, which will be somewhat beyond the capability of 2-lane roads. The Ulas-Toril section of Davao-Cotabato Road, which will still be a 2-lane road in 1990, should be upgraded (widened) soon thereafter.

In and around Poblacion, maximum traffic of 30,000 to 46,000 PCU/day is forecast in the section R. Castillo Street to McArthur Highway, whose 4-lane capacity will be about saturated. J.P. Laurel Extension/New Ma-a Road, which include said section and will constitute a part of Ring Road, is forecast to have the traffic of 11,000 to 15,000 PCU/day, indicating that Ring Road will perform its function as a distribution road.

6.2.4 Road Construction Cost

Table 6.3 shows the amounts of investment required for the construction of the medium term trunk road network by the target year of 1990 and for the completion of the long term trunk road network by the target year of 2000. The construction cost estimation assumes and is based on the same conditions discussed in Sub-Chapter 5.4.

The medium term trunk road network will consist of roads to be newly constructed for a total length of 10 kilometers and roads to be upgraded/improved for a total length of 63 kilometers by the projects to be completed by 1990 in accordance with the construction schedule recommended in Sub-Chapter 8.3. The required construction costs will total to 387 million pesos.

The long term trunk road network will consist of new roads for accumulative total length of 48.8 kilometers and upgraded/improved roads for accumulative total length of 112.0 kilometers. The cumulative total construction costs required by the year 2000 will be 1,170 million pesos. This road network has been planned bearing in mind the amount of available public investment fund (1.1 to 1.8 billion pesos) discussed in Sub-Chapter 5.2. It should be noted, however, that the road construction costs shown in Table 6.3 excludes the expenses pertaining to collector roads, local roads, and other traffic facilities. In any event, a substantial volume of road construction will be possible, judging from the estimated amount of available public investment funds, and, therefore, the recommended plan must be said financially realistic.

Table 6.3 Trunk Roads to be Developed and Construction Costs to be Invested by Years 1990 and 2000

Year	Type of Improvement	Length in Kilometers				Construction Costs in Million ₱ at 1980 Constant Price		
		2-Lane	4-Lane	6-Lane	Total	Construction	ROW	Total
By 1990	New Construction	6.3	3.4	–	9.7	75.5	76.1	151.6
	Upgrading/Improvement	19.7	43.0	–	62.7	178.5	56.9	235.4
	Total	26.0	46.4	–	72.4	254.0	133.0	387.0
By 2000	New Construction	37.1	11.7	–	48.8	342.5	171.2	513.7
	Upgrading/Improvement	43.4	57.9	10.7	112.0	384.4	269.2	653.6
	Total	80.5	69.6	10.7	160.8	726.9	440.4	1,167.3

6.3 Collector and Local Road Plan

6.3.1 Function and Planning Care

It has been predicted that, as population will rapidly increase and economic activities will be vitalized, the urbanized part of the Project Area will expand from the present 3,350 hectares to 7,860 hectares by the year 2000. In order that the healthy development of this urban area is to be achieved, the development of collector roads and local roads, in addition to trunk roads, will be essential.

The collector road (1) gathers traffic from local roads and efficiently and safely direct it to secondary roads, while distributing traffic from secondary roads to local roads and, (2) functions as the major road within a neighborhood residential community area, handling traffic destined to that area or to a neighboring area. In view of such functions, the following care should be taken in planning collector roads:

- Collector roads should not be directly connected with a major road. If connection is inevitable, the collector road should not cross the major road so that through and left turn vehicles can be eliminated.
- Through traffic should not be allowed to enter onto collector roads.
- Collector roads should be distributed with intervals appropriate to the particular purpose of land use; standard intervals are 200 to 300 meters in commercial/business districts and 500 meters in residential areas
- The distribution of collector roads must be coherent with public transport service routes.

The local road (1) serves traffic to and from the roadside housing premises (lots), (2) provides space for the installation of water pipes, drainage facilities, power cables and other public facilities, (3) provides open space needed by the residents in daily life, (4) offers open space for the preservation of desirable living environment, and (5) contours each block of housing premises. Although local roads are so basic a need to the livelihood of inhabitants as seen heretofore,local roads are conspicuously underdeveloped in some parts of Poblacion and Agdao; 3- to 5-hectare blocks – though crowded with randomly located houses – are observed to have no local road, access thereto being inevitably made on foot and the living environment being seriously deteriorated. The development of local roads with draining, water supply, and sewer facilities, currently progressing in Piapi and New Matina area under Slum Improvement and Resettlement Projects, should be extended to many other areas. Following care should be used in planning local roads:

- Local roads should be connected with each other or with a collector roads, and never directly with a major road or a secondary road.
- Through traffic should not be allowed to enter into local roads, and vehicle operation on local roads should be limited to reasonably low speed.
- Local roads should be distributed so as that traffic can be conducted to a collector road in a short distance.
- Local roads should be positioned not in conflict with the path of pedestrian flow.

- Local roads should be an integral part of the town's healthy image.

6.3.2 Required Investment

Based on the road density required for each land use purpose, the total length of road required for each land use purpose, the total length of road required in the Project Area by the year 2000 has been calculated as 780 kilometers (see Table 6.4). This will represent an overall average density of 4.3 kilometers per square kilometer, which about equals the level (4.2 km/km^2) of Metro Manila in 1980. As discussed in Sub-Chapter 6.2, 161 kilometers (21%) of this total 780 kilometers will be developed as major and secondary roads, therefore, collector and local roads will total to 619 kilometers (79%).

Table 6.4 Total Road Length to be Developed by 2000

Land Use	Land Area (Km^2)	Required Road Density (km/km^2)	Road Length (km)
Residencial	57.2	10.0	572
Commercial	9.0	8.0	72
Industrial	7.3	5.0	37
Institutional	5.1	3.0	15
Agricultural	84.0	1.0	84
Others	18.4	0	0
TOTAL	181.0	(4.3)	780

The current inventory of collector and local roads in the Project Area is 286 kilometers installed by the public sector (69 kilometers paved, 217 kilometers unpaved) and about 80 kilometers installed by the private sector in conjunction with private housing projects (almost all paved), for a total of 366 kilometers. Then, 253 kilometers more of collector and local roads are necessary to reach the required total of 619 kilometers.

The investment fund needed for the construction of 253 kilometers of collector and local roads and for the achievement of an overall pavement rate of 50% will be:

For the pavement of about 40% of the existing unpaved roads (85 km) = 70 million pesos

For the construction of new paved roads (about 40% of new roads; 100 km) = 170 million pesos

For the construction of new gravel roads (about 60% of new roads; 153 km) = 140 million pesos

Total = 380 million pesos

Judging from the estimated amount of public investment funds available, it appears rather unreasonable to assume that the entire 280 million pesos can be met with public funds. Therefore, strongly desired is private investment, such as seen in the construction of local roads in conjunction with and as a part of private housing projects. If the private sector will continue to build local roads at the trend heretofore, it is expected that about 55 kilometers of local roads will be built with about 100 million pesos of private investment.

6.4 Major Trunk Roads: Features and Technical Questions

Six-Lane Road

This road, to be made up of 6 existing roads, will be the spinal road running through about the center of Poblacion, Matina, and Agdao; the entire transport network of the Project Area will also be shaped based on this road. In commensuration with traffic demand, the road will be first upgraded to a 4-lane road utilizing the existing road right-of-way by 1987, and, in the second phase, it will be upgraded to a 6-lane road by the year 2000. In order to alleviate the expected difficulty in land acquisition (16 hectares) and building demolition (currently 33 concrete buildings) for the 13- to 18-meter road widening in this second phase, attempt should be made to acquire the necessary pieces of land as soon as possible, while statutory regulation be put in force to require that all new buildings will be set back off the proposed road right-of-way when constructed.

Between the planned Sta. Ana-Lapu-Lapu Section and a conceivable route alternative thereto (see Figures 6.8), it is believed that the planned route will have advantages over the latter, because, although the former will involve the removal/relocation of 1 church, 1 university, and 10 concrete structures, and the latter, only 1 high school, 1 university,and 3 concrete structure; the latter will require the acquisition of about twice as large a land space and make traffic handling complicated at Sta. Ana Intersection and Lapu-lapu Intersection.

Bankerohan Bridge

The Davao River divides Poblacion and the northern area from the area south of Poblacion. Bankerohan Bridge, a concrete bridge constructed in 1959, connects the two areas at the most strategic location and has already attracted a traffic of about 30,000 vehicles per day. It will continue to be the most important bridge in the Project Area in the future.

It is recommended that this path over the Davao River be widened to 6-lane by constructing, in the first stage, a new 3-lane bridge on the immediate upstream of the existing bridge by 1985, and by constructing, in the second stage, another new 3-lane bridge on the downstream by about 1996, with the existing bridge site retained for the construction of a railroad bridge upon the instruction of a rail-transit system in Davao City.

Although an alternative route shown in Figure 6.9 or utilization of the existing bridge by means of widening the existing structure at first or second stage will be possible, it is believed that the use of the existing structure in its present condition until the second phase will be more realistic and economical.

Ring Road

The central commercial/business district (CBD) will not remain confined to Poblacion but will expand to the vicinity of Ecoland in the future. A Ring Road to be formed around this expanded CBD will consist of 6 (3 new, 3 existing) roads representing 11 project elements. The Riverside Road and E. Jacinto Street, which will provide north-south connections of the formed ring, will function in unity with Ring Road and, therefore, should be completed about the same time as Ring Road. The northern hemicircle of Ring Road is to be completed by 1990 and the remaining southern hemicircle (which will be Coastal Road) by 2000. Thus, Bolton Road and M. Quezon will be used as the southern hemicircle of Ring Road in lieu of Coastal Road until its completion.

J.P. Laurel Extension route should be selected with care so as to preserve favorable environment for the subdivisions now under development. The location of the new Ma-a Bridge should be decided after careful examination of the limits of Davao River flood plain and the direction of flow.

Coastal Road

Coastal Road which will run along recreational beaches near Talomo and Ecoland, should be constructed with emphasis not only on economy but also on aesthetics and, in Bucana District, where the road will utilize reclaimed land, with a particular care that the road structure will fully support and withstand motor vehicle load. Also, it would be realistic that the southern section of the Riverside Road be built first, which will facilitate land reclamation/soil delivery and the construction of Coastal Road.

North Diversion Road

Constituting a pair with Davao-Agusan Road, this new road will run in north-south direction in the inland about 1.5 to 1.8 kilometers from the coast. As it will pass through an area highly undulating between 30 and 60 meters above sea level, it will have to clear gorges at 11 locations; it should be fully contrived so that its vertical alignment will help minimizing the volume of earthwork and the length of bridges.

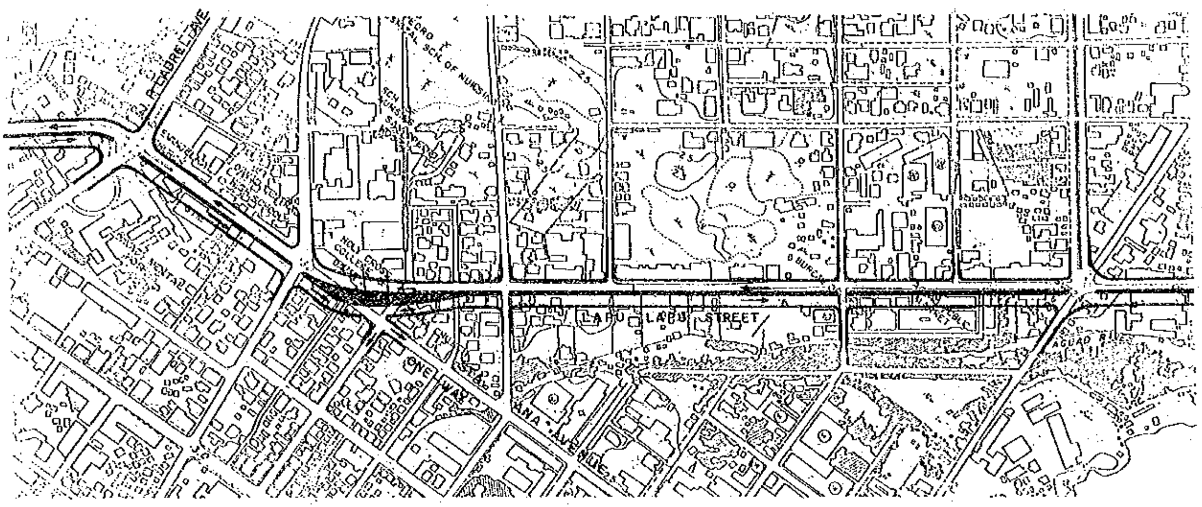


Figure 6.7 Planned Route (6-lane Road: Sta. Ana Ave.–Lapu-Lapu St. Section)

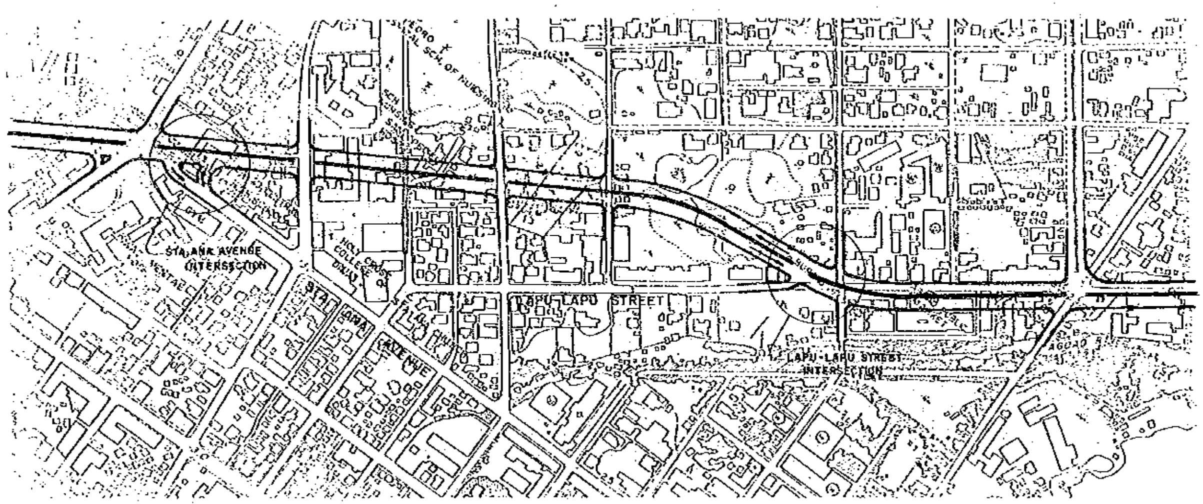


Figure 6.8 Alternative Route (6-lane Road: Sta. Ana Ave.–Lapu-Lapu St. Section)

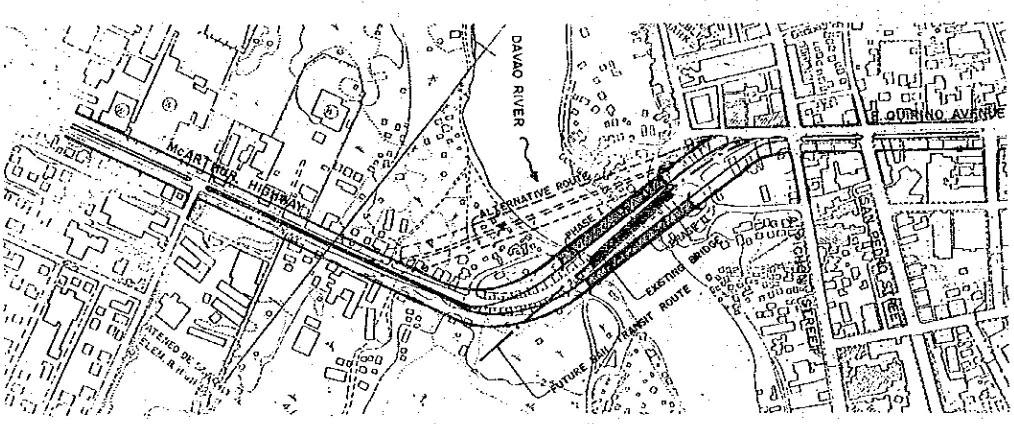


Figure 6.9 Construction Phases of Bankerohan Bridge.

6.5 Road Traffic Management Plan

6.5.1 Policy and Pre-Conditions

Road has multiple functions: motor traffic passage, pedestrian passage, public transport vehicle loading/unloading, and vehicle parking. The fundamental of road traffic management plan is to establish order so that the road may perform these functions with safety, convenience, and amenity.

1) Basic Planning Policy

- Safety

The incidence of traffic accident in Davao City is presently high on heavily travelled national and city roads, particularly on roads in CBD in Poblacion. As trunk roads will be greatly extended and CBD expanded through the redevelopment of Poblacion and the development of suburban areas and as the number of motor vehicles will increase in the future, it is feared that the incidence will quickly rise. The control of traffic accidents and the securing of safety on trunk roads are imperative.

- Convenience

Although the use of road space for multiple purposes is desirable in the significance of efficient use of public facility, to do so in an excessive degree, as seen in Davao City, tends to impair the convenience of motor traffic flow. For instance, on C.M. Recto Avenue, E. Quirino Avenue, San Pedro Street, and Sta. Ana Avenue, vehicle operation speed is inevitably held to a low 10- to 20-kilometers per hour in peak hours due to excessively frequent PUJ loading/unloading and on-street parking, the consequence being increases in total vehicle riding time and total waiting time and the degradation of PUV reliability.

- Environment

Trunk roads with their heavy traffic are sources of noise, vibration, and exhaust gas, which adversely affect the health of roadside inhabitants, though not yet an issue, such environmental pollution can develop to a serious traffic problem. Therefore, efforts must be made to minimize traffic nuisance to roadside inhabitants and to preserve environment.

2) Planning Pre-Condition

- Poblacion and the vicinity, where traffic is and will be very thinck in the future, is the area to which Traffic Management Plan is to be applied.
- The prime target year of the Plan is 1990, with long-term target year of 2000.
- The road network recommended for 1990 and that recommended for 2000 are assumed to have been completed by those years as recommended.
- The predicted traffic demand is assumed to have been realized by these target years, respectively.

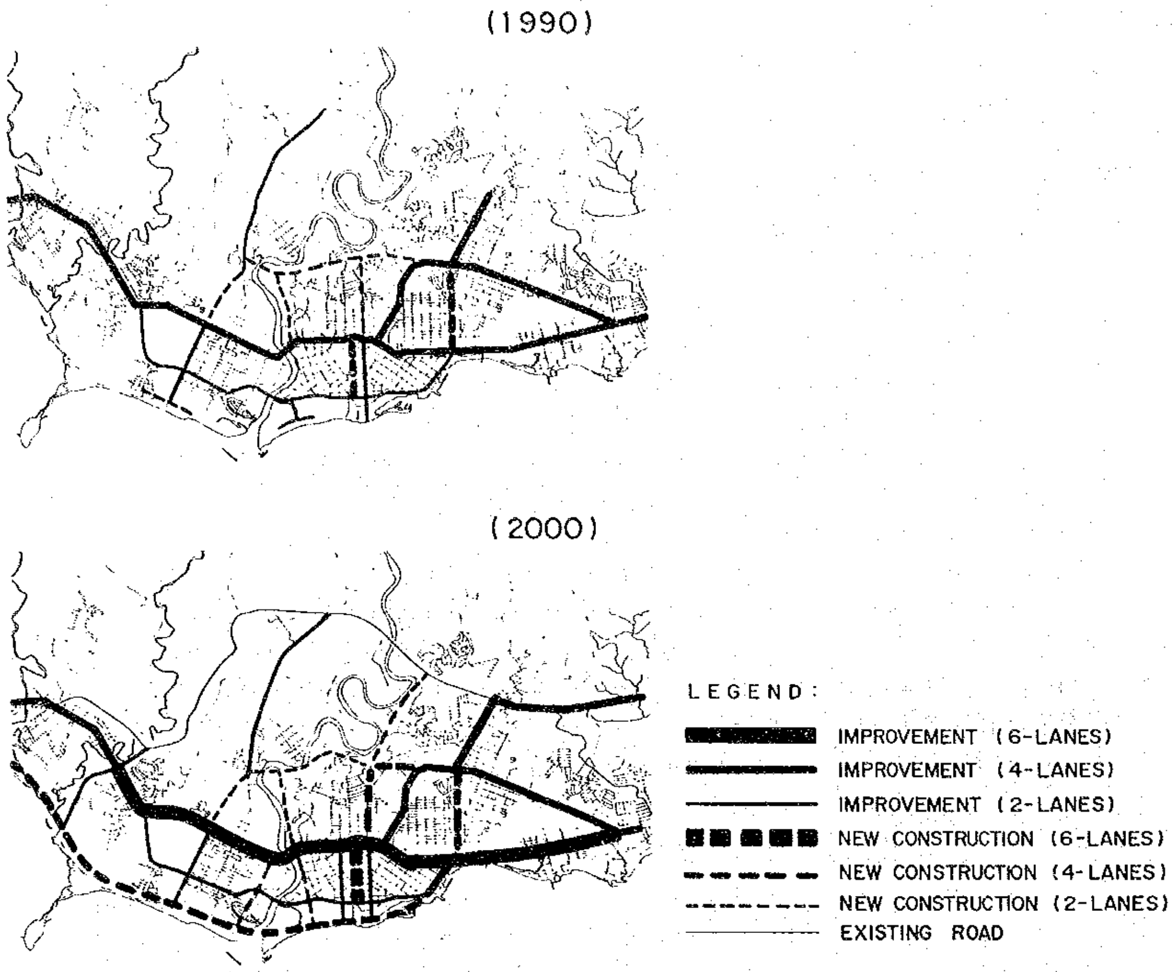


Figure 6.10 Traffic Management Planning Area and Future Road Network

6.5.2 Intersection Improvement/Traffic Signal Installation

1) Intersection Improvement Plan and Traffic Restriction

The existing road network in Davao City presents no hierarchial structure of road functions; local roads are indiscriminately connected with roads which should perform the function of major road, thereby hindering the full performance of major road function. Also, a ladder shaped road network pattern and a radial pattern coexist in Poblacion, and shaped at the interface of these patterns are multi-leg intersections, acute-angle intersections, zig-zag intersections, and other irregular intersections. These irregular shapes of intersection are much responsible for reduced vehicle operating speed, traffic congestion, and traffic accident.

In this situation, essential together with road development will be the correction of such existing irregular intersections and the effectuation of appropriate traffic control in order to secure orderly flow of traffic with few traffic accidents despite expanding traffic demand.

Intersections on roads to be upgraded/improved should be corrected at the time of the implementation of respective road upgrading/improvement projects. Aside from such intersections, a review of existing intersections in Poblacion, where the heaviest traffic in Davao City is present, has resulted in the identification of following 15 intersections whose correction is recommended, (see Fig. 6.12). The basic way of thinking for correcting intersections is also stated below.

(1) Multi-Leg Intersections

As the number of legs of an at-grade intersection increases, the number of traffic crossing, merging, and diverging points increases much faster requiring much intensified attention on the part of vehicle drivers and making the chances of traffic accident much greater as well as reducing intersection capacity.

Table 6.5 Number of Conflict Points

Number of Legs	Crossing	Merge	Diverge	Total
3	3	3	3	9
4	16	8	8	32
5	49	15	15	79
6	124	24	24	172

Therefore, multi-leg intersections are to be corrected as follows:

- As a principle, the number of at-grade intersection legs is to be reduced to four or less.
- Key intersections on trunk roads are to be signal controlled.
- As a principle, one-way traffic, no entry, and other necessary traffic restrictions are to be effected on collector roads and local roads which intersect with a trunk road.
- No parking, restricted stopping, control on the establishment of bus/PUJ

loading/unloading zones, and other necessary traffic restriction is to be effected in the vicinity of intersections, in order to maximize the effect of traffic control.

(2) Acute-Angle Intersections

At acute-angle intersections, the crossing distance and the intersection space tend to be greater than right angle intersections. Therefore, the closer to right angle the intersecting angle of two roads is, the better, Acute-angle intersections are to be corrected as follows:

- The inferior road is relocated so as that it will intersect with the superior road at right angle (or close to it) or if to do so is impossible.
- Effectuate traffic restriction on the inferior road to require full stop before entering the intersection and to allow only right turn onto the superior road (prohibiting straight crossing of, or making left turn onto, the trunk road).

(3) Too Closely Located Intersections

Too small an intervals between intersections results in increased number of conflict (traffic crossing) points for greater chances of traffic accidents and slow vehicle operating speed – hence traffic congestion. The following should govern the correction of intersections positioned too closely to each other.

- As a principle, intervals between intersections are to be at least 200 meters, in order to provide sufficient length for weaving and/or left turn lanes.
- If it is impossible to maintain the intervals of 200 meters, traffic restriction is to be effectuated on the inferior road to require full stop before entering the intersection.
- In addition to the above, appropriate road signs are to be errected.

(4) Zig-Zag Intersections

Zig-zag intersection is defined as a pair of closely positioned T-shaped intersections. The area of traffic crossing is much greater at zig-zag intersections than at normal intersections. Zig-zag intersections can be corrected either by relocating one of the inferior roads so as to form a crusiform (right-angle, 4-leg) intersection, or by relocating one of the inferior roads conversely away from the other to separate the two T-shape intersections with an interval (of at least 40 meters).

If neither of the above is possible, then channelization of traffic, such as seen in examples shown in the Figure, should be effected to minimize traffic conflicts, given the unfavorable shape of the intersection.

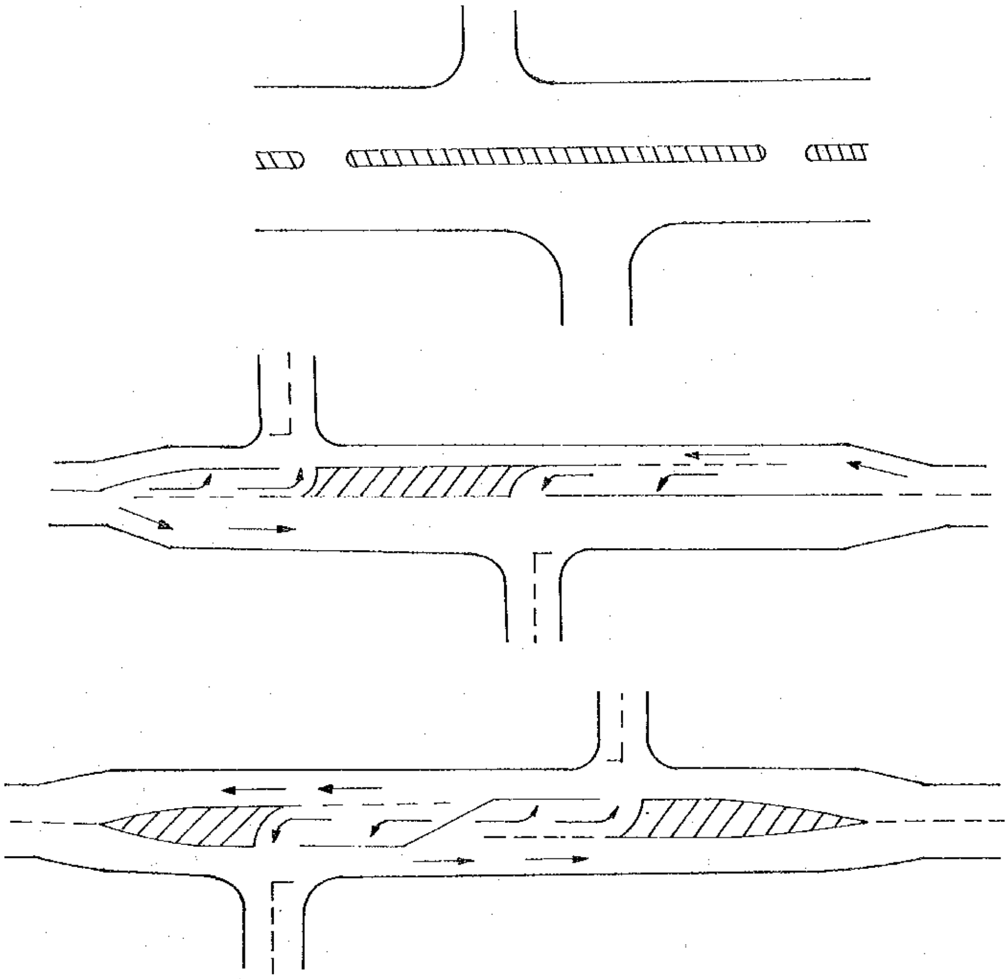


Figure 6.11 Examples of Zig-Zag Intersection Improvement

2) Signal Installation Plan

At intersections, the installation of traffic signal will facilitate the expansion of traffic capacity, reduction of traffic accidents, the securing of orderly traffic flow, and the protection of pedestrians. In and around Poblacion, 66 intersections shown in Figure 6.12, have been identified for the installation of necessary signals. Basic thinking about the installation of traffic signals is as follows:

(1) Traffic signal must be installed at intersections:

(a) On major roads, secondary roads, and collector roads;

(b) Where traffic is so heavy that the requirement of full stop on the inferior road would rather aggravate traffic confusion;

(c) Where saturation rate is 0.5 or greater (as installation standard)

(2) For the time being, automatic fixed-cycle signal is to be used.

(3) It is desirable that two or more signals installed with small intervals between them are synchronized with each other (in the direction of the main traffic flow).

(4) In order to maximize the effect of traffic signal, appropriate road signs and markings are to be installed in and near the intersection and appropriate traffic restrictions are to be effectuated in the vicinity (with about 40-meters) of intersection, to include the restriction of entry into or exits from premises and the prohibition of on-street parking and PUJ/bus loading/unloading zone.

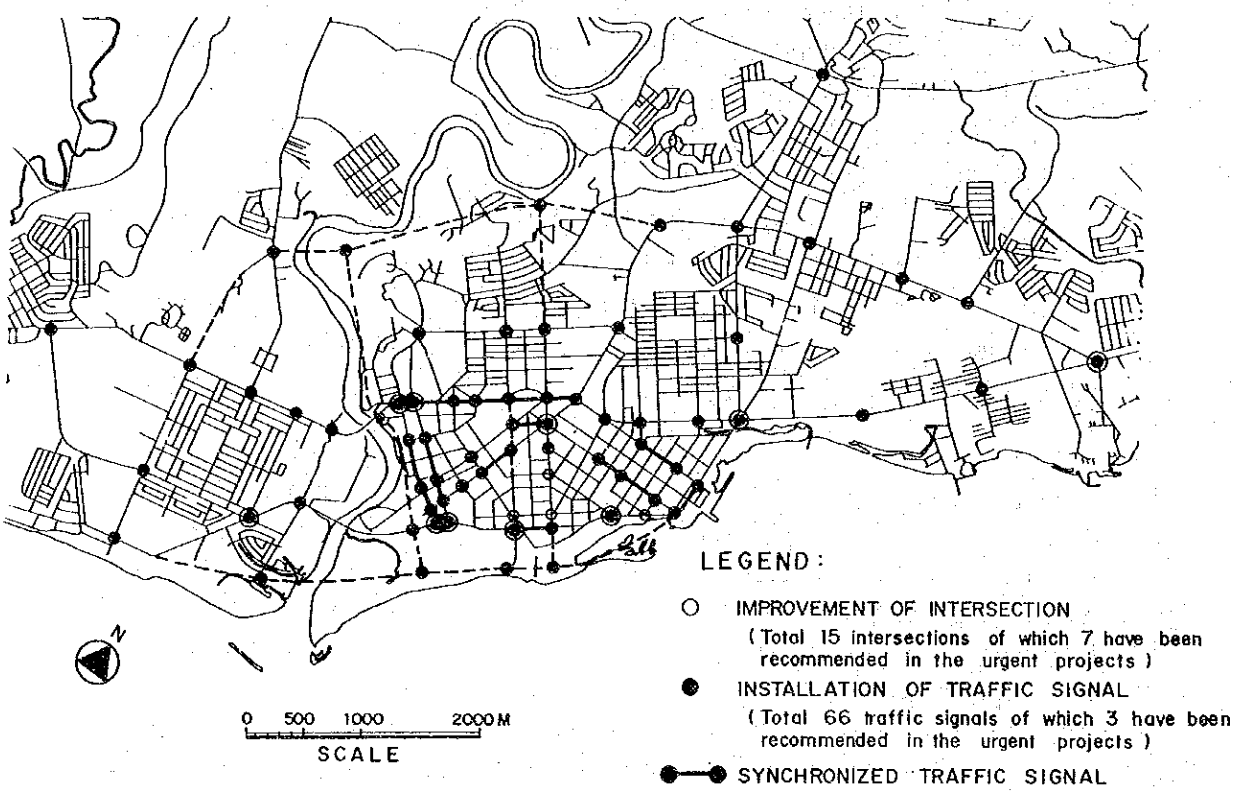


Figure 6.12 Location of Intersection Improvement and Traffic Signal Installation

6.5.3 Traffic Management Plan for Major Roads

The most important trunk road in the Project Area is Davao-Agusan-Cotabato Road, and of which, particularly R. Castillo Street, Lapu-lapu Street, E. Quirino Avenue, and McArthur Highway are to function as the public transport artery in the most congested area in and around Poblacion. In order that this road will be able to fully perform the function of major road and to support smooth and orderly flow of traffic, the following traffic management measures are in order:

- These major roads should be connected only with another major road or a secondary road under, as a principle, signal control. If under signal control, however, collector roads may be connected with a major road, provided that intervals between intersections are at least 200 meters in Poblacion and 300 meters in suburban areas.
- On collector roads and local roads otherwise connected with a major road, vehicles are to be required to make a full stop before entering into the intersection and not to make left turn onto the major road. In no event may a collector road or local road be connected with a major road in a manner as to

make intervals between intersections less than 100 meters.

- PUJ loading/unloading zones are to be installed at least 40 meters away from intersections, installed at the rate of one for each two blocks in suburban areas at the intervals of about 400 meters. These zones are to function as bus stops upon the introduction of bus service.
- Along with road upgrading, the correction of multi-leg, acute-angle, and other irregular intersections and the installation of sidewalks, street lights, and other safety facilities are to be accomplished.
- On-street parking is to be prohibited in the entire extension of Davao-Agusan/ Davao-Cotabato Road.
- Shrubs and trees are to be planted in center median and sidewalks so as to contribute to the healthy and aesthetic roadside environment.
- In addition to the above road facility development and traffic control efforts, appropriate road signs and markings are to be installed on the major road.

6.5.4 Traffic Management Plan for CBD

The existing CBD of Davao City is located along San Pedro Street, C.M. Recto Avenue, and R. Magsaysay Avenue and is gradually expanding. This CBD performs the central function of the urban activities in Davao City with not only the heavy concentration of administrative, economic, cultural, educational, information, and amusement functions, but also a dense accumulation of residential houses. Trips for commuting (to office, to school), shopping, and all other purposes converge into this CBD, but, because distinct functions are not assigned to roads in CBD, traffic overflowing from major roads are observed to enter into even narrow streets, threatening the peacefulness of living quarters. Traffic congestion is being aggravated also by road capacity reduction due to on-street parking and PUJ loading/unloading.

In order to meet the predicted future demand expansion, while maintaining the safety, amenity, and convenience in the downtown area, it is recommended that an environmental district plan, a one-way traffic system, and traffic management on M. Roxas Avenue be inplemented in CBD, as follows:

1) Environmental District and Traffic Management

Motor traffic is to be excluded from certain part of CBD to create an environmental district for the protection of pedestrians and CBD residents from traffic accidents. In the environmental district will be a network of pedestrian squares connected with each other by exclusive pedestrian streets (which are called pedestrian zones) where safe and pleasant walk is guaranteed.

In order to ensure that traffic accidents and pollution are minimized, the safety and pleasantness of walking is provided, shopping areas are promoted, and living environment is improved—as seen in a number of examples in many countries of the world—it will be necessary that the environmental district surrounded by a major road be closed to motor vehicles except on certain streets and that parking lots, PUV loading/unloading zones, and commodity loading/unloading zones be established along the major road on the outer rim of the area. The concept of environmental district is believed quite suggestive for the development of CBD in Davao City.

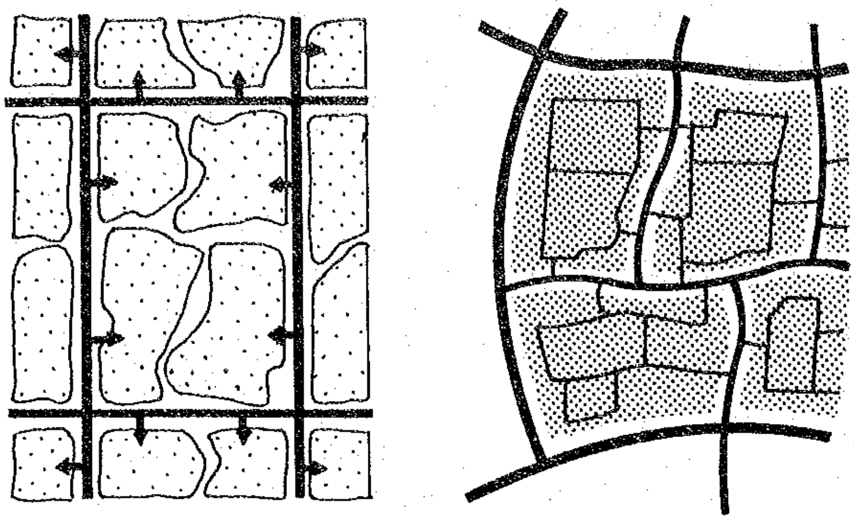


Figure 6.13 Conceptual Plan of Environmental District

(1) Measures to Secure Environmental District

The following measures are necessary in order to make downtown area a safe and pleasant area:

- The structuring of environmental district so as not to have a major road within the sectors.
- The exclusion of through traffic from environmental district by the proper street development, alteration of street structure (to create loops and cul-de-sacs), and the effectuation of one-way traffic, speed limit, and other traffic restrictions.
- The development of sidewalks and exclusive pedestrian streets, as well as the installation of safety facilities (guardrails, crosswalk, etc.) for the securing of pedestrian safety within environmental district.

(2) Environmental District: Establishment and Feature

An area of homogenous (or nearly homogenous) land use within a walking radius of man, surrounded by a major road or roads, is an appropriate candidate for environmental district. Several environmental districts are possible in CBD, but, from the viewpoint of ease of taking measures to create such areas, the following two candidates are most likely: (1) the area surrounded by Sta. Ana Street and R. Magsaysay Street, and (2) the area on M. Roxas Avenue and sandwitched by M. Mabini Street and Jacinto Street. Figure 6.14 shows the traffic management plan necessary for making these two areas Environmental Districts. Their features are as follows:

Sta. Ana-R. Magsaysay Area

- This is about 42 hectares of land surrounded by Sta. Ana Street and R. Magsaysay Avenue.
- It is planned that a one-way system be effectuated on these two roads so

that they may better perform the function of major road.

- T. Monteverde Street, running in the center of this area, is to be closed to motor vehicles for use as a pedestrian walk, children's playground and the place of communication.
- In addition, one-way traffic, no entry, and other traffic restrictions are to be effectuated in order to exclude through traffic from this area

M. Roxas Area

- This is about 34 hectares of land surrounded by E. Jacinto Street, E. Quirino Avenue, M. Mabini Street, and M. Quezon Boulevard.
- Running in the center of this area is M. Roxas Avenue with a right-of-way about 50 meters wide, and modern business district is to be developed around this Avenue in the future.
- M. Roxas Avenue is to be closed to motor vehicles and opened for exclusive use by pedestrians by about the year 2000, thereby becoming the symbol zone of Davao City.
- A cul-de-sac is to be created by prohibiting the crossing of R. Roxas Avenue in order to exclude through traffic from this area.

2) Effectuation of One-Way Traffic

As a result of the screening of candidate areas in CBD, it is recommended that one-way traffic be effectuated in the following three areas as one of traffic management techniques for the achievements of smooth and orderly flow of traffic in CBD:

(1) San Pedro Street/A. Pichon Street Area

In view of the frequent traffic congestions and accidents due to the high concentration of PUJs and other motor vehicles in this urban core with an accumulation of administrative (City Hall), educational, religious, and commercial facilities, the Urgent Implementation Program recommended the extension of A. Pichon Street up to and making a new link with M. Quezon Boulevard, the introduction of a one-way traffic system to the area in its entirety, the designation and development of PUJ loading/unloading zones, the effectuation of no parking, the installation of signals, the improvement of intersections, and the full installation of traffic signs and markings. Because the number of traffic crossing, merging, and diverging points when one-way traffic is effectuated in clockwise direction was about the same as such number when one-way is effectuated in counter-clockwise direction, the counter-clockwise direction of one-way has been selected in view of the traffic flow at A. Pichon Street/E. Quirino Avenue junction. By the effectuation of one-way traffic, on-street parking space will become available for about 250 vehicles (for a length of about 1.5 kilometers).

(2) C.M. Recto Avenue/C. Bangoy Street Area

(i) One-Way Traffic

In conformity with the direction of one-way traffic in San Pedro Street/A. Pichon Street Area, one-way traffic on C. Bangoy Street will have to flow toward south and that on C.M. Recto Avenue, toward the central traffic core. One-way traffic is to be effectuated also on collector roads connecting the two roads and on local roads.

(ii) No Parking and Stopping

On C.M. Recto Avenue and C. Bangoy Street, the right lane is to be designated no parking for the time being, Pedro Gil Street, A. Bonifacio Street, and J.P. Rizal Street, which connect C.M. Recto Avenue with C. Bangoy Street are also to be designated no parking on one side of the road. In the future, C.M. Recto Avenue and C. Bangoy Street are to be designated no parking on both sides. In this Area, total on-street parking space is for about 280 vehicles for a length of 1.7 kilometers for the time being, and 80 vehicles and 0.5 kilometers in the future.

Also, vehicles on Pedro Gil Street and J. Rizal Street are required to make a full stop before entering onto a major road.

(iii) Miscellaneous Restrictions

The designation of Bolton Road as an exclusive pedestrian road, the installation of signals, and the establishment of PUJ loading/unloading zones.

(3) R. Magsaysay Avenue/Sta. Ana Avenue Area

(i) One-Way Traffic

The number of conflict (crossing, merging, diverging) points will substantially be cut down by the effectuation of one-way traffic on R. Magsaysay Avenue and Sta. Ana Avenue. Based on the comparison of total number of conflict points at intersections in this area and on the number of conflict points at the Lapu-lapu Street/Sta. Ana Avenue Junction, which is the largest intersection in this area, it has been judged that the desirable direction of one-way traffic is as follows: On Sta. Ana Avenue, from central traffic core toward Magsaysay Park; on R. Magsaysay Avenue, from Magsaysay Park toward the central traffic core. Also, one-way traffic is to be effectuated on the collector roads which connect these two roads and on local roads in the area.

(ii) No Parking and Stopping

For the time being, the right lane of R. Magsaysay Avenue and of Sta. Ana Avenue is to be designated no parking. Also, one side of Chavez Street, Aklan Street, D. Suazo St., F. Sales Street, B. Gempesaw Street, C. Lizada Street, and F. Bangoy Street, which connect R. Magsaysay Avenue with Sta. Ana Avenue, is to be designated no parking. In the future, it will become necessary that both sides be designated no parking on R. Magsaysay Avenue and Sta. Ana Ave. On-street parking spaces are to be 440 vehicles for a length of about 2.6 kilometers for the time being, and in the future, 170 vehicles for a length of 1.4 kilometers. Vehicles will be required to make a full stop when leaving Chavez Street, Aklan Street, D. Suazo Street, B. Gempesaw Street, and C. Lizada Street.

(iii) Miscellaneous Restrictions

The designation of T. Monteverde Street as an exclusive pedestrian road, the installation of signals, and the establishment of PUJ loading/unloading zones.

3) Traffic Management on and Near M. Roxas Avenue

M. Roxas Avenue is a 4-lane road with the widest right-of-way in Davao City of 50 meters, but is still unpaved, and the acquisition of the right-of-way has not been completed. The future plan contemplates the development of a new business district along this road, with the accumulation of central administrative functions for Mindanao and with the development of a traffic core. The general direction of traffic management conceived of for this Davao City's symbol zone is as presented in Figure 6.14.

(1) Flow Path Plan

M. Roxas Avenue is to be characterized as a place for pedestrians. Motor traffic is to be directed to use E. Jacinto Street, and A. Mabini Street. Traffic core for serving a wide area is planned for the northern end of M. Roxas Avenue, and the development of new housing estates and open spaces on land to be reclaimed on the southern end. When these plans have been all fulfilled, M. Roxas "square" will be the place where the largest number of people in the Project Area will come to walk, talk, and enjoy in many ways.

(2) Traffic Control

(i) Traffic signals are to be installed at the junctions where M. Quezon Boulevard, F. R. Gomez Street, C.M. Recto Avenue, C. Bangoy Street, and E. Quirino Avenue intersect with E. Jacinto Street and A. Mabini Street.

(ii) M. Roxas Avenue is to be closed to all but emergency motor vehicles. Therefore, traffic control is to be effectuated so as that local roads which presently interesect with M. Roxas Avenue will become cul-de-sac.

(iii) The part of A. Mabini Street which is opened for service is only between F. R. Gomez Street and M. Quezon Boulevard. Therefore, F.R. Gomez Street—E. Quirino Avenue section is to be developed, together with the upgrading of local roads.

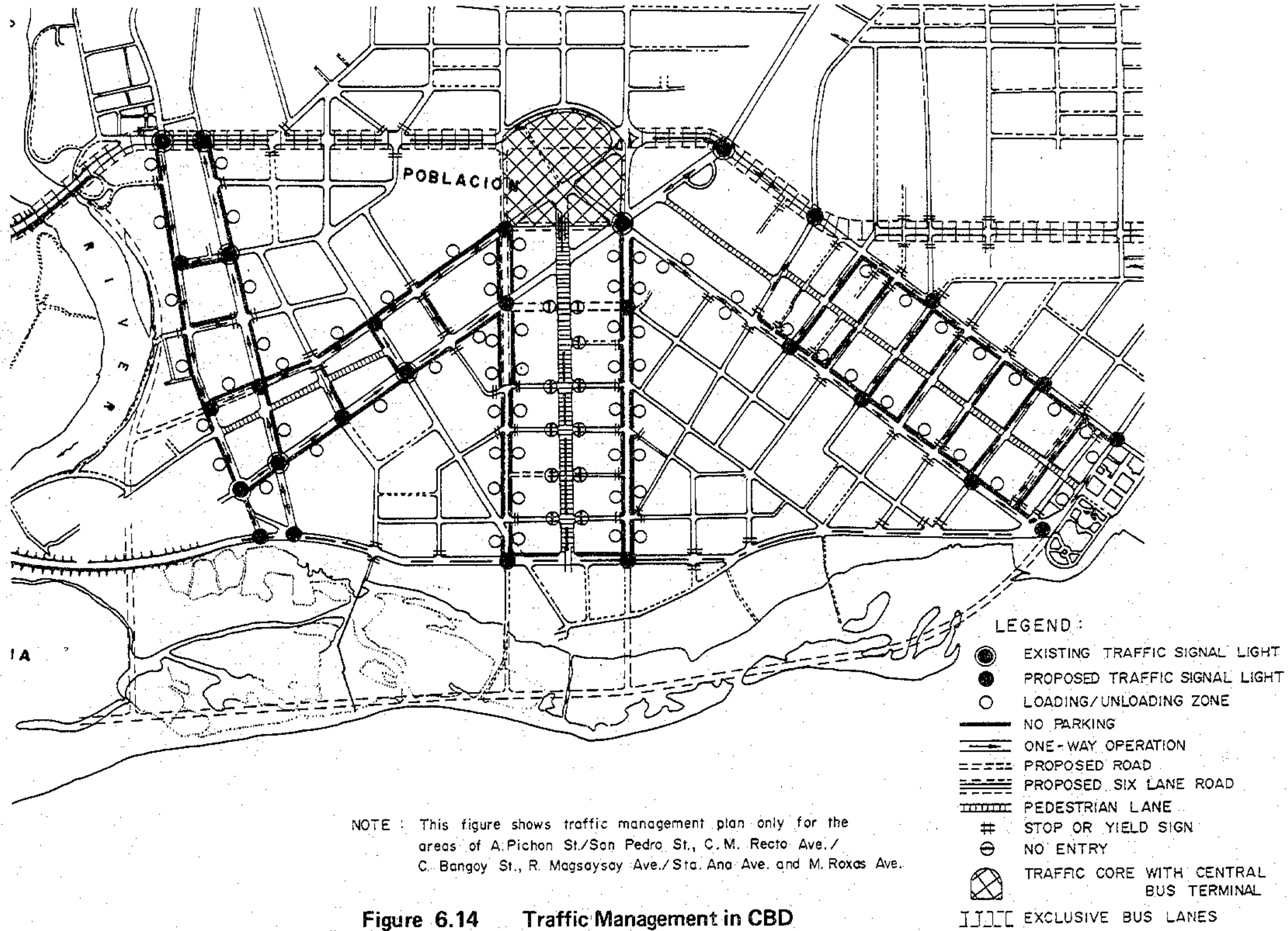
(iv) PUJ loading/unloading zones are to be installed at the rate of one for each block at the location about the middle of the block. Passenger waiting facilities are also to be developed.

(v) Acute-angle and multi-leg intersections on A. Mabini Street and E. Jacinto Street are to be corrected; sidewalks, street lights, and guardrails are to be installed; and no parking is to be enforced on both sides of these roads.

(vi) Buildings to be constructed along M. Roxas Avenue are expected to generate a substantial demand for parking space which may be beyond the capability of on-street parking on local roads. Therefore, the owners of buildings in excess of certain size are to be required to provide parking spaces, and off-street parking spaces are to be created.

(vii) In order to contribute to the desirable environment and aesthetic value of M. Roxas Avenue, shrubs and trees are to be planted, and sight seeing and resting facilities are to be planted, and sight seeing and resting facilities are to be errected.

(viii) In addition to the above road development, road facility development, and traffic control efforts, the installation of appropriate road signs and markings is to be promoted.



NOTE : This figure shows traffic management plan only for the areas of A. Pichon St./San Pedro St., C. M. Recto Ave./ C. Bangoy St., R. Magsaysay Ave./Sta. Ana Ave. and M. Roxas Ave.

Figure 6.14 Traffic Management in CBD

6.5.5 Parking Space Plan

(1) Parking Problems in Davao City

In Davao City, serious parking space shortage is felt in Poblacion. This can be understood from the fact that as much as 57% of total motor vehicle trips in the Project Area are either generated in or attracted to Poblacion. A parking survey (conducted in January 1980) of San Pedro Street, C.M. Recto Avenue, and R. Magsaysay Street, in Poblacion, where commercial facilities are concentrated, revealed a total off-street parking capacity of 1,306 vehicles in the downtown areal space of 227.5 hectares, which came to the rate of 5.74 vehicles per hectare (Table 6.6).

The person-trip survey, on the other hand, revealed the daily parking status of the entire Davao City: of the total 36,000 vehicles parked, 37% or 13,300 vehicles were parked on-street, and 63%, or 22,700 vehicles were parked off-street (see Table 6.7). In Poblacion, on-street parking is seriously impairing traffic safety and obstructing smooth traffic flow, and the establishment of parking spaces, particularly in CBD, is a great task that must be achieved through transportation planning.

Table 6.6 Parking Lots in Poblacion

Survey Area	227.5 ha.
No. of Parking Area	63
Total No. of Parking Capacity	1,306 lots

Source: 1979 Parking Survey (DCUTCLUS)

Table 6.7 Classification of Parking Trip by P.T. Survey in 1979

On Street Parking	13,300	(37%)	A
Free-Parking	22,400	(62%)	B
Paid Parking	300	(1%)	C
Total	36,000	(100%)	A + B + C
Off-Street Parking	22,700	(63%)	(B + C)

Source: P.T. Survey in 1979 (DCUTCLUS)

(2) Future Demand Forecast

The following basic policies have been established for the estimation of future parking demand:

(i) Estimation is to be based on the estimated number of person-trips by car, generated in or attracted to Block IV, as estimated by purposes, provided that "to school" trips are assumed to use other modes except car.

(ii) Car occupancy rate is assumed the same as the present— 1.8 persons per car across the board.

(iii) The turnover ratio of parking lots is assumed to be 1.0 for commuting (to office) and for "to home" trips, while that in the case of trips for business, shoppping, and private purposes, 6.0 (provided that some trips for the latter purposes utilize parking space at the place of work).

(iv) It is assumed that the parking space for trips "to office" is available at the place of work, and that for trips "to home" is available at the place of residence. Further, it is assumed that 80% of parking space to serve trips for "business", "shopping", and "private" purposes are available off-street, and 20% on-street. The off-street parking rate is held to a lower 20% than the presently registered 37%, and total no parking is assumed for all major roads and secondary roads.

(v) The parking space demand allocation in CBD assumes the development of CBD area from the current areal space of about 400 hectares (out of the total Block IV space of 2,080 hectares) around San Pedro Street, C.M. Recto Avenue, and R. Magsaysay Avenue, to about 800 hectares (nearly 40% of the Block space), cultural-educational facilities in the Block and 60% of total Block residents.

(vi) Used for the estimation of the size of land needed for the establishment of required parking spaces are the unit value of 30 square meters per vehicle for off-street parking (including on-premises parking spaces) and the value of 6 meters per vehicle for on-street parking.

(vii) It should be desirable that parking space for "to office" trips is established and operated by the employer and space for "to home" trips, by the land lord (house owner). While some of "business", "shopping," and "private" trips would utilize parking space available at the place of work (provided by the employer), the rest of parking space for such purposes of trip should be established and operated by a public organization and some by private organization with a reasonable distribution between public and private organizations.

Table 6.8 presents the result of estimation of parking space requirement in CBD based on the above policy/assumptions: a total of 18,100 lots (17,900 off-street and 200 on-street for an extension of 1.3 kilometers) by 1990, and an accumulated total of 25,800 (25,500 off-street and 300 on-street for an extension of 1.7 kilometers) by 2000.

Table 6.8 Assumption of Parking Facilities in C.B.D.

		OFFICE	HOME	BUSINESS	SHOPPING	PRIVATE	TOTAL
1) P.T. by Private Car	1979	6,470	20,948	14,392	1,809	16,396	60,015
	1990	17,449	25,235	24,508	4,069	24,645	45,406
	2000	27,288	32,408	35,749	5,802	33,286	134,533
2) P.T./Private Car				1.8			1.8
3) Private Car Trips	1979	3,594	11,638	7,996	1,005	9,109	33,342
	1990	9,694	14,019	13,616	2,261	13,692	53,282
	2000	15,160	18,004	19,861	3,223	18,492	74,740
4) Private Car Trips/ Parking Lot		1.0	1.0		6.0		
5) No. of Parking Lots	1979	3,594 + 399	11,638	18,110 ÷	6 x 0.5 =	1,509 △ 399	16,741
	1990	9,694 +1,077	14,019	29,569 ÷	6 x 0.5 =	2,464 △ 1,077	26,177
	2000	15,160 + 1,781	18,004	41,576 ÷	6 x 0.5 =	3,465 △ 1,684	36,629
6) Sub-Total of No. of parking lots	1979	3,993	11,638		1,110		16,741
	1990	10,771	14,019		1,387		26,177
	2000	16,941	18,004		1,781		36,629
7) Location of parking lots							
1990	within site/ off-street	10,771	14,019		1,110	80%	25,900
	on-street	—	—		277	20%	277
2000	within site/ off-street	16,941	18,004		1,425	80%	36,273
	on-street	—	—		356	20%	356
8) CBD/Block IV (%)		80%	60%		80%		
9) Location of parking lots in CBD							
1990	within site/ off-street	8,617	8,411		888	26,640 M²	17,916
	on-street	—	—		222	1,332M	2222
2000	within site/ off-street	13,553	10,802		1,140	34,200M²	25,495
	on-street	—	—		285	1,710M	285
10) Allocation of parking lots							
1990	Public	—	—		400		400
	Private	8,617	8,411		468		17,496
2000	Public	—	—		500		500
	Private	13,553	10,802		640		24,995

(3) Parking Lots Establishment Plan

(i) On-Street Parking Lots (Target: 200 lots by 1990, 300 lots by 2000)

On-street parking tends to impair traffic safety and to hinder smooth traffic flow. Therefore, on-street parking lots are not to be established on major roads and secondary roads. They are to be established only on collector roads and local roads, avoiding parts where the incidence of traffic accident is high and where connected with a trunk roads. As a principle, toll should be charged for on-street parking lots.

(ii) Publicly Established Off-Street Parking Lots
(Target: 400 lots by 1990, 500 lots by 2000)

Tolls collected on parking lots alone are often insufficient to pay for the operation and maintenance costs of the parking lots. Therefore, public organization(s) should be called upon to develop parking spaces up to a certain level. For the purpose of this Plan, public parking lots are to be established near the major and secondary roads surrounding CBD where multitudes of people tend to gather, namely, in the vicinity of the City Hall, of San Pedro Street, M. Quezon Boulevard intersection, of R. Magsaysay Park, and of the central traffic core area. Tolls are to be charged as a rule.

(iii) Privately Established Off-Street Parking Lots
(Target: 500 lots by 1990, 700 lots by 2000)

Privately operated off-street parking lots are to be established also near the major and secondary roads surrounding CBD where multitudes of people tend to gather, properly sharing the service areas with publicly established lots, namely, in the vicinity of Bankerohan Market, of Agdao Market, of R. Magsaysay Avenue, of M. Roxas Avenue, of C.M. Recto Avenue, and of E. Quirino Avenue.

(iv) Obligatory Parking Lots

Parking lots at the place of work and the place of residence are to be utilized by specific groups of users, and, therefore, it is reasonable to obligate the employers and the landlords (houseowners) to establish adequate parking spaces on their respective premises. These parking lots, also offered for use by visitors, will appreciate the value of the respective facilities.

(4) Parking Space Operation Profitability

(i) Basic Conditions

- Areal space per parking area: 3,000 square meters
- Parking capacity: 100 vehicles
- Unit land cost: 500 pesos per square meter
- Administration office space: 10 square meters
- Pavement cost: 40 pesos per square meter
- Unit construction cost: 300 pesos per square meter of building floor
- Number of staff: four
- Personnel expense: 800 pesos (average) per man-month

- Administrative expense: 800 pesos (average) per man-month

(ii) Initial Investment

• Land cost: 500 pesos x 3,000 m^2	=	1,500,000 pesos
• Pavement cost: 40 pesos x 3,000 m^2	=	120,000 pesos
• Other expenses:		
(1,500,000 + 120,000) x 10%	=	162,000 pesos
Total	=	1,782,000 pesos

(iii) Annual Income

2 pesos x 6-turnover x 100 vehicles x 365 days = 262,800 pesos

(iv) Annual Expenses

• Personnel Expense: 800 pesos x 4 staff x 12 months	=	38,400 pesos
• Administrative overhead	=	38,400 pesos
• Interests or Rent		
(I) If land cost included		
1,782,000 x 20%	=	356,400 pesos
(II) If land cost excluded		
132,000 x 20%	=	26,400 pesos
Total (I)		433,200 pesos
(II)		103,200 pesos

In view of the above rough profit and loss calculation, it is apparent that the establishment and operation of a parking lot by a private party will be impossible from business stand point, if a land acquisition cost is involved. Therefore, certain quantities of parking spaces should be provided by public entity, while the owner of an idle land space should be induced to participate in the establishment/operation of non-public parking spaces. Also, in view of the public nature of the service, certain tax and/or financial (loan) incentives should be offered to such private enterprises.

Table 6.9 Allocation of Parking Lots in CBD

(unit : lots)

			Office	Home	Business Shopping Private	Total Lot	Total Space
	On-Street		–	–	200	200	1.3 km.
1990	Off-Street	Public	–	–	400	400	1.2 ha.
		Private	8,600	8,400	500	17,500	52.5 ha.
	Sub-Total		8,600	8,400	1,100	18,100	1.3 km. 53.7 ha.
	On-Street		–	–	300	300	1.7 km.
2000	Off-Street	Public	–	–	500	500	1.5 ha.
		Private	13,500	10,800	700	25,000	75.0 ha.
	Sub-Total		13,500	10,800	1,500	25,800	1.7 km. 76.5 ha.

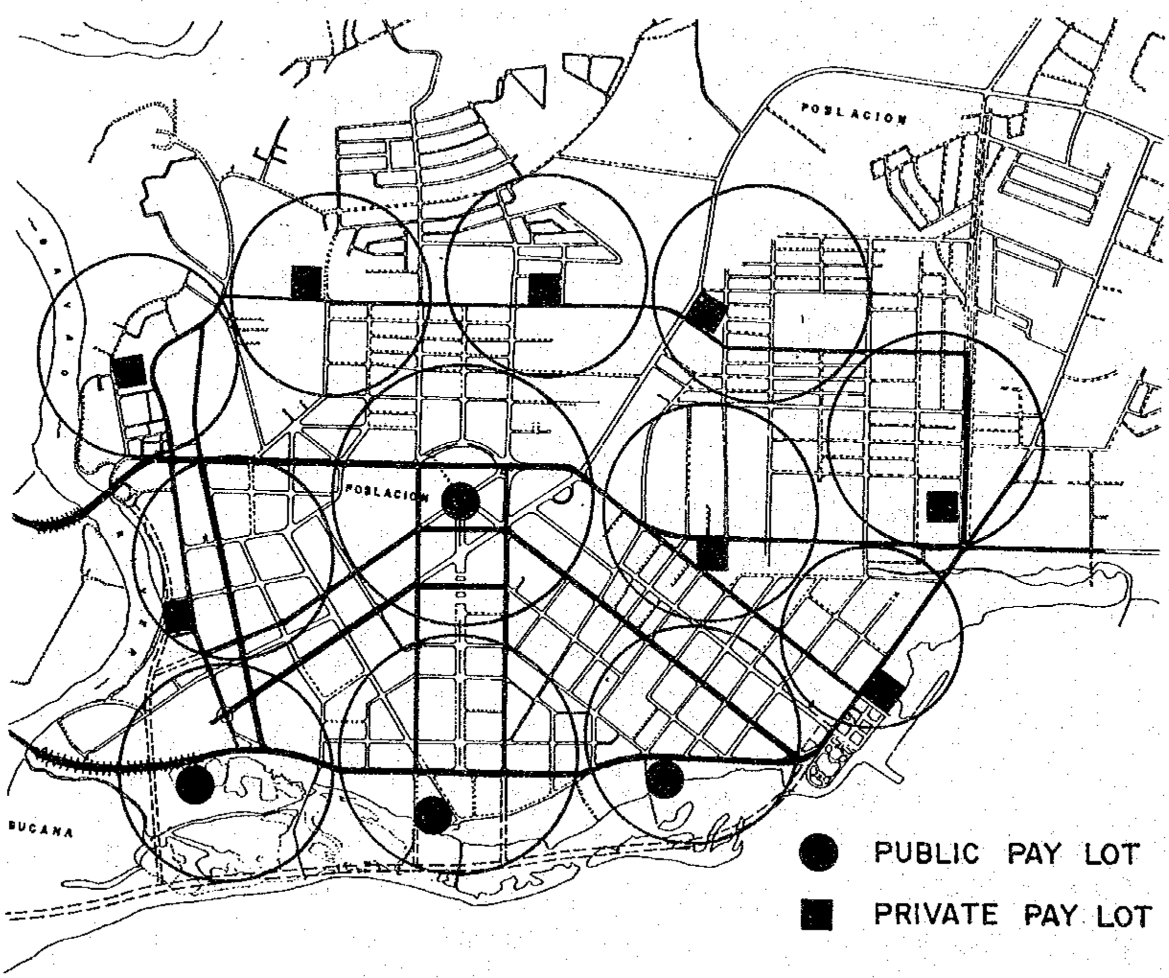


Figure 6.15 Proposed Distribution of Parking Facilities

CHAPTER 7 PUBLIC TRANSPORT PLAN

Tables and Figures

CHAPTER 7

PUBLIC TRANSPORT PLAN

7.1 Basic Policy

A public transport plan is usually an important part of urban transport plan. Particularly in a city like Davao, where rapid urban population increase and urban area expansion are expected with little hope for a high level of car utilization, people must largely depend on public transport for mobility.

This Sub-Chapter attempts to develop a future prospect of public transport in the presently jeepney-dominated Davao City, by identifying the future urban public transport demand characteristics with reference to situations in other Asian cities having a population comparable to that of Davao.

7.1.1 Demand and it's Characteristics

1) Increases in Number of Passengers and Passenger-kilometers

As estimated in Chapter 4, the total number of trips made by those utilizing public transport will be approximately 780,000 in the year 2000, which will constitute about 67% of all trips excluding walking, and is about 2.6 times the present level. This is a low increase relative to the 2.9 times in the total number of trips, but it is due to increases in the number and utilization of cars and is not to be construed to mean that public transport will play a less important role in Davao in the future (Fig. 7.1).

A review of public transport utilization in terms of passenger-kilometer value reveals the following. That is, the aggregate travel distance of public transport passengers in the year 2000 is approximately 5.45 million passenger-kilometers, which is about 61.5% of such aggregate of all modes of transport (excluding walking) and is 3.7 times the present value. The previously seen reduction in the rate of public transport trips to total trips (excluding walking) and the concurrent rise in the rate of public transport passenger-kilometer value to total passenger-kilometer value (excluding walking) from 58% to 62% means that the average length of trip by public transport will be extended rapidly. It follows that the importance of public transport service as the means of travel will increase in the Davao's urban area spreading along a long shoreline from north to south. (Fig. 7.2)

2) Trip Purpose Composition Change

Little difference is seen between the trip purpose composition of public transport passengers and that of total person-trips. Between the predicted future trip purpose composition of public transport passengers and that of the present, the following differences are noted: (Fig. 7.3. Table 7.1)

a) The composition rates of "to office" trips and "business" trips will increase, particularly the former will show a substantial increase.

b) The composition rates of "to school", "shopping", and "private" trips will decrease.

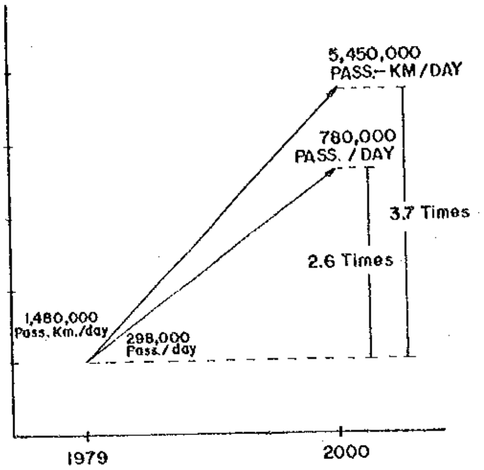


Figure 7.1 Variation of PUV Passengers

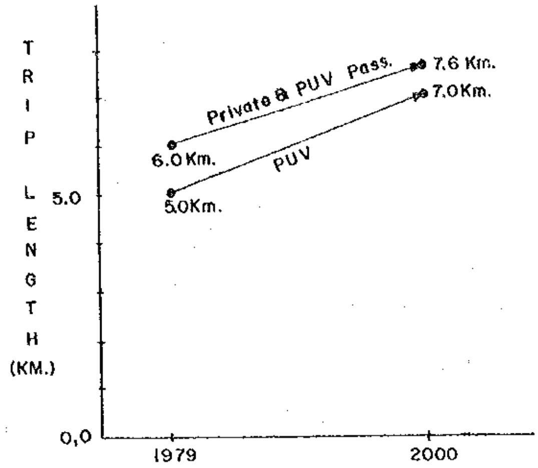


Figure 7.2 Variation of Average Trip Length

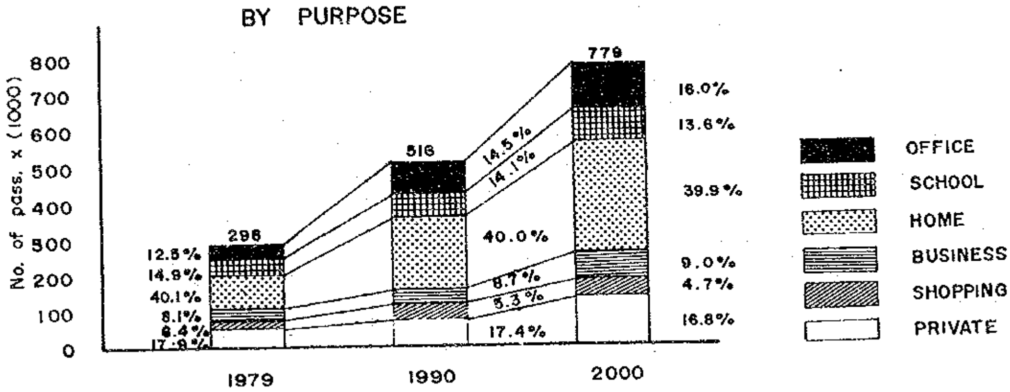


Figure 7.3 Purpose Composition of PUV Passengers

Table 7.1 Number of PUV Passenger Trips By Purpose

Trip Purpose	1979	1990	2000	Increasing Rate 2000/1979
OFFICE	37,200 (12.5)	74,900 (14.5)	124,500 (16.0)	3.3
SCHOOL	44,500 (14.9)	72,700 (14.1)	105,900 (13.6)	2.4
HOME	119,800 (40.1)	206,200 (40.0)	311,300 (39.9)	2.6
BUSINESS	24,200 (8.1)	44,800 (8.7)	69,900 (9.0)	2.9
SHOPPING	19,000 (6.4)	27,200 (5.3)	36,800 (4.7)	1.9
PRIVATE	53,400 (17.9)	90,100 (17.4)	130,900 (16.8)	2.4
UNKNOWN	300 (0.1)			
TOTAL	298,400 (100%)	515,900 (100%)	779,300 100%)	2.6

3) Change in Trip Length

Said increase in total passenger-kilometer value is attributable to increases in the length of trips by various modes of public transport. A review of the distribution of public transport passengers by trip length in 1979 shows that those of one to two kilometers were predominant and average trip length was five kilometers. As urban areas will develop in addition to Poblacion and a multi-center urban complex will be formed over the span of time from 1990 to 2000, the number of passengers whose trip length is from 5.0 to 7.5 kilometers will become predominant, by 1990, and from 10 to 15 kilometers by 2000, while average trip length will extend to 6.6 kilometers by 1990 and to 7.0 kilometers by 2000. (Fig. 7.4)

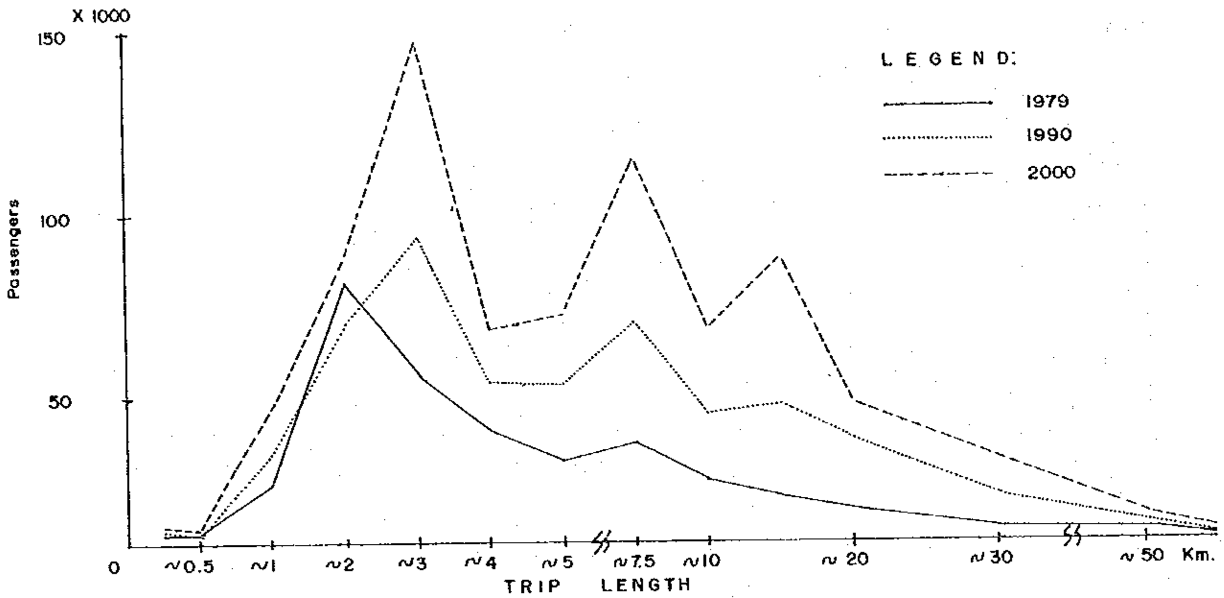


Figure 7.4 Number of PUV Passengers by Trip Length

4) Public Transport Passengers: Distribution

The division of public transport passenger travel between intra-block trips and inter-block trips will afford an opportunity to assess the geographical extent of their behavior. (Table 7.2 Fig. 7.5)

The future land use plan sees the development of each block as a self-sustaining area, but Poblacion will remain the center of the Project Area even in the year 2000 and will have much influence on the flow of transportation. Trips ending within each block will increase, while, at the same time, trips between Poblacion and other block will increase substantially with a resultant increase in the number of medium distance (5 to 20 kilometers) trips.

a) Of the total public transport passengers of 298,000 in 1979, 66% were intra-block trips and 34%, inter-block. These rates in 2000 are estimated at 55% and 45%, respectively, for an increase in the proportion of inter-block trips.

b) The rate of intra-block trips is estimated to decrease in Poblacion (Block IV) and increase in other Blocks.

c) The rate of inter-block trips between Poblacion and other Blocks is estimated to increase. Inter-block trips are heaviest between Poblacion (Block IV) and Talomo (Block V) with about 100,000 passengers, followed by Poblacion – Buhangin (Block III) with about 50,000 passengers Poblacion-Panacan (Block II) and, Poblacion-Toril (Block VI) – all having either origin or destination in Poblacion.

d) Passengers will also increase between neighboring block pairs without involving Poblacion such as Talomo-Toril and Panacan-Bunawan (Block I).

e) Few residents of the Project Area pass through Poblacion by public transport.

Table 7.2 Number of Intra and Inter-block Public Transport Passengers

	1979	1990	2000
TOTAL NUMBER OF PASSENGERS	298,000 (100)	516,000 (100)	779,000 (100)
INTRA-BLOCK PASSENGERS –	197,000 (66.2)	294,000 (57.0)	431,000 (55.3)
INTER-BLOCK PASSENGERS	101,000 (33.8)	222,000 (43.0)	348,000 (44.7)

Unit – Passengers
( ) – %

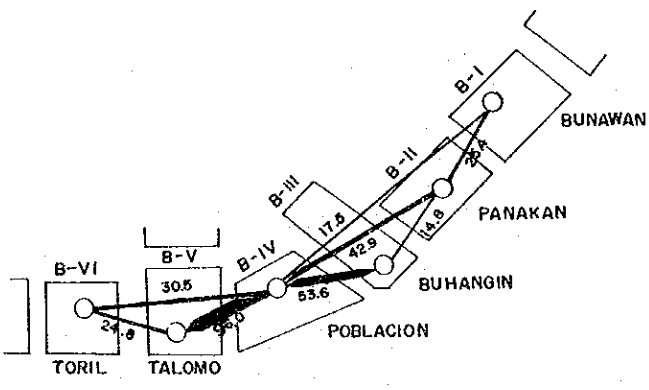


Figure 7.5 Desire Line of PUV Passengers, 2000 (x 1,000 Person Trips/Day)

5) Demand Characteristical Change: Effects and Counter-Measures

If the PUJ and the AC will continue to be the major means of urban public transport, the number of such public utility vehicles will increase from the present count of about 3,000 to about 9,000. This increase, piling up atop passenger car and truck increases, will bring about a phenomenal swell of road traffic by some 2.5 times from the present level of about 150,000 PCU-trip per day to about 430,000 PCU-trip per day by the year 2000 (Table 7.3). Also, public transport demand between Poblacion and Toril will expand from the present level requiring 60 PUJs to that which will require over 400 PUJs by 2000. (Table 7.4).

Table 7.3 Influence to Road Traffic by Increased Public Transportation Passengers Using Various Types of Public Transport Modes

	1979	1990			2000		
A. Total Passengers	430,000 $^{Pass.}$	746,000 $^{Pass.}$			1,169,000 $^{Pass.}$		
B. Passengers Using Private Car	132,000 $^{Pass.}$	230,000 $^{Pass.}$			390,000 $^{Pass.}$		
C. Passengers Using PUV	298,000 $^{Pass.}$	516,000 $^{Pass.}$			779,000 $^{Pass.}$		
		Case A	Case B	Case C	Case A	Case B	Case C
D. Vehicle Trip of Private Car 1/	73,300 ^{VT}	178,000			217,000		
Vehicle Trip of Public Utility Vehicles							
E. P U J	33,750 ^{VT} 50,625 ^{PCU}	60,500 90,750	– –	45,000 67,500	91,400 137,100	– –	48,800 73,200
F. BUS	450 ^{VT} 900 ^{PCU}	– –	22,000 44,000	5,600 11,200	– –	33,000 66,000	15,500 31,000
G. Others	31,000 ^{VT}	54,500			77,900		
H. Sub Total of PUV in Vehicle Trip	65,200 ^{VT} 82,525 ^{PCU}	115,000 145,250	76,500 98,500	105,100 133,200	169,300 215,000	111,200 143,900	142,200 182,100
I. Total Vehicle Trips	138,500 ^{VT} 155,825 ^{PCU}	293,000 323,250	254,500 276,500	283,100 311,200	386,300 432,000	328,200 360,900	359,200 399,100

1/ : NON-PUBLIC UTILITY VEHICLE

CASE A = PUV Modal Shares are following:
PUJ 93.8%, PU 6.2% in 1990 and PUJ 93.9%, PU 6.1% in 2000

CASE B = PUV Modal Shares are following:
BUS 93.8%, PU 6.2% in 1990 and BUS 93.9%, PU 6.1% in 2000

CASE C = PUV Modal Shares are following:
PUJ 70.0%, BUS 23.8%, PU 6.2% in 1990 and
PUJ 50.1%, BUS 43.8%, PU 6.1% in 2000

D = B ÷ 1.8

E = 270,000 ÷ 8 in 1979, (C – 0.062C) ÷ 8 in Case A in 1990,
(C – 0.061C) ÷ 8 in Case A in 2000

F = (1,320 + 8,500) ÷ 22 in 1979,
(C – 0.062 C) x 24.4% ÷ 22 in Case C in 1990
(C – 0.061 C) x 46.6% ÷ 22 in Case C in 2000

G = $\frac{18.700 \text{ Pass.}}{0.61}$ in 1979, $\frac{C \times 6.2\%}{0.61}$ in 1990, $\frac{C \times 6.3\%}{0.61}$ in 2000

Table 7.4 Increase of Number of Passengers and Vehicles of Public Transportation Between Poblacion & Toril

	1979	1990	2000	
NUMBER OF PASSENGERS BY PUV	4500	21,000	31,000	Pass
PASSENGER KILOMETERS	71,100	331,800	489,800	Pass-Km
NUMBER OF PUJ TO COPE WITH ABOVE PASSENGERS 1/	60	280	410	Unit
SAME IN PCU	90	420	620	PCU
NUMBER OF BUS TO COPE WITH ABOVE PASSENGERS 2/	15	75	110	Unit
SAME IN PCU	30	150	220	PCU

1/ PUJ's Average occupancy Rate = 8 pass. / Unit
PUJ's Daily Operation Distance = 150 Km. / Day

2/ BUS's Average Occupancy Rate = 22 pass / Unit
BUS's Daily Operation Distance = 200 Km. / Day

Distance between Poblacion and Toril is assumed 15.8 Kms.

Road traffic increase only brings about expanded demand for road construction. In order to fully meet the road traffic demand in 2000 with PUJs as the major mode of public transport, the construction of about 180-lane kilometers of new roads and the upgrading/improvement of about 420 lane-kilometers of the existing roads will be necessary, and the total construction cost required for this will be about 1.4 billion pesos.

From these observations, conclusion can be drawn that, without the substantial improvement in public transport efficiency, a surging swell of road traffic will be inevitable by the year 2000, and that, if the current level of road transportation service is to be sustained, huge sums of investment in road facilities will be mandatory.

While road traffic will swell, a heavy commuter traffic between home and office/school, such as seen on EDSA and Rizal Avenue in Manila, will appear on major trunk roads such as Davao-Agusan/Davao-Cotabato Road. A new means of public-transport with a capacity greater than that of the PUJ will be required on trunk roads,where concentrated public transport traffic with an orientation have appeared. The introduction of a mode or modes of public transport with a greater per-vehicle capacity and a faster service speed will contribute to the curbing of road traffic increase and the minimization of the volume of required road construction.

7.1.2 Long-Term Prospect

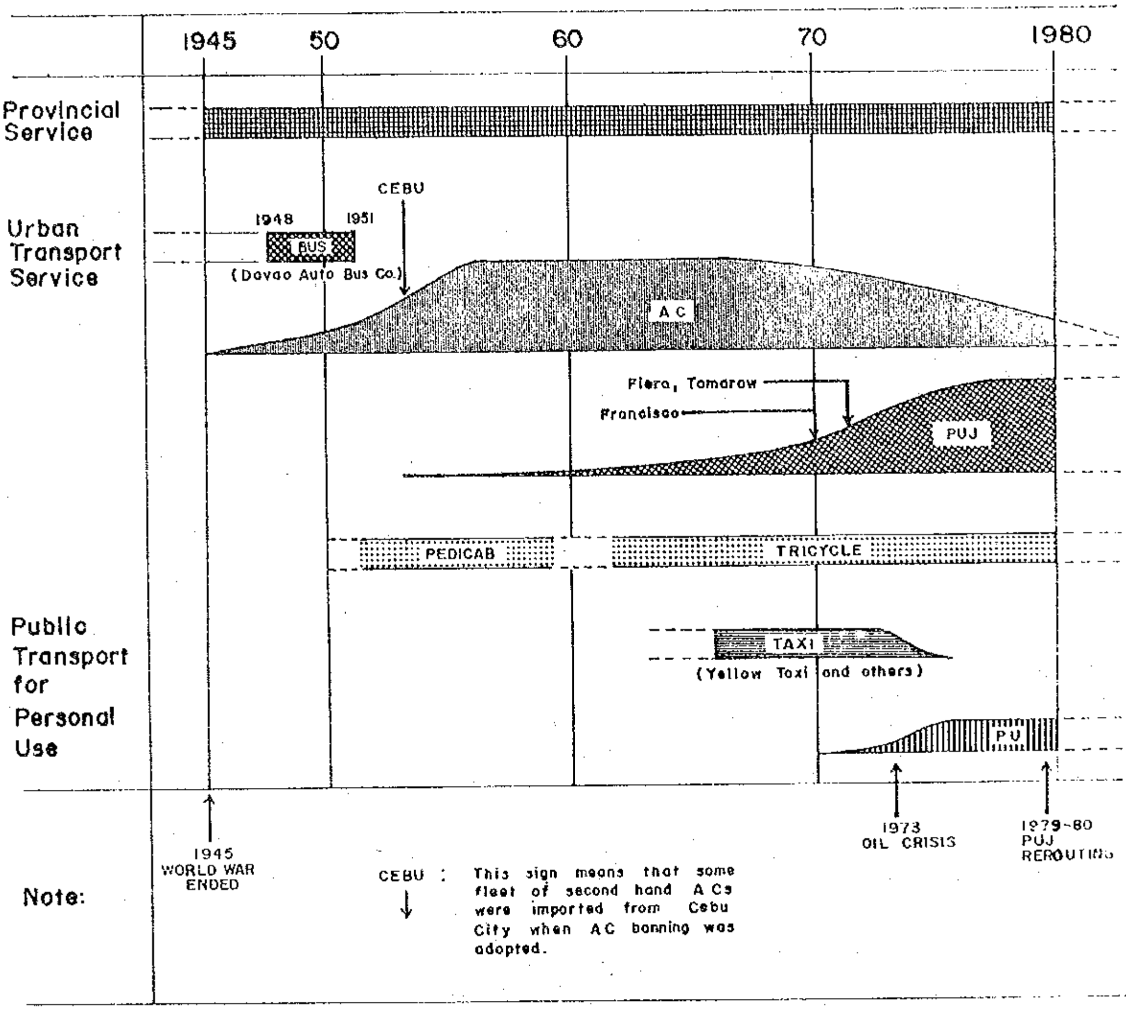
1) History

The postwar transition of public transport in Davao City can be summarized by the following three major events: (a) the postwar bus service in Poblacion was driven out of market by ACs; (b) ACs were gradually replaced by PUJs; and (c) taxi cabs were replaced by PUs.

Davao Autobus Company started to offer city bus service in 1948. With a fleet of two large buses, the service was available on the route starting from Bankerohan, following San Pedro Street, C.M. Recto Avenue, and R. Magsaysay Avenue and ending at Sta. Ana Wharf but with no predetermined bus stops; the buses used to stop at any place on the route for passenger loading and unloading at request (just as jeepneys do today). As jeepneys appeared in the postwar days and subsequently increased in number in Davao, as in elsewhere in the Philippines, and competition from jeepneys had become too severed, the bus service phased out in 1951.

These postwar jeepneys were a remodelling of used military jeep chases released from the United States Forces and were of the kind now registered as "AC". Since the beginning of the 1970's, domestic auto manufacturers raced to produce and sell chases for jeepneys with a greater passenger capacity than the postwar type. Those were the type produced by Francisco Motors and the so-called Asian cars (Ford's Fiera and Toyota's Tamaraw). The rapid increase of these new type of mass-produced jeepneys (now called PUJs) in Davao was because (a) almost all of the old type jeepneys (ACs) were approaching the end of their physical service life, and (b) jeepney operators wished to shift to PUJs with a larger capacity than the old type (ACs).

Taxi cabs existed in Davao City until about 1973, when gasoline price hike in the entire Philippines due to the oil crisis damaged the profitability of taxi operation to the extent that taxi cabs gave way to PUs. PUs, which are Mitsubishi's Minica are much more fuel efficient than taxi cabs, which are ordinary size passenger cars. Besides, PU had no fare meters installed and, therefore, could attract passengers by charging a rate somewhat lower than taxi cab rates. Thus, taxi cabs disappeared from Davao City in the middle of the 1970s. (Fig. 7.6)



SOURCE: DCUTCLUS Hearing from various officials concerned.

Figure 7.6 Historical Variation of Public Transport Modes in Davao City

The above reviewed history of public transport transition shows that the following would serve as criteria for the passenger and the operator in their selection of the mode of public transport:

a) Higher passenger convenience: which initially meant a reduction in the distance of walk before and after using the public transport. In the future, more emphasized upon will be the reduction in vehicle riding time, the regularity and reliability of service, and in-vehicle amenity.

b) Higher operational efficiency: the better fuel efficiency of smaller cars, expanded passenger capacity and easier maintenance by shifting from remodelled vehicle (initial postwar jeepneys) to dedicated chasis (such as Ford's Fiera). In addition, operational efficiency improvement by going to some larger means of transport will become important.

In search for the future public transport system most suitable to a given city, it is a matter of course that the peculiarities of the city must be taken into full account. On the other hand, however, it is vitally important that the universal process through which public transport system are being developed in many cities, while the cities accomplish their growth, be traced and analyzed in order that plans for the subject city will have a degree of rationality of universal application.

In the 1970s, public transport systems in the capitals and major cities of Asian countries were developed generally under the following policies: (Table 7.5)

a) In the cities of a population of about one million, urban transport requirement was usually met with such small means of transport as mini-buses and jeepneys, rather than by ordinary size buses. In many of such cities, efforts were made for the improvement of existing public transport systems or for the introduction of ordinary size buses under a medium range plan. (Examples: Kuala Lumpur, Cebu, Chiang Mai)

b) In the cities of a population of about three million, ordinary size buses were relied upon for urban transport service. In many of such cities, efforts were made for the improvement of the city bus system under short term or medium range plans, together with efforts to introduce rail-transit in the future under a long range plan. In Bangkok, for instance, measures were taken for the securing of land for use as future railroad tracks upon the introduction and improvement of the city bus system.

c) In many of cities with a population in excess of four million, the capacity of city bus system became short of satisfying the demand, and the introduction of rail-transit system was either under feasibility study, being accomplished, or had been completed.

Table 7.5 Comparison of Public Transport Characteristic of Major Cities in Asia

Name of City	ALOR SETAR	FUKUI	DAVAO	KUALA LUMPUR	CEBU 1/	CHIANG MAI	BANGKOK	JAKARTA	MANILA 1/	SEOUL	TOKYO 1/
Population (Million)	0.1 (1970)	0.5 (1975)	0.6 (1979)	0.8 (1970)	0.9 (1980)	1.1 (1975)	3.1 (1970)	4.2 (1970)	4.0 (1971)	5.5 (1970)	28.0 (1975)
3/ Modal Share for Public Transportation Mode	20%	13%	44%	40%	81%	61%	66%	61%	62%	95%	53%
Public Transportation Mode at present	Rail 0% Bus 15% PC 5%	Rail 6% Bus 7% —	— Bus 1% PC 48%	— Bus 35% PC 5%	— Bus few PC main	— Bus 19% PC 42% (Mini Bus)	— Bus 59% PC 7%	— Bus 60% — Other 1%	— Bus 19% PC 37% Other 6%	— Bus 74% PC 21%	Rail 45% Bus 8% —
Plans for R.T. Service	2/ Introduction of Intra-City Bus Service.	Improvement of Bus System is on-going.		RT will be introduced after 2000. Bus system Improvement is now on-going.	LRT will be introduced after 2000. Introduction of Intra-City Bus will be in 1990.	2/ Improvement of Mithi Bus System.	Bus Project	● Study for Introduction of Commuter Service is on-going. ● Improvement of Bus Project is on-going	LRT project is on-going Commuter Service began in 1973.	● Sub Way was introduced ● Expansion Project of Sub-way is now under implementation.	Continuous railway (subway) Construction.

1/Metropolitan Area
2/As recommended in Source 1
3/According to no. of person Trips

Sources:
1. Public Transport Requirements in Intermediate Size Cities, Oct. 1977, Mitsui Consultants Co., Ltd.
2. Population Movement in Metro Tokyo, May, 1979
3. Draft Final Report of "Metro Cebu Land Use and Transport Study"
4. Comprehensive Urban Transportation Planning 1980, JICA
5. DCUTCLUS

As it was seen from the examples of various Asian cities, as urban scale grows and as transport demand expands in a city, the mode of public transport is replaced by one after another in such a manner as that transport capacity will be expanded, service speed increased, and the level of regularity and adherence to the schedule improved.

In view of the past history of transition of public transport modes and the dramatic qualitative and quantitative changes in demand predicted for the future of Davao City, it is believed that the following public transport structure will be desirable:

a) That the PUJ to function as the major mode of public transport for the time being.

b) That a city bus system be introduced after a 2- or 3- year preparation period and become the major mode of urban public transport in about five years thereafter, with the PUJ remaining in service as peripheral mode to support the city bus and as the mode of intra-block transport.

c) That the AC disappear by that time or be merged with the PUJ for intra-block service.

d) That rail-transit system be introduced as the post-city bus mode, with the city bus functioning as supplementary to the rail-transit; that is, while the rail-transit will serve along the major trunk road traversing the Project Area, the city bus will serve on major roads running in parallel to the trunk traverse road.

e) These steps of public transport renovation in Davao City can be translated into the following matrix of time and mode function: (Table 7.6, Fig. 7.7)

Table 7.6 Major and Supplemental Urban Public Transport Modes in the Future

	Major Transport Mode	Supplemental Mode	Others	Activity for Innovation of Transport Modes
At Present and Near Future	PUJ	PUJ, AC Tricycle	Provincial Bus and PU	Provision for Introduction of City Bus
Future up to 2000	City Bus	PUJ (AC and Tricycle)	Provincial Bus and Taxi	Provision for Introduction of Rail Transit
Future Beyond 2000	Rail Transit	City Bus PUJ	Provincial Bus and Taxi	

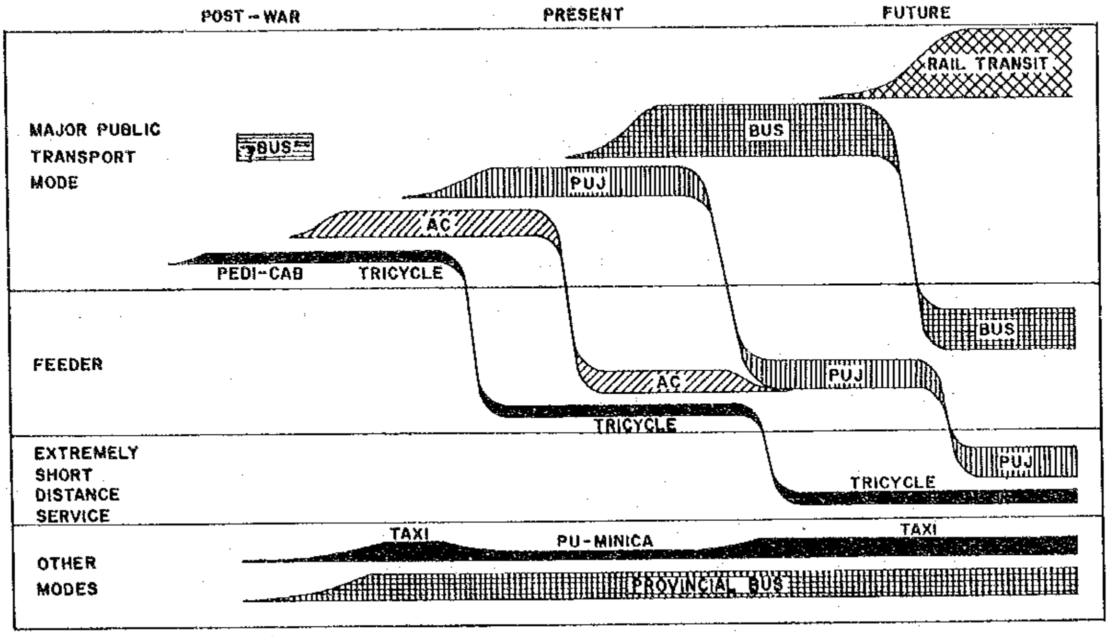


Figure 7.7 Evolution Model of Urban Public Transport Modes in Davao City

7.2 Long- and Medium-Term Plans for Public Transport System

7.2.1 Passengers by Public Transport Mode

1) Modal Share

Upon the introduction of the city bus, three modes of public transport will be in service in Davao City: the city bus as the major mode of urban public transport, the PUJ as the supplementary mode, and the taxi. In addition, the provincial bus will continue to offer service between this City and major cities in Mindanao.

Modal preference by passengers of these three modes of public transport is most influenced by the travel distance, with minor factors affecting the preference such as trip purpose, the availability of the mode at the place and time of trip start, and so forth.

The modal share of public transport passengers has been estimated under the following conditions/assumptions: (Table 7.7)

(a) The taxi represents about 5% to 6% of the total public transport passengers, and the rate of taxi passengers tends to decline as trip length become longer. It is assumed that this share and the tendency will remain unchanged in the future.

(b) For the year 2000, a 50:50 share of passengers between the bus and the PUJ is assumed at the trip length of five kilometers, and a greater proportionate share of the PUJ for shorter trip lengths are assumed. However, for 1990, when the city bus will still be a new comer, it is assumed that the PUJ will still be depended on for a longer trip lengths and, therefore, that the 50:50 share be reached at the trip length of 10 kilometers.

Table 7.7 Modal Shares of Public Transportation Modes by Trip Length

Trip Length	1990,2000	1990		2000	
	Taxi	PUJ	City Bus	PUJ	City Bus
~ 250 M	9.6%	90.2%	0.2%	90.4%	0.0%
~ 500	9.2	90.4	0.4	90.8	0.0
~ 1 Km	8.1	90.9	1.0	91.8	0.1
~ 2	7.5	90.1	2.4	91.5	1.0
~ 3	7.5	86.6	5.9	86.0	6.5
~ 4	7.5	82.4	10.1	74.7	17.8
~ 5	7.5	76.8	15.7	57.1	35.4
~ 7.5	6.5	68.6	24.9	31.6	61.9
~ 10	4.2	56.3	39.5	10.5	85.3
~ 15	3.0	39.8	57.2	4.0	93.0
~ 20	2.6	25.3	72.1	0.9	96.5
~ 30	2.0	16.5	81.5	0.0	98.0
~ 50	2.0	3.5	94.5	0.0	98.0
50 ~	2.0%	0.0%	98.0	0.0%	98.0%

2) Public Transport Passengers

The estimated number of future passengers of public transport is summarized as follows: (Table 7.8)

(a) The total number of public transport passengers will be 779,000 in the year 2000, and 516,000 in 1990, for respective increases of 2.6 times and 1.7 times the present level.

(b) The year 2000 modal share will be: 44% (341,000) for the city bus, 50% (391,000) for the PUJ, and 6% (47,000) for the taxi.

(c) The city bus' share will increase from the 3% in 1979 to 24% in 1990, and to 44% in the year 2000, while that of the PUJ will decline from the 91% in 1979 to 70% in 1990, and to 50% in 2000. One-half of the total passengers will still utilize the PUJ in 2000.

(d) PUJ passengers will drastically decline in terms of the percentage share of the total public transport passenger, but will increase by 1.4 times in terms of the absolute number.

(e) The share of the taxi will gradually decline but remain 6% plus, while the number of taxi passengers will increase by 2.4 times.

(f) The number of provincial bus passengers, practically all non-residents, will increase from 1979 to 2000 by about 13 times.

Table 7.8 Number of Public Transportation Passengers By Mode

(Unit Pass.)

Mode	1979	1990	2000
City Bus	9,000 1/ 3.1%	123,000 23.8%	341,000 43.8%
PUJ	270,000 90.6%	361,000 70.0%	391,000 50.2%
TAXI	19,000 6.4%	32,000 6.2%	47,000 6.0%
Total	298,000 100%	516,000 100%	779,000 100%
Provincial Bus	14,000	71,000 2/	110,000 2/

1/ Number of Residents in the survey area using Provincial Bus in 1979.
2/ Passengers using City Bus, if they serve to neighboring municipalities as Tagum and Digos, are included.

3) Passenger Trip Distance: Bus and PUJ

A comparison of trip lengths distribution of passengers of the bus and that of the PUJ—the two mainstays of future public transport in Davao—reveals the following: (Fig. 7.8)

a) The estimated average length of passenger trips in the year 2000 of about 3.0 kilometers for the PUJ and 11.9 kilometers for the bus clearly show the division of functional role between the PUJ and the bus, that of the former being chiefly intra-block service, and the latter, inter-block. Similar role sharing, but to a lesser extent, is estimated for 1990, which suggests that the role sharing will still be in a transitional stage in 1990.

b) The number of PUJ passengers with a trip length of 9 to 10 kilometers is estimated to reduce from 1979 to 1990, and that with a trip length of five to six kilometers, from 1990 to 2000, indicating that the shift of passengers from the PUJ to the bus will start with those on an inter-block trip with a longer trip length and reach down to those with a shorter trip length.

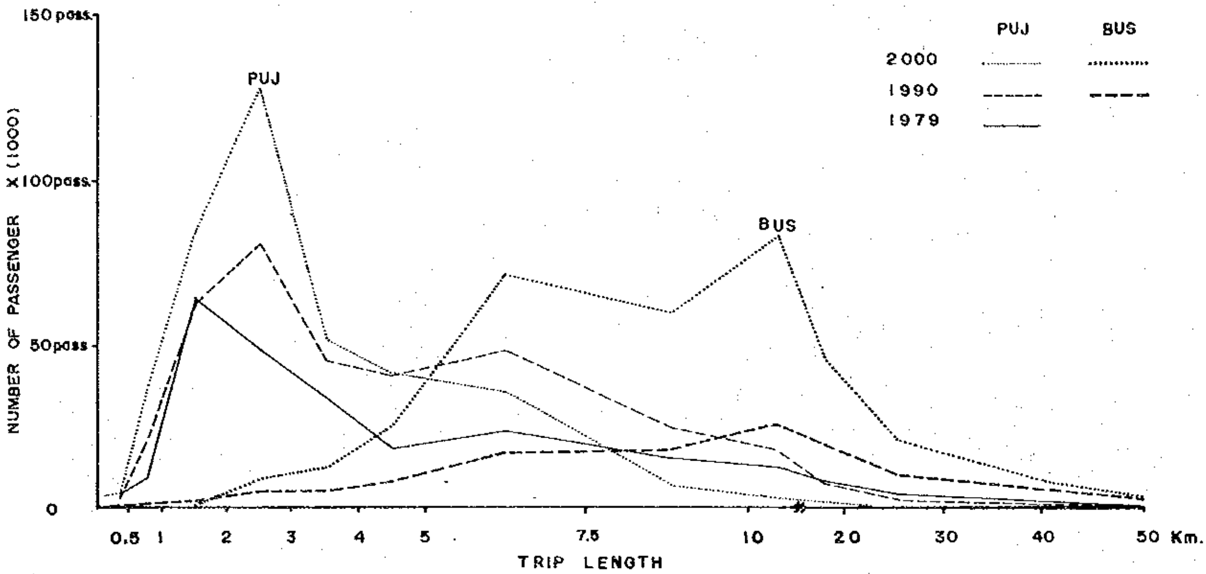


Figure 7.8 Variation of Bus and PUJ Passengers by Trip Length

4) Passenger Distribution: Bus and PUJ

Public transport passengers tend to move in the north-south direction, traversing the Project Area. While this tendency will remain true with both PUJ passengers and bus passengers, their predicted behavioral characteristics will be as follows:

a) As the number of city bus passengers will increase, communication will be intensified from 1990 to 2000 mostly between Poblacion (Block IV) and such blocks as Buhangin (Block III) and Talomo (Block V), followed by communication between blocks other than Poblacion, such as between Buhangin (Block I) and Panacan (Block II) and between Talomo (Block I) and Toril (Block VI). (Fig. 7.9 and 7.10)

b) On the other hand, inter-block trips of PUJ passengers will continue to dwindle. The estimated drop in the number of PUJ passengers is particularly phenomenal between Poblacion and such blocks as Buhangin and Talomo, where PUJ passengers will still be larger than bus passengers in 1990 but will be smaller in 2000. (Fig. 7.11 and 7.12)

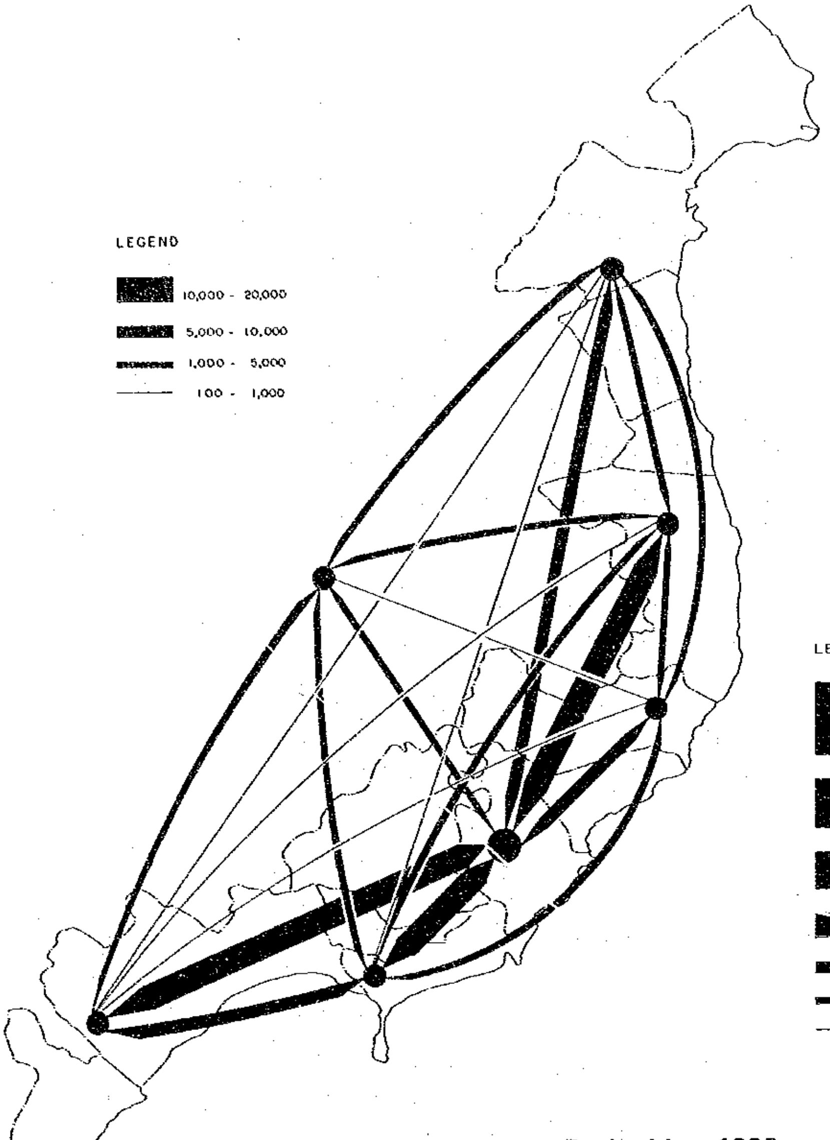


Figure 7.9　Bus Passengers Desire Line, 1990

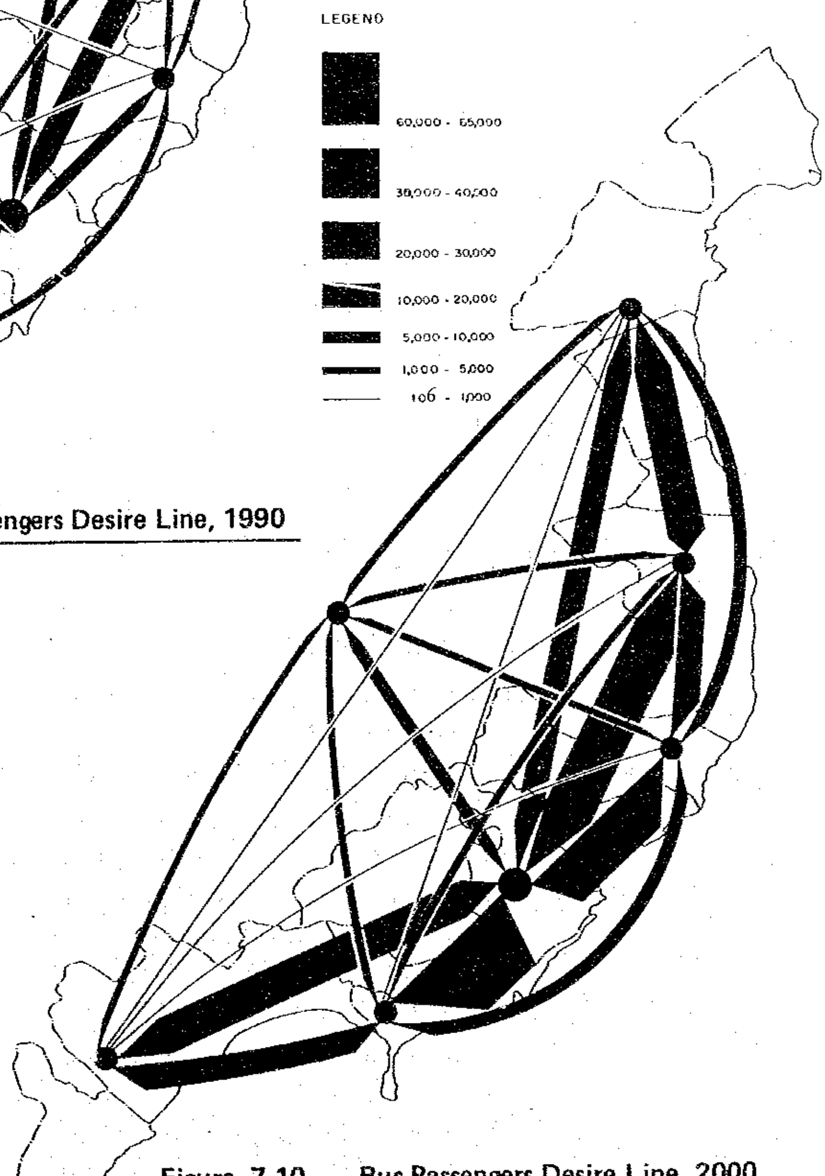


Figure 7.10　Bus Passengers Desire Line, 2000

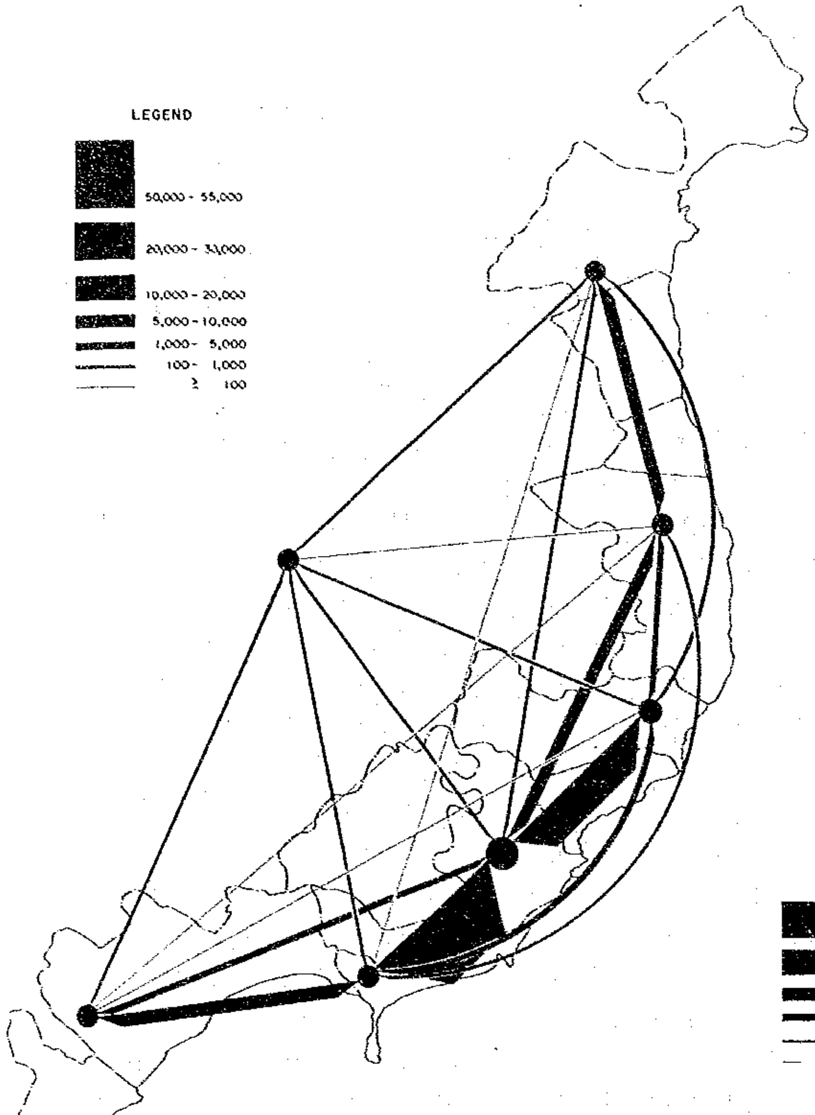


Figure 7.11 PUJ Passengers Desire Line, 1990

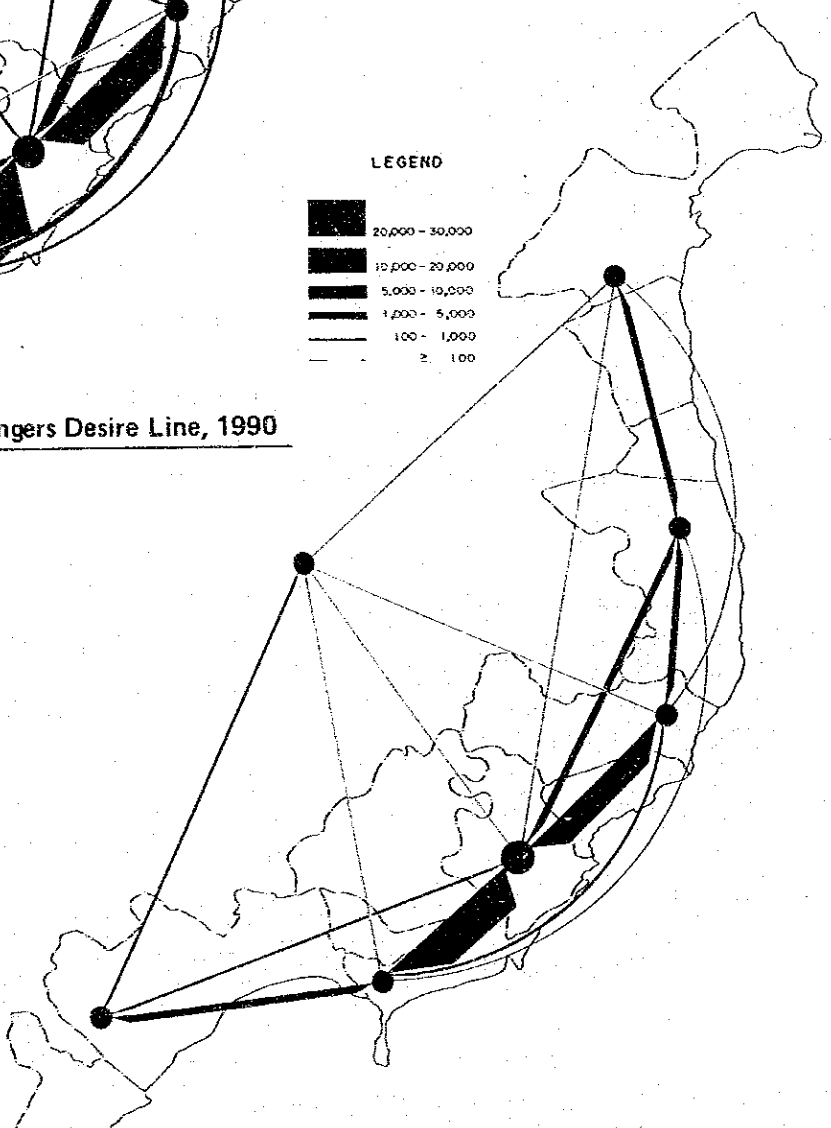


Figure 7.12 PUJ Passengers Desire Line, 2000

5) Principle Service Sharing Between Modes

The foregoing understanding of the passenger characteristics by the mode of transportation underlies the planned sharing of functional roles between the modes of public transport after the introduction of city bus service to Davao City. The service sharing is summarized as follows: (Fig. 7.13)

a) City buses will chiefly serve passengers on relatively long inter-block trips, and their routes are to be established on major trunk roads connecting the six blocks.

b) PUJs will chiefly serve passengers on relatively short trips travelling within a block of between neighboring blocks, and their routes are to be established mostly on collector roads with some exceptional short distance routes on major roads within a block or connecting neighboring blocks.

c) Tricycles, whose operational efficiency is so poor that its survival until 2000 is beyond prediction, are lumped with PUJs for the purpose of passenger estimation; if they are to remain in market, their service will be limited to each subdivision or each specific downtown block, their service routes being limited to local roads.

d) Taxi cabs, being a highly individualized means of transportation, will be utilized for door-to-door service in downtown areas.

e) In addition, provincial buses will continue to cater to long distance inter-city travellers to and from terminals to be established near the outer rim of Poblacion. Their routes will be limited to major trunk roads.

This principle service sharing between modes of public transport for the year 2000 will be basically true in 1990. Any friction, new competition between modes of public transport, due to the introduction of city bus service, will occur and will be solved between 1985 and 1990; meanwhile, the city bus will serve a greater number of passengers in 2000 than in 1990 as pointed out in 7.2.1. above.

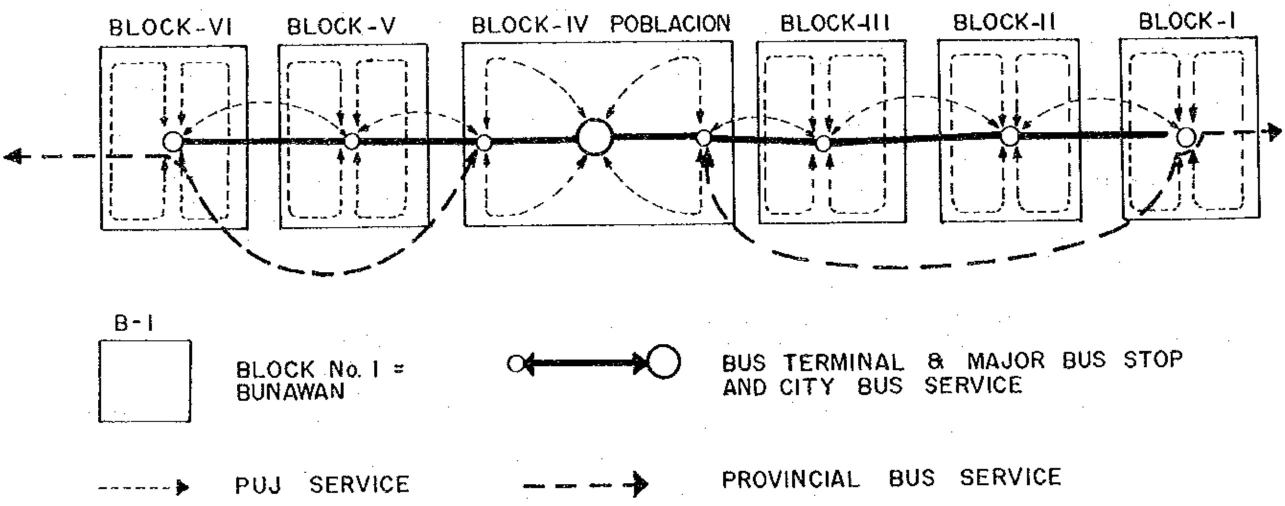


Figure 7.13 Conceptual Plan of Future Public Transport Service System