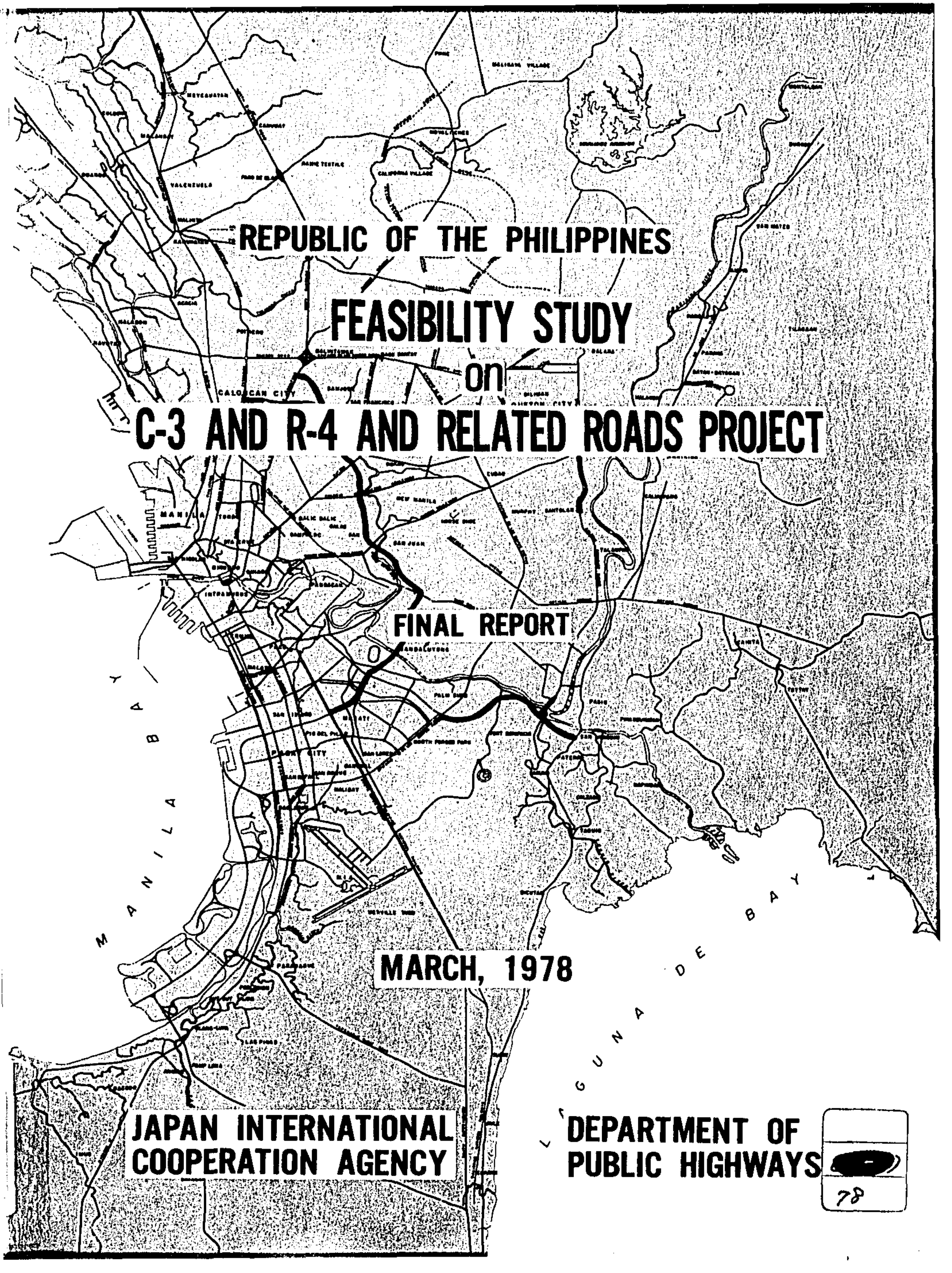

REPUBLIC OF THE PHILIPPINES

FEASIBILITY STUDY on C-3 AND R-4 AND RELATED ROADS PROJECT

FINAL REPORT

MARCH, 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

DEPARTMENT OF PUBLIC HIGHWAYS

REPUBLIC OF THE PHILIPPINES

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on
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PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a feasibility study on Circumferential Road C-3 and Radial Road R-4 and related roads Project in the Metropolitan Manila, and Japan International Cooperation Agency (JICA) carried it out.

Noting that Circumferential Road C-3 and Radial Road R-4 and related roads Project has a vital bearing on the future Urban Transportation System in the Metropolitan Manila Area, the Agency dispatched a preliminary Survey Team to the Philippines in February 1977 for planning and preparation of the feasibility study, and further sent, from May 1977 to October 1977, a 11-member supervisory group headed by Mr. Akira Ishido, Director of Road Department, Public Works Research Institute, Ministry of Construction and a 13-member survey team headed by Dr. Toshiro Fukuyama.

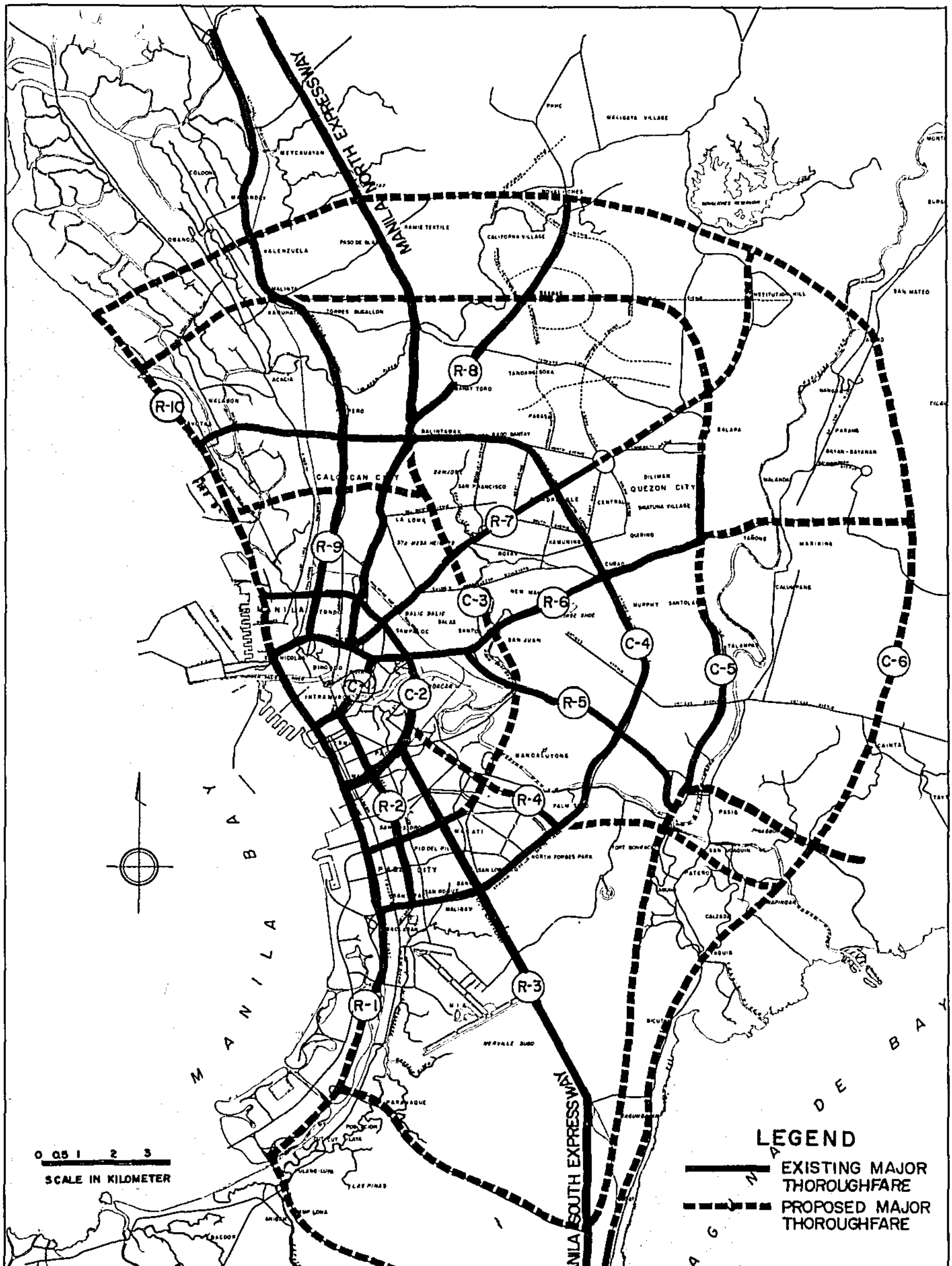
While in the Philippines, the Japanese survey team strove to transfer its technology to the Philippine counterpart during the joint work covering field surveys and analysis up to the preparation of a tentative draft final report for a period of about six months. The study was carried out smoothly with the close and unlimited cooperation of the competent Philippine authorities, of which the results are compiled into this report.

I sincerely hope that this study would contribute to the socio-economic development in the Metropolitan Manila Area and at the same time serve for enhancement of the friendly relations between the two countries.

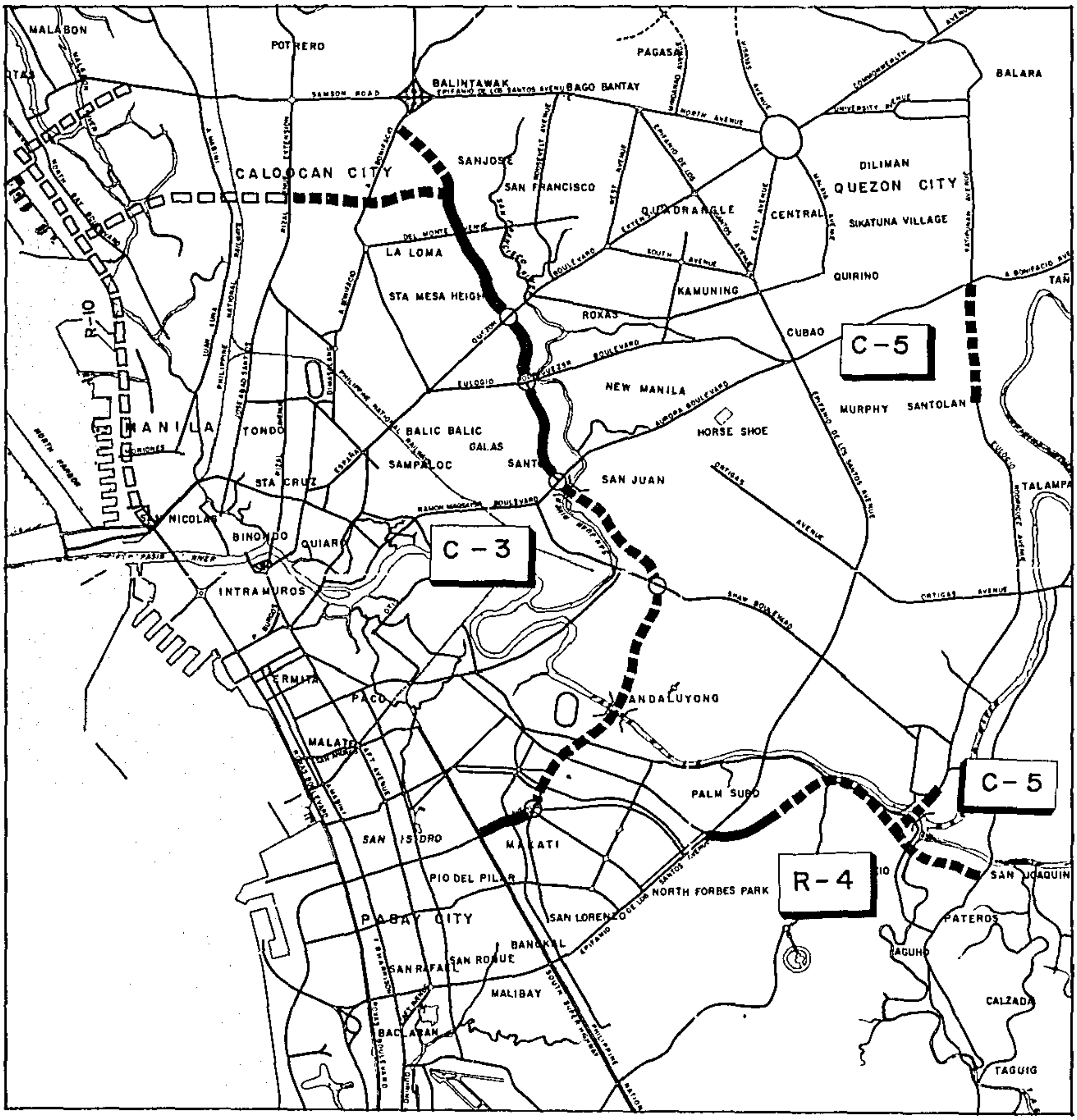
Finally, I would like to take this opportunity to express my heartfelt appreciation to all the people who participated in this study and to all the authorities concerned in the Republic of the Philippines.

March 1978

Shinsaku Hogen
President
Japan International
Cooperation Agency
Tokyo, Japan



CONCEPTUAL HIGHWAY NETWORK IN THE METROPOLITAN MANILA AREA



LEGEND

- NEW CONSTRUCTION
- IMPROVEMENT
- PROPOSED BRIDGE
- PROPOSED GRADE SEPARATION
- RELATED ROADS

PROJECT ROADS

FOREWORD

1. OBJECTIVE OF THE STUDY

The achivement of a remarkable progress and economic development in the Philippines have been mainly responsible for the rapid urbanization of Metro Manila. Consequently, the area is facing "development problems" principal of which are over-population and concentration of wealth.

Current statistics give a fairly representative picture of these urban problems. The population in Metropolitan Manila has been growing at a very high annual average rate of 5 per sent in comparison with the national average of 3.1 per sent. The average per capita income in Metropolitan Manila is more than twice that in other district. The gravitation of the population toward Metropolitan Manila and the resultant concentration of economic, social and cultural activities have been accelerating the traffic demand in the area, and the latter inevitably leads to traffic congestions in major sections of the metropolis.

In an attempt to relieve the situation, the Government of the Philippines (GOP) requested in 1971 the Government of Japan (GOJ) and its acting agency, OTCA (Predecessor of the Japan International Cooperation Agency: JICA), to conduct a traffic survey with the aim of developing an integrated system of traffic facilities in the Metropolitan Manila area to cope with the present and future transport problems. The results of the survey that was conducted for three years from 1971 to 1973, were compiled in a report titled "Urban Transport Study in Manila Metropolitan Area" (UTSMMA).

The UTSMMA recommended the construction of missing routes and links to form a complete network which is composed of six (6) circumferential roads (C-1 through C-6) and ten (10) radial roads (R-1 through R-10).

In 1974 the GOP requested the GOJ to conduct a feasibility study for R-10. After completion of the R-10 study, the construction of the R-10 has been implemented by the GOP in a reduced scale to serve the Dagat-Dagatan Resettlement Project. The Overseas Economic Cooperation Fund (OECF) of Japan extended assistance in the construction of three interchanges on E. De Los Santos Avenue (C-4).

Another important study undertaken recently by the GOP is for Metro-Manila Transport, Land Use and Development Planning Project (MMETROPLAN) by which the integrated transport infrastructure requirements of the metropolis have been established. In this study, C-3 and R-4 and related roads were put as top priorities for implementation. The GOP has taken into serious consideration the construction and improvement of C-3 and R-4 and related roads, thus in 1976, the GOP requested the GOJ its technical assistance to conduct the feasibility study for this project from 1977.

The main objective of the study is to determine the technical, economic and financial feasibility of the construction of C-3 and R-4 and related roads in accordance with the accepted standards of international financing institutions.

Furthermore, the Japanese team will seek to transfer its technology to the Filipino counterparts during the joint studies covering field surveys, and analysis up to the preparation of a tentative draft final report.

2. PROGRESS TO DATE

Acting on the request of the GOP for technical assistance, JICA sent the preliminary survey mission in March 1977. The scope of work in conducting the feasibility study was agreed upon and formally signed on March 10, 1977 by Mr. Baltazar Aquino, Secretary of the Department of Public Highways and Mr. Akira Ishido, Head of the Japanese Team.

The study formally started on May 15, 1977, with the arrival of a two-man supervisory committee and a five-man study team headed by Dr. Toshiro Fukuyama.

Mr. Akira Ishido, chairman of the supervisory committee, arrived on May 22nd with two other members and the inception report was prepared and submitted to the GOP at the end of May.

Mr. Kazuo Yoda, vice chairman of the supervisory committee, arrived on August 7th with three other members and the progress report was submitted in the middle of August.

Following the arrival of Mr. Akira Ishido and three other supervisory committee members, the tentative draft final report was completed and submitted to the GOP in October, 1977.

After the submission of the draft final report in January, 1978, a seven-man mission headed by Mr. Kazuo Yoda discussed the finalization of the report with the GOP officials. On the basis of the discussion, the final report was prepared in March, 1978.

3. *COMPOSITION OF THE REPORT*

This report is presented in three volumes.

Volume I: TEXT

This volume contains an overview of the project, the methodology used, summary of the results and recommendations, the detailed presentation of the engineering and economic analysis and the subsequent recommendations.

Volume II: SUPPLEMENTS

This volume contains the supplementary descriptions which support the results and recommendations in Volume I and is independent from the structure of Volume I.

- S1 - LAND USE AND POPULATION PLAN
- S2 - TRAFFIC SURVEY AND ITS RESULT
- S3 - TRAFFIC ANALYSIS
- S4 - SOIL INVESTIGATION AND MATERIAL SURVEY
- S5 - ASSESSMENT SURVEY OF LAND AND PROPERTY
- S6 - SOCIO-ECONOMIC SURVEY

Volume III: DRAWINGS

4. ORGANIZATION OF THE STUDY

The organization of the study is composed of the following:

4.1 PHILIPPINE GOVERNMENT ADVISERS

Name	Office	
Teodoro T. Gutierrez	Director, Special Projects Service	- DPH
Jose F. David	Director, Planning & Project Development Office	- DPH
Antonio I. Goco	Exec. Director, Special Local & Other Foreign Projects Office	- DPH
Hiroshi Yamano	JICA Consultant	- DPH
Hiroo Takeda	JICA Consultant	- DPH
Prudencio F. Baranda	Asst. Director, Planning & Project Development Office	- DPH
Tranquilino Atienza	Asst. Chief, Traffic Division, Planning & Project Development Office	- DPH
Luis U. Paraiso	Staff Civil Engineer, Special Local & Other Foreign Projects Office	- DPH
Clarita A. Bandonillo	Asst. Staff Civil Engineer, Special Local & Other Foreign Projects Office	- DPH
Jose R. Valdecañas	Director, Planning Service	- DPWTC
Tohru Ida	JICA Consultant	- DPWTC
Rosauro Paderon	Director, Operation Audit Office	- NHA
Cesar Valbuena	Transport Engineer	- NEDA
Nathaniel Von Einsiedel	Program Director, Metro Manila Planning	- MMC

4.2 PHILIPPINE COUNTERPART MEMBERS

Name	Position	Office
Godofredo Z. Galano	Project Manager	Supvg. CE II, SLOFPO, DPH
Edgardo C. Paruñgao	Adm. Officer IV	Adm. Officer, SLOFPO, DPH
Edgardo V. Semilla	Locating Engineer	Supvg. CE III, SLOFPO, DPH
Ignacio Gallego	Structural Engineer	Supvg. CE III, SLOFPO, DPH
Virgilio Alagar	Highway Engineer	Supvg. CE II, SLOFPO, DPH
Victoria Mago	Highway Engineer	Supvg. CE I, SLOFPO, DPH
Angelina F. Andrade	Materials Engineer	Supvg. CE I, SMQCS, DPH
Emerenciano Dorado	Traffic Engineer	Supvg. CE III, PPDO, DPH
Aurora S. Baldo	Maintenance Engineer	Supvg. CE I, CEO, Butuan City, DPH

4.3 SUPERVISORY COMMITTEE MEMBERS

Chairman	Akira Ishido	Director, Road Department, Public Works Research Institute, Ministry of Construction (MOC)
Vice Chairman	Kazuo Yoda	Senior Grade Engineer, Urban Road Division, City Bureau, MOC
Member	Daishiro Yamamoto	Senior Planning Engineer, Planning Bureau, MOC
"	Taiji Okazaki	Deputy Director, Urban Road Division, City Bureau, MOC
"	Dr. Takeshi Kurokawa	Chief Research Engineer, Urban Facility Planning Section, Building Research Institute, MOC
"	Kazuhiro Yamaguchi	Deputy Director, River Improvement Division, River Bureau, MOC
"	Masato Tamura	Deputy Superviser of Japan Highway Public Corporation and Honshu-Shikoku Bridge Authority, MOC
"	Shoichi Saeki	Chief Research Engineer, Bridge Research Section, Public Works Research Institute, MOC
"	Akiomi Shimazu	Chief Research Engineer, Seismology and Earthquake Engineering Section, Building Research Institute, MOC

Coordinator	Hironao Suzuki	Japan International Cooperation Agency
"	Isao Fukushima	Japan International Cooperation Agency

4.4 STUDY TEAM

Project Manager	Dr. Toshiro Fukuyama	Japan Oversea Consultants
Assist. Project Manager and City and Transport Planner	Kokuro Hanawa	"
Coordinator and Transport Economist	Toshio Kimura	"
Financial and Economic Analyst	Masamitsu Toriyama	International Deve-lopment Center
Highway Planner	Kunihiko Sawano	Japan Oversea Consultants
Bridge Engineer	Takashige Kanamori	"
Soil Engineer	Kazumasa Suzuki	"
Highway Designer	Hisao Nakamura	"
Survey Engineer	Iehiro Noda	"
Hydrological Engineer	Tsutomu Sugimura	"
Environmental Engineer	Takanori Shibata	"
Transport Engineer	Yooichi Yamamoto	"
Systems Engineer	Satoshi Kishi	"

Feasibility Study on C-3 and R-4 and Related Roads Project

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SUMMARY AND CONCLUSION

This part of the report is summary and conclusion on the feasibility study of C-3 and R-4 and related roads. The C-3 road starting from South Superhighway to Rizal Ave. and Balintawak Interchange measures approximately 15.5 kms. in length, while the R-4 and its related roads extend for 7.2 kms. from E. de Los Santos Ave. (EDSA) to Juan Luna with two related sections on C-5. On the basis of technical, economic and financial studies for the project roads, summary and conclusion are presented below.

A. CONCLUSION

1. From a result of the economic evaluation, it is evident that the project roads should be constructed at the earliest possible time.

2. On the basis of economic and technical evaluation of the various plans, a six-lane road for C-3 road has been found as the most feasible. It has also been found that R-4 road should preferably be of a four-lane type and its related roads of a six-lane type.

3. There has been found no significant difference in the results of economic evaluations between with and without the regulated bus lane cases for C-3 road. However, to provide the social equity in transport service, and in consideration of the urban transport policies, the regulated bus lane should be introduced to C-3 road.

4. The technical, economic and financial studies suggest that the project roads shall preferably be implemented in the following schedules:

   Phase 1. Southern Section of C-3 Road (1978-1985)*

   - Stage 1. Construction of a four-lane road (1979-1983)
   - Stage 2. Construction of two additional lanes (1983-1985)

   Phase 2. Northern Section of C-3 Road (1982-1987)*

   - Stage 1. Construction of a four-lane road on C-3 road (1983-1984)
   - Stage 2. Construction of two additional lanes on C-3 road and of grade separation at Quezon -C-3 intersection (1984-1985)
   - Stage 3. Construction of Balintawak branch (1986-1987)

   Phase 3. R-4 and its Related Roads (1983-1988)*

   Phase 4. Construction of Grade Separation at four Intersections (1987-1989)*

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* Including detailed engineering period.

5. The project costs for the recommended plan are given below.

   a. Total project cost for Phase 1 is ₱323 million, of which foreign currency component will amount to ₱97 million (US$13 million). The Right-of-way acquisition costs amount to over ₱125 million.
   The project cost in Phase 1 is estimated at ₱265 million for stage 1 and ₱58 million for stage 2.

   b. The total project cost in Phase 2 is ₱191 million, of which foreign currency component is ₱38 million (US$5 million). The project cost in Phase 2 is estimated at ₱48 million for stage 1, ₱78 million for stage 2 and ₱65 million for stage 3.

   c. The total project cost for Phase 3 is ₱268 million, of which ₱99 million (US$14 million) will be accounted for by the foreign currency.

   d. Phase 4 will require a total project cost of ₱148 million, of which ₱85 million (US$12 million) will be accounted for by the foreigh currency.

6. An overall appraisal of the environmental impact of the project suggests that the construction of the project roads will bring about favorable effects because it will serve as a catalyst for urban redevelopment and intensification of land use and improvement of accessibility.

   The families in the stress area affected by the project roads will be afforded improved quality of life in the resettlement area.

7. For the purpose of keeping the project roads in good service condition, it is highly desired to implement, at the earliest possible time, a proper flood control program to cover the specific flood-prone areas along the project roads.

B. SUMMARY

B.1 BACKGROUND

B.1.1 Present Conditions of Urban Transport

Transportation service in Metro-Manila is predominantly road-oriented. In terms of person trips, railway accounts only for less than one per cent of the total transportation service. The rest are all road-based with buses sharing 20 per cent; jeepneys, 40 per cent; and passenger cars, including taxis, sharing about 40 per cent.

The conceptual major road system for Metro-Manila as envisioned in previous studies (principally by UTSMMA*) consists mainly of ten radial and six circumferential roads; namely R-1 to R-10 and C-1 to C-6. Of these major roads, nine radial and three circumferential roads are existing, but are partially developed, characterized mainly by non-homogeneity due to non-existence of some sections and inconsistency of level of service. Most of the existing roads have already reached their traffic volume capacity, causing heavy traffic congestions. The most congested roads are those located within the area circumscribed by C-4. Heavy congestions are also observed on major bridges crossing the Pasig River.

B.1.2 *Rationale of the Study*

The Philippine Government has recently completed the Metro-Manila Transport, Land Use and Development Planning Project, code-named MMETROPLAN. The MMETROPLAN project was aimed at arriving at a plan and program to guide transport investments and operations within the context of a rational land use pattern. It thus developed a transport strategy in terms of policies and specific projects for both short and long terms within the context of a structure plan for the metropolis and the broad framework of government policy.

Among its long-term projects (from 1980 onwards) the constructions of the northern and south-eastern legs of circumferential Road 3 (C-3) and Raidial Road 4 (R-4, outside EDSA) have been given high priority. For C-3, it cited economic evaluation as the strong rationale for its construction in terms of very high rates of return even on the basis of resource savings only. But more significant is the benefits it will endow to the stress areas along the road alignment in terms of improved accessibility and greater opportunities for urban development and redevelopment.

For R-4 and related roads, the need for improved accessibility of the eastern towns of Metro-Manila (Pasig, Pateros and Taguig) as clearly demonstrated by the current severe problem of poor accessibility and traffic congestions provide the rationale for its construction. The completion of R-4 and related roads would also lead to substantial economic benefits to the areas within the influence zone of its alignment.

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* Urban Transport Study in Manila Metropolitan Area in 1973

As a consequence, the project roads C-3 and R-4 (outside EDSA) have been included in the ten-years (1978-1987) infrastructure development program for the Metro-Manila Area (MMA).

B.2 TRAFFIC PROJECTION

B.2.1 Framework Plan for Traffic Projection

The MMETROPLAN evaluated various conceptual forms of Metro Manila's growth based on five "urban expansion goals". Of these, the MMETROPLAN recommended a form that "establishes the new urban settlements outside the existing MMA minimizing the disadvantages of urban sprawl of the mother city".

The boundary of the MMA (including 17 jurisdictions) defined by Metro Manila Commission (MMC) was used as the study area.

The socio-economic inputs established by the MMETROPLAN for the years 1980 and 1990 was adopted, while the socio-economic inputs for the year 2000 was prepared by the Study team on the basis of the above mentioned form.

The planned population in the MMA was projected to be 6.1 million in the year 1980, 8.3 million in the year 1990 and 10.8 million in the year 2000.

Based on the socio-economic trends, the vehicle-owning households were forecasted to reach 0.28 million in 1980, 0.65 million in 1990 and 1.1 million in the year 2000.

In the traffic projections, the transport network for years 1980 and 1990 are in accordance with the MMETROPLAN recommendations and that for year 2000 was mainly based on the conceptual plan from previous studies.

B.2.2 Projection of Traffic Demand

General Procedure

To determine the traffic volume of the project roads, the total transport demand for the whole of MMA was projected, assuming that the project roads were part of the road system. Initially, the trip production in the entire MMA was projected. The trip generation and attraction was then determined, and the OD distribution was estimated by zone. Using the modal split method, these passenger trips were then segregated into two modes, i.e. passenger trips by mass transit, and passenger trips by car. On the other hand, truck and taxi trips were projected using the projected number of trips per day and the number of trucks and taxies.

This passenger flow by mode is then converted to vehicular traffic and assigned to the road network.

Results of Traffic Projection

1. Based on the traffic projections, the daily vehicle-kilometer in 1980 on the six-lane roads without regulated bus lane has been estimated to be about 629 thousand vehicle-kilometers on the C-3 road (15.5 kms), and approximately 202 thousand vehicle-kilometers on the R-4 and related roads (7.2 kms).

Between 1980 and 2000, it was estimated that the average annual traffic growth rate on C-3 would be 4.4 per cent while the traffic on R-4 would increase to 3.6 per cent yearly.

2. With the introduction of regulated bus lanes on the C-3 road, the number of car passengers for 1980 that would be diverted to buses was forecasted to be about 14,800 persons per day.

   The diversion was the consequence of the gradual increase in the travel speed of buses as compared to passenger car speed which would decrease on the contrary.

3. If a three-peso toll fee under the cordon pricing plan proposed by the MMETROPLAN would be charged in the year 1980, traffic volume on C-3 road would decrease by about 12,000 vehicles per day in 1980 owing to the diversion of car passengers to buses.

4. There would be a significant reduction in the traffic volume on the existing major roads directly affected by the construction of C-3 road as shown in Table B.2-1.

Table B.2-1

Estimated Traffic Volume on the Screen-line crossing the Pasig River With and Without the Project Roads in 1980

Unit: vehicles/day

	Nagtahan Bridge C-2	New Panaderos Bridge	C-3	Guadalupe Bridge C-4	C-5	Bambang Bridge
Without Project Roads(A)	100,300	39,300	0	138,000	0	16,100
With the Project Roads(B)	89,800	25,700	51,500	89,800	28,000	9,500
B/A	0.90	0.65	-	0.65	-	0.59

B.3 ROUTE SURVEY AND PRELIMINARY DESIGN

B.3.1 Characteristics of the Project Roads

The project roads will have the following characteristics:

C-3 road:

C-3 will assume the character of a major road with uncontrolled access. It will function as a circumferential collector-distributor road with major intersections invariably grade-separated or at-grade depending on their importance. Traffic on minor intersections will not be allowed to cross the C-3 but will be provided with access to and from it.

R-4 and related roads:

R-4 and related roads will also assume the character of a major road with uncontrolled access. R-4 will function as a radial road serving the traffic demand in the south-eastern portion of the MMA and will function more effectively with the completion of the related roads.

B.3.2 Surveys related to the Preliminary Design

The following surveys were conducted:

1. Reconnaissance and inventory surveys
2. Preparation of aerial photographic maps
3. Topographic survey
4. Flood record survey
5. Soil investigation
6. Material survey
7. Assessment of land and property
8. Socio-economic survey

B.3.3 Engineering Criteria

Design Standards and Considerations

The roads were designed on the basis of their assumed functions and the expected demand with principal consideration to construction and maintenance costs. Other factors considered in the design were as follows:

1. Important public structures be respected wherever possible.
2. Existing right-of-way be utilized to the extent possible.

3. In anticipation of the flood control works to be undertaken in the areas traversed, the design of the roads be directed to prevent the flood problems from being aggravated.

4. The accessibility of all existing roads be preserved.

The DPH design standard is basically derived from the 1973 edition "A Policy on Design of Urban Highways and Arterial Streets" (AASHTO). Considering the present design practice in the Philippines, the design standard of this project followed the above reference and Japanese design standards were applied in cases not covered satisfactorily by the AASHTO.

The design speed of the project roads was set at 60 kilometers per hour considering existing and future developments along the roads that would generate large access traffic, existence of access roads connected in short intervals and project cost.

Expecting that flood control and drainage program will be implemented in the future, the project roads' finished grades follow as close as possible to the elevation of the existing roads.

B.3.4 Preliminary Design

Alternatives

The alternatives were considered for each of the following requirements:

1. Route,
2. Number of travel lanes,
3. With and without regulated bus lane,
4. Type of intersection,
5. Stage construction by road section, and
6. Stage acquisition of right-of-way.

The most recommendable route was selected from among some alternatives on the basis of evaluation of construction and right-of-way acquisition costs, and environmental consideration, leaving the discussion of the two alternative routes between E. Rodriguez Avenue (C-5) and Aurora Boulevard to the later economic evaluation (See Fig. B.3-1). The selected route was subjected to preliminary design with some alternative combinations of road cross-sections and bus lane arrangements. On completion of the foregoing selection of the route and cross-section in relation to the number of lanes, the types of major intersections were discussed. Finally, due consideration was given to introduction of stage construction.

Sectioning of the Project Roads

The project roads were divided into four sections which consist of 13 segments, as shown in Table B.3-1 and Fig. B.3-1, for the application of stage construction plan. The division into segments was made based on the following guidelines:

1. The construction of one or more segments should function as a system in the overall road network.

2. A road segment should have a uniform traffic demand.

Table B.3-1 Sectioning of the Project Roads

Route	Section	Segment	Description
C-3	1	1	South Superhighway - Ayala Ave.
		2	Ayala Ave. - J. P. Rizal
		3	J. P. Rizal - Boni Ave.
		4	Boni Ave. - Shaw Blvd.
		5	Shaw Blvd. - Aurora Blvd.
		6	Aurora Blvd. - Quezon Blvd.
	2	7	Quezon Blvd. - Intersection of G. Araneta Ave. & Sgt. Emilio Rivera
		8	Intersection of G. Araneta Ave. & Sgt. Emilio Rivera - A. Bonifacio Ave.
		9	A. Bonifacio Ave. - Rizal Ave.
		10	Intersection of G. Araneta Ave. & Sgt. Emilio Rivera - Balintawak Interchange
R-4 and Related Roads	3	11	E. de Los Santos Ave. - J. Luna
		12	Proposed R-4 - Pasig Blvd.
	4	13	Santolan - Aurora Blvd.

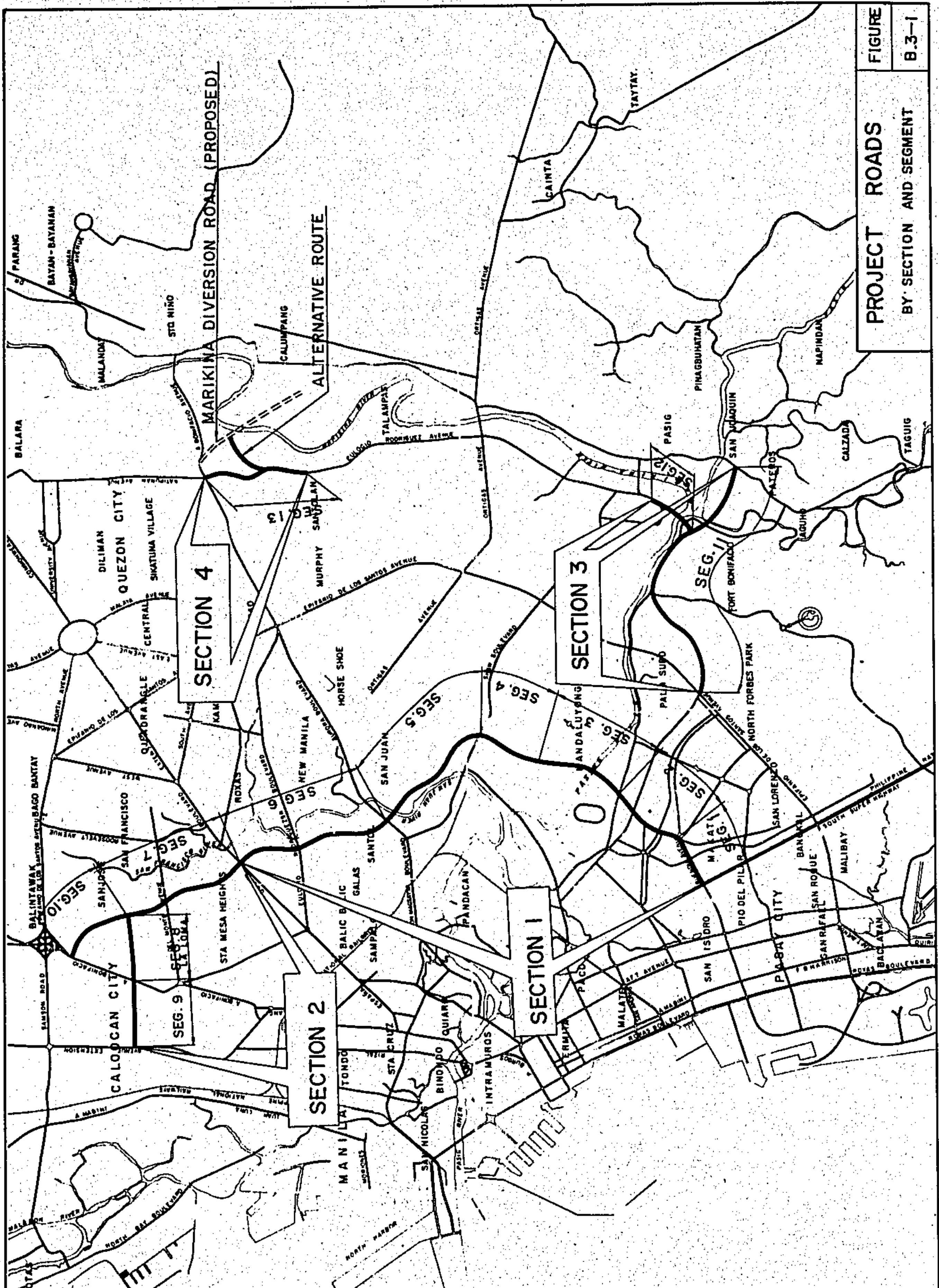


FIGURE B.3-1
PROJECT ROADS
BY SECTION AND SEGMENT

Road Cross-section and Regulated Bus Lane

Five standard cross-sections were selected as shown in Table B.3-2 and Fig. B.3-2. The regulated bus lane in "D2 + B" will be reserved for buses and jeepneys only during morning and afternoon peak hours, and the regulated bus lane in "D3 + B" or "D2 + B2" will be reserved for buses and jeepneys only.

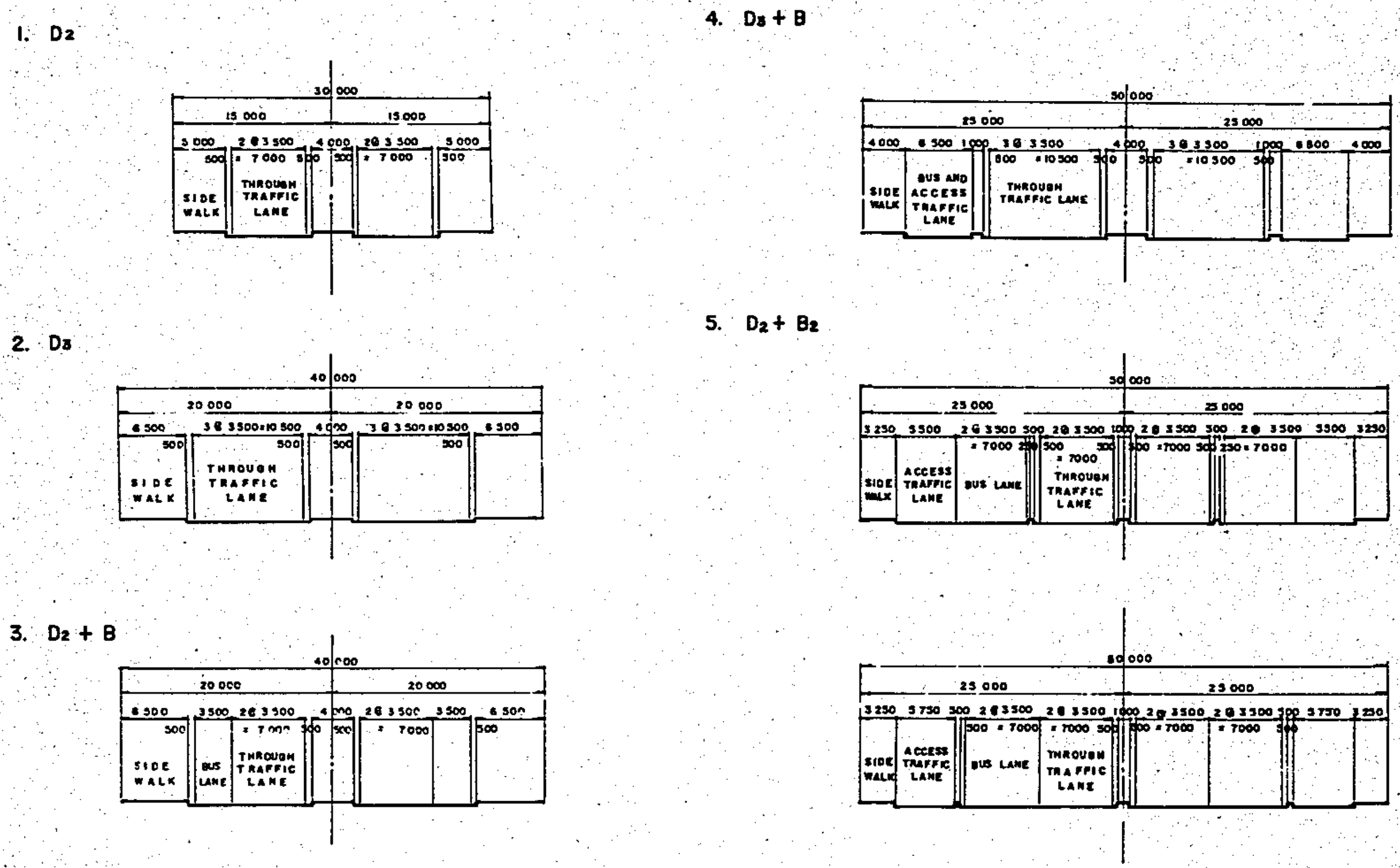
Table B.3-2 Particulars of Cross-section of Divided Highway

	Right-of-way width (m)	Number of normal traffic lanes	Number of bus lanes
D2	30	4	0
D3	40	6	0
D2 + B	40	4	2
D3 + B	50	6	2
D2 + B2	50	4	4

Based on the traffic demand and capacity analysis, five plans using combinations of the above five standard cross-sections were considered as alternatives for C-3. On the other hand, "D2" and "D3" were proposed for R-4 and its related roads, respectively, to be compatible with the existing roadway and at the same time to meet the expected traffic demand (See Table B.3-3).

Table B.3-3 Combinations of Cross-sections

		Segment 1	Segments 2-7	Segments 8-10	Segment 11	Segments 12-13
C-3 road	Plan - 1	D3	D2	D2	-	-
	Plan - 2	D3	D3	D2	-	-
	Plan - 3	D2 + B	D2 + B	D2	-	-
	Plan - 4	D3 + B	D3 + B	D3	-	-
	Plan - 5	D2 + B2	D2 + B2	D3	-	-
R-4 & Related roads		-	-	-	D2	D3



ROAD CROSS SECTION

Figure B.3-2

Intersection Design

The five intersections shown in Table B.3-4 are considered to require a series of study for introducing grade separation due to the large traffic expected when they are in use. For each of these intersections, both at-grade and grade-separated types using signalized control system were designed as alternatives.

A diamond interchange was selected for the grade-separated type because of limitation in space. For a diamond interchange of circumferential and radial roads, two alternatives can be considered for selecting a road which has through-traffic lanes either elevated or depressed. Generally, it is desirable to elevate or depress a circumferential road which is given priority to for its function as a collector-distributor. The selection should also be made taking economic analysis into consideration. Accordingly, two alternative types were considered at each intersection as listed in Table B.3-4, except at C-3-E. Rodriguez Avenue and C-3-Quezon Boulevard intersections where it is disadvantageous to elevate or depress the radial road because of geographical condition.

Table B.3-4 Connection Type of Diamond Interchange

Intersection	Road to be elevated or depressed		Type
	Alternative 1	Alternative 2	
Buendia Ave. - Ayala Ave.	Ayala Ave.	Buendia Ave. to Kamagong and Buendia Ave. Ext. (one way)	Elevated
C-3 - Shaw Blvd.	Shaw Blvd.	C-3	Elevated
C-3 - Aurora Blvd.	Aurora Blvd.	C-3	Elevated
C-3 - E. Rodriguez Ave.	C-3	-	Elevated
C-3 - Quezon Blvd.	C-3	-	Depressed

Pavement Design

Cement concrete pavement was adopted for the most part to satisfy economic considerations including maintenance cost, availability of materials and sub-grade condition. It likewise conforms to the recent trend in the MMA.

Bridge and Structure Design

C-3 is to have Pasig River bridge, San Juan River bridge and two other minor bridges, and two box culverts. R-4 and related roads are to have Pasig River bridge and two other minor bridges. Different types of structures crossing the Pasig and San Juan Rivers were studied. The results show that for the San Juan River prestressed concrete composite girder bridge is more economical, while for the Pasig River continuous steel box girder bridge is recommended from an integrated technical viewpoint in spite of negligible cost differences from other types. However, the type of bridge to be finally adopted should be further investigated during the detailed engineering. The locations and bridge types of the major bridges are shown in Table B.3-5 with their alternative types.

Table B.3-5 Major Bridges

Name	Location	Total Length	Longest Span	Type of Superstructure		
				Proposed	Alternatives	
Pasig River Bridge	Segment 3 on C-3	232.5^m	55.0^m	3-span continous steel box girder	3-span continous steel plate girder	3-span continuous prestressed concrete box girder
San Juan River Bridge	Segment 5 on C-3	131.0^m	27.5^m	Prestressed concrete composite girder	Steel composite girder	
Pasig River Bridge	Segment 12 on C-5	258.9^m	55.0^m	The same as Pasig River Bridge on C-3		

B.3.5 Environmental Considerations

The environmental impact of the project road was analyzed from the social and physical points of view. The data used in the analysis are the results of the following surveys:

a) Socio-economic survey of families in stress areas,

b) Parcellary/assessment survey of land and property, and

c) Survey of land and building uses.

The surveys indicate the existence of several depressed and stagnant urban areas along the project roads. The road development is expected to serve as a catalyst for the urban renewal of those areas, revitalizing social and economic activities there.

The surveys also indicate that about 1,600 families in the middle and high classes residential area will be directly affected by the project roads. These families will be fully compensated for their lands and properties in accordance with pertinent laws and decrees.

The families in stress areas affected by the project roads will be afforded improved quality of life in the resettlement area. The relocation of these families will be undertaken in close cooperation with the National Housing Authority and other government agencies.

Furthermore, to mitigate the adverse effects of traffic nuisance, adequate measures such as provision of wide sidewalk and greenbelts were included in the design of the roadway section. While nuisance and inconveniences can not be totally avoided during the construction, the effects can be significantly reduced by proper construction management and supervision and the use of proper construction methods.

B.4 ESTIMATION OF THE PROJECT COSTS (1977 PRICES)

B.4.1 Right-of-Way Acquisition Costs

The estimation of land and property acquisition costs were made on the basis of the result of the DPH parcellary/assessment survey along the areas traversed by the project roads, with the cooperation of the barrio captains and barangay leaders.

The estimated land and property acquisition costs for the entire length of C-3 for the different right-of-way widths are shown in Table B.4-1.

Table B.4-1 Right-of-Way Acquisition Costs

Plan	R-O-W Width (m)	Costs (₱ million)
1	30	133.5
2 or 3	40	158.1
4 or 5	50	472.1

The road section which has the highest right-of-way acquisition costs is between Shaw Blvd. and Aurora Blvd., amounting to about 25 per cent of the total acquisition cost. The Aurora Blvd. and Quezon Blvd. section is the lowest with less than 1 per cent.

Staging of right-of-way acquisition was not included in the economic evaluation because of the anticipated problems in the additional right-of-way acquisition in the future.

B.4.2 Construction Costs

Direct costs include labor, equipment, materials and other necesary items. Construction cost was estimated based on direct cost and allocations including contingency, overhead and profit of contractor, engineering and supervisory expenses and contractor's tax. The cost was broken down into foreign and local components. The latter was further divided into two categories of tax and others.

B.4.3 Maintenance Costs

Routine maintenance, periodic maintenance and occasional repair are required for preserving roads in good condition. Routine maintenance includes maintenance of pavement surface, lighting facilities, drainage facilities, green belts and guard rails and cleaning. Periodic maintenance includes repainting of steel bridges and re-marking. Repaving or overlay to be carried out when pavement is damaged is considered typical of occasional repairs.

The basic maintenance cost of national highways for fiscal year 1975-76 was about ₱8,000 per equivalent maintenance kilometer (EMK) of two-lane road.

In this study, the maintenance cost required to keep the roads serviceable in good condition was estimated at 1977 prices.

B.4.4 Project Costs

Total construction and maintenance costs are summarized in Table B.4-2. Table B.4-3 shows the construction costs of grade separation.

Table B.4-2 Construction and Maintenance Costs

(Unit: ₱ million)

		Construction Cost							Annual Maintenance cost			
		R-O-W acquisition	Road construction	Structure construction	Total Cost				Total	Component		
					Total	Component				Foreign	Local	Tax
						Foreign	Local	Tax				
C-3 Road	Plan-1	133.5	108.0	45.8	287.3	74.1	192.2	21.0	0.90	0.39	0.42	0.09
	Plan-2 or Plan-3	158.1	128.5	54.0	340.6	88.1	227.5	25.0	1.16	0.50	0.54	0.12
	Plan-4	472.1	181.5	67.3	720.9	119.4	567.0	34.5	1.53	0.67	0.70	0.16
	Plan-5	472.1	194.3	67.3	733.7	125.2	572.1	36.4	1.61	0.71	0.73	0.17
R-4 & Related Roads		42.5	60.1	42.8	145.4	53.4	78.6	13.4	0.52	0.22	0.25	0.05

Table B.4-3 Construction Cost for Grade Separation

(Unit: ₱ million)

Intersection	Alternative-1				Alternative-2			
	Total	Component			Total	Component		
		Foreign	Local	Tax		Foreign	Local	Tax
Ayala Ave. - Buendia Ave.	23.9	15.4	6.0	2.5	21.3	10.8	8.4	2.1
C-3 - Shaw Blvd.	14.6	8.0	4.7	1.9	16.8	9.0	5.6	2.2
C-3 - Aurora Blvd.	14.6	8.0	4.7	1.9	25.9 (Including San Juan River Bridge)	13.4	9.0	3.5
C-3 - E.Rodriguez Ave.	15.2	8.3	5.0	1.9				
C-3 - Quezon Blvd.	11.2	5.2	4.3	1.7				
Total	79.5	44.9	24.7	9.9				

B.5 ECONOMIC EVALUATION

B.5.1 General

Economic Indicators

There are three types of economic indicators used in the economic evaluation, which are the standard procedure of the National Economic Development Authority (NEDA) and also international financing agencies and are as follows:

1. Internal Economic Rate of Return (IRR),

2. Net Present Worth (NPW), and

3. Benefit-Cost Ratio (B/C Ratio).

In this study, a fifteen (15) per cent of the opportunity cost of capital in the Philippines was adopted.

Alternative Plans

The alternative plans discussed in Section B.3.4 and summarized below were subjected to economic analysis;

C-3 Road

1. Whole C-3 road

   Plan 1 ; 4-lane road without bus lanes

   Plan 2 ; 6-lane road without bus lanes

   Plan 3 ; 4-lane road with bus lanes (6 lanes in total)

   Plan 4 ; 6-lane road with bus lanes (8 lanes in total)

2. By Section (Only Plan 2 was adopted)

   Section 1 ; Southern Section of C-3 Road. (Segments 2 to 6)

   Section 2 ; Northern Section of C-3 Road. (Segments 7 to 10)

3. By Segment

   Segment 1 ; Widening of Buendia Ave. between South Superhighway and Ayala Ave.

   Segments 8 and 9; End of G. Araneta Ave. to Rizal Ave.

   Segment 10 ; End of G. Araneta Ave. to Balintawak Interchange

4. Grade Separation including Alternatives

   Quezon Blvd. - C-3 Intersection

   Aurora Blvd. - C-3 Intersection

   Shaw Blvd. - C-3 Intersection

E. Rodriguez Ave. - C-3 Intersection
Buendia - Ayala Intersection

R-4 and Related Roads

1. Whole R-4 and Related Roads

2. By Section

   Section 3 ; Southern Section of R-4 and Related Roads (Segments 11 and 12)

   Section 4 ; Northern Section of R-4 and Related Roads (Segment 13)

3. Route Alignment

   Alternative 1 ; E. Rodriguez Ave. to Aurora Blvd.

   Alternative 2 ; E. Rodriguez Ave. to Marikina Bypass

B.5.2 Cost Input

To obtain the economic indicators for the cost-benefit analysis, the economic project costs (using 1977 prices by plan, section, and segment) were used.

The economic costs shown in Table B.5-1 do not include taxes. The shadow princing of foreign and labor component was not included. The cost of public lands affected by the project roads was included as an economic cost because of their opportunity for other economic purposes or land use.

Table B.5-1 Economic Cost Estimates
(In Thousand Pesos)

C-3 Road			Cost
1. Whole C-3 Road	Plan 1		270,692
	Plan 2 & 3		327,562
	Plan 4		722,141
2. By Section (Plan 2)	Section 1		224,232
	Section 2		103,330
3. By Segment	Segment 1 (Plan 4)		261,982
	Segments 8 and 9 (Plan 2)		50,814
	Segment 10 (Plan 2)		33,799
4. Grade Separation			
	Quezon - C-3 Intersection		9,548
	E. Rodriguez - C-3 Intersection		13,220
	Aurora - C-3 Intersection	Alt. 1	12,716
		Alt. 2	13,950
	Shaw - C-3 Intersection	Alt. 1	12,716
		Alt. 2	14,617
	Ayala - C-3 Intersection	Alt. 1	21,433
		Alt. 2	19,215
R-4 and Related Roads			
1. Whole R-4 and Related Roads			144,200
2. By Section	Section 3		103,031
	Section 4		41,169
3. Route Alignment of Section 4	Alternative 1		41,169
	Alternative 2		35,451

B.5.3 Benefit Input

Among the various benefits that can be realized from the construction of the project roads, savings in travel time and running expenses are considered the most significant. These benefits are defined as the difference between the travel time and the running expenses of hitherto affected traffic with and without project roads.

The unit time value of each trip was calculated by purpose on the basis of the annual income of families and the annual working hours by non-car owners and car owners. The estimated time value of passengers was reduced by 50 per cent in the calculation of time cost because these passengers could not normally fully utilize the time they saved. The adjusted passenger time values in pesos per hour is as follows:

	Non-car owner	Car owner
1. To/from work	₱ 0.73	₱ 2.62
2. Business	1.47	5.25
3. Education	0	0
4. Others	0	0

Vehicle-operating costs are composed of running costs that depend on distance and speed and of fixed costs that depend on time. The unit running cost by travel speed and the fixed cost per operational hour were established for four types of vehicles. A 50 per cent shadow rate of the total fixed cost was applied because the travel time saved could not be fully utilized. The sums of fixed costs are as follows (pesos per vehicle hour).

1. Passenger Car	₱ 0.29
2. Truck	2.55
3. Bus	2.74
4. Jeepney	1.78

The traffic cost components considered in the quantification of benefits of improved intersection are as follows:

1. Excess running cost of speed change cycle,
2. Waiting time cost per speed change cycle, and
3. Cost of idling engine with stationary vehicle.

B.5.4 Economic Analysis

B.5.4.1 C-3 Road

Whole C-3 Road

The results of the economic evaluation of the whole section of C-3 as to the following four plans are summarized in Table B.5-2. The evaluation shows that all the plans described in Section B.3.4 are economically feasible. Plan 1 (4-lane road without BL) though has the lowest investment among the other plans will not be recommended because of high degree of congestion even in its opening year. The most viable plan for C-3 requires a six-lane road with or without bus lane (BL). The resulting economic indicators of plan 2 (6-lane road without BL) are a B/C ratio of 5.8, NPW of ₱929 million and IRR of 49 per cent. Plan 3 (6-lane road with BL) has a B/C ratio of 5.7, NPW of ₱919 million and IRR of 49 per cent.

As the economic indicators show, plans 2 and 3 have advantages over the others with high IRR.

Table B.5-2 Economic Indicators by Plan

	Net Present Worth ₱ Million	B/C Ratio	Internal Rate of Return %
Plan 1	318	3.0	34.7
Plan 2	929	5.8	48.8
Plan 3	919	5.7	48.8
Plan 4	856	2.9	31.6

Notes: 1) Project life; 25 years.

2) Discount rate; 15 %

The high IRR's obtained are due greatly to the benefits from the non-diverted traffic which shows that the project has a great influence in the improvement of existing traffic conditions in the MMA as a whole as shown in Table B.5-3.

Table B.5-3 Benefit Composition in 1990

	Plan 2 (%)	Plan 3 (%)
Normal Traffic	9.6	9.0
Diverted Traffic	40.9	41.1
Non-diverted Traffic	49.5	49.9
Total	100.0	100.0

By Road Section

The whole section of C-3 indicates that the plan for a six-lane road is the most viable of all plans. Due to the scale of the project, C-3 was divided into two sections and evaluated for finding which section should be implemented first. Section 1 starts from Ayala-Buendia Ave. intersection to Quezon Blvd. while section 2 is from Quezon Blvd. to Rizal Ave.

The result of the economic evaluation of Section 1 and 2 with six-lane indicates that the two road sections are both economically feasible as shown in Table B.5-4.

Table B.5-4 Economic Indicators by Section

Road Section	Net Present Worth (NPW) ₱ million	B/C Ratio	Internal Rate of Return %
Section 1	652	5.9	49.9
Section 2	222	4.7	42.5

Notes: 1) Project life; 25 years
2) Discounted rate; 15%

The economic indicators of Section 1 are a B/C Ratio of 5.9, NPW of ₱652 million and an IRR of 49.9 per cent compared to Section 2 with a B/C, NPW and an IRR of 4.7, ₱222 million and 42.5 per cent, respectively. This indicates that Section 1 has priority for implementation over Section 2.

By Road Segment

The economic evaluation of each road segment is regarded not necessary judging from the economic indicators. However, due to the route competition between some segments of C-3 road project and very high acquisition costs of R-O-W's, Segment 1 (Widening of Buendia Avenue), Segments 8 and 9 (End of G. Araneta Avenue to Rizal Avenue) and Segment 10 (End of G. Araneta Avenue to Balintawak Interchange) were evaluated separately.

The economic evaluation of these Segments is summarized in Table B.5-5.

Table B.5-5 Economic Indicators by Segment

Segment Number		Net Present Worth (NPW) ₱ million	B/C Ratio	Internal Rate of Return (IRR) %
1	Buendia Avenue	-36	0.8	12.5
8 and 9	End of G. Araneta Avenue to Rizal Avenue	124	5.1	44.3
10	End of G. Araneta Avenue to Balintawak Interchange	82	5.0	43.8

Notes: 1) Project life: 25 years
2) Discounted rate: 15 %

It is noted that widening of Buendia Ave. from 30 to 50 meters between R-3 and Ayala-Buendia intersection yields an IRR of 12.5%, B/C Ratio of 0.8 and NPW of negative ₱36 million. This can be explained by the very high R-O-W costs within this segment. However, the segment 8, 9 and 10 are economically feasible with segments 8 and 9 having relatively high economic indicators even though segment 8 is competing with segment 10. This is primarily due to the very large traffic volume forecasted within this segment. It should also be noted that segment 10 cannot be eliminated unless roadway section of segment 8 as proposed is widened to conform with segments to provide expected traffic volume.

B.5.4.2 R-4 and Related Roads

Whole R-4 and Related Roads

The economic evaluation of the whole section of R-4 and related roads was made. The economic indicators of these roads are a B/C Ratio of 2.6, NPW of ₱137 million and IRR of 30.5 per cent, justifying R-4 and related roads.

By Road Section

As regards R-4 and its related roads, the component sections, that is, section 3 (Segments 11 and 12) and section 4 (Segment 13) were subjected to economic evaluation independently. The economic indicators obtained show that both sections are economically feasible with section 3 having the higher economic indicators.

Comparative Analysis of Alternative Alignments

As far as section 4 is concerned, there are two alternative alignments, one of which has direct access to Aurora Blvd. (Alternative 1 which was already used in the evaluation of the whole R-4 and related roads) and the other to Marikina B.P. (Alternative 2).

The result of economic analysis is shown in Table B.5-6. From this Table, it is found that a high feasibility is given for the alternative 1 compared with the alternative 2.

Table B.5-6 Economic Indicators by Section

	Net Present Worth ₱ million	B/C Ratio	Internal Rate of Return (%)
Section 3	118	2.9	33.3
Section 4 (Alternative 1)	19	1.8	23.0
Section 4 (Alternative 2)	15	1.7	22.2

Notes: 1) Project life ; 25 years
2) Discount rate ; 15 %

B.5.4.3 Intersection Plan

Five (5) major intersections were evaluated from the economic viewpoint for the purpose of determining whether they should be of the at-grade or grade-separated type and what direction they should be separated.

The results of the economic analysis of these five intersections including the alternative are summarized in Table B.5-7.

Table B.5-7 Economic Indicators by Grade-Separated Intersection

	Net Present Worth ₱ million	B/C Ratio	Internal Rate of Return (%)
Buendia Ave. - Ayala Ave. Alt. 1	1	1.1	16.4
Alt. 2	1	1.1	16.2
C-3 - Shaw Blvd. Alt. 1	4	1.5	24.9
Alt. 2	4	1.4	21.6
C-3 - Aurora Blvd. Alt. 1	9	2.2	32.9
Alt. 2	9	2.1	31.0
C-3 - E. Rodriguez	2	1.2	20.8
C-3 - Quezon Blvd.	7	2.5	35.1

Notes : 1) Project life ; 25 years
2) Discount rate ; 15 %

Based on the resulting economic indicators, the grade separations at the five (5) intersections including alternative plans are economically feasible with the C-3 and Quezon intersection having highest economic indicators of all.

The economic indicators also show that the alternative 1 is a little more feasible than the alternative 2 at the three intersections, i.e. Buendia-Ayala, C-3 - Shaw and C-3 - Aurora intersections. However, the difference between the two alternatives is insignificant in terms of feasibility. In the inplementation program, it is recommended that the grade separations excluding Quezon - C-3 intersection are to be constructed after completion of C-3 road with at-grade intersections. In this case, further investigation shall be made for selecting type of the intersections by observing the traffic behaviors around the intersections after the opening.
However, the grade-separation type at C-3 - Aurora intersection should be discussed in the detailed engineering stage of San Juan River bridge for its close relationship with the intersection structure.

B.5.5 Sensitivity Analysis

B.5.5.1 C-3 Road

The sensitivity analysis of C-3 Road was made by changing the following parameters:

1. Project cost,
2. Project benefit,
3. Yearly construction cost,
4. Economic life of project road, and
5. Cordon pricing within C-2.

The results are as summarized in Table B.5-8.

Table B.5-8 The Resulting Changes in the Economic Indicators by Plan of C-3 Road

(₱ million)

	Plan 2			Plan 3		
	B/C Ratio	NPW	IRR (%)	B/C Ratio	NPW	IRR (%)
1. Original Result	5.8	929	48.8	5.7	919	48.8
2. +20% Project Cost	4.8	891	43.6	4.8	880	43.6
3. -20% Project Benefit	4.6	705	42.5	4.8	696	42.5
4. Variation of Construction Cost	5.6	923	46.6	5.6	912	46.2
5. 20-year Economic Life	5.5	864	48.8	5.4	855	48.8
6. With Cordon Pricing	5.7	907	48.1	5.6	896	48.1

Notes: 1) Project life ; 25 years
2) Discount rate ; 15 %

Even when the risky changes of parameters are made, the project still remains high in feasibiiity.

B.5.5.2 R-4 and Related Roads

R-4 and its related roads were also put to a sensitivity analysis with the following parameters changed:

1. Project cost,
2. Project benefit,
3. Yearly construction cost, and
4. Project life.

The analysis was made to handle R-4 and its related roads in the lump. The results are shown in Table B.5-9.

Table B.5-9 The Resulting Changes in the Economic Indicators of R-4 and Related Roads

	B/C	NPW ₱ million	IRR (%)
1. Original Result	2.6	137	30.5
2. +20% Project Cost	2.2	120	26.9
3. -20% Project Benefit	2.1	92	26.1
4. Variation of Construction Cost	2.5	133	29.0
5. 20-year Economic life	2.6	125	30.4

Notes: 1) Project life ; 25 years

2) Discount rate ; 15%

B.6 IMPLEMENTATION PROGRAM

B.6.1 General

To determine the financial viability of the recommended project roads, yearly expenditure of the implementation program should be within the financial resources of the Philippine Government. The procedure for establishing the implementation program is as follows:

1. Forecast of highway funds in the MMA
2. Investment requirements of highway projects in the MMA
3. Comparative study between funds and investment requirements
4. Preparation of recommended implementation schedule
5. Annual investment requirement estimates

B.6.2 MMA's Highway Funds and Investment Requirements

The Gross National Product (GNP), the National Capital Expenditure (NCE) and Infrastructure Expenditure (IE) were projected for years 1980 and 1985 (at 1975 prices) based on historical trend and NEDA's projection (projected on 1977). The projected GNP, NCE and IE in million pesos are tabulated below:

(₱ million)

GNP Growth Rate	1978 - 1982 1983 - 1987	7.4% 7.7%
GNP	1980 1985	163,000 235,000
NCE	1980 1985	8,150 12,460
IE	1980	4,890 (Low Projection) 5,700 (High Projection)
	1985	7,470 (Low Projection) 8,720 (High Projection)

The projected National Infrastructure Expenditure was further broken down to Highway Funds for the MMA for years 1980 and 1985 as follows:

Projected Highway Funds for the MMA (₱ million)

Year	Low	Medium	High
1980	88	145	222
1985	134	222	340

On the other hand, the total investment requirement for highway projects in the MMA for ten years (1978 - 1987) is $44 million in foreign currency and ₱2,225 million in local currency. For the first five years (1978 - 1982), the investment requirement for highway projects is well above the projected highway funds. In order that the investment requirements for the project be within the projected highway funds, the project should be implemented in stages and in a longer period from 1980 to 1989.

B.6.3 Recommended Implementation Schedule

From the results of the economic evaluation discussed in previous section, the southern section of C-3 from Buendia Avenue to Quezon Boulevard will be implemented ahead of northern section from Quezon Boulevard to Rizal Avenue and the R-4 and related roads. Due to the limited highway funds in the MMA for the first five years (1978 - 1982) the project roads will be implemented by stage construction. The recommended stage construction plan consists of four phases and their stages as briefly described below.

Phase 1. Southern Section of C-3 Road
(Ayala-Buendia intersection to Quezon - C-3 intersection)

- Stage 1. Construction of a four-lane road above mentioned section
- Stage 2. Construction of two additional lanes

Phase 2. Northern Section of C-3 Road

- Stage 1. Construction of a four-lane road on C-3 road
- Stage 2. Construction of two additional lanes on C-3 road and of grade separation at Quezon - C-3 intersection
- Stage 3. Construction of Balintawak branch

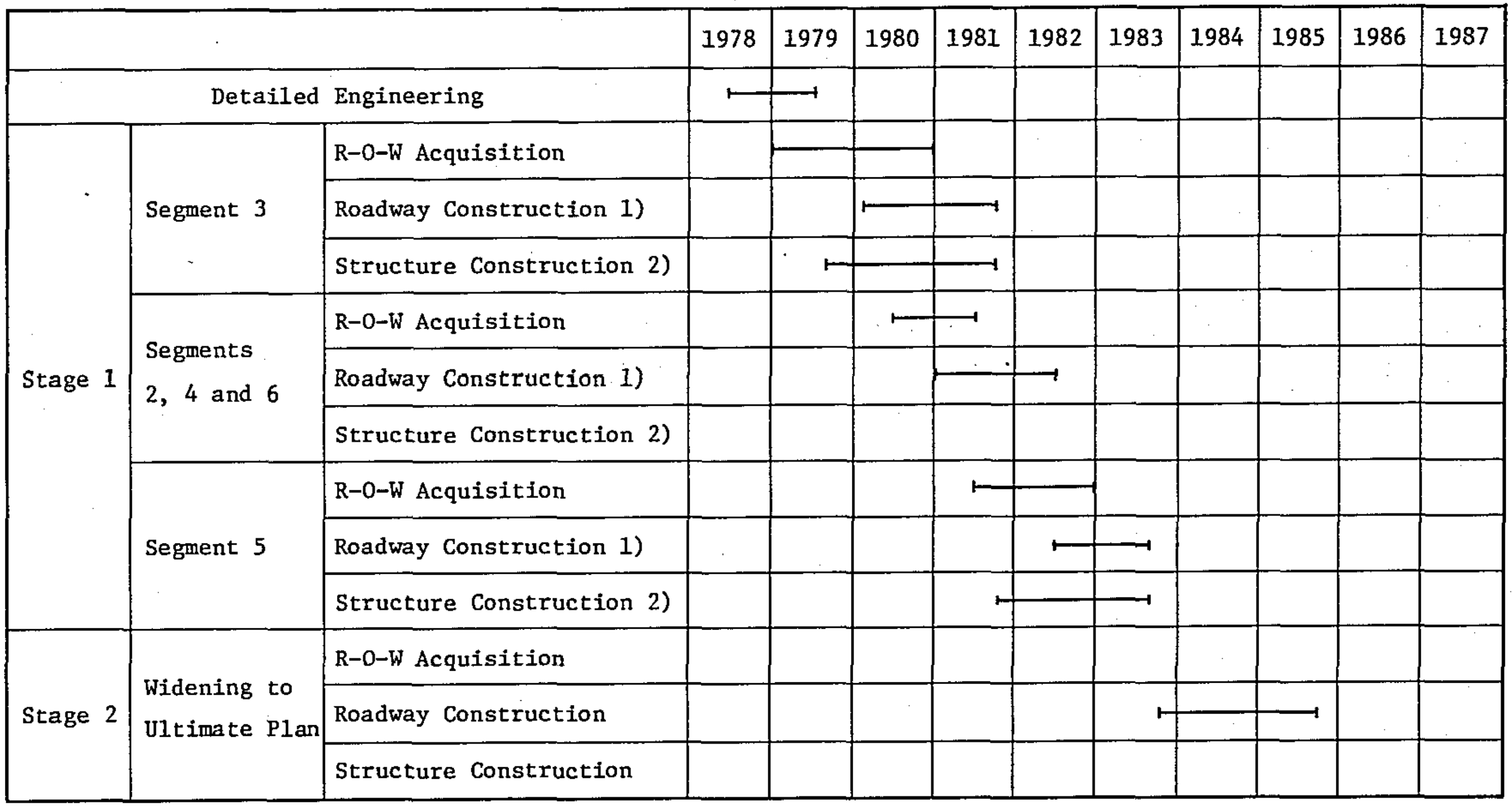
Phase 3. R-4 and its Related Roads

Phase 4. Construction of Grade Separation at four Intersections

Roadways for C-3 road will be first constructed of a four-lane type while bridge structures will be constructed based on the ultimate plan. The ultimate plan of the roadway structures will be implemented after the completion of the four-lane type road. The detailed implementation schedule for the four phases and their stages is presented in Figs. B.6-1 to B.6-3.

Fig. B.6-1 Recommended Implementation Schedule for Phase 1

(Southern Part of C-3 Road)



Notes: 1) 4-lane road should be constructed as stage construction plan.

2) 6-lane road should be constructed as ultimate plan.

Fig. B.6-2 Recommended Implementation Schedule for Phase 2

(Northern Part of C-3 Road)

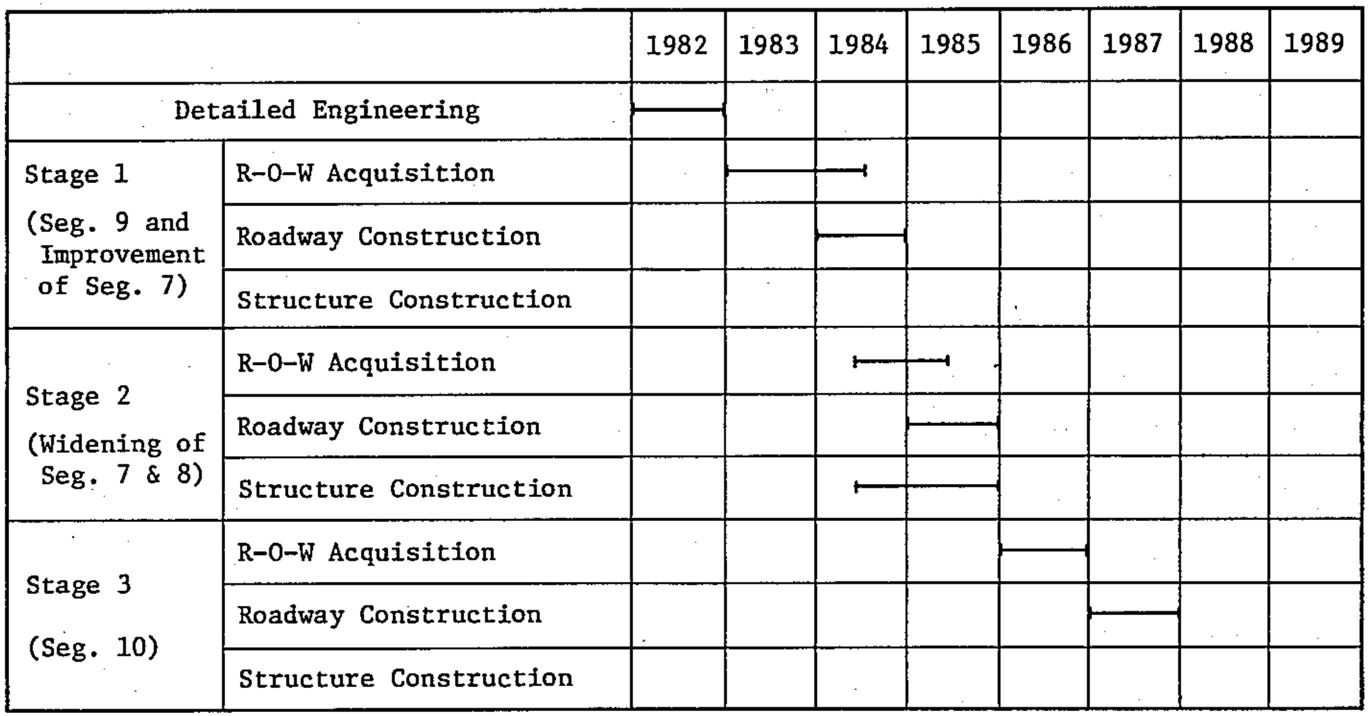
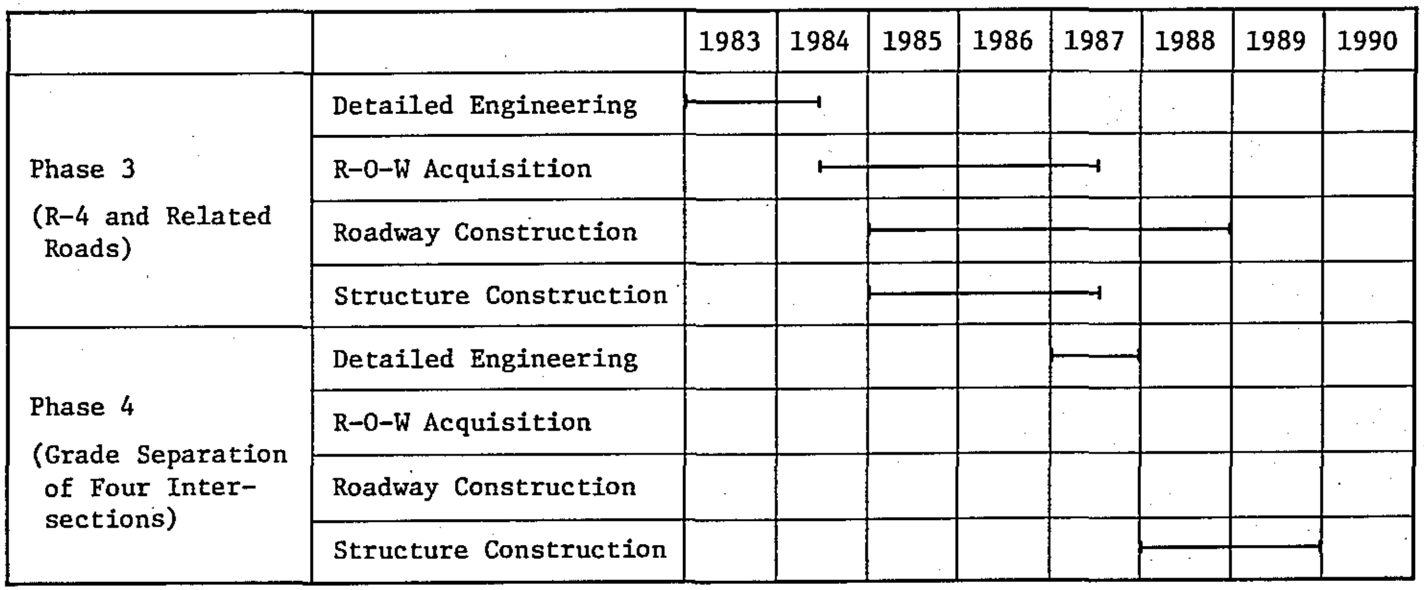


Fig. B.6-3 Recommended Implementation Schedule for Phases 3 and 4



B.6.4 Investment Requirements

The annual investment requirements of the project were set based on the implementation schedule. The amount of annual investment required consists of R-O-W acquisition costs and construction costs of roadway and bridge structures. The yearly investments are in 1977 prices and broken down into foreign and local components. An inflation rate of 7 per cent per year was used to estimate the final annual investments. The annual investment requirements of the project are shown in Tables B.6-1 to B.6-6.

Table B.6-1

Summary of Financial Project Costs
(Thousand Pesos at Current Prices)

	Total Project Costs	Foreign	Local	Remarks
Phase 1	₱ 323,000 $ 44,250	₱ 97,250 $ 13,320	₱ 225,750 $ 30,930	Southern Part of C-3 Road
Stage 1	₱ 265,080 $ 36,310	₱ 71,920 $ 9,850	₱ 193,160 $ 26,460	
Stage 2	₱ 57,920 $ 7,930	₱ 25,330 $ 3,470	₱ 32,590 $ 4,460	
Phase 2	₱ 191,400 $ 26,220	₱ 38,070 $ 5,220	₱ 153,330 $ 21,000	Northern Part of C-3 Road
Stage 1	₱ 48,220 $ 6,600	₱ 7,400 $ 1,010	₱ 40,820 $ 5,590	
Stage 2	₱ 78,350 $ 10,730	₱ 23,130 $ 3,170	₱ 55,220 $ 7,560	
Stage 3	₱ 64,870 $ 8,890	₱ 7,540 $ 1,040	₱ 57,330 $ 7,850	
Phase 3	₱ 268,120 $ 36,730	₱ 98,710 $ 13,520	₱ 169,410 $ 23,210	R-4 and Related Roads
Phase 4	₱ 148,220 $ 20,300	₱ 84,970 $ 11,640	₱ 63,250 $ 8,660	Grade Separation of Four Intersections
Total	₱ 930,740 $ 127,500	₱ 319,000 $ 43,700	₱ 611,740 $ 83,800	

Notes: 1) Financial project costs include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

3) Exchange rate is assumed as follows:
1US$ = 7.3₱.

Table B.6-2

Annual Investment Requirements for Phase 1 (Southern Section of C-3 Road)

(Thousand Pesos at Current Prices)

	R-O-W Acquisition	Construction and Detailed Engineering and Supervision			Total Project Costs		
Year	Local	Foreign	Local	Total	Foreign	Local	Total
1978	-	1,407	1,407	2,814	1,407	1,407	2,814
1979	16,111	5,221	3,568	8,789	5,221	19,679	24,900
1980	30,242	19,611	13,743	33,354	19,611	43,985	63,596
1981	40,801	24,038	22,227	46,265	24,038	63,028	87,066
1982	37,800	11,728	14,807	26,535	11,728	52,607	64,335
1983	-	12,811	16,166	28,977	12,811	16,166	28,977
1984	-	12,512	16,097	28,609	12,512	16,097	28,609
1985	-	9,923	12,777	22,700	9,923	12,777	22,700
Total	124,954	97,251	100,792	198,043	97,251	225,746	322,997

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

Table B.6-3

Annual Investment Requirements for Phase 2 (Northern Section of C-3 Road)

(Thousand Pesos at Current Prices)

Year	R-O-W Acquisition	Construction and Detailed Engineering and Supervision			Total Project Costs		
	Local	Foreign	Local	Total	Foreign	Local	Total
1982	-	1,161	1,161	2,322	1,161	1,161	2,322
1983	20,178	249	249	498	249	20,427	20,676
1984	23,384	7,986	10,452	18,438	7,986	33,836	41,822
1985	13,466	21,164	27,053	48,217	21,164	40,519	61,683
1986	46,837	274	335	609	274	47,172	47,446
1987	-	7,240	10,218	17,458	7,240	10,218	17,458
Total	103,865	38,074	49,468	87,542	38,074	153,333	191,407

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

Table B.6-4

Annual Investment Requirements for Phase 3 (R-4 and Related Roads)

(Thousand Pesos at Current Prices)

Year	R-O-W Acqui-sition	Construction and Detailed Engineering and Supervision			Total Project Costs		
	Local	Foreign	Local	Total	Foreign	Local	Total
1983	-	1,907	1,907	3,814	1,907	1,907	3,814
1984	13,351	1,021	1,021	2,042	1,021	14,372	15,393
1985	18,860	23,813	22,602	46,415	23,813	41,462	65,275
1986	23,797	33,784	27,238	61,022	33,784	51,035	84,819
1987	20,221	24,481	22,807	47,288	24,481	43,028	67,509
1988	-	13,701	17,609	31,310	13,701	17,609	31,310
Total	76,229	98,707	93,184	191,891	98,707	169,413	268,120

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

Table B.6-5

Annual Investment Requirements for Phase 4 (Grade Separation of Four Intersections)

(Thousand Pesos at Current Prices)

	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
Year	Local	Foreign	Local	Total	Foreign	Local	Total
1987	-	2,488	2,488	4,976	2,488	2,488	4,976
1988	-	39,833	29,346	69,179	39,833	29,346	69,179
1989	-	42,646	31,417	74,063	42,646	31,417	74,063
Total	-	84,967	63,251	148,218	84,967	63,251	148,218

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

Table B.6-6

Annual Investment Requirements for the Project Roads

(Thousand Pesos at Current Prices)

	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
Year	Local	Foreign	Local	Total	Foreign	Local	Total
1978	-	1,407	1,407	2,814	1,407	1,407	2,814
1979	16,111	5,221	3,568	8,789	5,221	19,679	24,900
1980	30,242	19,611	13,743	33,354	19,611	43,985	63,596
1981	40,801	24,038	22,227	46,265	24,038	63,028	87,066
1982	37,800	12,889	15,968	28,857	12,889	53,768	66,657
1983	20,178	14,967	18,322	33,289	14,967	38,500	53,467
1984	36,735	21,519	27,570	49,089	21,519	64,305	85,824
1985	32,326	54,900	62,432	117,332	54,900	94,758	149,658
1986	70,634	34,058	27,573	61,631	34,058	98,207	132,265
1987	20,221	34,209	35,513	69,722	34,209	55,734	89,943
1988	-	53,534	46,955	100,489	53,534	46,955	100,489
1989	-	42,646	31,417	74,063	42,646	31,417	74,063
Total	305,048	318,999	306,695	625,694	318,999	611,743	930,742

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

CHAPTER 1 INTRODUCTION

1 INTRODUCTION

1.1 PRESENT CONDITION OF URBAN TRANSPORT

1.1.1 Existing Urban Transport System

1.1.1.1 Road Network and its Condition

The main road network in the Metropolitan Manila area (MMA) consists of nine radial and three circumferential roads, most of which constitute wide dual carriageways. However, some links among them are still non-existent.

Two expressways, the North Expressway and the South Expressway serve traffic in the northern and southern parts of the MMA. They are toll highways which are fully access-controlled.

Traffic flows on the road network, based on the traffic surveys conducted by the Department of Public Highways (DPH) in 1974, show that the heaviest traffic flows are found in in-bound direction on the main radial roads and on the circumferential road C-4.

The most congested area is clearly seen to be within circumferential road C-2. Bottlenecks are also observed on the Pasig River, i.e., Panaderos and Guadalupe bridges.

1.1.1.2 Mass Transit Network and its Conditions

At present over 99 per cent of daily mass transit passenger trips are by buses and jeepneys. The passenger trips by the Philippine National Railways (PNR) and other passenger modes are less than 1 per cent.

Buses

There are at present about 2750 buses and mini-buses authorized to operate in 27 jurisdictions of the MMA. In 1971 the share of passenger trips by bus was approximately 20 per cent of all passenger trips.

Jeepneys

About 17,000 jeepneys currently operate in the MMA with seating capacities ranging from 8 to 16 passengers per vehicle. In 1971 they carried almost 40 per cent of all passengers.

Railways

The Philippine National Railways (PNR) operates a commuter train service along a North-South line.
In March 1976, the commuter services carried about 10,000 passenger trips per day in the MMA.

1.1.2 Characteristics of Road Traffic

This section discusses the characteristics of road traffic, which will be used as basic data for traffic prospect. After reviewing the data from previous traffic surveys conducted by the DPH, the following traffic surveys were conducted in this study;

Screen line survey,

Mid-block traffic survey,

Turning movement traffic survey, and

Load meter survey.

An analysis of the above data gives the following characteristics of road traffic:

1. Traffic Volume Variation;

   The daily variations of traffic volumes on circumferential road C-2 and radial road R-7 show that, as a whole, there are no significant changes in daily traffic volume from day to day, except on Sundays.

   According to the hourly variations of traffic volumes on circumferential roads C-2, C-4 and radial road R-7, significant peak-hours concentration is not observed during the 12-hour period from 7:00 a.m. to 7:00 p.m.

2. Traffic Composition by Vehicle Types;

   The composition of traffic by vehicle types on screen line stations (i.e. Nagtahan, Panaderos, Guadalupe and Bambang bridges) is as follows:

   Approximately 80 to 90 per cent of total traffic volume consists of cars and jeeps. The composition of jeepneys on Bambang bridge is remarkably high, amounting to more than 40 per cent of the total volume. The share of buses in the total volume is comparatively small i.e. that on Nagtahan bridge is 2.1 per cent, that on Panaderos bridge is less than 1 per cent, that on Guadalupe bridge is 8.3 per cent and that on Bambang bridge is 7.3 per cent.

1.2 BRIEF DESCRIPTION OF THE PROJECT ROADS

The location of the project roads are illustrated in Fig. 1.2-1.

1.2.1 Circumferential Road C-3

C-3, starting at the intersection of Buendia and South Superhighway follows Buendia Avenue. The latter is a divided 6-lane road with a total width of 31 meters and at both sides of which modern multi-storied buildings are so densely developed that widening would face some difficulties. It crosses PNR track, the services of which are not so frequent that grade-separation would not be of urgent necessity at this stage.

At the intersection with Ayala Avenue where modern signalization has been adopted and the space for grade-separation in the future has been reserved, C-3 turns left and proceeds to J. P. Rizal Ave. This route passes beside Manila South Cemetery and then runs through a residential area where physical environmental complaints such as noise will arise.

From the intersection with J. P. Rizal, C-3 extends northeast along Trabajo Street which has many houses on both sides, and crosses the Pasig River. After crossing, it passes beside the swampy area where it sometimes floods.

After crossing Boni Avenue, C-3 extends northeast through densely populated area and crosses PNR.

At the intersection with Shaw Boulevard, it turns northwest and gets to Aurora Blvd. In this section, it passes through a residential area and then beside an industrial area along the San Juan River. The river improvement plan will have to be taken into consideration in planning the San Juan River bridge.

From the intersection with Aurora Blvd. to Quezon Blvd., C-3 follows the existing road called G. Araneta Avenue whose right-of-way about 40 meters wide, has already been acquired. In the northern part, settlements of squatters exist even within the right-of-way. It extends northwards to the intersection with Sgt. Emilio Rivera after crossing Quezon Boulevard. G. Araneta Avenue has about 40 meters right-of-way with two carriageways separated in the middle by Talayan creek, which serves as a median and sometimes overflows. Along the northern part, commercial centers and factories have been developed.

At the north end of G. Araneta Avenue, C-3 turns to west and follows the existing road called Sgt. Emilio Rivera which terminates at the intersection with Bonifacio Avenue and has about 15 meters right-of-way. Big factories existing on both sides present some difficulties in securing additional right-of-way.

Crossing the intersection with Bonifacio Avenue, C-3 runs westwards through the settlements of squatters beside La Loma Cemetery and then follows 5th Avenue which is a 2-lane road passing through a residential area and terminates at the intersection with Rizal Avenue Extension.

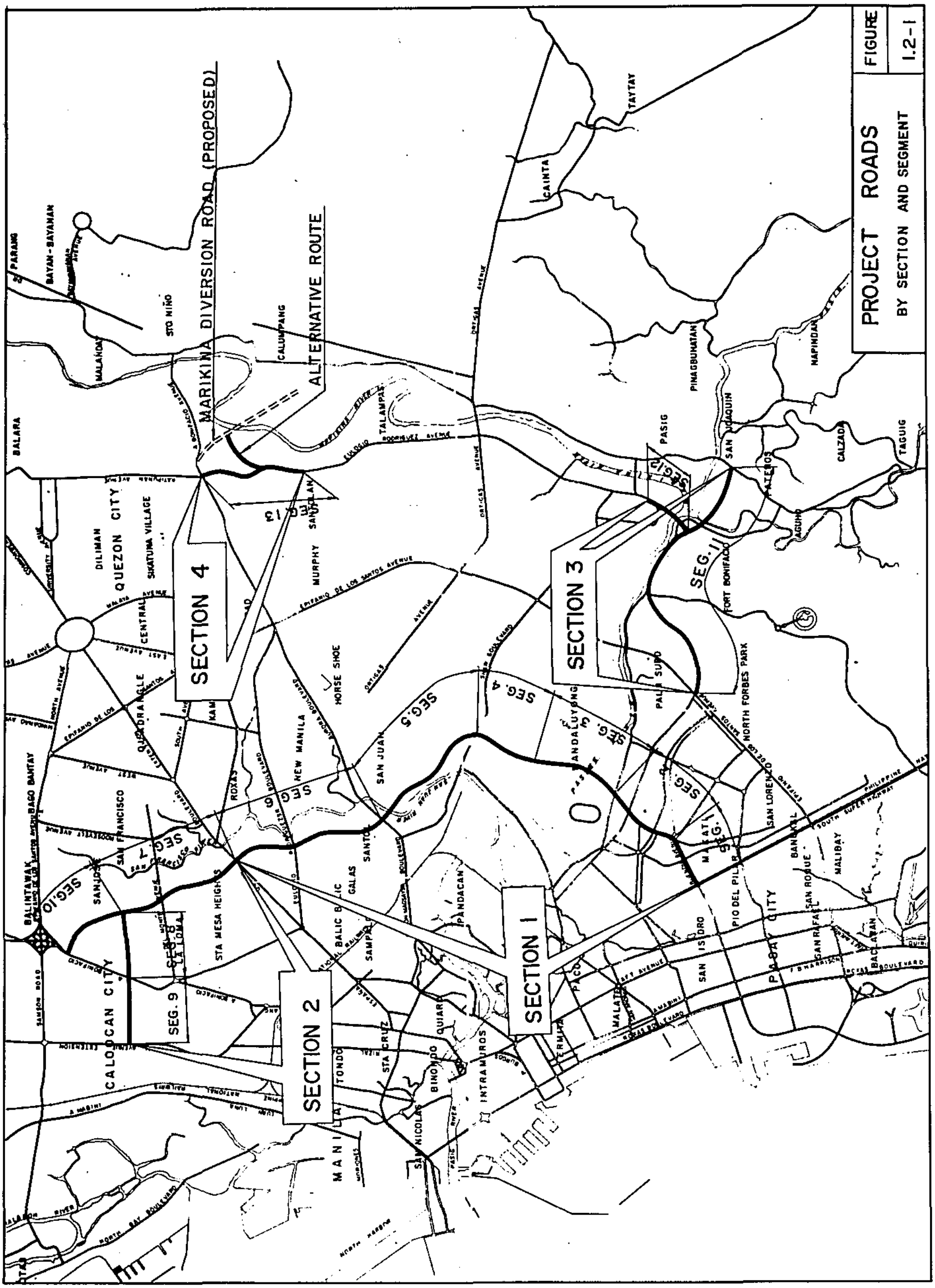


FIGURE
1.2-1
PROJECT ROADS
BY SECTION AND SEGMENT
MARIKINA DIVERSION ROAD (PROPOSED)
ALTERNATIVE ROUTE
SECTION 1
SECTION 2
SECTION 3
SECTION 4
SEG. 1
SEG. 3
SEG. 4
SEG. 5
SEG. 6
SEG. 7
SEG. 8
SEG. 9
SEG. 10
SEG. 11
SEG. 12
SEG. 13
QUEZON CITY
CALOOCAN CITY
MANILA
PASAY CITY
MAKATI
PASIG
TAYTAY
CAINTA

Another route which connects the north end of G. Araneta Avenue to Bonifacio Avenue near Balintawak interchange is proposed. The route passes through industrial areas.

1.2.2 Radial Road R-4 and its Related Road

Project section of R-4, starting at the intersection with C-4, follows the existing 1.4-kilometer stretch of Imelda Marcos Avenue which is a divided 4-lane road. Then it passes through Fort Bonifacio, where settlements of military families exist along the Pasig River. After crossing the Taguig River, it passes eastward through residential and industrial areas and terminates at the intersection with Juan Luna.

The related road is a road section which connects the project section of R-4 to existing E. Rodriguez Avenue (C-5). It starts at the junction with project road section of R-4 near the merging point of the Pasig and Taguig Rivers and then crosses the Pasig river. It extends northeast through the residential area and joins E. Rodriguez Avenue (C-5).

1.2.3 Project Road Section of C-5

This project road section connects existing E. Rodriguez Avenue to Aurora Boulevard. This route, starting at the intersection with Santolan, passes a wealthy residential area located in a hilly terrain and crosses Aurora Boulevard after climbing the fairly steep slope.

1.2.4 Sectioning of the Project Roads

The project roads were divided into four sections which consist of 13 segments, as shown in Table 1.2-1 and Fig. 1.2-1. The division into segments was made based on the following guidelines:

1. The construction of one or more segments should function as a system in the overall road network.

2. A road segment should have a uniform traffic demand.

Table 1.2-1 Sectioning of the Project Roads

Route	Section	Segment	Description
C-3	1	1	South Superhighway - Ayala Ave.
		2	Ayala Ave. - J. P. Rizal
		3	J. P. Rizal - Boni Ave.
		4	Boni Ave. - Shaw Blvd.
		5	Shaw Blvd. - Aurora Blvd.
		6	Aurora Blvd. - Quezon Blvd.
	2	7	Quezon Blvd. - Intersection of G. Araneta Ave. & Sgt. Emilio Rivera
		8	Intersection of G. Araneta Ave. & Sgt. Emilio Rivera - A. Bonifacio Ave.
		9	A. Bonifacio Ave. - Rizal Ave.
		10	Intersection of G. Araneta Ave. & Sgt. Emilio Rivera - Balintawak Interchange
R-4 and Related Roads	3	11	E. de Los Santos Ave. - J. Luna
		12	Proposed R-4 - Pasig Blvd.
	4	13	Santolan - Aurora Blvd.

1.3 RATIONALE OF THE STUDY

The Philippine Government has recently prepared the Metro-Manila Transport, Land Use and Development Planning Project (MMETROPLAN). The study team, in its review of the MMETROPLAN, has judged that the report is generally acceptable to the Philippine Government as a master plan for the area's development. Some government officials have, in fact, signified their approval of the plan's contents by implementing some of its recommendations, for example, organization of consortia of bus operators.

The MMETROPLAN report has established the following set of priorities for the implementations of its transport infrastructure plan recommendations:

<u>A-1. Phase I (1977-1980)</u>

1. Feasibility study for Light Rail Transit (LRT) should be undertaken as early as possible especially on the Rizal and Taft lines.

2. Feasibility and detailed engieering studies on highway improvements should be done in the following sections:

   Improvement of existing G. Araneta Avenue (C-3 and extension to Balintawak intersection),
   Improvement of the northern portion of C-3,
   Extension of the Republic Avenue and Mindanao Avenue,
   Improvement of Tandang Sora,
   New bridge construction between Navotas and Malabon,
   New bridge construction between Sucat and South Superhighway,
   Improvement of Sucat Road.

<u>A-2. Phase II (1981-1985)</u>

3. LRT system should be constructed in the Rizal and Taft lines

4. Feasibility and detailed engineering should be undertaken in the LRT system of Quezon Boulevard and Shaw lines

5. Improvement and construction of the following highways should be undertaken:

   New construction of the northern portion of C-3 between the existing G. Araneta Avenue and R-10,
   New construction of the southern portion of C-3, including a bridge crossing the Pasig River,
   Extension of Republic Avenue and Katipunan,
   Construction of R-4 from EDSA to Pateros,
   New construction of Sucat and Pamplona Road,
   Extension of R-1.

<u>A-3. Phase III (1986-1990)</u>

6. Construction of LRT in the Quezon Blvd. and Shaw lines

7. Road construction in Phase III:

   Republic Avenue,
   Extension of Visayas Avenue,
   Development of road in Marikina Valley,
   Extension of R-10 to connect it to Republic Avenue.

Most of the sections of the project roads have been given high priority. For C-3, it cited economic evaluation as the strong rationale for its construction in terms of very high rates of return even on the basis of resource savings only. But more significant is the benefits it will endow to the stress areas along the road alignment in terms of improved accessibility and greater opportunities for urban development and redevelopment.

For R-4 and related roads, the need for improved accessibility of the eastern towns of Metro Manila (Pasig, Pateros and Taguig) as clearly demonstrated by the current severe problem of poor accessibility and traffic congestions provide the rationale for ist construction. The completion of R-4 and related roads would also lead to substantial economic benefits to the areas within the influence zone of its alignment.

As a consequence, the project roads C-3 and R-4 (outside EDSA) have been included in the ten-year (1978-1987) infrastructure development program for the MMA.

1.4 STUDY APPROACH

1.4.1 General Procedure

The general approach to achieve the objective of the study is illustrated in the flow diagram in Fig. 1.4-1. It consists of the following principal activities:

1. Traffic projection (discussed in Chapter 2);

   The traffic demand is projected on the basis of existing traffic condition analysis and future framework forecast. The results of the traffic projection are mainly used for preliminary engineering and benefit calculation.

2. Preliminary engineering including environmental considerations (Chapter 3);

   Route selection and preliminary design of roads and structures are conducted taking into account the traffic projection. The influence on environs is studied as well.

3. Cost estimate (Chapter 4);

   Construction and maintenance costs are estimated on the basis of the preliminary design and they are used as basic data in economic evaluation and preparation of implementation program.

4. Economic evaluation (Chapter 5);

   The economic analysis is made using results of benefit and economic cost estimates. Based on the economic analysis, the alternative plans are evaluated and the investment timing are established.

5. Preparation of implementation program (Chapter 6);

   Based on the above-mentioned studies, the implementation program is prepared following the steps mentioned below:

   a. Comparative examination between highway funds and investment requirements,

   b. Financial cost estimates,

   c. Preparation of implementation schedule,

   d. Investment requirements estimates.

1.4.2 Alternatives

Establishment of Alternatives

The alternatives are considered for each of the following requirements:

1. Route,
2. Number of travel lanes,
3. With and without regulated bus lane,
4. Type of intersection,
5. Stage construction by road section,
6. Stage acquisition of right-of-way, and
7. With and without cordon pricing.

The alternatives are established mainly from the findings of the reconnaissance survey.

Evaluation of Alternatives

The routes are selected mostly on the basis of evaluation of construction and right-of-way acquisition costs and environmental consideration. Number of travel lanes, with or without regulated bus lane and type of major intersections are discussed in the economic evaluation. Stage construction is considered in the implementation program on the basis of priority ranking established by the economic evaluation. Stage acquisition of right-of-way is considered after examination of its possibility. Cases with and without cordon pricing are examined in the sensitivity analysis.

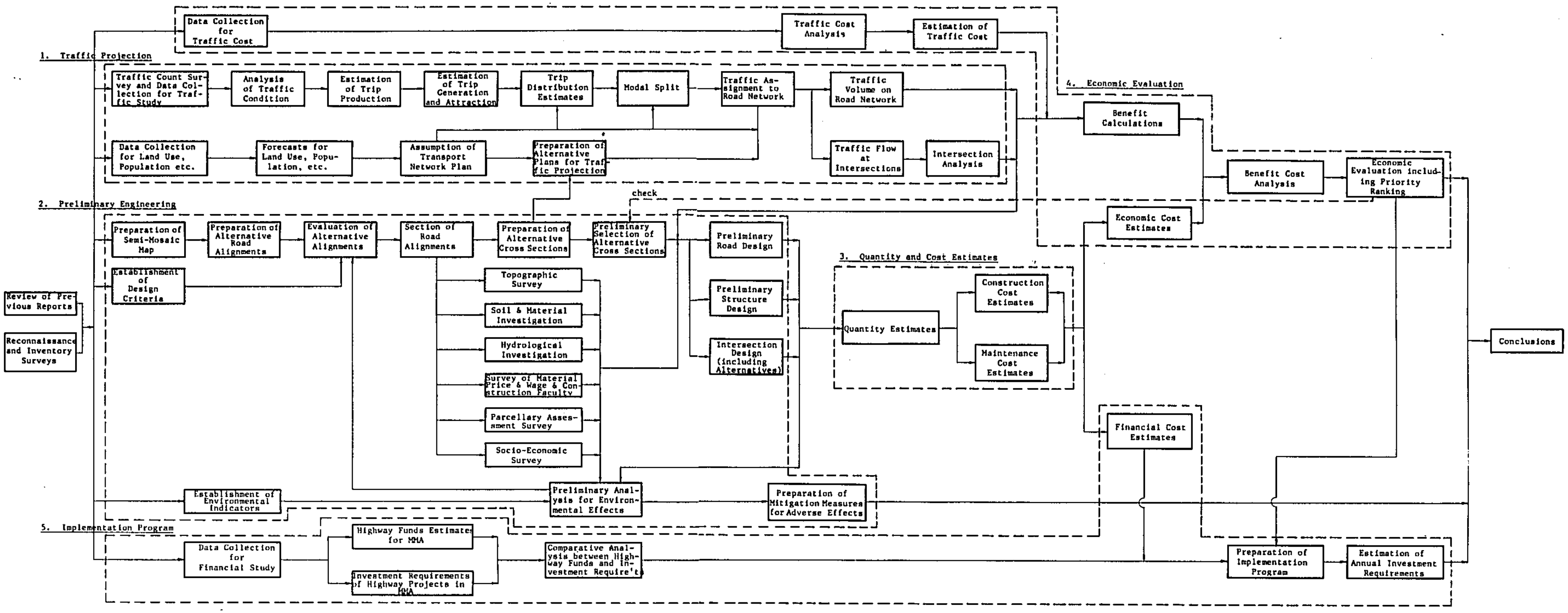


Fig. 1.4-1 Study Approach

1.5 STUDY AREA AND ZONE PLAN

1.5.1 Study Area

At present, there exist three kinds of boundaries for the MMA which were developed by the UTSMMA, MMETROPLAN and MMC. For this study, the definition of boundary (the 17 jurisdictions) established by the MMC were adopted as study area.

The following are the jurisdictions in this study:

MANILA, CALOOCAN CITY, MAKATI, MANDALUYONG, NAVOTAS, PASAY CITY, QUEZON CITY, SAN JUAN DEL MONTE, LAS PIÑAS, MALABON, MARIKINA, MUNTINGLUPA, PARAÑAQUE, PASIG, PATEROS, TAGUIG, VALENZUELA.

Fig. 1.5-1 shows the study area in this study.

1.5.2 Zone Plan

Substantially, zoning plan was established based on zoning plans of the UTSMMA and MMETROPLAN. The reasons are as follows:

a. It can be utilized the results of person trip survey carried out in 1971.

b. It is possible to utilize the future socio-economic data (e.g. population, employed person, etc.) by zone.

Among the zones of the UTSMMA and MMETROPLAN, the zones related to C-3 and R-4 were sub-divided into smaller ones while the outside zones were combined into larger zones. Finally, 80 internal zones and 6 external zones were planned. Moreover, the boundary of the sectors were prepared referring to the UTSMMA.

Internal zones	80
External zones	6
Sectors	16

Fig. 1.5-2 shows the zone plan in this study.

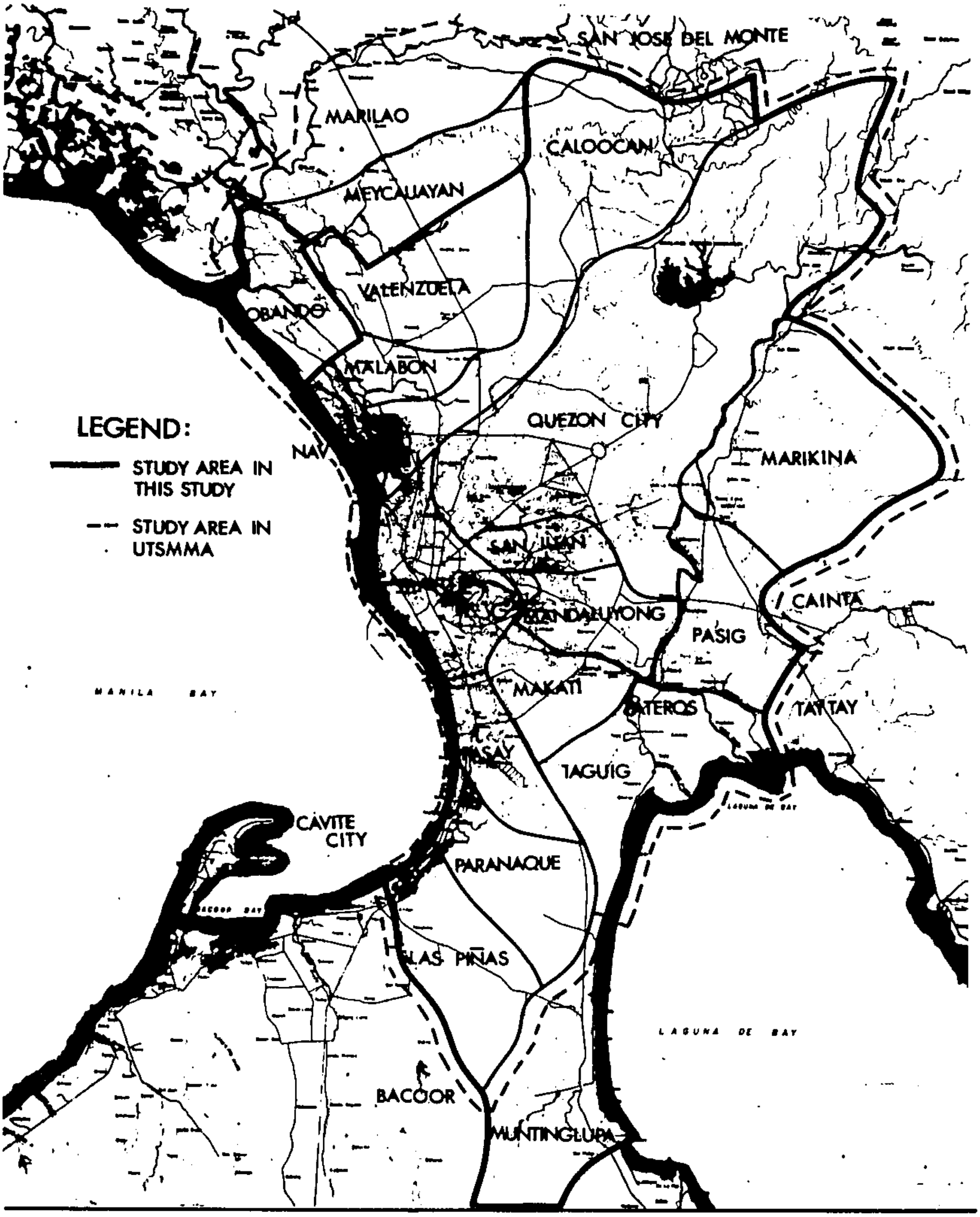


Figure 1.5—1

STUDY AREA

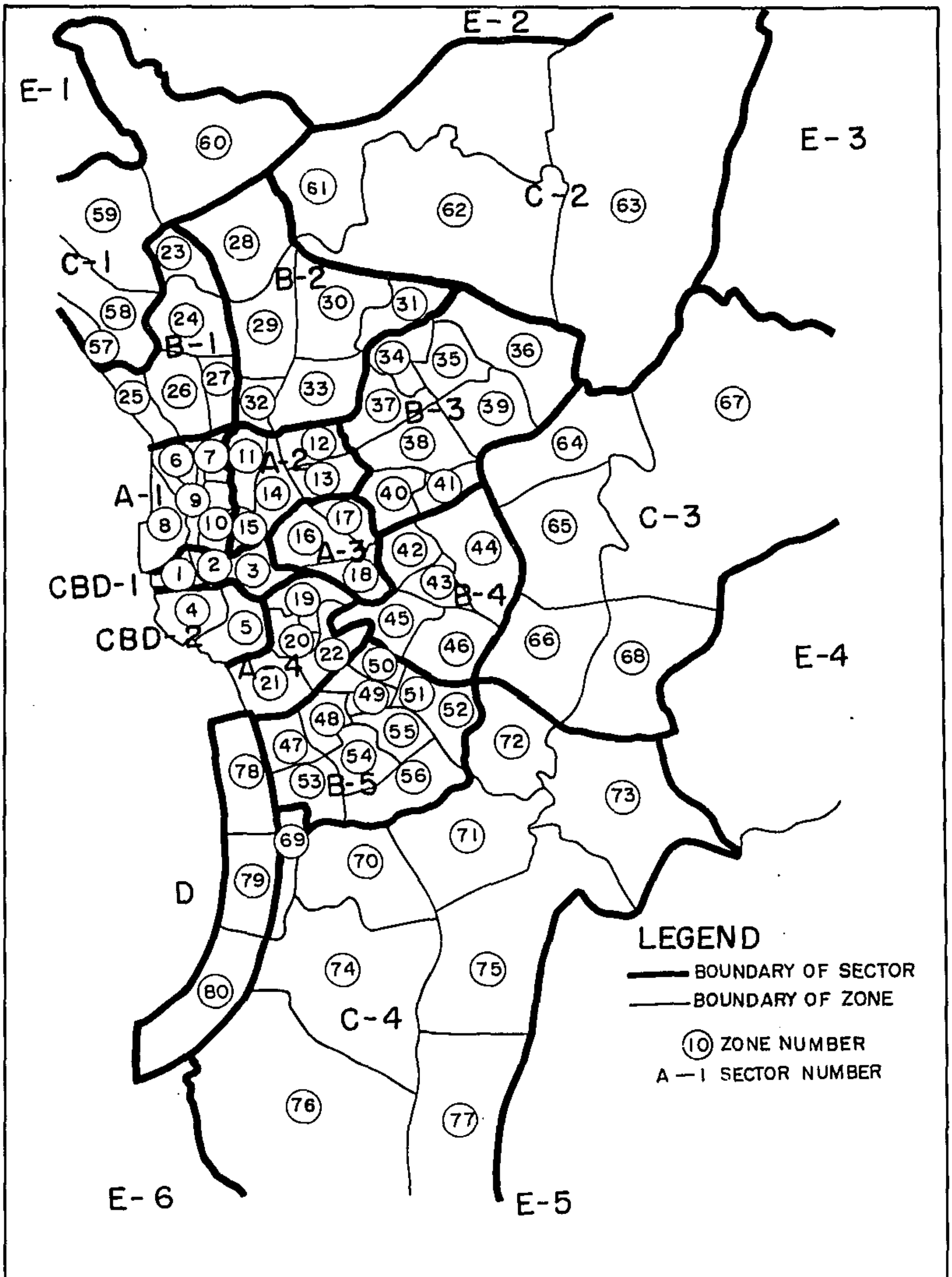


FIG 1.5-2 ZONE PLAN

CHAPTER 2 TRAFFIC PROJECTION

2. TRAFFIC PROJECTION

2.1 FRAMEWORK PLAN FOR TRAFFIC PROJECTION

2.1.1 Prospective Land Use Pattern

It is said that there is no shortage of land development in Metro Manila. In fact, much of the land on the verge of urbanization such as those in Quezon City, Las Piñas and Parañaque is more suitable for urban development than the lowlying, flooded land on which large part of the city of Manila is situated. Locally, there may be shortage of land for development or redevelopment, but this is induced more by increasing demand rather than by actual physical shortage of land. If future development is possible in numerous places, the question as to which form of urban development is most desirable will arise.

In MMETROPLAN, the conceptual forms of growth of Metro Manila have been discussed. These forms were based on five "urban expansion goals." These are:

1. to follow current government policies and the development trends;
2. to minimize the diseconomies of urban sprawl and to increase the efficiency of the existing urban area;
3. to preserve and enhance the degree of social and economic interdependence that exists in large cities;
4. to establish new urban settlements within Metro Manila; and
5. to optimize obvious opportunities for the rapid urban expansion.

These forms of urban development expected in MMETROPLAN have been examined in detail by the feasibility study team. In examining the "urban expansion goals", the consolidation of forms of the urban growth and the refinement of these studies, the five "urban expansion goals" determined by MMETROPLAN were compressed into three. These forms are:

Form 1. expansion of the main urban area corresponding with the availability of land and the pressures for development, establishing the new urban communities;

Form 2. establishment of new urban centers along the major corridors, improving the functions of the existing urban areas; and

Form 3. establishment of new urban settlements outside the existing urban area, minimizing the disadvantages of urban sprawl in the "mother city."

These forms are illustrated in Fig. 2.1-1.

For Metro Manila, it is not only most likely that Form 3 will arise in the coming 15-20 years but also most desirable. This is because the concentrated investments for the new urban settlements will be relatively less than those of providing all services and facilities needed for the expansion of the existing urban area. Moreover, this is because of the existence of the new urban settlement projects initiated by the Government, such as "Sapang Palay" and "Dasmariñas", especially the implementation of "Lungsod Silangan", in the Antipolo highlands.

Form 3 was therefore considered in preparing the land use and population forecasts.

2.1.2 Land Use Forecasts for Years 1980, 1990 and 2000

The preparation of the land use and socio-economic inputs by traffic zones in 1980 and 1990 has already been carried out and prepared in MMETROPLAN. Therefore, the forecast for 1980 and 1990 prepared in MMETROPLAN were adopted and applied to this feasibility study, being made over as the new zoning plan defined by the Team. The methodology which have been applied in MMETROPLAN was largely adopted and applied in preparing the Land Use and Population Plan for the year 2000.

Population

The policies of decentralization aimed to encourage the growth of other urban centers and the rural areas will help reduce the migration to the Metropolitan Manila area. They could be expected to significantly reduce the rate of migration 10-15 years later. The existence of organized family planning in the Philippines could be expected to reduce the rate of natural population increase in the MMA. Based on these considerations, the assumption has been made that the rate of population growth in the MMA will decline progressively. However, it is still expected that the absolute increase of population will continue further.

The actual number of population estimated for the year 2000 is given in Table 2.1-1, compared with the recent growth and the forecast prepared in MMETROPLAN. This table shows that approximately 10.8 million of population in medium forecast will live in the MMA in the year 2000.

In addition to the estimation of the annual rate of population increase, the forecast on the basis of change of the gross density by jurisdictions were carried out to check the actual number of population.

On the basis of the estimation of gross density by jurisdiction, the total number of population in the MMA as a whole were obtained to be 10.7 million in 2000. This figure was compatible with that of the medium forecasts on the basis of the annual rate of increase.

The estimated total number of population in 2000 were allocated to the individual traffic zones on the basis of distribution of population in 1990, making allowance on the change of accessibility of the individual traffic zones between 1990 and 2000.

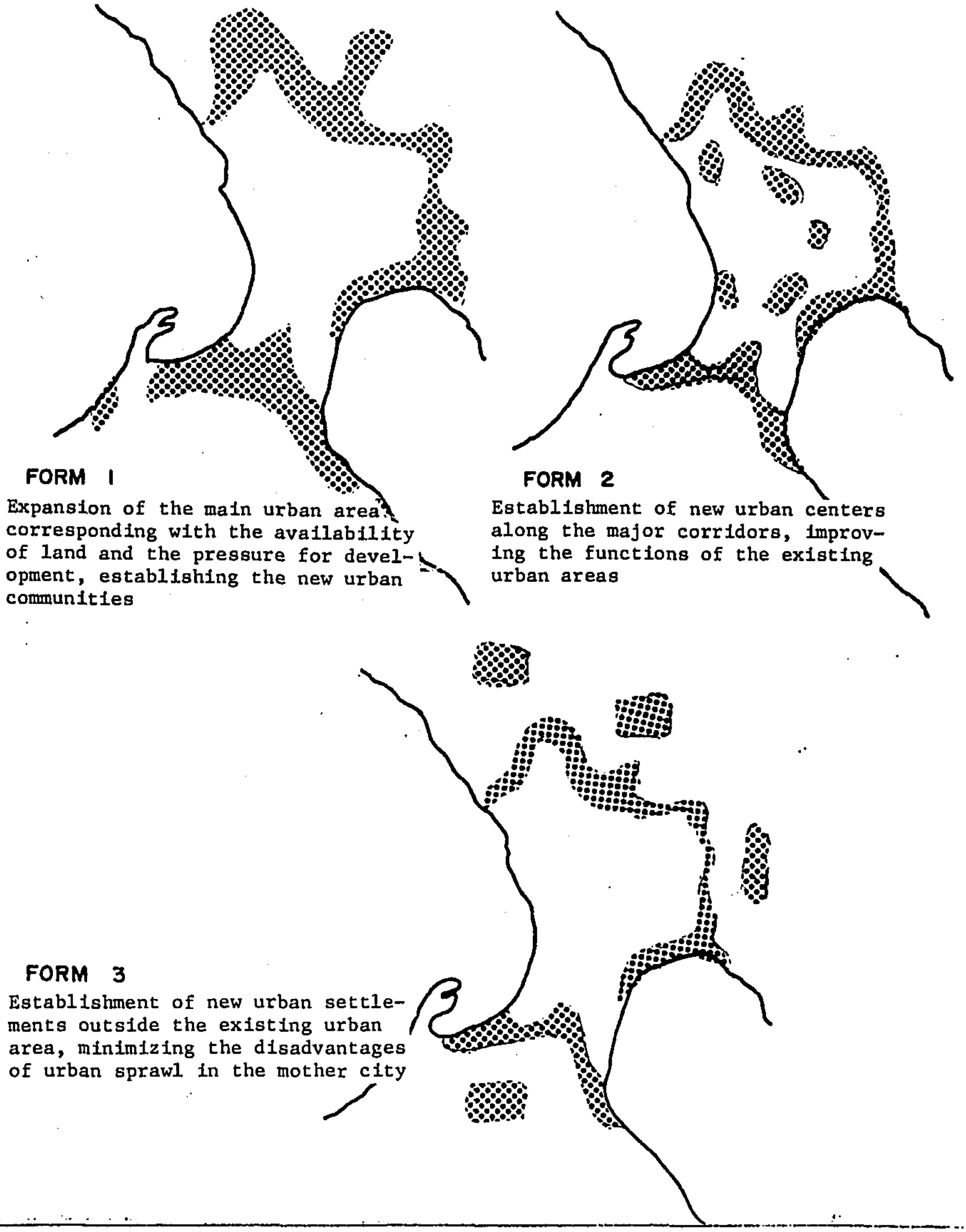


Figure 2.1-1

FORMS OF URBAN DEVELOPMENT

Table 2.1-1 Forecasts of Population in the MMA in 2000

YEAR		Population (persons)	Actual increase (persons)	Annual rate of increase (percent)		
1948		1,567,000	-	-		
1960		2,464,000	897,000	3.8%		
1970		3,964,000	1,500,000	4.9%		
1975		4,863,000	899,000	4.2%		
1980		6,092,000	1,229,000	4.6%		
1990		8,281,000	2,189,000	3.1%		
2000				Natural increase	Migration	Total
	High forecasts	11,457,000	3,176,000	1.5	1.8	3.3%
	Medium forecasts	10,809,000	2,528,000	1.5	1.2	2.7%
	Low forecasts	9,983,000	1,702,000	1.5	0.6	2.1%

Notes: 1948 - 1975 .... Population Census
1980 & 1990 .... Forecasts in MMETROPLAN
2000 .... Forecasts in this study (C-3 & R-4 project)

Employed Persons by Workplace

The MMETROPLAN's report and the change of the economic indices in the Philippines from 1967 to 1976 were used to arrive at the total number of each of the three categories of employment. From the analysis of the data available, the following assumptions were made:

1. Primary employments in 1990 would remain static up to 2000.
2. Secondary employments would grow at 5 per cent annually from 1990 to 2000.
3. Tertiary employments would grow at 2.5 per cent from 1990 to 2000.

Following these assumptions, 4.2 million of employments in MMA was reached in 2000. This forecast of employed persons by workplace was examined by the total number of employed persons by residence (3.7 million) and the number of inflowing employment from outside MMA (0.5 million). The number of inflowing employment was estimated on the basis of the past trend of inflowing employment.

The total number of employed persons by workplace and by categories in 2000 were allocated to the individual traffic zones on the basis of the forecasted distribution of employment in 1990, making allowance for the estimated gross density of employment in the year 2000.

Educational Attendance

The estimation of school and college attendance in the future were carried out by multiplying the ratio of educational attendance to population, by the expected increase of population, and adding this to the existing number of attendance. Accordingly, the actual increase of educational attendance in the period 1990-2000 were estimated to be 0.7 million in the MMA as a whole, applying the ratio of 270 educational attendance to 1000 people. According to these assumptions, 3.1 million were obtained as the total number of educational attendance in the MMA for the year 2000.

It was assumed that 70 per cent of the total additional educational attendance in 1990-2000 would be distributed in proportion to the expected distribution of population, making allowance for the improvement of educational standards, and the remaining 30 per cent of the demand would be distributed in proportion to the distribution pattern of school and college attendance that existed in 1971.

Other Socio-Economic Characteristics of Population

In addition to the estimated population, employed persons by workplace and educational attendance, the other socio-economic characteristics of population were estimated.

The other socio-economic characteristics of population was defined by employed persons by residence, household size, private vehicle ownership and family income.

Household size in the MMA declined from 6.4 persons per family in 1960 to 6.2 in 1970. Figures of 5.8 in 1980 and 5.0 in 1990 were already estimated in MMETROPLAN by following this past trend. It was assumed that this decline would continue further and the household size in the MMA would be 4.5 in 2000 in this feasibility study. Accordingly, the number of households by each traffic zones were estimated in dividing the individual population of each traffic zones by the estimated household size.

On the basis of the trends of socio-economic indices, it is projected that the number of private vehicles and motorcycles per thousand population would be 107 in 2000. This figure was adopted and applied to the assumption of vehicle owning households in 2000. The results of this analysis were obtained as vehicle-owning households of 1.1 million and vehicle ownership of 45.3 per cent in 2000.

On the basis of the forecasts of the annual rate of increase on the total income in the MMA and the time series information of annual rate of increase of GNP between 1972 to 1976, it was assumed that the total income in the MMA would grow at 7.4 per cent of annual rate of increase from 1980 to 1982 and 7.7 per cent from 1983 to 2000. Accordingly, the average family income of ₱12,678 at 1971 prices for the year 2000 was estimated as a resultant figure.

Summary of Forecasts

Summary of forecasts for the years 1980, 1990 and 2000 are given in Table 2.1-2.

2.1.3 Transport Network for Years 1980, 1990 and 2000

This section presents the assumed transport network for the traffic projection for the years 1980, 1990 and 2000. The phasing of transport network for 1980 and 1990 were based on the recommendations contained in the MMETROPLAN. For the purposes of this report, however, the three phases recommended by the MMETROPLAN have been compressed into two phases as shown in Figs. 2.1-2 to 2.1-5.

The transport network for the year 2000 was assumed on the basis of the MMETROPLAN, the UTSMMA and the previous studies by the MMC. The highway network to be incorporated in it adopted the network proposed in the MMC and the UTSMMA (See Fig. 2.1-6), and the mass transit network adopted the network for 1990 recommended in the MMETROPLAN.

Table 2.1-2 Summary Table of Forecasts

(MMA as a whole)

YEAR / SECTORS	1971	1980	1990	2000
Population	4,096,445	6,092,000	8,281,000	10,809,000
Employed persons by workplace	1,412,793	2,149,670	3,049,650	4,224,950
(Primary)	20,897	20,670	17,150	17,150
(Secondary)	368,352	541,000	934,000	1,522,200
(Tertiary)	1,023,544	1,588,000	2,098,000	2,685,600
Educational attendance	1,300,804	1,849,300	2,441,000	3,123,600
Employed persons by residence	1,386,641	1,940,300	2,776,400	3,735,600
Households	662,797	1,054,000	1,657,000	2,401,900
Non-vehicle owning households	593,348	776,900	1,011,100	1,313,100
Family incomes at 1971 prices	-	7,785	9,342	12,678

Notes: 1980 & 1990 ..... forecasts in MMETROPLAN
2000 .... forecasts in this study (C-3 & R-4 project)

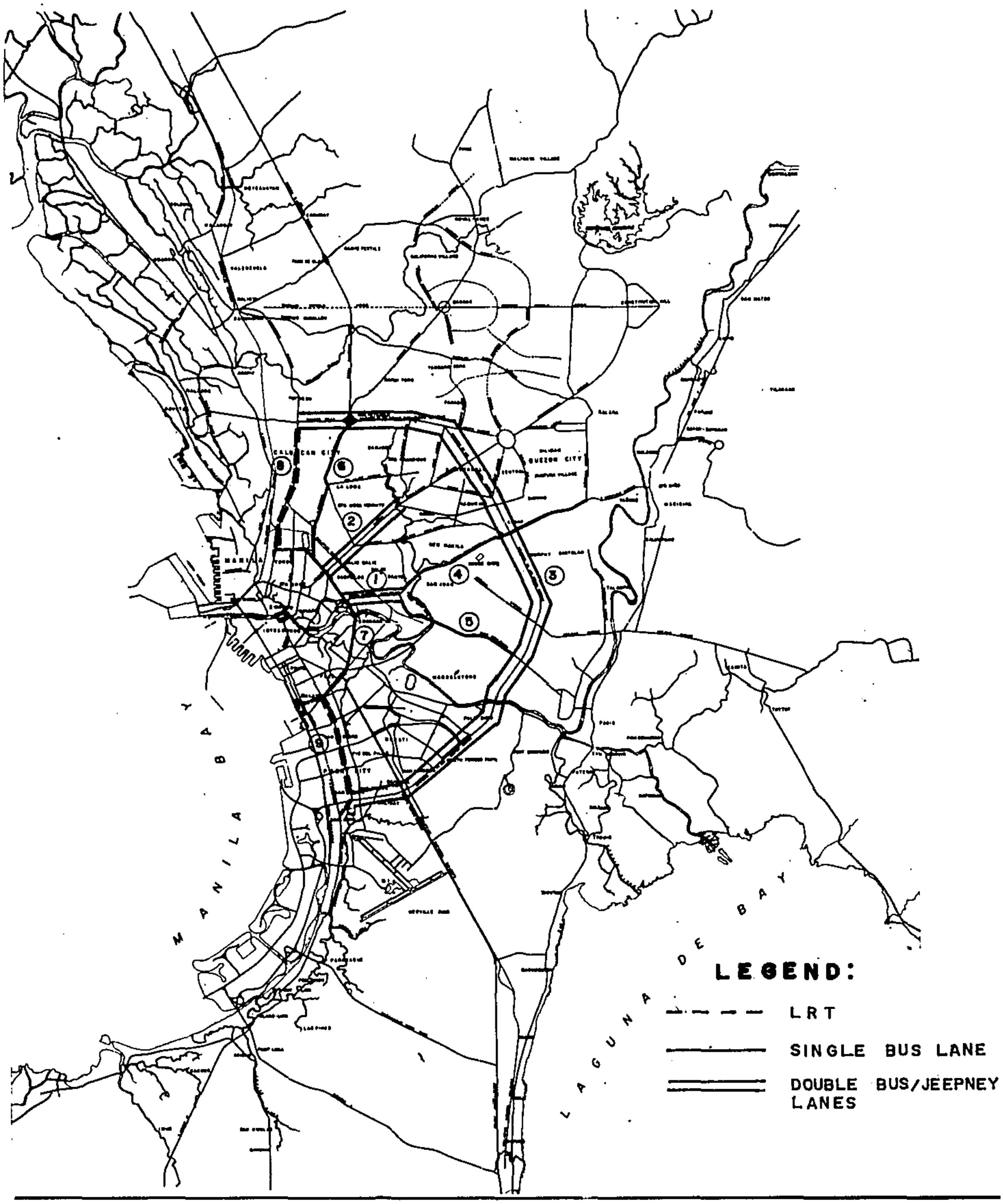


Figure 2.1-2

TRANSPORTATION PROPOSALS FOR THE YEAR 1980 (MASS TRANSIT)

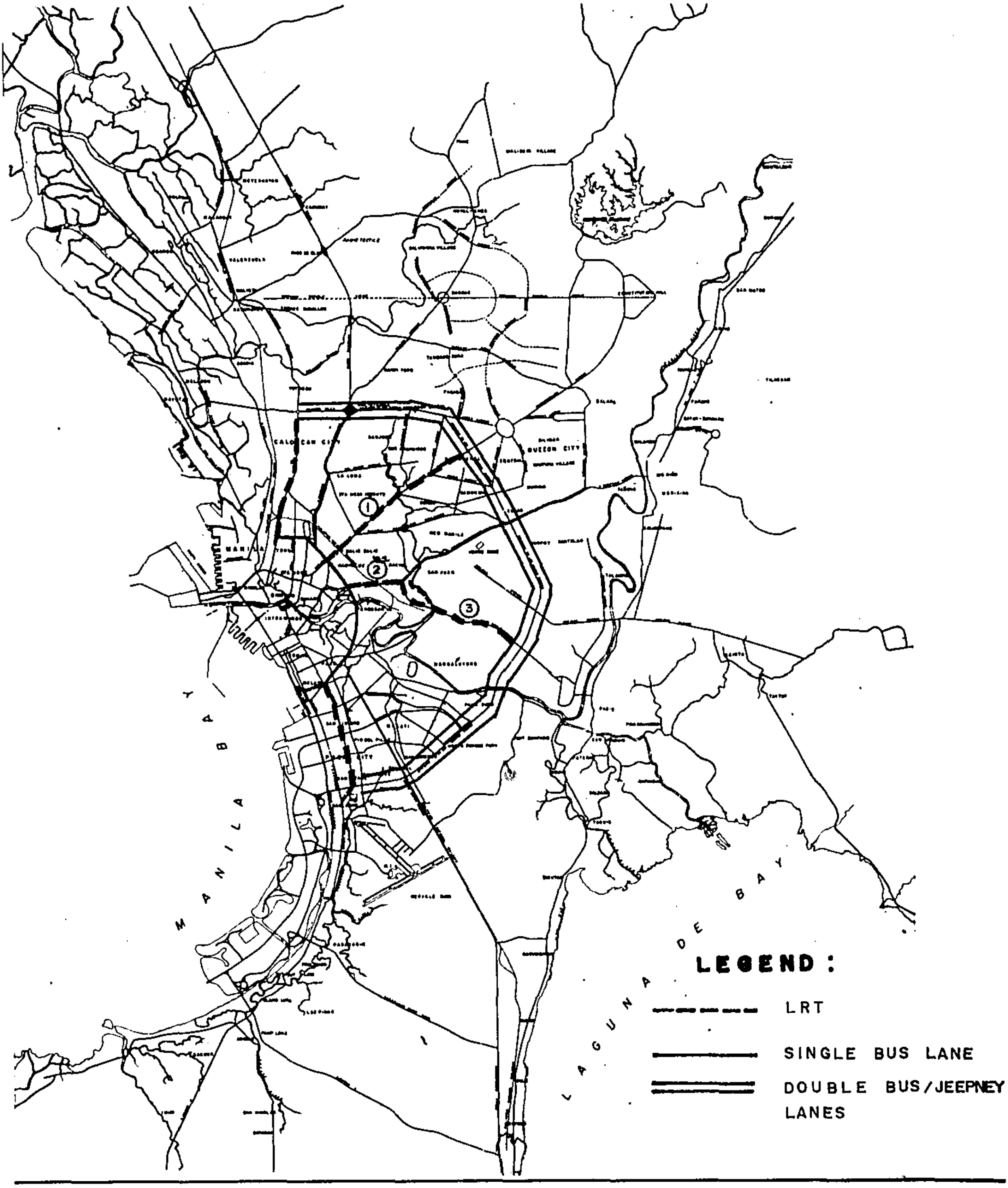


Figure 2.1-3

TRANSPORTATION PROPOSALS FOR THE YEAR 1990 (MASS TRANSIT)

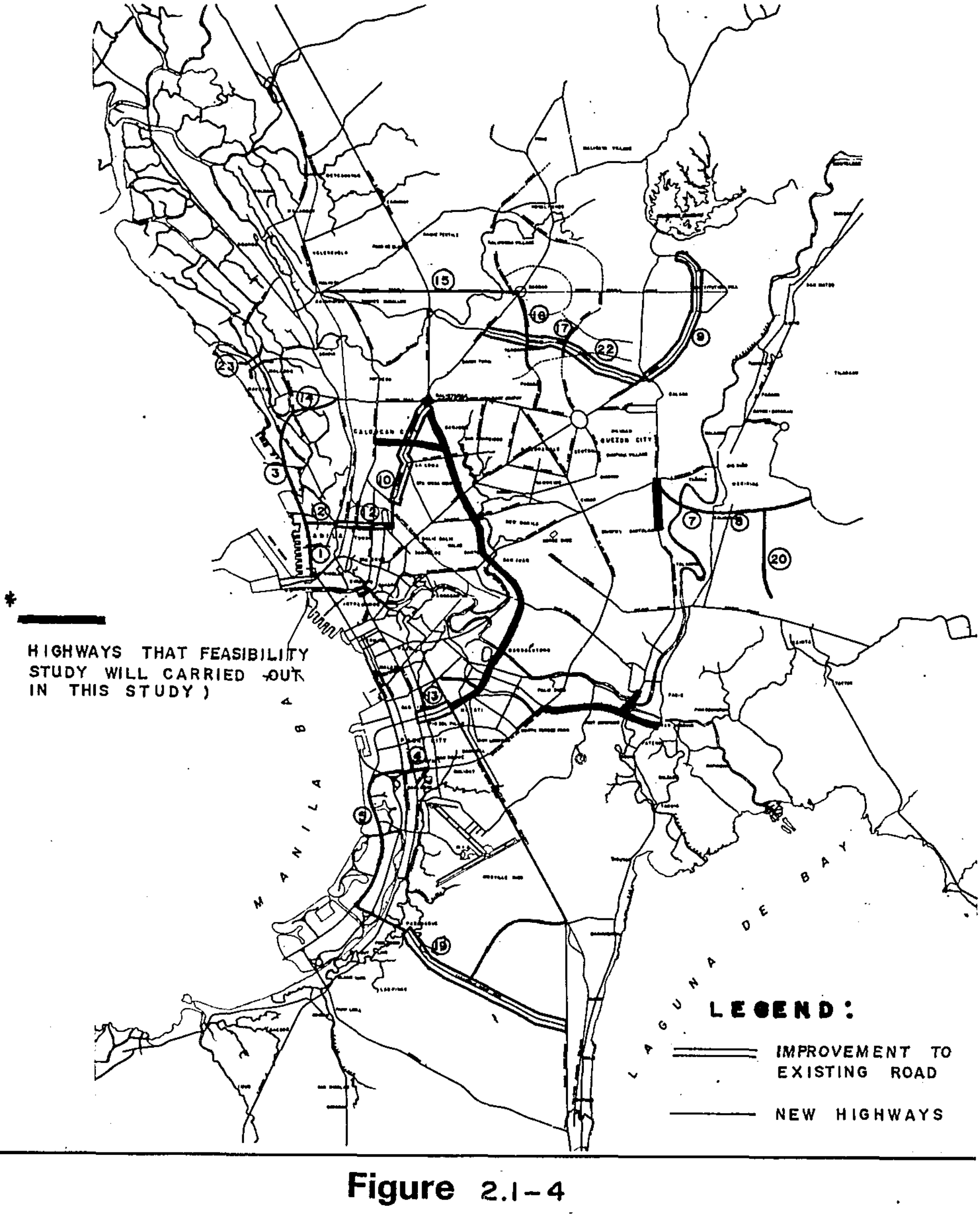


Figure 2.1-4

TRANSPORTATION PROPOSALS FOR THE YEAR 1980 (HIGHWAYS)

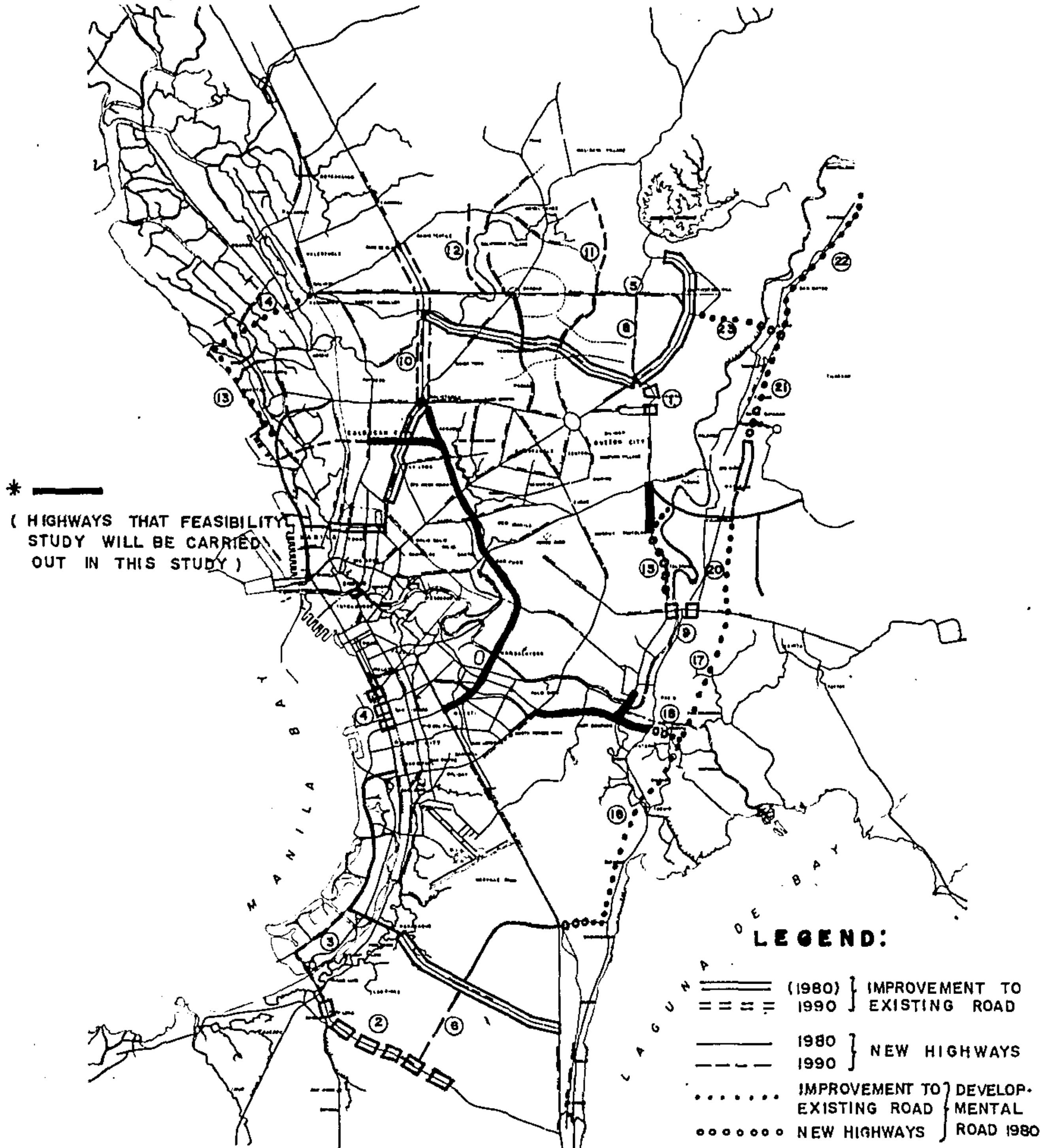


Figure 2.1-5

TRANSPORTATION PROPOSALS FOR THE YEAR 1990 (HIGHWAYS)

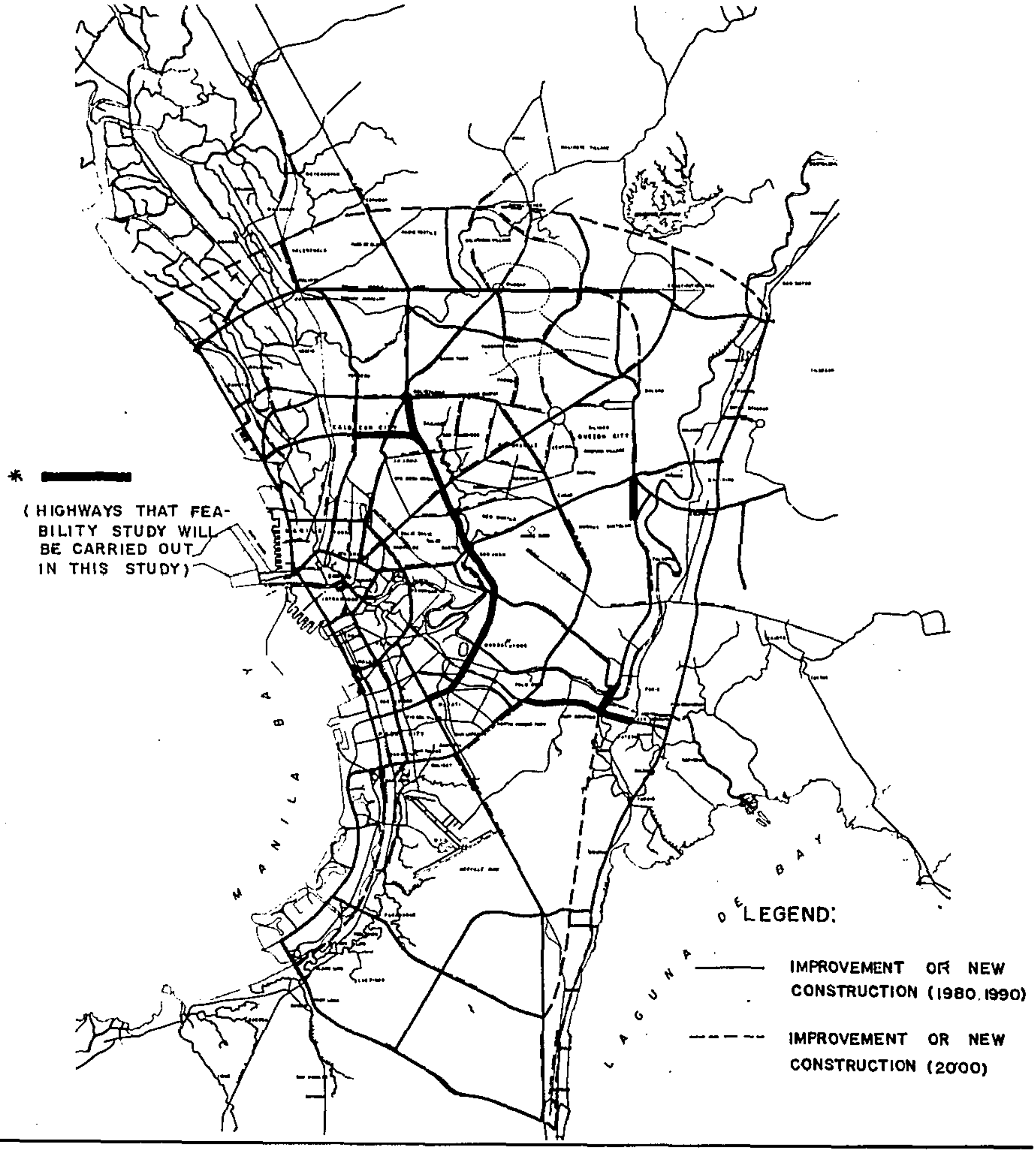


Figure 2.1-6

TRANSPORTATION PROPOSALS FOR THE YEAR 2000 (HIGHWAYS)

2.2 PROJECTION OF TRAFFIC DEMAND

2.2.1 General

Data used in the projection of traffic demand for the project roads were basically obtained from the results of the person trip and other related surveys conducted in 1971 under the UTSMMA.

In the projection of traffic demand, the method adopted by the MMETROPLAN group has been taken into consideration. However, although the MMETROPLAN projection method was found to be generally acceptable, the team has adopted a different approach for the following reasons:

1. The study area established in the MMETROPLAN covers twenty-seven (27) jurisdictions. The area covered by this study, on the other hand, covers only seventeen (17) jurisdictions. The team, therefore, has done several modifications on the zones identified in the MMETROPLAN. The zones adjoining C-3 and R-4 were subdivided, while other zones were combined into larger zone

2. The MMETROPLAN study was designed on the basis of the 1980-1990 time frame, whereas this study extends up to the year 2000.

3. The MMETROPLAN used household units as a basis for making forecasts of trip generation and attraction. For this project, however, the team has decided to use person units as a basis for trip production and trip generation and attraction forecasts. This is because the person trip unit in the 1971 person trip survey have been defined.

2.2.2 Procedure for Traffic Projection

The traffic demand on the project roads should be estimated as an integral part of the road network in the entire Metro Manila Area (MMA) because the construction of the project road affects the traffic demand on the network. Thus, the projections for traffic demand for the project roads were taken from following overall projection for the entire MMA. The traffic demand of Metro Manila's road network was made on the basis of person trips. The general procedure for traffic projection is shown in Figure 2.2-1.

The major inputs were obtained from the person trip surveys previously conducted for the UTSMMA and from the available informations in the MMETROPLAN. The projection was primarily by trip purpose, since it is the principal factor used in the projection process, namely:

Work,
Education,
Business, and
Others.

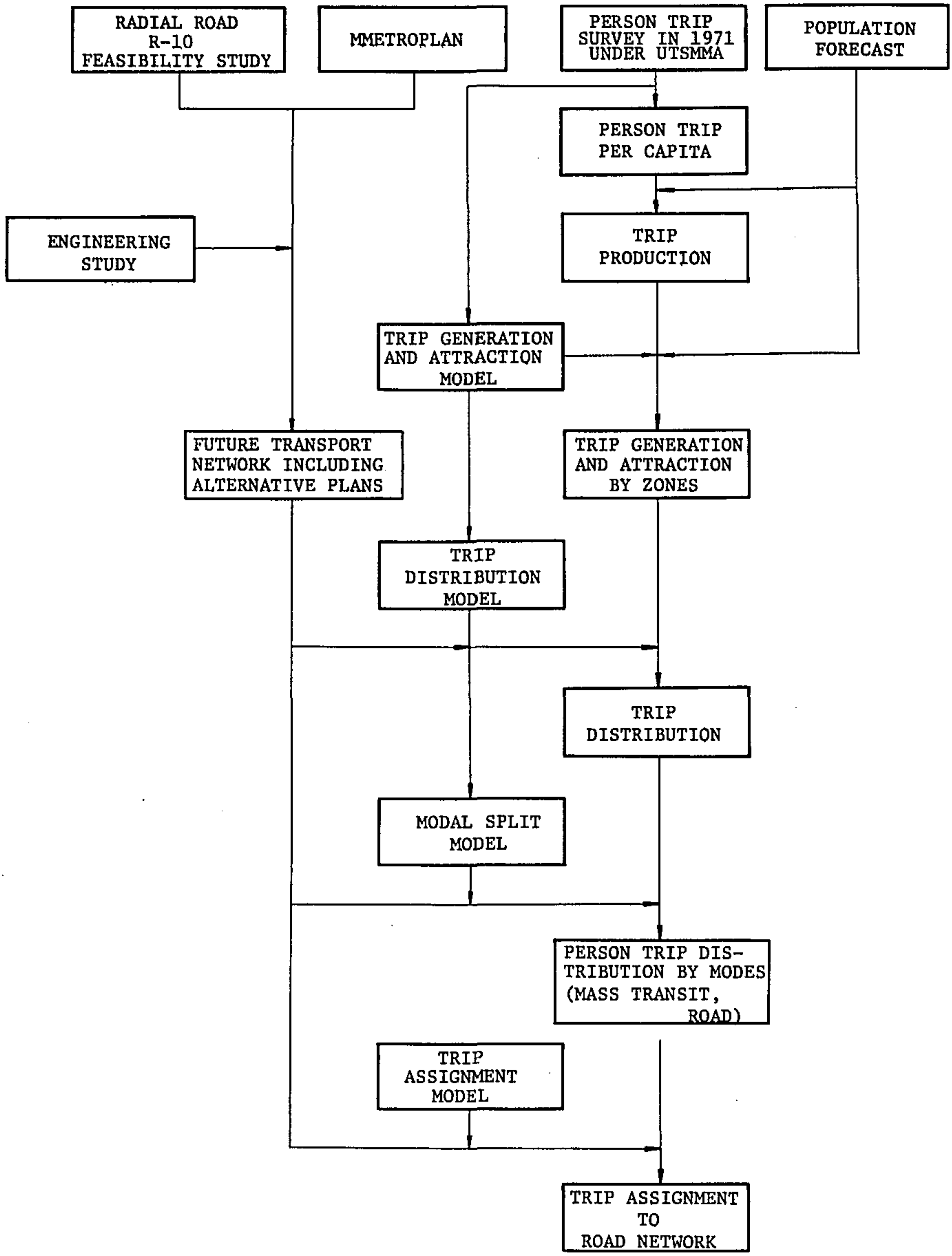


Fig. 2.2-1 General Procedure for Traffic Projection

Each step of the estimation procedure is described as follows:

Trip production in the MMA was obtained from the product of trips per capita and population, while trip generation and attraction were estimated on the basis of the population distribution pattern as related to each trip purpose.

The Gravity Model was applied in estimating trip distribution. In the Gravity Model, travel time between zones was taken as resistance factor.

For the modal split, a trip interchange model was used because it can be easily adopted to introduce Light Rail Transit System, as proposed in the MMETROPLAN. The modal split was determined by taking into account relative travel times between the two modes, i.e., mass transit and cars. Mass transit passengers were further subdivided into those of buses and jeepneys, and other transport modes using the traffic assignment method.

For truck and taxi trip estimates, another method was adopted for this study. Estimates of truck and taxi trips were determined by multiplying the number of vehicle registrations by the number of trips per day.

The team adopted what is called the minimum travel time path method using the traffic volume-travel speed curves. Assignments were performed five times; mass transit, trucks, 50 per cent, 30 per cent and 20 per cent of passenger cars and taxis sequentially.

2.2.3 Trip Generation

2.2.3.1 *Trip Production*

The number of trips per capita and per day, classified by car ownership and occupation were obtained from the results of person trip surveys for the UTSMMA as shown in Table 1.2-1 of the Supplement S3.

The ratio of car owners to total population is presented in subsection 2.1.2 of this report and the population by occupation is displayed in Table 1.1-1 through 1.1-3 of the Supplement S3.

The estimated total trips by trip purposes are shown in Table 2.2-1.

Table 2.2-1 Daily Person Trip Estimates by Trip Purpose

YEAR \ PURPOSE	WORK	EDUCATION	BUSINESS	OTHERS	TOTAL
1971 (Base year)	1,670 32.1	2,118 40.7	532 10.1	889 17.1	5,209 100.0
1980	2,376 29.7	3,435 42.9	829 10.4	1,367 17.0	8,007 100.0
1990	3,247 28.3	4,750 41.5	1,367 11.9	2,093 18.3	11,457 100.0
2000	4,189 27.1	6,129 39.6	2,051 13.3	3,098 20.0	15,467 100.0
1980/1971	1.42	1.62	1.56	1.54	1.54
1990/1971	1.94	2.24	2.57	2.35	2.20
2000/1971	2.51	2.89	3.86	3.48	2.97

Notes: 1) Upper figure: Number of trips (Unit in 1000)
Lower figure: Share of trips (%)

2) Excluding external trips

2.2.3.2 Trip Generation and Attraction

In estimating trip generation and attraction, it is necessary to establish the relationship of these trip generation and attraction with several related activity indices.

The trip generation of work trips and education trips are proportional to the resident population, while the attraction of these trips are proportional to the number of employee and educational attendance. The trips generated for other (private) purpose are proportional to the resident population, while attraction of these trips are proportional to the number of tertiary employed populations. As far as business trip is concerned, the generated and attracted trips are proportional to the number of employed populations. Trip generation and attraction models by purpose have been developed through a multiple regression analysis based on the 1971 UTSMMA data.

The future socio-economic indices such as resident and employed populations were already determined in accordance with the land use forecast as shown in Section 2.1 of this report.

Using these framework forecasts and the multi-regression models, trip generation and attraction by zones were estimated, as shown in Fig. 2.2-2.

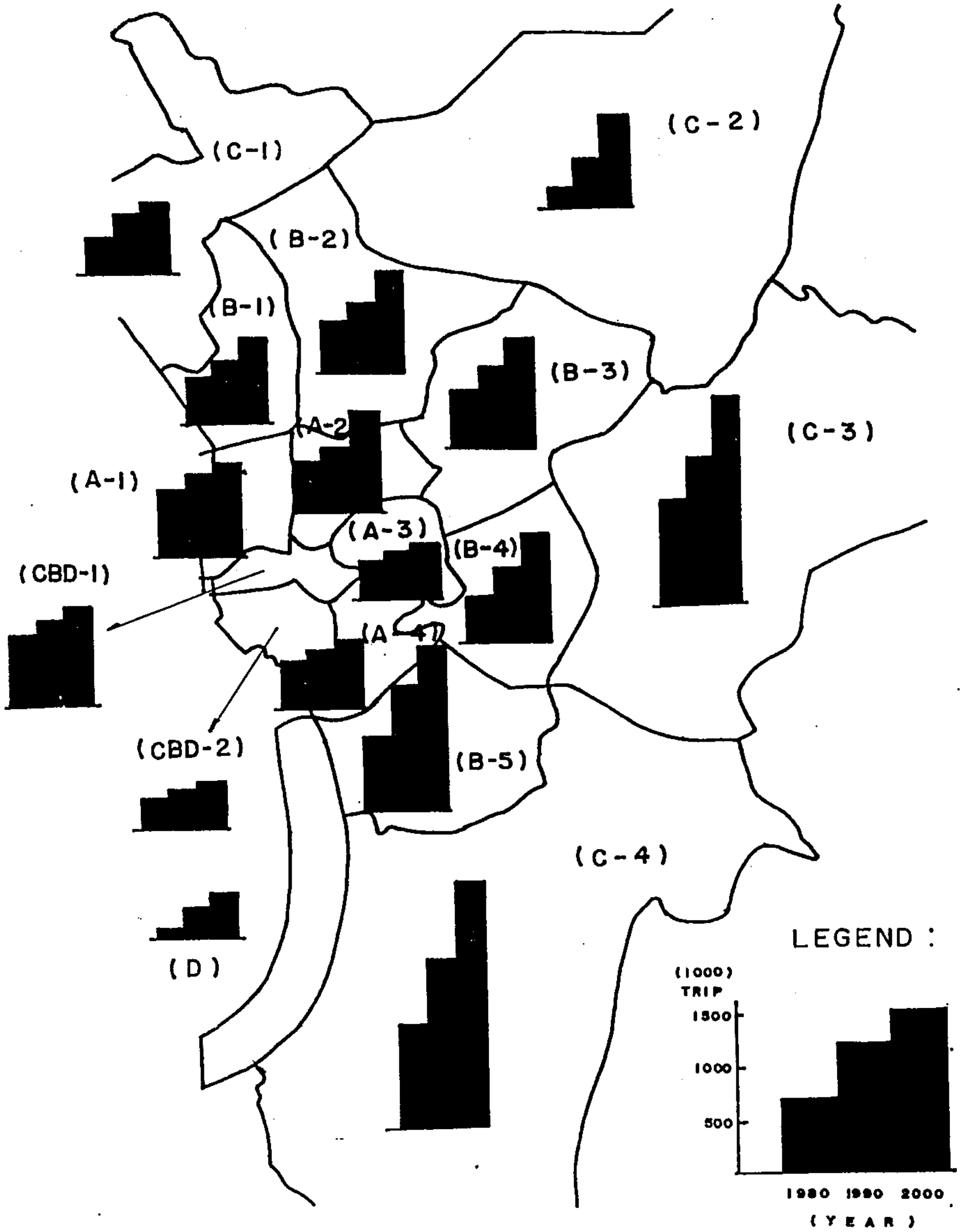


FIG. 2.2-2 TRIP GENERATION OF ALL PURPOSES BY SECTOR

2.2.4 Preparation of Transport Network and its Characteristics

2.2.4.1 Assumed Transport Network

The transport network of the projected years discussed in Section 2.1 was adopted in estimation of trip distribution, modal split and traffic assignment.

2.2.4.2 Road Classification

The roads were classified into seven types based on the classification adopted in Highway Capacity Manual and the Road Structural Standards in Japan and they are as follows:

Type A Applies to expressways between principal localities, such as the Manila North and South Expressway.

Type B Applies to high standard major thoroughfare in the urban or sub-urban areas such as the South Superhighway (R-3), C-4, C-5 and C-6.

Type C Applies to major thoroughfares located in sub-urban areas with "at-grade" intersections such as R-7, C-3 and Roxas Blvd. (R-1).

Type D Applies to major thoroughfares located between the C-2 and C-4 roads.

Type E Applies to multi-lane roads with many "at-grade" intersections such as those within C-2 road.

Type F Applies to 2-lane roads in sub-urban areas

Type G Applies to 2-lane roads in urban area

Type C, D and E roads were classified into two categories: one with bus lane and the other without bus lane.

2.2.4.3 Transport Network Conditions

Figures of transport network condition were determined based on RTR Line No. 1 feasibility study report* and MMETROPLAN.

1. Travel Speed

   The average running speeds of passenger car on the road by type were determined on the basis of the typical relationship between average lane volume and travel speed (see Supplements S3).

   Mass transit modes were classified into PNR, Light Rail Transit, bus and jeepney with the following established travel speed of 20 km/h for PNR line and 25 km/h for Light Rail Transit.

   The average travel speed for bus and jeepney is shown in Table 2.2-2.

---

* The Feasibility Study for Manila Rapid Transit Railway Line No. 1, June 1976, Japan International Cooperation Agency.

Table 2.2-2 Travel Speed by Vehicle Type

Unit: kms/hour

	Passenger Car		Bus, Jeepney	
	Maximum Travel Speed	Saturation Point of Travel Speed	Maximum Travel Speed	Saturation Point of Travel Speed
Type A	80	60	60	40
B	50	30	25	20 (25)
C	40	25	20	10 (20)
D	35	20	20	10 (20)
E	30	15	15	8
F	40	30	20	10
G	30	15	15	8

Notes: 1) These figures were determined based on the previous survey data and reports such as RTR Line No. 1, MMETROPLAN and travel speed survey conducted by DPH.

2) ( ) means the travel speed on bus lane.

2. Travel Time

The followings were considered in the process of identifying travel time within the project roads.

1. Walking time to/from Mass Transit Terminals

Bus, Jeepney and LRT

Within C-2	4 min.
Within C-4	6 min.
Outside C-4	8 min.

PNR

Within C-2	6 min.
Within C-4	8 min.
Outside C-4	10 min.

2. Waiting time

Bus,Jeepney and LRT

Within C-2	2 min. (1)
Within C-4	4 min. (2)
Outside C-4	6 min. (-)

Notes: Figures in parenthesis refer to the waiting time for LRT.

3. Time in Changing Modes

Railway to railway	4 min.
Railway to/from bus	5 min.

Notes: Time in changing modes from bus to bus is included in the travel speed.

4. Terminal Time for Car Users

The terminal time of cars and trucks was set, taking into account the time needed to look for and get in the vehicle and leave the parking area, and the time needed to look for a parking space and get out of the vehicle, upon reaching the destination.

Within C-2	6 min.
Within C-4	3 min.
Outside C-4	2 min.

2.2.4.4 Alternative Plans for Traffic Projection

The alternative plans considered in the traffic projection are as follows:

a. Design of cross section with and without bus lane,

b. Phasing plan in road section,

c. With and without cordon pricing, and

d. Intersection plan.

The alternatives discussed in section 1.4 included road alignments. But owing to the negligible variation in traffic demand, the traffic projection by the road alignments was not taken into consideration.

1. Design of cross section with and without bus lane

The following typical cross sections of the project roads were adopted in the traffic projections:

a. C-3 Road

1) Four-lane road without bus lane (D_2)

2) Six-lane road without bus lane (D_3)

3) Six-lane road with bus lane (D_2 + B)

4) Eight-lane road with bus lane (D_3 + B)

b. R-4 Road

Four-lane road without bus lane (D_2)

c. Related Road

Six-lane road without bus lane (D_3)

2. Phasing plan in road sections

On the basis of the discussion under section 1.4, the traffic demand on the project roads was estimated for the following sections:

a. Section 1 of C-3 road,

b. Section 2 of C-3 road,

c. Section 3 of R-4 and related roads,

d. Section 4 of R-4 and related roads.

3. With and without cordon pricing

The "without cordon pricing" scheme was taken as a principal premise. The "with cordon pricing" case was similarly considered as an alternative in the traffic projection.

4. Intersection plan

The at-grade intersection scheme was basically adopted in the traffic projections. The grade-separation case was also taken into consideration after the computation of traffic demand.

5. Summary of alternative plans

The above-mentioned alternative plans for the traffic projections are summarized below.

a. C-3 Road

Plan 1	Four-lane road without bus lane	(D_2)
" 2	Six-lane "	(D_3)
" 3	Six-lane road with bus lane	(D_2 + B)
" 4	Eight-lane "	(D_3 + B)

Case 1	Phasing plan in plan 2
" 2	"With cordon pricing" case in plan 2

b. R-4 and Related Road

R-4 Road	Four-lane road without bus lane	(D_2)
Related Road	Six-lane road without bus lane	(D_3)

2.2.5 Trip Distribution

The Gravity Model was used in determining the trip distribution for 1980 and 1990. The Gravity Model has been prepared using the following formula:

$$X_{ij} = \alpha\, U_i\, V_j\, t_{ij}^{-\gamma}$$

where:
- X_{ij} : traffic volume between zones
- U_i : trip generation in zone i
- V_j : trip attraction in zone j
- t_{ij} : travel time between zones
- α, γ : Parameters

After computation of trip distribution, the traffic volume on the screen lines was examined and modified on the basis of traffic count survey in 1977 and the MMETROPLAN forecasts.

Trip distribution for the year 2000, however, was estimated using the FRATAR method and following the Origin Destination (OD) pattern for the year 1990.

2.2.6 Modal Split

The procedure for establishing modal split is shown in Fig. 2.2-3. In this study, it was assumed that the two kinds of transport networks are to be used in the modal split. The first network consists of roads being used by passenger cars. The other network consists of those utilized by buses and jeepneys and Light Rail Transit and railway routes of PNR.

After determining the minimum paths and travel times between zones in each transport network, the travel time ratio for the two modes were determined by applying the formula:

$$\text{Travel Time Ratio} = \frac{\text{Travel Time by Mass Transit}}{\text{Travel Time by Passenger Car}}$$

The diversion curve between two modes of transport was developed from the statistical data modified to suit results of the person trip survey. The curve is shown in Figure 1.5-1 of the Supplement S3.

The share of each mode obtained from the diversion curve was multiplied to the OD volume of person trips by trip purpose to estimate the OD volume for each mode.

After computation of modal split, the traffic volume by mode were compared with the result of the screen line count survey in 1977 and the MMETROPLAN forecast and then modified the results to suit the two studies.

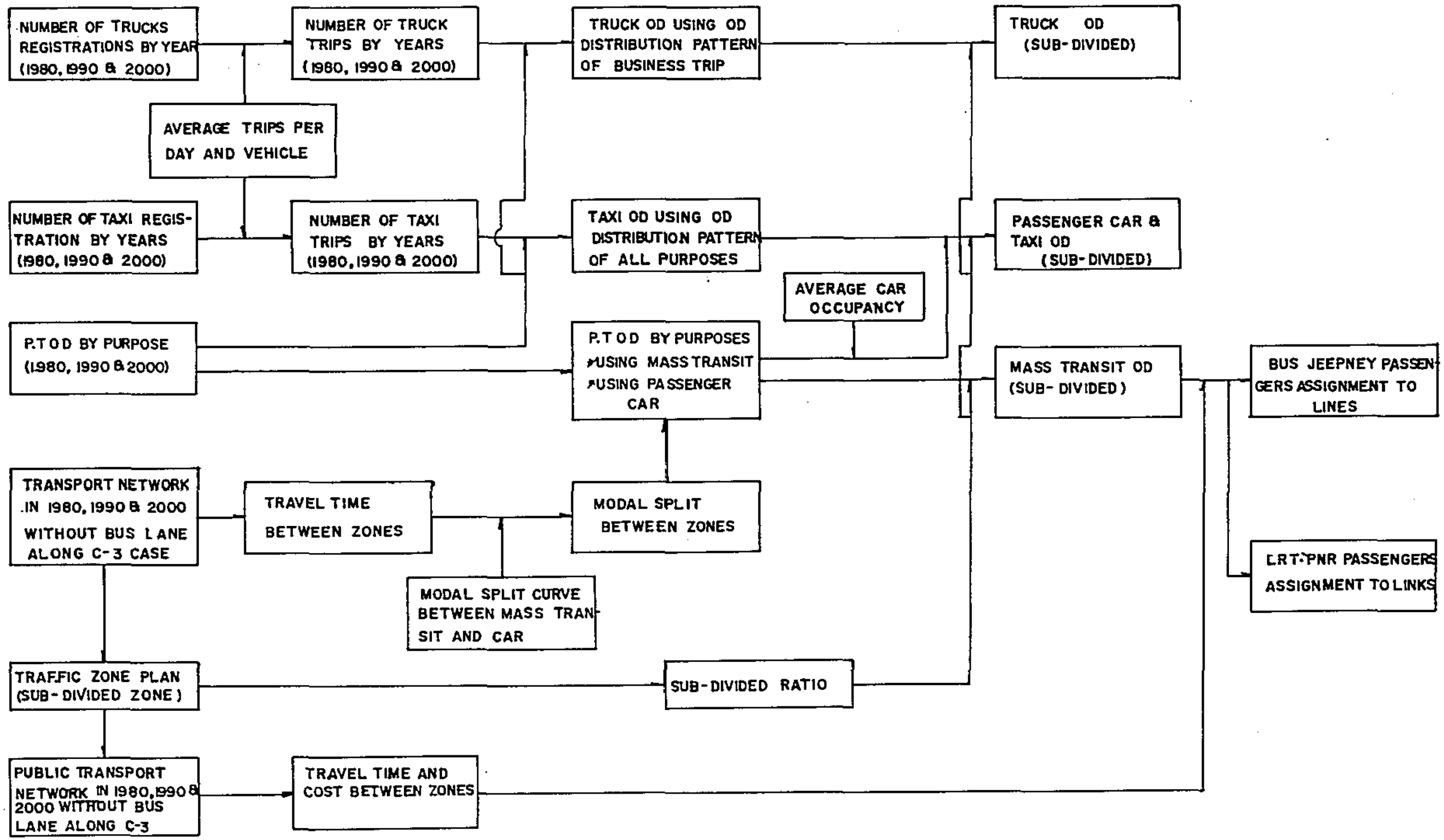


FIGURE 2.2-3 FLOW DIAGRAM FOR MODAL SPLIT

2.2.7 Traffic Assignment

Person trip OD volumes by modes which have been obtained from Section 2.2.6 were converted into passenger car OD volumes using the average number of passengers per vehicle. On the other hand, truck and taxi trips were projected using the projected number of trips per day and the number of trucks and taxies.

Vehicular OD volumes added to truck and taxi trips were assigned to the roads following the traffic assignment technique, as explained below:

1. For each link of the networks to which vehicles are to be assigned, the relationship between traffic volume and travel time was established beforehand. In this relationship, the travel time increases with the increment in traffic volume. When the traffic volume exceeds the rated capacity, the travel time increases sharply so as to check the rise of traffic volume.
2. A specific OD traffic volume is assumed on a route with the minimum travel time. Accordingly, the all or nothing method is applied to the road assignments.
3. Vehicular OD traffic volume is divided into bus and car OD traffic volumes. In the first stage, the bus OD traffic volume is assigned to bus network. The car OD traffic volume is sub-divided into four parts and travel time for each link is recalculated to meet the traffic volume allocated. Then, on the basis of the recalculated travel time, the minimum-travel-time route is again selected. This process is repeated until all the OD traffic volume has been completely distributed.

2.2.8 Evaluation of Traffic Projection

2.2.8.1 Six-lane Road without Bus Lane (Plan 2)

1. C-3 Road

With respect to plan 2 for the C-3 road, it was estimated that the daily vehicle-kilometers in the year 1980 would be about 629,400 on the C-3 road. On a per-kilometer basis, the traffic volume of unit length was found to be 40,660 vehicles. During the 1980 - 2000 period, it was also estimated that the average annual traffic growth rate would be about 4.4 per cent per annum (See Table 2.2-3).
Figs. 2.2-4 through 2.2-6 illustrate the flow of daily traffic volume by road segments and Table 2.2-4 shows the daily traffic volume by road segments. From the Table and these Figures, the following observations can be made;

a. The projected traffic volume on the C-3 road is generally heavy.

b. The projected traffic volume of the southern part of C-3 road is much bigger than the projected traffic volume of the northern part of this road.

c. The daily traffic volume of segment 3 (from J.P.Rizal to Boni Ave.) is significantly bigger than in the other segments.

2. R-4 and its related roads

As respects the R-4 and related roads, it was estimated that the projected vehicle-kilometers would be about 201,800 in 1980. On a per-kilometer basis, the traffic volume was estimated at 27,840 vehicles per day. During the 1980 - 2000 period, the average growth rate would be about 3.6 per cent per annum (See Table 2.2-3).

3. Other major thoroughfares

Figs. 2.2-7 and 2.2-8 illustrate the traffic flows on the major thoroughfares including the project roads in 1980 and 1990 and Table 2.2-5 shows the projected traffic volume with and without the project roads on the screen line crossing the Pasig River.

From this table, it can be said that there would be a significant reduction in the traffic volume on the existing major roads directly affected by the construction of the project roads.

4. Traffic Flow at Intersections

Fig. 2.2-9 shows the turning movements at the major intersections on the C-3 road in 1980. The turning movements were projected assuming at-grade intersections.

Table 2.2-3 Daily Traffic Volume and Growth on the Project Road in Plan 2

	C - 3 Road			R - 4 and Related Roads		
	Total Vehicle Kilometer	Traffic Volume per Km	Traffic Growth	Total Vehicle Kilometer	Traffic Volume per Km	Traffic Growth
	Veh.Km	Veh				
1980	629,440 (573,380)	40,660 (39,530)	1.00	201,842	27,840	1.00
1990	1,060,000 (949,000)	68,470 (65,470)	1.68 (1.66)	302,918	41,782	1.50
2000	1,507,200 (1,349,980)	97,364 (92,590)	2.39 (2.34)	410,238	56,585	2.03

Notes: Figures in parenthesis are the traffic volume on C-3 excluding South Superhighway and Ayala Ave. section.

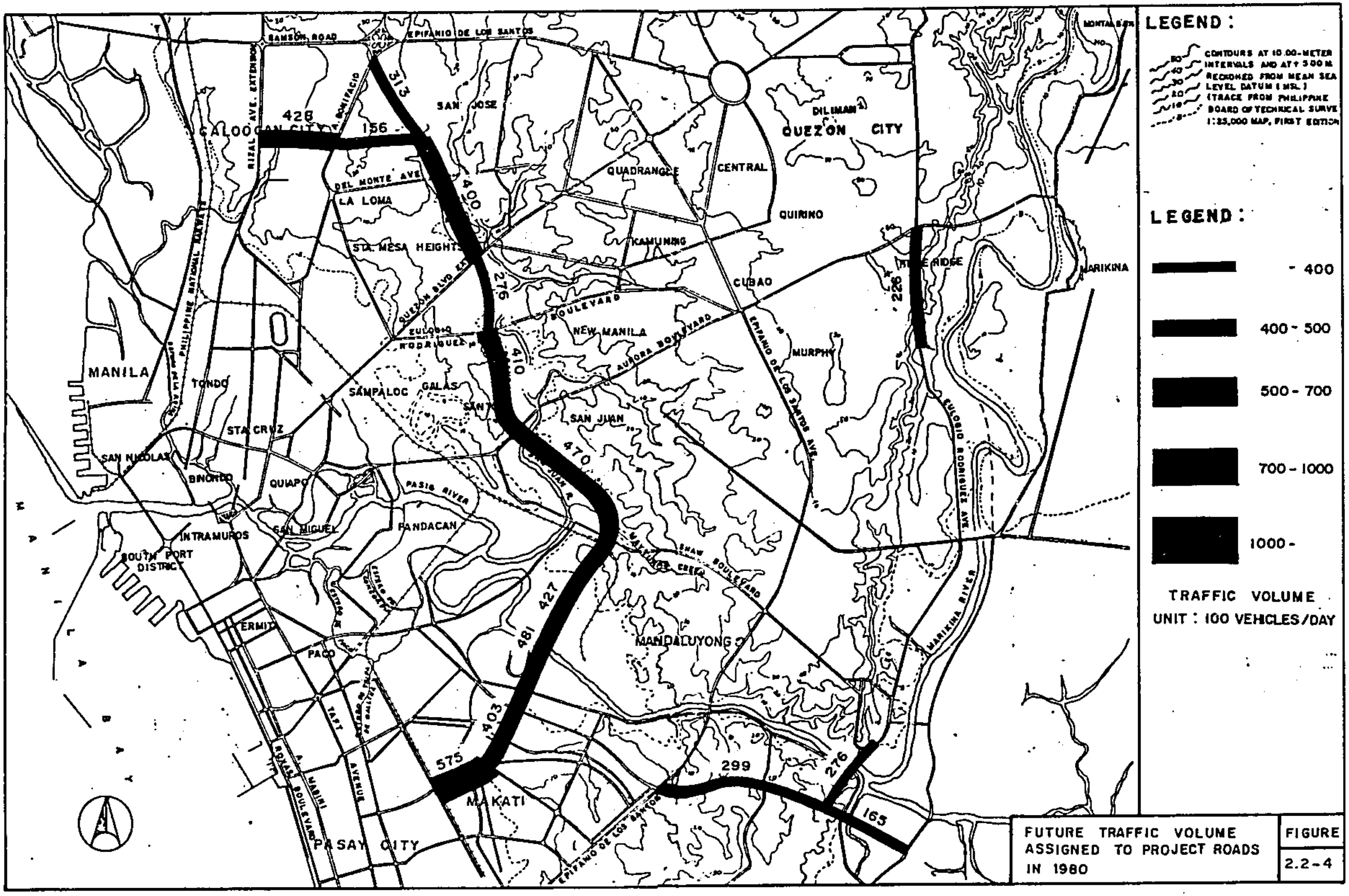
Table 2.2-4 Daily Traffic Volume and Traffic Growth of Each Segment (Plan 2)

	Segment No.	Daily Traffic Volume (in 1,000 veh.)			Traffic Growth	
		1980	1990	2000	1990/1980	2000/1990
C-3 Road	1	57.5	113.6	161.3	1.98	1.41
	2	40.3	76.1	107.2	1.89	1.41
	3	48.1	92.5	130.1	1.92	1.40
	4	42.7	75.8	104.8	1.78	1.38
	5	47.0	76.3	107.5	1.62	1.40
	6	41.0	63.4	88.7	1.55	1.40
	7	40.0	61.1	87.5	1.53	1.43
	8	15.6	26.0	38.3	1.67	1.47
	9	42.8	65.2	92.9	1.52	1.42
	10	31.3	47.1	68.3	1.50	1.45
R-4 and its Related Roads	11	29.9	44.9	61.5	1.50	1.37
	12	27.6	42.6	58.3	1.54	1.37
	13	22.6	33.4	43.2	1.48	1.29

Table 2.2-5 Estimated Traffic Volume on the Screen Line crossing the Pasig River With and Without the Project Roads in 1980

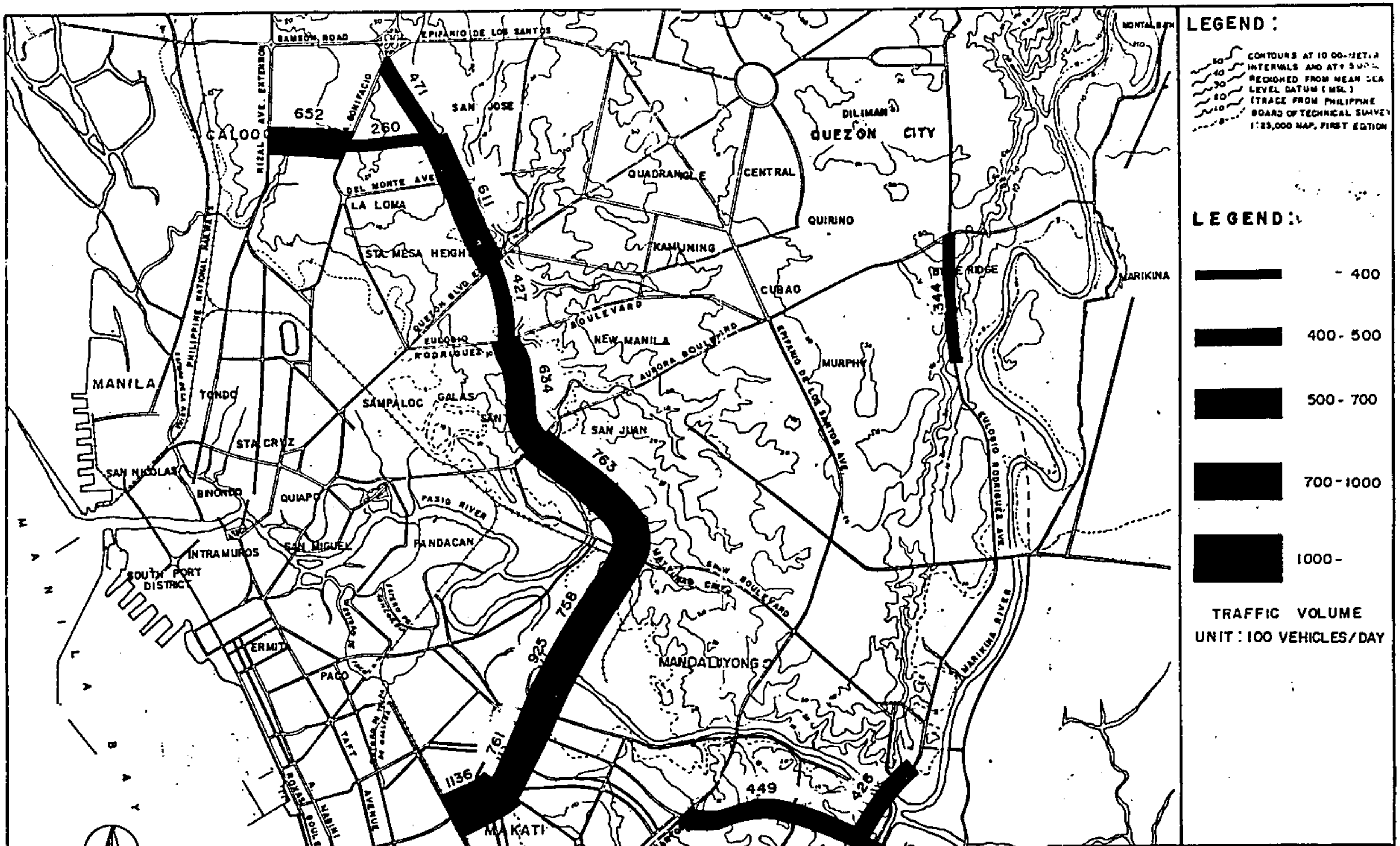
Unit: vehicles/day

	Nagtahan Bridge C-2	New Panaderos Bridge	C-3	Guadalupe Bridge C-4	C-5	Bambang Bridge
Without the Project Roads (A)	100,300	39,300	0	138,000	0	16,100
With the Project Roads (B)	89,800	25,700	51,500	89,800	28,000	9,500
B/A	0.90	0.65	-	0.65	-	0.59



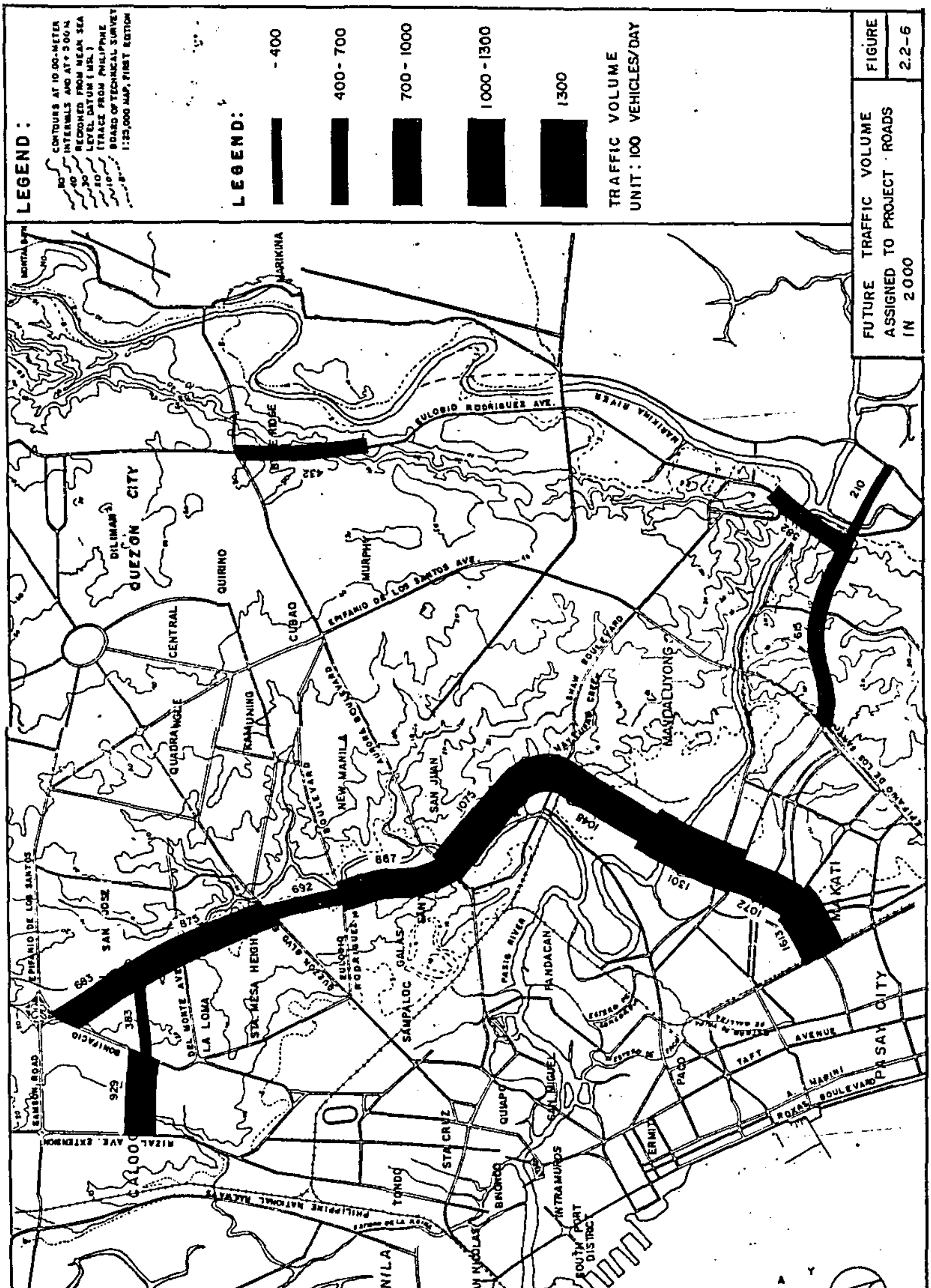
FUTURE TRAFFIC VOLUME ASSIGNED TO PROJECT ROADS IN 1980

FIGURE 2.2-4



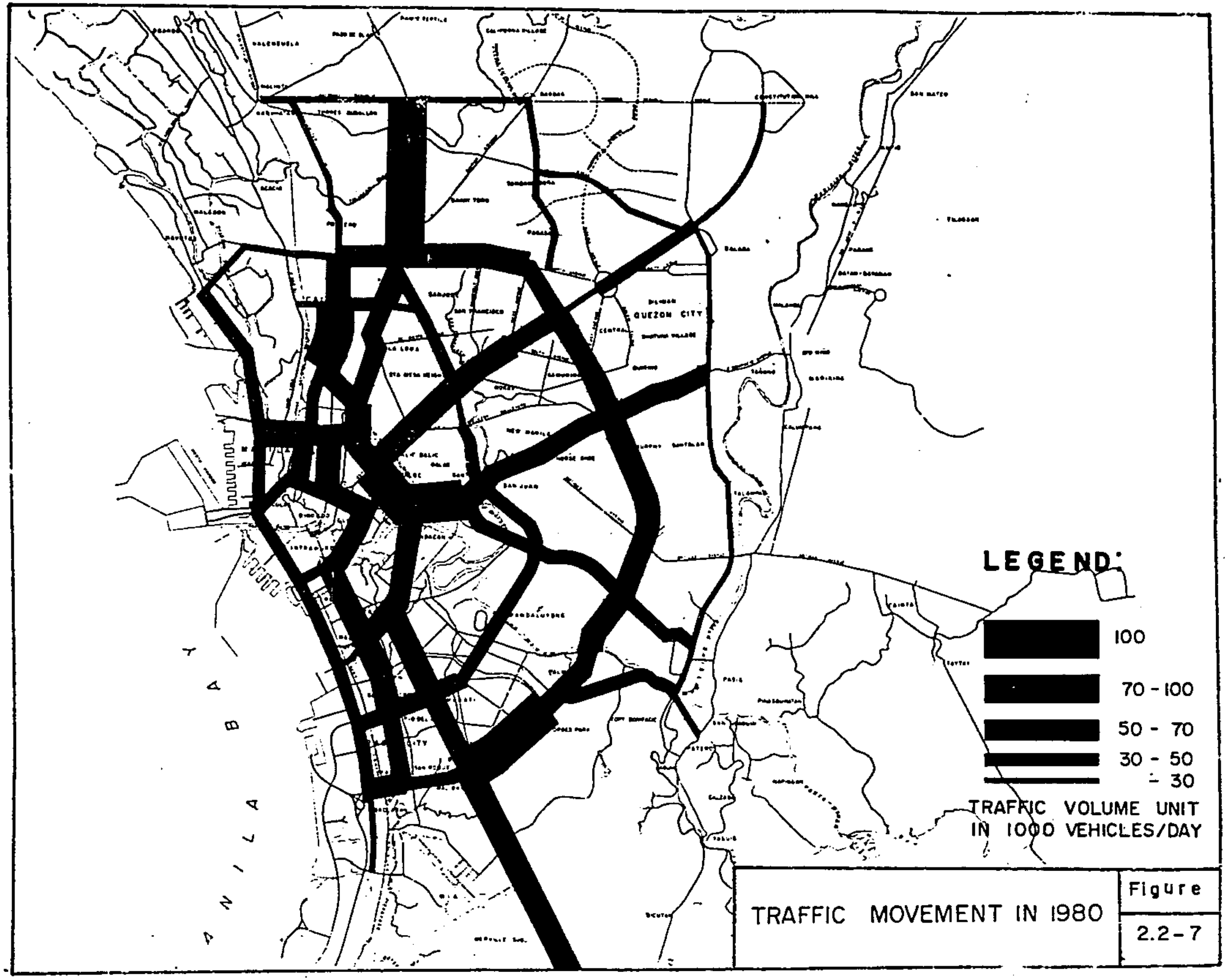
FUTURE TRAFFIC VOLUME ASSIGNED TO PROJECT ROADS IN 1990

FIGURE 2.2-5



FUTURE TRAFFIC VOLUME ASSIGNED TO PROJECT ROADS IN 2000

FIGURE 2.2-6



TRAFFIC MOVEMENT IN 1980

Figure 2.2-7

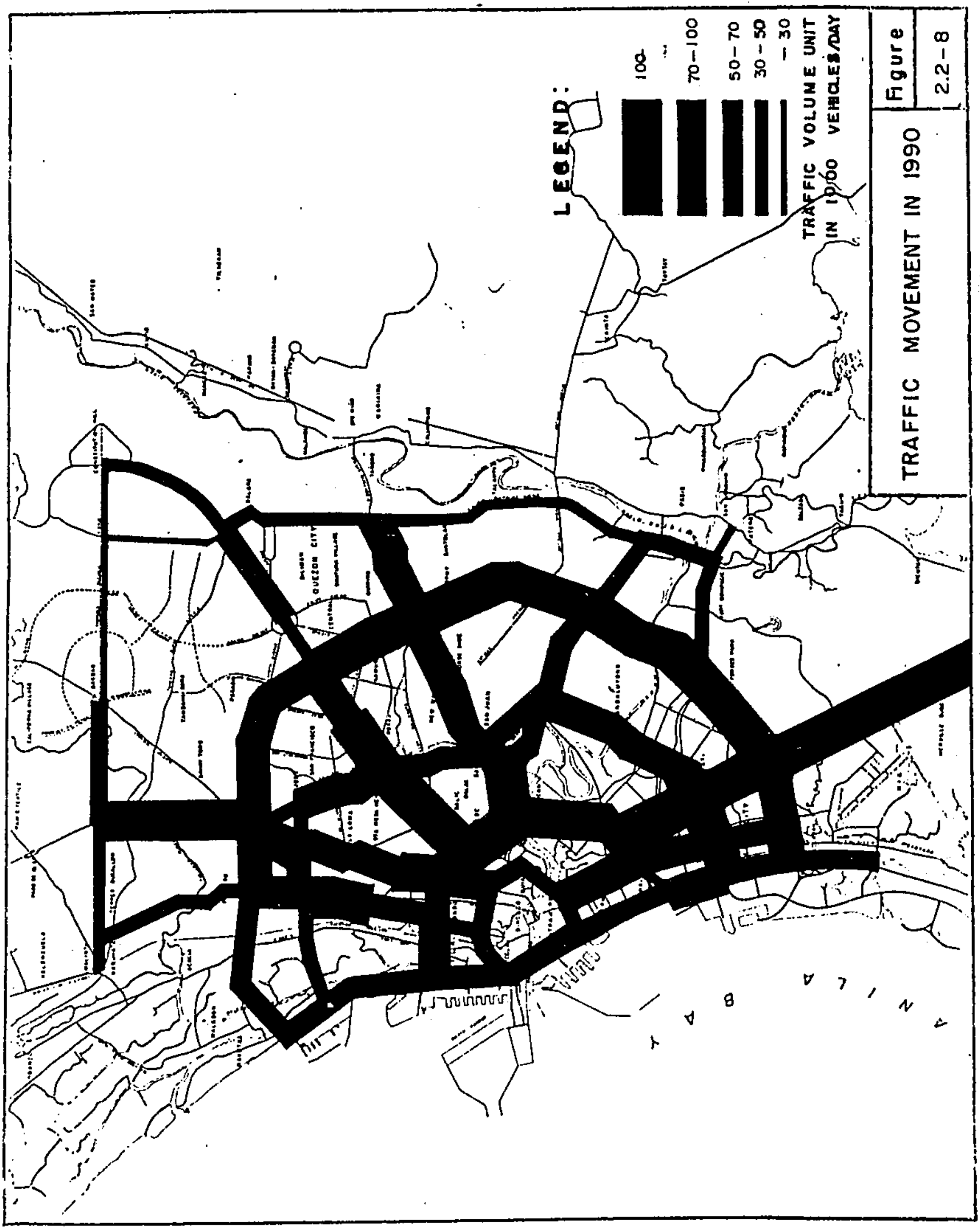
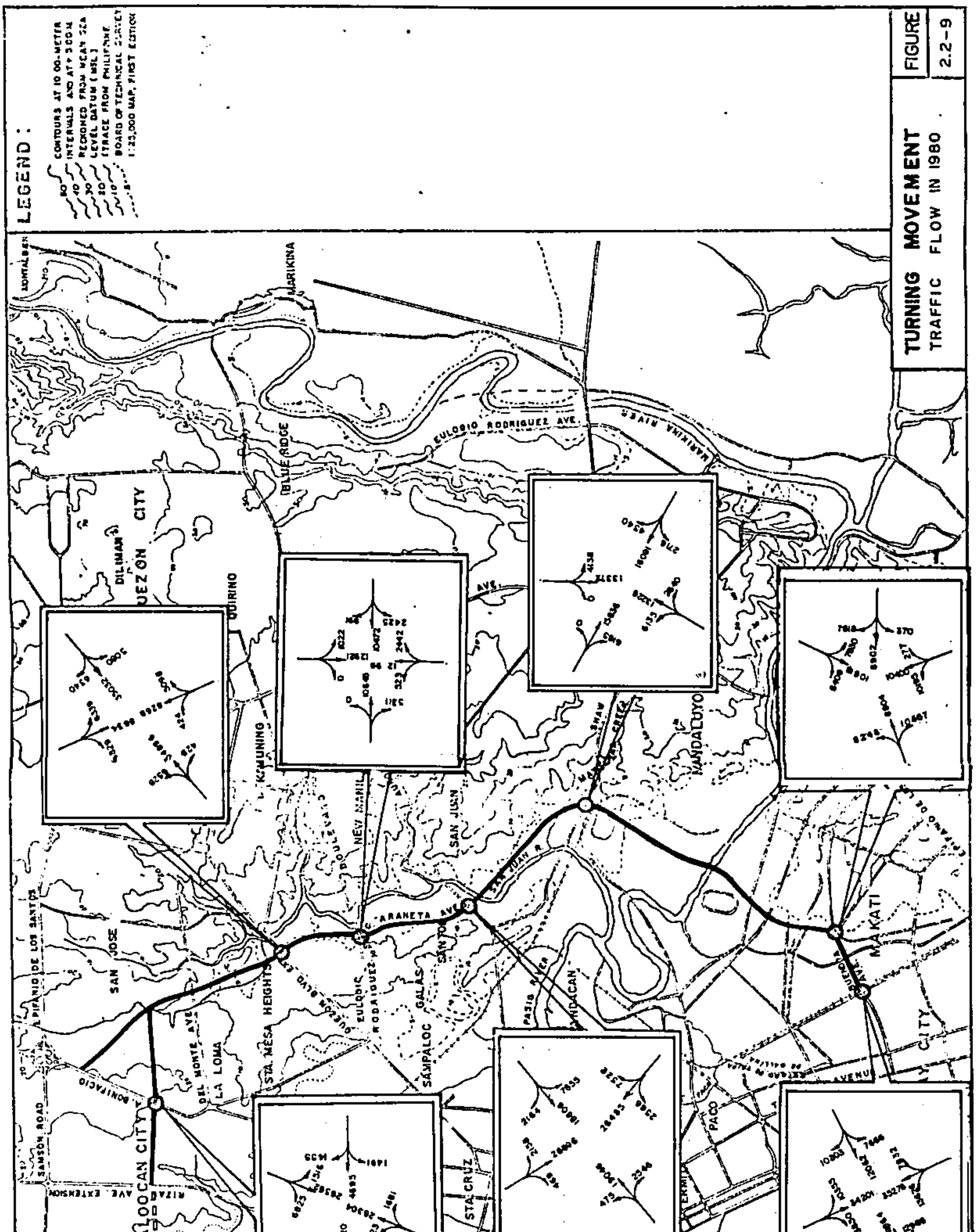


Figure 2.2-8 TRAFFIC MOVEMENT IN 1990



LEGEND:
TURNING MOVEMENT
TRAFFIC FLOW IN 1980
FIGURE
2.2-9
QUEZON CITY
CALOOCAN CITY
MAKATI
MANILA BAY
ARANETA AVE.
EULOGIO RODRIGUEZ AVE.
MARIKINA
MANDALUYONG
SAN JUAN
STA. MESA HEIGHTS
SAMPALOC
STA. CRUZ
SAN NICOLAS
SOUTH PORT DISTRICT
PACO
LA LOMA
SAN JOSE
SAMSON ROAD
RIZAL AVE. EXTENSION

2.2.8.2 Six-lane Road with Bus Lane (Plan 3)

The effect of introducing bus lane into C-3 road was examined in terms of the change in traffic volume using diversion rate that corresponds to the elastricity between variation of the bus velocity and its traffic demand.

The travel speed with and without bus lane was already discussed in Section 2.2.4. On the basis of this assumption and the experimental diversion rate in Tokyo, three diversion rates, 4%, 6% and 10% were applied to car passengers. It was assumed that the diversion from car to bus will occur only within the direct influence areas of the C-3 road (for detailed discussions see Supplements S3).

The results are shown in Tables 2.2-6 to 2.2-8.

Table 2.2-6 Number of Car Passengers Diverted to Buses

Diversion Rate (%) \ Year	1980	1990
4	9,894	16,086
6	14,842	24,128
10	24,736	40,214

Table 2.2-7 Daily Traffic Volume on C-3 Road by Case

Case \ Mode \ Year		1980			1990		
		Bus	Car	Total	Bus	Car	Total
Without Bus Lane		18,583	229,801	248,384	29,604	363,068	392,672
With Bus Lane	4(%)	18,830 (247)	224,854 (4947)	243,684 (4700)	30,006 (402)	355,025 (8043)	385,031 (7641)
	6(%)	18,954 (371)	222,380 (7421)	241,334 (7050)	30,207 (603)	351,004 (12064)	381,211 (11461)
	10(%)	19,201 (618)	217,433 (12368)	236,634 (11750)	30,609 (1005)	342,961 (20107)	373,570 (19102)

Notes: The figures in parenthesis express the difference between "with" and "without" bus lane.

Table 2.2-8 Daily Traffic Volume on Each Segment with Bus Lane (Plan 3)

(In 1,000 vehicles)

Segment No.	1980	1990
1	55.9	110.4
2	39.2	74.0
3	46.8	90.0
4	41.5	37.6
5	45.5	73.8
6	40.0	61.8
7	39.0	59.5
8	15.2	25.3
9	41.6	63.3
10	30.4	45.7

Notes: Six per cent of diversion rate was adopted in this calculation.

2.2.8.3 Other Plans (Plans 1 and 4)

If plans 1 and 4 were adopted for C-3 road, the daily vehicle-kilometers would be as shown in Table 2.2-9. The daily traffic volume on each segment of C-3 road is shown in Table 2.2-10.

Table 2.2-9 Daily Traffic Volume and Growth by Plans on the C-3 Road

	Plan 1			Plan 4		
	Daily Vehicle Kilometers	Traffic Volume per Kilometer	Growth Rate	Daily Vehicle Kilometers	Traffic Volume per Kilometer	Growth Rate
1980	629,440 (573,380)	40,660 (39,530)	1.00	629,440	40,660	1.00
1990	955,200 (856,700)	61,700 (59,060)	1.52 (1.49)	1,161,774	75,050	1.84

Notes: Figures in parenthesis are the traffic volume on C-3 excluding South Superhighway and Ayala Ave. Section.

Table 2.2-10 Daily Traffic Volume on Each Segment

	1980		1990	
	Plan 1	Plan 4	Plan 1	Plan 4
1	57.5		101.1	127.2
2	40.3		67.7	85.2
3	48.1		82.3	103.6
4	42.7		67.4	84.9
5	47.0		67.9	85.4
6	41.0		56.4	71.0
7	40.0		56.8	68.4
8	15.6		24.2	28.6
9	42.8		60.6	71.7
10	31.3		43.8	51.8

2.2.8.4 Stage Construction Plans of the Northern and Southern Sections of C-3 Road

Tables 2.2-11 and 2.2-12 show the projected daily traffic volume in two cases; one in which the southern section (Section 1) is implemented without the northern section (Section 2) and the other in which Section 2 is implemented without Section 1. The traffic volume per kilometer in 1980 on Section 1 was forecasted at 31.9 thousand vehicles per day, while the traffic per kilometer for Section 2 was estimated at 30.9 thousand vehicles per day. The following observations were made as the results of the forecast.

1. The daily traffic volume per kilometer in Section 1 is a little higher than that in Section 2.
2. The traffic growth in the period from 1980 to 1990 in Section 1 is higher than that in Section 2 for the same period. This is attributable to the fact that the development magnitude within the areas to be influenced by Section 1 is stronger than that in the influence areas within Section 2.

Table 2.2-11 Daily Traffic Volume and Growth by Implementation of Section 1 or 2

	Section 1			Section 2		
	Total Vehicle Km	Traffic Volume per Km	Traffic Growth	Total Vehicle Km	Traffic Volume per Km	Traffic Growth
1980	275,700	veh. 31,899	1.00	180,995	veh. 30,876	1.00
1990	482,515	55,827	1.75	277,991	47,422	1.54

Notes: These figures are listed up the traffic volume on the improved project roads.

Table 2.2-12 Daily Traffic Volume by Implementation of Section 1 or 2

(In 1,000 vehicles)

	Segment	1980		1990	
		Section 1	Section 2	Section 1	Section 2
C-3 Road	1	(56.0)	(42.5)	(110.6)	(84.0)
	2	36.4	0	68.8	0
	3	42.2	0	81.0	0
	4	35.2	0	62.6	0
	5	37.8	0	61.3	0
	6	17.5	(10.2)	27.1	(15.7)
	7	(12.3)	36.5	(18.7)	55.8
	8	(8.2)	15.0	(12.4)	25.1
	9	(1.9)	41.3	(3.0)	62.8
	10	0	29.4	0	44.1

Notes: ( ) means the traffic volume on the existing road.

2.2.8.5 "With Cordon Pricing" Case in Plan 2

Cordon pricing was also examined using the results of elasticity analysis set out in MMETROPLAN.

The change in daily traffic volume on the C-3 road was estimated when ₱2 and ₱3 charges were levied on the passenger cars passing the cordon line (C-2). The results are shown in Tables 2.2-13 and 2.2-14 (for detailed examination see Supplements S3).

Table 2.2-13 Number of Car Passengers Diverted to Buses

(Unit in person)

Charge \ Year	1980	1990
₱ 2	11,900	19,346
₱ 3	25,502	41,457

Table 2.2-14 Daily Traffic Volume on C-3 by case

Case \ Mode \ Year		1980			1990		
		Bus	Car	Total	Bus	Car	Total
Without Cordon Pricing		18,583	229,801	248,384	29,604	363,068	392,672
With Cordon Pricing	₱2	18,881 (298)	223,851 (5950)	242,732 (5652)	30,088 (484)	353,395 (9673)	383,483 (9189)
	₱3	19,221 (638)	271,050 (12751)	236,271 (12113)	30,640 (1036)	342,340 (20728)	372,980 (19692)

Notes: The figures in parenthesis express the difference between "with" and "without" cordon pricing.

2.2.8.6 Evaluation of Congestion Degree

The congestion degree of the project roads by the alternative plans is shown in Table 2.2-15.

The capacity of the project roads ranges from 12,000 to 13,500 vehicles per day per lane considering the character of a major thoroughfare.

The congestion degree is desirable not to exceed 1 for effective operation of the traffic. From this point of view, plan 1 is not suitable to be applied to the C-3 road because the congestion degree is anticipated to exceed 1 too early.

Table 2.2-15 Average Congestion Degree of the Project Road

		C - 3 Road				R-4 and Related Roads
		Plan 1	Plan 2	Plan 3	Plan 4	
1980	Average Traffic Volume A	39,530	39,530	38,450	39,550	28,240
	Average Road Capacity B	48,000	65,680	59,030	82,010	56,310
	Congestion Degree A/B	0.82	0.60	0.65	0.48	0.50
1983	Average Traffic Volume A	42,080	47,320	46,010	50,200	32,570
	Average Road Capacity B	48,000	65,680	59,030	82,010	56,310
	Congestion De-Gree A/B	0.88	0.72	0.77	0.61	0.58
1990	Average Traffic Volume A	59,060	65,470	63,630	75,050	42,680
	Average Road Capacity B	48,000	65,680	59,030	82,010	56,310
	Congestion Degree A/B	1.23	0.99	1.07	0.91	0.76

Notes: Average traffic volume and average road capacity were calculated using the following equation:

$$\bar{x} = \frac{\sum_i \ell_i x_i}{\sum_i \ell_i}$$

where $\bar{x}$: Average capacity or traffic volume,
ℓ_i : Length of segment i,
x_i : Road capacity or traffic volume of segment i.

2.2.9 Intersection Analysis

For the major intersections on the project roads which might have been deemed necessary to have grade separation in future, traffic volume was estimated by direction. And then, capacity analysis and examination of traffic operation at intersection were carried out.

The intersections for which analysis was made are as follows:

1. C-3 (Buendia) - Ayala
2. C-3 - Shaw Blvd.
3. C-3 - Aurora Blvd.
4. C-3 - E. Rodriguez
5. C-3 - Quezon Blvd.

It should be noted by the way that the discussion was made over Plan 2 (6-lane, w/o bus lane) alone.

2.2.9.1 Traffic Volume by Direction

The analysis was carried out with the traffic demand for the year 1980 in mind.
The direction-wise traffic volume at the intersection at peak hour in 1980 is as illustrated in Fig. 2.2-10.

2.2.9.2 Traffic Operation at Intersection

According to the direction-wise traffic volume in 1980 shown in Fig. 2.2-10, the traffic operations system for the case of at-grade intersections was studied.

In principle, each intersection was handled as independent from the other and as subjected to fixed-time signal control, and the traffic capacity and traffic controllability were studied on the following conditions.

1. Basic traffic capacity

   The basic traffic capacity was set as follows based on H.C.M, Japanese Road Structural Ordinance and the traffic count which was taken recently in Japan.

   Approach Volume; 1,800 passenger cars/hr. of green.
   Right/left-turn; 1,620 passenger cars/hr. of green.

2. Peak ratio; 7%

   (The ratio of peak hour traffic volume to daily one.)

3. Ratio of trucks and buses.

   For each intersection, the ratio of trucks and buses was set at 15%. The adjustment factor of trucks and buses for the basic traffic capacity is 0.885.

4. Assumed phasing lay-out.

   In principle, the 4-phase system (see Fig. 2.2-11) was adopted.

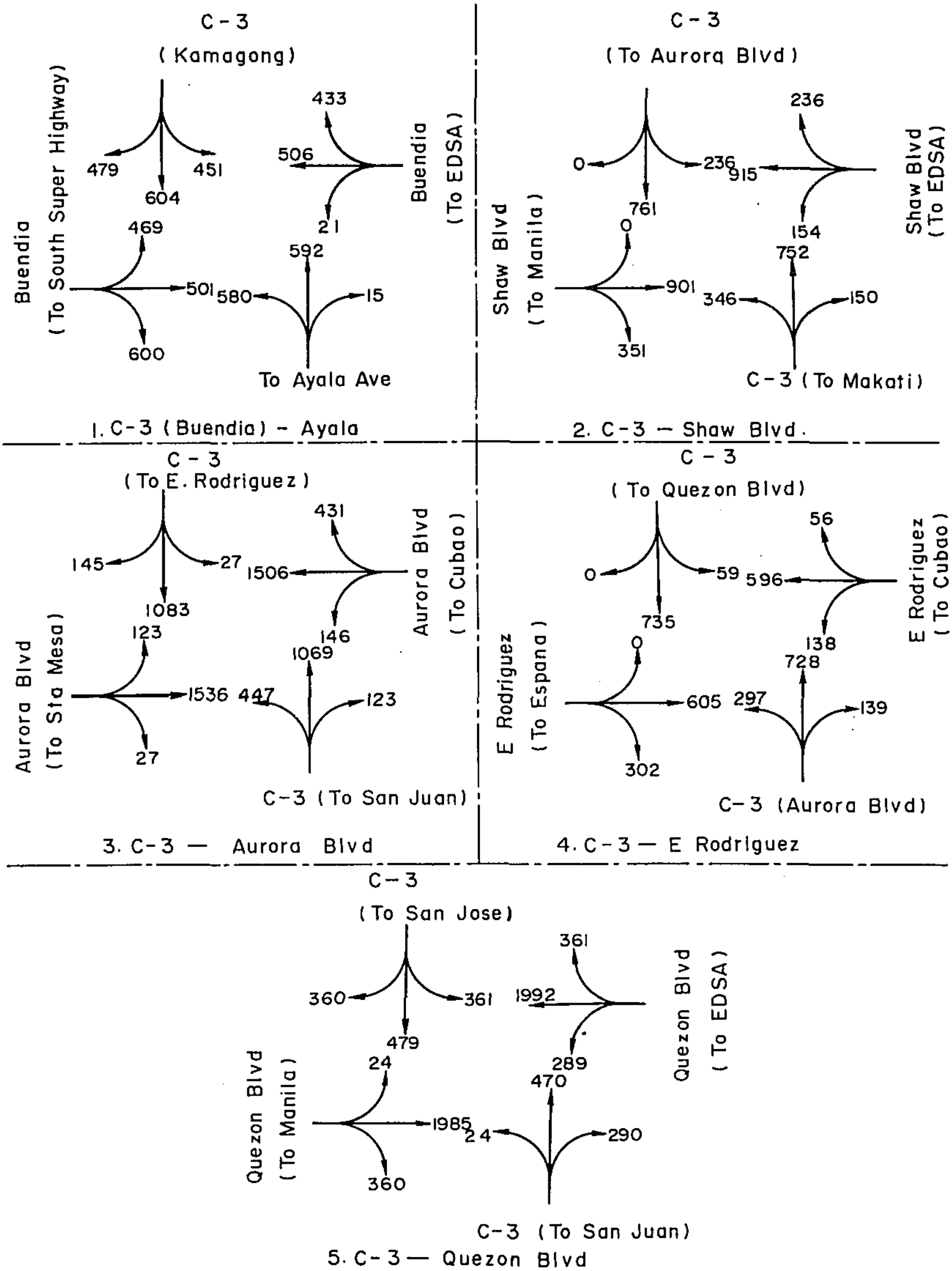


Fig 2.2-10 Traffic Volume by direction of Intersections in 1980
(Vehicle Peak hour)

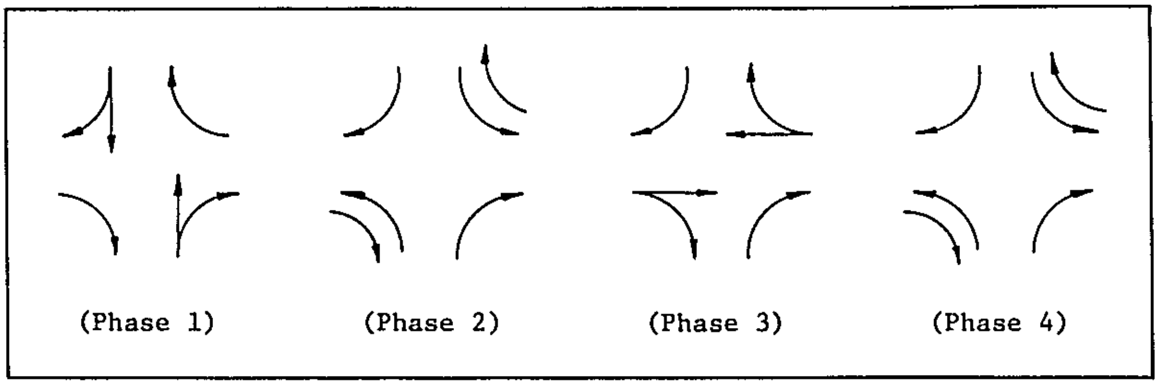


Fig. 2.2-11 Example of Signal Light Phase

Table 2.2-16 Number of Lane at Approach

Inter-section	Approach	Number of Lane	
C - 3 (Buendia) - Ayala	Buendia (South Super Highway)	T & R	2
		L	2
	Buendia (EDSA)	T & R	2
		L	1
	Ayala Ave.	T & R	2
		L	3
	C - 3 (Kamagong)	T & R	3
		L	2
C - 3 - Shaw Blvd.	Show Blvd. (Manila)	T & R	3
		L	-
	Show Blvd. (EDSA)	T & R	2
		L	1
	C - 3 (Makati)	T & R	3
		L	2
	C - 3 (Aurora Blvd.)	T & R	3
		L	2
C - 3 - Aurora Blvd.	Aurora Blvd. (Sta. Mesa)	T & R	3
		L	1
	Aurora Blvd. (Cubao)	T & R	3
		L	1
	C - 3 (E.Rodriguez)	T & R	3
		L	1
	C - 3 (San Juan)	T & R	3
		L	2

Inter-section	Approach	Number of Lane	
C - 3 - E. Rodriguez	C - 3 (Quezon Blvd.)	T & R	3
		L	1
	C - 3 (Aurora Blvd.)	T & R	3
		L	1
	E.Rodriguez (Espanã)	T & R	2
		L	1
	E.Rodriguez (Cubao)	T & R	2
		L	1
C - 3 - Quezon Blvd.	Quezon Blvd. (EDSA)	T & R	3
		L	2
	Quezon Blvd. (Manila)	T & R	3
		L	1
	C - 3 (San Jose)	T & R	3
		L	2
	C - 3 (San Juan)	T & R	3
		L	1

* T - Through
R - Right
L - Left

5. Cycle length

For each intersection, the cycle length was set at 130 sec.

6. Number of lanes at approach

The number of lanes at approach by intersection is shown in Table 2.2-16.

The degree of saturation (traffic volume/traffic capacity) of each intersection as calculated from the above conditions is given in Table 2.2-17.

Table 2.2-17 The Result of Capacity Analysis in 1980

	C-3 (Buendia) -Ayala	C-3 -Shaw Blvd.	C-3 -Aurora Blvd.	C-3 -E.Rodriguez	C-3 -Quezon Blvd.
Saturation Degree*	0.786	0.750	0.859	0.726	0.837

So far as the table shows, and in view of the traffic volume expected to grow after 1980, each intersection will be saturated to nearly the full in several years after 1983 scheduled for commencement for use.
In order to cope with the situation, grade separation should be studied at once.

For computation process and details of the result, refer to the Supplements.

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* Assuming that the approach, j, has an actual traffic volume, Qj, and a saturation flow, Sj, the ratio, Qj/Sj, is defined as normalized flow. The maximum value of the normalized flow of the traffic flow in a specific phase is the degree of saturation for that phase. Then, the degree of saturation of the intersection, (S_D), is defined by the following formula.

$$S_D = \sum_i \phi_s^i$$

where;

ϕ_s^i ; degree of saturation for the phase i.

2.2.9.3 Study of Grade Separation Plan

What must be born in mind in discussing the grade separation is the technical and economic feasibility for desired traffic operations. In this study, various plans were examined in view of desired traffic operations (in this section), along with technological aspects. Then, the costs and benefits resulting from grade separation were estimated. Upon the results of estimation of costs and benefits, the economic feasibility of the grade separation plan was discussed (See Chapter 5).

At first, the traffic capacity of the grade separation was analyzed on the following conditions.

1. Elevation or depression of the through lanes for each intersection was selected as a basic plan of grade separation based on rough engineering discussion and also in view of the fact they bear the majority of traffic.
2. The basic traffic capacity, ratio of trucks and buses, cycle length, etc., for the grade section are assumed to remain just the same as in the foregoing paragraph.
3. The signal phase for the grade section is shown in Fig. 2.2-12.

According to the condition specified in item 1 above, capacity analysis was carried out on two plans (C-3 grade separation plan and radial road grade separation plan) for each intersection. The results are as shown in Table 2.2-18.

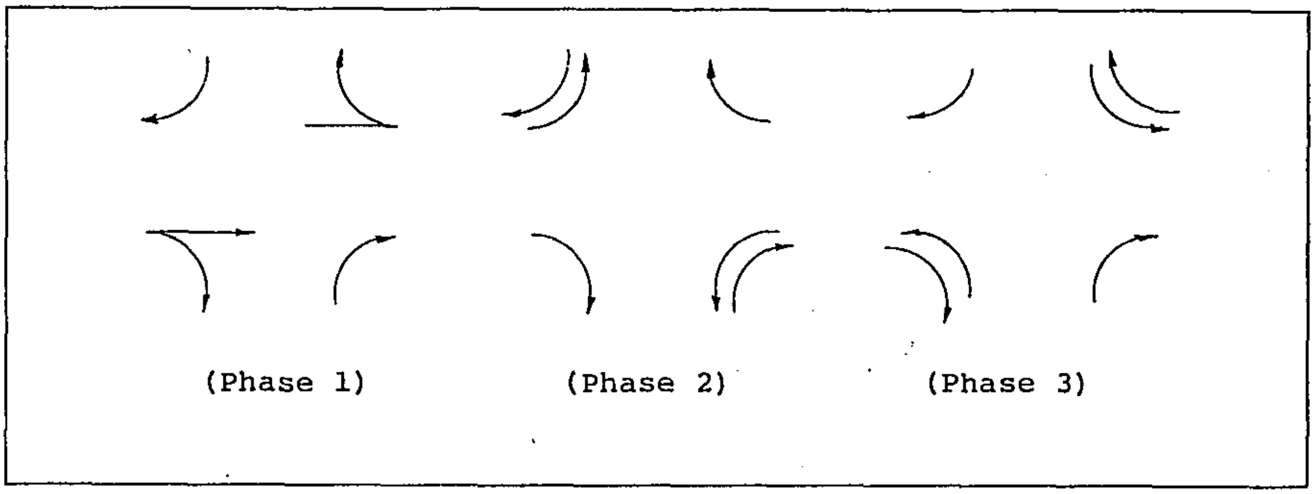


Fig. 2.2-12 Example of Signal Light Phase

Table 2.2-18 The Results of Capacity Analysis by Grade Separation Plan in 1980

	1		2		3		4		5	
Inter-section	C-3 -Ayala		C-3 -Shaw Blvd.		C-3 -Aurora Blvd.		C-3 -E. Rodriguez		C-3 -Quezon Blvd.	
Grade Separation Plan	1-1	1-2	2-1	2-2	3-1	3-2	4-1	4-2	5-1	5-2
	C-3 (Kamagong) -Ayala	Buendia -Kamagong and Buendia Ext.	C-3	Shaw Blvd.	C-3	Aurora Blvd.	C-3	E. Rod-riguez	C-3	Quezon Blvd.
Saturation Degree	0.590	0.592	0.586	0.409	0.592	0.508	0.554	0.476	0.697	0.444

CHAPTER 3 ROUTE SURVEY AND PRELIMINARY DESIGN

3. ROUTE SURVEY AND PRELIMINARY DESIGN

This section presents the engineering information on design policy and criteria, route selection procedure, cross sectioning, design of pavement and structures including bridges and others.

3.1 PHYSICAL BACKGROUND

3.1.1 General Condition

Metropolitan Manila is located in the middle of Luzon island, shaped like the half of a circle and spreads around Manila Bay with a radius of 15 kilometers.

The project roads are planned to run through these areas and will include bridges, culverts, embankments and other structures. The meteorological and other conditions will be explained in this Section.

Geology

The Sierra Madre mountain range running along the whole eastern breadth of Luzon, and the western Zambales mountain range running from Lingayen Gulf downward to the Bataan peninsula on the west side of Manila, are both composed of igneous rocks. The city of Manila and its adjoining northern hilly land are on a foundation of tuff belonging to the latter part of the Tertiary Period or the early part of Quarternary Period (Recent) of the Cenozoic Era. The surface of this tuff slopes down toward Manila Bay, with the delta of the Pasig River deposited thereon. The hilly land is an diluvium table between 13 to 20 meters in altitude, which is covered with a 1 to 2-meter depth of clayey volcanic ash and underlain by a deep adobe (tuff) stratum with a low density. The low alluvial land consisting of silty sand covers the tuff strata. The thickness of the alluvial layer decreases as it approaches the hilly terrain and increases towards Manila Bay, although some variations are observed on the site of the drowned valley.

Precipitation

In general, the climatic variation of the Metropolitan Manila area (MMA) is determined by seasonal patterns of precipitation rather than by temperature differences. The area is characterized by two pronounced seasons; a dry season during the months of November through April and a rainy season during the months of May through October. The normal annual rainfall in the area varies from 2000 to 2500 millimeters of which more than 80 per cent in the rainy season. The area is affected by typhoons and tropical cyclones which produce high intensity rainfall of persistent duration. July, August and September are the principal months of their activity. Thunderstorms also occur in a period from May to October at an average of eight days per month.

Temperature

The highest recorded temperature, taken in April, 1948 was 38.6°C and the lowest was 14.5°C, recorded in January 1914. The daily mean for the year is about 27°C, varing from a maximum of 29°C in May to a minimum of 25°C in January.

Humidity

The month of September has the highest relative humidity with an average of 84 per cent, while April has the lowest range with an average of 69 per cent.

Wind

During the October - January period, the northeast monsoon blows across the Manila area. During the February - April period, the region has the east trade wind and for the remainder of the year, the southwest monsoon frequents the region.

Evaporation

The prevailing winds, temperature and himidity influence the evaporation rate. A typical annual average evaporation of 1150 millimeters which is approximately half the annual precipitation, has been recorded at Laguna de Bay, southeast of Manila.

Geodetic Datum Level

The datum level is different for each agency such as the DPH, the DPWTC and others. The relation between the datum of the DPH and the Flood Control project including tide elevations is shown in Fig. 3.1-1.

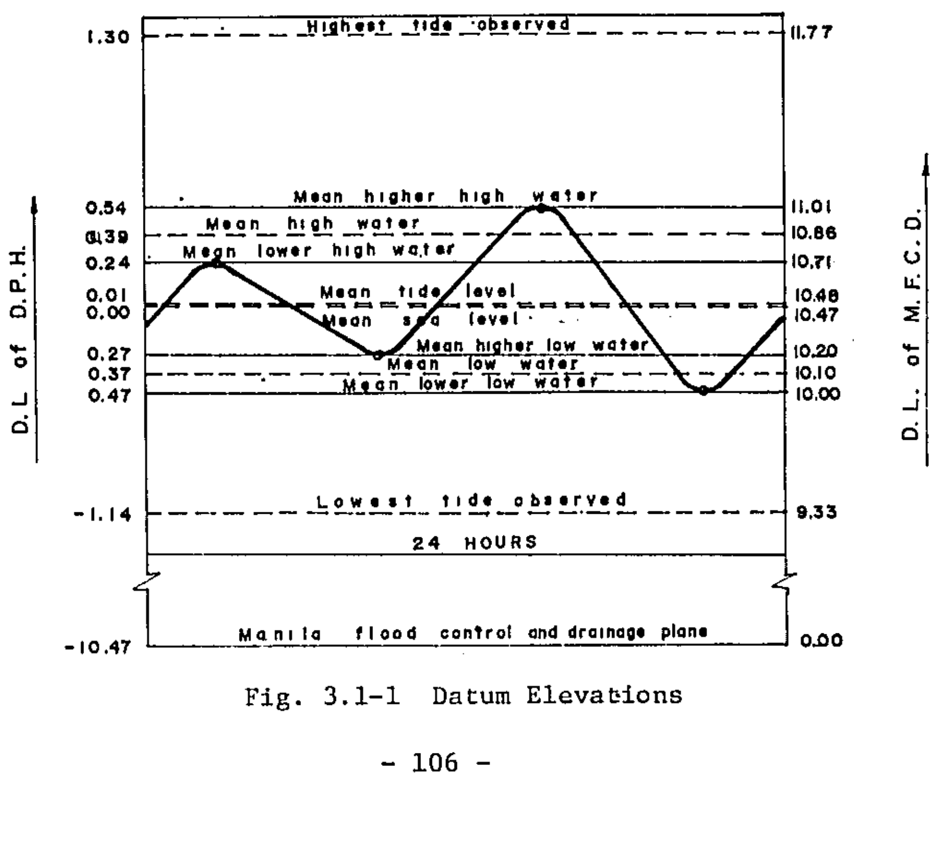


Fig. 3.1-1 Datum Elevations

3.1.2 Flood Condition

The concentration of about 60 per cent of the annual heavy rainfall during the months of July through September has caused the repeated floodings in the lowlands of the MMA. The areas along the Pasig River suffered most from inundations during the months when the southwest monsoon prevailed. The Overseas Economic Cooperation Fund-assisted Manila and Suburbs Flood Control and Drainage Program is presently being implemented by the Department of Public Works, Transportation and Communications. This program is expected to be completed by 1978. However, the design of the project roads should consider the fact that the right side bank of the Pasig River is still left without improvement. Moreover, the flood control project is not expected to eliminate all flood problems.

The improvement of the creeks related to the project roads depends on the improvement of the rivers downstream. But since a road project does not necessarily involve an integrated flood control, the project roads shall be so designed as to avoid additional flood damage caused by the road construction.

The location of the flood areas along the project roads is shown in Fig. 3.1-2.

Lowland Area in Mandaluyong

The low swampy area in Mandaluyong which is bounded by the Pasig and the San Juan Rivers has been flooded often by the overflow of these rivers. The area is poorly drained because of the limited capacity of the creek flowing into the San Juan River.

A feasibility study on flood control and drainage plan in Mandaluyong district was conducted in May, 1972 by Tectonics Asia Architects and Engineers Consultants. This study includes improvements on the right side of the Pasig River and on the left side of the San Juan River. However, the complete implementation of this flood control plan has not yet been disclosed by the authorities concerned.

If the project road is aligned across the swampy area and designed as an all-season road even before flood control and river improvement works are implemented, its formation level should be at least two meters above mean sea level and its banking should be one-meter high. For the drainage problem, it is advantageous that the project road is aligned keeping as away as possible from the swampy area.

San Juan River Bridge Site

The pipeline bridge with five big piers and the highway bridge cross the San Juan River, about 300 meters downstream from the proposed bridge site. After heavy rains, these bridges restrict the flow of water so much that the neighboring areas are flooded. There is a proposed improvement plan of these bridges but there is no plan as yet for the improvement of the San Juan River itself.

Talayan Creek along G. Araneta Avenue

Talayan Creek runs along the median portion of G. Araneta Avenue and curves out at a site of about 50 meters before Retiro Street to flow into the San Francisco River. Another creek on the south of Talayan Creek flows into the San Francisco River, about 200 meters north of Quezon Boulevard.

This area along the creeks is often flooded due mainly to the backwater of the San Francisco River.

An integrated flood control plan designed to control the backwater of the San Francisco River and to improve these creeks should be implemented as early as possible. However, in this feasibility study, the improvement of these creeks is not included.

Other Flooded Areas

Other areas related to this study are listed as follows:

Area between E. Rodriguez Avenue and Quezon Boulevard

West side area of La Loma Cemetery

South side area of N. Domingo

The floods in these areas come from the uncontrolled flow of rivers and its branches. The river control and drainage program will be completed in 1978 but it is only a first step and further development is expected.

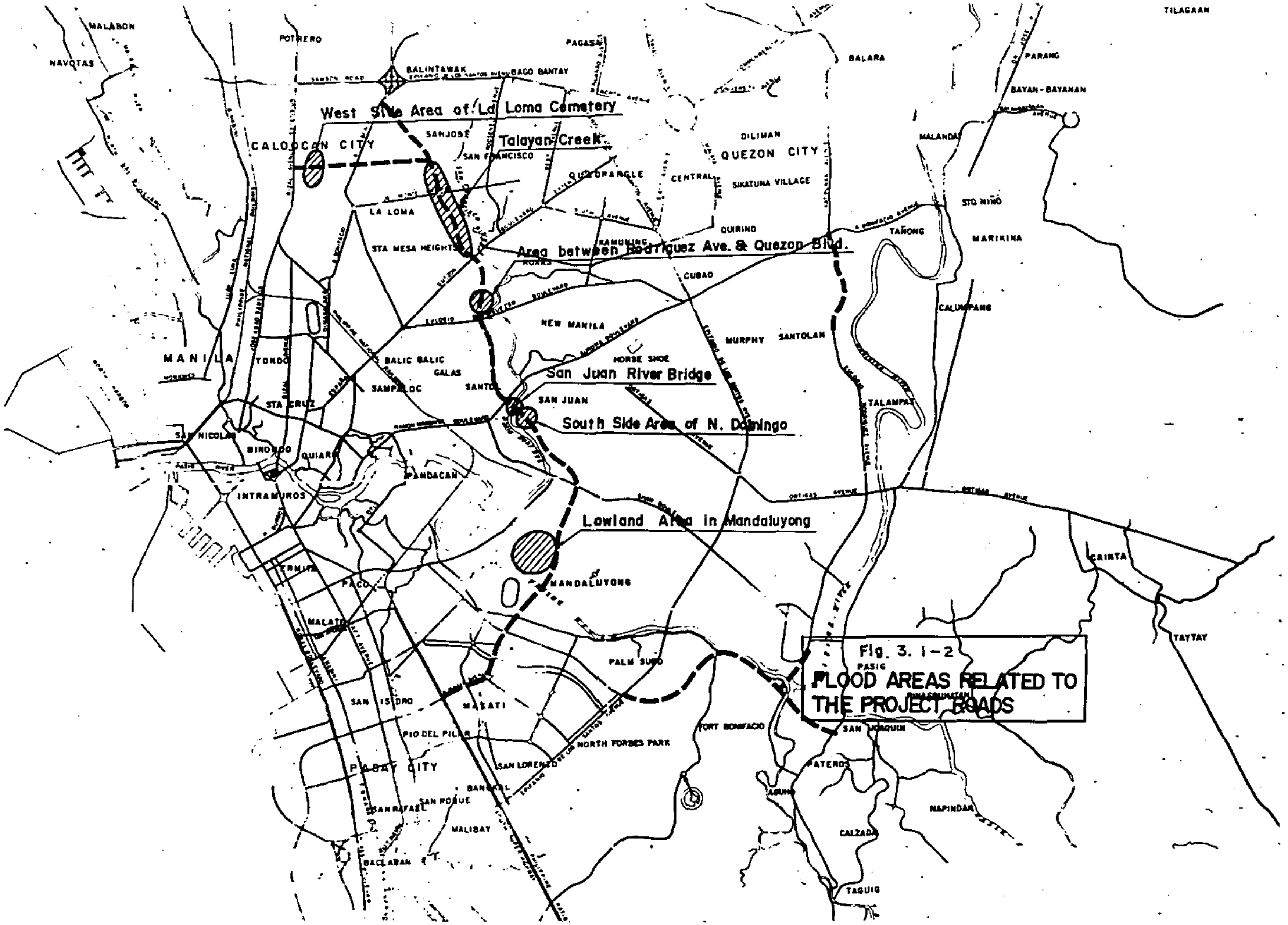


Fig. 3. 1-2
FLOOD AREAS RELATED TO THE PROJECT ROADS

3.2 BASIC CONSIDERATIONS FOR ROAD PLANNING

3.2.1 Characteristics of the Project Roads

The project roads, C-3 and R-4 and related roads, will assume the character of major roads in the Metropolitan Manila area (MMA). The present road network in the MMA is characterized by radiating routes from the central business district (CBD) and only one major road, Epifanio de Los Santos Avenue, which serves circumferentially for the huge areas outside the CBD. The radii of C-1, C-2 and C-4 are about 1.5, 3 and 8 kilometers, respectively. It means that transportation in the inter-area between C-2 and C-4 has been depressed. Each road stretch contained in this project will be characterized as follows:

C-3 Road

C-3 will assume the character of a major road with uncontrolled access. It will function as a circumferential collector-distributor road with major intersections invariably grade-separated or at-grade depending on their importance. Traffic on minor intersections will not be allowed to cross the C-3 but will be provided with access to and from it.

Utilizing existing stretches of Buendia, G. Araneta and Sgt. Emilio Rivera Avenues, C-3 road will run on predominantly developed areas and will connect urban centers, namely, the municipalities of Makati and Mandaluyong, Quezon City and Caloocan City.

R-4 and Related Roads

R-4 and related roads will also assume the character of a major road with uncontrolled access. R-4 will function as a radial road serving the traffic demand in the southeastern portion of the MMA and will function more effectively with the completion of the related roads. R-4 and related roads are divided into following two parts:

R-4 and C-5 (Segment 12):

Existing Imelda Marcos Avenue will be extended to connect C-2 to C-4, passing through the developed area of Makati. However, its extension does not reach C-5. The projected stretch of R-4 is expected to meet the anticipated traffic flow from the South Superhighway and others to C-5. On the other hand, C-5 ends at the right of the Pasig River because of the absence of a bridge. This stretch which is not connected to R-4 is taken as a related road and it includes a bridge crossing the Pasig River.

C-5 (Segment 13):

The surrounding area outside of C-4 is recognized as developing area and yet its road network is not improved. Katipunan Avenue runs from north to south direction on hilly area in Quezon City and is not connected to Eulogio Rodriguez Avenue which runs on low land developing area along the Marikina River. The studied stretch of C-5 is intended to connect both roads directly on steep slope area to accommodate much of the expected through traffic.

3.2.2 Principal Considerations

The project roads aligned mostly in developed areas are constrained by a lot of factors: topography including flood problems, soil and ground conditions, confinements from town development, cemeteries, schools, accessibility with other roads, national railway, and etc. While it is very difficult to fully reconcile these multiple and sometimes conflicting constraints, a more satisfactory "balance" is intended to be achieved by integrating factors such as minimum construction cost possible, less negative environmental impact, and a more widespread benefits.

This principle guided the formulation of the design criteria described in Section 3.4. Major factors considered in the road planning were as follows:

1. Schools, cemeteries and other important public structures be respected wherever possible.
2. Existing right-of-way be utilized to the extent possible.
3. In anticipation of the flood control works to be undertaken in the areas traversed, the design of the roads be directed to prevent the flood problems from being aggravated.
4. The accessibility of all existing roads be preserved.

3.3 ENGINEERING SURVEY

3.3.1 Reconnaissance and Inventory Surveys

Project site inspection by air and reconnaissance survey were conducted by the main staff of the study team.

Road and structure inventory surveys were carried out along the streets and paths which were located within the area related to this study.

The results of these surveys were reflected in the selection of routes and their evaluations.

3.3.2 Preparation of Aerial Photographic Maps

Aerial photographic mosaic maps in scale of 1/8,000 and 1/2,000 were prepared for the preliminary route selection. The original negatives were photographed in 1973, and these do not reflect changes in topographic and environmental conditions. However, after noting the important changes, these maps were still utilized for many purposes.

3.3.3 Topographic Survey

Topographic survey; traversing, leveling, cross-section and complemental topographic survey, were conducted along the several alternative routes which were tentatively aligned on the aerial photographic maps. The surveyed data were plotted in the scale of 1/2000 horizontal and 1/400 vertical. On the other hand, planimetric survey and leveling on the bridge sites and the major intersections were also conducted and plotted in the scale of 1/500.

These surveyed data were utilized for preliminary design of roads and bridges.

3.3.4 Flood Record Survey

Flood control and drainage programs are now on-going and road and bridge design should be integrated with these programs. Accordingly, the flood control and drainage plans and records of past flood were reviewed.

3.3.5 Soil Investigation

Borings and soil tests which include standard penetration tests, sampling of undisturbed soil, unconfined compression and consolidation tests and CBR tests were conducted after the review of all available soil data.

A total of 25 borings were conducted at the proposed bridge sites and other required places. Results of these investigations could be used in the stabilization analysis of the materials for the embankment, design of foundation and pavement. The total drilling depth reached 500 meters with an average depth of 20 meters per hole. Standard penetration tests were conducted at intervals of one meter depth to confirm the consistency or relative density of each stratum. Samples taken out from bore holes were tested for gradation, water content, Atterberg limits, etc. Compaction and CBR tests of earth materials were carried out for possible use in the design of the road. Location of borings are shown in Fig. 3.3-1 while soil profile, CBR and other test results are shown in the Supplement Volume.

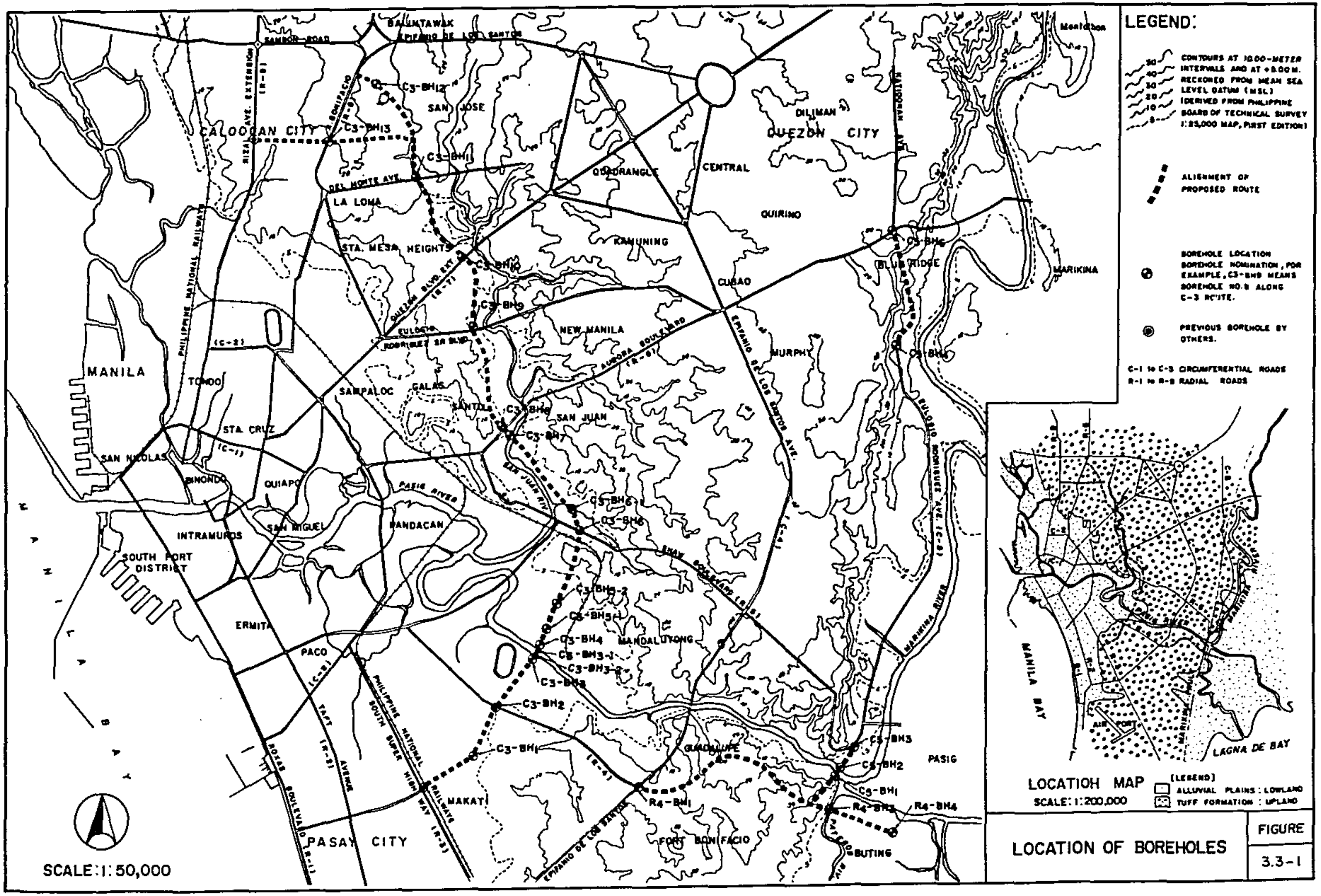
3.3.6 Material Survey

Material survey was also conducted on common borrow, coarse and fine aggregates, crushed stone and others. This survey included several kinds of material tests which were conducted in the laboratory of a local firm.

The location of material sources, quality, and available quantities are shown in the Supplement Volume.

3.3.7 Assessment of Land and Property

Assessment survey for the right-of-way (ROW) acquisition plan was conducted on the lots and properties with a 100-meter strip along the proposed alignment.



LOCATION OF BOREHOLES

FIGURE 3.3-1

3.4 ENGINEERING STANDARD

3.4.1 Design Policy

The project roads are defined as major thoroughfares in the Metropolitan area. Considering the present condition and future development of the influenced area along the project roads, the design policy was set up as follows:

1. The horizontal alignment shall be set taking the expected traffic flow into account and based on the considerations for utilizing acquired right-of-way to a greatest extent, for minimizing demolition of properties and for preserving the environment of affected areas as much as possible.

2. Staging on the road construction shall be considered not only on segmental staging of the roads but also on the widening of the roads and grade separation of intersections.

3. Recommendations presented by MMETROPLAN and other studies, for example, introduction of bus lane on C-3 road, shall be taken into consideration after studying further.

4. Connections with existing roads shall be preserved because the project roads are serving and running through developed areas. However, minor roads are connected to the project roads with the type of junction which is described as "only turning to and from side streets is allowed and crossing is prohibited". At-grade or grade-separated intersections using signalized control system shall be provided in the junctions with main roads.

3.4.2 Method of Implementing Bus Lanes

Exclusive bus and jeepney lanes were proposed in MMETROPLAN. Its necessity was analyzed and its location, median side or sidewalk side was discussed. The following factors were considered for this purpose:

1. Safety of passengers in

    Boarding
    unloading
    Transferring
    Access to bus stops

2. Accessibility to bus stops

    Bus stop interval
    Bus stop location
    Ease of transferring

3. Efficiency of bus operation

    Bus travel speed
    Possibility of eliminating disturbance to bus operation

4. Degree of affecting normal traffic
   Reduction of intersection capacity

5. Cost
   Cost needed to guarantee the above-mentioned items

Median side bus lanes can be suitable to high speed. However, as far as trip time is concerned, high speed is not considered so important a factor because the trips which have both origin and destination on C-3 are not anticipated so much. Thus, sidewalk side bus lane is superior in most itmes mentioned above. Sidewalk side bus lane was adopted if the bus traffic warrants the implementation of bus lane.

3.4.3 Design Standard

The DPH design standard is basically derived from the 1973 edition "A Policy on Design of Urban Highways and Arterial Streets" (AASHTO). Considering the present design practice in the Philippines, the design standard of this project followed the above reference and Japanese design standards were applied in cases not covered satisfactorily by the AASHTO.

Geometric design standards are mentioned in Sub-section 3.4.4 and other standards are described as follows:

1. Pavement Design

   "AASHTO Interim Guide for Design of Pavement Structures", 1972 shall be applied.

2. Right-of-way

   Widening of existing roads shall be limited to one side only as much as possible to facilitate the acquisition of right-of-way.

3. Transition

   Circular curbs on horizontal alignment shall be transitioned with clothoid curbs.

4. Vertical Alignment

   Vertical alignment shall be designed to match the existing topographic condition as much as possible.

5. Lateral Gradient

   Maximum superelevation is defined in Table 3.4-1. However, normal lateral gradient on asphalt or cement concrete pavement shall be 1.5 per cent.

6. Clearance Height

   Clearance height above the roadway shall be minimum of 4.88 meters.

7. Travel Lane

The number of travel lanes on bridge shall correspond to that of the road. However, the width of sidewalk and median on bridge may be reduced to the minimum required.

8. Bridge Length

The flood control and drainage program does not include all areas related to this project and the bridge span length which is estimated with discharge volume, water level profile and other condition without future improvement plan of river shall be adjusted compared with existing bridge spans.

9. Loading for Structure Design

HS-20 loading shall be applied to the design of bridges and culverts. Allowable stress can be increased by 50 per cent in case of stress calculation under loading, including lateral force due to earthquake which is defined in the next paragraph.

10. Lateral Force

Lateral force due to earthquake shall be calculated using the formula which was established as "National Structural Code for Buildings (The Association of Structural Engineers of the Philippines, January 1977).

3.4.4 Geometric Design Standard

Geometric design standards adopted in the study are shown in Table 3.4-1.

Table 3.4-1 Geometric Design Standards

Design Speed		Kph	40	50	60
Minimum Radius of Curvature		m	90	130	170
Maximum Superelevation		%	4	4	4
Superelevation Run-off		%	0.66	0.62	0.58
Sight Distance	Stopping	m	60	80	90
	Passing	m	340	410	460
Maximum Road Gradient		%	6	6	6
Critical Length of Grade Design		m	300	420	580
Vertical curve Length	Crest	m	9A*	17A*	17A*
	Sag	m	11A*	17A*	17A*

* A is the algebraic difference of grade in per cent.

The design speed of the project roads was set at 60 kilometers per hour, considering the following conditions.

1. The project roads pass through the developed area so that access traffic which is anticipated much will disturb the through traffic.

2. The distance between the major intersections is not so long and many access roads are connected in shorter intervals. Thus, a lot of weaving may arise.

3. Approach to bridges and grade-separated intersections will be lengthened under higher design speed, so that accessibility will be more limited and construction cost will get higher.

Lane Width

There is no uniformity about lane width in the MMA, in contrast to AASHTO where 12 feet width is recommended. In this study, the width of 3.50 meters, which is compatible with that of C-2 and C-4, was set as the standard for the unit travel lane width.

Median

Taking into consideration the following conditions, the width of median was proposed at 4 meters.

1. Existing median width along C-2 and C-4 is 4 meters.
2. The green belt is desirable to be provided in arterial thoroughfare.
3. The additional lane for left turn is to be provided in median side.

However, one-meter median width was proposed for the long bridges.

Curb and Gutter

Gutter of 50-centimeter width was proposed on both out-sides of carriageways and median side strips of 50 centimeter width, which was reduced to 25 centimeters on the long bridges, was proposed to be provided.

Sidewalk

The width of the sidewalk, including verge, was set at 6.50 meters as standard due to the following reasons:

1. The large volume of pedestrians is expected.
2. From environmental and aesthetic point of view, a wider pedestrian walk is preferable.

The width of sidewalk on the long bridges is narrowed to 2 meters to cut the construction costs.

3.4.5 Criteria for Formation Level

Major thoroughfares should serve travels for emergency and other welfare aids even if surrounding areas are flooded. Thus, it is desirable that the design formation be elevated higher than existing ground level in low land areas. However, this will impede the accessibility and exchange of communications between residents on both sides of the road. Expecting that flood control and drainage program will be implemented in the future, the road design formation adopted in this study shall follow as close as possible to the elevation of the existing roads.

3.4.6 Intersection Plan

Methods of Selecting Junction Types

In MMETROPLAN, five main junction improvements along C-3 were recommended. The type of junction is to be determined after traffic projection. The method of selecting junction types is briefly described below:

1. Only turning to and from side streets is allowed and crossing is prohibited.

   It will be applied to the junction where existing side streets are used mostly by local traffic. Cross traffic is banned by median so that only turnings to and from side streets will be possible. This kind of approach minimizes the disturbance of traffic flow.

2. Signalized and channelized intersection

   This will be generally applied to the junctions of major street where traffic flow can be efficiently handled by signal.

3. Grade-separated intersection without interchangeable facilities

   This will be applied to the junction near bridge sites where the elevation of the crossing road is different from that of main road and the interchanging traffic volume is not so heavy.

4. Grade-separated intersection

   This will be applied to the junction where crossing and interchanging traffic are so heavy that signalization and channelization cannot control the traffic.

The intersections on this project roads were designed by applying one of four types to each junction.

3.5 PRELIMINARY DESIGN

3.5.1 Road Alignment and Alternatives

Alternative routes were considered for C-3 section between South Superhighway and Aurora Boulevard, while no alternative route was taken for the other section of C-3 as the route follows the existing roads for the most part.

From the results of the reconnaissance survey, two control points each were set on Buendia Avenue and J. Rizal Avenue and three control points each were set along the Pasig River, Boni Avenue and Shaw Boulevard, as shown in Fig. 3.5-1. A combination of these control points yields many alternatives.

As far as traffic benefit is concerned, the difference among those alternatives seems to be very slight. Therefore, the evaluation of alternatives was mostly based on the construction cost including right-of-way acquisition cost and this process also answered the criterion of environmental impact. The alternatives are shown in Fig. 3.5-1 with brief descriptions of their characteristics and construction costs.

The process of evaluating the alternatives for R-4 and related roads was similar to C-3 except the C-5 section between E. Rodriguez Avenue and Aurora Boulevard which has two alternatives, leaving their evaluation to the later economic analysis. The data are shown in Figs. 3.5-2 and 3.5-3.

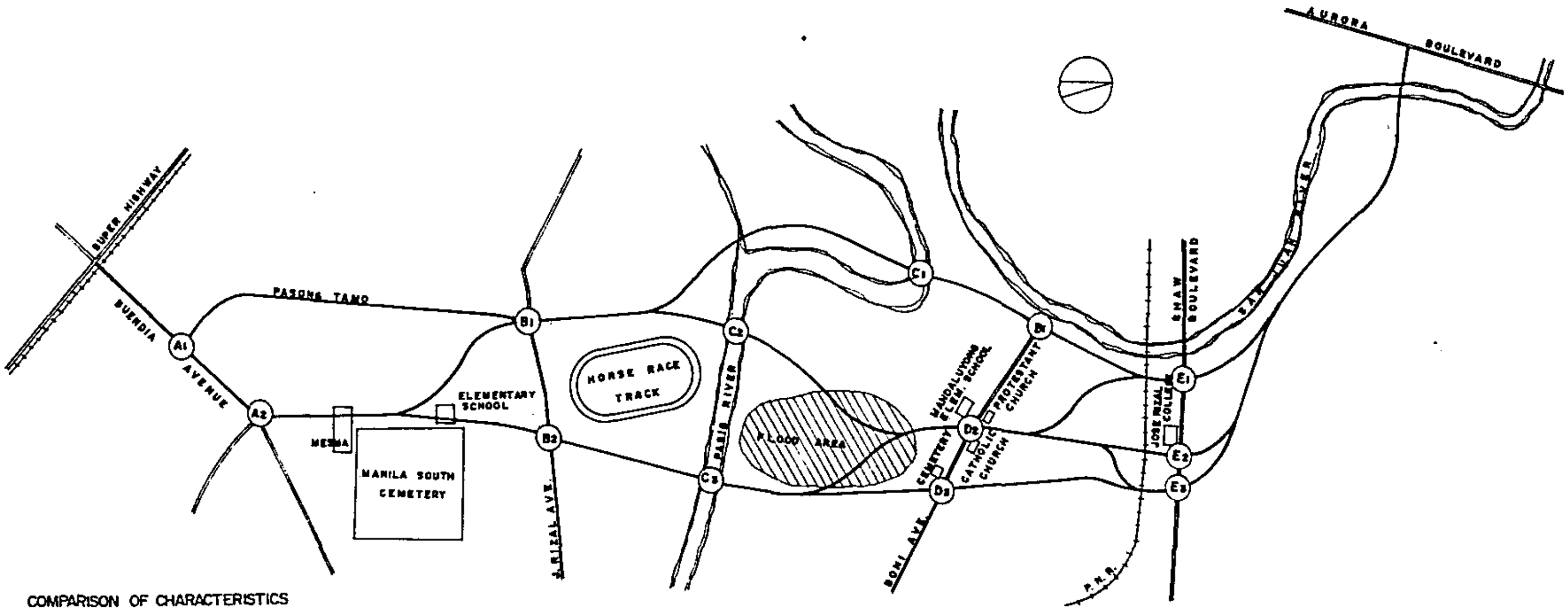
Both points at the beginning and at the end of the project roads were connected smoothly to the existing roads and environs. Simple curves were utilized in cases of more than 1,000-meter radius while clothoid transition curves were applied for other cases. Vertical alignments were designed to be as close as possible to the ground levels. However, the minimum gradient of 0.3 per cent was retained.

3.5.2 Road Cross-section and Regulated Bus Lane

Five standard cross-sections were selected as shown in Table 3.5-1 and Fig. 3.5-4. The regulated bus lane in "D2 + B" will be reserved for buses and Jeepneys only during morning and afternoon peak hours, and the regulated bus lane in "D3 + B" or "D2 + B2" will be reserved for buses and Jeepneys only.

Table 3.5-1 Particulars of Cross-section of Divided Highway

	ROW Width (m)	Number of Normal Traffic Lanes	Number of Bus Lanes
D2	30	4	0
D3	40	6	0
D2 + B	40	4	2
D3 + B	50	6	2
D2 + B2	50	4	4



COMPARISON OF CHARACTERISTICS

A1 : IT PASSES THROUGH A HIGHLY DEVELOPED AREA WITH TALL BUILDINGS ON BOTH SIDES.

A2 : R.O.W. ACQUISITION WILL BE EASY EXCEPT REMOVAL OF A FACTORY (MESMA).

B1 : IT PASSES THROUGH A HIGHLY DEVELOPED AREA.

B2 : *IT AFFECTS EITHER THE ELEMENTARY SCHOOL OR MANILA SOUTH CEMETARY*

C1 : ONE-LANE BRIDGES ARE NOW UNDER CONSTRUCTION ON BOTH SIDES OF THE EXISTING BRIDGE. HOWEVER, THE FUTURE TRAFFIC IS ANTICIPATED TO EXCEED THEIR CAPACITY.

C2 AND C3 : NO BRIDGE EXISTS BETWEEN PANADEROS ST AND E. DE LOS SANTOS AVE. THEREFORE, IT SEEMS TO BE ADVANTAGEOUS TO CONSTRUCT A NEW BRIDGE.

D1 : IT PASSES THROUGH A HIGHLY DEVELOPED AREA.

D2 : IT PASSES THROUGH A SWAMPY AREA SOMETIMES FLOODED. THIS INTERSECTION IS ADJACENT TO CENTRAL SCHOOL AND TWO CHURCHES

D3 : IT PASSES THROUGH A RESIDENTIAL AREA.

E1 : RECONSTRUCTION OF P.N.R. BRIDGE IS NECESSARY. IT PASSES THROUGH A SHOPPING AND COMMERCIAL DISTRICT WHICH HAS ALREADY HEAVY TRAFFIC

E2 : THIS INTERSECTION IS LOCATED JUST BESIDE JOSE RIZAL COLLEGE.

E3 : IT PASSES A RESIDENTIAL AREA.

ROUGH ESTIMATION OF COST

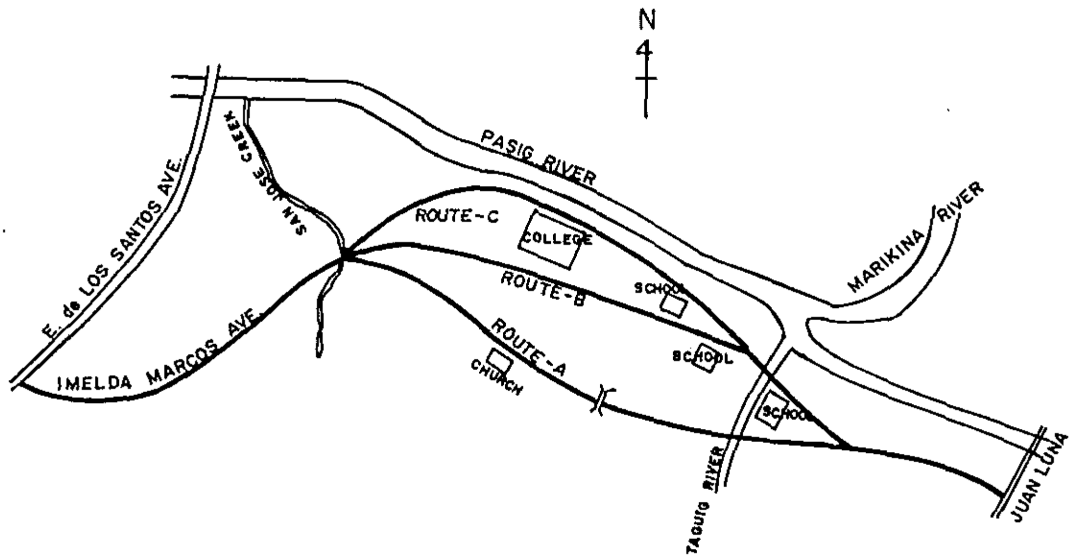
BETWEEN SUPERHIGHWAY AND AURORA BLVD.
FOR 6-LANE ROAD (40 M-ROW)

(UNIT : ₱ 1,000)

ROUTE	R.O.W ACQUISITION	ROAD CONSTRUCTION	STRUCTURE CONSTRUCTION	TOTAL
A2 - B2 - C3 - D3 - E3	97,100	64,510	53,570	215,180
A2 - B2 - C3 - D2 - E2	97,740	64,720	53,570	216,030
A2 - B1 - C2 - D2 - E2	106,350	66,510	58,070	230,930
A1 - B1 - C2 - D2 - E2	165,590	71,040	58,070	294,700
A2 - B1 - C1 - D1 - E1	127,610	64,140	45,570	237,320

ROUTE A2-B2-C3-D3-E3 IS FINALLY PROPOSED.

Fig. 3.5-1
ALTERNATIVE ALIGNMENTS OF C-3



COMPARISON OF CHARACTERISTICS:

	ROUTE-A	ROUTE-B	ROUTE-C
EFFECTS ON MILITARY OPERATION	Δ	X	O
IMPACT TO EXISTING INSTITUTIONAL BUILDINGS	O	X	Δ
NUMBER OF RESIDENCES TO BE AFFECTED	O	X	X
DIVISION OF COMUNICATION	O	X	Δ

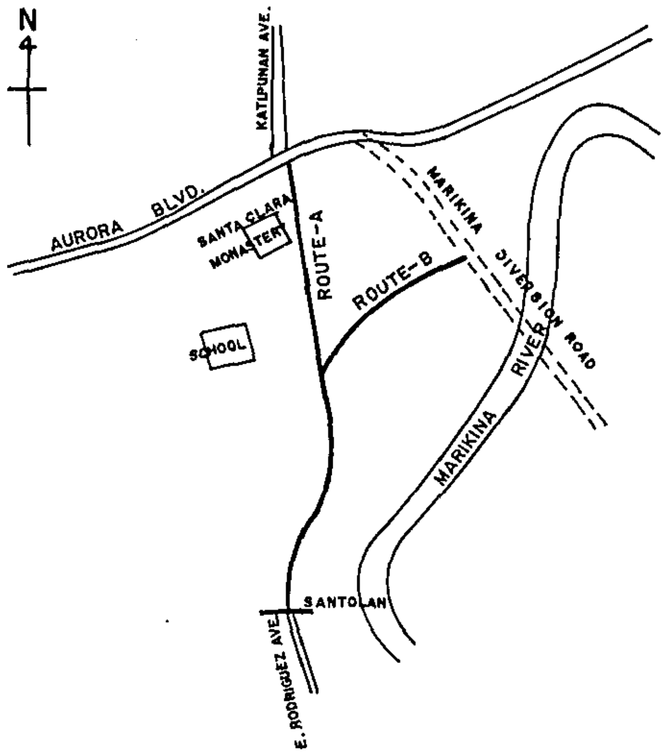
O GOOD
Δ MIDDLE
x BAD

ROUGH ESTIMATION OF COST (UNIT: ₱ 1,000)

	ROUTE-A	ROUTE-B	ROUTE-C
R.O.W. ACQUISITION	13,500	15,700	17,500
ROAD CONSTRUCTION	29,700	29,200	30,500
STRUCTURE CONSTRUCTION	4,200	3,200	3,200
TOTAL COST	47,400	48,100	51,200

MILITARY PREFER ROUTE-C BUT NOT YET OFFICIAL.
ROUTE-C WAS STUDIED FOR PRELIMINARY DESIGN.

FIG. 3.5-2 ALTERNATIVE ALIGNMENTS OF R-4



ROUGH ESTIMATION OF COST

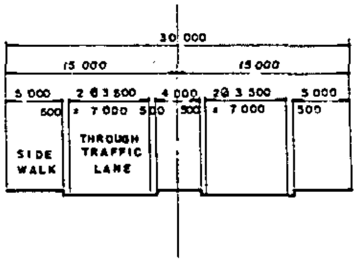
(UNIT : ₱ 1,000)

	ROUTE-A	ROUTE-B
ROW ACQUISITION	20,600	21,600
ROAD CONSTRUCTION	24,100	16,200
TOTAL COST	44,700	37,800

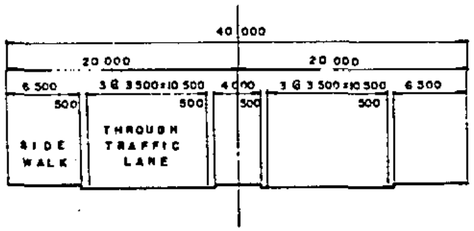
ROUTE - A IS RECOMMENDED BASED ON THE ECONOMIC EVALUATION.

FIG. 3.5-3 ALTERNATIVE ALIGNMENTS OF C-5 (SEGMENT - 13)

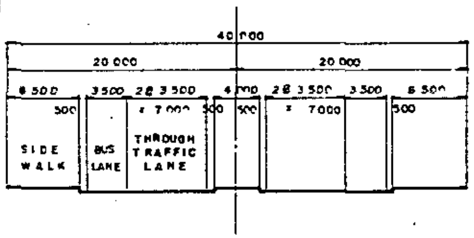
1. D_2



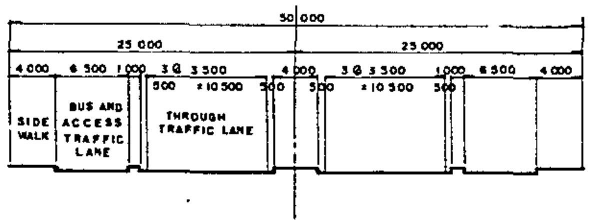
2. D_3



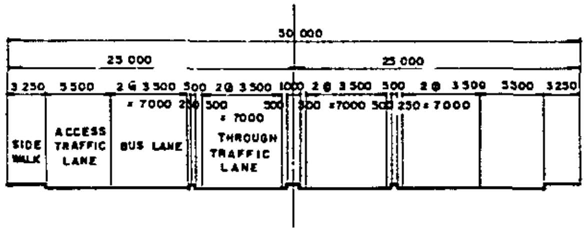
3. D_2 + B

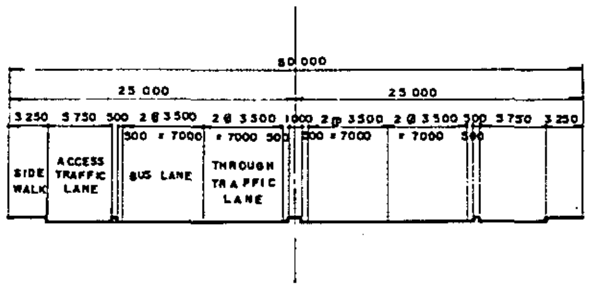


4. D_3 + B



5. D_2 + B_2





ROAD CROSS SECTION

Figure 3.5-4

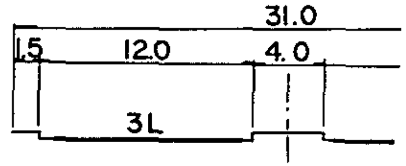
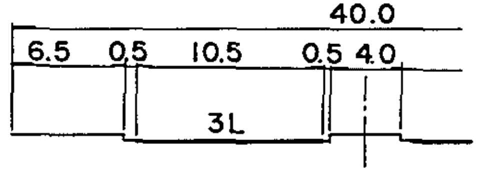
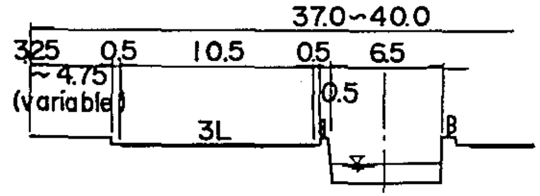
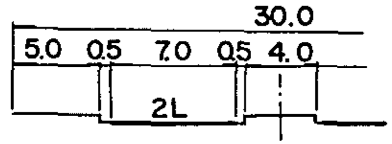
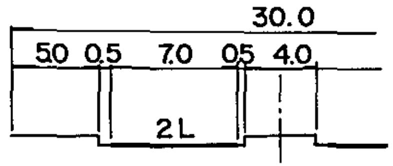
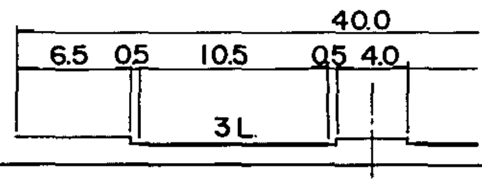
Based on the traffic demand and capacity analysis, five plans using combinations of the above five standard cross-sections were considered as alternatives for C-3. On the other hand, "D2" and "D3" were proposed for R-4 and its related roads, respectively, to be compatible with the existing roadway and at the same time to meet the expected traffic demand (See Table 3.5-2).

Table 3.5-2 Combinations of Cross-sections

		Segment 1	Segments 2 to 7	Segments 8 to 10	Segment 11	Segments 12 to 13
C-3 Road	Plan - 1	D3	D2	D2	-	-
	Plan - 2	D3	D3	D2	-	-
	Plan - 3	D2 + B	D2 + B	D2	-	-
	Plan - 4	D3 + B	D3 + B	D3	-	-
	Plan - 5	D2 + B2	D2 + B2	D3	-	-
R-4 & Related Roads		-	-	-	D2	D3

The typical cross-sections which were finally proposed are shown in Table 3.5-3.

Table 3.5-3 TYPICAL CROSS SECTIONS

ROUTE	SEGMENT	RIGHT-OF-WAY (m)	NUMBER OF LANES	TYPICAL CROSS-SECTION
C-3	1. South Superhighway-Ayala Ave.	31	6	
	2. Ayala Ave. — J.P. Rizal 3. J.P. Rizal — Boni Ave. 4. Boni Ave. — Shaw Blvd. 5. Shaw Blvd.— Aurora Blvd. 6. Aurora Blvd.— Quezon Blvd.	40	6	
	7. Quezon Blvd. — Sgt. Emilio Rivera	37~40 (variable)	6	
	8. G.Araneta Ave. — A.Bonifacio Ave. 9. A.Bonifacio Ave. — Rizal Ave. 10. Sgt. Emlio Rivera — A.Bonifacio Ave.	30	4	
R-4	11. E. De Los Santos Ave.—J. Luna	30	4	
C-5	12. R-4 — Pasig Blvd. 13. Santolan — Aurora Blvd.	40	6	

3.5.3 Intersection Design

The five intersections shown in Table 3.5-4 are considered to require a series of study for introducing grade separation due to the large traffic expected when they are in use. For each of these intersections, both at-grade and grade-separated types using signalized control system were designed as alternatives.

The number of lanes at the approach of at-grade intersection was set as per the traffic operation plan set forth in Sub-section 2.2.9.

A diamond interchange was selected for the grade-separated type because of limitation in space. For a diamond interchange of circumferential and radial roads, two alternatives can be considered for selecting a road which has through-traffic lanes either elevated or depressed. Generally, it is desirable to elevate or depress a circumferential road which is given priority to for its function as a collector-distributor. The selection should also be made taking economic analysis into consideration. Accordingly, two alternative types were considered at each intersection as listed in Table 3.5-4 and as illustrated in Fig. 3.5-5, except at C-3-E. Rodriguez Avenue and C-3 - Quezon Boulevard intersections which have no alternative. E. Rodriguez Avenue and Quezon Boulevard cross the San Juan River near respective intersections with C-3, and if they are elevated or depressed at the intersections, it will be accompanied by the reconstruction of the existing bridges over the San Juan River. For this reason, the through-traffic lanes were proposed to be introduced on C-3 at these two intersections.

Table 3.5-4 Connection Type of Diamond Interchange

Intersection	Road to be elevated or depressed		Type
	Alternative 1	Alternative 2	
Buendia Ave. - Ayala Ave.	Ayala Ave.	Buendia Ave. to Kamagong and Buendia Ave. Ext. (one way)	Elevated
C-3 - Shaw Blvd.	Shaw Blvd.	C-3	Elevated
C-3 - Aurora Blvd.	Aurora Blvd.	C-3	Elevated
C-3 - E. Rodriguez Ave.	C-3	-	Elevated
C-3 - Quezon Blvd.	C-3	-	Depressed

Considering the topography, ground condition and construction cost, a depressed type was proposed at C-3 - Quezon Boulevard intersection, while at the other intersections, elevated types were recommended in anticipation of difficulties in drainage.

According to the traffic operation discussed in Subsection 2.2.9, the through-traffic roadway either elevated or depressed was planned to have four lanes except in Alternative 2 at Buendia Avenue - Ayala Avenue intersection where one to three through-traffic lanes were planned as illustrated in Fig. 3.5-5. Following the geometric design standard, a maximum road gradient of 6 per cent was used and a maximum superelevation of 4 per cent was applied in case of curved alignment.

The construction costs were estimated on the assumption that a steel box girder or a steel plate girder with a 50 meter span would be adopted for the center span of the viaduct, and a two-cell reinforced concrete box culvert for the underpass. However the structure should be reviewed for the best type in the stage of detailed engineering.

3.5.4 Pavement and Drainage Design

Pavement and Subgrade

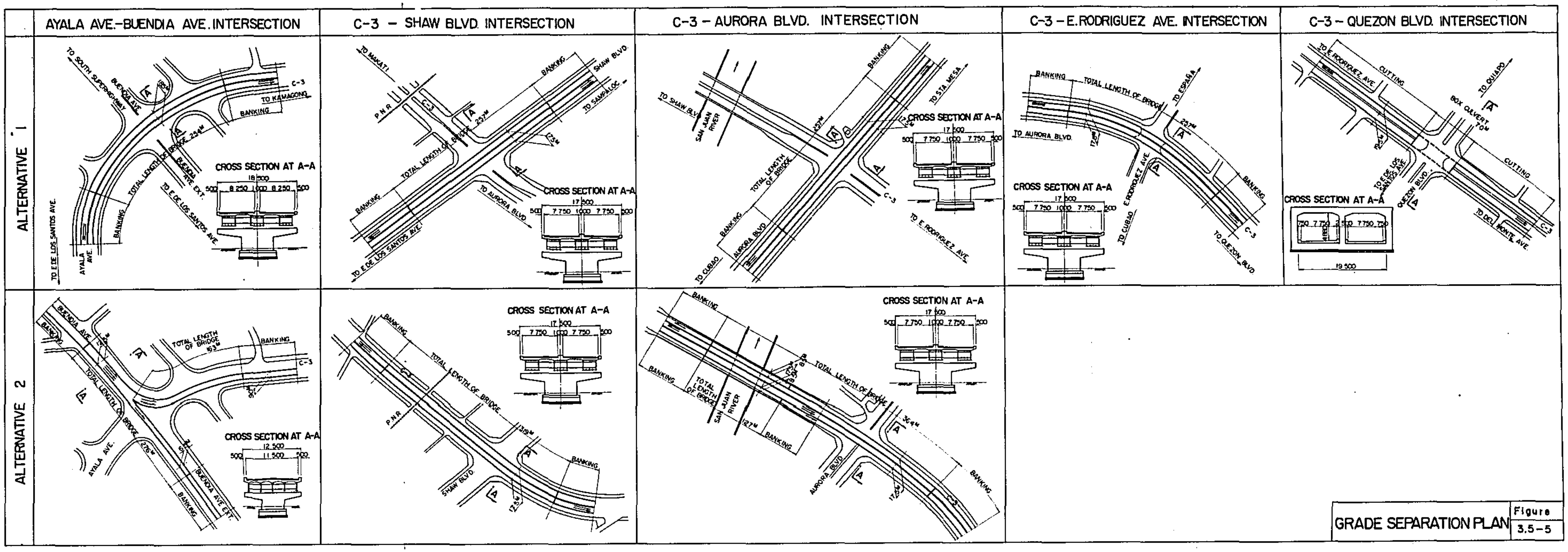
Top soil and pavement, where existing, were planned to be removed and replaced with selected materials and pavement, for the most part of road. However, subgrade within 2-meter depth from ground surface in both access sites to San Juan River bridge was planned to be replaced with borrows because of soft ground condition and embanked up to a maximum of 4 meters high. Cement concrete pavement was adopted to satisfy economic considerations which include maintenance cost for 20 years, availability of materials and subgrade condition (see Table 3.5-5). However, on the embankment at bridge approach portion, the application of asphalt concrete pavement should be examined in the detailed engineering stage.

Pavement design was conducted based on the "AASHTO Interim Guide for Design of Pavement Structures", 1972.
Soil factors in its design method was derived from CBR value taken from the subgrade materials along the proposed roads.

The thickness of cement concrete pavement was fixed to 23 centimeters and each thickness of base and sub-base coarse ranged from 5 to 20 centimeters.

Drainage

Vertical alignment followed mostly the existing ground level so that regional drainage was not concerned to this project. Road surface drainage was designed using Manning formula and the precipitation intensity tabulated by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)



GRADE SEPARATION PLAN

Figure 3.5-5

which is shown in Fig. 3.5-6. Gutters were planned to be provided on both sides of the road and inlets to be installed at about 25-meter intervals to connect drainage pipes buried under the sidewalks.

Table 3.5-5 Comparison of Costs between Cement and Asphalt Concrete Pavements

Cement Concrete Pavement			Asphalt Concrete Pavement		
Item	Thick-ness (cm)	Cost (₱/m^2)	Item	Thick-ness (cm)	Cost (₱/m^2)
Cement Concrete Slab	23	142	Asphalt Concrete Surface Course	5	39
Base Course	20	20	Asphalt Concrete Binder Course	15	116
Sub-base Course	20	16	Base Course	25	25
			Sub-base Course	25	20
Total	63	178	Total	70	200

(Design CBR of Subgrade = 3 %)

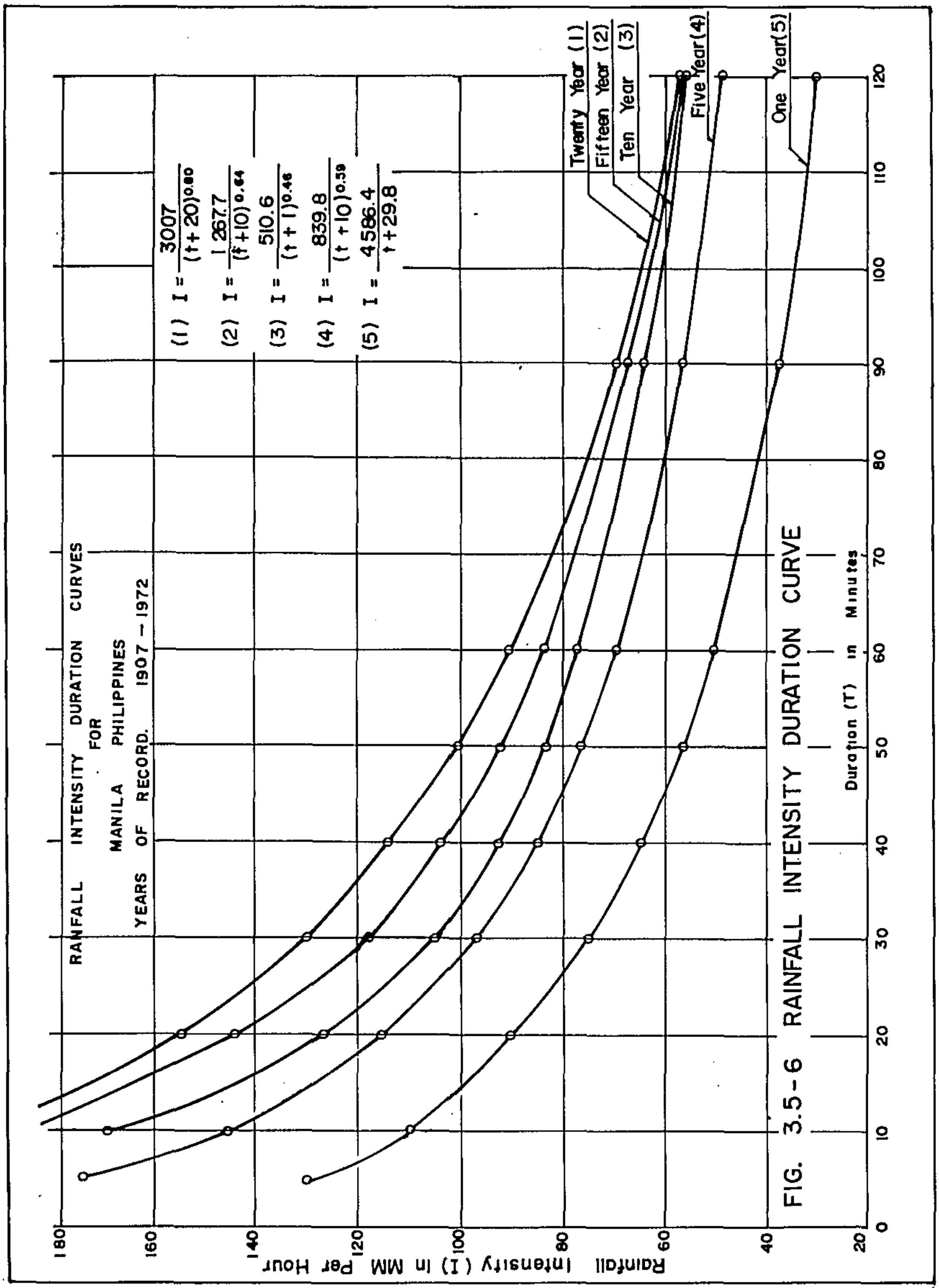


FIG. 3.5-6 RAINFALL INTENSITY DURATION CURVE

3.5.5 Bridge and Structure Design

General

Four bridges and two box culverts were designed for C-3, two bridges for R-4, and a bridge for C-5.

The longest bridge is Pasig River bridge along C-5 which is 258.9 meters in length. Next is Pasig River bridge on C-3 which is 232.5 meters long. The location of the bridges are shown in Figs. 3.5-7 and 3.5-8 with brief descriptions of their types and dimensions.

The design horizontal seismic coefficients of 0.2 and 0.15 were taken at Pasig River Bridge site and at San Juan River Bridge site, respectively based on the design criteria described in Sub-section 3.4.3. These coefficients were verified to be reasonable by geological analysis, which is included in the Supplement Volume.

Pasig River Bridge on C-3

A clearance width of 45 meters was adopted, referring to the condition of navigation under the bridges which are located downstream. The vertical clearance of New Panaderos bridge, located around 1.5 kilometers downstream was taken as the calculation base for the clear height and it comes out with an elevation of 16.63 meters from datum level of M.F.C.D.

Comparative preliminary design and construction cost estimation were conducted for continuous-steel-box-girder, continuous-steel-plate-girder and continuous-prestressed-concrete-box-girder bridges with three spans. The first type was chosen after the evaluation of construction cost including erection and substructures, construction period, technology and other factors (see Fig. 3.5-9). However, the type of bridge to be finally adopted should be further investigated in the detailed engineering, as the differences from other types are insignificantly small.

For the foundation, caissons of steel pipe piles are proposed to be utilized for piers while steel pipe pile foundations are recommended for abutments and piers on land.

San Juan Bridge

Navigation was not taken into consideration because the bridges downstream block navigation. The clear height for high-water level was estimated at an elevation of 16.2 meters from D.L. of M.F.C.D.

Considering future improvement of the San Juan River and present flood condition, a bridge of two spans of each 27.5 meters, which is 15 meter wider than the existing river width, was recommended.

LIST OF MAIN STRUCTURES ALONG C-3 ROUTE

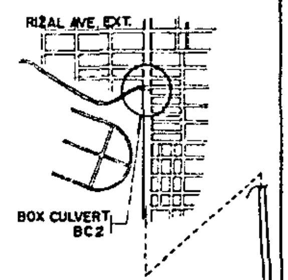
NAME	EFFECTIVE WIDTH OF BRIDGE (M)	LENGTH OF BRIDGE	AREA OF BRIDGE	TYPE OF BRIDGE			REMARKS
				SUPERSTRUCTURE	SUB STRUCTURE	FOUNDATION	
PASIG RIVER BRIDGE	S.W. C.W. M. C.W. S.W. 2.0+11.25+1.0+11.25+2.0 Σ = 27.5	232.5 M	6394 M²	3-SPAN CONTINUOUS STEEL BOX GIRDER AND SIMPLE COMPOSITE H-BEAM	INVERTED T REINFORCED CONC.	STEEL PILE CAISSON STEEL PIPE PILE	SEE DRAWINGS FIG. 34
SAN JUAN RIVER BRIDGE	S.W. C.W. (2.0+11.5) X 2 Σ = 27.0	130.85	3536	PRESTRESSED CONCRETE COMPOSITE GIRDER	INVERTED T REINFORCED CONC.	REVERSE CIRCULATION PILE	SEE DRAWINGS FIG. 35
CREEK BRIDGE CB1	S.W. C.W. (6.0+11.5) X 2 Σ = 35.0	12.8	448	REINFORCED CONCRETE SLAB BRIDGE	INVERTED T REINFORCED CONC.	P. C. PILE	SEE DRAWINGS FIG. 36
CREEK BRIDGE CB2	S.W. C.W. (6.0+11.5) X 2 Σ = 35.0	12.8	448	REINFORCED CONCRETE SLAB BRIDGE	INVERTED T REINFORCED CONC.	SPREAD	SEE DRAWINGS FIG. 36
QUEZON BOULEVARD UNDERPASS	S.W. C.W. M. C.W. S.W. 0.75+7.75+2.5+7.75+0.75 = 19.5	APPROXIMATE 390.0	APPROXIMATE 7605	BOX CULVERT L=70M RETAINING WALL	REINF. CONC. TYPE L=140 M. GRAVITY TYPE L=180 M.	SPREAD	SEE DRAWINGS FIG. 37
BOX CULVERT BC1	EFFECTIVE WIDTH B=2.0 EFFECTIVE HEIGHT H=1.5	APPROXIMATE 40.0	—	REINFORCED CONCRETE		SPREAD	SEE DRAWINGS FIG. 32
BOX CULVERT BC2	EFFECTIVE WIDTH B=6.0 EFFECTIVE HEIGHT H=2.0	APPROXIMATE 40.0	—	REINFORCED CONCRETE		SPREAD	

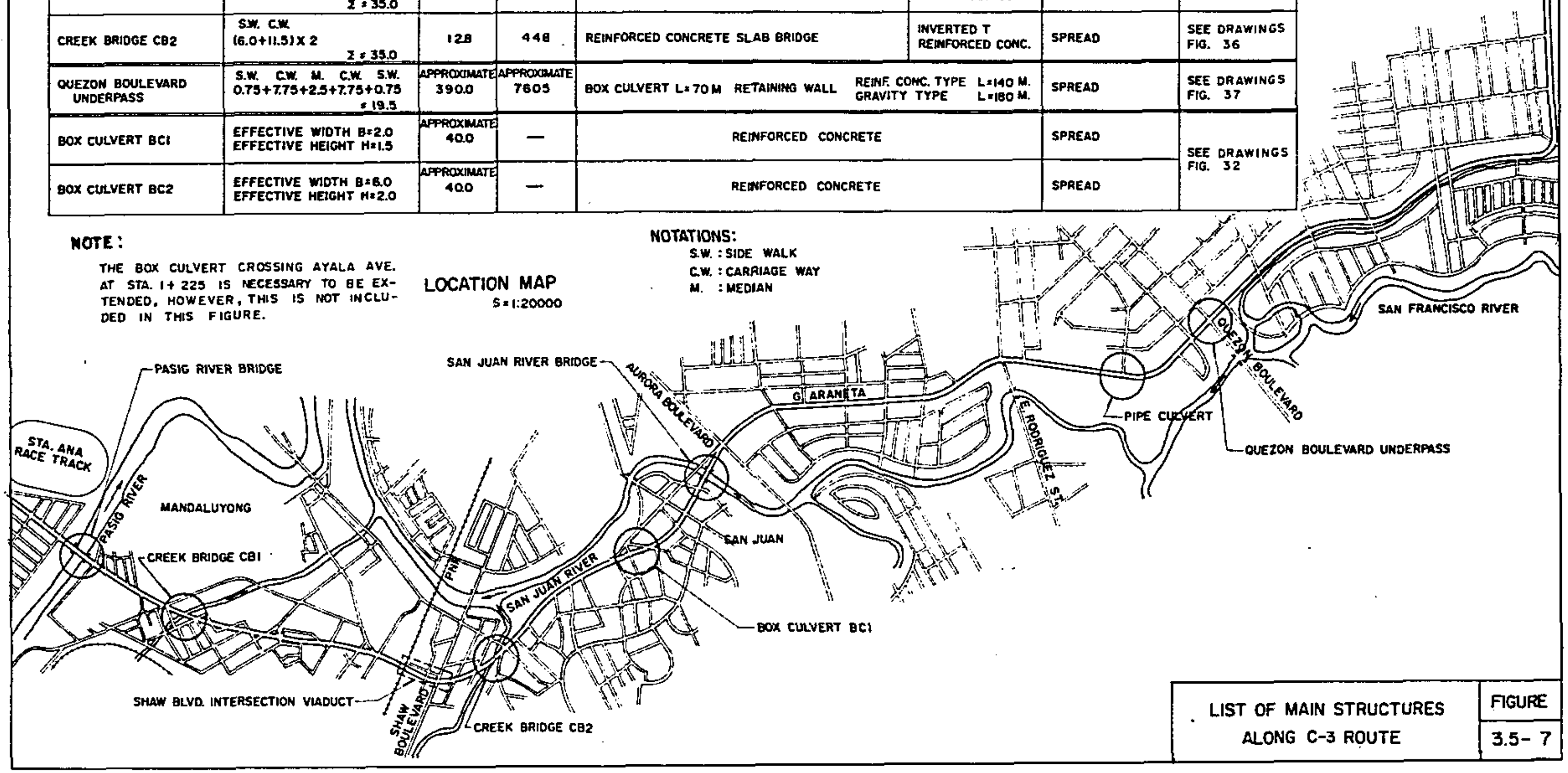
NOTE:

THE BOX CULVERT CROSSING AYALA AVE. AT STA. 1+225 IS NECESSARY TO BE EXTENDED, HOWEVER, THIS IS NOT INCLUDED IN THIS FIGURE.

LOCATION MAP
S=1:20000

NOTATIONS:
S.W. : SIDE WALK
C.W. : CARRIAGE WAY
M. : MEDIAN





LIST OF MAIN STRUCTURES ALONG C-3 ROUTE

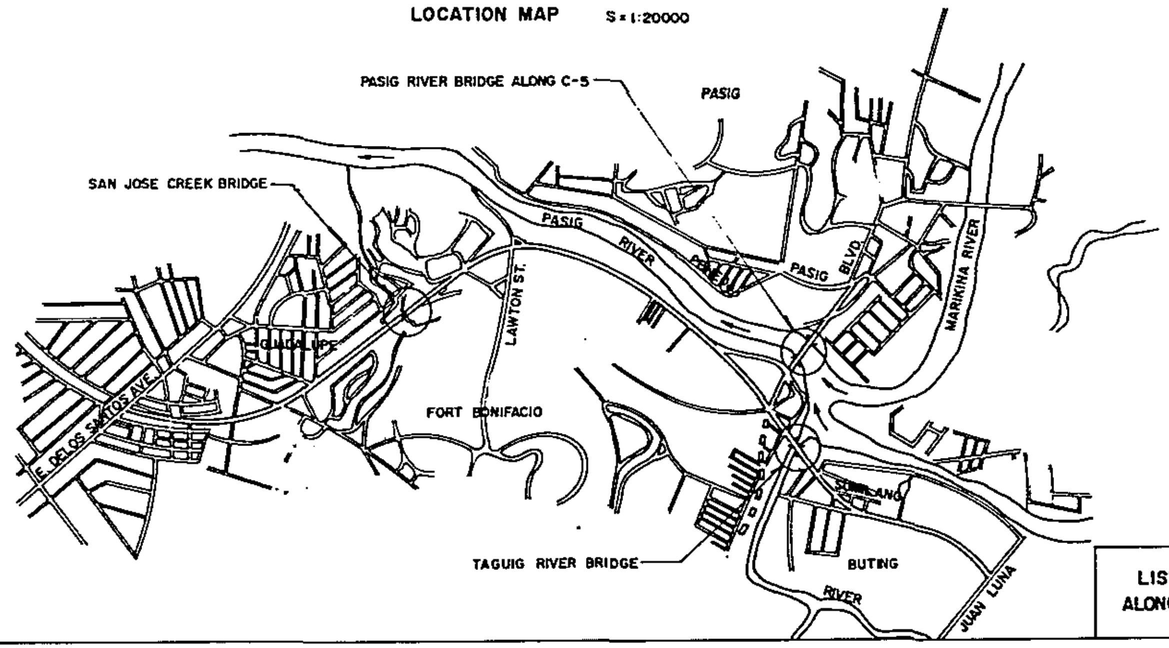
FIGURE 3.5-7

LIST OF MAIN STRUCTURES ALONG R-4 AND C-5 ROUTES

NAME	EFFECTIVE WIDTH OF BRIDGE (M)	LENGTH OF BRIDGE	AREA OF BRIDGE	TYPE OF BRIDGE			REMARKS
				SUPERSTRUCTURE	SUBSTRUCTURE	FOUNDATION	
PASIG RIVER BRIDGE (ALONG C-5)	S.W. C.W. M. C.W. S.W. 2.0+11.25+1.0+11.25+2.0 Σ = 27.5	258.85 M.	7118 m^2	3-SPAN CONTINUOUS STEEL BOX GIRDER AND SIMPLE COMPOSITE H-BEAM	INVERTED T REINFORCED CONC.	SPREAD AND STEEL PIPE PILE	SEE DRAWINGS FIG. 39
SAN JOSE CREEK BRIDGE	S.W. C.W. (4.5 + 8.0) X 2 Σ = 25.0	13.80 M.	345 m^2	SIMPLE REINFORCED CONCRETE SLAB BRIDGE	INVERTED T REINFORCED CONC.	SPREAD	SEE DRAWINGS FIG. 38
TAGUIG RIVER BRIDGE	S.W. C.W. (4.5+8.0) X 2 Σ = 25.0	20.80 M	520 m^2	PRESTRESED CONCRETE GIRDER	INVERTED T REINFORCED CONC.	SPREAD AND P.C. PILE	SEE DRAWINGS FIG. 38

NOTATIONS
S.W. : SIDEWALK
C.W. : CARRIAGE WAY
M. : MEDIAN

LOCATION MAP S = 1:20000



LIST OF MAIN STRUCTURES ALONG R-4 AND C-5 ROUTES	FIGURE 3.5-8

For the superstructure, prestressed-concrete-composite girder bridge was compared with steel-composite girder bridge including substructures. The former was recommended due to economic reasons (See Fig. 3.5-10).

Cast in place concrete pile foundation was recommended for the substructure.

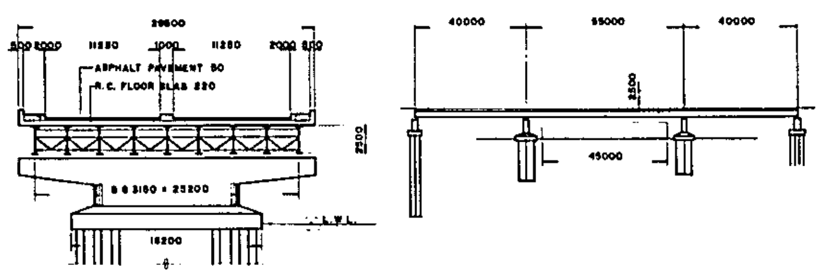
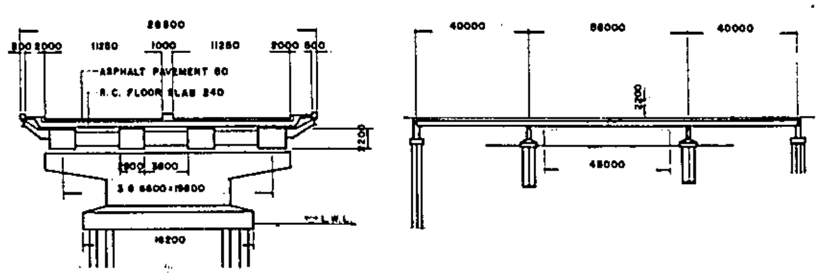
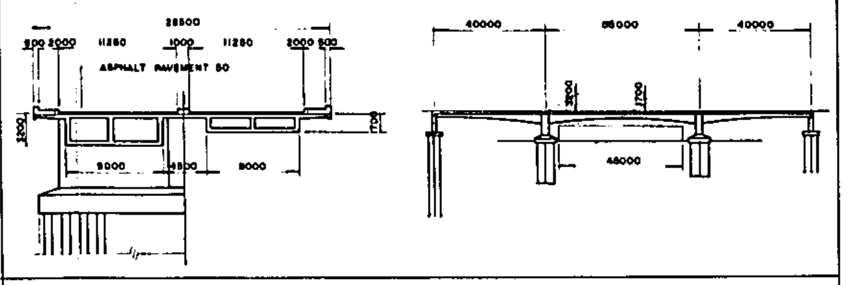
Pasig River Bridge on C-5

This bridge was designed just the same as Pasig River Bridge on C-3, except for the foundation. Namely, spread foundation was adopted for the pier on the Fort Bonifacio side where the ground is sound, and steel pipe pile foundation for the other substructures.

3.5.6 Miscellaneous Works

Pavement marking, signals on eight main intersections, lighting facilities at 50-meter intervals, traffic signs, gird rails along embankment portions and replacement of electric poles with high voltage near Shaw Boulevard (C-3) and along Garcia Street (R-4) were considered as miscellaneous works.

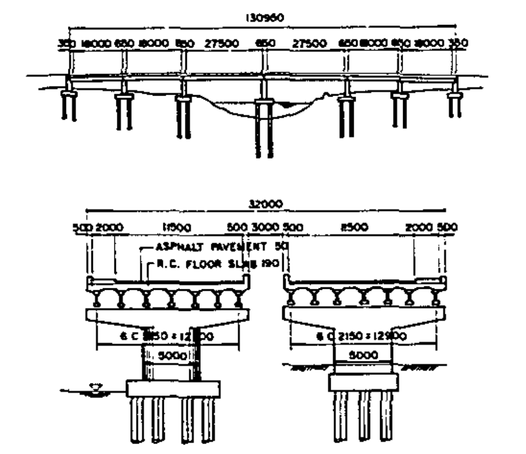
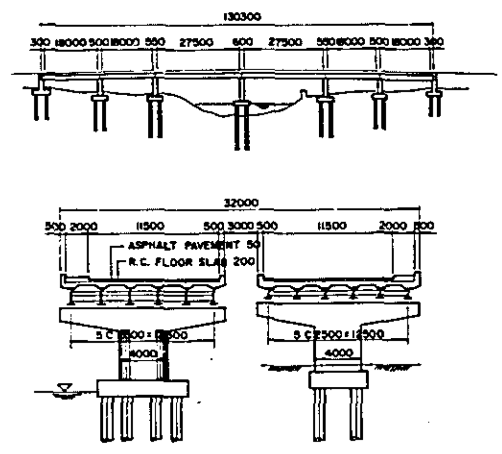
COMPARATIVE ANALYSIS OF BRIDGE TYPE OVER PASIG RIVER ALONG C-3

TYPE OF BRIDGE	3-SPAN CONTINUOUS STEEL PLATE GIRDER	3-SPAN CONTINUOUS STEEL BOX GIRDER	3-SPAN PRESTRESSED CONCRETE BOX GIRDER
TYPICAL CROSS SECTION AND SIDE VIEW			
APPROXIMATE METERIALS	SUPERSTRUCTURE STEEL WEIGHT 1,000 t REINFORCEMENT 200 t CONCRETE 995 m^3 PAVEMENT t = 5 cm. 3,040 m^2 t = 3 cm. 540 m^2 HANDRAIL 270 m. SUBSTRUCTURE CONCRETE 1,400 m^3 REINFORCEMENT 110 t STEEL PIPE PILE 940 m (φ 609.6) 812 m (φ 812)	SUPERSTRUCTURE STEEL WEIGHT 1,040 t REINFORCEMENT 235 t CONCRETE 1,165 m^3 PAVEMENT t = 5 cm. 3,040 m^2 t = 3 cm. 540 m^2 HANDRAIL 270 m. SUBSTRUCTURE CONCRETE 1,275 m^3 REINFORCEMENT 105 t STEEL PIPE PILE 940 m (φ 609.6) 790 m (φ 812)	SUPERSTRUCTURE CONCRETE 2,600 m^3 P. C. ROD 210 t REINFORCEMENT 165 t PAVEMENT t = 5cm. 3,040 m^2 t = 3cm. 540 m^2 HANDRAIL 270 m. SUBSTRUCTURE CONCRETE 2,085 m^3 REINFORCEMENT 165 t STEEL PIPE PILE 950 m (φ 609.6) 1,795 m (φ 812)
APPROXIMATE CONSTRUCTION COST (UNIT IN PESO)	SUPERSTRUCTURE 24,830,000 SUBSTRUCTURE 4,680,000 T O T A L 29,500,000 ◎	SUPERSTRUCTURE 26,100,000 SUBSTRUCTURE 4,300,000 T O T A L 30,400,000 ○	SUPERSTRUCTURE 23,980,000 SUBSTRUCTURE 8,400,000 T O T A L 32,380,000 △
PRACTICABILITY OF ERECTION	EASIER ERECTION SHORT CONSTRUCTION PERIOD ○	EASIER ERECTION SHORT CONSTRUCTION PERIOD ◎	CANTILER ERECTION METHOD IS RECOMMENDED, BUT COMPARING IT TO THE STEEL BRIDGE, HIGHER LEVEL CONSTRUCTION AND SUPERVISORY TECHNOLOGY WILL BE NEEDED AND A MUCH LONGER PERIOD FOR CONSTRUCTION. △
MAINTENANCE	MANY MINOR STRUCTURE MEMBERS ARE NEEDED AND THE AREA TO BE PAINTED IS MORE THAN THAT OF BOX-GIRDER-TYPE. THE DISCOUNTED MAINTENANCE FOR PAINTING IN 25 YEARS IS ₱1,755,000 BASED ON ASSUMED DISCOUNT RATE OF 15 % △	THE DISCOUNTED MAINTENANCE FOR PAINTING IN 25 YEARS IS ₱1503,000 BASED ON ASSUMED DISCOUNT RATE OF 15 % ◎	MAINTENANCE COST IS NEGLIGIBLE BUT REPAIR IS DIFFICULT. ◎
AESTHETICS	○	○	◎
NOTES	THREE SPAN CONTINUOUS STEEL BOX GIRDER BRIDGE IS RECOMMENDED BECAUSE OF FOLLOWING REASONS; 1. THE DIFFERENCES IN COST ARE INSIGNIFICANTLY SMALL. 2. EASIER ERECTION WORK THAN OTHERS. 3. SMALLER SHAPE OF SUBSTRUCTURE THAN OTHERS.		

◎ EXCELLENT
○ GOOD
△ FAIR

COMPARATIVE ANALYSIS OF BRIDGE TYPE OVER PASIG RIVER ALONG C-3 — FIGURE 3.5-9

COMPARATIVE ANALYSIS OF BRIDGE TYPE OVER SAN JUAN RIVER ALONG C-3

TYPE OF BRIDGE	SIMPLE PRESTRESSED CONCRETE COMPOSITE GIRDER	SIMPLE STEEL COMPOSITE GIRDER AND SIMPLE STEEL COMPOSITE H-BEAM
PROFILE AND TYPICAL CROSS SECTION		
APPROXIMATE MATERIALS	**SUPERSTRUCTURE** P.C. GIRDER L = 18 m. n = 56 L = 27.5 m. n = 28 CONCRETE 860 m^3 REINFORCEMENT 170 t PAVEMENT t = 5cm. 3012 m^2 t = 3cm. 524 m^2 HANDRAIL 524 m **SUBSTRUCTURE** CONCRETE 2150 m^3 REINFORCEMENT 132 t PILE 908 m.	**SUPERSTRUCTURE** STEEL 215 t STEEL - H-BEAM 220 t CONCRETE 880 m^3 REINFORCEMENT 175 t PAVEMENT t = 5 cm. 2997 m^2 t = 3cm. 522 m^2 HANDRAIL 522 m **SUBSTRUCTURE** CONCRETE 1810 m^3 REINFORCEMENT 110 t PILE 820 m.
APPROXIMATE CONSTRUCTION COST (UNIT IN PESO)	SUPERSTRUCTURE 6,266,000 SUBSTRUCTURE 3,865,000 T O T A L 10,131,000 ◎	SUPERSTRUCTURE 9,141,000 SUBSTRUCTURE 3,377,000 T O T A L 12,518,000 ○
PRACTICABILITY OF ERECTION	EASY ERECTION CONSTRUCTION PERIOD WILL BE LONGER THAN THAT OF THE STEEL - GIRDER - TYPE. ○	EASY ERECTION SHORTER CONSTRUCTION PERIOD. ◎
MAINTENANCE	PAINTING IS NOT NEEDED. ◎	PAINTING IS NEEDED. ○
AESTHETICS	ALLMOST THE SAME AS STEEL - GIRDER - TYPE. ○	ALLMOST THE SAME AS PRESTRESSED CONCRETE GIRDER TYPE. ○
NOTES	SIMPLE PRESTRESSED CONCRETE COMPOSITE GIRDER IS RECOMMENDED FROM ECONOMIC VIEW POINT INCLUDING MAINTENANCE, HOWEVER, THIS TYPE CAN BE CHANGED TO STEEL COMPOSITE GIRDER TYPE, CONSIDERING CONSTRUCTION SCHEDULE.	

NOTATIONS
◎ EXCELLENT
○ GOOD
△ FAIR

COMPARATIVE ANALYSIS OF BRIDGE TYPE OVER SAN JUAN RIVER ALONG C-3	FIGURE 3.5-10

3.6 ENVIRONMENTAL CONSIDERATIONS

3.6.1 Establishment of Indicators and Preliminary Analysis

According to the Draft Guidelines for the Preparation of Environmental Impact Statements prepared by the National Environmental Protection Council in August 1977, the term "environment" is defined as man's surroundings inclusive of all physical, economical, historical, institutional, aesthetic, cultural and social conditions existing within the area which will be affected by the proposed project. Therefore, environmental indicators were established as follows in this feasibility study and they were classified into two categories, of which one is physical and the other is social and economical:

a. Physical Indicators

   * Biology and ecology (flora, fauna and aquatic)
   * Topography and geology (land shape and soil condition)
   * Hydrography (drainage, underground water and floods)
   * Meteorology (climate and weather)
   * Traffic nuisance (noise, air pollution, vibration and other nuisance factors)
   * Traffic accident
   * Construction nuisance

b. Social and Economical Indicators

   * Transport mobility and accessibility
   * Land use potentiality
   * Population distribution
   * Tourism and recreation
   * Historical and cultural sites
   * Urban renewal and townscape
   * Community cohesion
   * People displacement
   * Employment opportunities
   * Agricultural and industrial production
   * Land price
   * Prices of commodities

The following components were also established and taken into consideration in this analysis.

1. Project Roads (see Fig. 3.6-1)

   * Southern part of C-3
   * Northern part of C-3
   * R-4 and related roads

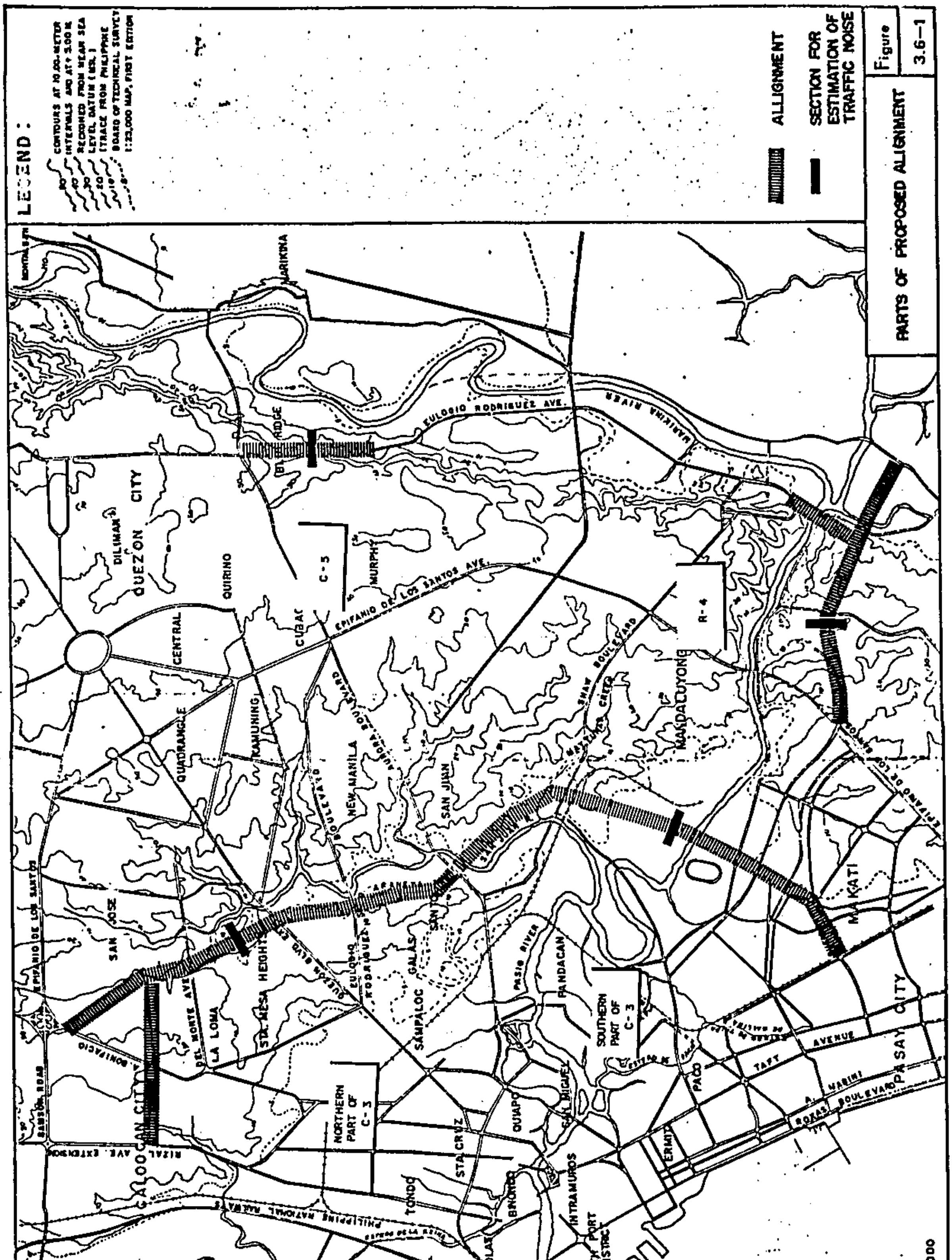


Figure 3.6-1 PARTS OF PROPOSED ALIGNMENT

2. Affected Area

   * Corridor of the project roads

   * MMA

3. During and After Construction

   * During construction

   * After construction

The preliminary qualitative analysis for the reasonably foreseeable effects of the project roads on the above environmental indicators was carried out and the foreseeable magnitude matrix composed of environmental indicators and individual components was obtained as shown in Table 3.6-1. In this analysis, the magnitude was classified into five grades (see the index of Table 3.6-1).

The result of this preliminary analysis shows that a high degree of favorable effects will be brought about on transport mobility and accessibility, land use potentiality, urban renewal and town scape, community cohesion and land price and a high degree of adverse effects on traffic nuisance, construction nuisance and displacement.

These foreseeable high effects are discussed in detail in the following sections.

3.6.2 Favorable Effects

Favorable effects that the magnitude will get to high level are discussed in detail in this section.

Transport Mobility and Accessibility

The circular routes along the alignments of C-3 and C-5 are not completely established at present. The project roads will make circular pass possible and greatly enhance and strengthen the function of the road network system in the MMA.

Moreover, establishment of the project roads will improve traffic service within their surrounding area, and reduce traffic congestion within C.B.D. Accordingly, transport mobility and accessibility of the corridor along the project roads will be improved because of reduction of travel and traffic cost.

Furthermore, improvement of mobility and accessibility will enhance land use potentiality and land value because the value of the location is increased with increase in mobility and accessibility.

Land Use Potentiality

Land use potentiality in the surrounding area of the project roads, especially C-3, will be greatly enhanced. Fig. 3.6-2 indicates difference between land use along major thoroughfares and that not. The corridor of the project roads will be progressively

Table 3.6-1 MAGNITUDE MATRIX

✚ ---- high-degree favorable effect
\+ ---- low-degree " "
---- no change
− ---- low adverse effect
▭ ---- high " "

Category	Environmental indicator	Effects on corridor						Effects on MMA					
		During construction			After construction			During construction			After construction		
		C-3 S	C-3 N	R-4	C-3 S	C-3 N	R-4	C-3 S	C-3 N	R-4	C-3 S	C-3 N	R-4
Physical	Biology and ecology			−									
	Topography and geology												
	Hydrography	−	−										
	Meteorology												
	Traffic nuisance				▭	▭	−						
	Traffic accident				−	−	−						
	Construction nuisance	▭	−	−									
Social and economical	Transport mobility and accessibility				✚	✚	✚				✚	✚	✚
	Land use potentiality				✚	✚	+				✚	✚	✚
	Population distribution				+	+	+				+	+	+
	Tourism and recreation												
	Historical and cultural sites												
	Urban renewal and townscape				✚	+	+						
	Community cohesion	−		−		+					✚	✚	✚
	People displacement	▭	−	−									
	Employment opportunities				+	+	+	+	+	+			
	Agricultural and industrial production												
	Land price				✚	✚	+						
	Prices of commodities												

Notes: S - Southern part
N - Northern part

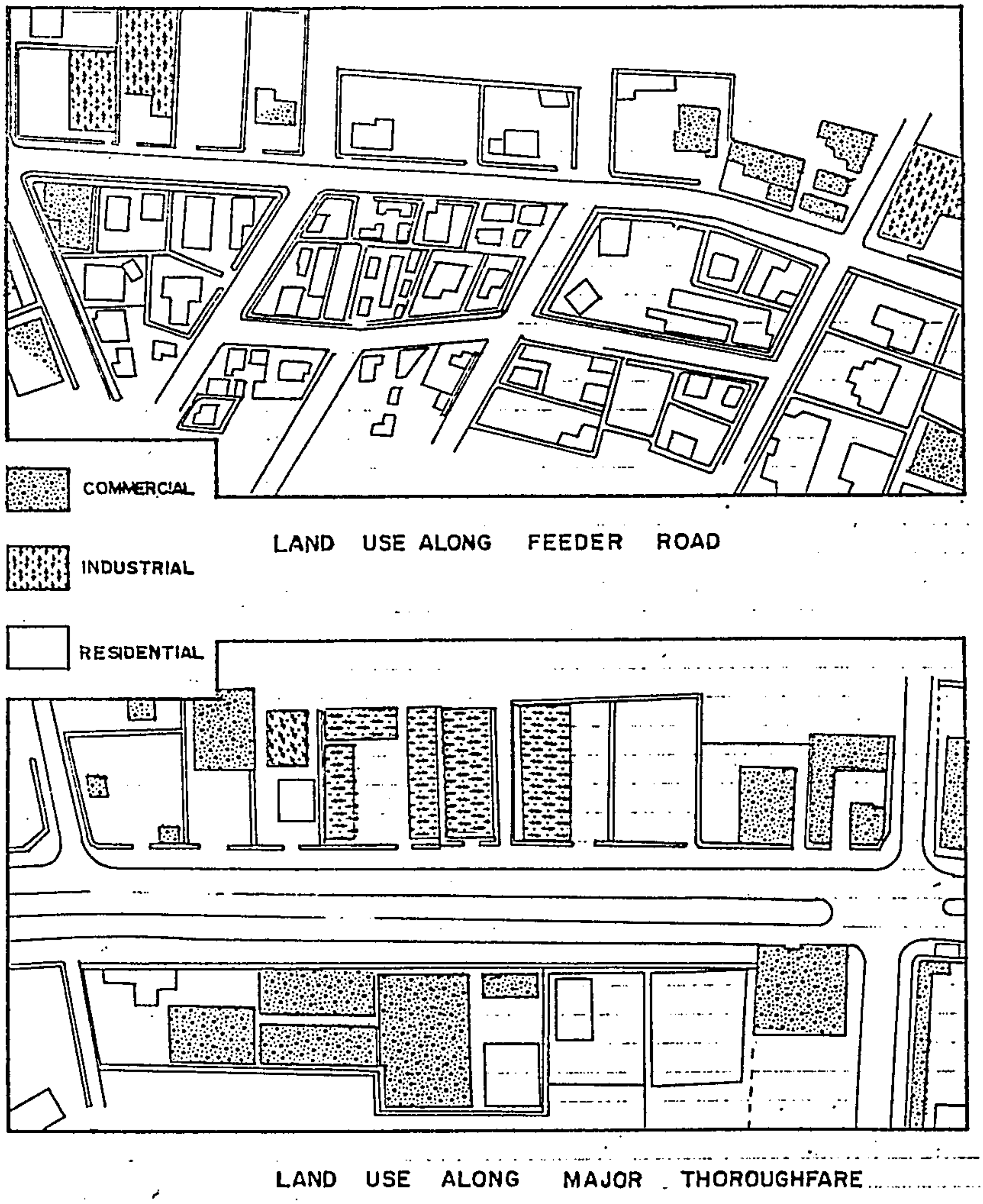


FIGURE 3.6—2

EFFECT OF MAJOR THOROUGHFARE ON LAND USE developed by high development potentials, such as commercial activities with the enhancement of land use potentiality.

Urban Renewal and Townscape

Roads are a very important component in forming townscape. Establishment of the project roads will not only handle the expected traffic in the area but will also change the townscape to comfortable and acceptable human environments as shown in Fig. 3.6-3. Moreover, existence of open space along a tree-lined street will relieve a person from his high-tension living in metropolitan such as Manila and it will play an important part in saving the city from disaster such as fire.

Community Cohesion

At first, existing community cohesion will be reduced by appearance of the project roads in the southern part of C-3. However, immediate growth of new community will be promoted by the Government and inhabitants in the area and establishment of new community will, moreover, hasten realization of the comfortable and adequate area.

Land Price

As already mentioned, the improvement in accessibility will reasonably induce enhancement in land use potentiality. It means the increase in development demand due to favorable condition of location, and thus the increase in land value in the surrounding area of the project roads. Fig. 3.6-4 shows the relationship between accessibility and land value. This figure indicates that land value will be enhanced with increase in accessibility.

3.6.3 Measures for Improved Environmental Quality

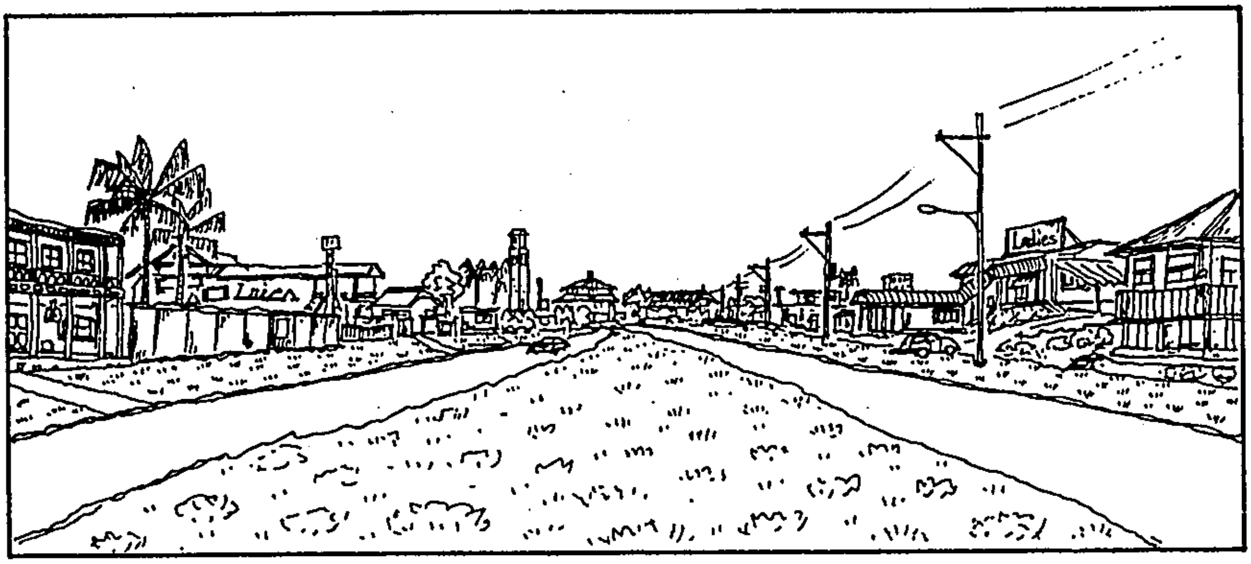
Measures for improved environmental quality against adverse effects are discussed in this section.

Effects on Biological, Ecological and Hydrographical Conditions

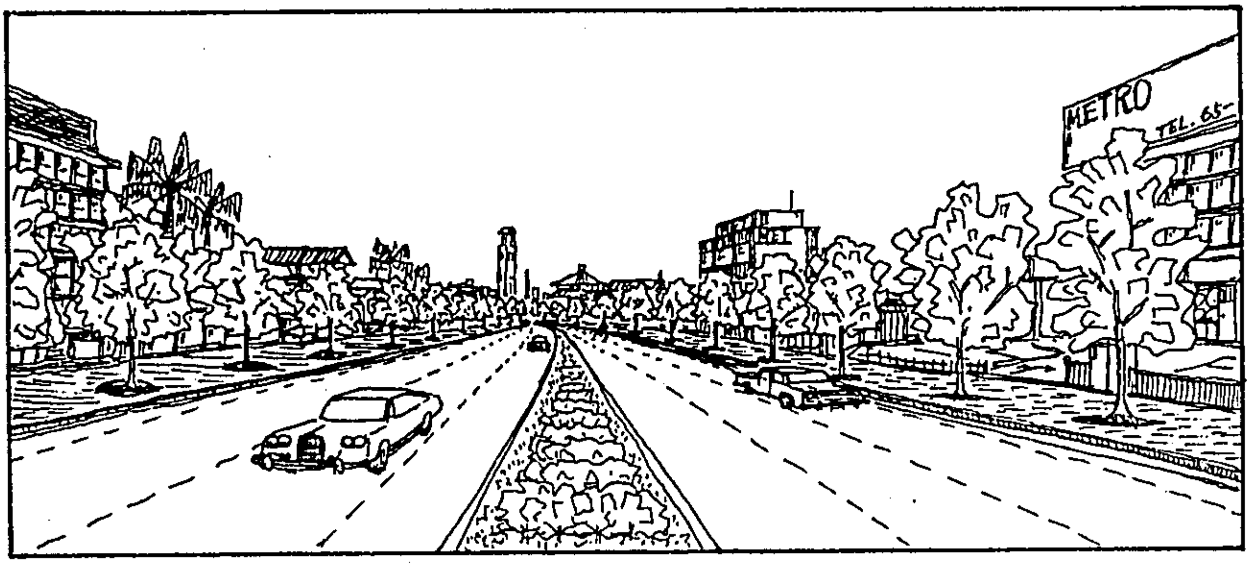
There will be no particular effect on the topographical, geological and meteorological conditions. This is due to the fact that the surrounding area of the project roads have already been developed and established as an urban district. Establishment of C-3 will, however, change the existing surface drainage pattern, and the cut and embankment along R-4 will slightly affect biological and ecological conditions of the surrounding area.

(Measures)

Sufficient investigations on biological, ecological and hydrographical conditions should be carried out to prepare the acceptable construction methods that will minimize adverse effects. Careful measures should also be provided against hydrographical problems in the flood area such as Mandaluyong.



BEFORE IMPROVEMENT



AFTER IMPROVEMENT

Figure 3.6—3

CHANGE OF TOWNSCAPE

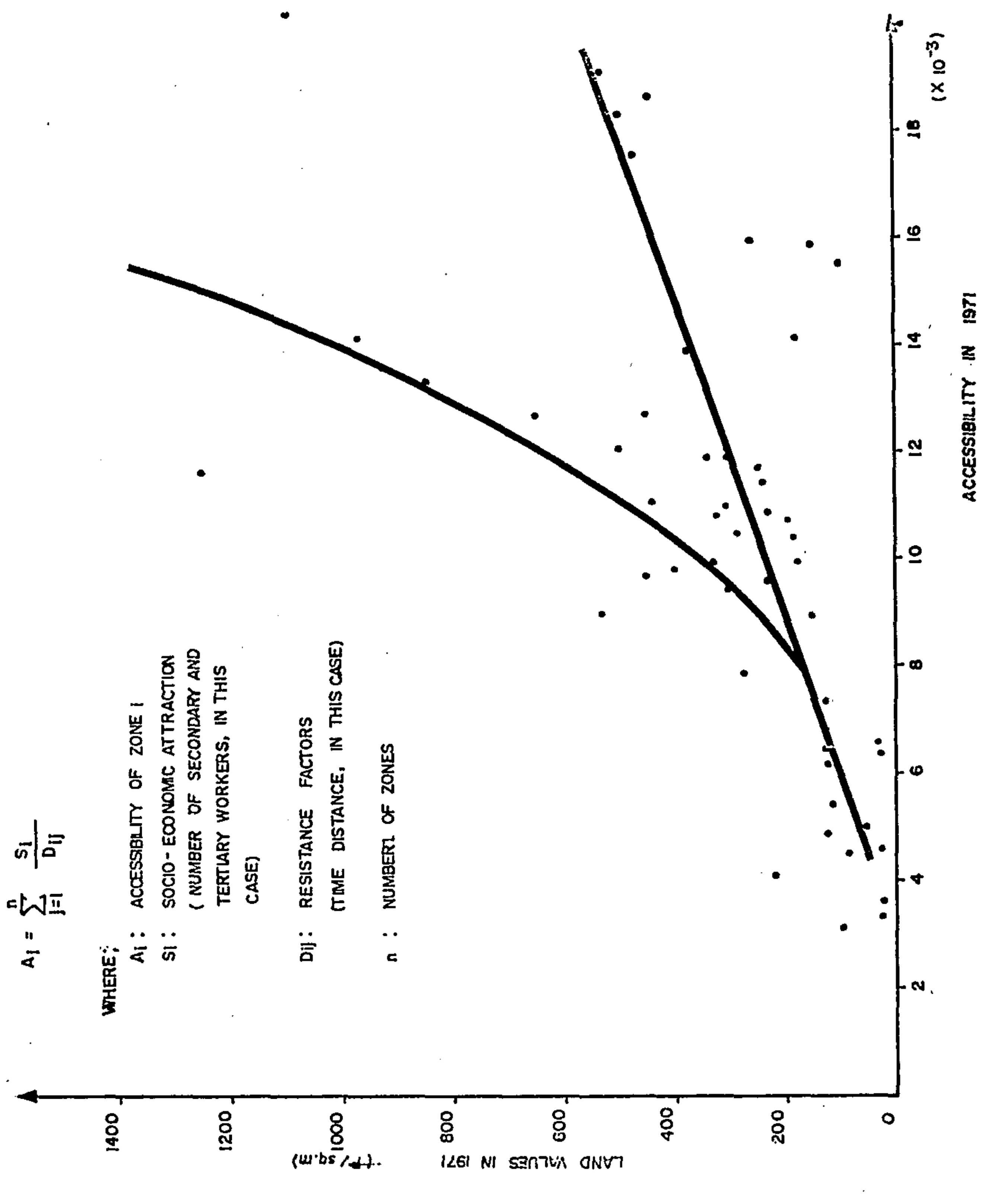


Figure 3.6–4

RELATIONSHIP BETWEEN LAND VALUES AND ACCESSIBILITY

Traffic Nuisance

The surrounding communities will be constantly inconvenienced by noise, air pollution, vibration, and other nuisances caused by the project roads in the surrounding area of the southern part of C-3 and R-4 and related roads and by the increase in traffic volume on the project roads in the northern part of C-3. Noise level to be caused by estimated future traffic volume was forecast with the result that the noises would have adverse influence upon the surrounding communities.

(Measures)

However traffic nuisance cannot completely be shut out for the time being, and the adequate measures such as tree planting on the sidewalk and median strip should be provided effectively both in dimension and layout, especially in residential area and near hospital and school. Therefore, 6.5-meter sidewalk and 4.0 meter median strip are proposed as basic requirements for the plan recommended in this report.

Construction Nuisance

The surrounding communities will be inconvenienced during construction, by noise, gas, fumes, dust and dirt caused by unstable and abnormal conditions incidental to construction activities. Moreover, the migratory workers to stay during construction will strain existing services and facilities, and aggravate public health in the area.

(Measures)

Nuisance and inconvenience during construction should be significantly reduced by introduction of proper construction management and supervision and adoption of proper construction equipments and methods. Against the latter problem, the Government and the contractors should collaborate in providing necessary services and facilities.

People Displacement

The existing residential developments along the proposed alignment will have to be removed in accordance with right-of-way acquisition of the project roads, so that the total number of approximately 1,800 families, inclusive of 200 families in squattered areas as shown in Table 3.6-2, will be displaced.

(Measures)

The displaced families will be sufficiently compensated by resettlement to proper area and/or adequate compensation. The squatter families affected by the project roads will be afforded better opportunities and improved quality of life in the resettlement projects of Government. The relocation of these squatters will be undertaken with close coordination with the NHA and other government agencies.

Table 3.6-2 Number of Displaced Families

	Squatter area	Other area	Total
Southern part of C-3	50	680	730
Northern part of C-3	140	300	440
R-4 and related roads	-	620	620
Total	190	1,600	1,790

CHAPTER 4 ESTIMATION OF THE PROJECT COSTS

4. ESTIMATION OF THE PROJECT COSTS

4.1 ESTIMATION OF RIGHT-OF-WAY ACQUISITION COSTS

4.1.1 Parcellary/Assessment Survey and its Analysis

The estimation of land and property acquisition cost was made on the basis of the result of the parcellary/assessment survey. In the absence of detailed alignment in the project during the conduct of the survey, a 100-meter strip was surveyed by the DPH with the coordination of the Barrio Captains and Barangay Leaders in the areas traversed by the project. A sample survey format used by the DPH is shown in Table 4.1-1. The result of the survey was reflected on a map scaled 1 to 2,000.

4.1.2 Right-of-Way to be Acquired

Land and properties are acquired by the Government with the permission of the owners. An area could be made ready for construction even in the absence of formal agreements between the two parties, if the owner is willing to extend his full cooperation in the prosecution of the project. When the owner manifests cooperation, field personnel advise him on the proposed right-of-way limits and stake this out on the ground. For lots that have been totally affected, a certification to that effect is submitted by the project engineer or project surveyor or any authorized government representative, so that the property owner could claim a cancellation of ownership from the land tax office.

After the establishment of the final alignment, improvements will be undertaken to determine the right-of-way acquisition cost.

4.1.3 Right-of-Way Acquisition Cost

The basis of compensation for land and property affected by road construction is the minimum of the following two figures:

1. The fair market value determined by the city or provincial assessor; and

2. The value declared by the owner or administrator.

The latest assessments were done in 1974 and the value stays constant until the next revision, scheduled for 1978. The value declared by the owner or administrator is that sworn under PD 76 or PD 464.

4.1.4 Range of Unit Cost

The range of acquisition cost is summarized as follows:

Land	: ₱100-1,000	per sq. meter
Multi-storey R.C. Building	: ₱600-1,500	per sq. meter
Simple storey concrete Building	: ₱400-900	per sq. meter

Table 4.1-1 EXAMPLE OF ASSESSMENT SURVEY REPORT

ROUTE: C-3

STARTING POINT: J. WRIGHT TO VALENZUELA-E. FERNANDEZ

BLOCK NO. & LOT NO.	INDEX NO.	LAND USE	LAND AREA (SM)	LAND COST	BLDG. USE	NO. OF STORIES	CONS-TRUCT-ION TYPE	AREA	OTHER IM-PRVT.COST	BLDG.COST	TOTAL COST	REMARKS
BLK #17	231	R	194	38,820	R	2	M	170		25,000	63,820	
"	233	R	504	126,000	R	2	M	88		24,000	150,000	3 houses
"	233-A	R	990	198,000	R	2	M & W	293		158,300	356,300	13 houses
"	235	R	226	45,280	R & C	2	M	58		30,000	75,280	
"	237	R	994	198,800	R & C	2	M	81	3,500	32,450	234,750	
"	239	R	528	185,608	R & C	2	M	397	117,683	220,000	523,283	
"	241	C	237	47,400	R	2	M	72		45,000	92,400	
"	243	R	1,096	219,200	R & C	1	M	200		284,600	503,800	
"	245	R	740	207,200	R	2	M	256		125,491	332,691	
"	247	R	630	176,400	R	2	M	160		78,432	254,832	
"	249	R & C	908	181,600	R & C	2	M	350	9,500	140,500	331,100	2 houses
"	251	R	1,104	276,000	R	1 & 2	M	96		150,000	426,000	2 houses
"	253	R	180	50,400	R	2	C	169		82,843	133,243	

REFERENCE INDEX MAP NO. C-3 Sheet No. 2-A

Wooden structure	:	₱150-550	per sq. meter
Temporary structure	:	₱ 60-180	per sq. meter

4.1.5 Right-of-Way Acquisition Procedure

Private land and properties affected by government infrastructure projects are compensated for by the implementing agency. The DPH, as the implementing agency for the C-3 and R-4 project, will compensate these land and properties.

The names and technical description of the affected property owners, including the assessed values of their properties, are usually obtained by the DPH at the project planning stage. Once the decision is taken to proceed with the project, the DPH sends a formal notice notifying the owner concerned of the government's intention to acquire his property or a portion of it for road purposes.

The property owner is then requested to submit the following documents:

- a certified true copy of the tax declaration of real properties of the assessors showing the market value of the property;
- a certified true copy of the owner's sworn statement or in the event of its non-availability, a certification from the assessor that the owner did not file any as required in PD 76/PD 464;
- a true copy of his original or transfer certificate of title; and
- a tax clearance or evidence that the owner had paid his real estate taxes on the property.

A written agreement will be made between the owner and the government with the condition that the government will pay in advance 50 per cent of the value of the affected improvements upon the approval of the contract. The owner may start the demolition of his property as soon as the contract is approved if he can provide the funds for this from his personal resources. The remaining 50 per cent will be paid upon the complete demolition of the affected structures and upon the approval of the Inspection Report attached with original approved contract by the authorized representative. All materials salvaged from the property become the legal property of the owner. The DPH, however, in line with the policy of the Commission on Audit, deducts a percentage from the market value of these salvable materials.

For lot owners who desire a new title for the remaining portion of their affected original lot, a private land surveyor may be commissioned to undertake the formal sub-division survey. All survey expenses advances by the owner are reimbursed by the government.

When the owner is unwilling to let the DPH enter his property, the DPH is constrained to file expropriation proceedings in accordance with the provision of PD 42. This is done when the project has high priority and may be unduly delayed by lack of cooperation on the part of the owners. A request is trasmitted to the Solicitor General to institute expropriation proceedings and assist the DPH in the right-of-way acquisition. A complaint for eminent domain is then filed with the Court of First Instance and the DPH deposits the assessed value of the property with the Philippine National Bank, subject to the disposition of the Court. The DPH then issues a final notice to the owner stating that an expropriation case has been filed against him and that the required deposits had been made with the PNB. This notice states the date of entry into his property after a reasonable period which allows the owner time to vacate the premises. The affected structures are removed by demolition gangs and the costs charged to the owner at the appropriate time. The owner then has to make representations to the court regarding the value of his demolished property and of the land acquired by the Government. By that time, the DPH will have entered his property and have started road construction.

Trees, plants or agricultural crops destroyed during the clearing operations are paid for providing that they are covered by special assessment by the assessor.

4.1.6 Possibility of Adopting the Stage Acquisition of Right-of-Way

The possibility of the stage acquisition of right-of-way was discussed with reference to the parcellary/assessment survey data and the procedure of right-of-way acquisition. It was concluded that the staging scheme for right-of-way acquisition cannot be adopted because the acquisition of additional right-of-way in a few years to come will involve difficulties as follows:

1. The value of land along the project roads will be raised by the construction of said routes and its subsequent opening to traffic. This will induce a heavy investment along the roads and would impose high acquisition cost for additional right-of-way.

2. The construction of the project roads will drastically change the physical condition in the area which will tend to settle down after the completion. However, the succeeding construction for widening would foul up the environmental condition.

4.2 CONSTRUCTION COST

4.2.1 General

Cost estimates were carried out based on 1977 prices. Direct construction costs include costs of labor, equipment, material and other necessary items. The total construction cost was estimated based on direct cost and allocations including contingency, overhead and profit of contractor, engineering and supervisory expenses and contractor's tax. These are shown on Table 4.2-1.

The cost was broken down into foreign and local components. The latter was further divided into two categories of tax and others.

Table 4.2-1 Allocation of Overhead and Others

ITEM	Share by Component (%)		
	Foreign	Local	Tax
Overhead (10%)	0	90	10
Profit (10%)	0	90	10
Contractor's tax (3%)	0	0	100
Contingency (5%)	Depends on the component of direct cost and above 3 items		
Engineering and Supervisory fee (8%)	50	44	6
Total (41.33%)			

4.2.2 Prices of Materials and Wages

Table 4.2-2 presents wages and the prices of main materials which were planned to be used in road construction. The analysis of these price components was largely based on the reference "Price Analysis" which was reported by NORCONSULT A.S. for the second IBRD Highway Project in 1973 and considered rapid price escalation brought by the oil crisis.

Fabricated structural steel and steel pipe were assumed to be imported but exempted from customs duty.

Table 4.2-2 Costs of Major Materials and Wages

Item	Unit	Unit Price (pesos)	Component (%)		
			Foreign	Local	Tax
Portland cement	t	412.5	50	35	15
Sand	m^3	55.0	57	29	14
Gravel	m^3	65.0	57	29	14
Borrow material	m^3	24.5	57	29	14
Base course material	m^3	51.0	57	29	14
Ready mixed concrete (3000 psi)	m^3	244.5	53	32	15
Reinforcing steel bar	t	3,850	76	6	18
High tension strand	t	9,500	76	10	14
Fabricated steel of box girder	t	14,000	93	1	6
Fabricated steel of H-beam	t	7,500	92	2	6
Steel pipe pile	t	3,500	90	4	6
Asphalt cement	t	1,100	67	16	17
Emulsified asphalt	t	1,300	67	16	17
Gasoline	liter	1.7	60	20	20
Lumber	bd.ft.	2.0	46	46	8
Labor Cost:					
Foreman	day	26	0	100	0
Equipment operator	day	21	0	100	0
Skilled labor	day	21	0	100	0
Labor	day	16	0	100	0

4.2.3 Hourly Rate of Equipment

Hourly rates of equipment applied to the estimation of costs were set up based on CIF prices which were surveyed during the study period. Hourly rates include depreciation of equipment, maintenance expenses, spare parts and consumption expenses like fuel and lubricating oil. The life time of equipment was assumed to be the same as that described in the reference mentioned above.

4.2.4 Construction Cost

Five plans were considered as alternatives for C-3 route (see sub-section 3.5.2). On the other hand, 4-lane road and 6-lane road were proposed for R-4 route and C-5 route, respectively.

Construction costs were calculated based on the estimated work quantities shown on Tables 4.2-3 and 4.2-4 and summarized by route and segment on Tables 4.2-5 to 4.2-9. Table 4.2-10 shows the costs for grade separations at major intersections.

For C-3, plan 3 is finally proposed after the economic evaluation. Total construction cost of this plan is ₱341 million, excluding the construction costs for grade separations. Right-of-way acquisition cost accounts for a substantial part of the total cost, about 46 per cent, while the costs of road and structure construction represent about 38 and 16 per cent, respectively. Foreign currency is about ₱88 million equivalent to 26 per cent of total cost, and about one-third of foreign currency allotment is necessary for the construction of Pasig River and San Juan River bridges.

TABLE 4.2-3 QUANTITIES OF PRINCIPAL WORK ITEMS (C-3 ROUTE, PLAN - 3)

ITEM	UNIT	SEGMENT 1	SEGMENT 2	SEGMENT 3	SEGMENT 4	SEGMENT 5	SEGMENT 6	SEGMENT 7	SEGMENT 8	SEGMENT 9	SEGMENT 10	TOTAL
R-O-W WIDTH	m	31	40	40	40	40	35-40	35-40	30	30	30	
LENGTH	km	0.975	1.190	1.780	0.885	2.085	2.703	2.042	1.315	1.100	1.405	15.480
REMOVAL OF EXISTING PAVEMENT	m^2	—	10840	13371	2320	11175	36570	30630	19725	4576	7260	136467
EXCAVATION (SOIL)	m^3	—	23995	56604	5990	96344	52125	58593	20129	26784	17172	357826
EXCAVATION (ADOBE)	m^3	—	—	—	31300	—	—	—	—	—	—	31300
EMBANKMENT	m^3	—	5358	65646	—	96505	—	—	—	17906	4991	190406
SUBGRADE PREPARATION	m^2	—	41933	63813	30858	68065	104165	66672	32380	27275	34585	469746
SUB-BASE COURSE	m^3	—	5372	8985	3238	8532	14299	10067	3846	3255	4107	61701
BASE COURSE	m^3	—	6879	10874	3121	11072	10417	11701	5161	4355	3932	67512
CONCRETE PAVEMENT	m^3	—	7685	12222	5602	12353	19711	13211	5738	4843	6128	87493
L-TYPE CURB AND GUTTER	m	—	2380	3108	1770	3908	5942	4508	2630	2200	2810	29256
CONCRETE CURB	m	—	2369	3435	1770	3908	5942	4508	2630	2200	2810	29572
DRAIN PIPE (φ 12")	m	—	160	—	—	—	471	1459	70	—	446	2606
DRAIN PIPE (φ 18")	m	—	650	470	370	644	2450	580	500	466	928	7058
DRAIN PIPE (φ 24")	m	—	1730	308	1400	740	1956	464	1340	1150	800	9888
DRAIN PIPE (φ 36")	m	—	—	2284	—	1480	800	—	720	590	400	6284
DRAIN PIPE (φ 48")	m	—	—	—	—	860	45	—	—	—	700	1605
CATCH BASIN	unit	—	96	138	70	156	238	180	106	88	112	1184
MANHOLE (φ 1.2 m.)	unit	—	47	20	36	37	90	20	38	34	36	358
MANHOLE (φ 1.8 m.)	unit	—	—	45	—	48	16	—	14	12	22	157
GUARD RAIL	m	—	152	642	—	—	466	2904	—	—	—	4164
LIGHTING FACILITIES	unit	—	52	62	38	83	117	90	55	48	57	602
TRAFFIC SIGN	unit	—	2	6	2	12	8	8	2	4	2	46
PAVEMENT MARKING	m	—	10717	14405	8955	22275	25633	19482	10985	11360	10615	134427
PLANTING FOR MEDIAN	m^2	—	3486	5032	3215	7074	10080	3018	5098	4075	5458	46536
MASONRY (0-2 m. high)	m	—	2590	390	290	2590	120	100	—	—	750	6830
RETAINING WALL (2-4 m. high)	m	—	160	170	320	160	200	120	—	300	—	1430
RETAINING WALL (4-7 m. high)	m	—	—	—	—	—	146	134	—	—	—	280
RETAINING WALL With pile (4-7 m. high)	m	—	—	70	—	—	—	—	—	—	—	70
TRAFFIC SIGNAL	unit	—	1	—	1	1	1	1	1	1	1	8
TRANSFER OF ELECTRIC POLES WITH HIGH VOLTAGE	unit	—	—	—	—	1	—	—	—	—	—	1

TABLE 4.2-4 QUANTITIES OF PRINCIPAL WORK ITEMS (R-4 AND RELATED ROADS)

ITEM	UNIT	SEGMENT 11	SEGMENT 12	SEGMENT 13	TOTAL
R-O-W WIDTH	m	30	40	40	
LENGTH	km	4.738	0.690	1.820	7.248
REMOVAL OF EXISTING PAVEMENT	m^2	23,955	2,460	9,860	36,275
EXCAVATION (SOIL)	m^3	68,363	3,276	118,109	189,748
EXCAVATION (ADOBE)	m^3	16,102	10,461	—	26,563
EMBANKMENT	m^3	15,129	16,572	24,825	56,526
SUBGRADE PREPARATION	m^2	92,864	12,787	62,790	168,441
SUB-BASE COURSE	m^3	11,059	1,545	7,826	20,430
BASE COURSE	m^3	10,874	1,734	10,192	22,800
CONCRETE PAVEMENT	m^3	16,475	2,283	11,366	30,124
L-TYPE CURB AND GUTTER	m	7,515	1,842	3,640	12,997
COCRETE CURB	m	7,515	1,842	3,640	12,997
DRAIN PIPE (Φ 12")	m	500	—	—	500
DRAIN PIPE (Φ 18")	m	4,790	—	1,380	6,170
DRAIN PIPE (Φ 24")	m	2,296	660	2,300	5,256
DRAIN PIPE (Φ 36")	m	—	520	80	600
DRAIN PIPE (Φ 48")	m	—	—	—	—
CATCH BASIN	unit	300	34	146	480
MANHOLE (Φ 1.2 m)	unit	149	12	72	233
MANHOLE (Φ 1.8 m)	unit	—	10	—	10
GUARD RAIL	m	419	372	82	873
LIGHTING FACILITIES	unit	162	19	77	258
TRAFFIC SIGN	unit	12	4	4	20
PAVEMENT MARKING	m	28,139	4,888	15,860	48,887
PLANTING FOR MEDIAN	m^2	14,922	1,220	6,956	23,098
MASONRY (0-2 m high)	m	1,798	240	1,277	3,315
RETAINING WALL (2-4 m high)	m	168	50	319	537
RETAINING WALL (4-7 m high)	m	480	—	968	1,448
RETAINING WALL WITH PILE (2-4 m high)	m	191	82	—	273
TRAFFIC SIGNAL	unit	4	—	1	5
TRANSFE OF ELECTRIC POLES WITH HIGH VOLTAGE		1	—	—	1

Table 4.2-5 Construction Cost (C-3 Route, Plan-1)

(Unit: ₱ 1,000)

Segment No.	R-O-W Width (m)	Length (km)	Land Acquisition Local	Property Acquisition Local	Road Construction Foreign	Road Construction Local	Road Construction Tax	Road Construction Total	Structure Construction Foreign	Structure Construction Local	Structure Construction Tax	Structure Construction Total	Remarks	Total Cost Foreign	Total Cost Local	Total Cost Tax	Total Cost Total
1	31	0.975	0	0	0	0	0	0	0	0	0	0	Extension Of Box Culvert (On Buendia Avenue)	0	0	0	0
2	30	1.190	5,740	7,742	3,314	3,492	1,125	7,931	0	0	0	0	Extension Of Box Culvert (On Ayala Avenue)	3,314	16,974	1,125	21,413
3	30	1.780	7,400	8,425	7,333	7,073	2,427	16,833	21,769	8,255	3,622	33,646	Pasig River Bridge	29,873	31,764	6,282	67,919
									771	611	233	1,615	Buhangin River Bridge				
4	30	0.885	5,550	7,114	2,803	2,801	941	6,545						2,803	15,465	941	19,209
5	30	2 085	11.740	18,567	8,744	8,621	2,879	20,244	721	571	219	1,511	Creek Bridge On North Side Of Shaw Blvd	13,571	42,724	4,329	60,624
									55	53	18	126	Box Culvert On South Side Of N.Domingo				
									4,051	3,172	1,213	8,436	San Juan River Bridge				
6	35-40	2.703	60	150	7,476	7,329	2,546	17,351						7,476	7,539	2,546	17,561
7	35-40	2.042	240	100	5,611	5,195	1,883	12,689						5,611	5,535	1,883	13,029
8	30	1.315	4,510	10,476	3,550	3,566	1,207	8,323						3,550	18,552	1,207	23,309
9	30	1.100	5,270	14,895	3,798	3,786	1,282	8,866	213	181	69	463	Box Culvert On West Side Of La Loma Cemetery	4,011	24,132	1,351	29,494
10	30	1.405	8,680	16,789	3,871	4,029	1,322	9,222						3,871	29,498	1,322	34,691
Total	30	15.480	49,190	84,258	46,500	45,892	15,612	108,004	27,580	12,843	5,374	45,797		74,080	192,183	20,986	287,249

Prices In 1977

Table 4.2-6 Construction Cost (C-3 Route, Plan-2 or 3)

(Unit: ₱ 1,000)

Segment No.	R-O-W Width (m)	Length (km)	Land Acquisition Local	Property Acquisition Local	Road Construction Foreign	Road Construction Local	Road Construction Tax	Road Construction Total	Structure Construction Foreign	Structure Construction Local	Structure Construction Tax	Structure Construction Total	Structure Construction Remarks	Total Cost Foreign	Total Cost Local	Total Cost Tax	Total Cost Total
1	31	0.975	0	0	0	0	0	0	0	0	0	0	Extension Of Box Culvert (On Buendia Avenue)	0	0	0	0
2	40	1.190	7,650	10,326	4,481	4,525	1,520	10,526	97	83	32	212	Extension Of Box Culvert (On Ayala Avenue)	4,578	22,584	1,552	28,714
3	40	1.780	9,870	11,237	9,079	8,617	3,018	20,714	25,611	9,712	4,261	39,584	Pasig River Bridge	35,597	40,154	7,554	83,305
									907	718	275	1,900	Buhangin River Bridge				
4	40	0.885	7,400	9,495	3,671	3,570	1,235	8,476						3,671	20,465	1,235	25,371
5	40	2.085	15,660	24,753	10,789	10,430	3,572	24,791	848	672	257	1,777	Creek Bridge On North Side Of Shaw Blvd	16,477	55,317	5,280	77,074
									74	70	24	168	Box Culvert On South Side Of N. Domingo				
									4,766	3,732	1,427	9,925	San Juan River Bridge				
6	35-40	2.703	120	310	9,345	9,161	3,182	21,688						9,345	9,591	3,182	22,118
7	35-40	2.042	480	210	7,014	6,494	2,353	15,861						7,014	7,184	2,353	16,551
8	30	1.315	4,510	10,476	3,550	3,566	1,207	8,323						3,550	18,552	1,207	23,309
9	30	1.100	5,270	14,895	3,798	3,786	1,282	8,866	213	181	69	463	Box Culvert On West Side Of La Loma Cemetery	4,011	24,132	1,351	29,494
10	30	1.405	8,680	16,789	3,871	4,029	1,322	9,222						3,871	29,498	1,322	34,691
Total		15.480	59,640	98,491	55,598	54,178	18,691	128,467	32,516	15,168	6,345	54,029		88,114	227,477	25,036	340,627

Prices In 1977

Table 4.2-7 Construction Cost (C-3 Route, Plan-4)

(Unit: ₱ 1,000)

Segment No.	R-O-W Width (m)	Length (km.)	Land Acquisition Local	Property Acquisition Local	Road Construction Foreign	Road Construction Local	Road Construction Tax	Road Construction Total	Structure Construction Foreign	Structure Construction Local	Structure Construction Tax	Structure Construction Total	Remarks	Total Cost Foreign	Total Cost Local	Total Cost Tax	Total Cost Total
1	50	0.975	12,800	217,100	4,526	4,453	1,538	10,517	110	93	35	238	Extension Of Box Culvert (On Buendia Avenue)	4,636	234,446	1,573	240,655
2	50	1.190	10,620	14,335	6,074	6,029	2,061	14,164	158	135	51	344	Extension Of Box Culvert (On Ayala Avenue)	6,232	31,119	2,112	39,463
3	50	1.780	12,590	14,335	11,974	11,293	3,990	27,257	32,013	12,140	5,326	49,479	Pasig River Bridge	45,102	51,242	9,654	105,998
									1,115	884	338	2,337	Buhangin River Bridge				
4	50	0.885	9,370	12,024	4,873	4,694	1,641	11,208						4,873	26,088	1,641	32,602
5	50	2.085	19,830	31,343	14,115	13,502	4,685	32,302	1,043	826	317	2,186	Creek Bridge On North Side Of Shaw Blvd	20,967	70,065	6,743	97,775
									90	85	29	204	Box Culvert On South Side Of N. Domingo				
									5,719	4,479	1,712	11,910	San Juan River Bridge				
6	50	2.703	8,270	7,494	13,124	12,753	4,471	30,348						13,124	28,517	4,471	46,112
7	50	2.042	7,580	6,247	9,860	9,219	3,321	22,400						9,860	23,046	3,321	36,227
8	40	1.315	7,550	17,534	4,603	4,498	1,561	10,662						4,603	29,582	1,561	35,746
9	40	1.100	7,320	20,676	4,858	4,717	1,636	11,211	274	233	88	595	Box Culvert On West Side Of La Loma Cemetery	5,132	32,946	1,724	39,802
10	40	1.405	11,940	23,088	4,887	4,906	1,664	11,457						4,887	39,934	1,664	46,485
Total		15.480	107,870	364,176	78,894	76,064	26,568	181,526	40,522	18,875	7,896	67,293		119,416	566,985	34,464	720,865

Prices In 1977

Table 4.2-8 Construction Cost (C-3 Route, Plan-5)

(Unit: ₱ 1,000)

Segment No.	R-O-W Width (m)	Length (km.)	Land Acquisition Local	Property Acquisition Local	Road Construction Foreign	Road Construction Local	Road Construction Tax	Road Construction Total	Structure Construction Foreign	Structure Construction Local	Structure Construction Tax	Structure Construction Total	Structure Construction Remarks	Total Cost Foreign	Total Cost Local	Total Cost Tax	Total Cost Total
1	50	0.975	12,800	217,100	4,897	4,772	1,663	11,332	110	93	35	238	Extension Of Box Culvert (On Buendia Avenue)	5,007	234,765	1,698	241,470
2	50	1.190	10,620	14,335	6,671	6,557	2,262	15,490	158	135	51	344	Extension Of Box Culvert (On Ayala Avenue)	6,829	31,647	2,313	40,789
3	50	1.780	12,590	14,335	12,927	12,134	4,311	29,372	32,013	12,140	5,326	49,479	Pasig River Bridge	46,055	52,083	9,975	108,113
									1,115	884	338	2,337	Buhangin River Bridge				
4	50	0.885	9,370	12,024	5,279	5,054	1,780	12,113						5,279	26,448	1,780	33,507
5	50	2.085	19,830	31,343	15,074	14,350	5,009	34,433	1,043	826	317	2,186	Creek Bridge On North Side Of Shaw Blvd	21,926	70,913	7,067	99,906
									90	85	29	204	Box Culvert On South Side Of N. Domingo				
									5,719	4,479	1,712	11,910	San Juan River Bridge				
6	50	2.703	8,270	7,494	14,571	14,034	4,961	33,566						14,571	29,798	4,961	49,330
7	50	2.042	7,580	6,247	10,891	10,130	3,668	24,689						10,891	23,957	3,668	38,516
8	40	1.315	7,550	17,534	4,603	4,498	1,561	10,662						4,603	29,582	1,561	35,746
9	40	1.100	7,320	20,676	4,858	4,717	1,636	11,211	274	233	88	595	Box Culvert On West Side Of La Loma Cemetery	5,132	32,946	1,724	39,802
10	40	1.405	11,940	23,088	4,887	4,906	1,664	11,457						4,887	39,934	1,664	46,485
Total		15.480	107,870	364,176	84,658	81,152	28,515	194,325	40,522	18,875	7,896	67,293		125,180	572,073	36,411	733,664

Prices in 1977

Table 4.2-9 Construction Costs (R-4 And Related Roads)

(Unit: ₱1,000)

Route	Seg-ment No.	R-O-W width (m)	Length (Km)	Land Acquisition Local	Property Acquisition Local	Road Construction Foreign	Road Construction Local	Road Construction Tax	Road Construction Total	Structure Construction Foreign	Structure Construction Local	Structure Construction Tax	Structure Construction Total	Remarks	Total Cost Foreign	Total Cost Local	Total Cost Tax	Total Cost Total
R-4	11	30	4.738	4,104	12,521	13,335	12,735	4,395	30,465	736	589	228	1,553	San Jose Creek Bridge	14,870	30,584	4,864	50,318
										799	635	241	1,675	Taguig River Bridge				
C-5	12	40	0.690	2,820	2,510	2,409	2,336	794	5,539	25,622	9,681	4,241	39,544	Pasig River Bridge	28,031	17,347	5,035	50,413
C-5	13	40	1.820	13,000	7,550	10,521	10,098	3,516	24,135						10,521	30,648	3,516	44,685
Total			7.248	19,924	22,581	26,265	25,169	8,705	60,139	27,157	10,905	4,710	42,772		53,422	78,579	13,415	145,416
Alternative Of Seg. 13		40	1.692	11,500	10,140	6,937	6,874	2,340	16,151						6,937	28,514	2,340	37,791

Table 4.2-10 Construction Costs for Grade Separation

(Unit :₱1,000)

Junction	Alternative - 1 Foreign	Alternative - 1 Local	Alternative - 1 Tax	Alternative - 1 Total	Alternative - 2 Foreign	Alternative - 2 Local	Alternative - 2 Tax	Alternative - 2 Total
Ayala Ave. - Buendia Ave.	15,425	6,008	2,526	23,959	10,816	8,399	2,052	21,267
C-3-Shaw Blvd.	7,986	4,730	1,853	14,569	9,046	5,571	2,167	16,784
C-3- Aurora Blvd.	7,986	4,730	1,853	14,569	13,465 (Including San Juan River Bridge)	8,983	3,484	25,932
C-3-E.Rodriguez Ave.	8,249	4,971	1,939	15,159	—			
C-3- Quezon Blvd.	5,180	4,368	1,689	11,237	—			
Total	44,826	24,807	9,860	79,493	—			

4.3 MAINTENANCE COST

4.3.1 General

Routine maintenance, periodic maintenance and occasional repair are required for preserving roads in good condition. Routine maintenance includes maintenance of pavement surface, lighting facilities, drainage facilities, green belts and guard rails and cleaning. Periodic maintenance includes repainting of steel bridges and re-marking. Repaving or overlay to be carried out when pavement is damaged is considered typical of occasional repairs.

The basic maintenance cost of national highways for fiscal year 1975-76 was about ₱8,000 per equivalent maintenance kilometer (EMK) of two-lane road.

In this study, the maintenance cost required to keep the roads serviceable in good condition was estimated at 1977 prices.

4.3.2 Routine Maintenance

Maintenance of Pavement Surface

Sealing of joints and cracks and partial repair of damaged portion are required in routine maintenance for pavement surface. Joints and cracks should be sealed with joint-sealing compound to prevent ingress of water into subgrade, to keep the surface smooth and to improve durability of slab. Sealing work is desirable to be carried out once a year.

Damaged portion of concrete slab such as breaking off at edge is needed to be repaired as soon as possible. In this study, hot asphalt mixture is proposed for repairing such defects following the practice in the MMA.

Maintenance of Lighting Facilities

Cost for electric power and replacement of demaged lamp should be taken into account.

Maintenance of Drainage Facilities

Maintenance of drainage facilities should be included in routine work. It is very important, particularly after heavey rains.

Maintenance of Green Belt

Green Belt should be maintained to give the road a wholesome environment.

Maintenance of Guard Rail

Damaged portion should be repaired and regular cleaning and repainting are desirable.

Cleaning

Cleaning of roads is necessary for preservation of the function of roads, fine view and wholesome environment.

Lighting facilities and traffic signs should be cleaned periodically to keep their functions.

4.3.3 Periodic Maintenance

Repainting of Steel Bridge

It is recommended to repaint steel bridges every five to ten years. Periodic repainting will protect steel structures from corrosion.

Re-marking

Heavy traffic erases road markings. Periodic re-marking will be necessary.

4.3.4 Repair of Pavement

Either overlaying or repaving is carried out for repair of demaged cement concrete pavement. When damage is observed and it appears to expand extensively in the future, excution of overlay will lengthen the life of pavement and improve the surface smoothness. If pavement is left uncared for until damaged seriously, repaving will be required.

In this study, overlaying of 10 centimeters thick is assumed to be carried out with asphalt concrete in 15 to 20 years after commencement of service.

4.3.5 Maintenance Cost

Estimated annual maintenance costs excluding overlay are shown in Table 4.3-1.

Table 4.3-2 shows the estimated cost for overlay.

Table 4.3-1 Annual Maintenance Cost

(Unit: ₱1,000)

		Length (Km)	Plan-1		Plan-2		Plan-3		Plan-4		Plan-5	
			Eco-nomic	Finan-cial	Eco-nomic	Finan-cial	Eco-nomic	Finan-cial	Eco-nomic	Finan-cial	Eco-nomic	Finan-cial
C-3	Segment-1	0.975	66	74	66	74	66	74	86	96	92	103
	Segment-2	1.190	57	63	81	90	81	90	105	118	113	126
	Segment-3	1.780	137	152	182	202	182	202	234	260	244	273
	Segment-4	0.885	42	47	60	67	60	67	78	87	84	94
	Segment-5	2.085	100	111	142	158	142	158	185	206	197	221
	Segment-6	2.703	129	144	184	205	184	205	239	267	256	287
	Segment-7	2.042	98	109	139	155	139	155	181	202	193	217
	Segment-8	1.315	63	70	63	70	63	70	89	100	89	100
	Segment-9	1.100	53	59	53	59	53	59	75	83	75	83
	Segment-10	1.405	67	75	67	75	67	75	96	106	96	106
	Total	15.480	812	904	1,037	1,155	1,037	1,155	1,368	1,525	1,439	1,610

		Length (Km)	Eco-nomic	Finan-cial
R-4 & Related Rds.	Segment-11	4.738	226	253
	Segment-12	0.690	113	125
	Segment-13	1.820	124	138
	Total	7.248	463	516

Table 4.3-2 Cost For Overlay

(Unit: ₱1,000)

		Length (Km)	Plan-1		Plan-2		Plan-3		Plan-4		Plan-5	
			Eco-nomic	Finan-cial	Eco-nomic	Finan-cial	Eco-nomic	Finan-cial	Eco-nomic	Finan-cial	Eco-nomic	Finan-cial
C-3	Segment-1	0.975	1,148	1,337	1,148	1,337	1,148	1,337	1,762	2,051	2,056	2,393
	Segment-2	1.190	945	1,100	1,401	1,631	1,401	1,631	2,151	2,504	2,509	2,921
	Segment-3	1.780	1,413	1,645	2,096	2,440	2,096	2,440	3,218	3,745	3,753	4,369
	Segment-4	0.885	703	818	1,042	1,213	1,042	1,213	1,600	1,862	1,866	2,172
	Segment-5	2.085	1,656	1,927	2,456	2,858	2,456	2,858	3,769	4,387	4,397	5,118
	Segment-6	2.703	2,146	2,499	3,183	3,705	3,183	3,705	4,886	5,687	5,700	6,635
	Segment-7	2.042	1,622	1,888	2,405	2,799	2,405	2,799	3,691	4,296	4,306	5,012
	Segment-8	1.315	1,044	1,216	1,044	1,216	1,044	1,216	1,549	1,803	1,549	1,803
	Segment-9	1.100	874	1,017	874	1,017	874	1,017	1,295	1,508	1,295	1,508
	Segment-10	1.405	1,116	1,299	1,116	1,299	1,116	1,299	1,655	1,926	1,655	1,926
	Total	15.480	12,667	14,746	16,765	19,515	16,765	19,515	25,576	29,769	29,086	33,857

		Length (Km)	Eco-nomic	Finan-cial
R-4 & Related Rds.	Segment-11	4.738	3,762	4,380
	Segment-12	0.690	813	946
	Segment-13	1.820	2,143	2,495
	Total	7.248	6,718	7,821

CHAPTER 5 ECONOMIC EVALUATION

5 ECONOMIC EVALUATION

5.1 PROCEDURE

5.1.1 General

The procedure for economic evaluation of the project roads are illustrated in Fig. 5.1-1.

The items of analytical procedure in the economic evaluation are as follows:

1. Choice of indicators for economic evaluation
2. Preparation of alternative plans
3. Economic Project Costs
4. Unit Traffic Cost Analysis
5. Economic benefit calculations
6. Economic Analysis
7. Sensitivity analysis
8. Economic Evaluation

5.1.2 Choice of Indicators for Economic Evaluation

There are three types of economic indicators used in the project evaluation, which are the standard procedure of the National Economic Development Authority and also International financers and are as follows:

a) Internal Economic Rate of Return (IRR)

There are two kinds of internal rate of return, financial and economic. The internal financial rate of return are use only for private investments. Since this project is a government undertaking, the internal economic rate of return will be used in the evaluation. In this report IRR means the internal economic rate of return. In order that the project be economically feasible the resulting IRR should be more than the prevailing opportunity cost of capital in the Philippines, which is 15 per cent.

b) Net Present Worth (NPW)

The NPW will indicate the difference of the discounted cost and benefits using the rate of opportunity cost of capital. A positive NPW means the project is economically feasible.

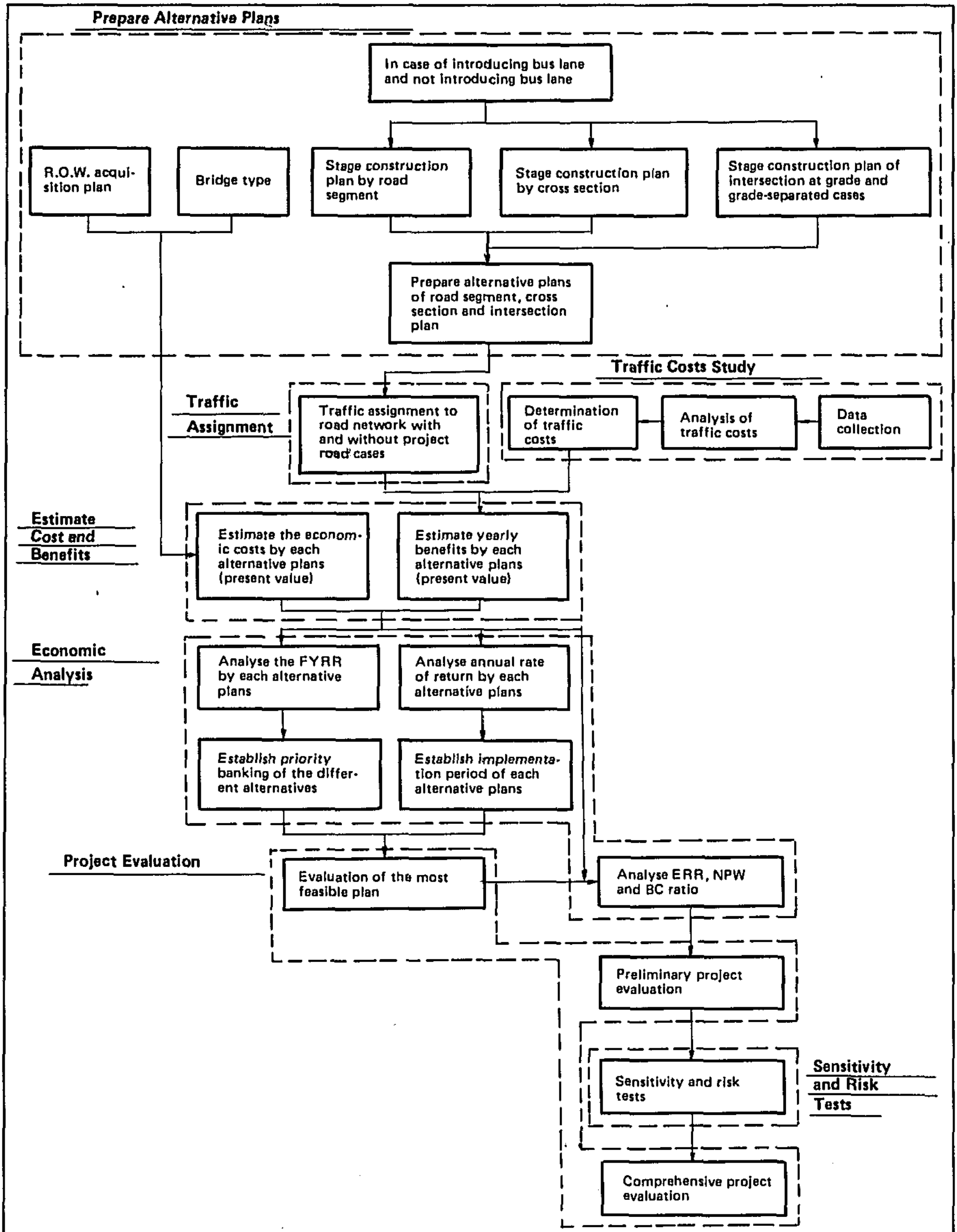


Fig. 5.1-1 Procedure for Economic Evaluation

c) Benefit-Cost (B/C) Ratio

The B/C ratio will show the proportion of the discounted stream of benefits and costs using the prevailing rate of opportunity cost of capital. A ratio of more than 1.0 means a project is economically viable.

Among the three economic indicators used in this study, the IRR was used to establish the investment timing and the best combination of the different alternative plans.

5.2 ALTERNATIVE PLANS

5.2.1 General

The alternative plans discussed in the engineering and traffic study were evaluated economically. The alternative plans are as follows:

a. Route Alignment and Bridge Type

b. Design of Cross-section with and without Bus Lane

c. Phasing Plan in Road Segment

d. Intersection Plan

e. Cordon Pricing

f. Stage Acquisition Plan for R.O.W.

Alternative alignments on the C-3 Road were considered between South Superhighway and Aurora Boulevard, about 7 kms.

Because of little difference both in traffic volume and expected benefits for each alternative route, the alignment was selected only from engineering viewpoint.

The other alternatives to be discussed include those for the extension of E. Rodriguez Ave. towards Katipunan Ave. or to the proposed Marikina Bypass. The alignments would be evaluated in terms of economy.

For item e, "with and without cordon pricing" case was analyzed in the sensitivity analysis.

Item f, Staging of R.O.W. acquisition as an alternative in the economic evaluation was not included because of the findings in Section 4.1.

For other items, the best alternative plan was selected for implementation through the economic evaluation.

5.2.2 Design of Typical Cross-Section with and without Bus Lane

The design of the cross-section of the project roads will follow item b in the preceding alternative plans. Preliminary engineering studies indicate the following typical cross-sections:

a. Four-lane road without bus lane (D_2)

b. Six-lane road without bus lane (D_3)

c. Six-lane road with bus lane (D_2 + B)

d. Eight-lane road with bus lane (D_3 + B, D_2 + B_2)

Based on the result of the traffic projection and the composition of vehicle, D_2 + B_2 cross-section was not included in the economic analysis. This is because the car users will not be able to expect significant benefits from the route which is given four lanes only.

5.2.3 Road Sections and Segments

On the basis of the guidelines discussed in Section 1.2.4 of this report, the project roads are subdivided into the following sections and as shown in Table 5.2-1.

Table 5.2-1 Road Sections of Project Road

(a) C-3

Section	Segment	Portion of Segment	Length of Segment (kms.)
Section 1			9.618
	Segment 1	South Superhighway to the Buendia-Ayala intersection	0.975
	Segment 2	Buendia-Ayala intersection to J.P. Rizal	1.190
	Segment 3	J.P. Rizal to Boni. Ave.	1.780
	Segment 4	Boni. Ave. to Shaw Blvd.	0.885
	Segment 5	Shaw Blvd. to Aurora Blvd.	2.085
	Segment 6	Aurora Blvd. to Quezon Blvd.	2.703
Section 2			5.862
	Segment 7	Quezon Blvd. to the end of Gregorio Araneta Ave.	2.042
	Segment 8	The end of Gregorio Araneta Ave. to A. Bonifacio Ave.	1.315
	Segment 9	A. Bonifacio Ave. to Rizal Ave.	1.100
	Segment 10	The end of Gregorio Araneta Ave. to Balintawak	1.405
	C-3 and its related road		15.480

(b) R-4 and Related Roads

Section	Segment	Portion of Segment	Length of Segment (kms.)
Section 3			5.428
	Segment 11	C-4 to Juan Luna	4.738
	Segment 12	Project Section of R-4 to E. Rodriguez Ave.	0.690
Section 4			1.820
	Segment 13	E. Rodriguez Ave. to Aurora Blvd.	1.820

The stage construction plan by road section would be prepared after a comparative analysis of alternatives has been made through the economic evaluation.

5.2.4 Intersection Plans

The type of intersection, whether "at-grade" or "grade-separated" and the direction of separated roads will be evaluated from economic viewpoint. The five major intersections were analyzed and studied for possible grade-separation as listed below:

1. Ayala - Buendia Intersection
   a. Ayala - Kamagong Direction
   b. Buendia - Buendia Ext. and Kamagong Direction
2. C-3 - Shaw Blvd. Intersection
   a. Shaw Direction
   b. C-3 Direction
3. C-3 - Aurora Blvd. Intersection
   a. Aurora Direction
   b. C-3 Direction
4. C-3 - E. Rodriguez Ave. Intersection
   (C-3 Direction only)
5. C-3 - Quezon Blvd. Intersection
   (C-3 Direction only)

5.2.5 Cases of Economic Analysis

The following cases of alternative plans are analyzed economically:

1. All C-3 road

a. Plan 1 4-lane road without bus lane (D_2)

b. Plan 2 6-lane road without bus lane (D_3)

c. Plan 3 6-lane road with bus lane (D_2 + B)

d. Plan 4 8-lane road with bus lane (D_3 + B)

2. Stage construction plan of road sections and segments on the C-3 road (only Plan 2 was adopted)

   a. Section 1

   b. Section 2

   c. Segment 1

   d. Segments 8 and 9 and segment 10

3. Grade separation at five (5) major intersections on the C-3 road

4. All R-4 and related roads ("D_2" for the R-4 road and "D_3" for the related roads were adopted)

5. Stage construction of road sections on the R-4 and related roads

   a. Section 3

   b. Section 4

6. Road alignment on the related road (segment 13)

   a. Alternative 1: E. Rodriguez Ave. to Aurora Blvd.

   b. Alternative 2: E. Rodriguez Ave. to Marikina Bypass.

5.3 ESTIMATION OF ECONOMIC COSTS

5.3.1 Construction Schedule

For the purpose of establishing the best investments plan, an initial assumption of five years from 1978 including the negotiation, detailed engineering and actual construction has been made. The preliminary schedule of preliminary economic analysis of project roads are shown below:

May 1977 - March 1978	- Feasibility Study
Dec. 1977 - July 1978	- Negotiation
Aug. 1978 - July 1979	- Detailed Engineering
Jan. 1979 - Dec. 1981	- R-O-W Acquisition
Oct. 1979 - Dec. 1982	- Construction

5.3.2 Economic Construction Costs

The construction costs estimate was described in detailed in Chapter 4. The construction costs consist of the land and property acquisition; roadway and bridge structures. The roadway and bridge structures were sub-divided into foreign and local component costs and taxes while the land and property acquisition are purely local components costs.

For the evaluation of the project, the costs and benefits are expressed in economic values. The reason for this is that the values of the costs and benefits should be in real price. Generally, economic cost is financial cost less taxes and the shadow priced foreign and local component of the project costs. Taxes was deducted because it is only a transfer of payments within the Government. In this study, however, the shadow pricing of foreign and labor component is not included in the conversion of the investment cost (financial cost) to economic cost. This is because the real peso value of the foreign component equals the official exchange rate. Road construction in urban areas like the project road, the labor component was estimated to be about 5 to 10 per cent of the cost. Shadow pricing this cost to get the economic cost would not change much the result of the economic evaluation. Therefore, to estimate the economic cost from the financial cost, taxes were only used.

In addition, the following items were considered to be added to economic costs because these items have economic value though they will not be paid by government actually.

1. Business indemnity:

   5 per cent of property acquisition cost was assumed.

2. Land value of the reserved space on the existing G. Araneta Avenue which will be utilized for additional traffic lanes:

   200 ₱/m^2 was assumed.

3. Land value of the R-O-W in Fort Bonifacio:

   180 ₱/m^2 was assumed.

The economic construction costs plan by road segment and section are summarized in Table 5.3-1 (a), (b) and (c).

5.3.3 Streams of Economic Project Costs

Based on the activities mentioned on Section 5.3.1, the implementations period of the project roads will take about 4 years. The distribution of the different cost per year in per cent were assumed as follows:

Year	ROW Acq.	Bridge Const.	Other Structures	Roadway
1979	25	10		
1980	25	20		
1981	50	40	50	50
1982		30	50	50

The detailed estimate of the yearly maintenance cost up to the economic life of the project was described in Section 4.3.

Table 5.3-1 Economic Project Costs by Segment (1977 Price)

(a) C-3 Road

Unit: ₱1,000

	4-lane road plan (Plan 1)			6-lane road plan (Plan 2 and 3)			8-lane road plan (Plan 4)		
	R-O-W acqui-sition	Const-ruction	Total	R-O-W acqui-sition	Const-ruction	Total	R-O-W acqui-sition	Const-ruction	Total
Section 1	73,020	100,583	173,603	101,314	122,918	224,232	397,784	168,260	566,044
Segment 1	0	0	0	-	-	-	252,800	9,182	261,982
2	13,560	6,806	20,366	18,080	9,186	27,266	25,100	12,396	37,496
3	15,910	40,338	56,248	21,220	46,501	67,721	27,070	58,820	85,890
4	12,750	11,078	23,828	17,010	15,384	32,394	21,540	20,168	41,708
5	30,590	25,988	56,578	40,790	31,381	72,171	51,650	39,858	91,508
6	210	16,373	16,583	4,214	20,466	24,680	19,624	27,836	47,460
Section 2	61,960	35,129	97,089	65,169	38,161	103,330	106,379	49,718	156,097
Segment 7	340	12,135	12,475	3,549	15,168	18,717	16,749	20,739	37,488
8	15,480	7,116	22,596	15,480	7,116	22,596	25,910	9,101	35,011
9	20,240	7,978	28,218	20,240	7,978	28,218	28,100	10,085	38,185
10	25,900	7,900	33,800	25,900	7,899	33,799	35,620	9,793	45,413
All C-3 and related road	134,980	135,712	270,692	166,483	161,079	327,562	504,163	217,978	722,141

Note: Excluding Tax

(b) R-4 and Related Roads

Unit: ₱1,000

		R-O-W Acquisition	Construction	Total
R-4 and related roads		54,704	89,496	144,200
Section 3		34,154	68,877	103,031
Section 4	Alternative 1	20,550	20,619	41,169
	Alternative 2	21,640	13,811	35,451

(c) Five Intersections

Unit: ₱1,000

		Construction
Buendia-Ayala Intersection	Alternative 1	21,433
	2	19,215
C-3 - Shaw Intersection	Alternative 1	12,716
	2	14,617
C-3 Aurora Intersection	Alternative 1	12,716
	2	13,950
C-3 - E Rodriguez Ave. Intersection		13,220
C-3 - Quezon Blvd. Intersection		9,548

5.4 UNIT TRAFFIC COST ANALYSIS

5.4.1 Outline of Unit Traffic Cost

There are various kinds of benefits that could be realized from road construction in urban areas such as the project roads. Among them, savings in travel time and running expenses are said to be the most reliable one. These two types of benefits were used in the justification of the project roads. The traffic cost can be defined as composite cost relating to travel time and running expenses. The reports of the Norconsult A.S. Road Feasibility Study and the R-10 Feasibility Study were examined. All unit costs presented in this report have been measured on the basis of 1977 price levels. The vehicle operating cost and time cost are tax excluded.

1. Unit Vehicle Operating Cost

Vehicle operating costs are composed mainly of running (distance depending) and fixed (time depending) costs. The running costs are directly related to the use of the vehicle. The fixed costs are related to vehicle ownership and are incurred independent of the degree of vehicle usage.

The running costs were divided into the following cost items:

a. Fuel cost

b. Oil cost

c. Tire cost

d. Maintenance and repair cost

e. Fifty per cent (50%) of depreciation cost

The fixed cost component is divided into the following cost items:

a. Fifty per cent (50%) of depreciation cost

b. Crew cost

c. Interest cost

d. Overhead and insurance costs

2. Unit Passenger Time Costs

Time costs refer to the time value for the driver and passengers using cars, buses and jeepneys.

5.4.2 Unit Vehicle Operating Cost

5.4.2.1 Unit Running Cost

1. Fuel Cost

The fuel cost was calculated based on fuel consumption per kilometer of paved road and running speed.

2. Oil and Grease Cost

The oil and grease cost was computed on the basis of oil and grease consumption per kilometer.

3. Tire Cost

The tire cost was also calculated based on the tire lifetime and paved road and the tire set prices.

4. Maintenance and Repair Costs

Maintenance and repair costs were divided into labor cost and spare parts. The labor cost was calculated by using the total labor hour for each type of vehicle during its lifetime and the cost of spare parts was estimated on the basis of per cent of vehicle cost obtained from "Norconsult Road Feasibility Study."

5. Depreciation Cost

Fifty per cent (50%) of the depreciation cost was regarded as running costs due to physical wear and tear. The other half was made part of the fixed costs because of the decrease in value as a result of obsolescence and time wear. This division was based on the Final Report of the Norconsult Road Feasibility Study (1975) after examination. The scrap value was neglected mainly because it is negligible after discounting.

6. Total Running Cost

The total unit running cost per kilometer is the sum of all the aforementioned costs as shown in Table 5.4-1.

5.4.2.2 Unit Fixed Cost

1. Crew Cost

The crew costs was calculated separately for bus and truck drivers, bus conductors and cargo loading and unloading laborers for heavy trucks.

2. Time Determined Vehicle Depreciation Cost

The fixed cost element was assumed to be half of the depreciation value of the retailed price, based on the Norconsult Road Feasibility Study.
The depreciation costs were determined on the basis of vehicle life and the annual running time.

Table 5.4-1

Unit Running Cost by Travel Speed

Unit: Centavos per kilometer

Road Type		Travel Speed Km per hour							
		5	8	16	32	40	48	64	80
Pass-enger Car	A to C	55.05	48.05	36.37	30.02	28.70	28.26	28.48	30.00
	D to G	60.56	52.86	40.00	32.02	31.57	31.09	31.33	33.00
Truck	A to C	111.04	101.86	80.33	67.75	66.55	66.94	70.81	77.71
	D to G	122.14	112.05	88.36	74.53	73.20	73.63	77.89	85.48
Bus and Jeep-ney	A to C	85.61	78.53	61.93	52.24	51.31	51.61	54.59	59.91
	D to G	40.45	35.31	26.73	22.06	20.77	20.77	20.85	24.25

Note: Road Type A to G refer to Sub-Section 2.2.4.2.

3. Opportunity Cost of Capital

Since the opportunity cost of capital has been estimated at fifteen per cent (15%) annually, investments in commercial vehicles were therefore costed using the same interest rate.

4. Insurance and Overhead Costs

As a substitute for accident costs, insurance cost was included as a part of the fixed costs.

After the determination of the various cost items above, the fixed cost per operational hour was established for each type of vehicle. The summary of fixed costs per vehicle hour is shown in Table 5.4-2.

Table 5.4-2 Fixed Costs by Vehicle Type

	Road type	Peso per vehicle hour (real price)	Peso per vehicle hour (shadow price)
Passenger Car	A to C	0.57	0.29
Truck	A to G	5.11	2.55
Buses and	A to G	5.49	2.74
Jeepneys	A to G	3.57	1.78

The share of the different components to the total unit fixed costs is about 50 per cent of crew costs, 30 per cent of opportunity cost of capital, 12 per cent of the depreciation costs and 8 per cent of insurance and overhead costs. The increase in productivity of each vehicle type due to travel time savings varies in each component. For example, the travel time savings of the crew members could not be utilized fully in other economic purposes. Some is true to other costs components. Applying shadow pricing these different components will result to about 50 per cent reduction of the total fixed costs. This cost per vehicle type hour was used in the calculations of the vehicle fixed costs.

5.4.3 Passenger Time Value

Time cost is calculated according to the family income approach method, on the basis of the following assumptions:

1. Travellers will pay something to save travel time

2. The traveller's value of travel time is a function of his personal income

3. The traveller's value of travel time is a function of his travel purpose

The time values by each trip purpose is shown below based on the aforementioned assumptions:

1.	Business Trip	100% of hourly income
2.	Commuting to and from work	50% hourly income
3.	Travel to and from school	No value
4.	Others	No value

The time value of each trip purpose was calculated on the basis of annual income of families and annual working hours by non-car owners and car owners. The results are summarized below:

		Non-Car-Owner	Car-Owner
1.	To/from work	₱ 1.47 per hour	₱ 5.24 per hour
2.	Business	2.95 per hour	10.49 per hour
3.	Education	0	0
4.	Others	0	0

However, the travel time savings gained by these passengers could not produce as much production during his regular time. This assumption means that the estimated passenger time value based on hourly income should be less than his actual contribution to the national economy. On this basis, a 50 per cent reduction for each type of passengers were used in the calculation of travel time cost. The adjusted passenger time value is Peso per hour are as follows:

		Non-Car-Owners	Car-Owner
1.	To/from work	0.73	2.62
2.	Business	1.47	5.25
3.	Education	0	0
4.	Others	0	0

5.4.4 Traffic Cost on the Intersection

The vehicle operating cost component on the intersection was taken into consideration in this study are as follows:

1. Excess traffic cost of speed change cycles.
2. Excess hours consumed per speed change cycles.
3. Cost of idling engine with stationary vehicle.

The vehicle operating cost on intersection for the three different costs mentioned above are summarized in Table 5.4-3 (a), (b), (c) and 5.4-4.

Table 5.4-3 (a) Excess Cost of Speed-Change Cycles (Passenger Car)

Unit: Centavos per 1 cycle

	Speed Reduced to and Return from, Kms per hour						
	Stop	8	16	24	32	40	48
8	1.12						
16	2.41	1.23					
24	4.26	2.81	1.53				
32	6.47	4.98	3.48	1.88			
40	9.10	7.59	6.02	4.29	2.34		
48	12.24	10.71	9.13	7.34	5.26	2.86	
56	16.01	14.45	12.86	11.03	8.95	6.46	3.53

Notes: 1) Cost includes fuel, engine oil, maintenance and depreciation.
2) A speed-change cycle is reducing speed from and returning to an initial speed.

Table 5.4-3 (b) Excess Cost of Speed - Change Cycles (Truck)

Unit: Centavos per 1 cycle

	Speed Reduced to and Return from; Kms per hour						
	Stop	8	16	24	32	40	48
8	3.18						
16	7.82	3.84					
24	13.73	9.16	4.88				
32	20.79	16.04	11.41	6.07			
40	19.19	24.33	19.48	13.99	7.53		
48	39.30	34.34	29.28	23.64	17.04	9.21	
56	51.39	45.15	35.33	28.65	20.69	11.30	

Notes: 1) Cost includes fuel, engine oil, maintenance and depreciation.
2) A speed-change cycle is reducing speed from and returning to an initial speed.

Table 5.4-3 (c) Excess Cost of Speed-Change Cycles (Bus & Jeepney)

Unit: Centavos per vehicle

	Speed Reduced to and Return from: Kms per hour						
	Stop	8	16	24	32	40	48
8	2.45						
16	6.03	2.96					
24	10.59	7.07	3.76				
32	16.03	12.37	8.80	4.68			
40	22.51	18.76	15.02	10.79	5.80		
48	30.31	26.48	22.59	18.23	13.14	7.10	
56	39.63	35.69	31.73	27.24	22.09	15.96	8.71

Notes: 1) Cost includes fuel, engine oil, maintenance and depreciation.

2) A speed-change cycle is reducing speed from and returning to an initial speed.

Table 5.4-4 Cost of Idling Engine with Stationary Vehicles
Pesos per 1000 Vehicle-hours

Vehicle Type / Cost Item	Car	Truck	BUS
Fuel	1,646	2,907	1,789
Engine Oil	24	33	72
Engine Maintenance	55	81	118
Depreciation	141	410	829
Total	1,866	3,431	2,808

* Source: Winfrey, "Economic Analysis for Highway"

The above-mentioned traffic costs which had been established in "The Economic Analysis for Highways*" was adopted in this study.

5.5 BENEFIT CALCULATIONS

5.5.1 Characteristics of Benefits

The benefits of the construction of the project roads can be defined as the difference in the traffic cost between the case where the project is implemented and the case where it is not. The following beneficiaries of project roads were taken into consideration in this study.

1. Vehicles which currently use the unimproved project roads (normal traffic)

2. Vehicles which will be diverted to the project roads (diverted traffic)

3. Vehicles not diverted to the project roads (non-diverted traffic)

Normal traffic is the traffic that always uses the project road with and without improvement. This traffic will experience benefits in terms of savings in running costs and travel time.

The diverted traffic means the traffic that will be diverted to the project roads upon its completion. This divertible traffic to the project roads will experience savings in running costs and travel time compared to its previous longer and congested route.

Non-diverted traffic will gain benefits in terms of traffic costs due to the decongestion of existing roads.

Besides the three kinds of benefits mentioned above, there is the generated benefits from generated traffic. But the generated traffic was not taken into account in this study because it is anticipated to be negligible. Therefore, all traffic within the project roads consist of normal and diverted traffic only.

Benefits derivable from normal, diverted and non-diverted traffic are:

1. Reduction in travel time (Time Benefit)

2. Saving in vehicle operating cost (Running Benefit)

    - saving in running cost
    - saving in fixed cost

* Winfrey, Economic Analysis for Highways, International Textbook Company.

5.5.2 Benefit Calculation Method

Each type of benefit was calculated using the following formulas:

1. Normal and Diverted Traffic

   a. Time benefits

$$TB = \sum_{ij} P_{ij} (t_{ij}^{wo} - t_{ij}^{w}) V$$

where:

TB : time benefit

P_{ij} : passenger using the project road between zones i and j

t_{ij}^{wo} : travel time between zones i and j in case the project is not implemented

t_{ij}^{w} : travel time between zones i and j in case that the project is implemented.

V : time value

   b. Saving in running cost

$$RB = \sum_{ij} T_{ij} (L_{ij}^{wo} \cdot RC_{ij}^{wo} - L_{ij}^{w} \cdot RC_{ij}^{w}) + (t_{ij}^{wo} - t_{ij}^{w}) FC_{ij}$$

where:

RB : savings in running costs

T_{ij} : traffic volumes between zones i and j using the project road

L_{ij} : travel distance between zones i and j

RC_{ij} : running cost between zones i and j

FC_{ij} : fixed cost between zones i and j

Benefits of normal and diverted traffic were computed on the basis of the above-mentioned formulas. These computations were done by vehicle type.

2. Non-Diverted Traffic

   a. Time benefit

$$TB = \sum_{ij} P_{ij}^{ND} (t_{ij}^{wo} - t_{ij}^{w}) V$$

where:

TB : time benefit

P_{ij}^{ND} : passengers between zones not using the project roads

b. Running benefit

$$RB = \sum_{ij} T_{ij}^{ND} (L_{ij}^{wo} \cdot RC_{ij}^{wo} - L_{ij}^{w} \cdot RC_{ij}^{w}) + (t_{ij}^{wo} - t_{ij}^{w}) \cdot FC_{ij}$$

where:

RB : running benefit

T_{ij}^{ND} : traffic volume between zones not using the project roads

5.5.3 Benefit Calculation for Intersection Plan

5.5.3.1 Characteristics of Benefits

The following benefits were taken up for calculation.

1. Time benefit and saving of fixed cost due to reduction in running hours by grade separation.
2. Saving of running cost because grade separation makes it possible for the cars to dispense with acceleration, deceleration and idling at the intersection.

Additional costs due to acceleration and deceleration of the vehicles running through the intersection without stoppage and also due to the longitudinal slope are negligibly small as against above factors and were disregarded, accordingly.

5.5.3.2 Method of Benefit Calculation

Just as with the through sections on C-3, the difference in running cost between at-grade and grade separation was taken as a benefit. The procedure for benefit calculation is as shown in the flow chart in Fig. 5.5-1.

Outlined below is the process of computation of each benefit.

1. Time Benefit

The time benefit is a function of stop time.
The stop time is calculated according to the following formula.

$$T_W^{\ell} = \frac{q_i^{\ell}(c-g_i)^2}{2\,c\,(1-y_i^{\ell})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)^*$$

where,

c : cycle (sec), g_i : green time (sec)

q_i^{ℓ} : traffic volume at approach i by time zone (veh/hr.)

y_i^{ℓ} : degree of saturation by time zone (q_i^{ℓ}/s_i^{ℓ})

S_i^{ℓ} : saturation flow rate at approach i by time zone (veh/hr.)

T_W^{ℓ} : waiting time by time zone (sec)

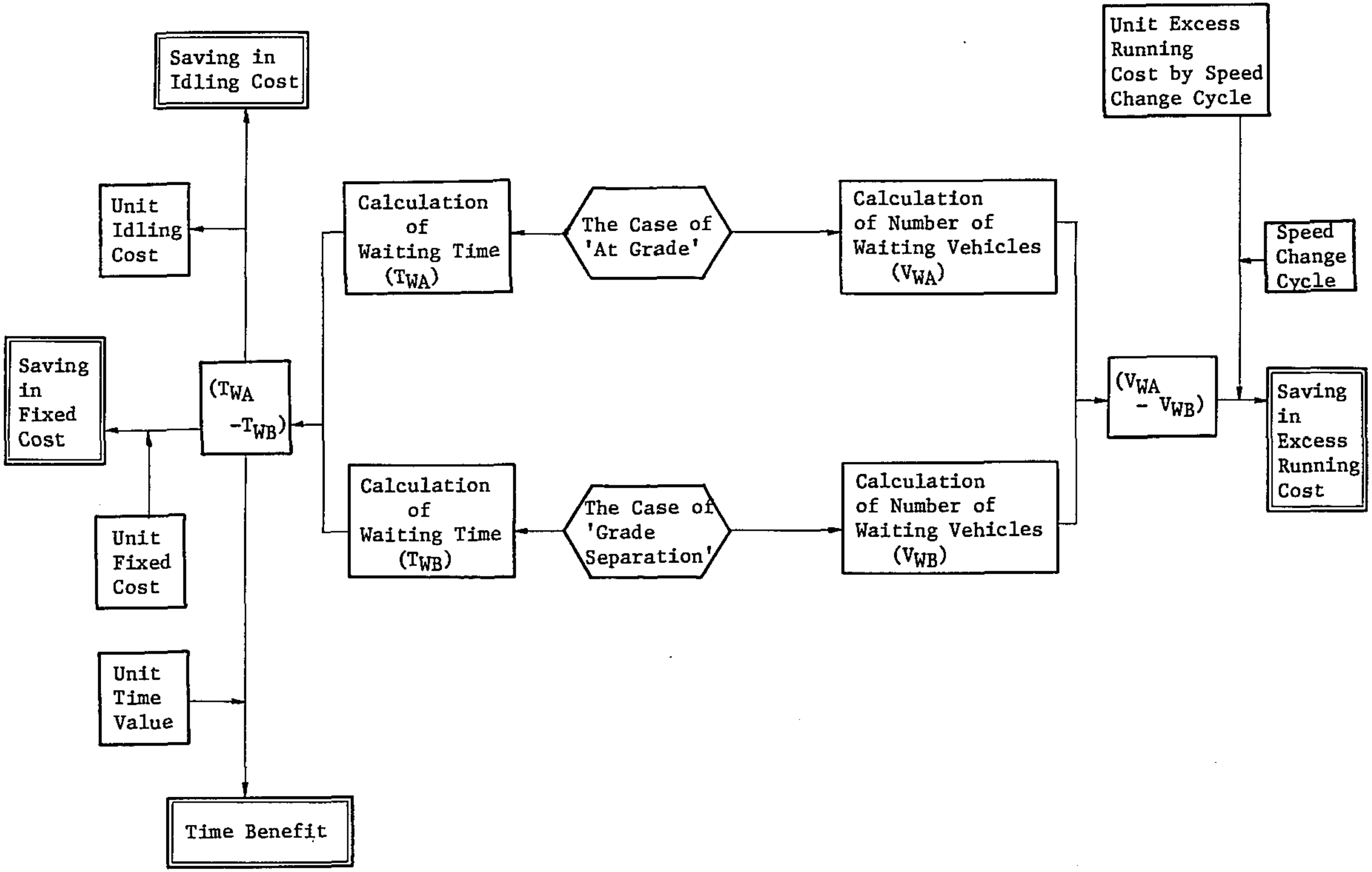


Fig. 5.5-1 Basic Idea for Benefit Calculation

* For details of Eq. (1), refer to the Supplementary Report S3.

The stop-time is calculated for each of the time zones into which a day is devided, and then is summed up to obtain the total stop time of the day. Then, the time benefit expected from grade separation is calculated according to the following formula.

$$T_B = \sum_{\ell} (T_{WA}{}^{\ell} - T_{WB}{}^{\ell})\, T_V \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where,

$T_{WA}{}^{\ell}$: waiting time by time zone in the case of at-grade.

$T_{WB}{}^{\ell}$: waiting time by time zone in the case of grade separation.

T_V : time value

T_B : time benefit

2. Saving in Idling Cost

The cost was calculated on presupposition that all the vehicles standing at the intersection are in a state of idling.

Thus, the product of the stop time difference calculated in the foregoing paragraph and the idling cost is the saving in idling cost.

3. Saving in Fixed Cost

In the same way as above, the saving in fixed cost was calculated by multiplying the stop time difference by the unit fixed costs.

4. Saving in Excess Running Cost

The vehicle forced to stop at the intersection will follow the speed-change cycle shown below.

Approaching to intersection	(Approaching speed)
↓	↓
	(Deceleration)
	↓
Approach section	(Stop)
↓	↓
	(Acceleration)
	↓
Exit	(Approaching speed)

The number of vehicles forced to stop at the intersection was calculated according to the following formula.

$$\frac{c-g_i}{c}\left(1 - \frac{1}{y_i{}^{\ell}}\right) \cdot q_i{}^{\ell}$$

The saving in running cost can be calculated by multiplying the excess costs and the difference in the number of vehicles stopped between at-grade and grade separation. The speed of approaching to the intersection was set at 40 km/hr. for the year 1980 and 30 km/hr. for the year 1990, irrespective of the type of vehicle.

5.5.4 Results of Benefit Calculations

The results of benefit calculations are shown in Appendices 1 through 4, on which follow some observations.

1. Benefit composition by traffic type estimated for 1990 is as shown in Table 5.5-1.

Table 5.5-1 Benefit Composition by Type of Traffic in 1990

	Plan 2 (%)	Plan 3 (%)
Normal Traffic	9.6	9.0
Diverted Traffic	40.9	41.1
Non-diverted Traffic	49.5	49.9
Total	100.0	100.0

As is clear from the above table, the direct benefits due to normal and diverted traffic are almost the same as the indirect benefits due to non-diverted traffic.

2. The benefit composition by vehicle type for the year 1990 is shown in Table 5.5-2.

The benefit of bus and jeepney users comes to only 22 per cent in case of plan 2. The share of benefit of car users is much higher than that from bus and jeepney users.

Table 5.5-2 Benefit Composition by Vehicle Types

	Plan 2 (%)	Plan 3 (%)
Bus · Jeepney	22.4	26.6
Car	77.6	73.4
Total	100.0	100.0

5.6 ECONOMIC ANALYSIS

5.6.1 C-3 Road

5.6.1.1 Plan for the Whole of C-3 Road

The benefits by plan and their breakdown for the design years and the yearly flow of undiscounted benefits and costs are shown in Appendices 1 and 5.1.

According to these benefits and costs, an economic analysis was made, and the results are obtained as shown in Table 5.6-1.

Table 5.6-1 Economic Indicators by Plan

	Discounted Benefits (M₱)	Discounted Costs (M₱)	Net Present Worth (M₱)	B/C Ratio	Internal Rate of Return (%)
Plan 1 : D2	479	161	318	3.0	34.7
Plan 2 : D3	1,123	194	929	5.8	48.8
Plan 3 :D2+B1	1,113	194	919	5.7	48.8
Plan 4 :D3+B1	1,290	434	856	2.9	31.6

Notes: 1) Discount Rate: 15%

2) Project Life: 25 years

The economic indicators given in Table 5.6-1 tell that the plans discussed in Section 5.2 are all feasible. It is found from the table that the six-lane plan is the best of all irrespective of whether the bus lane is present or not.

As regards Plan 2 (6 lanes, w/o bus lanes), the economic indicators are:
B/C, 5.8; net present value, ₱ 929 million; and internal rate of return, 48.8%. On the other hand, Plan 3 (6 lanes, with bus lanes) shows B/C of 5.7, net present value of ₱ 919 million, and an internal rate of return of 48.8%.

5.6.1.2 Evaluation by Section

As shown in the foregoing paragraph, high internal rates of return have been obtained for the plan for the whole of C-3 road.

In order to study the following two problems, the 6-lane plan not introducing the bus lane was subjected to economic analysis by section.

1) Can such a high internal rate of return (IRR) as in the foregoing paragraph still be achieved when the road is divided into two sections?

2) Then, which one of the two sections be given the investment priority over the other?

The breakdown of benefits and the yearly flow of benefits and costs are as shown in Appendices 3 and 5.2. The study resulted in a high IRR of over 40% for both sections as shown in Table 5.6-2 below, suggesting that the project implementation should be prompted irrespective of whether Section 1 or 2 is concerned.

From the economic viewpoint, however, Section 1 should be placed above Section 2 in terms of investment order.

Considering the high IRR obtained, there will be not much point making further economic analysis section by section.

Table 5.6-2 Economic Indicators by Section

	Discounted Benefits (M₱)	Discounted Costs (M₱)	Net Present Worth (M₱)	B/C Ratio	Internal Rate of Return (%)
Section 1	784	132	652	5.9	49.9
Section 2	282	60	222	4.7	42.5

Notes: 1) Discount Rate: 15%

2) Project Life: 25 years

5.6.1.3 Comparison Analysis of Balintawak Road and Segments (8 and 9)

Balintawak Road on the one hand and the segments 8 and 9 on the other are alternative to each other in making the proposed road network. A study was therefore made as to which is better from the economic viewpoint.

As a result, the economic indicators shown in Table 5.6-3 were derived, from which it is found that the segments (8 and 9) is a little better so far as the economics stand. While the segments (8 and 9) is justified as they play an important role as a link of C-3 road and an access to R-10, Balintawak Road shows a high economic feasibility as well and its implementation should be discussed sooner or later.

Table 5.6-3 Comparison of Economic Indicators between Balintawak Road and Segments 8 and 9

	Discounted Benefits (M₱)	Discounted Costs (M₱)	Net Present Worth (M₱)	B/C Ratio	Internal Rate of Return (%)
Balintawak Road	102	20	82	5.0	43.8
Segments 8 and 9	154	30	124	5.1	44.3

Notes: 1) Discount Rate: 15%

2) Project Life: 25 years

5.6.1.4 Study of a Widening Plan for Segment 1

An economic analysis was made in an attempt to investigate the investment priority concerning a case of expanding from the hitherto 6 lanes to 8 lanes in the segment 1 running from the South Superhighway on Buendia to Ayala Ave. The results are as shown in Table 5.6-4.

Although the widening will bring about a lot of benefits, it will also call for a vast sum of money in acquiring land and properties. Taken altogether, the plan will be low in the investment priority.

Table 5.6-4 Economic Indicators of Segment 1

Discounted Benefits (M₱)	Discounted Costs (M₱)	Net Presnet Worth (M₱)	B/C Ratio	Internal Rate of Return (%)
125	161	Δ36	0.8	12.5

Notes: 1) Discount Rate: 15%

2) Project Life: 25 years

5.6.2 R-4 and Related Roads

As regards R-4 and its related roads, the component sections, that is, Section 3 (R-4 and part of C-5) and Section 4 (E. Rodriguez-Aurora Blvd. section of C-5) were subjected to economic evaluation independently. (For the yearly flow of benefits and costs, refer to Appendix 5.3.)

As regards Section 4, the alternative 1 (access to Aurora Blvd.) and the alternative 2 (access to Marikina B.P.) were also compared. The results are as shown in Table 5.6-5. It is found that a considerably high feasibility is given for the road project, though the priority is low compared with C-3 Road.

On the other hand, Section 3 is higher in investment priority than Section 4, though Section 4 shows a high IRR as it is expected to have a traffic of some 35,000 vehicles in 1990. As for Section 4, the alternative 1 is a little better than the alternative 2.

Table 5.6-5 Economic Indicators by Section

	Discounted Benefits (M₱)	Discounted Costs (M₱)	Net Present Worth (M₱)	B/C Ratio	Internal Rate of Return (%)
Section 3	179	61	118	2.9	33.3
Section 4 (alternative 1)	43	24	19	1.8	23.0
Section 4 (alternative 2)	36	21	15	1.7	22.2

Notes: 1) Discount Rate: 15%

2) Project Life: 25 years

5.6.3 Intersection Plan

The modification of the five major intersections on the project roads from at-grade to grade separation gives rise to the following questions.

1) What economic indicator do the intersections make?

2) What ranking do they show in the investment priority?

3) What direction should they be grade-separated economically?

In order to examine these, economic evaluation was made and the results are as shown in Table 5.6-6 (for the undiscounted benefits, refer to Appendix 4).

The evaluation was made on assumption that the grade separation will be made in 1983, the scheduled year for commencement for use of C-3, and that, just as with the other cases, the discount rate is 15%, and the project life 25 years. From Table 5.6-6, it is evident that the C-3-Quezon Blvd. intersection leads the top of ranking in the investment priority, and the C-3-Ayala intersection comes at the bottom. But this is due mainly to the effects of costs arising from the difference in the type of grade separation among them.

The economic indicators also show that the alternative 1 is a little more feasible than the alternative 2 at the three intersections, i.e. Buendia-Ayala, C-3-Shaw and C-3-Aurora intersections.

However, the difference between the two alternatives is insignificant in terms of feasibility. In the inplementation program, it is recommended that the grade separations excluding Quezon-C-3 intersection are to be constructed after completion of C-3 Road with at-grade intersection. In this case, further investigation should be made for selecting type of the intersections by observing the traffic behaviours around the intersections after the opening.

However, the grade-separation type at C-3-Aurora intersection should be discussed in the detailed engineering stage of San Juan River bridge for its close relationship with the intersections structure.

Table 5.6-6 Economic Indicators by Intersection

		Discounted Benefit (M₱)	Discounted Cost (M₱)	Net Present Worth (M₱)	B/C Ratio	Internal Rate of Return (%)
C-3-Ayala Ave.	Alt. 1	13	12	1	1.1	16.4
	Alt. 2	12	11	1	1.1	16.2
C-3-Shaw Blvd.	Alt. 1	12	8	4	1.5	24.9
	Alt. 2	12	8	4	1.4	21.6
C-3-Aurora Blvd.	Alt. 1	17	8	9	2.2	32.9
	Alt. 2	17	8	9	2.1	31.0
C-3-E Rodriguez		10	8	2	1.2	20.8
C-3-Quezon Blvd.		12	5	7	2.5	35.1

Notes: 1. Discount Rate: 15%

2. Project Life: 25 years

5.7 SENSITIVITY ANALYSIS

5.7.1 C-3 Road

The sensitivity analysis of C-3 Road was made by changing the following five parameters.

1. Project cost
2. Project benefit
3. Yearly construction cost
4. Economic life of project road
5. Cordon pricing within C-2

The results are as summarized in Table 5.7-1.
Now let us discuss the plans parameter by parameter with center on Plans 2 and 3.

Table 5.7-1 The Resulting Changes in the Economic Indicators by Plan of C-3 Road

	Plan 2			Plan 3			Plan 4		
	B/C	NPW (M₱)	IRR (%)	B/C	NPW (M₱)	IRR (%)	B/C	NPW (M₱)	IRR (%)
1. Original Result	5.8	929	48.8	5.7	919	48.8	2.9	856	31.6
2. +20% Project Cost	4.8	891	43.6	4.8	880	43.6	2.5	769	28.1
3. -20% Project Benefit	4.6	705	42.5	4.8	696	42.5	2.4	588	27.3
4. Variation of Construction Cost	5.6	923	46.6	5.6	912	46.2	2.9	841	30.2
5. 20-Year Economic Life	5.5	864	48.8	5.4	855	48.8	2.8	781	31.4
6. With Cordon Pricing	5.7	907	48.1	5.6	896	48.1	2.9	830	31.1

Notes: 1) Discount Rate: 15%

2) Project Life: 25 years

5.7.1.1 Project cost

The factors that govern the construction cost includes:

a. Quantity

b. Unit rate of material

c. Unit rate of equipment

d. Efficiency of equipment

e. Efficiency of labor

Analysis was made as to the case where the project cost is sent up to nearly a ceiling of 20 per cent. Even with this, Plans 2 and 3 remain quite feasible with a slight reduction of 5.2 per cent in IRR.

5.7.1.2 Project benefit

A case where the benefit is reduced by 20% was studied by making allowances for statistic error of benefits. Even under this strict condition, IRR sustained a level of over 40 per cent.

5.7.1.3 Yearly construction cost

Study was made by changing the yearly investment ratio as follows with the construction period kept constant.

Year	Right-of-way acquisition	Bridge construction	Other structure	Roadway
1979	25	10		
1980	50	40		
1981	25	40	75	75
1982		10	25	25

As will be clear from Table 5.7-1, such changes do little affect the feasibility.

5.7.1.4 Project life

Even when the project life is cut by 5 years to 20 years, the project still remains high in feasibility.

5.7.1.5 Cordon pricing within C-2

An analysis was made on assumption that the cordon pricing recommended in MMETROPLAN would be practised. What is concerned most with the cordon pricing is the radial traffic. Little effect is imposed on the traffic utility of C-3, manifesting the feasibility of the project with no significant difference in the results of sensitivity analysis between the case of with and without cordon pricing.

5.7.2 R-4 and Related Roads

R-4 and its related roads were also put to a sensitivity analysis with the following parameters changed.

1. Project cost
2. Project benefit
3. Yearly construction cost
4. Project life

The analysis was made to handle R-4 and its related roads in the lump. The results are as shown in Table 5.7-2. For the analysis, the parameters were changed just the same as with the case of C-3. Table 5.7-2 proves that the project gives a good account of itself with an undauntedly high feasibility against the severity.

Table 5.7-2 The Resulting Changes in the Economic Indicators

	B/C	NPW (M₱)	IRR (%)
1. Original Result	2.6	137	30.5
2. +20% Project Cost	2.2	120	26.9
3. -20% Project Benefit	2.1	92	26.1
4. Variation of Construction Cost	2.5	133	29.0
5. 20-Year Economic Life	2.6	125	30.4

5.8 CONCLUSION OF ECONOMIC ANALYSIS

5.8.1 *Summary*

The flow of economic evaluation of the project roads is shown in Figs. 5.8-1 (C-3 Road) and 5.8-2 (R-4 and related roads), along with its results.

The results of the comparison study of the plans with respect to the investment priority made in each step of economic evaluation in 5.6 are summarized in Table 5.8-1.

Evaluation of Whole of C-3

Plan 1		Plan 2		Plan 3		Plan 4	
B/C	IRR	B/C	IRR	B/C	IRR	B/C	IRR
3.0	34.7	5.8	48.8	5.7	48.8	2.9	31.6

Evaluation by Section

Section 1 (in Plan 2)		Section 2 (in Plan 2)	
B/C	IRR	B/C	IRR
5.9	49.9	4.7	42.5

Evaluation by Segment

Segment 1 (in Plan 4)		Segment 8, 9 (in Plan 2)		Segment 10 (in Plan 2)	
B/C	IRR	B/C	IRR	B/C	IRR
0.8	12.5	5.1	44.3	5.0	43.8

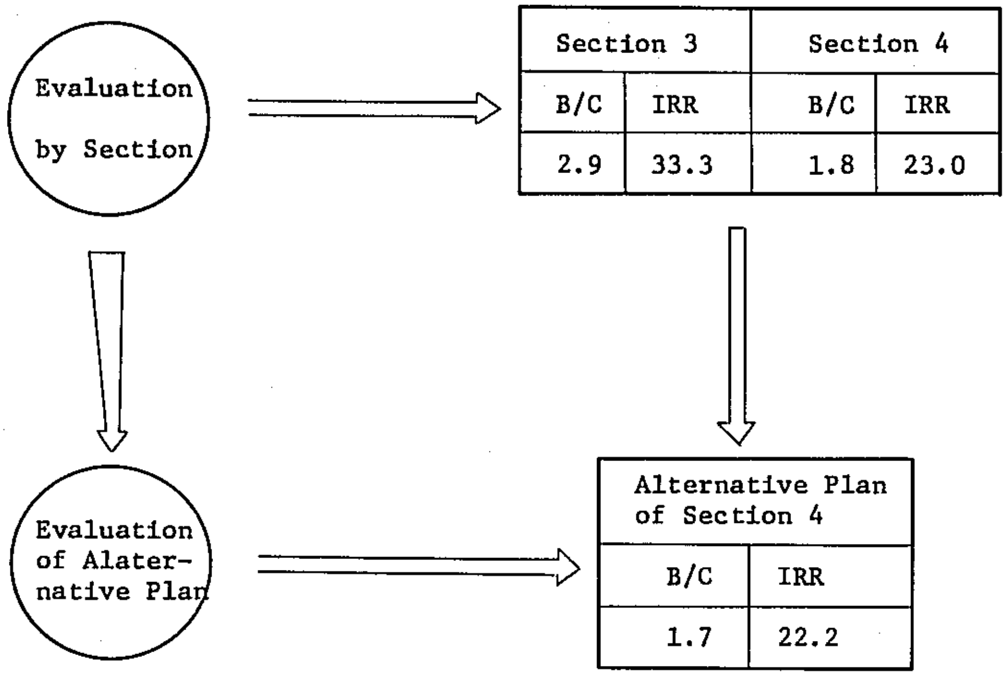
Evaluation by Intersection

Plan 2									
C-3 -Ayala		C-3 -Shaw Blvd.		C-3 -Aurora Blvd.		C-3 -E. Rodriguez		C-3 -Quezon Blvd.	
B/C	IRR	B/C	IRR	B/C	IRR	B/C	IRR	B/C	IRR
0.8	14.0	1.5	24.9	2.2	32.9	1.2	20.8	2.5	35.1

* Discount Rate: 15%

Project Life: 25 years

Fig. 5.8-1 Flow Diagram of Economic Evaluation of C-3 Road



Section 3		Section 4	
B/C	IRR	B/C	IRR
2.9	33.3	1.8	23.0

Alternative Plan of Section 4	
B/C	IRR
1.7	22.2

* Discount Rate: 15%

Project Life: 25 years

Fig. 5.8-2 Flow Diagram of Economic Evaluation of R-4 and Related Roads

Table 5.8-1 A Comprehensive List of Plans and Their Investment Priority

	Evaluation Step	Plan	Investment Priority
C - 3	Whole of C-3 Road	Plan 1	4
		Plan 2	1
		Plan 3	1
		Plan 4	3
	Section	Section 1	1
		Section 2	2
	Segments in Section 2	Segment 8, 9	1
		Segment 10	2
	Intersection	C-3 - Ayala	5
		C-3 - Shaw Blvd.	3
		C-3 - Aurora Blvd.	2
		C-3 - E.Rodriguez	4
		C-3 - Quezon Blvd.	1
R-4 and Related Road	Section	Section 3	1
		Section 4 (Alternative) 1	2
		Section 4 (Alternative) 2	3

5.8.2 Conclusion

As a result of economic analysis, the study team has arrived at the following conclusions:

1. The project road, C-3, having six lanes, should be constructed as soon as possible.
   And it is desirable to introduce bus lanes to C-3 Road.

   In so far as the economic evaluation shows, Plan 2 and Plan 3 have the same internal rate of return. Since the bus lanes are installed only by marking, there is no difference between the costs of the two.

   However, the following reasons tip the balance in favor of plan 3, though both plans are equally competent from the economic viewpoints:

   a) Installation of bus lanes is desirable not only for making preparations for the introduction of mass transit system in the future, but also in view of the efficiency of public space.

   b) In order to economize on the irreplaceable natural resources, it is mandatory to improve the service level of buses with a high transportation efficiency and urge the people to take the buses instead of private cars.

   c) In the Manila-Cavite Reclamation Project, the introduction of bus lanes to the Reclamation-Makati has been planned. This also supports the introduction of the bus lanes to C-3 Road.

2. The construction of R-4 and its related roads should be started following the start of C-3 Road.

   a) Lower in the investment priority though they may be as compared with C-3 Road, R-4 and its related roads show a considerable high internal rate of return and their implementation should be studied immediately after start of C-3 construction.

3. The grade separation should begin with the C-3 - Quezon Blvd. intersection, with all other intersections commenced for use as they are of the "at-grade" type.

   a) When C-3 is made of the depressed type, the C-3 - Quezon Blvd. intersection shows the highest priority of all and the costs required are not so much. All these claim that its grade separation should be realized as soon as possible.

   b) As regards C-3 - Aurora Blvd. and - Shaw Blvd. intersections, the radial roads (Aurora and Shaw) are planned to straddle C-3. But their grade separation has yet to be studied in its relation to the improvement plan of the roads concerned.

c) As regards C-3 - Ayala intersection, although it still suffers an insufficient capacity for the traffic operation, it is desirable to start its operation as an at-grade intersection because it is tied up by the Manila-Cavite Reclamation Project and, moreover, it shows the lowest priority of all. And the construction of grade separation shall be taken into consideration after all of the related projects have been realized.

d) As regards C-3 - E. Rodriguez, it is desirable to start its operation as an at-grade intersection, because it has a little allowance for the traffic operation and it does not show higher priority in the investment.

4. If the technical and financial limitations require stage construction in the case of C-3, Section 1 (Southern part) should be launched upon first, followed by Section 2 (Northern part). And also the segments 8 and 9 shall have the priority over the segment 10.

CHAPTER 6 IMPLEMENTATION PROGRAM

6. IMPLEMENTATION PROGRAM

6.1 GENERAL

The economic evaluation in Chap. 5 has concluded that the project roads should be constructed as soon as possible.

The principal purpose of this chapter is to examine whether the construction of the project roads as recommended is financially viable, and to formulate the implementation program if viable. The process of preparing the implementation program is as shown in Fig. 6.1-1. The process consists mainly of the following steps.

1. Comparative analysis between highway funds and investment requirements of highway projects
   a. Forecast of highway funds
   b. Investment requirements of highway projects
   c. Comparative study between highway funds and investment requirements
2. Financial cost estimates by stage construction
3. Preparation of implementation schedule
4. Investment requirements

These steps mentioned above will be discussed in detail hereafter.

6.2 EXAMINATION OF GOVERNMENT'S FINANCIAL POSITION

6.2.1 Past Trend and Forecast of Government Spending in Infrastructure

Table 6.2-1 shows the transition of Gross National Product for the 1965-75 period. In the past decade, GNP has grown up at an annual rate of 4.2% to 9.8%, registering 9% growth once, 6% growth once, 5% growth five times, and 4% growth three times, respectively. This year, 1977, falls on the last year of the Four-Year Development Plan starting in 1974, and the economic growth seems to have been going well with the Plan.

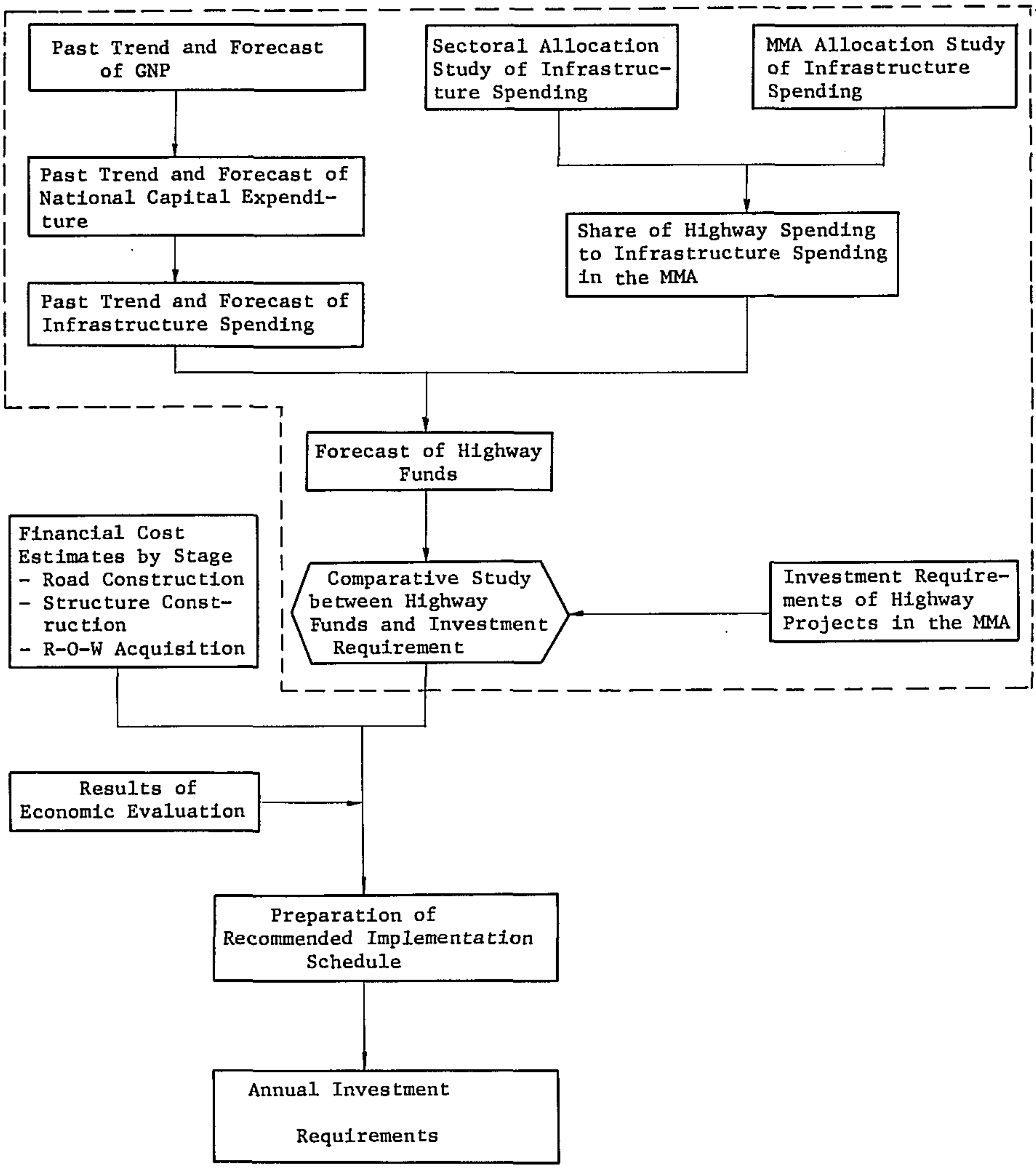


Fig. 6.1-1 General Approach for Preparation of Implementation Program

The ratio of national capital expenditure to GNP is shown in Table 6.2-2. The national capital expenditure includes the investments in the infrastructure. According to Table 6.2-2, the ratio is on a steady rise; from 1% level in 1970 and 1971, it had been shifted upward to a level of 5% in 1974 and 1975. It may be interpreted as the results of the Philippine Government's efforts to have promoted the piecing-out of social capital as one of selective measures under the Four-Year Development Plan.

The ratio of the infrastructural spending to the total national capital expenditure is shown in Table 6.2-3.

According to Table 6.2-3, the ratio has changed between 53% to 74% since 1970, marking a 70% level for two years, 60% level for three years and 50% level for one year, respectively.

On the basis of these past trends and on the projections by the National Economic and Development Authority (NEDA), the future spending in the national infrastructure is forecast in Table 6.2-4.

The GNP growth rate is predicated on NEDA's Revised Long-Term Development Plan, and is expected to be 7.4% for the 1976-82 period and 7.7% for the 1982-87 period.

According to these values, the future GNP will be ₱163,000 million in 1980 and ₱235,000 million in 1985 at 1975 prices. The infrastructural spending was thus estimated by making use of GNP projections along with GNP-to-national capital expenditure ratio and infrastructural spending-to-national capital expenditure ratio. With low projections, the infrastructual spending is estimated at ₱4,890 million in 1980 and ₱7,470 million in 1985, and with high projections, ₱5,700 million in 1980 and ₱8,720 million in 1985. With the World Bank's projections, on the other hand, it is estimated at ₱5,500 million in 1980 and ₱7,800 million in 1985, justifying our projections.

Table 6.2-1 Gross National Product 1965 ∿ 1975 at 1967 Prices (in Million Pesos)

	G N P	% INCREASE
1965	24,650	
1966	25,840	4.8
1967	27,348	5.8
1968	28,781	5.2
1969	30,468	5.9
1970	32,191	5.7
1971	34,190	6.2
1972	35,613	4.2
1973	39,102	9.8
1974	40,953	4.7
1975	43,389	5.9

Source: MMETROPLAN

Table 6.2-2 National Capital Expenditures and Gross National Product 1970 ∿ 1975 at Current Prices (in Million Pesos)

	National Capital Expenditure	G N P	%
1970	726	41,156	1.8
1971	671	49,599	1.3
1972	1217	55,526	2.2
1973	2288	71,616	3.2
1974	5626	99,631	5.6
1975	5676	114,072	5.0

Source: NEDA's Yearbook in 1977

Table 6.2-3 Government Infrastructure Spending and National Capital Expenditure 1970 ∿ 1975 at Current Prices

(in Million Pesos)

	Infrastructure Spending	Capital Expenditure	%
1970	538	726	74.1
1971	431	671	64.2
1972	804	1,217	66.1
1973	1,612	2,288	70.5
1974	2,992	5,626	53.2
1975	3,463	5,676	61.0

Source: NEDA's Year Book in 1977

Table 6.2-4 Summary of Projections of Government Infrastructure Spending 1975 ∿ 1985 (at 1975 Prices)

<table>
<tr><th rowspan="2"></th><th rowspan="2">NEDA Projection 1)</th><th rowspan="2">World Bank Projection 1)</th><th colspan="2">MMETROPLAN Projection 1)</th><th colspan="2">Study Team Projection</th></tr>
<tr><th>Low</th><th>High</th><th>Low</th><th>High</th></tr>
<tr><td>GNP growth rate 1975 ∿ 1985</td><td>8.0</td><td>7.0</td><td colspan="2">5.7</td><td colspan="2">'76∿'82 7.4 2)
'82∿'87 7.7 2)</td></tr>
<tr><td>GNP (Million ₱) 1980
1985</td><td>163,900
240,800</td><td>156,400
219,400</td><td colspan="2">147,200
194,200</td><td colspan="2">163,000
235,000</td></tr>
<tr><td>National Capital Expenditure as % of GNP 1980
1985</td><td>5.0
5.3</td><td>5.2
5.3</td><td colspan="2">5.0
5.3</td><td colspan="2">5.0
5.3</td></tr>
<tr><td>National Capital Expenditure (Million ₱) 1980
1985</td><td>8,200
12,800</td><td>8,100
11,600</td><td colspan="2">7,400
10,300</td><td colspan="2">8,150
12,455</td></tr>
<tr><td>Infrastructure Spending as % of N.C.E. 1980
1985</td><td>58.1
57.2</td><td>67.4
(67.4)</td><td>58.1
57.2</td><td>67.4
67.4</td><td>60.0
60.0</td><td>70.0
70.0</td></tr>
<tr><td>Infrastructure Spending (Million ₱) 1980
1985</td><td>4,800
7,300</td><td>5,500
(7,800)</td><td>4,300
5,900</td><td>5,000
6,900</td><td>4,890
7,470</td><td>5,700
8,720</td></tr>
</table>

Note: 1) METROPLAN Report

2) Reviced NEDA Forecast Projected on 1977

6.2.2 Forecast of Highway Funds in the Metro Manila Area

Table 6.2-5 shows sectoral allocations of the Government spending in the national infrastructure, and Table 6.2-6 the share by sector. From Tables 6.2-5 and 6.2-6, the following will be derived:

a. The spending in transportation was ₱311 million in 1970 and ₱2,105 million in 1976, a growth of 677%, showing a high rate of yearly increase.
On the other hand, the ratio of the expenditure in transport infrastructure to the total infrastructural spending has been on the decline since 1970, with 58% in 1970 as against 32% recorded in 1976.

b. Like the spending in transportation, the spending in highways has marked a high rate of growth. This is also demonstrated by the fact that the highways' share of expenditure in the transport sector shown in Table 6.2-7 has been moving at a high level of 81% to 83%.

Table 6.2-8 shows the inftrastructural spending by sector in the MMA, which includes 27 jurisdictions. Over the past three years, the infrastructural spending in the MMA accounted for 9.7% to 11.4% of the national total. In regard to the transport sector, the MMA accounted for 11% to 13% of the national total.

Table 6.2-9 shows the transition over the past three years of the ratio of highways to total infrastructural spending in the MMA. It ranged from 16% to 30%.

From all these past trends, the funds for the highways for the years 1980 and 1990 are estimated in Table 6.2-10. Namely, the highway funds for the year 1980 are estimated at ₱222 million with high projections, ₱145 million with medium projections and ₱88 million with low projections.

For the year 1985, the corresponding values are ₱340 million, ₱222 million, and ₱134 million, respectively. Judging from the ₱94 million to which the highway funds in the MMA amounted in 1975, the above estimates will be justifiable. Taking an escalation rate of 7% per annum, the yearly highway funds are estimated as shown in Table 6.2-11.

Table 6.2-5 National Government Infrastructure Spending-Sectoral Allocation 1970 ∿ 1976[1]/ (in Million Pesos at Current Prices)

	Fiscal Year						
	1970	1971	1972	1973	1974	1975	1976
Transport	311	293	378	716	676	1066	2105
highways	252	239	308	590	546	871	1743
railways	7	-	13	28	37	62	107
airports and airnavs	33	16	41	57	21	24	81
ports and harbours	19	38	16	41	72	109	174
Telecommunications	9	-	8	15	1	4	47
Water resources and flood control	84	104	95	231	366	699	1285
Power and electrifications	38	58	74	75	109	414	1686
Social infrastructures, misc. Public works and special projects	88	75	70	93	84	677	1425
Total	530	531	625	1130	1236	2860	6548

[1]/ Source: 1970 ∿ 1975, Actual expenditures, NEDA Infrastructure Staff
1976, Realigned Program, NEDA Infrastructure Staff

Note: 1976 figures are program estimates; actual domestic expenditure is usually 75 ∿ 80% of programmed expenditure.

Table 6.2-6 National Government Infrastructure Spending-Percentage Allocation by Sector 1970 ∿ 1976[1]/

	Fiscal Year						
	1970	1971	1972	1973	1974	1975	1976
Transport	58	55	60	63	55	37	32
highways	47	45	48	52	44	30	26
railways	1	-	2	2	3	2	2
airports and airnavs	6	3	7	5	2	1	1
ports and harbours	4	7	3	4	6	4	3
Telecommunications	2	-	1	1	0	0	1
Water resources and flood control	16	20	15	21	29	25	20
Power and electrifications	7	11	12	7	9	14	25
Social infrastructure, misc. Public works and special projects	17	14	12	8	7	24	22
Total	100	100	100	100	100	100	100

[1]/ Source: 1970 ∿ 1975, Actual expenditures, NEDA Infrastructure Staff
1976, Realigned Program, NEDA Infrastructure Staff

Note: 1976 figures are program estimates; actual domestic expenditure is usually 75 ∿ 80% of programmed expenditure.

Table 6.2-7 Highways and Railways Expenditure as a Percentage of Total Transport Sector Infrastructure Spending[1]/ (in Million Pesos at Current Prices)

	Highways	Railways	Highways and Railways	Transport Sector	%
1970	252	7	259	311	83
1971	239	0	239	293	82
1972	308	13	321	378	85
1973	590	28	618	716	86
1974	546	37	583	676	86
1975	871	62	933	1066	88
1976	1743	107	1850	2105	88

[1]/ Source: 1970 ∿ 1975, Actual expenditures, NEDA Infrastructure Staff
1976, Realigned Program, NEDA Infrastructure Staff

Note: 1976 figures are Program estimates; actual domestic expenditure is usually 75 ∿ 80% of programmed expenditure

Table 6.2-8 Allocation of *National* Government Infrastructure Spending to the Metro Manila Area [1]/
(in Million Pesos at Current Prices)

	1973/4			1974/5			1975/6		
	Phil.	MMA	%	Phil.	MMA	%	Phil.	MMA	%
Transport:	841	92	11	1645	173	11	1751	224	13
highways	639	28	4	1347	100	7	1361	94	7
railways	45	22	49	76	0	0	88	26	30
airports	45	10	22	96	36	38	141	46	33
ports and harbours	82	32	39	126	37	29	160	58	36
Telecommunications	19	7	37	20	3	15	33	11	34
Water resources	320	38	15	527	33	6	787	38	5
Flood control	155	12	8	221	74	33	372	133	36
Power and electrifications	271	0	0	821	0	0	732	0	0
Social infrastructure	131	20	15	243	43	18	379	50	13
Special projects	0	0	0	157	0	0	320	50	16
Miscellaneous	32	3	10	140	1	1	343	31	9
Total	1770	172	9.7	3374	327	9.7	4717	537	11.4

[1]/ Source: NEDA Infrastructure Program 1973/4, 74/5 and for FY 1975 the Program revised 24 November 1976, NEDA Infrastructure Staff. Note that actual expenditures are usually about 75% of the programmed figures.
Figures are given for the Philippines (PHIL) and the Metro Manila Area (MMA).

Table 6.2-9 Metro Manila Area: Government Infrastructure Spending-Percentage Allocation by Sector 1973 ∿ 1976[1]/

	1973/4	1974/5	1975/6
Transport	53	53	42
highways	16	31	18
railways	13	0	5
airports	6	11	9
ports and harbours	18	11	10
Telecommunications	4	0	2
Water resources and flood control	28	34	32
Power and electrifications	0	0	0
Public works and special projects	13	13	24
Total	100	100	100

[1]/ Source: NEDA Infrastructure Program

Table 6.2-10 Projection of Highway Funds for the MMA (In Million Pesos at 1975 Prices)

				In 1980			In 1985		
				Low	Medium	High	Low	Medium	High
National Infrastructure Fund				4890	5290	5700	7470	8090	8720
Study Area Funds	9%	Highways Funds	20%	88	95	103	134	146	157
			25%	110	119	128	168	182	196
			30%	159	143	154	202	218	235
	11%	Highways Funds	20%	108	116	125	164	178	192
			25%	134	145	157	205	222	240
			30%	161	175	188	247	267	288
	13%	Highways Funds	20%	127	138	148	194	210	227
			25%	159	172	185	243	263	283
			30%	191	206	222	291	316	340

Table 6.2-11 Projection of Highway Funds for the Study Area (MMA)
(In Million Pesos)

	Low Projection		Medium Projection		High Projection	
	1975 Price	Current Price	1975 Price	Current Price	1975 Price	Current Price
1978	74	79	122	131	187	200
1979	81	92	133	152	204	233
1980	88	115	145	190	222	291
1981	96	144	158	237	242	363
1982	104	167	172	277	263	423
1983	113	194	187	322	286	492
1984	123	225	203	371	311	569
1985	134	255	222	422	340	646
1986	146	307	242	508	370	777
1987	159	358	263	592	402	905
Total	1,118	1,936	1,847	3,202	2,827	4,899

Note: Annual inflation rate was assumed 7%.

6.2.3 Investment Requirements for Highway Projects in the MMA

The investment requirements for the highway projects including these project roads in the Metro Manila Area were established in October 1977 by the officers of DPWTC and DPH under the leadership of the infrastructural section's officers of NEDA. According to this Ten-Year Infrastructure Development Program (1978 ∿ 1987), ten foreign-assisted projects are planned with a foreign currency component of $44 million and local currency component of ₱798 million (See Appendix 6).

On the other hand, fourty-four locally funded projects amounting to ₱1,428 million are also planned.

Looking at these with reference to the Five-Year Investment Requirements (1978 ∿ 1982), the foreign-assisted projects will necessitate US$27.2 million in foreign currency and ₱492.5 million in local currency, and the locally funded projects ₱750.2 million.

In regard to the five years from 1983 to 1987, the foreign-assisted projects will require US$10.2 million in foreign currency and ₱203.7 million in local currency, and the locally funded projects ₱499.4 million.

6.2.4 Comparative Analysis between Investment Requirements and Highway Funds

As far as local funds are concerning, the highway funds projected in 6.2.2 and the investment requirements reviewed in 6.2.3 were subjected to comparative analysis over the ten-year period of 1978 to 1987. On the other hand, it was assumed that the foreign investment requirements of the foreign assisted projects will be funded fully. The results are as shown in Table 6.2-12.

For the first five-year period (1978 ∿ 1982);

Investment requirements	₱1,623 million
Highway funds	₱ 987 million

Namely, the funds are ₱636 million too short.

For the second five-year period (1983 ∿ 1987);

Investment requirements	₱1,605 million
Amount carried over from the first five-year period	₱ 636 million
Highway funds	₱2,215 million
Balance	₱ 25 million

A slight shortage of funds will still exist, but the financial position will be far better compared with the first five years. The above analysis suggests that the projects planned for the first five years be put over as long as possible, or undertaken in the second five years, if at all possible, through proper measures to offset such delay.

Table 6.2-12 Balance between Investment Requirements and Highway Funds (In Million Pesos)

	Investment Requirements	Amount of Escalation	Cumlative Investment Requirements	Highway Funds	Amount of Escalation	Cumlative Highway Funds	Balance
1978	300		300	131			- 169
1979	300	12	481	152			- 329
1980	321	23	673	190			- 483
1981	253	34	770	237			- 533
1982	343	37	913	277			- 636
five-year total	1,517	106	-	987			
1983	324	45	1,005	322			- 682
1984	362	48	1,092	371			- 721
1985	256	50	1,027	422			- 605
1986	138	42	785	508			- 277
1987	321	19	617	592			- 25
five-year total	1,401	204		2,215			

6.3 IMPLEMENTATION SCHEDULE

6.3.1 General

Chapter 5 has been devoted to the economic evaluation of the project roads, and para. 6.2 of the present chapter to the discussions of the highway funds availability. As a result, the following conclusions have been reached.

1. Results of economic evaluation

    a. The project roads should be constructed as soon as possible.

    b. For the C-3 part of the project roads, the six-lane road is most feasible irrespective of whether bus lanes are introduced or not.
    For R-4 and its related roads, the construction of either 4-lane or 6-lane structure is most feasible from the economic viewpoint.

    c. Of the project roads, the southern section (Ayala-Buendia Intersection to Quezon Blvd. - C-3 Intersection) of the C-3 Road is given the highest priority, followed by the northern section of the C-3 Road. Ranked the lowest in priority are R-4 and its related roads.

    d. The grade-separation is feasible, but the economic indicators are generally low, except for Quezon-C-3 Intersection.

2. Availability of highway funds

    a. If the projects are implemented true to the Ten-Year Infrastructure Development Program for the MMA prepared by the Philippine Government, the first five years from 1978 to 1982 will meet with a deficit spending, or else a sharp reduction of the investments in the projects or a planned delay of project implementation should be made.

    b. In the second five-year period from 1983 to 1987, the highway funds leave a slight margin, and some of the projects scheduled for the first five-year period may as well be put off till the second period.

In view of what the conclusions reached above, the implementation schedule of the project is discussed hereunder.

6.3.2 Stage Construction Plan

The stage construction plan has been discussed in full detail in Chap. 5. Here are recited the findings by way of precaution.
The following plans are available for the phased implementation of the project.

1. Stage construction by road section
2. Stage construction by cross-sectional profile of road

3. Stage construction in the priority order of upgrading the major intersections from at-grade to grade-separation

In implementing the project, however, a stage construction plan in which the above three schemes are properly combined should be mapped out. As already noted in para. 6.3.1, "GENERAL", this is due to the fact that, although the project should preferably be implemented right away as the economics dictate, the financial sinews are not enough to sustain the accelerated construction. Thus, the stage construction is planned as follows:

Regarding the stage construction by road section, the project road is divided into the following three sections:

(1) southern section of C-3 Road (Section 1),

(2) northern section of C-3 Road (Section 2), and

(3) R-4 and its related roads (Section 3)

Regarding the stage construction by cross-sectional profile of the road, it is planned that: (1) for the 6-lane roads, the 4-lane strip should be constructed tentatively, (2) two additional lanes should be constructed if the four-lane roads have been put into full swing as a road network, that is, when the traffic demand has been increased enough to justify such additional construction, and (3) the existing unimproved roads alone should be improved first, leaving those which can satisfactorily stand the duty for some time now till later on, and the major intersections should be constructed of the at-grade type for the time being and modified into grade-separated type to suit the occasion after completion of the roads.

With these considerations in mind, the following stage construction is proposed.

For the stage construction, the following four phases are set:

Phase 1: Southern section of C-3 Road

Phase 2: Northern section of C-3 Road

Phase 3: R-4 and its related roads

Phase 4: Grade separation of four major intersections

The concept of stage construction is incorporated into each of these phases as follows:

a. Phase 1: Southern section of C-3 Road

Stage 1: To be constructed to have four lanes tentatively provided that the bridges will have six lanes from the outset, and that only that part of the existing Aurora Blvd. to Quezon Blvd. section which is left unimproved will be improved.

Stage 2: Construction of two additional lanes after commencement for use with tentative four-lane network.

b. Phase 2: Northern section of C-3 Road

Stage 1: Improvement of that part existing between Segments 7 and 9 which is left unimproved. (This will complete the road network.)

Stage 2: Widening construction of Segments 7 and 8 according to plan 3 of C-3. (incl. the underpass at C-3-Quezon Blvd. intersection)

Stage 3: Construction of Balintawak Road

c. Phase 3: R-4 and its related roads

Stage 1: Construction of Segment 11

Stage 2: Construction of Segment 12

Stage 3: Construction of Segment 13

d. Phase 4: Grade separation

Reconstruction of the major intersections into grade-separated type, except for Quezon Blvd. intersection.

Stage 1 in Phase 1 is further divided into substages as described in the implementation program.

6.3.3 Financial Construction Costs

The estimate of construction costs has been discussed at large in Chap. 4. The construction costs include those for the acquisition of land and properties, construction of roads and structures, detailed engineering and construction management.

The costs for the construction of roads and structures, detailed engineering and construction management are subdivided into foreign and local currency components and taxes, and the acquisition of land and properties is assumed to be financed out of local currency only.

The financial construction costs for the project are as itemized below:

Southern section of C-3 Road	(in 1977 price)
Right-of-way acqusition	96,821 thousand pesos
Construction	131,543 thousand pesos
* Roadway	81,941 thousand pesos
* Structure	49,602 thousand pesos
Sub-total	228,364 thousand pesos
Detailed engineering and Construction supervision	18,269 thousand pesos
Total	246,633 thousand pesos

Northern section of C-3 Road

Right-of-way acquisition	61,310 thousand pesos
Construction	47,853 thousand pesos
* Roadway	40,945 thousand pesos
* Structure	6,908 thousand pesos
Sub-total	109,163 thousand pesos
Detailed engineering and construction supervision	8,733 thousand pesos
Total	117,896 thousand pesos

R-4 and its related roads

Right-of-way acquisition	42,505 thousand pesos
Construction	95,289 thousand pesos
* Roadway	55,685 thousand pesos
* Structure	39,604 thousand pesos
Sub-total	137,794 thousand pesos
Detailed engineering and construction supervision	11,024 thousand pesos
Total	148,818 thousand pesos

6.3.4 Implementation Schedule

According to the stage construction plan and financial cost estimates discussed in the foregoing, it is judged desirable that the project roads be constructed in accordance with the implementation program specified in Figs. 6.3-1 through 6.3-3.

This judgement is predicated on the financial restrictions and economic priority.

In Phase 1, the tasks will be undertaken as scheduled below.

May 1977 - Mar. 1978	Feasibility study
Dec. 1977 - Jul. 1978	Negotiation
Aug. 1978 - Jul. 1979	Detailed engineering
Jul. 1979 - Dec. 1982	Right-of-way-acquisition
Oct. 1979 - Sep. 1983	Construction of tentative four-lane roads
Oct. 1983 - Sep. 1985	Expansion to originally projected roads

Phase 2 is as shown in Fig. 6.3-2. The grade separation of the major intersections is planned to come after 1987 when the C-3 Road will be commenced for use with six lanes.

6.4 INVESTMENT PLAN

The investment requirements for the project according to the implementation schedule discussed in para. 6.3 are summarized in Table 6.4-1.

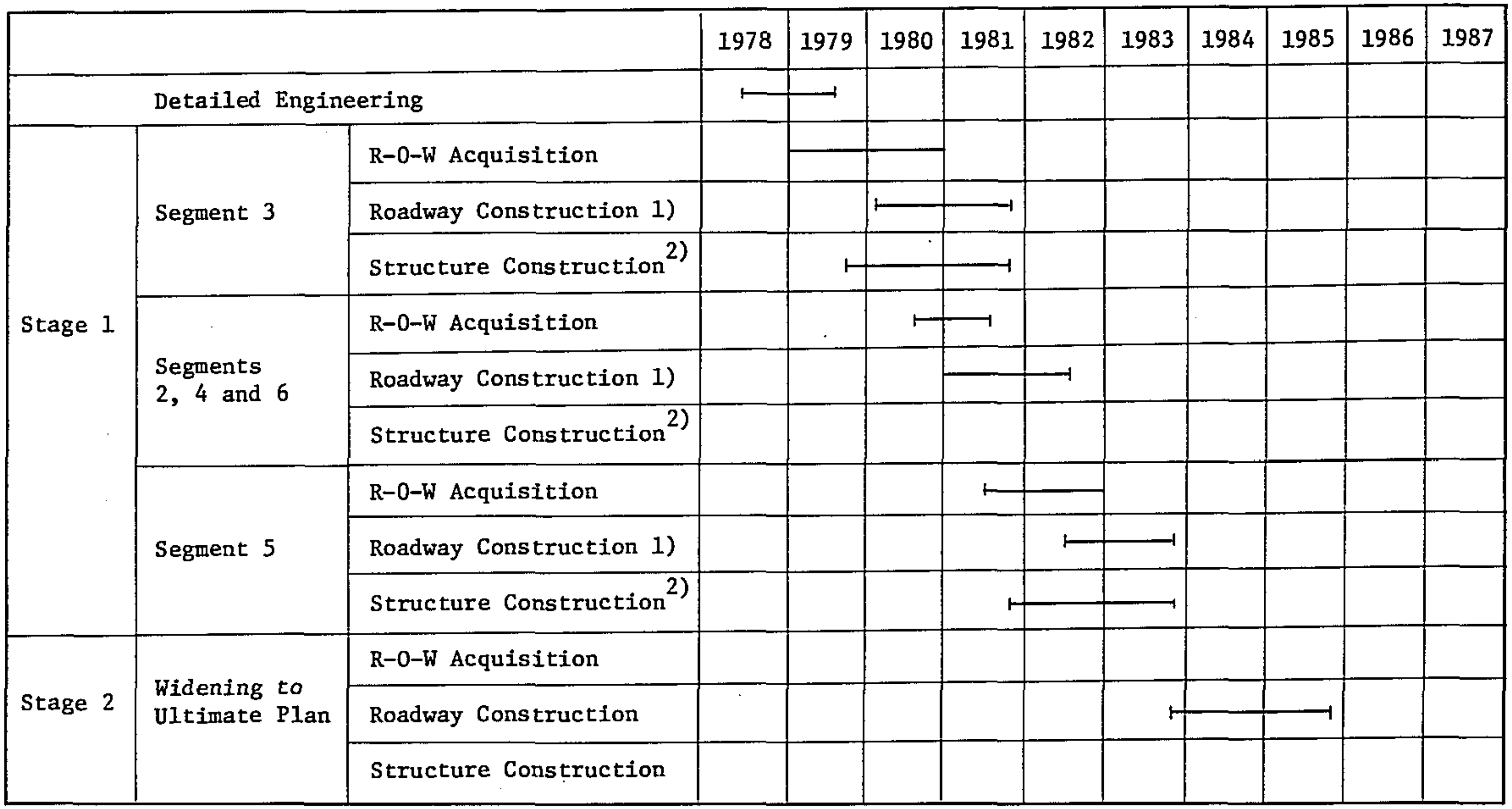
The financial project costs for Phase 1 (southern section of C-3 Road) will amount to ₱323 million (US$44 million) of which ₱226 million (US$31 million) will be accounted for by the local currency and ₱97 million (US$13 million) by the foreign currency.

The financial project costs for Phase 2 (northern section of C-3 Road) are estimated to amount to ₱191 million (US$26 million) of which ₱153 million (US$21 million) will be accounted for by the local currency and ₱38 million (US$5 million) by the foreign currency.

For Phase 3, a total ₱268 million (US$37 million) investments will be required.

Tables 6.4-2 through 6.4-5 show the financial costs for detailed engineering, right-of-way acquisition, roadway construction and the construction of structures. Tables 6.4-6 through 6.4-10 show the yearly investment requirments in terms of local and foreign currency components.

Fig. 6.3-1 Recommended Implementation Schedule for Phase 1
(Southern Part of C-3 Road)



Notes: 1) 4-lane road should be constructed as stage construction plan.

2) 6-lane road should be constructed as ultimate plan.

Fig. 6.3-2 Recommended Implementation Schedule for Phase 2 (Northern Part of C-3 Road)

		1982	1983	1984	1985	1986	1987	1988	1989
Detailed Engineering									
Stage 1 (Seg. 9 and Improvement of Seg. 7)	R-O-W Acquisition								
	Roadway Construction								
	Structure Construction								
Stage 2 (Widening of Seg. 7 & 8)	R-O-W Acquisition								
	Roadway Construction								
	Structure Construction								
Stage 3 (Seg. 10)	R-O-W Acquisition								
	Roadway Construction								
	Structure Construction								

Fig. 6.3-3 Recommended Implementation Schedule for Phases 3 and 4

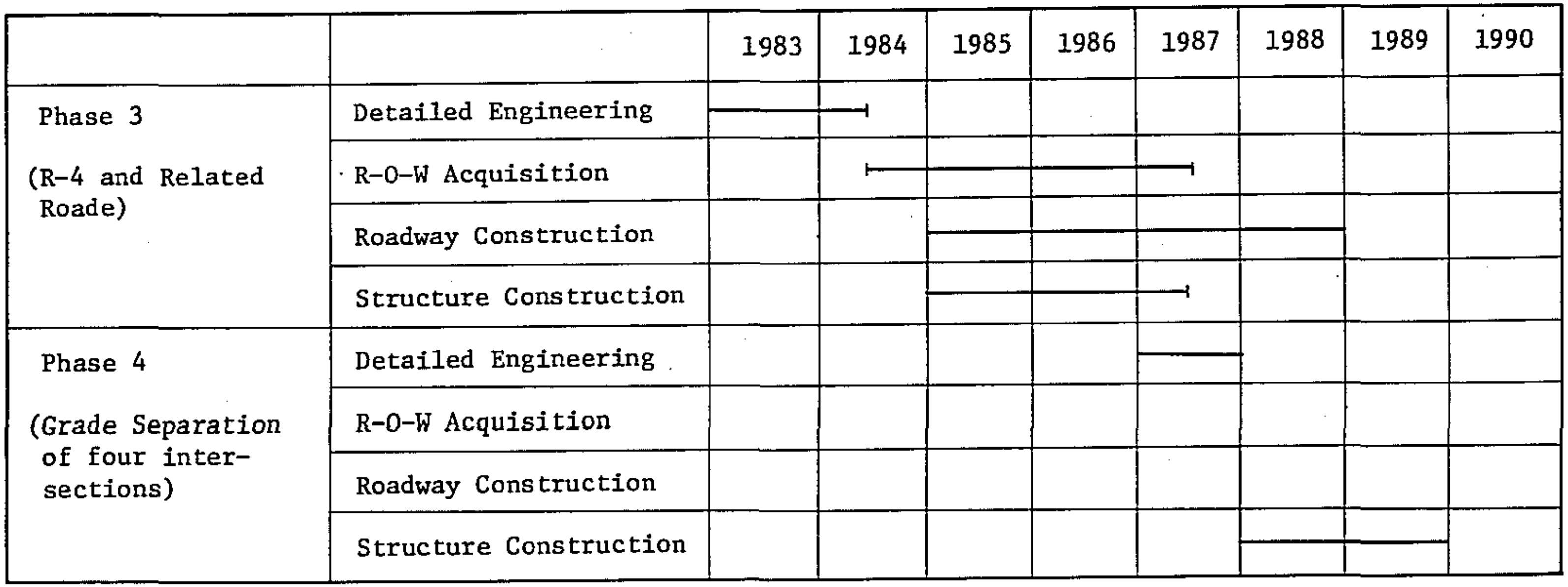


Table 6.4-1 Summary of Financial Project Costs
(Thousand Pesos at Current Prices)

	Total Project Costs	Foreign	Local	Remarks
Phase 1	₱ 323,000 $ 44,250	₱ 97,250 $ 13,320	₱ 225,750 $ 30,930	Southern Part of C-3 Road
Stage 1	₱ 265,080 $ 36,310	₱ 71,920 $ 9,850	₱ 193,160 $ 26,460	
Stage 2	₱ 57,920 $ 7,930	₱ 25,330 $ 3,470	₱ 32,590 $ 4,460	
Phase 2	₱ 191,410 $ 26,220	₱ 38,080 $ 5,220	₱ 153,330 $ 21,000	Northern Part of C-3 Road
Stage 1	₱ 48,220 $ 6,600	₱ 7,400 $ 1,010	₱ 40,820 $ 5,590	
Stage 2	₱ 78,350 $ 10,730	₱ 23,130 $ 3,170	₱ 55,220 $ 7,560	
Stage 3	₱ 64,880 $ 8,890	₱ 7,550 $ 1,040	₱ 57,330 $ 7,850	
Phase 3	₱ 268,120 $ 36,730	₱ 98,710 $ 13,520	₱ 169,410 $ 23,210	R-4 and Related Roads
Phase 4	₱ 148,220 $ 20,300	₱ 84,970 $ 11,640	₱ 63,250 $ 8,660	Grade Separation of Four Intersections
Total	₱ 930,750 $ 127,500	₱ 319,010 $ 43,700	₱ 611,740 $ 83,800	

Notes: 1) Financial project costs include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

3) Exchange rate is assumed as follows:

1US$ = 7.3₱

Table 6.4-2 Financial Project Costs for Phase 1
(Thousand Pesos at Current Prices)

	Foreign	Local	Total
Detailed Engineering and Supervision	6,523	6,523	13,046
R-O-W Acquisition		124,954	124,954
Construction	90,728	94,269	184,997
(Roadway)	52,147	69,458	121,605
(Structure)	38,581	24,811	63,392
Total	97,251	225,746	322,997

Table 6.4-3 Financial Project Costs for Phase 2
(Thousand Pesos at Current Prices)

	Foreign	Local	Total
Detailed Engineering and Supervision	2,589	2,590	5,179
R-O-W Acquisition		103,865	103,865
Construction	35,485	46,878	82,363
(Roadway)	30,347	41,147	71,494
(Structure)	5,138	5,731	10,869
Total	38,074	153,333	191,407

Table 6.4-4 Financial Project Costs for Phase 3
(Thousand Pesos at Current Prices)

	Foreign	Local	Total
Detailed Engineering and Supervision	6,563	6,564	13,127
R-O-W Acquisition		76,229	76,229
Construction	92,144	86,620	178,764
(Roadway)	46,203	60,068	106,271
(Structure)	45,941	26,552	72,493
Total	98,707	169,413	268,120

Table 6.4-5 Financial Project Costs for Phase 4
(Thousand Pesos at Current Prices)

	Foreign	Local	Total
Detailed Engineering and Supervision	5,253	5,252	10,505
Construction	79,714	57,999	137,713
Total	84,967	63,251	148,218

Table 6.4-6 Annual Investment Requirements for Phase 1
(Southern Section of C-3 Road)
(Thousand Pesos at Current Prices)

Year	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
	Local	Foreign	Local	Total	Foreign	Local	Total
1978		1,407	1,407	2,814	1,407	1,407	2,814
1979	16,111	5,221	3,568	8,789	5,221	19,679	24,900
1980	30,242	19,611	13,743	33,354	19,611	43,985	63,596
1981	40,801	24,038	22,227	46,265	24,038	63,028	87,066
1982	37,800	11,728	14,807	26,535	11,728	52,607	64,335
1983		12,811	16,166	28,977	12,811	16,166	28,977
1984		12,512	16,097	28,609	12,512	16,097	28,609
1985		9,923	12,777	22,700	9,923	12,777	22,700
Total	124,954	97,251	100,792	198,043	97,251	225,746	322,997

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

Table 6.4-7 Annual Investment Requirements for Phase 2 (Northern Section of C-3 Road) (Thousand Pesos at Current Prices)

Year	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
	Local	Foreign	Local	Total	Foreign	Local	Total
1982		1,161	1,161	2,322	1,161	1,161	2,322
1983	20,178	249	249	498	249	20,427	20,676
1984	23,384	7,986	10,452	18,438	7,986	33,836	41,822
1985	13,466	21,164	27,053	48,217	21,164	40,519	61,683
1986	46,837	274	335	609	274	47,172	47,446
1987		7,240	10,218	17,458	7,240	10,218	17,458
Total	103,865	38,074	49,468	87,542	38,074	153,333	191,407

Notes: 1) Annual investment requirements include the detailed engineering and construction.

2) A 7 per cent of escalation rate is considered in this calculation.

Table 6.4-8 Annual Investment Requirements for Phase 3
(R-4 and Related Roads)
(Thousand Pesos at Current Prices)

	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
Year	Local	Foreign	Local	Total	Foreign	Local	Total
1983		1,907	1,907	3,814	1,907	1,907	3,814
1984	13,351	1,021	1,021	2,042	1,021	14,372	15,393
1985	18,860	23,813	22,602	46,415	23,813	41,462	65,275
1986	23,797	33,784	27,238	61,022	33,784	51,035	84,819
1987	20,221	24,481	22,807	47,288	24,481	43,028	67,509
1988		13,701	17,609	31,310	13,701	17,609	31,310
Total	76,229	98,707	93,184	191,891	98,707	169,413	268,120

Notes: 1) Annual investment requirements include the detailed engineering and construction.

2) A 7 per cent of escalation rate is considered in this calculation.

Table 6.4-9 Annual Investment Requirements for Phase 4
(Grade Separation of Four Intersections)
(Thousand Pesos at Current Prices)

	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
Year	Local	Foreign	Local	Total	Foreign	Local	Total
1987		2,488	2,488	4,976	2,488	2,488	4,976
1988		39,833	29,346	69,179	39,833	29,346	69,179
1989		42,646	31,417	74,063	42,646	31,417	74,063
Total		84,967	63,251	148,218	84,967	63,251	148,218

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

Table 6.4-10 Annual Investment Requirements for the Project Roads (Thousand Pesos at Current Prices)

Year	R-O-W Acquisition	Construction & Detailed Engineering & Supervision			Total Project Costs		
	Local	Foreign	Local	Total	Foreign	Local	Total
1978		1,407	1,407	2,814	1,407	1,407	2,814
1979	16,111	5,221	3,568	8,789	5,221	19,679	24,900
1980	30,242	19,611	13,743	33,354	19,611	43,985	63,596
1981	40,801	24,038	22,227	46,265	24,038	63,028	87,066
1982	37,800	12,889	15,968	28,857	12,889	53,768	66,657
1983	20,178	14,967	18,322	33,289	14,967	38,500	53,467
1984	36,735	21,519	27,570	49,089	21,519	64,305	85,824
1985	32,326	54,900	62,432	117,332	54,900	94,758	149,658
1986	70,634	34,058	27,573	61,631	34,058	98,207	132,265
1987	20,221	34,209	35,513	69,722	34,209	55,734	89,943
1988		53,534	46,955	100,489	53,534	46,955	100,489
1989		42,646	31,417	74,063	42,646	31,417	74,063
Total	305,048	318,999	306,695	625,694	318,999	611,743	930,742

Notes: 1) Annual investment requirements include the detailed engineering and construction supervision.

2) A 7 per cent of escalation rate is considered in this calculation.

APPENDIX

Appendix 1.1 Undiscounted Benefits by Plan (1983)
(1977 Price)

Unit: ₱1,000/year

		Plan 1	Plan 2	Plan 3	Plan 4
Normal Traffic	Time Saving	6,176	10,172	9,384	10,400
	Saving in Running Cost	3,646	5,950	7,096	8,214
	Saving in Fixed Cost	1,320	2,203	2,394	2,659
	Sub-total	11,142	18,925	18,874	21,273
Diverted Traffic	Time Saving	34,136	53,597	45,158	49,534
	Saving in Running Cost	16,370	26,476	33,435	43,993
	Saving in Fixed Cost	8,255	12,674	11,490	12,543
	Sub-total	58,761	92,747	90,083	106,070
Non-diverted Traffic	Time Saving	31,480	52,816	55,350	56,760
	Saving in Running Cost	9,599	19,724	21,010	21,683
	Saving in Fixed Cost	6,765	11,344	12,029	12,337
	Sub-total	47,844	83,884	88,389	90,780
Total		117,747	194,956	197,346	218,123

Appendix 1.2 Undiscounted Benefits by Plan (1990)
(1977 Price)

Unit: ₱1,000/year

		Plan 1	Plan 2	Plan 3	Plan 4
Normal Traffic	Time Saving	8,096	20,543	18,496	21,882
	Saving in Running Cost	4,606	11,739	13,890	17,617
	Saving in Fixed Cost	1,785	4,548	4,825	5,709
	Sub-total	14,487	36,830	37,211	45,208
Diverted Traffic	Time Saving	38,008	96,873	79,650	94,236
	Saving in Running Cost	20,096	51,221	57,621	92,815
	Saving in Fixed Cost	8,498	21,658	19,160	22,669
	Sub-total	66,602	169,752	156,431	209,720
Non-diverted Traffic	Time Saving	47,806	121,797	125,700	130,402
	Saving in Running Cost	22,699	57,832	60,000	62,244
	Saving in Fixed Cost	10,261	26,141	27,450	28,477
	Sub-total	80,766	205,770	213,150	221,123
Total		161,855	412,352	406,792	476,051

Appendix 1.3 Undiscounted Benefits by Plan (2000)

Unit: ₱1,000/year

		Plan 1	Plan 2	Plan 3	Plan 4
Normal Traffic	Time Saving	9,181	27,168	21,553	25,578
	Saving in Running Cost	5,212	15,424	17,353	20,593
	Saving in Fixed Cost	4,090	12,102	11,246	13,346
	Sub-total	18,483	54,694	50,152	59,517
Diverted Traffic	Time Saving	37,342	110,499	92,823	110,154
	Saving in Running Cost	22,623	66,942	91,424	108,495
	Saving in Fixed Cost	18,413	54,491	44,657	52,996
	Sub-total	78,378	231,932	228,904	271,645
Non-diverted Traffic	Time Saving	50,680	147,583	145,834	173,063
	Saving in Running Cost	24,065	70,074	69,244	82,174
	Saving in Fixed Cost	21,755	63,350	62,261	73,886
	Sub-total	96,500	281,007	277,339	329,123
Total		193,361	567,633	556,396	660,285

Appendix 2.1 Undiscounted Benefits by Vehicle Type (1983)
(1977 Price)

Unit: ₱1,000/year

		Plan 2	Plan 3
Bus, Jeepney	Time Saving	33,834	43,105
	Saving in Running Cost	10,716	15,635
	Saving in Fixed Cost	13,306	16,579
	Sub-total	57,856	75,319
Car	Time Saving	82,751	66,787
	Saving in Running Cost	41,434	45,906
	Saving in Fixed Cost	12,915	9,334
	Sub-total	137,100	122,027
Total	Time Saving	116,585	109,892
	Saving in Running Cost	52,150	61,541
	Saving in Fixed Cost	26,221	25,913
	Total	194,956	197,346

Appendix 2.2 Undiscounted Benefits by Vehicle Type (1990)
(1977 Price)

Unit: ₱1,000/year

		Plan 2	Plan 3
Bus, Jeepney	Time Saving	56,367	65,264
	Saving in Running Cost	13,046	17,304
	Saving in Fixed Cost	22,792	25,816
	Sub-total	92,205	108,384
Car	Time	182,846	158,582
	Saving in Running Cost	107,746	114,207
	Saving in Fixed Cost	29,555	25,619
	Sub-total	320,147	298,408
Total	Time Saving	239,213	223,846
	Saving in Running Cost	120,792	131,511
	Saving in Fixed Cost	52,347	51,435
	Total	412,352	406,792

Appendix 3.1 Undiscounted Benefits by Section (1983)
(1977 Price)

Unit: ₱1,000/year

		Section 1	Section 2
Normal Traffic	Time Saving	1,351	7,740
	Saving in Running Cost	1,958	2,773
	Saving in Fixed Cost	560	1,813
	Sub-Total	3,869	12,326
Diverted Traffic	Time Saving	42,489	11,520
	Saving in Running Cost	35,641	5,218
	Saving in Fixed Cost	15,799	1,995
	Sub-Total	93,929	18,733
Non-Diverted Traffic	Time Saving	21,819	10,261
	Saving in Running Cost	9,392	4,404
	Saving in Fixed Cost	8,372	3,916
	Sub-Total	39,583	18,581
Total		137,381	49,640

Appendix 3.2 Undiscounted Benefits by Section (1990)
(1977 Price)

Unit: ₱1,000/year

		Section 1	Section 2
Normal Traffic	Time Saving	2,739	15,695
	Saving in Running Cost	4,381	6,205
	Saving in Fixed Cost	1,127	3,650
	Sub-Total	8,247	25,550
Diverted Traffic	Time Saving	97,761	23,360
	Saving in Running Cost	71,729	11,680
	Saving in Fixed Cost	28,975	4,015
	Sub-Total	198,465	39,055
Non-Diverted Traffic	Time Saving	43,564	20,805
	Saving in Running Cost	21,707	9,855
	Saving in Fixed Cost	15,406	7,884
	Sub-Total	80,677	38,544
Total		287,389	103,149

Appendix 3.3 Undiscounted Benefits by Section (2000)
(1977 Price)

Unit: ₱1,000/year

		Section 1	Section 2
Normal Traffic	Time Saving	3,730	21,377
	Saving in Running Cost	6,112	8,656
	Saving in Fixed Cost	1,532	4,962
	Sub-Total	11,374	34,995
Diverted Traffic	Time Saving	137,241	31,817
	Saving in Running Cost	97,506	16,296
	Saving in Fixed Cost	37,387	5,458
	Sub-Total	273,134	53,571
Non-Diverted Traffic	Time Saving	59,096	28,336
	Saving in Running Cost	30,504	13,749
	Saving in Fixed Cost	20,431	10,718
	Sub-Total	110,031	52,803
Total		394,539	141,369

Appendix 4 Undiscounted Benefits by Intersection (Alternative 1)
(1977 Price)

Unit: ₱1,000/year

		Buendia -Ayala	C-3 -Shaw Blvd.	C-3 -Aurora Blvd.	C-3 -E.Rodriguez Ave.	C-3 -Quezon Blvd.
Time Benefit	1983	1,231	1,147	1,595	1,012	1,401
	1990	1,687	1,879	2,818	1,574	1,556
Saving in Running Cost (Including idling cost)	1983	1,528	1,466	2,130	1,287	1,666
	1990	1,679	1,870	2,804	1,566	1,728
Saving in Fixed Cost	1983	265	246	343	218	301
	1990	362	404	605	338	353
Total	1983	3,024	2,859	4,067	2,517	3,368
	1990	3,728	4,153	6,227	3,478	3,638

Appendix 5.1 Stream of Undiscounted Benefit and Cost by Plan

Unit: ₱1,000

(1) Plan 2			(2) Plan 3		
YEAR	BENEFIT	COST	YEAR	BENEFIT	COST
1977	0	0	1977	0	0
1978	0	0	1978	0	0
1979	0	0	1979	0	0
1980	0	99,137	1980	0	99,137
1981	0	155,833	1981	0	155,833
1982	0	72,592	1982	0	72,592
1983	194,956	1,122	1983	197,346	1,122
1984	226,013	1,122	1984	227,267	1,122
1985	257,069	1,122	1985	257,188	1,122
1986	288,126	1,122	1986	287,109	1,122
1987	319,182	1,122	1987	317,030	1,122
1988	350,238	1,122	1988	346,951	1,122
1989	381,295	1,122	1989	376,872	1,122
1990	412,352	1,122	1990	406,793	1,122
1991	427,880	1,122	1991	421,752	1,122
1992	443,408	1,122	1992	436,712	1,122
1993	458,936	1,122	1993	451,672	1,122
1994	474,465	1,122	1994	466,632	1,122
1995	489,993	1,122	1995	481,592	1,122
1996	505,521	1,122	1996	496,552	1,122
1997	521,049	1,122	1997	511,512	1,122
1998	536,577	1,122	1998	526,472	1,122
1999	552,105	1,122	1999	541,432	1,122
2000	567,633	1,122	2000	556,392	1,122
2001	583,161	1,122	2001	571,352	1,122
2002	598,689	1,122	2002	586,312	1,122
2003	614,217	1,122	2003	601,272	1,122
2004	629,745	1,122	2004	616,232	1,122
2005	645,273	1,122	2005	631,192	1,122
2006	660,801	1,122	2006	646,152	1,122
2007	676,329	1,122	2007	661,112	1,122

Appendix 5.2 Stream of Undiscounted Benefit and Cost by Section (C-3 Road)

Unit: ₱1,000

(1) Section 1			(2) Section 2		
YEAR	BENEFIT	COST	YEAR	BENEFIT	COST
1977	0	0	1977	0	0
1978	0	0	1978	0	0
1979	0	0	1979	0	0
1980	0	66,420	1980	0	2,107
1981	0	103,254	1981	0	11,360
1982	0	52,598	1982	0	9,253
1983	137,381	953	1983	14,595	78
1984	158,811	953	1984	16,901	78
1985	180,240	953	1985	19,208	78
1986	201,670	953	1986	21,514	78
1987	223,100	953	1987	23,820	78
1988	244,529	953	1988	26,126	78
1989	265,959	953	1989	28,433	78
1990	287,389	953	1990	30,740	78
1991	298,103	953	1991	31,892	78
1992	308,817	953	1992	33,044	78
1993	319,531	953	1993	34,196	78
1994	330,245	953	1994	35,348	78
1995	340,959	953	1995	36,500	78
1996	351,673	953	1996	37,652	78
1997	362,387	953	1997	38,804	78
1998	373,101	953	1998	39,956	78
1999	383,815	953	1999	41,108	78
2000	394,529	953	2000	42,260	78
2001	405,243	953	2001	43,412	78
2002	415,957	953	2002	44,564	78
2003	426,671	953	2003	45,716	78
2004	437,385	953	2004	46,868	78
2005	448,099	953	2005	48,020	78
2006	458,813	953	2006	49,172	78
2007	469,527	953	2007	50,324	78

Appendix 5.3 Stream of Undiscounted Benefit and Cost by Section (R-4 and Related Roads)

Unit: ₱1,000

(1) Section 3			(2) Section 4		
YEAR	BENEFIT	COST	YEAR	BENEFIT	COST
1977	0	0	1977	0	0
1978	0	0	1978	0	0
1979	0	0	1979	0	0
1980	0	24,977	1980	0	10,275
1981	0	51,804	1981	0	20,585
1982	0	26,827	1982	0	10,309
1983	36,268	536	1983	7,854	79
1984	40,189	536	1984	8,935	79
1985	44,111	536	1985	10,017	79
1986	48,032	536	1986	11,099	79
1987	51,954	536	1987	12,179	79
1988	55,875	536	1988	13,261	79
1989	59,797	536	1989	14,343	79
1990	63,718	536	1990	15,424	79
1991	65,679	536	1991	15,965	79
1992	67,640	536	1992	16,506	79
1993	69,601	536	1993	17,047	79
1994	71,562	536	1994	17,588	79
1995	73,523	536	1995	18,129	79
1996	75,484	536	1996	18,670	79
1997	77,445	536	1997	19,211	79
1998	79,406	536	1998	19,752	79
1999	81,367	536	1999	20,293	79
2000	83,328	536	2000	20,834	79
2001	85,289	536	2001	21,375	79
2002	87,250	536	2002	21,916	79
2003	89,211	536	2003	22,457	79
2004	91,172	536	2004	22,998	79
2005	93,133	536	2005	23,539	79
2006	95,094	536	2006	24,080	79
2007	97,055	536	2007	24,621	79

Appendix 6 Ten-Year Infrastructure Development Program by 1978∿1987
Investment Requirements
(In Thousand)

1/ Project Identified
2/ Pre-feasibility Study Completed
3/ Feasibility Study Completed
4/ Funding for Construction Committed
5/ Detailed Engineering Completed
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Invest-ment	Total during 1978∿1987	Yearly Investments										Later Years	Aver-age % Porex	Remarks
				1978	1979	1980	1981	1982	1983	1984	1985	1986	1987			
Region IV																
I FOREIGN ASSISTED	₱ 921,960 $ 49,463	123,725 5,458	798,235 44,005	97,238 5,330	129,562 5,130	158,735 8,760	51,000 4,550	56,000 3,400	60,900 1,700	83,900 4,200	58,900 4,335			102,000 6,600		
A. On-going	389,260 17,448	123,725 5,458	265,535 11,990	97,238 5,330	107,262 3,530	61,035 3,130										
1. Urban Project Three Major Interchanges:	98,260 3,538	68,010 2,438	30,250 1,100		30,250 1,100											
a. Cubao Interchange Quezon City	30,695 1,026	21,445 726	9,250 300		9,250 300										25	
b. Shaw Boulevard Interchange	25,030 684	18,530 484	6,500 200		6,500 200										20	
c. Manila South Expressway (MSE) Interchange	42,535 1,828	28,035 1,228	14,500 600		14,500 600										34	
2. Radial Road 10, C-1 to Dagat-Dagatan Spine Road	127,000 6,040	5,000	122,000 6,040	39,000 2,270	45,000 1,570	38,000 2,200										
3. *Circumferential Road* 2 R-10 to Laong Laan	32,000 1,470		32,000 1,470	10,000 335	10,000 335	12,000 800										
4. Traffic Engineering & Mgt. (*Metro Manila*)	132,000 6,400	50,715 3,020	81,285 3,380	48,238 2,725	22,012 525	11,035 130										
a. Transport & Traffic Improvement Including Cordon-Pricing	113,550 5,340	43,750 2,540	69,800 2,800	43,750 2,500	17,825 300	8,225									35	
b. Technical Assistance	18,450 1,060	6,965 480	11,485 580	4,488 225	4,187 225	2,810 130									40	
B. New	532,700 32,015		532,700 32,015		22,300 1,600	97,700 5,630	51,000 4,550	56,000 3,400	60,900 1,700	83,900 4,200	58,900 4,335			102,000 6,600		

Appendix 5.3 Stream of Undiscounted Benefit and Cost by Section (R-4 and Related Roads)

Unit: ₱1,000

(1) Section 3			(2) Section 4		
YEAR	BENEFIT	COST	YEAR	BENEFIT	COST
1977	0	0	1977	0	0
1978	0	0	1978	0	0
1979	0	0	1979	0	0
1980	0	24,977	1980	0	10,275
1981	0	51,804	1981	0	20,585
1982	0	26,827	1982	0	10,309
1983	36,268	536	1983	7,854	79
1984	40,189	536	1984	8,935	79
1985	44,111	536	1985	10,017	79
1986	48,032	536	1986	11,099	79
1987	51,954	536	1987	12,179	79
1988	55,875	536	1988	13,261	79
1989	59,797	536	1989	14,343	79
1990	63,718	536	1990	15,424	79
1991	65,679	536	1991	15,965	79
1992	67,640	536	1992	16,506	79
1993	69,601	536	1993	17,047	79
1994	71,562	536	1994	17,588	79
1995	73,523	536	1995	18,129	79
1996	75,484	536	1996	18,670	79
1997	77,445	536	1997	19,211	79
1998	79,406	536	1998	19,752	79
1999	81,367	536	1999	20,293	79
2000	83,328	536	2000	20,834	79
2001	85,289	536	2001	21,375	79
2002	87,250	536	2002	21,916	79
2003	89,211	536	2003	22,457	79
2004	91,172	536	2004	22,998	79
2005	93,133	536	2005	23,539	79
2006	95,094	536	2006	24,080	79
2007	97,055	536	2007	24,621	79

Appendix 6 Ten-Year Infrastructure Development Program by 1978∿1987
Investment Requirements
(In Thousand)

1/ Project Identified
2/ Pre-feasibility Study Completed
3/ Feasibility Study Completed
4/ Funding for Construction Committed
5/ *Detailed Engineering Completed*
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Invest-ment	Total during 1978∿1987	Yearly Investments										Later Years	Aver-age % Porex	Remarks
				1978	1979	1980	1981	1982	1983	1984	1985	1986	1987			
Region IV																
I FOREIGN ASSISTED	₱ 921,960 $ 49,463	123,725 5,458	798,235 44,005	97,238 5,330	129,562 5,130	158,735 8,760	51,000 4,550	56,000 3,400	60,900 1,700	83,900 4,200	58,900 4,335			102,000 6,600		
A. On-going	389,260 17,448	123,725 5,458	265,535 11,990	97,238 5,330	107,262 3,530	61,035 3,130										
1. *Urban Project Three* Major Interchanges:	98,260 3,538	68,010 2,438	30,250 1,100		30,250 1,100											
a. Cubao Interchange Quezon City	30,695 1,026	21,445 726	9,250 300		9,250 300										25	
b. Shaw Boulevard Interchange	25,030 684	18,530 484	6,500 200		6,500 200										20	
c. Manila South Expressway (MSE) Interchange	42,535 1,828	28,035 1,228	14,500 600		14,500 600										34	
2. Radial Road 10, C-1 to Dagat-Dagatan Spine Road	127,000 6,040	5,000	122,000 6,040	39,000 2,270	45,000 1,570	38,000 2,200										
3. Circumferential Road 2 R-10 to Laong Laan	32,000 1,470		32,000 1,470	10,000 335	10,000 335	12,000 800										
4. Traffic Engineering & Mgt. (Metro Manila)	132,000 6,400	50,715 3,020	81,285 3,380	48,238 2,725	22,012 525	11,035 130										
a. Transport & Traffic Improvement Including Cordon-Pricing	113,550 5,340	43,750 2,540	69,800 2,800	43,750 2,500	17,825 300	8,225									35	
b. Technical Assistance	18,450 1,060	6,965 480	11,485 580	4,488 225	4,187 225	2,810 130									40	
B. New	532,700 32,015		532,700 32,015		22,300 1,600	97,700 5,630	51,000 4,550	56,000 3,400	60,900 1,700	83,900 4,200	58,900 4,335			102,000 6,600		

Appendix 6 Ten-Year Infrastructure Development Program by 1978∿1987
Investment Requirements
(In Thousand)

(cont'd)

1/ Project Identified
2/ Pre-Feasibility Study Completed
3/ Feasibility Study Completed
4/ Funding for Construction Committed
5/ Detailed Engineering Completed
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Invest-ment	Total During 1978∿1987	Yearly Investments 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Later Years	Aver-age % Forex	Remarks
1. Circumferential Road 3, R-10, Aurora Blvd., Buendia	₱ 289,000 $ 17,500		289,000 17,500		22,300 1,600	82,700 4,900	36,000 3,800	56,000 3,400	52,000 1,700	36,000 1,500	4,000 600					
2. Radial Road 4, EDSA to Pateros Road to Almeda Street	46,400 2,475		46,400 2,475						7,000	15,500 800	23,900 1,675					
3. Dagat-Dagatan Spine Road (R-10 to Detour)	30,000 1,480		30,000 1,480			15,000 730	15,000 750									
4. Radial Road 10, Dagat-Dagatan Spine Road to C-5	62,000 4,000													62,000 4,000		
5. C-5, MacArthur Highway to R-10	40,000 2,600													40,000 2,600		
6. C-5 End of E. Rodriguez to Pateros Road	65,300 3,960								1,900	32,400 1,900	31,000 2,060					

Appendix 6 Ten-Year Infrastructure Development Program by 1978∿1987
Investment Requirements
(In Thousand)

(cont'd)

1/ Project Identified
2/ Pre-Feasibility Study Completed
3/ Feasibility Study Completed
4/ Funding for Construction Committed
5/ Detailed Engineering Completed
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Invest-ment	Total During 1978∿1987	Yearly Investments 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Later Years	Aver-age % Porex	Remarks
II LOCALLY FUNDED (only)	1,719,650	292,000	1,427,650	183,200	132,100	104,100	142,000	188,800	155,100	140,650	90,400	75,000	38,300	178,000		
A. ON-GOING	411,000	275,000	136,000	105,000	20,000	11,000										
1. Marikina By-pass; Aurora Blvd. to Infanta Road	61,000		61,000	30,000	20,000	11,000										
2. Manila South Expressway Ext. 20.3 kms.	220,000	160,000	60,000	60,000												
3. *Marikina-Infanta Road, 103 kms.*	130,000	115,000	15,000	15,000												
B. NEW	1,308,650	17,000	1,291,650	78,200	112,100	93,100	142,000	188,800	155,100	140,650	90,400	75,000	38,300	178,000		
1. Widening Buendia Ave., Taft Ave. to South Super highway	23,000		23,000	1,000	10,000	12,000										
2. EDSA Ext., Taft Ave. to Roxas Blvd.	20,000		20,000	20,000												
3. Radial Road 1, EDSA Ext. to Zapote	76,000		76,000				24,000	24,000	24,000							
4. New Route, G. Araneta to Balintawak	21,000		21,000					1,000	20,000							
5. A. Mabini by pass C-3 to Dagat-Dagatan Spine Road	5,000		5,000								5,000					
6. Santolan Road, 3.1 kms.	9,000	7,000	2,000	2,000												
7. Commonwealth Ave., Quezon City, 5.9 kms.	20,000	10,000	10,000		10,000											
8. Junction Grade Separation																
a. Nagtahan/Gov. Forbes	20,000		20,000	7,500	12,500											

Appendix 6 Ten-Year Infrastructure Development Program by 1978∿1987
Investment Requirements
(In Thousand)

(cont'd)

1/ Project Identified
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5/ Detailed Engineering Completed
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Invest-ment	Total During 1978∿1987	Yearly Investments										Later Years	Aver-age % Porex	Remarks
				1978	1979	1980	1981	1882	1983	1984	1985	1986	1987			
b. Guadalupe Bridge (Construction of 2 Service Roads)	49,000		49,000	9,000	20,000	20,000										
c. Various recommended Junction Grade Separation from MMETROPLAN Study	192,000		192,000				2,000	45,000	29,000	29,000	29,000	29,000	29,000			
9. Marikina Bridge, Replacement and Widening of Aurora Blvd. Bridge	28,000		28,000				2,000	26,000								
10. Republic Avenue																
a. MacArthur Highway to Quirino Highway	65,000		65,000			3,000	31,000	31,000								
b. Quirino Highway to Commonwealth Avenue	24,000		24,000					1,000	11,000	12,000						
11. Mindanao Ave. Ext. to Quirino Highway	27,000		27,000	1,000	10,000	16,000										
12. Visayas Avenue Ext. to Tandang Sora	10,000		10,000		10,000											
13. Bicutan-Parañaque-Sucat - Alabang-Kapok Road																
a. Bicutan Interchange to Parañaque-Sucat Road	47,000		47,000		2,300	22,000	22,700									
b. Parañaque Sucat Road to Alabang-Zapote road	25,000		25,000					1,200	11,000	12,800						
14. Widening of Dr. Sixto Antonio Street and Link roads	16,000		16,000						8,000	8,000						
15. Cainta-Marikina By-pass Link	7,000		7,000				400	6,600								

Appendix 6 Ten-Year Infrastructure Development Program by 1978～1987
Investment Requirements
(In Thousand)

(cont'd)

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3/ Feasibility Study Completed
4/ Funding for Construction Committed
5/ Detailed Engineering Completed
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Invest-ment	Total During 1978～1987	Yearly Investments 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Later Years	Aver-age % Porex	Remarks
16. Sumulong Highway-Marikina Green Height Access Road	14,000		14,000			700	13,300									
17. Bridge Linking Malabon and Navotas	12,000		12,000	12,000												
18. Congressional Ave. Ext. to Mindanao Avenue	4,000		4,000		4,000											
19. Visayas Ave. Ext., Tandang Sora to Republic Avenue	12,000		12,000						600	11,400						
20. Katipunan Ave. Ext., U.P. to Commonwealth Avenue	8,000		8,000			400	7,600									
21. Widening of Parañaque Sucat Road	37,000		37,000			2,000	15,000	20,000								
22. Widening of Alabang Zapote Road	34,000		34,000					2,000	16,000	16,000						
23. Marikina By-pass-Sumulong Highway Link Road	4,000		4,000					4,000								
24. Katipunan Ave. Ext., Commonwealth Ave. to Republic Avenue	24,000		24,000						1,000	11,000	12,000					
25. Widening of Ortigas Ave. from Bridge to Dr. Sixto Antonio St.	14,000		14,000	700	13,300											
26. Dagat-Dagatan Spine Road Ext. to Concepcion	3,000		3,000					3,000								
27. Widening of Katipunan Ave., Aurora Blvd. to Commonwealth Ave.	18,000		18,000							1,000	17,000					
28. Mindanao Ave. Ext., Republic Ave. to Malinta-Novaliches Road	13,000		13,000								700	12,300				
29. Constitutional Hill Ampid Link Road	35,000		35,000								2,000	33,000				

Appendix 6 Ten-Year Infrastructure Development Program by 1978∿1987
Investment Requirements
(In Thousand)

(cont'd)

1/ Project Identified
2/ Pre-Feasibility Study Completed
3/ Feasibility Study Completed
4/ Funding for Construction Committed
5/ Detailed Engineering Completed
6/ Construction on-going

CATEGORY: HIGHWAYS

Project/Category	Total Cost (Current)	Previous Investment	Total During 1978∿1987	Yearly Investments 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Later Years	Average % Porex	Remarks
30. Marikina By-pass-E. Rodriguez Ave. link Road	34,650		34,650						10,500	14,450	9,700					
31. Developmental Roads Near (but not necessarily adjacent to) North Expressway; Quirino highway to Malinta Interchange	16,000		16,000							1,000	15,000					
32. Visayas Ave. Ext., Republic Ave. to Commonwealth Ave. Ext.	10,000		10,000									700	9,300			
33. National Gov't. Center Circulation/access Road	158,000		158,000	25,000	20,000	17,000	24,000	24,000	24,000	24,000						
34. Widening of Marikina By-pass, Pasig Road to Sumulong highway	9,000													9,000		
35. Taguig-Pateros By-pass, R-4 Ext. to Bicutan Interchange	65,000													65,000		
36. New Route, Ortigas Ave. to R-4 Extension	8,000													8,000		
37. R-4 Ext. Pateros Road to Taguig-Pateros By-pass	13,000													13,000		
38. Widening of Marikina Cainta Road	6,000													6,000		
39. New Route, Ortigas Ave. (de Castro Subdivision) to Marikina By-pass	14,000													14,000		
40. Marikina Green Height-Ampid Road	28,000													28,000		
41. San Mateo-Montalban By-pass	35,000		35,000											35,000		
TOTAL for Region IV	2,639,610	415,725	2,225,885	280,438	261,662	262,835	193,000	244,800	216,000	224,550	149,300	75,000	38,300	280,000		

Note: These materials were prepared by the Philippine Government.