VOLUME I: MAIN REPORT

PART I. GENERAL

CHAPTER 1. OVERALL CONCEPT AND EXECUTION OF THE STUDY

1.1 Project Background

The Government of Japan, in compliance with the request of the Government of the Republic of the Philippines (hereinafter called the "Government") has agreed to extend technical cooperation to the Government on the Feasibility Study for Manila-Bataan Coastal Road and Its Related Roads (C-5 & C-6) Project (hereinafter called the "Study").

Based on this decision, the Japan International Cooperation Agency (hereinafter called the "JICA"), an official agency responsible for the execution of the technical cooperation program of the Japanese Government, carried out this study jointly with the Government.

The necessity to strengthen the road network in the region is primarily due to the recent increase in vehicle traffic demand accompanying the development of the region.

In connection with the Manila-Bataan Coastal Road extending to Bataan, an initial study has been conducted by the Coordinating Committee of the Government in accordance with an Administrative Order issued in 1970.

In 1977, the Government recognized the urgent need to undertake the Study, and established an Inter Agency Committee to promote the Study.

In August 1978, the JICA despatched a mission composed of experts on highways and urban/regional planning to Manila for the initial survey as well as discussions on the scope of work to be executed in the Study. During the stay of the mission in the Philippines, the full cooperation of the Government departments and agencies made it possible for the survey and discussions to be carried out very smoothly, expeditiously and successfully.

Metro Manila has a total area of 870 square kilometers which is about 0.3 percent of the total area of the Philippines, 300,000 square kilometers.

The total population of the Philippines was 44 million in 1976 and the average growth rate in recent years was 3.0 percent per annum.

On the other hand, the population of the Metro Manila for the year of 1976 was 5.5 million which is equivalent to about 13 percent of the total for the Philippines and the average annual growth of Metro Manila in recent years showed the very high growth rate of 5.0 percent per annum compared with the above mentioned national average.

The rapid population growth in Metro Manila is considered to be due to the larger opportunity for employment in response to the strong demand of industrial activities and to the presence of very high cultural and educational levels.

The rapid urban expansion in Metro Manila inevitably has entailed various urban problems and this has become increasingly serious especially in the north-west section of the region. Inadequacy of basic infrastructures, misuse of land and the great need to improve the substandard and congested housing conditions in these areas are the main problems.

The Circumferential Roads, C-5 and C-6, will not only make up the vital portion of the main trunk road network of the Metropolitan and distribute traffic in the region to avoid serious traffic congestion which would otherwise occur in certain radial roads but will also allow the land use pattern for the region to be improved.

The importance of the Manila-Bataan Coastal Road is that it will ultimately provide a short cut between Metro Manila and the Bataan peninsula where many national industrial development projects are under way and also will facilitate the development of the coastal area along the planned route and its hinterland.
It is envisioned that the road will be constructed passing through the area to be reclaimed extending from the planned R-10 heading towards the north-west and turning towards the west via the mouth of the Pampanga river and will be connected with the existing Bataan Expressway.

The implementation of the project must therefore be geared towards the most effective use of various potentials conceived in the region to attain the optimum economic and social development.

1.2 Conduct of the Study

The Study was carried out jointly by the JICA and the Ministry of Public Highways (hereinafter called the "MPH") of the Government.

The study team despatched by the JICA spent 199 days (from 5 February to 25 March 1979 and from 19 June to 15 November, 1979) in Manila and its vicinity for fact finding, data collection, topographic, soils and materials and traffic surveys, and various studies as well as for discussions with the officials of various relevant ministries and agencies of the Government.

Subsequent works were carried out in the head office of Pacific Consultants International in Tokyo where the full support of the engineering staff of the consultant as well as the consultant's electronic computer facilities were used.

The representatives of the supervisory committee made three separate visits to Manila during the study team's working period to confirm the essential points of decision with the Government.

1.3 Organization of the Project Team

The complete staff who directly participated in the Study is as follows:

A. Supervisory Committee Members of the Japanese Government

Shoji Miyazaki (Chairman)	Ministry of Construction, Japan
Akio Namiki (Chairman)	Ministry of Construction, Japan
Keiichi Tanaka	Ministry of Construction, Japan
Masahiro Yabe	Ministry of Construction, Japan
Takayuki Inoue	Ministry of Construction, Japan
Hiroshi Yamano	Ministry of Construction, Japan
Ichiro Kubota	Japan International Cooperation Agency

B. Steering Group of the Goverment of the Philippines

Antonio I. Goco	Ministry of Public Highways (MPH)
Jesus Sunga	National Economic and Development Authority (NEDA)
Jose R. Valdecanas	Ministry of Public Works, Transportation & Communication (MPWTC)
Nathaniel Von Einsidel	Ministry of Human Settlements
Theron V. Lacson	Public Estate Authority
Francisco D. Corona	Ministry of Finance
Pedro P. Viray	National Pollution Control Commission
Rouel Lanche	Ministry of Agriculture
Honorate Santos	Bureau of Fisheries and Aquatic Resources
Cireneo Punzalan	National Housing Authority

C. JICA Study Team

Pacific Consultants International

Akira Shikichi	Project Manager (Highway Planner)
Teruhiko Horie	Transport Planner/Economist
Seiji Homma	Regional Economist
Hidemoto Nojima	Highway Engineer
Masayuki Hasegawa	Structural Engineer
Hiroyuki Shiraiwa	Hydrological Engineer
Hiroaki Furuya	Reclamation Engineer

Kunio Taniguchi	Utilities Engineer/Cost Estimates Engineer
Isamu Watanabe	Fishery Planner

Japan Overseas Consultants

Toshio Kimura	Asst. Project Manager (Urban Planner/Environment)
Seiichi Horie	Traffic Engineer
Yoshihiro Daicho	Soils and Materials Engineer
Iehiro Noda	Surveyor

D. Counterpart Staff

Teodulo M. Kasala	Project Manager (SPO, MPH)
Milardo D. Salvador	Asst. Project Manager (SPO, MPH)
Edgardo Semilla	Location Engineer (SPO, MPH)
Teofilo Landicho	Reclamation & Location Engineer (SPO, MPH)
Virgilio Alagar	Highway Engineer (SPO, MPH)
Ignacio Gallego	Structural Engineer (SPO, MPH)
Bienvienida Firmalino	Structural Engineer (SPO, MPH)
Dominador Pajela	Hydrological & Drainage Engineer (MPWTC)
Godofredo Galano	Transport Planner (MPH)
Generoso Crisostomo	Civil Engineer (MPH)

1.4 Study Objectives

Among the national goals that shaped the planning of the Project Roads and the development of the reclamation area are:

- Promotion of social development and justice through the creation of employment opportunities and improvement of standards of living;

- Attainment of high and sustained economic growth; and

- Human settlements development and proper environmental management.

Therefore, the following regional development policies were considered in the Study to produce the greatest socio-economic impact for the region and the best interests of the Government:

- The physical growth for the MMA and MMR will make maximum use of the existing development trends, conditions and special projects with minimum drastic relocation;

- The process of industrialization should not slow down or hamper the development of the primary sector, particularly crop, livestock and fish production;

- Areas with existing infrastructure, utilities and services within the region will serve as a nucleus for urban expansion and utilities support will be provided in identified growth centers within the region to hasten industrial, commercial and related developments; and

- The Manila-Bataan Coastal Road that will link the northern part of the MMA and the Bataan Peninsula is critical to the development of agricultural and marine industries.

In broad terms, the main objectives of the Study were:

i) to determine technical and economic feasibility of, and to prepare an optimum program for the construction of the Phase I of the Manila-Bataan Coastal Road, from C-4 to C-6, and its Related Roads. The road sections covered by the Study (hereinafter called the "Project Roads") included the following:

   - Manila-Bataan Coastal Road, Phase I, from C-4 to C-6, (hereinafter called the "Coastal Road");

   - Circumferential Road, C-5, from Manila-Bataan Coastal Road to the existing Manila North Expressway (hereinafter called the "C-5"); and

   - Circumferential Road, C-6, from Manila-Bataan Coastal Road to the existing Manila North Expressway (hereinafter called the "C-6"), and

ii) to identify technical, financial and economic feasibility and to prepare an optimum program for developing a reclaimed land along the Coastal Road. The necessity of the study of the reclamation area from the stortages in industrial lots in MMA and the route requirement of the Coastal Road.

However, a prefeasibility study was also required for the Phase II of the Manila Bataan Coastal Road, from C-6 to Bataan Peninsula, to obtain necessary data for the study of the Project Roads abovementioned and a study dealt with socio-economic and technical aspects of the said Phase II Road and involved the following basic activities, among others:

- Identification of possible influences on the regional economy resulting from the construction of the Road. For this purpose, the development potentials of the project influence area including the Bataan Peninsula were investigated;

- Study of the functional role of the Road in relation to the regional transportation system;

- Study of possible alternative routes, their advantages and disadvantages;

- Study of alternative road formation plans;

- Development of stage construction, if there is any; and

- Identification of possible adverse environmental impacts.

1.5 Study Approach

1.5.1 General

In planning the efficient execution of the Study, the Study Team has separated it into two major divisions under the headings of Part 1 and 2 respectively. These major headings were further subdivided into logical functions as briefly shown in Fig. I-1-1.

The General scope of work is summarized for these stages as follows:

Part 1 of the Study - to consist of basic technical and socio-economic investigations of the Phase I and II of Manila-Bataan Coastal Road as well as the proposed alternatives leading to a recommendation of the final sub-corridor of the Project Roads and the extent of the reclamation area to be provided.

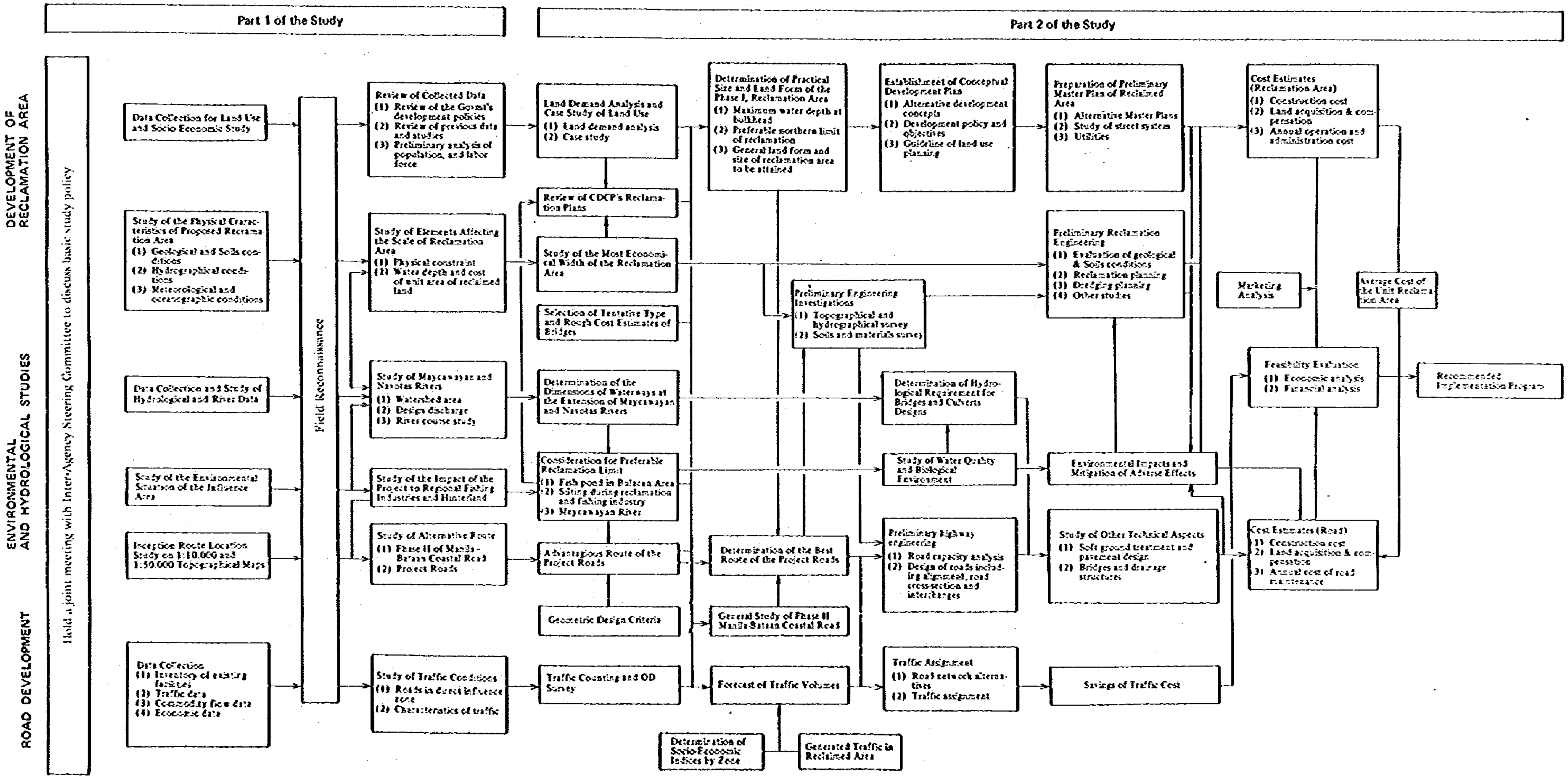
Part 2 of the Study - to consist of preliminary engineering for the Project Road, preparation of the development plan of the reclaimed area and reclamation study and the economic and financial analysis.

Although the Study Team concentrated on these prime objectives, special attention was also given to specific objectives, such as the preparation of various reports and attendance at Inter-Agency Steering Committee meetings. Throughout the period of the Study, the Study Team kept close contact with the Government and care was excercised to secure concurrence at all the stipulated stages.

In the preparation of reports an attempt was made to present the Study completely and as clearly as possible, including not only results and conclusions, but also all steps leading to the final results and the basic assumptions used. This was done to make it possible for those in charge of the implementation to have at their disposal all possible variations which actual development might require.

The following covers the Study Team's outline of study approach in executing the Study, placing emphasis on some of the important aspects.

Fig. I-1-1
GENERAL FLOW CHART OF
FEASIBILITY STUDY FOR
MANILA-BATAAN COASTAL ROAD AND ITS RELATED ROADS (C-5 & C-6) PROJECT



1.5.2 General Study of the Phase II of the Manila-Bataan Coastal Road (Discussed in Volume II)

The general study was made on the basis of available plans and data and other relevant studies prepared by the Government taking into consideration the overall regional characteristics and the review of the development potential of the coastal region of Manila Bay, the analysis of the data collected which are related with the Study and the results of field reconnaissance.

Alternative routes of phase II of Manila-Bataan Coastal Road were selected from the point of view of the effect on the short cut to the Bataan region, the development of coastal region and the creation of new town structure for appropriate land use.

The output of the study included the followings:

- Identification of possible benefits other than those related to traffic;
- Study of the functional role of the Road in relation to the regional transport system;
- Study of possible alternative routes; and
- Comparizon of Alternatives.

1.5.3 Study of the Development of the Project Roads (Discussed in Part III of Volume I)

Safe but fast means of transportation is an important factor in the development of the national economy of a country. Unimproved roads not only retard such development but may eventually prevent the exploitation of the socio-economic resources and establishment or expansion of industries in areas apart from the markets because of prohibitively high transport costs. The indirect advantages of good roads, although not measurable in monetary terms are, nevertheless, substantial. Good roads play an important part in facilitating inter-regional communication and in connecting previously inconvenient communities and population groups, thus improving regional solidarity.

Prior knowledge and a thorough background of the requirements of the region, not only in the field of highways but also in various other projects in other sectors, is very important. The accuracy of the projections as well as conclusions reached in the feasibility studies depend to a large measure on the inside knowledge of other inter-related development projects. The highways have to function as an important sub-sector service, fitting into the overall transportation and communication system to serve other key sectors such as agriculture, industry, and export promotion, all within the economy of the region. Thus, highway projects in themselves may not obviously add to the gross national product of the country but they are basic in building up proper social gains and assisting all sectors in achieving their targets in the shortest possible period.

A feasibility study for the Project Roads should be built around a framework composed of the essential elements listed below:

- Study of the socio-economic condition of influence area;
- Investigation of existing traffic conditions;
- Forecast of future traffic volume;
- Establishment of road network alternatives;
- Study of traffic assignment;
- Initial route studies;
- Preliminary highway engineering;
- Study of environmental impact;
- Preliminary construction and maintenance cost estimates;
- Appraisal of the economic factors in evaluating alternatives and to justify the capital and recurrent costs of the proposed road project; and
- Study of implementation program.

1.5.4 Study of the Development of the Reclamation Area (Discussed in Part IV of Volume I)

While the main objectives of the project were to improve land travel and develop the socio-economic resources of the region through the provision of much improved land access, for a long time, the Government also looked at the project as an opportunity to alleviate other problems in the region, particularly those arising from the rapid urbanization of Metro Manila. The Government's desire for this corollary objective was the project's own potential to accommodate other elements such as the development of reclaimed areas created by the provision of the Coastal Road. The utilization of such reclaimed areas for various land uses to meet the needs of Metro Manila was believed not only realize all the project's potential benefits but also to make the project more responsive to the region's needs.

In order to have a better perspective of the Government's concept of the reclamation project, the proposal of the Construction and Development Corporation of the Philippines (CDCP) was utilized as the "take-off" plan for the Study by the request of the Inter-Agency Steering Committee.

In view of the foregoing, the study approach for the land development planning and feasibility study of the development of the reclaimed area offshore along the Coastal Road was determined to follow the following steps:

- Establishment of the conceptual development plan for the reclaimed area;

- Preparation of preliminary master plan of reclaimed area;

- Preliminary reclamation engineering;

- Study of environmental impact;

- Economic and financial appraisal in evaluating alternatives and to justify the capital and recurrent costs of the reclamation project; and

- Study of implementation program.

1.5.5 Study of Integration of the Road and Reclamation Projects (Discussed in Part V of Volume I)

It should be emphasized that the reclamation project and the road project are inseparable from the standpoint of project implementation. Until the reclamation project can provide the reclaimed right-of-way for the Coastal Road, the road project seems hardly to be started. Moreover, the construction of C-5 alone without the Coastal Road can not be justified on the basis of traffic needs. The same thing can be said for the reclaimed area, since the area contributes to the economic development only when good access to the Port of Manila and other places can be provided.

1.6 Report Procedure

1.6.1 Guidelines

The report on the Feasibility Study for the Manila-Bataan Coastal Road and Its Related Road (C-5 & C-6) Project consists of the following volumes and parts:

VOLUME I : MAIN REPORT

- PART I. GENERAL
- PART II. CONTEXT
- PART III. FEASIBILITY STUDY OF MANILA-BATAAN COASTAL ROADS AND ITS RELATED ROADS (C-5 & C-6) PROJECT
- PART IV. STUDY OF RECLAMATION AREA
- PART V. PROJECT INTEGRATION

VOLUME II : GENERAL STUDY OF MANILA-BATAAN COASTAL ROAD

VOLUME III : DRAWINGS

VOLUME IV : APPENDIX

Volumes I and II are divided into chapters that are numbered with decimal numerals. The chapters are divided into sections and sub-sections and articles. Sections are denoted by the use of two decimal figures (i.e. 1.1, 1.2, 1.3), sub-sections by three decimal figures (i.e. 1.1.1, 1.1.2, 1.1.3), and articles by capital letters. All tables and figures have been numbered with Roman numerals for part together with decimal numbers expressing chapter and item number (i.e. II-2-1, II-2-2). Tables normally contain substantially all the necessary basic data for the conclusions arrived at in the report.

1.6.2 Abbreviations Used in the Study Report

A. Authorities and Agencies

ADB	Asian Development Bank
BEU	Bureau of Energy Utilization
BPW	Bureau of Public Works
IBRD	International Bank for Reconstruction and Development
MHS	Ministry of Human Settlements
MPH	Ministry of Public Highways
MPWTC	Ministry of Public Works Transportation & Communication
NCSO	National Census and Statistics Office
NEDA	National Economic Development Authority
NHA	National Housing Authority
PCG	Philippine Coast Guard
PCWID	Presidential Committee on Wood Industries
PFC	Philippine Fisheries Commission
SPO	Special Project Office, MPH

B. Other Abbreviations

ADT	Annual Daily Traffic
B/C	Benefit Cost Ratio
CBD	Central Business District
bd.ft.	board feet
cu.m	cubic meter(s)
EL.	Elevation
GDP	Gross Domestic Product
GNP	Gross National Product
GVA	Gross Value Added
G.T.	Gross Ton(s)
ha	hectare(s)
HHW	Highest High Water
I.C.	Interchange
IRR	Internal Rate of Return
Km	Kilometer(s)
LLW	Lowest Low Water
M	Meter(s)
MBCRP	Manila - Bataan Coastal Road Project
MCCRRP	Manila - Cavite Coastal Road and Reclamation Project
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MMA	Metro Manila Area
MMR	Metro Manila Region
MSL	Mean Sea Level
NDP	Net Domestic Product
NPW	Net Present Worth
PC	Prestressed Concrete
PCU	Passenger Car Unit
PW	Present Worth
RC	Reinforced Concrete
t	ton(s)

CHAPTER 2. DESCRIPTION OF METROPOLITAN MANILA

2.1 Geography

Metro Manila is located in the central western part of Luzon Island, bordered by Manila Bay on the west, tidal flats heavily-developed into fishponds on the northwest, the Central Plain of Luzon to the north, the foothills of the Sierra Madre Mountain Range to the northeast and east, Laguna de Bay to the southeast, and by a narrow neck of flatlands on the south.

2.2 Topography

The topography of Metro Manila is largely divided into the hilly area and the lowland area. The hilly area, with altitudes ranging from 13 to 20m above Mean Sea Level, is indented by erosion valleys draining westward to the bay and eastward to the Marikina River. The lowland area, with altitudes of 1.5 to 2.5m above Mean Sea Level, is the principal delta area of the Pasig River which drains Laguna de Bay, and meanders through the city in an east-west direction.

The Project Roads are located for the most part on the shallow offshore area and lowlands spread out in the deltas of Navotas and Meycawayan Rivers.

2.3 Climate

The Metro Manila is located between 14°20' and 14°40' north of the equator and consequently has a tropical climate. The seasons are influenced by the monsoons and trade winds which blow in a general direction from the northeast from October to February (monsoon), from the southeast from March to April (trade wind) and from the southwest from June to September.

Statistical data show that about 16% or 20 out of 123 typhoons that have entered Philippine territory during the past 32 years have passed within a radius of 120km from Manila, with half of them occuring within the period from June to September.

Southwest monsoons and typhoons bring heavy rainfalls. The heaviest rainfalls occur during the months of June, July and August. The average total yearly rainfall in Manila is approximately 1,600mm.

The highest recorded temperature was 38.6°C measured in April 1948 and the lowest was 14.5°C in January 1914. January has the lowest monthly average temperature, while April has the highest. The yearly average temperature falls within the range of 25°C to 28°C.

The month of September has the maximum relative humidity on record with an average of 84%, while April has the minimum average relative humidity with 69%.

PART II. CONTEXT

CHAPTER 1. SUMMARY OF DEVELOPMENT GOALS, STRATEGIES, POLICIES, TARGETS AND THE PREPARATION OF PRELIMINARY DEVELOPMENT SCHEME

1.1 National Development Goals [1/]

The goals of the country for the next decade are embodied in the Five-Year Development Plan. Briefly stated these are:

- Promotion of social development and social justice;
- Attainment of self-sufficiency in food and greater self-reliance in energy;
- Attainment of high and sustained economic growth;
- Maintenance of acceptable prices and improvement in local financing efforts and balance of payments;
- Regional and Rural development;
- Human settlements development and proper environmental management; and
- Maintenance of peace and order.

1.2 Strategy for Development

The Five-Year Development Plan also states that the strategy for development is two-pronged; namely: i) Balanced Growth Strategy, and ii) Human Resource Development. The balanced growth strategy calls for, among others, the following:

- Pursuit of industrial development to complement agricultural development;
- More efficient and competitive service sector to support rural growth;
- Production of more processed goods for domestic and export markets; and
- Rationalization of energy demand.

The human resource development seeks, among others, the expansion of health, nutrition and housing services of the poor and the provision of more productive and better-income earning opportunities for the people.

1/ Resume of the Five-Year Development Plan, 1978-1982 (Including the Ten-Year Development Plan, 1978-1987)

1.3 Economic Targets[2/]

The country will pursue higher and sustained economic growth in the next ten years (See Table II-1-1). Within that period the GNP will grow at a rate of 8 percent per annum, which will be made possible through increased production in various economic sectors, notably the agricultural and industrial sectors. The agricultural sector will have to step-up food production and the modernization of farm management and technology while the industrial sector will focus on cottage, small and medium scale industries, industrial estates and large scale industrial plants.

Table II-1-1 GROSS NATIONAL PRODUCT, POPULATION, AND PER CAPITA GNP, 1977-82 AND 1987

Description	Value (In Million Pesos)							Annual Growth Rates (In Percent)					
	1977[1)]	1978	1979	1980	1981	1982	1987	1977 1978	1978 1979	1979 1980	1980 1981	1981 1982	1982 1983
Gross National Product (In Million Pesos at Constant Prices of 1972)	77,804	83,250	89,494	96,206	103,902	112,214	164,879	7.0	7.5	7.5	8.0	8.0	8.0
Gross National Product (In Million Pesos at Current Prices)	152,029	174,076	200,198	230,317	266,093	307,578	633,795	14.5	15.0	15.0	15.5	15.6	15.6
Total Population (In Thousands, Medium Assumption)[2)]	45,028	46,350	47,719	49,137	50,557	52,026	59,903	2.9	3.0	3.0	2.9	2.9	2.9
Per Capita GNP (In Pesos at Constant Prices of 1972)	1,728	1,796	1,875	1,958	2,055	2,157	2,752	3.9	4.4	4.4	5.0	5.0	5.0
Per Capita GNP (In Pesos at Current Prices)	3,376	3,756	4,195	4,687	5,263	5,912	10,580	11.3	11.7	11.7	12.3	12.3	12.3

1) Estimate

2) Although the medium assumption is used, the target population level uses the low assumption.

Source : EPRS-NEDA

Industry will grow at a much faster rate than agriculture. Exports will comprise substantially of agricultural and industrial products, but an increasing proportion of the exports will be made up of manufactured goods of the industrial sectors. The industrial targets are shown on Table II-1-2.

2/ Resume of the Five-Year Development Plan, 1978-1982. (Including the Ten-Year Development Plan, 1978-1987)

Table II-1-2 NET DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN, 1977-82 AND 1987

(In millions of pesos at constant 1972 prices)

Description / Year	1977 1)	1978	1979	1980	1981	1982	1987
Net Domestic Product	63,920	68,446	73,577	79,055	85,311	92,037	135,893
Agriculture, Fishery and Forestry	19,691	20,676	21,721	22,797	24,016	25,279	32,969
Industrial Sector	18,312	19,949	21,841	23,961	26,416	29,252	50,201
Mining and Quarrying	1,071	1,151	1,249	1,355	1,484	1,625	2,553
Manufacturing	12,179	13,161	14,285	15,548	17,000	18,707	31,579
Construction	4,655	5,189	5,812	6,511	7,325	8,243	14,874
Electricity, Gas and Water	407	448	495	547	607	677	1,195
Service Sector	25,912	27,821	30,015	32,297	34,879	37,506	52,723
Transport, Communication and Storage	2,642	2,881	3,153	3,448	3,771	4,124	6,435
Commerce	14,042	15,047	16,210	17,436	18,808	20,275	28,623
Services	9,233	9,893	10,652	11,413	12,300	13,107	17,665

1) Estimate

Source : EPRS-NEDA

1.4 Regional Development Policies for Metropolitan Manila Region (MMR) and Metropolitan Manila Area (MMA) 3/

In the pursuit of the above-stated goals and targets, the development of the MMR and MMA are built around several development policies:

1.4.1 Development Policy for MMR

- For population distribution, the policy is to disperse the population to growth poles in selected urban centers;

- The major consideration for the primary sector is continued growth to promote regional development;

- For urban expansion, the policy is basically to limit, control and redirect it to other growth centers and existing urban modes which are being developed into multi-functional clusters to ensure a desired level of self-sufficiency;

- Natural scenic areas and historical places are preserved to meet recreational and tourist needs; and

- Development control is emphasized for critical areas. Critical areas for development of the region include potential agricultural/marine areas in Bulacan and Pampanga and the fishing industry of Pampanga Delta and Candaba Swamps.

3/ Extracted from "1978 Budget and General Appropriations Ordinance", Metro Manila Commission.

MMR comprises Manila, and the provinces of Pampanga, Zambales, Bulacan, Bataan, Quezon, Cavite, Laguna and Batangas.

MMA comprises Manila, Caloocan City, Pasay City, Quezon City, Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinglupa, Navotas, Parañaque, Pasig, Pateros, San Juan, Taguig and Valenzuela.

1.4.2 Development Policy for MMA

- In land use allocation, inefficient concentrations are decentralized and inefficient dispersions are integrated;

- Employment opportunities are dispersed to selected alternative growth centers;

- Support services and facilities are provided for and/or improved in the new projects and are also strengthened in the existing centers; and

- In transportation and communication, the objective is to improve accessibility between and among vital development centers.

CHAPTER 2. SOCIO-ECONOMIC CHARACTERISTICS OF INFLUENCE AREA

2.1 Population

2.1.1 Existing and Future Population

A. Project Area

MMETROPLAN'S delineation of MMA comprised 27 zones; e.g., 17 jurisdictions under the Metro Manila commission and additional 10 zones situated outside the Metro Manila area. Population estimate was made for these 27 zones.

In this study, the zones in the Project Area are determined by considering the proposed C-5 and C-6 alignment which is located at the northern periphery of the MMA between the Coastal Road and the Manila North Expressway. This difference from MMETROPLAN'S delineation is shown in Fig. II-2-1.

B. Population Indices

MMETROPLAN presents the forecasted distribution of population in the Metro Manila area together with land utilization plans for 1980 and 1990. The estimates for the zones delineated by MMETROPLAN are adopted, and adjusted in this study, since it is found that they generally indicate an agreeable feature of the region for the next ten (10) to fifteen (15) years. However, there are some zones being delineated by this study which are not covered by MMETROPLAN. Indices for these zones have been estimated by the Study Team. Also, the figures for year 2000 for all zones are estimated by extrapolating the trend up to 1990.

According to the MMETROPLAN, the total population of MMA in 1980 and 1990 were determined by finding a mean value of low and medium estimates of UNFPA-NCSO[1] Population in each zone were estimated by studying the past trend and availability of open land. The total estimated population for selected years 1948 to 1990 are shown in Table II-2-1.

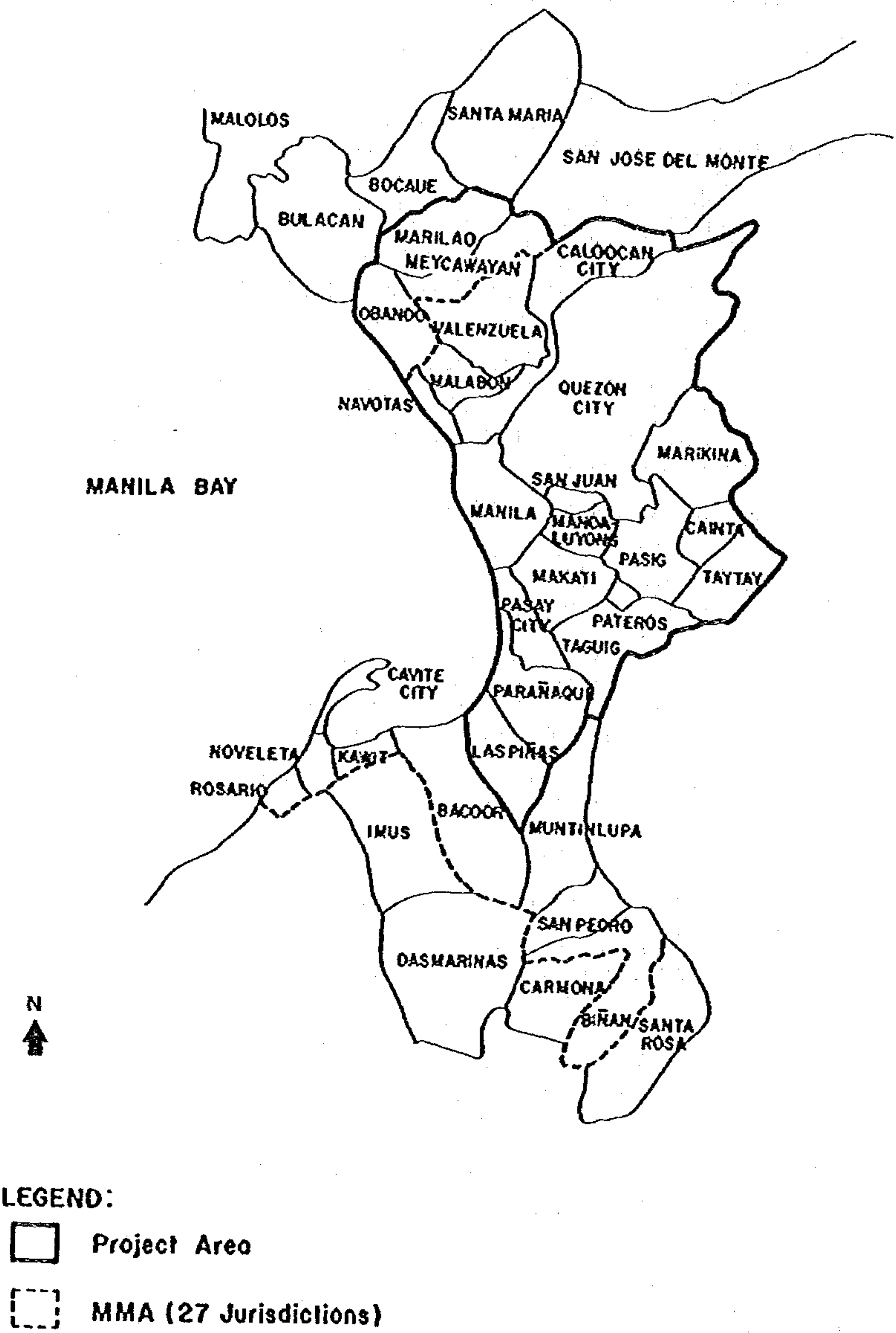
For this study, the estimates of population of MMA for 1980 and 1990 are adopted and then adjusted to suit the delineated zones. For those in the outer zones not covered by MMA, the basic estimate of UNFPA-NCSO is utilized with certain modification by applying the following ratio for each zone.

Estimated Population in Zone-k for year-i

= (Census Pop.-k 1975/Est.Pop.-k 1975) x (Est.Pop.-k in year-i)

1/ United Nations Fund for Population Activities - The National Census and Statistics Office, 1975.

Fig. II-2-1 BOUNDARY OF THE PROJECT AREA



where: Census Pop.-k 1975 means population census of zone-k in 1975.

Est. Pop.-k 1975 means estimated population of zone-k for 1975 by UNFPA-NCSO.

Est. Pop.-k in year-i means estimated population of zone-k for year-i by UNFPA-NCSO.

The growth trend for the period 1980-1990 is extrapolated for another ten (10) years to forecast the population in 2000 (See Table II-2-2). The population in the project area is estimated to be 5.88 million in 1979, 8.41 million in 1990 and 10.86 million in 2000. Average annual growth rate is estimated to be 3.2% p.a. from 1980 to 1990 and 2.6% from 1990 to 2000.

Table II-2-1 TOTAL POPULATION IN PROJECT AREA AND MMA (Selected years between 1948 and 2000)

Year	This Study		MMETROPLAN [1)]	
	Total Population in Project Area	Annual Rate of Increase	Total Population in MMA	Annual Rate of Increase
1948	1,608,378		1,723,000	
1960	2,529,319	3.8%	2,696,000	3.8%
1970	4,063,350	4.9%	4,361,000	4.9%
1979	5,877,590	4.2%		
1980	6,136,150	4.4%	6,711,000	4.4%
1985			7,900,000	3.3%
1990	8,405,300	3.2%	9,250,000	3.2%
2000	10,864,930	2.6%		

1) Source: MMETROPLAN, July 1977

Notes: 1. Project area is composed of Obando, Marilao and MMA except Cavite, Kawit, Bacoor, Noveleta, Rosario, Muntilupa, San Pedro and Biñan.

2. MMETROPLAN'S delineation of MMA includes 27 jurisdictions.

C. Employed Persons

Employed persons based in residences are estimated by multiplying certain factors to the population. The factors from 1971 to 1990 are quoted from MMETROPLAN while those after 1991 are determined by studying the changes that will have occured during the previous years.

	1971	1980	1990	2000
Proportion of the population aged 10 years and over	72.0%	73.5%	77.5%	81.5%
Participation rate	48.0%	48.0%	48.0%	48.0%
Employment rate	90.0%	90.0%	90.0%	90.0%

The ratio of employed persons over the population is calculated as:

1980: 0.48 x 0.735 x 0.9 = 0.32
1990: 0.48 x 0.775 x 0.9 = 0.33
2000: 0.48 x 0.815 x 0.9 = 0.35

The above ratios are multiplied to the population of the zones in the respective year to determine the employed persons by residence.

D. Employed persons by Workplace

The estimate is made based on two methods: one is by adjusting the estimates of MMETROPLAN for the zones of the project area and then extrapolating to the year 2000, and the other is by estimating those in the zones of indirect influence.

The assumptions for the estimate in the zones of the project area are as follows:

- Employment in the primary sector will not change until 1990, but will decrease by 2% p.a. after 1990 in the zones of the Project area;
- Employment in the secondary secondary sector will grow at 5.5% p.a. from 1979 to 2000 in the zones of the project area;
- Employment in the tertiary sector will grow at 3.3% p.a. from 1979 to 2000 in the zones of the project area.

The delineation of zone of indirect influence are expanded to comprise one or two provinces. Accordingly, it is assumed that employed persons by residence and by workplace are equal, because the difference becomes negligible when the delineated area is wide.

Employed persons are then divided into three sectors, where the division is based on the changes in national employed persons during 1973-1976. It is determined that the percentage composition in the primary sector will decrease by 3% p.a. while that in secondary will increase by 3% p.a. the tertiary sector will account for the remaining percentage.

E. Summary

The population forecast, employed by residence and those by work place, for 1979, 1980 and 2000 in the Project Area is shown in Table II-2-2 with the supporting estimated figures for all zones presented in Appendix I-1.

Table II-2-2 SUMMARY OF POPULATION FORECASTS IN THE PROJECT AREA[1)]

Population \ Year	1979	1980	1990	2000
Total Population	5,877,590	6,136,150	8,405,300	10,864,930
Employed Persons by Residence	1,861,433	1,948,228	2,814,094	3,825,540
Employed Persons by Workplace	2,052,741	2,131,616	3,121,090	4,626,804
Primary	26,616	26,616	21,490	17,472
Secondary	539,129	569,000	975,500	1,672,254
Tertiary	1,486,996	1,536,000	2,124,100	2,937,078

Note: 1) Project Area is composed of zone numbers 1 – 33 and 50 – 52.
Other outer zones are classified as indirect zones of influence of the project.

2.1.2 Problems Associated with Population Growth

A. The Fundamental Problem

The problem in Metro Manila is its extremely rapid population growth. The population for 17 jurisdictions in the years 1990 is estimated to be 8.3 million. The actual increase in population over the year 1975 is more than 3 million.

Table II-2-3 POPULATION PROJECTION (MMA 17 JURISDICTIONS), 1980~2000

Year		Population	Actual Increase	Annual Growth Rate (%)
1970		3,964,000	-	
1975		4,970,000	1,006,000	4.6
1980		6,092,000	1,122,000	4.1
1990		8,281,000	2,189,000	3.1
2000	High	11,457,000	3,176,000	3.3
	Medium	10,809,000	2,528,000	2.7
	Low	9,983,000	1,702,000	2.1

Notes: 1. 1970 and 1975 Population Census
2. 1980 and 1990 Projected by MMETROPLAN
3. 2000 Projected by C-3 Study.

This means urban areas and facilities should increase in proportion to population increase.

B. Changing of Urban Structure

Although the population growth in inner core area is experiencing a rapid population increase. This phenomenon is caused by the mobility of some residents who would rather have a better standard of living in proportion to high income. Since this trend is likely to continue in the future, there is a need to provide the necessary infrastructure in the outer area and an efficient transportation system between the inner core and the outer areas.

2.2 Economic Activities

2.2.1 Industrial Structure

A. Structure of Manufacturing Industry in the Philippines

Table II-2-4 summarizes past industrial growth between 1956 and 1973.

On a value added basis, industries in the organized sector (5 or more workers) show an annual growth of 7.8 percent in real terms during the period. The growth figure contains the growth of small scale industries, with 5 to 19 employees, which had stagnated in this period.

Table II-2-4 GROWTH OF MANUFACTURING INDUSTRIES

Category	1956	1962	1968	1973	Annual Growth Rate (Per Cent)			
					1956~62	1962~68	1968~73	1956~73
Number of Firms								
20 or more workers	1,833	2,180	2,385	2,912	2.9	1.5	4.1	2.8
5 ~ 19 workers	5,375	6,285	7,673	9,469	2.7	3.4	4.3	3.4
Total	7,208	8,469	10,058	12,381	2.7	2.9	4.2	3.2
Employment (Thousands)								
20 or more workers	150.9	230.5	325.1	454.4	7.3	5.9	6.9	6.7
5 ~ 19 workers	54.9	48.0	69.2	72.4	−2.2	6.3	0.9	1.6
1 ~ 4 workers	829.2	845.5	912.7	788.2	0.4	1.3	−3.0	−0.3
Total	1,035.0	1,124.0	1,307.0	1,315.0	1.4	2.5	0.1	1.4
Value Added (₱ @ 1967 Prices)								
20 or more workers	1,532.8	2,769.9	4,457.1	5,948.0	10.3	8.2	5.9	8.3
5 ~ 19 workers	181.8	132.3	266.9	191.3	−5.4	13.8	−7.0	0.3
Total	1,714.6	2,902.2	4,724.0	6,139.3	9.2	8.5	5.4	7.8
Value Added Per Worker (Thousands of Pesos @ 1967 Prices)								
20 or more workers	10.2	12.0	13.7	13.1	2.8	2.2	−1.0	1.5
5 ~ 19 workers	3.3	2.8	3.9	2.6	−3.0	5.8	−7.3	−1.4
Average	8.3	10.4	12.0	11.7	3.8	2.4	−0.5	2.0

Source: *The Philippines – Priority and Prospects for Development, World Bank Country Report.*

Employment is shown to have an annual growth rate of 1.4 percent during 1956-1973, while the larger industries, having 20 or more workers had a high annual growth rate of 6.7 percent. Small-scale industries, with 1 to 19 employees also stagnated during that period.

Table II-2-5 indicates change of individual industries in total manufacturing value added and employment. The structure of industry in 1974 was not substantially different from that of the mid-1950's. The five fastest growing industries (i.e. chemical, basic metals, electrical and machinery, rubber and tobacco) increased their combined share in total value added from 17 percent in 1956 to 29 percent in 1974.

The five slowest growing industries (i.e. food, metal products, machinery, transport equipment and miscellaneous industry) decreased from 46 to 36 percent during the same period. Similar trends were recorded in the distribution of employment, although with a somewhat different industrial composition.

Table II-2-5 DISTRIBUTION OF VALUE ADDED IN ORGANIZED MANUFACTURING (%)

Industry	Value Added (Constant 1967 Prices)						
	1956	1960	1964	1968	1972	1973	1974
Apparel	6.5	3.7	2.6	2.4	5.3	5.0	4.8
Beverages	9.2	7.6	8.4	8.2	8.9	8.1	8.1
Chemicals	8.9	9.8	10.1	11.9	13.6	14.3	11.9
Food Processing	30.1	27.6	28.5	23.5	27.8	26.2	27.8
Furniture	1.1	0.9	0.9	0.6	1.1	1.0	1.0
Leather Products	0.4	0.5	0.3	0.3	0.1	0.1	0.1
Machinery	1.6	1.9	0.7	0.9	1.1	1.2	1.2
Electrical Machinery	1.0	3.1	4.6	3.3	3.8	3.8	4.7
Metal Products	3.9	5.5	4.1	4.4	3.0	2.9	2.8
Metal, Basic	0.9	1.5	1.6	2.6	1.6	2.0	2.2
Non-metallic Mineral Product	3.6	3.7	4.8	5.1	3.1	3.4	2.8
Petroleum	3.0	3.0	3.8	4.9	4.8	4.4	4.2
Printing & Publishing	3.4	3.5	3.2	2.9	2.9	2.7	3.0
Pulp and Paper	1.5	2.6	1.9	2.7	1.8	1.7	1.8
Rubber Products	0.9	3.2	3.2	2.8	1.9	1.8	2.7
Textiles	3.8	5.7	5.9	7.0	5.4	5.5	4.9
Tobacco	5.4	4.8	5.9	6.4	5.6	7.0	7.2
Transport Equipment	5.1	3.0	5.0	3.6	2.1	2.0	2.4
Wood Products	4.6	4.3	5.4	5.5	4.5	5.3	4.9
Miscellaneous	5.1	4.1	1.1	1.0	1.6	1.6	1.5
Total	100.0	100.0	100.0.	100.0	100.0	100.0	100.0

Source: The Philippines – Priority and Prospects for Development, World Bank Country Report.

B. Industrial Structure in Metropolitan Manila

The distribution of establishment in the Metro Manila Area for years 1972 and 1975, is shown in Table II-2-6. For both years, the wholesale and retail trade garnered the highest percentage composition, followed by manufacturing and then by community and personal services. However, the percentage for wholesale and retail trade decreased from 67.5% in 1972 to 63.9% in 1975 and that for community and personal services slid down from 11.9% in 1972 to 10.8% in 1975. The manufacturing sector was up from 14.6% in 1972 to 17.6% in 1975.

Nevertheless, at 1973 prices, the gross value added (GVA) of the manufacturing sector presented a different picture. As shown in Table II-2-7, the annual growth of GVA of the construction sector in Manila and the Rizal Province was the highest at 28%. The manufacturing sector registered the lowest percentage at 3%. It also recorded a very low rate (4%) in the entire Philippines.

The Five-year Development Plan envisioned the growth of manufacturing industry to lead other industries, but up to this time, actual conditions have apparently differed from this prediction. Considering this fact, the expansion of the manufacturing industry is strongly anticipated.

Table II-2-6 DISTRIBUTION OF ESTABLISHMENT BY MAJOR INDUSTRY GROUP MMA, 1972 AND 1975

Description	1975		1972	
	Number	Percent	Number	Percent
Metro Manila	89,412	100.0	95,651	100.0
Agriculture, Fishing and Forestry	347	0.4	59	0.1
Mining	167	0.2	135	0.1
Manufacturing	15,760	17.6	13,955	14.6
Electricity, Gas and Water	18	-	13	-
Construction	464	0.5	347	0.4
Wholesale and Retail Trade	57,176	63.9	64,592	67.6
Transport Storage and Communication	2,256	2.5	1,915	2.0
Financing and Business Services	3,686	4.1	3,223	3.4
Community and Personal Services	9,660	10.8	11,406	11.9

Source: NCSO

2.2.2 Fisheries

At present a total of about 17,400 hectares of fishponds in Bulacan Province are annually producing 15,700 tons of fish and other fauna. It is estimated that about 90 percent of this production are milkfish.

In addition to the above production from fishponds the same province annaully producing 5,600 tons of fish by municipal fisheries.

Table II-2-8 shows basic data of municipal fishing in Bulacan Province, 1975∿1976.

Table II-2-7 SHARE OF GROSS VALUE ADDED BY INDUSTRIAL SECTOR IN MANILA-RIZAL AND THE PHILIPPINES (millions of pesos at 1973 prices)

Industrial Sector	Manila City & Rizal Province Total	%	Philippines Total	%	Manila & Rizal as a % of Philippines	Approximate Annual Growth 1971 ∿ 1973 Manila & Rizal %	Philippines %
Agriculture	-	-	20,297	29	-	-	8
Mining	30	0	2,428	4	1	22	4
Manufacturing	6,856	32	15,639	23	44	3	4
Construction	908	4	2,860	4	32	28	18
Transport	1,660	8	2,908	4	57	5	6
Commerce	7,427	35	14,721	21	50	13	6
Service	4,394	21	10,195	15	43	5	3
Total	21,275	100	69,048	100	31	8	6

Source: MMETROPLAN

Table II-2-8 BASIC DATA OF MUNICIPAL FISHING IN BULACAN, 1975∿1976

Description	Characteristics
No. of fishermen	5,150
No. of fishing craft	2,646
Prevalent fishing gear	Bintol, dalungkit baby trawl
Fishing season	Year round
Annual production (tons)	5,588

Source: Fisheries Regional Office No. III, San Fernando, Pampanga.

2.3 Land Use

2.3.1 Industrial Land Use[5/]

The distribution of industrial land use is shown in Appendix I-2. The main concentration to the east are along the banks of the Pasig and the Marikina Rivers, to the north in Caloocan, Malabon and Valenzuela, and to the south along the Manila South Expressway and the Zapote-Alaban road.

Appendix I-3 illustrates the industrial development during the period 1960∿1975. The trend shows that industrial development veered away from the center toward cheaper lands on the periphery which are served by major new highways, and where bodies of water

5/ Source: MMETROPLAN Interim Report.

are relied upon for transport. The trend, however is only conspicious for the high value added industries. The low value added industries remain along the bank of Pasig River.

2.3.2 Commercial Land Use

Appendix I-4 shows the distribution of commercial land uses. These are spread widely throughout the urban area, especially along the major throughfares. There are two major concentrations in the Central Business District (CBD) and in Makati, and smaller concentrations in Ermita, Pasay, Cubao, Caloocan, etc.

Appendix I-5 illustrates commercial development in the period 1960∿1975. There is an increasing trend to rely on the newer centers in Makati and Cubao rather in the CBD.

2.3.3 Housing Situation

A. Existing Condition[6/]

Provision of housing is a fundamental need for man, but a large percentage of Metro Manilans live in areas which suffer from inadequate housing and insufficient social and physical infrastructure. These are the basic problems that plague Metro Manila.

These problems stem from the following factors:

- the prevailing low level of family income;
- rising construction and land costs;
- shortage of credit; and
- the lack of government involvement in the housing market.

For instance, in 1972, as illustrated in Appendix I-6, only 14 percent of families earning over ₱10,000 per annum could afford open market housing while 36 percent between ₱4,000∿₱10,000 per annum could afford economic housing. Accomodation of any type was beyond the reach of the remaining 50 percent.

On the other hand, the results of the survey of the housing quality in the metropolis conducted by MMTROPLAN (shown in Appendix I-7 and Table II-2-9) indicate that 15 percent is poor quality and makeshift housing, 30 percent is mixed quality housing and rural settlement and 55 percent is medium and good quality housing.

6/ MMETROPLAN Interim Report.

Table II-2-9 HOUSING QUALITY IN METRO MANILA

Type of Housing	Land Area (Hectares)	% of Land Area	Assumed Average Density (persons per ha.)	Population	% of Population
Good quality	4,820	38%	120	580,000	18%
Medium quality	2,140	17%	220	470,000	14%
Poorer quality	1,040	8%	550	570,000	17%
Makeshift areas	870	7%	850	740,000	22%
Mixed quality	2,460	19%	300	740,000	22%
Rural settlement	1,450	11%	150	220,000	7%
Total	12,780	100%		3,320,000	100%

Source: MMETROPLAN

B. Problems

It has been estimated that 30 percent of Manila's total housing stock is made up of makeshift and slum houses.7/ This situation is made worse by the rapid population growth which is estimated to be 3.4 percent annually.

Low income families are greatly affected by the existing housing problems. Approximately 50 percent of all households have too low a level of income to afford housing at all.8/ This situation calls for the social housing that will be provided through direct government involvement.9/

In addition, encouragement will be necessary to increase the provision of economic housing for medium income level.

These sites will have to be located either within the existing built up area or in peripheral areas.

7/ Urban Sector Survey, IBRD, 1975

8/ & 9/ MMETROPLAN, Interim Report.

2.3.4 Present Land Use and Zoning Plan

Appendix I-8 illustrates the existing land use in the influence area of the Project. Fishpond areas are widely scattered in Obando and the northern part of Malabon, especially along the Meycawayan River. It is noted that some previous fishpond area in Malabon have been converted to other land uses such as residential or industrial uses to absorb the growth from nearby cities and municipalities in the Metro Manila.

Large vacant areas are found some distance beyond C-4. These areas are already manifesting some development, predominantly for residential uses. It can be safely said that these developments have been brought about by the highway.

The land use zoning map prepared for the area by the Ministry of Human Settlement is shown in Appendix I-9. The predominant use would be for residential areas even encroaching upon space presently being utilized for fishponds. A considerable portion of the land is assigned for industrial use. The fishpond portion which constitutes as large percentage of the areas will be able to absorb residential, agricultural, planned unit development uses and provide open space.

A summary of the zoning plan for the Five Year Development Plan, 1978∿1982, prepared by the Ministry of Human Settlement is shown in Appendix I-10 to explain future land demand in Metro Manila by sector.

2.4 Development Projects Along the Coastal Area

There are four major development projects along the coastal area of Metro Manila (Appendix I-11), namely:

- Manila-Cavite Coastal Road and Reclamation Project;
- Manila International Port Project;
- Navotas Fishery Port Project; and
- Dagat-Dagatan Project.

Located in the southern part of the coast these projects are expected to accomodate urban growth and activities especially in the inner core of the metropolis.

The development trend in the southern coast is a valid reason to expect that strong pressure for development will be exerted on the northern coast in the future.

2.5 Transportation Situation

The existing transportation situation in Metro Manila is characterized by inefficient use of infrastructure and inadequate capacity of the public transportation system which is causing a general decline in the efficiency of living in the Metropolis.

2.5.1 Road Network

The main road network in the Metropolitan Manila Area is a partially developed circumferential and radial system. This main network is composed of nine radial and four circumferential roads. Some of these consist of wide dual carriageways or high capacity single carriageways. These road networks are shown in Fig. II-2-2.

Two expressways, the Manila North Expressway and the Manila South Expressway, serve traffic in the northern and southern parts of the Metropolitan Manila Area. The two expressways are both high capacity roads with grade-separated intersections and they are toll roads which are fully controlled access type roads.

The remainder of Manila's road system consists of narrow, winding roads running through densely developed areas where concentration of traffic leads to congestion, pedestrian/vehicular conflict and poor access for emergency vehicles.

Based on traffic surveys, traffic flows on the road network are heaviest in the inbound direction on the main radial roads and on the circumferential road C-4. The most congested area is within circumferential road C-2 and bottlenecks are observed on the Pasig River, Panaderos, Quadalupe Bridges and in Rizal Avenue extension.

2.5.2 Public Transport Network

At present over 99 percent of the daily public transport passenger trips are by means of buses and jeepneys, but tricycles, rail services and taxis are also significant passenger carriers.

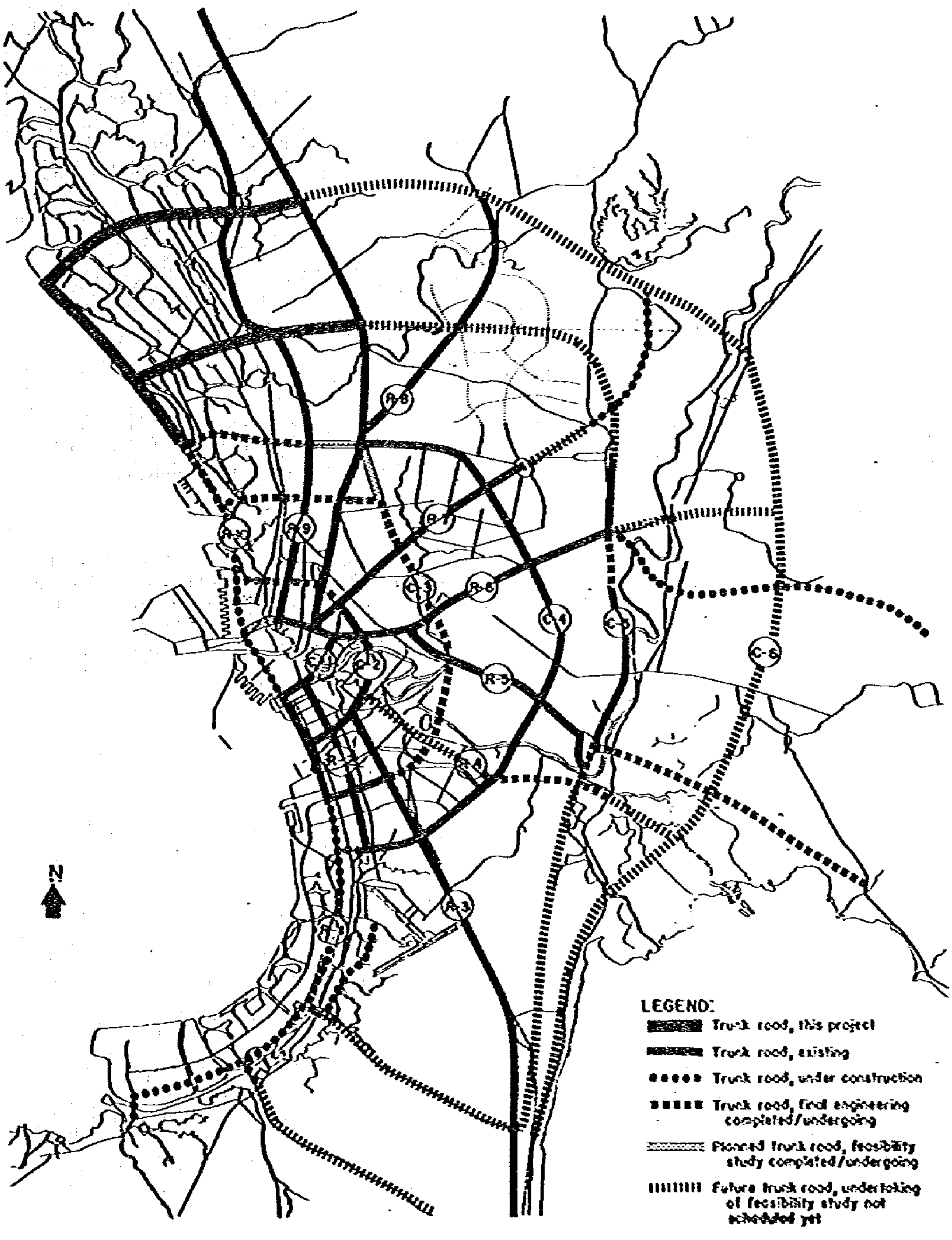
A. Buses

There are, at present, about 2,750 buses and mini-buses authorized to operate in Metropolitan Manila. Mini-buses have a seating capacity of about 30 passengers while large buses can accommodate 55 passengers. In 1971, buses which were operated by more than 130 private companies, constituted 20 percent of the passenger trips.

B. Jeepneys

There are currently about 17,000 jeepneys operating in Metropolitan Manila with seating capacities ranging from 8 to 16 passengers per vehicle. In 1971 they carried almost 40

Fig. II-2-2 ROAD NETWORK IN METRO MANILA



percent of all passenger trips and its is estimated that there are over 1,000 jeepney operators in Metropolitan Manila, many of whom are owner-operators.

C. Tricycles

The two main forms of tricycles operating in Metropolitan Manila are the foot-pedal type which serves poorer areas and motor powered tricycles which serve many of the low density, more affluent areas. The vehicles have a capacity of two (2) passengers.

D. Taxis

There are about 8,000 taxis, authorized to operate in Metropolitan Manila. In 1971 they carried approximately six percent of the total number of passenger trips.

E. Horse Drawn Calesas

In addition, to these main modes of public transport, horse drawn calesas still operate in some of the poorer areas of towns and ferries across the Pasig River.

F. Railways

The Philippine National Railways (PNR) operate a commuter Train Service along a North-South line which skirts the Central Business District of Manila. In March 1976, immediately before the PNR commissioned new rail cars, the commuter services carried about 10,000 passengers per day in the Metropolis.

PART III . FEASIBILITY STUDY OF MANILA-BATAAN COASTAL ROAD AND ITS RELATED ROADS (C-5 & C-6) PROJECT

CHAPTER 1. INTRODUCTION

1.1 Study Objectives

The purpose of this study is to determine the technical and economic feasibility of, and to prepare an optimum program for, constructing about 26 km of road network in the Metro Manila and vicinity. Fig. III-1-1 shows the roads to be included in this study.

1.2 Scope of Work

All of the work necessary to attain the objectives set out above will be performed, including field investigations, engineering, traffic and economic studies.

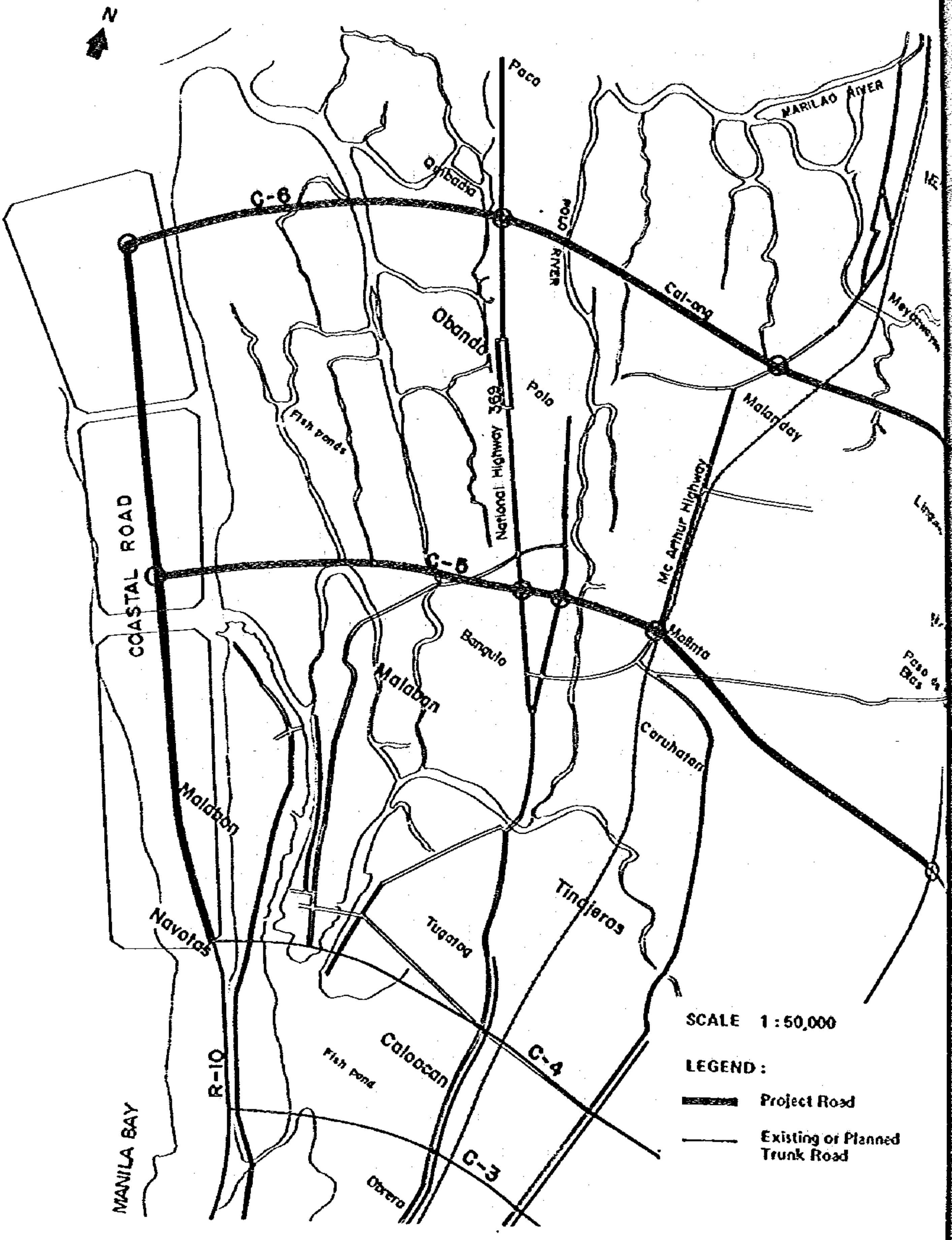
Based on the characteristics of the Study, the work will be carried out in two parts. In Part 1 of the Study, the initial field investigations and data collection would be carried out.

A general study of the Manila-Bataan Coastal Road will also be made on the basis of available plans and data and other relevant studies prepared by the Government. This study will also take into consideration the overall regional characteristics, a review of the development potential for the coastal region of Manila Bay, the analysis of the data collected which are related with this project and the results of a field reconnaissance.

Part 2 fo the Study will consist of the second field investigation in the Philippines and all subsequent work. In the field investigations during the early stage of the Part 2 Study, the best route for the feasibility study will be proposed based on engineering survey and the analysis of each field investigation.

During the latter stage of the Part 2 of the Study, the preliminary design of the best route and the economic analysis and evaluation will be performed.

Fig. III-1-1 PROJECT ROADS



CHAPTER 2. DESCRIPTION OF THE DIRECT INFLUENCE ZONE FOR THE PROJECT ROADS

2.1 Direct Influence Zone

The direct influence zone for the Project Roads includes the six municipalities of Valenzuela, Malabon, Navotas, Obando, Meycawayan and Marilao (See Fig. II-2-1). The economic growth fo MMA has influenced this area by encouraging the development of housing areas and the location of business establishments.

2.2 Population

The six municipalities have been registering a high population growth rate. It was 4.6 p.a. during 1948-1960, then it increased to 5.9% p.a. during 1960-1975 which was higher than that (4.9% p.a.) of the MMA. During the same period, the population of Valenzuela increased by as much as 9% p.a. Even in Navotas where the new location of business and housing areas are less likely to occur due to the shortage of open areas, the population growth rate during 1960-1970 and 1970-1975 were 5.4% p.a. and 3.1% respectively. Population by municipality in 1948, 1960, 1970 & 1975 is shown in Appendix II-1 of Volume II.

2.3 Development of New Establishments

The development of new establishments is most predominant around Malinta of Valenzuela, through which C-5 is proposed to pass.

Appendix I-12 presents the trend of the development of new establishments, and is prepared based on aerial photos taken in 1967 and those taken in 1978 together with the results of the field reconnaissance survey made by the Team in 1979.

2.4 Present Land Utilization

On the southern part of Malabon and Valenzuela, the area being utilized for fishponds and rice fields is quite minimal in size due to the urbanization of the two towns. Houses, subdivisions, factories, and warehouses are located not only along the roads but also in some part of interior area away from the main roads. Upgrading of the road network, water supply lines and power lines would have contributed to the development of urbanization.

Appendix I-13 presents the developed areas in the direct influence zone. This zone is utilized for fishponds, rice fields, cultivated fields and residential/industrial uses. Residential and industrial lots have also developed in strips along side the roads, while the interior areas are used for fishponds, rice and cultivated fields.

2.5 Future Prospect of the Direct Influence Zone

Through field reconnaissance (See Appendix I-12), the new development of establishments have been identified to be concentrated in the area adjacent to the Malinta and Meycawayan interchanges of Manila North Expressway. This concentration could be caused by the following factors;

- good accessibility to Manila using existing roads;
- availability of river for water transportation and industrial water intake; and
- lower price of land.

There are still virgin lands, rice fields and fishponds, which may be developed into housing subdivisions or industrial areas. Specifically, the area in the eastern side of the McArthur Highway has better soils conditions than the western side which has been pointed out in the Study and in other studies as well.

Present trends indicate that in the coming decades new housing areas and establishments will be located in the area between the McArther Highway and the Manila North Expressway. The National Housing Authority has a "Housing Site and Service Project" in Valenzuela. Although the project is still in the comprehensive study stage, the NHA expects that the World Bank may cooperate in financing this project in 1981. The total area of the project is 70 hectares in two blocks. When completed, the project will serve 5,000 households of lower and middle income classes.

Urbanization of the area to the east beyond the Manila North Expressway will depend upon the improvement of infrastructures including the construction of a road network.

Upon completion of C-5 and/or C-6 linked to the Coastal Road, the area would have good accessibility to and from the port of Manila. Development of export industries in the area will be encouraged. The supply of resources and materials from northern Luzon could easily be brought to the industries through the improved road network. Considering the past trend of changes in land utilization the development will be more intensive in the area along C-5, while the development in the area along C-6 will come at a later stage.

CHAPTER 3. EXISTING TRAFFIC CONDITIONS

3.1 Roads in Direct Influence Zone

The main road network in the Project Area has been introduced in previous part of this report (See Sub-Section 2.5.1 in PART II). Fig. III-1-1 shows the roads which will be subject to more careful traffic studies.

Except for Manila North Expressway, all existing roads are undivided 2-way 2-lane roads. The dimensions and statistics for these roads are shown in Table III-3-1.

Table III-3-1 INVENTORY DATA OF EXISTING ROADS

Road Name	Carriageway Width (m)	Shoulder Width (m)	Side Clearance (m)	Sidewalk	Pavement
Manila North Expressway	2 x 7.3	3	3	-	Concrete w/ asphalt overlay
McArthur Highway	10.3	1-3	1-3	-	Asphalt
National Road 369	5.0-6.0	-	0.5-1.0	-	Concrete
Malinta I.C. Access Road	5.2	-	0.5-1.0	-	Concrete partially asphalt
Meycawayan I.C. Access Road	5.0	-	0.5-1.0	-	Concrete
Malanday-Polo-Banghulo Road	7.4	-	0.5-2.0	-	Concrete
Polo-Malabon Road	6.0	-	0.5-1.0	-	Concrete & gravel
Malinta-Banghulo Road	5.0	-	0.5-1.0	-	Concrete & gravel

Notes: Asphalt --- Bituminous Pavement
Concrete -- Portland Cement Concrete Pavement

Most of the long trips taken by highway users are served by the Manila North Expressway and the McArthur Highway, while a few by Road 369 (Obando-Banghulo-Caloocan). Another road between polo and Banghulo is used by more traffic than Road 369. Roads crossing the area from west to east are few, consequently, Malinta-I.C.-Novaliches road has the most traffic (See Section 3.2 in Part III).

The existing problems related to local traffic are summarized below:

- Mixture of through traffic and local traffic;

- Free parking of vehicles and frequent stops of jeepneys.

- Direct use and occupation of roadsides by vehicles; and

- Free crossing of road by pedestrians.

Heavy traffic congestion can be seen in the road sections at the local centers, Malinta, Meycawayan, Malanday, Polo, Malabon and Navotas.

The status of the existing roads, and services are shown below:

- Two traffic signal intersections are located only at Caruhatan and Meycawayan along the McArthur Highway;

- Poor drainage system is provided at roadside;

- Sidewalk is provided only for a few sections; and

- Maintenance is insufficient.

3.2 Characteristics of Traffic

3.2.1 Registered Number of Vehicles

The number of vehicles registered in the Philippines from 1971 to 1978 is shown in Table III-3-2. It indicates that an average rate of increase was 10% p.a. during these years. In recent years after 1977 the rate of increase was as high as 11% and 13%, resulting in 1.1 million vehicles in 1978.

The ratio of increase and number of registered vehicles in the regions around MMA are shown in Table III-3-3. Economic activities are highly concentrated in these regions. Approximately 65% of the vehicles in the country were registered in Region III, IV and IV-A. It registered 17% as a growth rate from 1977 to 1978, far larger than the 13% for the country as a whole.

3.2.2 Manual Traffic Counting

AADTs on the roads of the project influence area in 1976 and 1978 are shown in Appendix I-14. Fig. III-3-1 presents the AADT

Table III-3-2 REGISTERED VEHICLES, PHILIPPINES

Year	Cars	Trucks	Trailers	Sub-Total	Motor Cycles	Total	Annual Increase
1971	289,381	185,189	14,070	488,640	95,486	588,336	1.00
1972	312,137	204,391	13,358	529,886	128,750	657,934	1.12
1973	332,233	239,114	13,740	585,087	150,155	735,241	1.12
1974	397,603	272,889	17,477	687,969	164,484	852,253	1.16
1975	399,574	272,303	14,520	686,397	176,751	865,027	1.02
1976	402,328	290,619	14,597	707,544	177,822	885,386	1.02
1977	440,466	327,925	17,151	795,542	200,923	986,466	1.11
1978	493,374	369,351	20,525	883,250	235,357	1,118,607	1.13

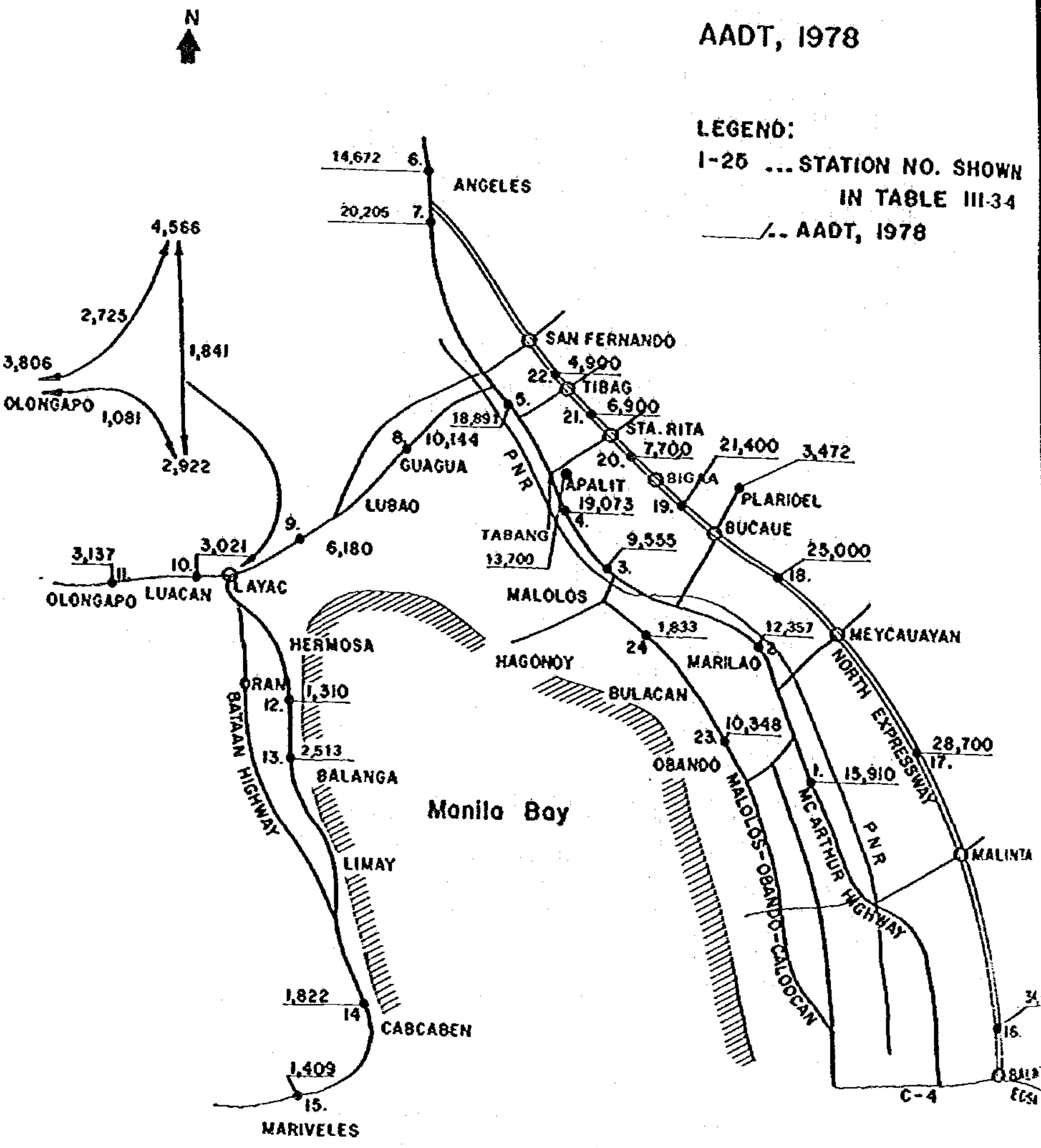
Source: Land Transport Commission, March 1979

Table III-3-3 REGISTERED VEHICLES REGION III, IV, AND IV-A

Year	Designation	Cars	Trucks	Trailers	Sub-Total	Motor Cycles	Total	Index
1977	Region							
	III	58,811	36,821	3,942	98,574	26,977	125,551	1.00
	IV	241,911	115,102	6,301	363,314	39,378	402,692	1.00
	IV-A	25,294	31,954	1,378	58,626	19,630	78,256	1.00
	Total	326,016	183,877	11,621	520,514	112,962	606,499	1.00
1978	Region							
	III	69,145	39,398	5,274	113,817	36,399	150,216	1.20
	IV	278,727	137,995	7,287	423,778	50,607	474,610	1.18
	IV-A	25,051	36,702	1,954	63,708	21,832	85,540	1.09
	Total	372,923	214,095	14,515	601,303	108,838	710,366	1.17

Source: Land Transport Commission, March 1979

Fig. III-3-1 TRAFFIC ON ROADS
Manila - Bataan Project Area



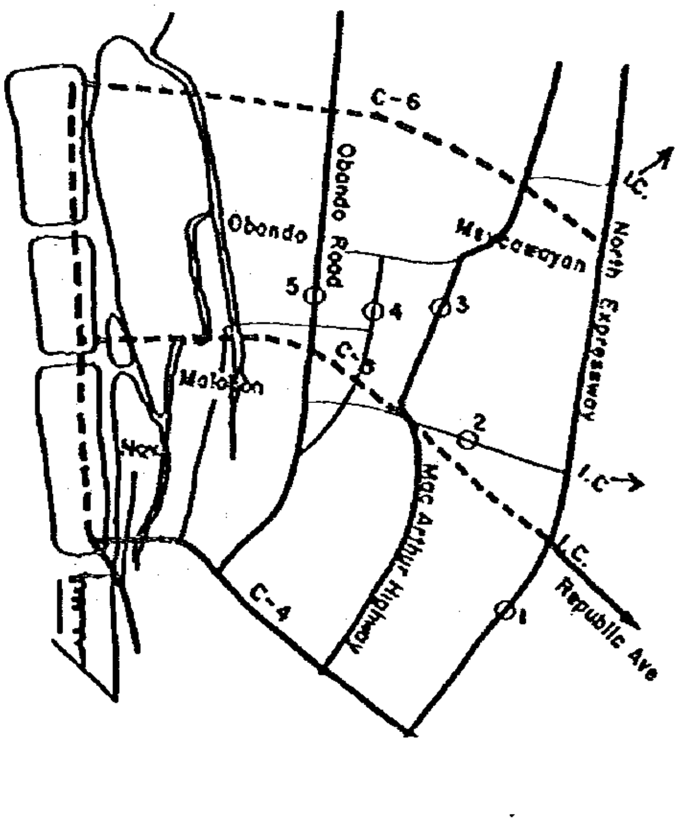
on the roads of the influence area in 1978. No definite trend of change over the two years on these road sections is indicated. However, it is anticipated that AADT increased by 20% on the corridor along McArthur Highway and 30% on the roads in Bataan province during these two years.

At the section where the C-5 is located, the AADT of 1978 was estimated to be 67,500, the section on which C-6 is located 47,000 and on the southern side of San Fernando the volume was 19,000. On the northern side of the Junction of San Fernando-Olongapo-Balanga Road and AADT was 6,200, on the section towards Olangapo 3,000 and on the section towards Balanga 3,000.

The results of traffic counting on the roads adjacent to the proposed C-5 on week days in July 1979, (conducted by the Team simultaneously with the OD interviewing) are presented in Appendix I-15. The location is shown in Fig. III-3-2. The total volume of traffic on 5 stations was 75,200. When compared with the AADT of 67,500 at C-5 section in 1978 shown in Fig. III-3-1, the daily traffic volume in 1979 indicates an increase of 11%.

According to the traffic counting data in MPH, it is found that ADT in July is approximately same to the AADT of that year on the main roads of the direct influence zone (See Appendix I-16).

Fig. III-3-2 SURVEY LOCATIONS



3.2.3 OD Survey

The origin and destination survey was conducted on the roads in the direct influence zone on a weekday in mid July 1979. The locations shown in Fig. III-3-2 are as follows:

No.1 Manila North Expressway at Balintawak, 500 m south of the toll gate.

No.2 Malinta-Interchange of Malinta-Novaliches Road, at Our Lady of Fatima College, 100 m east of the junction at the Valenzuela Municipality Hall.

No.3 McArthur Highway, at Malanday, 500 m south of Malanday junction.

No.4 Obando-Caloocan Road, at Banghulo, 100 m north of Polo-Malabon Road.

No.5 National Road 369, at Banghulo, 100 m north of Polo-Malabon Road.

The interview survey was conducted with a sampling of 1 out of 10 because of difficulties caused by heavy traffic volume and other restraints for interviewing. The entire 24 hour period was covered by three groups of interviewers, each working for 8 hours. PC policemen assisted in stopping vehicles at the survey site. The ratio of sampling calculated after the coding of data is shown in Appendix I-17.

3.2.4 Vehicle Type Composition and Other Characteristics

The percentage composition by vehicle type is also shown in Appendix I-15. It was found that 4,200 buses and 2,300 jeepneys used the Manila North Expressway, while 63 buses and 11,200 jeepneys were using the McArthur Highway. Jeepneys on McArthur Highway shared 50% of the total traffic and those on Obando-Caloocan Road at Station 4 and Station 5, shared 43% and 34% respectively. Medium and large trucks registered 13% and 10% on the two trunk roads in contrast to 8% and 4% on Obando-Caloocan Road.

The small passenger car had an average of 2.8 people while jeepneys carried 14.8, and buses 43.7 (See Appendix I-18).

Trip-purpose distribution for small passenger cars is shown in Appendix I-19. Of the total trips 22% are to and from home, 24% for work and business and the remaining 54% for other purposes.

Fuel use was determined in the survey (See Appendix I-20). Gasoline was used by 94% of the passenger cars and 88% of the pick-ups and vans. On the other hand, diesel fuel was used by 73% of the jeepneys, 91% of the buses and 82% of medium and large trucks.

Appendix I-20 presents the average loading weight in tons for three kinds of trucks together with the loading-empty ratio. The loading ratio was found to be low at 35% of the trucks.

The average loading weight, excluding empty trucks, is shown in Appendix I-21. The table indicates that a medium truck carried 6.5 tons of cargoes, while heavy vehicles including trailers carried 11 tons on an average. Among the ten classified commodities, item 8 which comprises cement, steel products, construction materials, etc., accounted for 56% of the total weight of commodities.

Trip distance distribution for small vehicles (cars and vans) and trucks is shown in Appendix I-22 and Fig. III-3-3. The average trip distance was 43 km for small cars and 60 km for trucks.

3.2.5 OD Trips

Fifty-five zones were delineated in order to classify the OD trips. They are shown in Appendix I-23 and Fig. III-3-4. The vehicles interviewed at the five survey stations (See Fig. III-3-2) were classified into the number of origin and destination trips between these zones.

The interzonal trips for 1979 are presented in an OD Table for the total vehicles in Appendix I-161 and the total number of trips for 1979 is shown together with 1988 and 1998 in Table III-3-4.

According to the above OD table, the number of trips to and from the west side of Manila city and Navotas (Zone 18, 20, 26 and 27) was 3,200, while for the rest of the city it was 18,500. Quezon (zone 29-33) had 15,400 trips and Makati-Pasig (Zone 51 and 50) 5500. The zones 52, 53 and 54 which are south beyond Manila had only 3600 trips. Manila city generates 30% of the total trips and Quezon City 20%.

There were 6,700 trips to and from Pampanga (zone 43, 44 and 48), 1,200 to Bataan (zone 45 and 46), 700 to Olangapo (zone 47) and 6,000 to and from provinces beyond Pampanga (zone 39). The desired lines for representative trips among the enlarged zones are shown in Fig. III-3-5.

The above OD table includes short distant trips in and around Meycawayan Municipality, which were not surveyed by one of the interviewing stations but estimated by applying the OD pattern of personal trips of UTSMA in 1971.

Fig. III-3-3 TRIP LENGTH DISTRIBUTION

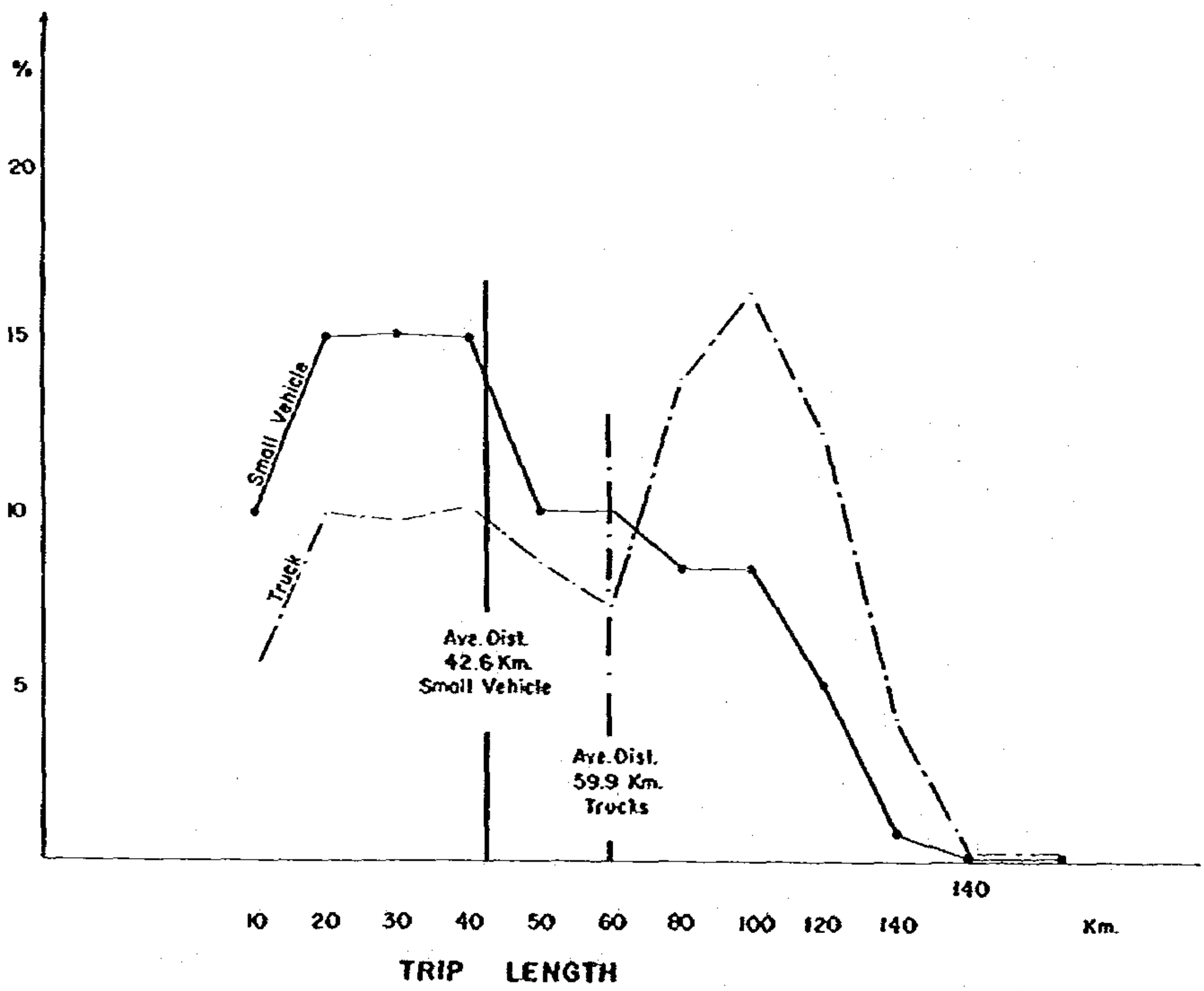


Fig. III-3-4 ROAD NETWORK AND ZONING

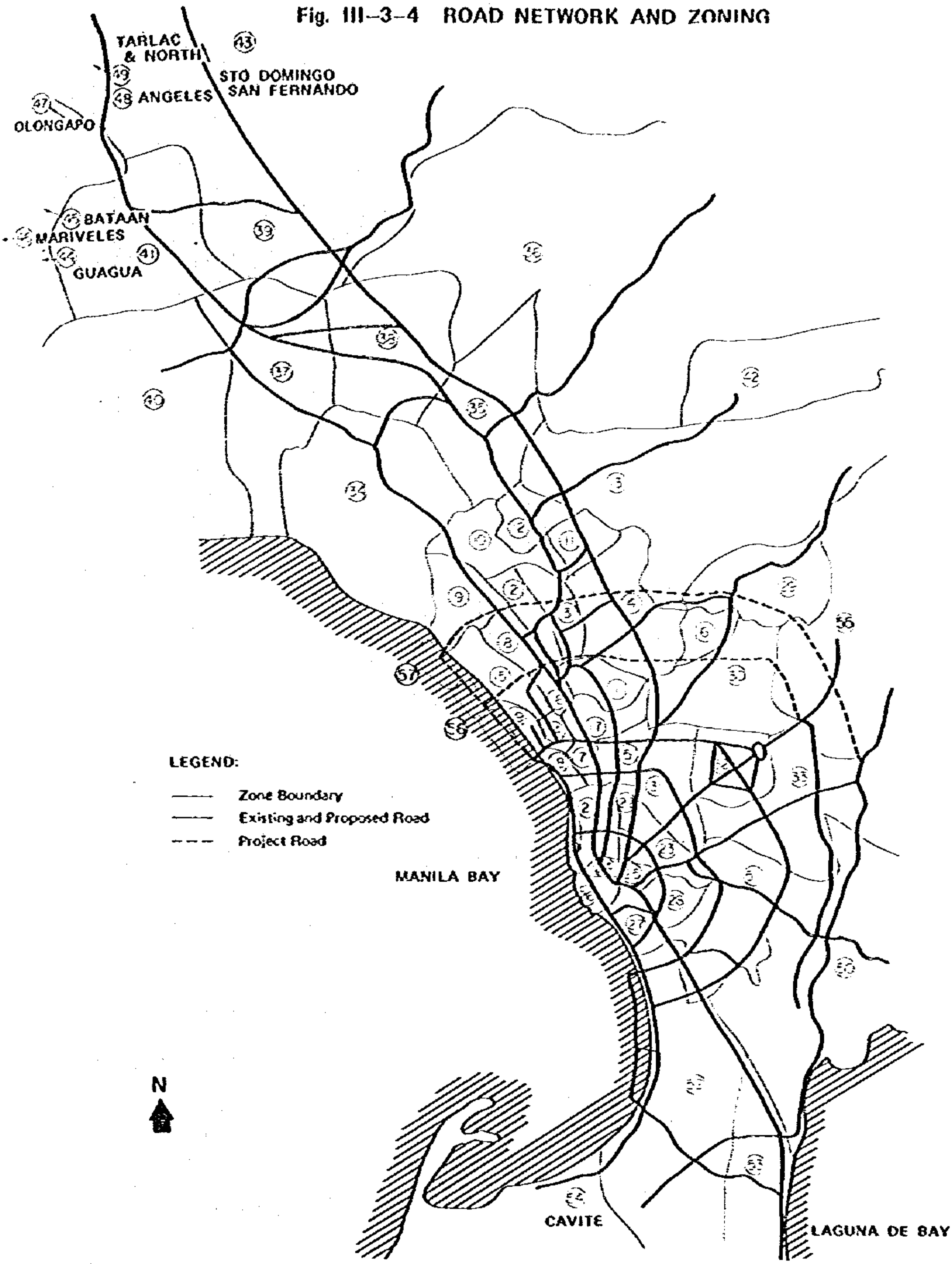


Fig. III-3-5 DESIRED LINES OF TRIPS, 1979

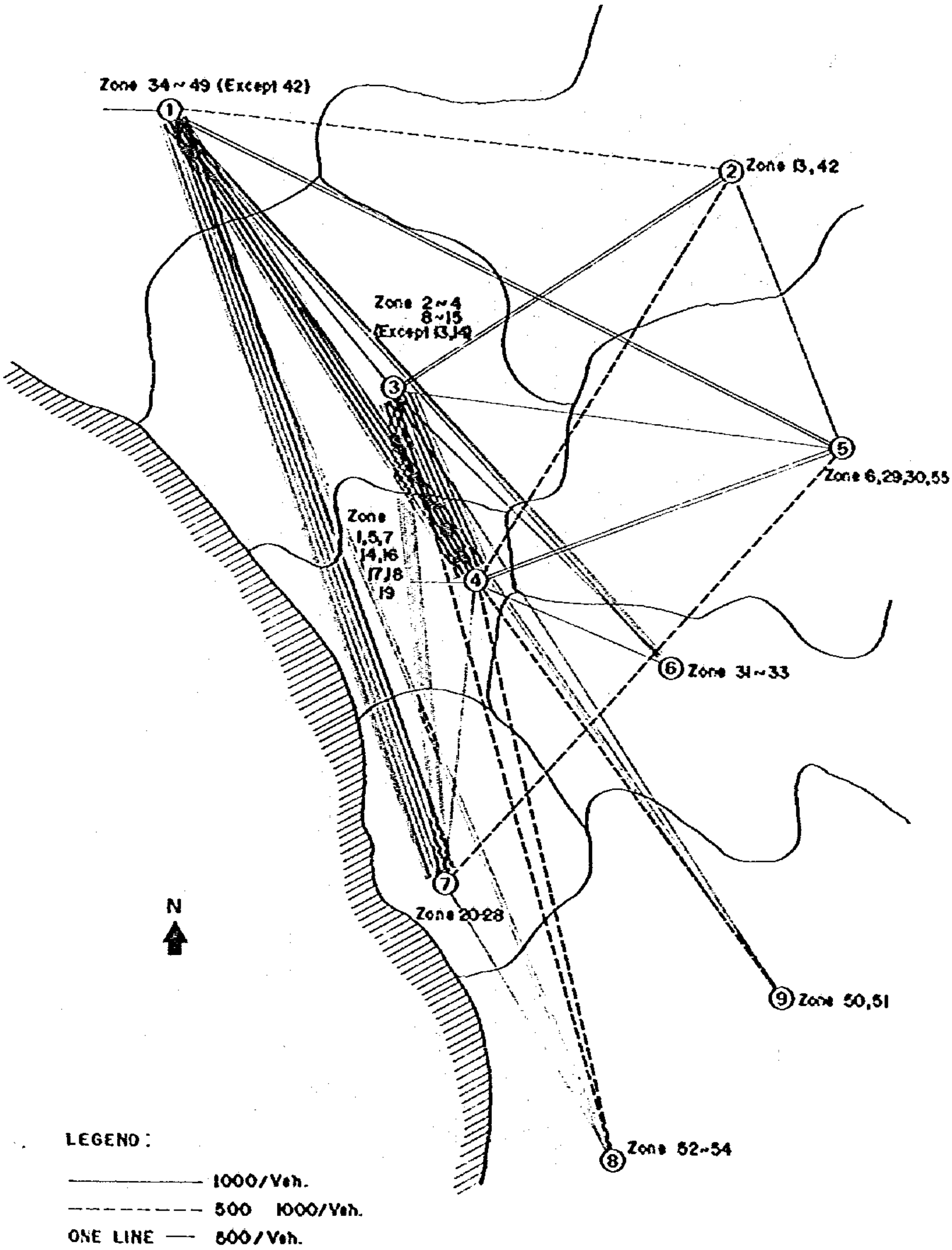


Table III-3-4 THE TOTAL TRIPS OF THE OD TABLES FOR 1979, 1988 AND 1998

Vehicle Type / Year	1979		1988 1)		1998 2)
1. Small Vehicles	47,391	(2.013) 8.1% p.a.	95,387	(1.708) 5.5% p.a.	162,891
2. Trucks	9,575	(1.946) 7.7% p.a.	18,629	(1.584) 4.7% p.a.	29,514
3. Public Utilities	27,754	(1.722) 6.2% p.a.	47,799	(1.463) 3.9% p.a.	69,933
4. Total	84,718	(1.910) 7.5% p.a.	161,815	(1.621) 5.0% p.a.	262,338

Notes: 1) Generated trips from Zone 56 and induced traffic are included.
2) Generated trips from Zone 56 and 57 and induced traffic are included.
3) Figures in ( ) show the ratio of increase during this period and percent figures show the average growth rate per annum.

CHAPTER 4. FORECAST OF FUTURE TRAFFIC VOLUME

4.1 Overall Traffic Growth Rate

The traffic growth rate is determined by two factors, first by estimating a growth trend of the traffic in the overall zones of influence from 1979 to 1990 and to 2000, and secondly by estimating the growth rate for each zone (Zone 1 to 57) within the framework of the overall growth trend for the same period. The growth rate for each vehicle type in each zone is based on the population growth and employment situation, which is shown in the next section.

Due to the unavailability of the time serial statistical data for the project area such as the total number of generated trips and per capita regional income, two methods of computing the overall traffic growth rate are studied and compared. One is related to the number of registered vehicles and the other related to transport expenditure.

4.1.1 Registered Number of Vehicles and Overall Traffic Growth Rate

The elasticity of per capita vehicles on per capita GNP is identified for the period of 1973-1978 in the Philippines. Then, it is associated with the growth rates of population and per capita GNP, resulting in the growth rate of car, public utility vehicles and trucks in terms of vehicle registration in the country. It is considered reasonable to assume the growth of the number of registered vehicles to be equivalent to the growth of traffic in the country as a whole. The result is shown in Table III-4-1.

Table III-4-1 GROWTH RATE OF TRAFFIC, 1979-1990 AND 1990-2000

Vehicle Type	Growth ratio 1990-1979	Annual growth rate 1979-1990	Growth ratio 2000-1990	Annual growth rate 1990-2000
Car	2.26	7.7%	1.63	5.0%
PU Vehicles	1.59	4.3%	1.34	3.0%
Trucks	2.19	7.4%	1.63	5.0%
Total	2.06	6.7%	1.56	4.5%

4.1.2 Transport Expenditure and Overall Traffic Growth Rate

A. Passenger Vehicle Traffic

The growth rate for passenger transport is derived from a model as follows:

$$TGR\ (\%) = 100 \times \left[\left(\frac{I \times E}{100} + 1\right) CP - 1 \right]$$

Where: TGR = the traffic growth rate p.a. in percent.

I = the growth rate in percent for per capita income at constant prices.

E = the elasticity of transport expenditures on disposable household income.

CP = the compound ratio of population growth p.a. (not in percent).

The 1971 Household Survey conducted by the NCSO provided the basic data for the analysis of public and private passenger transport income elasticities which were re-checked with data from the 1975-1976 household survey. In addition, the elasticity has been calibrated on the basis of actual past transport growth rates. The elasticities derived are shown in Table III-4-2.[1]

Table III-4-2 PASSENGER TRANSPORT INCOME ELASTICITIES (PTIE)

Annual per capita 1) income in 1971 (P)	Private & Public PTIE	Public PTIE
170-350	0.5	0.5
351-520	0.9	0.7
521-690	1.1	0.8
691-860	1.3	1.0
861-1040	1.5	1.1
1041-1210	1.6	1.0
1211-1550	1.6	0.8
1551-2070	1.7	0.6
2071-	1.7	0.5

Source: Samar Integrated Ru. Dev. Project, quoted from NCSO.

Note : 1) Family income is divided by 5.8 persons.

The elasticity assumed in the National Transport System[2] Study was 1.8 for private transport and 1.0 for public transport. From the figures in Table III-4-2 as well as the above assumptions, the elasticities (E) of private transport are found to be 1.6 and for public transport 1.0. These shall be adopted in the traffic forecast for this project.

1/ PPDO of MPH and Samar Int. Rural Dev. Project Office, Samar Integrated Rural Development Project: Road Component, Feasibility Study Re-evaluation. March 1979.

2/ Inter-Agency Technical Committee on Transport Planning National Transportation System Study Vol. II (Interim Report). February 1978.

According to the long term development policy of the Government[3], per capita real GNP and per capita real income would grow at the rate of 4.8% p.a. and 4.0% p.a. respectively from 1976-2000. Considering the development potentiality of MMA, the growth of per capita income in the project area would be higher than the national average rate of 4.0%.

However, the country, like other oil-importing countries, will suffer from economic stagnation due to the price increase of crude oil. Also the growth trends of the national income (See Appendix I-26) and the population (See Table 2-1 in Vol. II) must be considered. The value of I is therefore determined by reducing the growth target by one third thus obtaining a rate of 3% p.a.

The population growth rate is estimated to be 2.4% p.a. in the total influence area (See Appendix I-1) from 1979 to 1990.

By adopting the above parameters, the growth rates are as follows:

Vehicles	TGR, 1979-1990
Cars	7.3%
PU Jeepneys	5.3%
PU Buses	5.3%

B. Truck Traffic

Commodity movements by trucks were surveyed by the Study Team in July 1979. The percent distribution of the categorized items are shown in Appendix I-24, where the commodity category is compared to the category of industrial origin of the national income account in Appendix I-25.

The government plan for economic development on a long term basis indicates a structural transformation as shown in Appendix I-25. Changes in percent of sectors as forecast in the plan would result in different growth rates of commodities to be carried by truck traffic.

Based on the assumption that the economy will develop at 8.3% in terms of net domestic product at constant prices,[4] and that percent share of commodity will change corresponding to the changes in structural transformation and the growth of sectors, the overall growth rate of commodities on trucks is estimated to be 9.4% p.a.

3/ NEDA, Long-term Philippine Development Plan up to the year 2,000, September 1977.

4/ NEDA, op. cit.

This figure should, however, be revised if the present world economic situation would affect the Philippines. In such case, the growth rate would be lower than 9.4% p.a. Appendix I-26 shows the increases in Net and Gross Domestic products at constant prices from 1969-1978. In this period the NDP increased at 5.4% p.a. Accordingly, with the assumption that the national economy will develop at a rate approximately equal to that in 1969-1978, the movement of commodity on truck traffic is forecast to be as follows:

5.4/8.3 = 0.65 ≑ 0.70

9.4 x 0.7 = 6.6% p.a., applicable to medium and large trucks.

Considering the range of trip distance and current pattern of uses it is assumed that the pick-ups and vans will have the same rate of growth as that for passenger cars.

Vehicle	1979-1990	1990-2000
Pick-ups	7.3% p.a.	5.0% p.a.

4.1.3 Conclusion

The two approaches, as just discussed, have different results, but the difference is only marginal. However, in order to achieve uniformity with all other MPH feasibility studies, the latter approach is adopted for this traffic forecast: For the period 1990-2000, the rate is reduced by 1/3 from that of 1979-1990 in order to avoid an over-estimate. The adopted figures for the traffic forecast are shown in Table III-4-3.

Table III-4-3 ADOPTED OVERALL TRAFFIC GROWTH RATE

Vehicle Type	1978 - 1990		1990 - 2000	
	Growth rate	Annual growth rate	Growth rate	Annual growth rate
Car	2.17	7.3%	1.63	5.0%
PU Jeepney	1.76	5.3%	1.41	3.5%
PU Buses	1.76	5.3%	1.41	3.5%
Pick-ups	2.17	7.3%	1.63	5.0%
Truck (medium & large)	2.02	6.6%	1.48	4.0%

4.2 Forecast OD Trips

4.2.1 Normal Trips

The OD Tables forecast for 1988 and 1998 is composed of the following 3 elements: normal trips, induced trips and reclamation-generated trips. The normal trips are based on the existing OD trips in 1979, which increase the volume year by year with the growth rate as estimated in the previous sections of 4.1.2. Zonepair trips are calculated by the following formula with the population data estimated in Chapter 2 of Part II.

Trucks $Tij\ 88 = Tij\ 79 \times (Wi.\ Wj)$

Passenger vehicles $Tij\ 88 = Tij\ 79 \times (Pi.\ Wj + Wi.\ Pj)/2$

Where Tij 79 : trips between i and j of 1979

Tij 88 : trips between i and j of 1988

Pi, Pj : the growth ratio of Population in i and j (See Table II-2-3)

Wi, Wj : the growth ratio of employed persons in work place of i and j. (See Table II-2-3)

The above interzonal trips in an OD matrix in 1988 is converged to the total trips which is determined by applying the overall growth rate. The total trips of each vehicular type has been determined in the previous section 4.1.

There is an argument that a regression analysis method should be applied to estimate the parameters of the growth factor formula instead of the above formulas. The reasons in adopting the above formulas are described as follows:

- Trips which pass through the cordon interview stations are numerated in OD tables. However, there are other trips which would generate from each of the zones but not passing through cordon stations. These are not shown in OD tables. Accordingly, the total trips in a zone shown in the OD tables do not mean the total generated from the zone. In this case a reliable trip generation formula cannot be determined; and

- While population, workers in residence and these in work-place were estimated, the zonal land use classification and the zonal income data were not found during the study period.

4.2.2 Induced Trips

If the road network is improved by adding a new road or improving the existing road, the travel time and cost of vehicle operation is reduced, resulting in the generation of additional trips. The formula adopted in the estimate of additional (induced) trips is as follows:

$$Aij = Tij. \{ (\frac{DB}{DA})^{\alpha} - 1 \}$$

Where Aij : induced additional trips between i and j

Tij : normal trips between i and j

DA : time distance or travel cost between i and j with the road improvement

DB : time distance or travel cost between i and j without the road improvement

α : the value of 2 is quoted from UTSMA

The ratio of induced trips over normal trips varies because of location and economic background of the project road. Although there are some data in Philippines which indicate the generation of induced traffic, it is hard by the data to predict the volume of induced trips on the project road. In the case of this project area, the new road of C-5 or C-6 is assumed to generate an additional 10% in total trips. The percentage may be changed if necessary as a result of a sensitivity test.

4.2.3 Reclamation Generated Trips

A. Industrial Zones

In order to determine the magnitude of vehicle trip generation at the existing factories, interviews were conducted in August 1979 of 61 manufacturing establishments in Quezon, Valeuzuela and Malabon. The questionnaire sheet is shown in Appendix I-28.

After reviewing the answers, a relationship was found between the total volume of vehicle trips/day/hectare and the area of factory in hectares. The relationship is presented in Appendix I-29 by a curve drawn to indicate the magnitude of the average volume of trips per hectare which is inversely proportional to the area of the factory. Since the sample size was modest and there were some answers which were considered not reliable, the result was not conclusive. The curve was drawn by judging the overall tendency.

The area of industrial use in the reclaimed areas are shown in Appendix I-27. The summary is shown below. It is also assumed that the factories with the area of 1 ha. will share 2/3 and those with 3 hectars will share 1/3 of the total designated zone. The estimated number of generated trips from the industrial zones of the reclaimed areas is based on these assumptions and the average trips per hectar.

B. Housing Zones

Population density of the housing zone is assumed to be 300 persons per hectar. It is also assumed that the average number in a family is 6 persons of which 2.5 persons are working, that 90% of the employment opportunity is within the reclaimed areas and 10% outside, that non-working persons make 2 trips/day/ten families to and from the reclaimed areas using private cars (15%) and buses and jeepneys (85%).

The estimated trips generated from the residential area in 1988 were calculated and the results are shown in Appendix I-27. The summary is shown in Table III-4-4.

Table III-4-4 GENERATED TRIPS PER DAY, 1988 AND 1998

Alternatives	I		II		III	
	1988	1998	1988	1998	1988	1998
Zone	56	57	56	57	56	57
Trucks	2,958	2,706	2,026	1,108	2,720	1,584
Cars	88		82	260	88	88
Jeepneys & buses	51		48	150	51	51
Total	3,097	2,706	2,156	1,518	2,859	1,723

C. Distribution Among the Zones

It was decided to distribute the generated trips among the other zones by weighting the percent of population in the respective zones. These generated trips in 1988 are included in the forecast OD Tables together with induced and normal traffics. They are shown in the Appendix I-161.

It is assumed that zone 56, consisting of Blocks I, II, and III will generate the traffic after 1988, the year the construction of the blocks and C-5 are completed. It is assumed that zone 57, block IV will generate the traffic several years later.

CHAPTER 5. TRAFFIC ASSIGNMENT

5.1 Road Network Alternatives

5.1.1 Road Network Alternatives

Road network alternatives are shown in Fig. III-5-1. The first are the roads with no project designation. Usually, this will provide a basis for the comparative study of alternatives.

The second plan is composed of the Coastal Road from C-4 to C-5 as a causeway in the sea offshore from Navotas and the C-5 section connecting the Coastal Road with the Manila North Expressway. At a later stage the extension of the Coastal Road and the addition of C-6 is proposed to meet the anticipated traffic growth demands. No reclamation is necessary for this plan.

The third plan is a joint project of land reclamation and road construction. The Coastal Road is located on the reclaimed area and connected to the Manila North Expressway through C-5. The grade separation structures will be provided to meet the traffic demands at a later stage. No C-6 road is proposed in this plan.

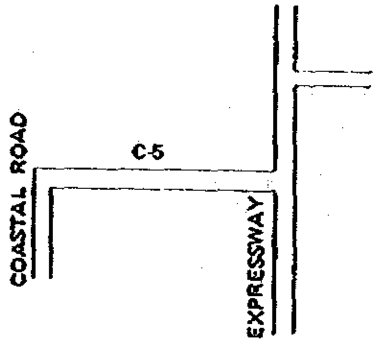
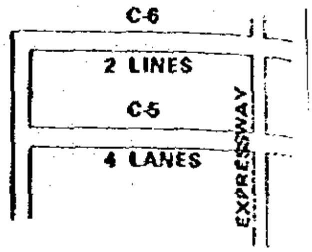
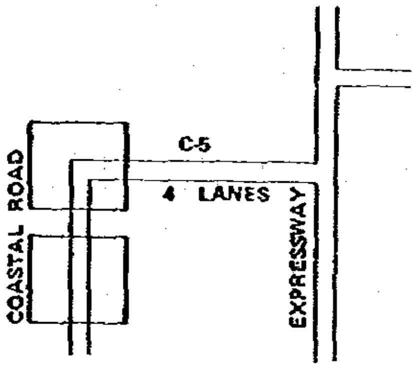
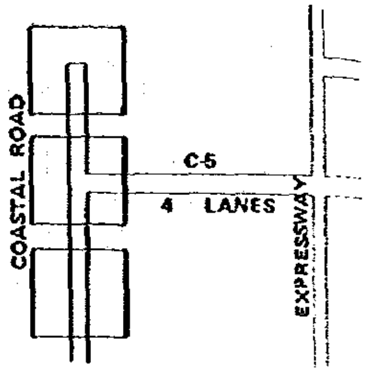
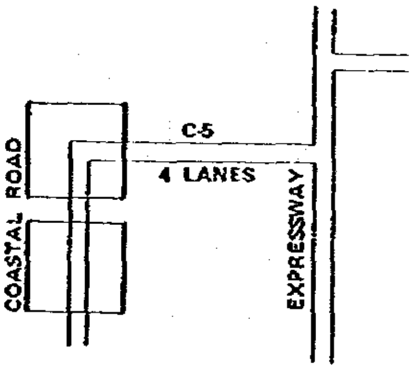
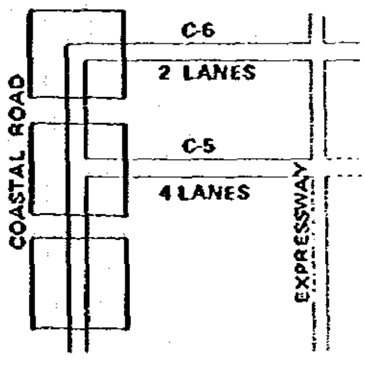
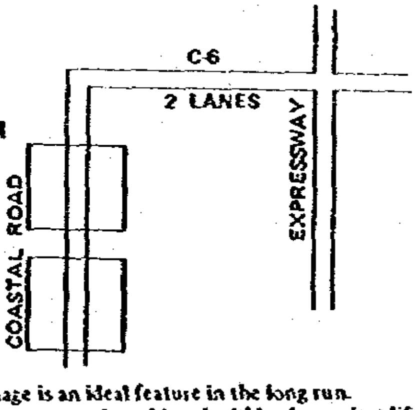
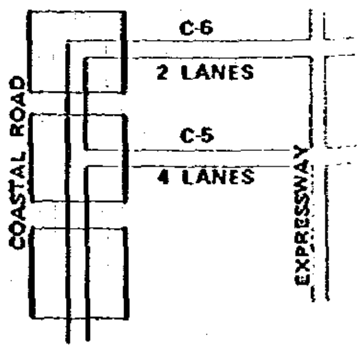
The fourth plan begins the same as the third plan, however at a later stage the extension of the Coastal Road together with the addition of C-6 section is proposed. Land reclamation is assumed to be another part of this project.

The fifth plan starts with the construction of the C-6 and the Coastal Road. The Coastal Road extension consists of two sections: one a road on the reclaimed area, the other as a causeway in the sea. At a later stage, C-5 would be constructed. There would be no basic difference at the final stage in the network between the plans for 4 and 5.

In determining these alternative road plans, other alignments were studied. In the case of the Coastal Road, the alignments along the coastal line of Navotas, widening of the existing North Bay Boulevard, and a route along the border line of Navotas and Malabon municipalities were studied. They were deleted because of their complex impact on the community and existence of private properties in the right of way which might include disputes in the court.

In case of both the C-5 and C-6 route determinations, the routes were established, after the field reconnaissance survey, to provide the least evacuation of existing buildings and houses (See Section 6.2 for further description).

Fig. III-5-1 ALTERNATIVES OF ROAD PLAN

PLAN NO.	DESCRIPTION	THE FIRST STAGE (1988)	THE FINAL STAGE [1]
1	NO PROJECT		
2	ROAD PLAN WITHOUT RECLAMATION		
3	ROAD PLAN WITH RECLAMATION		
4	ROAD PLAN WITH RECLAMATION		
5	ROAD PLAN WITH RECLAMATION		

Notes: 1) The final stage is an ideal feature in the long run. It may be or may not be achieved within the project life, depending on the growth of traffic demand. In some cases, the second stage plan is proposed between the first and final stages.

5.1.2 Development of Related Roads

At the mid-point of the study period, it was noticed by MPH that a toll road construction is under study, which would connect the Manila North Expressway and South Expressway.

However, the schedule of detailed engineering study and implementation of the said toll road is not yet known.

Under the circumstances, the following assumptions have been made as basis for the traffic estimate and economic evaluation.

- C-6 extension (a toll road system is proposed beyond Manila North Expressway) is to be constructed by 1987; and
- C-5 extension beyond Manila North Expressway (sometimes called Republic Avenue) is to be constructed at a later date when the traffic volume in that area will increase to a level which may justify the construction.

5.2 Traffic Assignment

In order to estimate the traffic flows on the road network, the future traffic volume in 1988 in OD tables are simulated using the following methods, which are similar to the methods applied in other studies.[5]

i) Trips in each pair of OD tables are grouped into five sub-groups each with a percent of 30, 20, 20, 20 and 10 respectively. A route between every origin and destination in a sub-group is simulated to be the time-shortest one being given a speed condition in the Velocity-Quantity Relationships. The speed condition is to be evaluated after the assignment of traffic in each sub-group is completed.

ii) The speed conditions on all road sections are set by the Q-V curves shown in Fig. III-5-2B. The curves indicate a speed which decreases in response to the larger number of assigned traffic. These curves were based on previous studies and adjusted to suit the highway characteristics for this project.

iii) For OD trips in the sub-group, two routes are determineed-one with the Manila North Expressway and the other without, to find the ratio of diversion to the toll road. The diversion ratio is determined by applying the curve given in Fig. III-5-2A which was developed by analysing the data surveyed in July 1979.

Although there must be additional cost in stopping at toll gates, the cost is not included in this estimate. The effect of the exclusion is considered negligible in this analysis.

5/ MPH & OCTA, JAPAN, Urban Transport Study in Manila Metropolitan Area, (September, 1973) and MPH & JICA, Feasibility Study on C-3 and R-4 related Roads Project (March, 1978).

Fig. III-5-2A DIVERSION CURVE

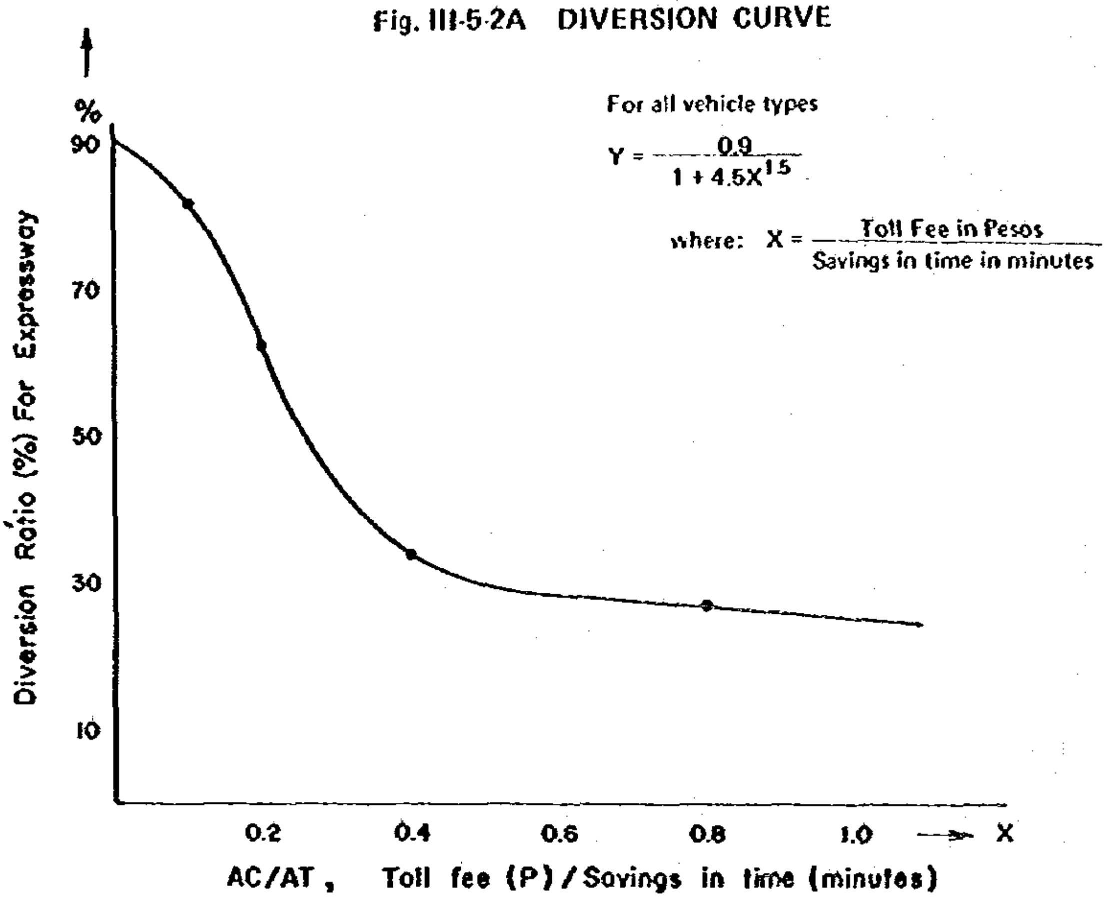
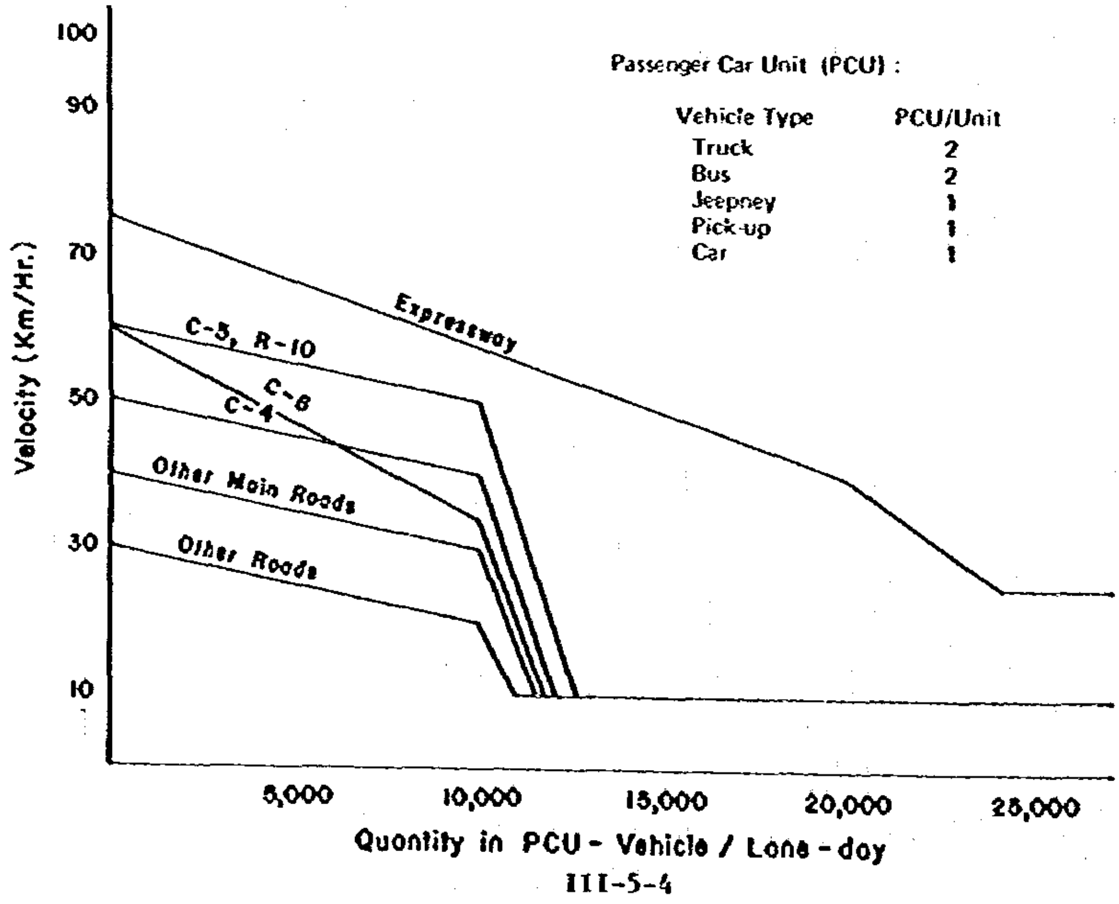


Fig. III-5-2B VELOCITY QUANTITY CURVE



iv) The road network adopted for the simulation of traffic assignment is one that the roads outside the direct influence zone are simplified in a way to respond to the large size of the zones.

5.3 The Result of the Traffic Assignment

Estimated traffic flows on the roads of the alternative road plans in 1988 are presented in Figs. III-5-3 ∿ III-5-6. The average traffic volume on C-5 and C-6 in 1988 are shown in Table III-5-1. The estimates for Plan 3 & 4 in 1998 and 2008 are also shown in Table III-5-2.

Fig. III-5-7 presents the distribution of traffic in 1988 for the case where the extension of C-6 is not assumed but the extension of C-5 (the Republic Avenue) is assumed. Compared to the traffic flows on road plan 3 (Fig. III-5-5), the increases of the traffic on the sections of C-5 are generally modest. The increase is by 20% on the section close to the North Expressway and by 10% on the section close to the causeway.

There are some sections which indicate a different pattern compared to the present traffic flow. No further iterative modification was conducted since the difference would not affect the traffic on the Project Roads and the relative comparison of the Alternatives.

It is found that the traffic volume on C-5 is 18,300 in 1988 (See Table III-5-2). It is quite likely that the volume is too small to justify the economic viability of the simultaneous construction of C-6 together with C-5. The addition of C-6 will become necessary some years beyond 2008.

Fig. III-5-3 ESTIMATED TRAFFIC AADT IN 1988

Alternative 1
(No Project)

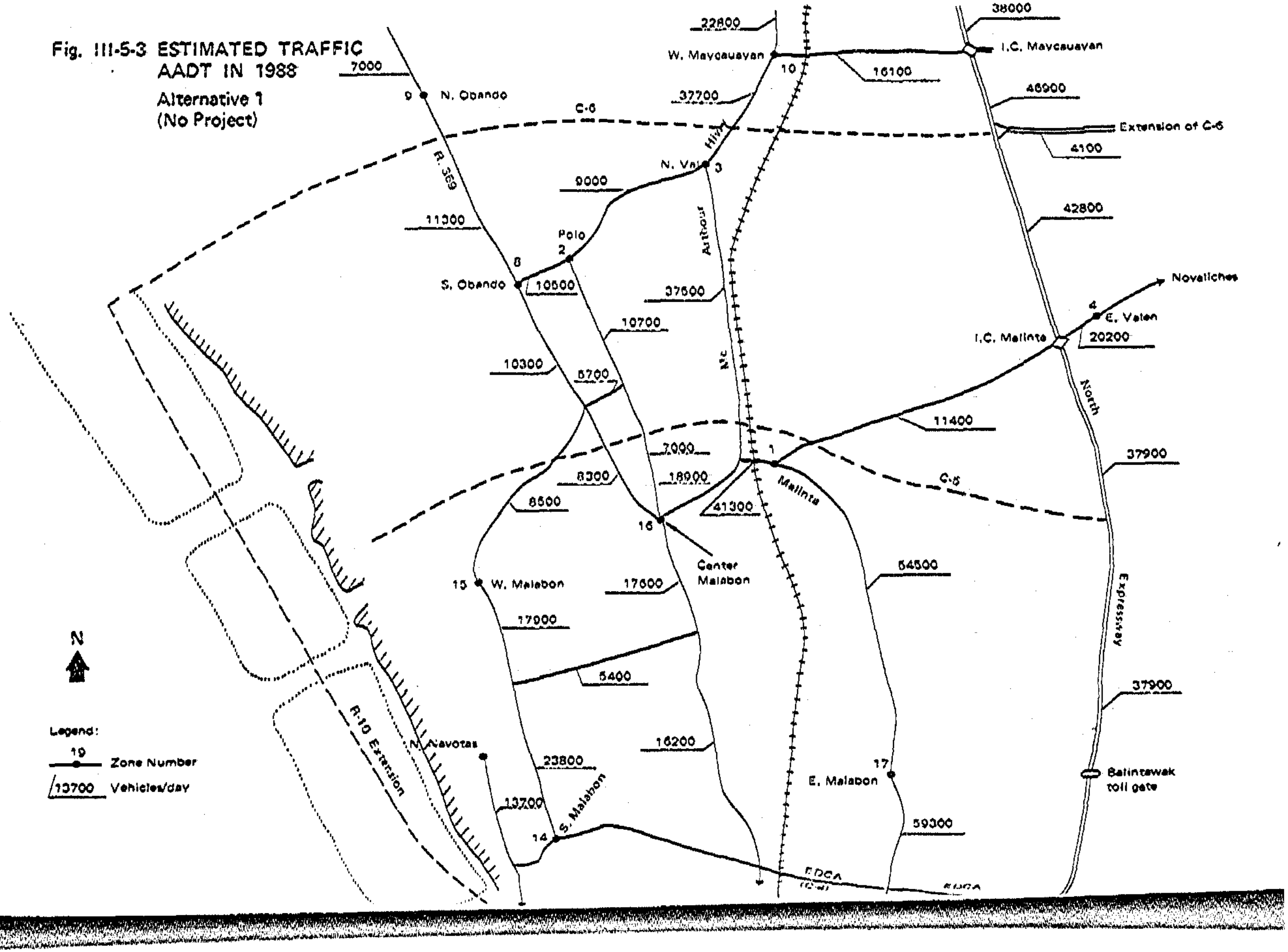


Fig. III-5-4 ESTIMATED TRAFFIC AADT IN 1988
Alternative 2
(C-5 with no reclamation)

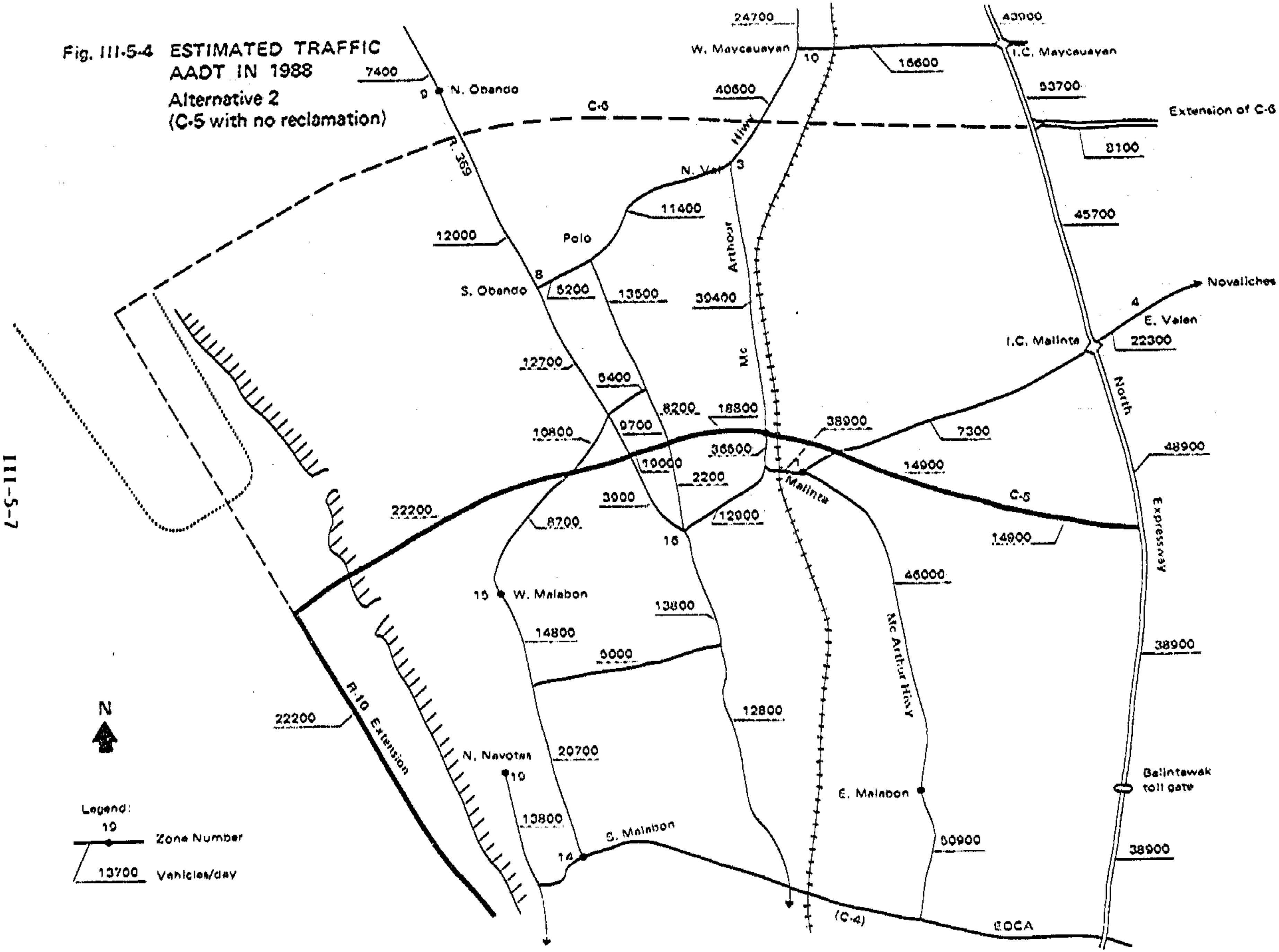


Fig. III-5-5 ESTIMATED TRAFFIC AADT IN 1988
Alternative 3 and 4
(C-5 with reclamation)

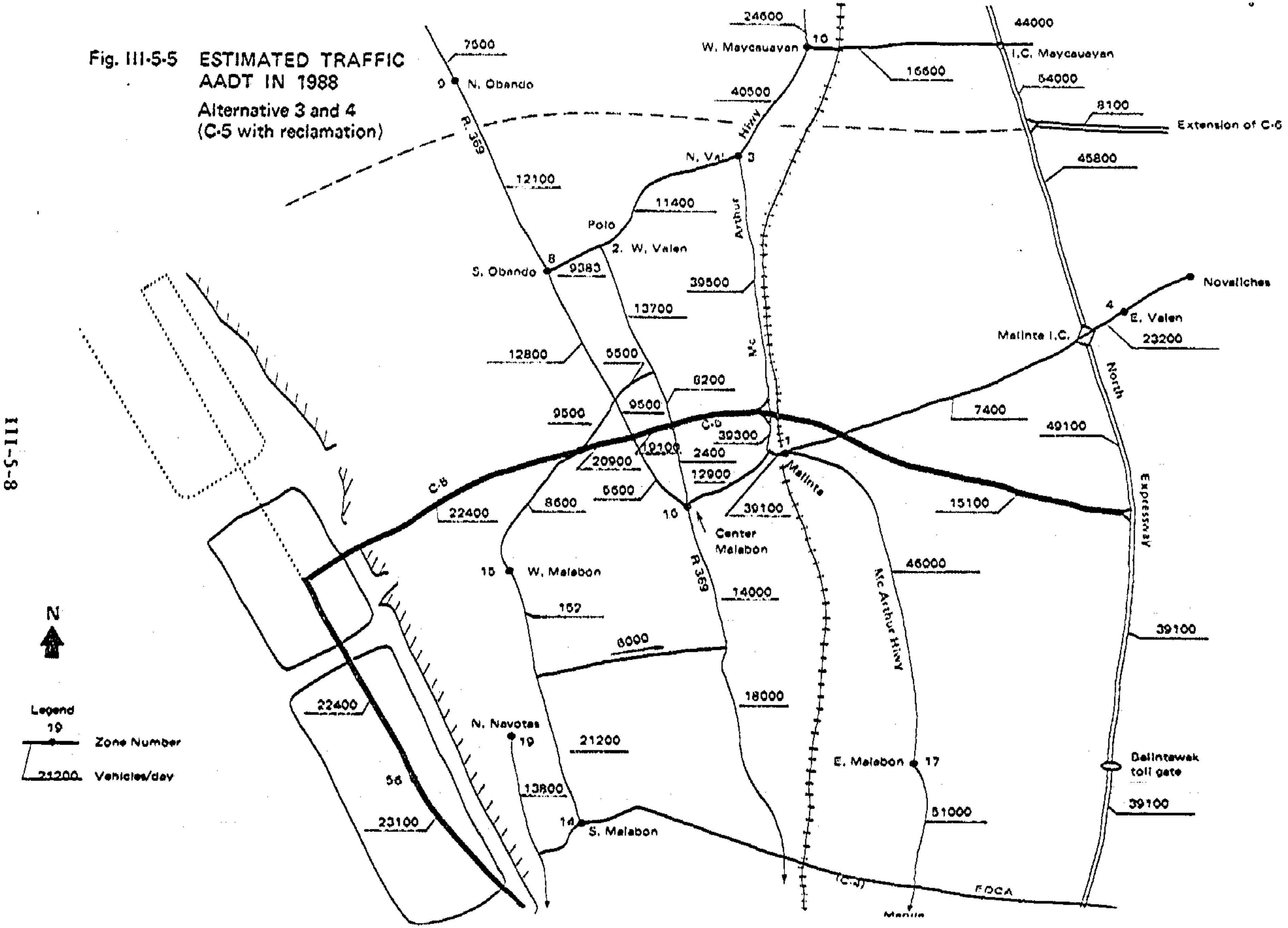


Fig. III-5-6 ESTIMATED TRAFFIC AADT IN 1988
Alternative 5
(C-6 with reclamation)

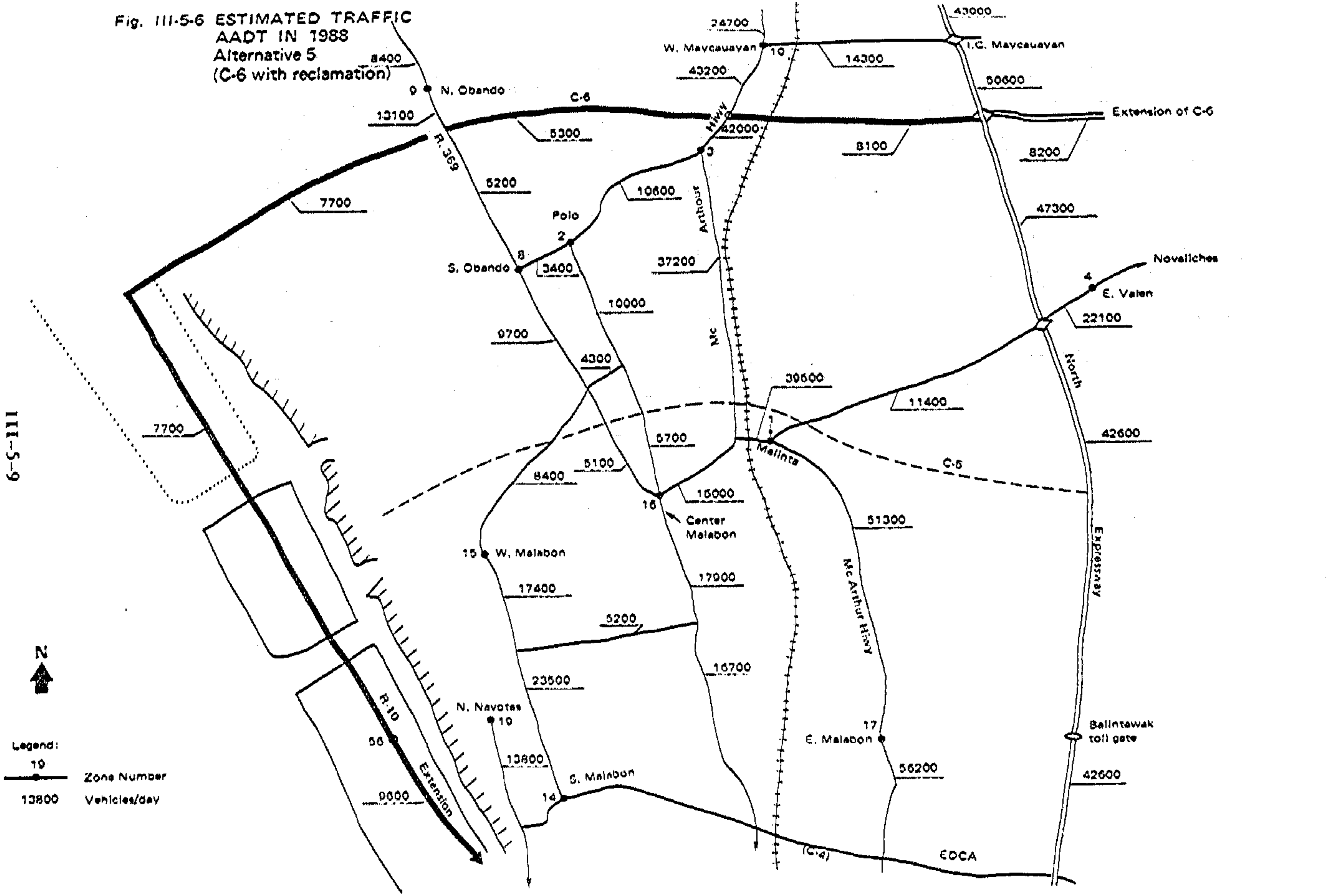


Fig. III-5-7 ESTIMATED TRAFFIC AADT IN 1988

Alternative 6
(C-5 with reclamation)
(No extension of C-6, but with C-5 extension)

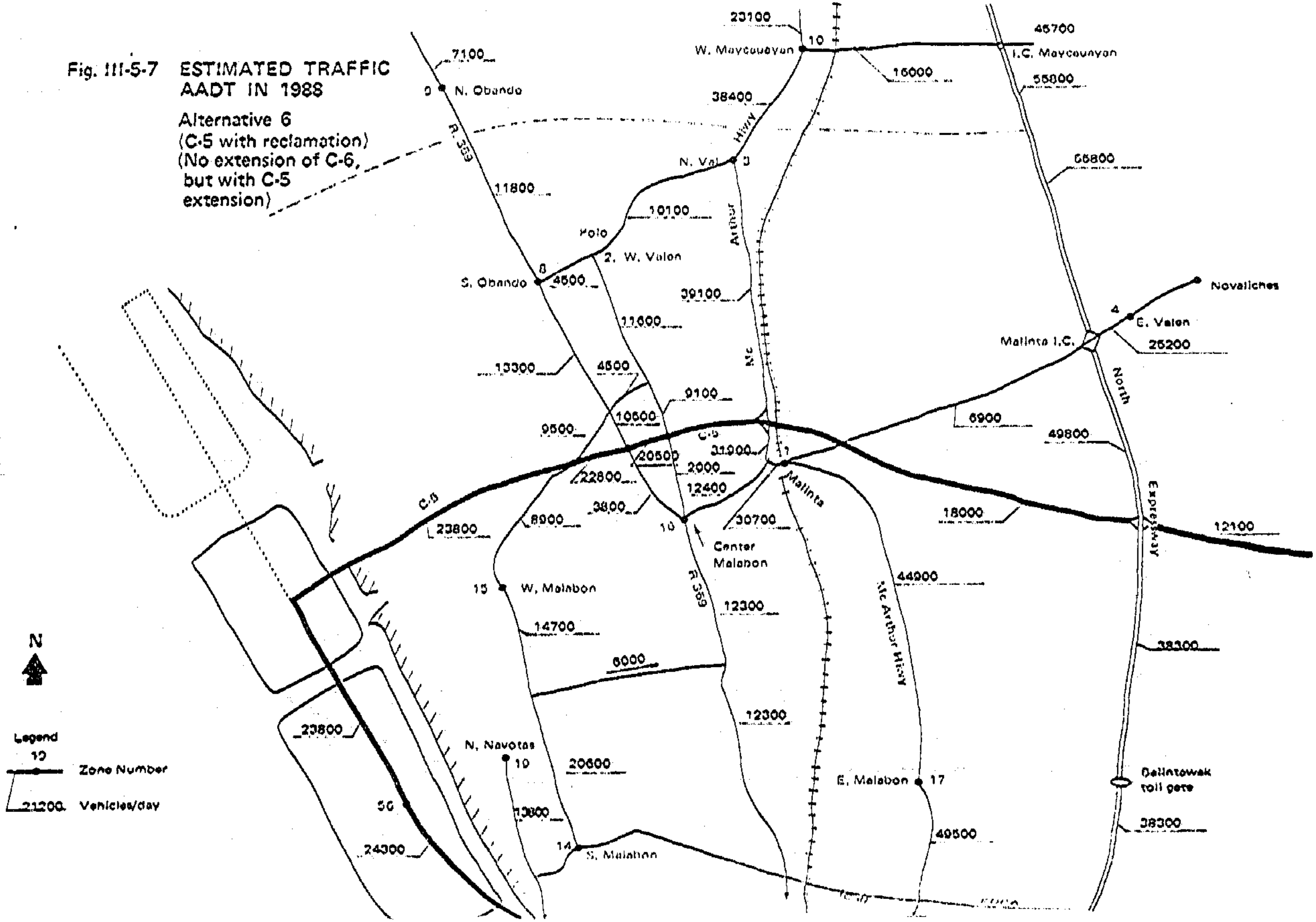


Table III-5-1 AVERAGE TRAFFIC VOLUME ON THE PROPOSED ROADS

(per day, 1988)

Road Plan	Plan 2		Plan 3 and 4		Plan 5	
Road Section	Coastal Road	C-5	Coastal Road	C-5	Coastal Road	C-6
Vehicles:						
Cars	9,356	7,816	9,021	7,783	3,059	2,932
Pickups	3,118	2,605	3,007	2,594	1,019	977
Jeepneys	4,704	4,090	5,268	4,257	2,118	1,723
Buses	1,704	1,200	1,318	1,065	530	431
Trucks	3,315	2,482	4,357	2,654	1,803	937
Total	22,233	18,193	22,971	18,342	8,529	7,001

Table III-5-2 AVERAGE TRAFFIC VOLUME ON THE PROPOSED ROADS (PLAN 3 AND 4)

(per day)

	1988		1998		2008	
Road Section	Coastal Road	C-5	Coastal Road	C-5	Coastal Road	C-5
Small vehicles	12,028	10,377	20,307	18,478	24,732	24,490
Trucks	4,357	2,654	5,955	4,204	4,168	5,045
Bus & Jeepneys	6,586	5,322	8,703	8,176	9,646	10,156
Total	22,971	18,342	34,965	30,858	40,544	41,711

CHAPTER 6. INITIAL ROUTE STUDIES

6.1 Characteristics of the Project Roads

6.1.1 Background

A. Project Roads

The Project Roads to be studied, as established in the Overall Concept of the Study in Part I, consist of:

- Manila-Bataan Coastal Road, Phase I (hereinafter called the Coastal Road), from C-4 to C-6;

- Circumferential Road, C-5, (hereinafter called C-5) from the Coastal Road to the existing Manila North Expressway; and

- Circumferential Road, C-6 (hereinafter called C-6), from the Coastal Road to the existing Manila North Expressway.

These roads are located in the northern part of Metro Manila Area (MMA). They will be added to the arterial road network either as radial roads or as a circumferential road.

In the Metro Manila Area, the main arterial roads are being improved to form a network composed of radial roads and circumferential roads. They are shown in Fig. II-2-2, where the roads within C-4 are under partial improvement, while the outside roads including C-5 and C-6 are still in the planning stage.

In the northern part of MMA, housing and industrial estates have been developed in recent years. There are three radial roads extending northwards : Caloocan-Obando-Malolos Road (No. 369), McArthur Highway (No. 3) and Manila North Expressway. But no circular roads have been constructed yet outside the C-4 (EDSA).

B. Traffic Conditions

On the northern side of the Valenzuela municipality (intersecting with C-5 corridor), the ADT was counted in July 1979 as follows:

Existing Road	ADT
Manila North Expressway	36,600
Malinta-Malinta I.C. (to Novaliches)	9,300
McArthur Highway	22,300
Caloocan-Obando (to Malolos)	8,200
Total	76,400

According to the annual traffic count for PPDO in 1976 and 1978, it is considered that the general growth rate per annum would be 8-10% for these two years in this area. Fig. III-3-1 presents the traffic volume on roads of MMA to Bataan in 1978.

6.1.2 Salient Features of the Project Roads

A. General

It is apparent that the principal arterial road systems in many metropolises of the world are able to have the vehicles running at 60 mph or more in the suburban areas, while lower speeds of 10-20 mph are seen in the central business district (CBD). Metro Manila is no exception to this rule evidenced by the similar traffic speed in CBD. The roads in the suburbs are in short of capacity due to the rapid growth of traffic volume. Frequent congestion occurs on some sections of roads outside metropolitan Manila.

The Manila North Expressway, one of the most vital intercity roads in the Philippines, has the best capability to meet a traffic demand of more than 30,000 ADT in the northern corridor up to Angeles. The McArthur Highway, which thus parallel to the Manila North Expressway, is serving traffic simultaneously in the same corridor, but its service to the local traffic is far greater than the Manila North Expressway.

The proposed project roads C-5 and C-6 are linked to these existing roads in distributing the traffic towards the Coastal Road. At the same time, the proposed roads will serve the region by providing better road service in the west-east direction.

B. Salient Features of the Coastal Road

The Coastal Road will be part of the entire stretch of Manila-Bataan Coastal Road, when it is completed some years from now. At the moment, the Coastal Road included in the study is not conceived to be part of the coastal road to Bataan. It should be an extension of R-10 which supplements the service of both C-5 and C-6 and should also serve the traffic generated in the reclamation area.

C. Salient Features of the C-5

The C-5 is planned between the reclaimed land, offshore of Navotas, to the Manila North Expressway crossing the Caloocan-Obando road, McArthur Highway and other local roads. The surrounding area of the road specifically in Valenzuela has been mostly urbanized already by the development of residential, warehouse, and factory areas.

Accordingly, the C-5 will have two features of service:

- Increase the road service in the direct influence zone by joining it to the existing network. The C-5 will serve particularly the traffic to and from work, traffic of business and work generated in the newly developed urban area along the C-5. This traffic will not be long trips, but will be intra-region or intra-zonal short trips; and
- Supplement the service of McArthur Highway and Manila North Expressway for long distant inter-city traffic by absorbing some of the traffic to and from MMA.

D. Salient Features of the C-6

The C-6 passes through a less urbanized area. Municipalities are developed around its eastern portion adjacent to McArthur Highway and the Manila North Expressway. Its western portion passes through rice fields and fish pond areas, where the impact of urbanization of MMA has been quite modest to date.

Therefore, the C-6 will serve mainly for inter-city traffic as a distributive route to and from MMA for the initial years after its opening. If the inter-city traffic is diverted to C-6, then the reduction of traffic on C-5 and the southern section of Manila North Expressway would be realized, which would contribute greatly toward raising the efficiency of traffic movement in the direct influence zone. As seen elsewhere, after the opening of the road, new development of housing and business establishment areas and other local development will be encouraged and should result in a rapid-growth of urbanization. As the urbanization of the area increases, the local traffic demand should be met by the C-6.

6.1.3 Function of the Project Roads

A. General

The Manila North Expressway running north-south in the direct influence zone, one of the most vital inter-city roads in the Philippines, is the highest type of transportation facility and has the highest design speed. It is also characterized as the highest traffic volume corridor and has the longest trip desires.

In the region, the C-6 could become part of a substantial ultimate outer ring road for Metro Manila within about 30 years considering the physical limitation of the Meycawayan River and the speed of regional development. From the point of view of functional requirements and vital connections with the inter-city roads, the high type facilities and high design speed should be provided for the C-6.

The C-5 should have a medium grade of unction between that of C-6 and C-4, and should be provided with accessibility to adjacent areas due to the urbanized status of the direct influence zone.

The Coastal Road shall function initially as a principal arterial road and shall ultimately be a portion of the expressway which will comprise the R-10 (from C-2 to C-4), Coastal Road and the whole of C-6.

B. Types and Grades Access Control of the Project Roads

The recommended types and the grades of access control of the Project Road based on their functional requirements are as follows: (descriptions in brackets indicate the existing roads):

Road	Type of Road	Grade of Access Control
Future Extension of the Coastal Road	Expressway	Full control of access.
The Coastal Road (C-4 to C-6)	Principal Arterial Road	Partial access control with at-grade crossings, U-turn allowed only at limited medium openings and entrance or exit to and from the thoroughfare by means of outer separators for frontage road vehicles at initial stage.
(R-10)	(Principal Arterial Road)	(Partial control of access).
C-6	Expressway	Full access control.
C-5	Principal Arterial Road	Partial access control with no crossing at grade, U-turn allowed only at limited median openings and entrance or exit to and from throughfare by means of outer separators for frontage road vehicles.
(C-4)	Principal Arterial Road	(Partial control of access.)

6.2 Study of Alternative Routes

6.2.1 General Study of the Corridors of the Project Roads

Prior to the study of alternative routes for the Project Roads, the general study of corridors was made as follows:

A. Corridor of the Coastal Road

The corridor for the Coastal Road (C-4 to C-6) is expected to be located offshore or at inland areas to extend the R-10 in its general northward direction. Comparative study may be required to select the best sub-corridor.

B. Corridor of the C-5

The corridor of the C-5 was established by the MPH in 1971 as the extension of Republic Avenue. The location of C-5, therefore, would be roughly fixed in compliance with the above mentioned government policy.

C. Corridor of the C-6

The corridor of the C-6 was initially studied and the location decided at the south end of the Meycawayan river, based on the following factors:

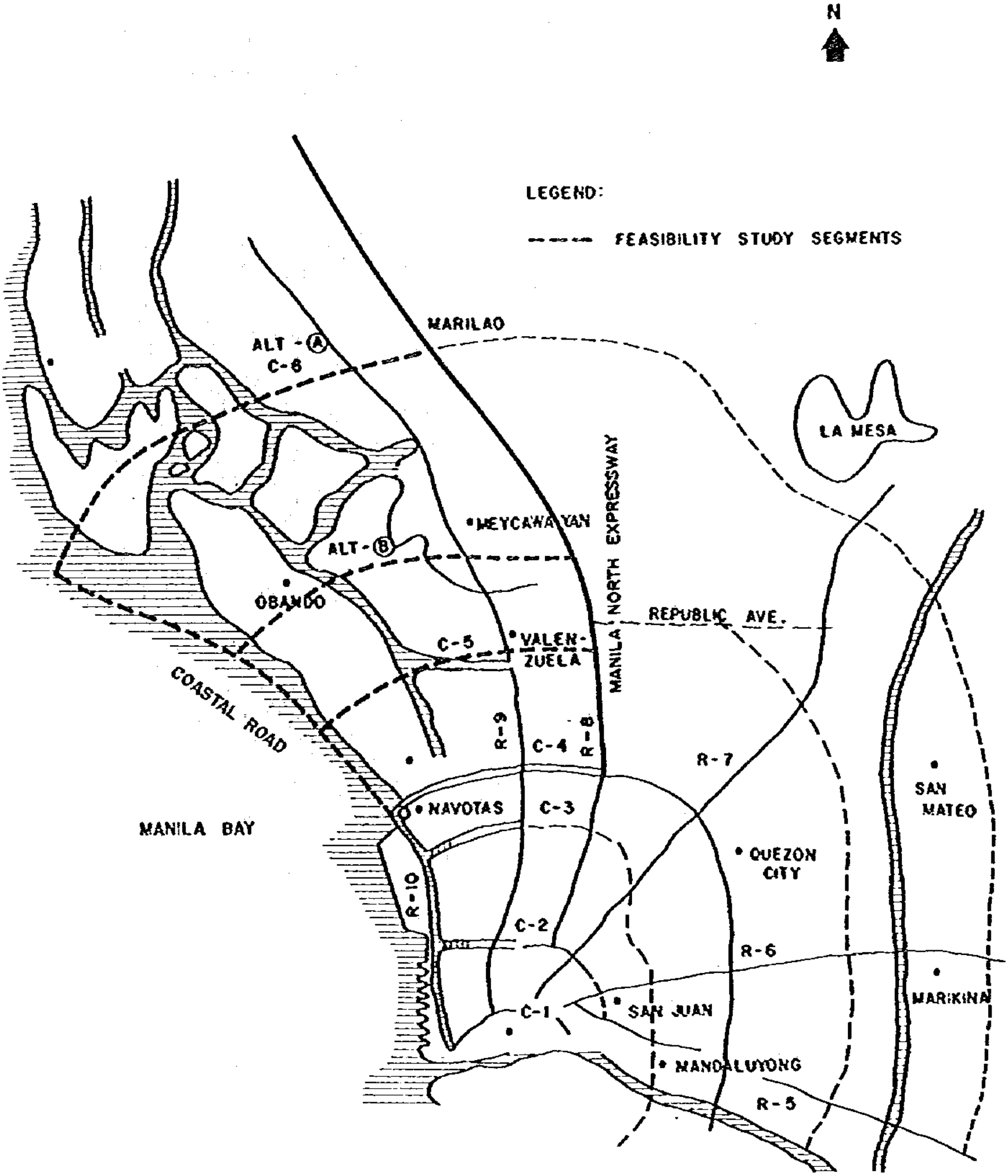
- Respective spacings between each circumferential road of C-1 through C-6 in Metro Manila Area; and
- The north limit of reclamation as stated in Chapter 3 in Part IV.

In connection with the respective spacings between the existing and planned circumferential roads, the location of the sub-corridors of the C-6 are studied as follows:

Generally, trunk roads in the city are located close to each other within the central business district (CBD) area, while they are more sparsely located at the fringes of the CBD.

When the location of the initially planned route of the C-6, at the north of the Meycawayan River, was reviewed with respect to the location of C-2 through C-5, it was found that the distance between C-5 and C-6 appeared to be too large. If the location of the C-6 is moved closer to C-5 as shown by Alternative B in Fig. III-6-1, the developed areas in Obando and Meycawayan can be fairly well connected to the Coastal Road and the Manila North Expressway.

Fig. III-6-1 LOCATION OF THE PROJECT ROADS



6.2.2 Alternative Route Study

In this study also the field investigations using aerial photo mosaics to a scale of 1:4,000 were carried out in detail to provide a basis for the selection of the best route for each Project Road.

A. Route of the Coastal Road

The Coastal Road is part of a strategic transportation framework for the coastal area of Metro Manila together with Roxes Boulevard, R-10 and the future extension of the Coastal Road to Bataan.

i) Studied Alternative Routes

Based on the functions of the Coastal Road aforementioned (See Sub-Section 6.2.1), the alternative routes were considered as follows (See Fig. III-6-2):

- Alternative I - Offshore route in the proposed reclaimed area.
- Alternative II - 200 m offshore route along the existing coastal line.
- Alternative III - Inland route located parallel to the general topographic features of the coastal line.

With the aim of preserving the existing fishery facilities, the other alternative running along the existing shoreline affecting these areas was not considered.

ii) Comparison of Alternative Routes

Positive and negative aspects for these alternative routes are studied and summarized in Table III-6-1.

Fig. III-6-2 ROUTE ALTERNATIVES MAP

S = 150,000

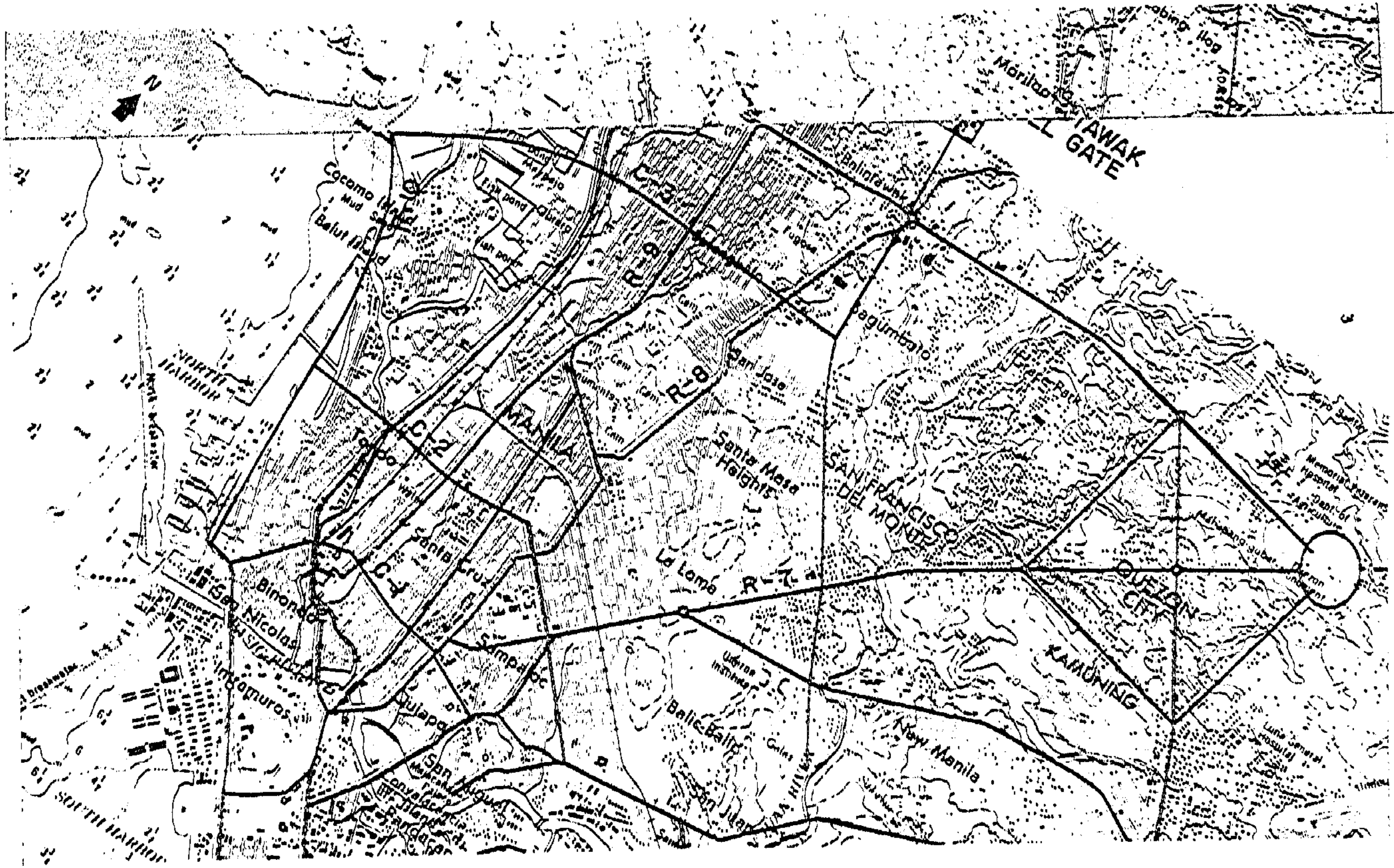


Fig. III-6-2 ROUTE ALTERNATIVES MAP
S = 150,000

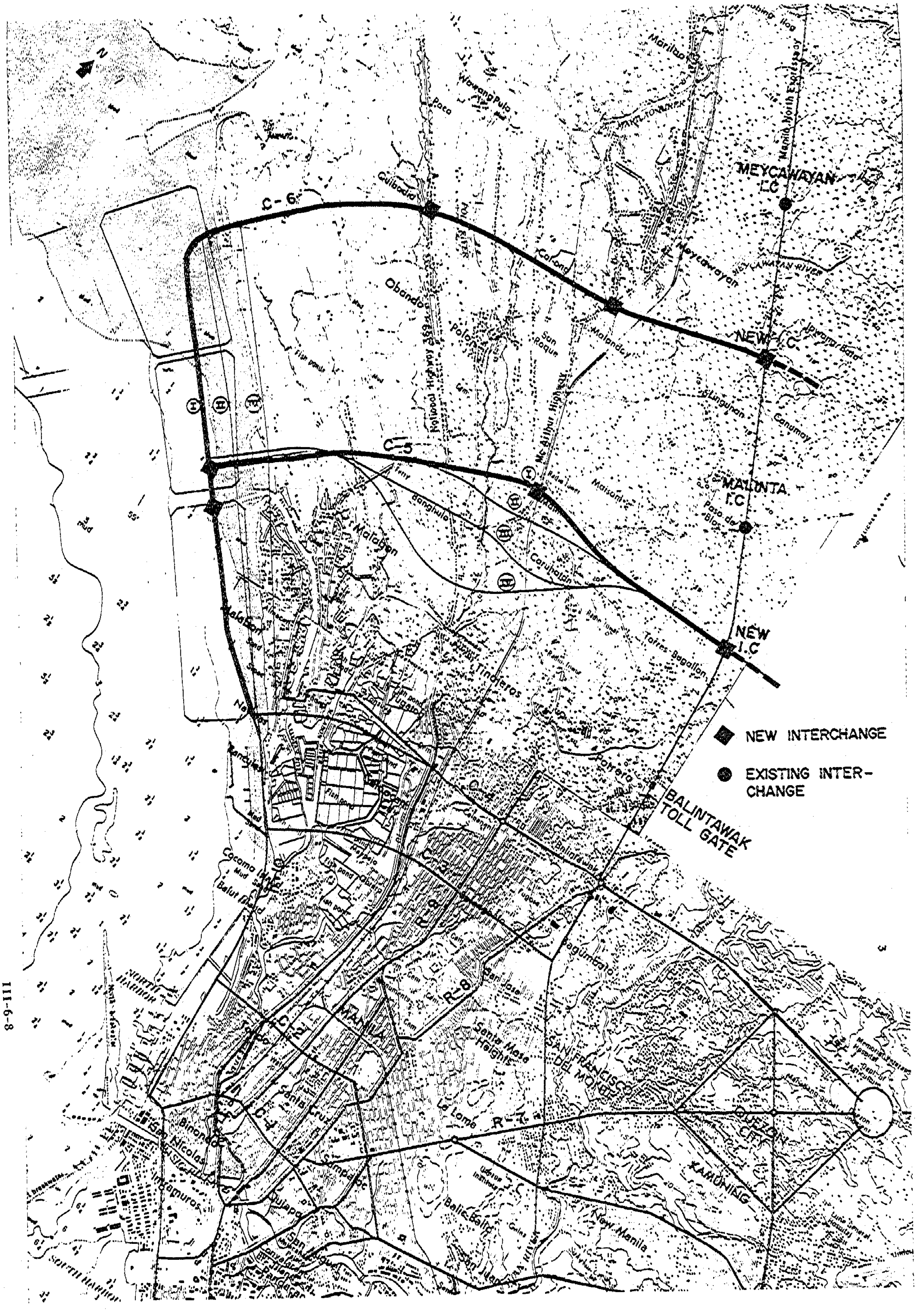


Table III-6-1 COMPARISON OF ALTERNATIVE ROUTES, COASTAL ROAD

Alternative / Item	Alternative I	Alternative II	Alternative III	Remarks
Social Problems, Destruction of Existing Community:	Small	Small	Great	
Design of Coastal Road:	The Coastal Road can be designed as an at-grade structure for most of its length	Same to the Alternative I	Design of viaduct would be necessary for a considerable length of the Coastal Road	
Cost:				
Construction	Low	Comparatively expensive	Very expensive	
Compensation	Low except for fisheries	Same to the Alternative I	Very expensive	
Land Acquisition	Low	"	Very expensive	
Base of Construction:	Easy	Easy	Difficult	
Environmental Problems during the construction:	Insignificant	Insignificant	Substantial	

iii) Conclusion

Alternative III is not recommended because it entails social problems and the destruction of the existing community in Navotas area, to the extent that implementation of the project becomes impossible. This alternative would involve a large cost for compensation, land acquisition and construction.

Alternative II is also not recommended because it has less potential for enhancing the regional development, compared with Alternative I because it is an off-shore causeway.

Alternative I is therefore recommended as the best route for the Coastal Road because of the following:

- The route will not cause social problems and will not affect any existing community;
- It will enhance the value of the reclamation area;
- Less construction and compensation cost; and
- Comparatively easy consrtruction.

B. Route of the C-5 and C-6

1) Basic Study

Prior to the determination of the alternative routes for C-5 and C-6, the basic study was conducted in the sub-corridor based on the factors listed hereunder:

- Connection with Manila North Expressway;
- Minimum spacing between connecting roads;
- Land use and community; and
- Existing public facilities and major factories.

Connection with Manila North Expressway

On the existing Manila North Expressway, the minimum respective spacing between the existing interchanges and the new interchanges for C-5 and C-6 were determined based on the criteria of AASHTO standard, which specifies a minimum spacing of 1.6 km (1 mile).

The said AASHTO criteria is set out on the basis of safety consideration of weaving, diverging and merging maneuvers on an expressway as well as good directional signing.

The interchange spacing provided for the existing and new interchanges on the Manila North Expressway are as follows:

Interchange or Toll Gate	Spacing (km)
Balintawak toll gate	
	2.3
New I.C. for C-5	
	1.9
Malinta I.C.	
	2.4
New I.C. for C-6	
	2.5
Meycawayan I.C.	

Minimum Spacing for Connecting Roads

The spacing is determined according to the AASHTO Standard shown in Table III-6-2.

Table III-6-2 SUGGESTED MINIMUM SPACING BETWEEN CONNECTING ROADS

Type of Highways	Minimum Spacing
Freeway	one mile
Other Principal Arterial	1/2 mile
Other Principal Arterial (Central core)	500 feet
Minor Arterial	400 feet
Collector	300 feet

There are several roads to be crossed by the C-5 and C-6. Among these roads four (4) roads listed below are recommended to have priority connections with the C-5 and C-6 on the basis of their importance for the future road network after C-5 and C-6 have been constructed.

- The Coastal Road;
- National Highway 369;
- McArthur Highway; and
- Manila North Expressway.

Land use, Community and Existing Public Facilities and Major Factories

Existing land use, and the location of community and public facilities and major factories will affect the alignment of the C-5 and C-6. Therefore, a detailed site reconnaissance has been made on the ground based on 1:4000 scale photo mosaics.

ii) Studied Alternative Routes

The location of the alternative routes for the C-5 and C-6 are as shown in Fig. III-6-2. Since no serious control factor was found in the sub-corridor of the C-6, only one alternative route has been surveyed along an ideal road alignment.

iii) Description of Alternative Routes

C-5 Route

Four alternative routes were studied. Except for the starting and terminus points the major control points in selecting alternative routes are as follows:

Alternative I

- Avoid crossing a tributary of the Navotas River;
- Edge of Merville Subdivision in Dampalit;
- Fil-Hispano Ceramic Inc; and
- College Building in Malinta.

Alternative II

- Avoid crossing a tributary of the Navotas River;
- Edge of Merville Subdivision in Dampalit;
- Antenna Tower; and
- Malinta Intersection and McArthur Highway.

Alternative III

- Avoid crossing a tributary of the Navotas River;
- Banghulo Intersection;
- Far East Advanced School;
- Distance from the existing intersection on McArthur Highway; and
- Biblical Seminary Philippines.

Alternative IV

- Avoid crossing a tributary of the Navotas River,
- Athletic Dress Factory;
- The existing intersection of Mabini Road extension and National Road 369;
- The existing intersection of McArthur Highway; and
- Biblical Seminary Philippines.

C-6 Route

Major control points in selecting the C-6 route are listed below.

- A branch of Meycawayan River;
- School and church;

- Connecting point to McArthur Highway;
- Connecting point to Manila North Expressway;
- Connecting point to the Coastal Road.

The selected C-6 route is as shown in Fig. III-6-2.

iv) Comparison of Alternative Routes of the C-5

Positive and negative aspects of the four alternative routes studied are summarized in Table III-6-3.

Interchanges with McArthur Highway for Alternatives I and II are shown in Appendixes I-30 and I-31.

v) Conclusion

C-5 Route

Alternative IV is not recommended because of its excessive route length and unsuitable alignment features.

Alternative III will encounter traffic problems with two existing intersections located closely and large social problems are expected due to the relocation of a new subdivision (residential area).

Alternative II has good horizontal alignment but traffic problems are anticipated at the Malinta Intersection (See Appendix I-31).

As the result of a comparison of the alternative routes, Alternative I would be recommended as the best C-5 route based on the reasons listed below:

- Lowest construction, land acquisition and compensation costs;
- Easier traffic management; and
- Easier construction.

C-6 Route

As mentioned before, no serious control point was found in the sub-corridor of the C-6 as described below, and therefore the route has been selected based on an ideal road alignment.

- Fish pond and rice paddy areas are predominant in the areas; and
- Developed areas are limited to about 70 meter wide strips along the existing roads.

Table III-6-3 COMPARISON OF ALTERNATIVE ROUTES
(C-5)

Item / Alternative	Length (Km)	Length and Area of Bridges (M, M^2)	Connection with existing road	Existing Facilities and Effects: Factory	School	Residential Subdivision	Radio Tower	Residence	Problems on Traffic Treatment	Construction Cost
Alternative I	8.47	L = 295 M A = 5,900M^2	Half Clover --- 1 No. Split Diamond --- 1 No.	4 Nos.	Needs relocation - 1 No. Environmental Influence --- 1 No.	Partially affected --- 2 Nos.	-	L = 1,300M	Less problems	Lowest
Alternative II	8.37	L = 385 M A = 7,700M^2	Varied Diamond Type - 1 No. Split Diamond --- 1 No.	3 Nos. (Supermarket) 1 No.	Needs relocation - 1 No. Environmental Influence --- 1 No.	Partially affected --- 1 No.	1 No.	L = 1,540M	Problem of the connection with McArthur Highway intersection at Malinta as well as a longer trip due to the limited 4 ramps.	Highest
Alternative III	8.43	L = 325 M A = 6,500M^2	Diamond --- 1 No. Split Diamond --- 1 No.	10 Nos.	Needs relocation - 1 No. Environmental Influence --- 1 No.	Directly affected --- 1 No.	2 Nos.	L = 2,610M	(1) Two planned intersections pass very closely to the existing intersections. (2) The intersections made by 4 diamond ramps with McArthur Highway are very close to the existing intersection.	High
Alternative IV	8.83	L = 265 M A = 5,300M^2	Diamond --- 2 Nos.	6 Nos.	Needs relocation - none Environmental Influence --- 3 Nos.	-	2 Nos.	L = 1,240M	The intersection made by diamond ramps with McArthur Highway is very close to the existing intersection.	Low

Note: (1) Area planned for bridges are calculated based on the 20 m width of road.
(2) In the column "Connection with existing road", Interchanges with Manila North Expressway and Manila-Bataan road are excluded.
(3) Quantities under the column of "Residence" mean the length of residential area traversed by the planned roads.

vi) <u>Interchange Spacing</u>

The proposed C-5 is linked to Manila North Expressway providing an interchange with toll gates, resulting in a distance to the existing Malinta interchange at 1.9 km which is considered to be reasonable in accordance with the spacing suggested by AASHTO standard. (See Table III-6-2). In common practices the spacing of approximate 2 km is normal where the surrounding area is anticipated to be densely urbanized.

However, there will still remain a few points to be clarified in relation to the abovementioned new interchange. They are as follows:

- When the new interchange is provided, it may accompany the closure of the existing Malinta interchange to reduce the operation cost of the toll gates;
- If the Malinta toll gates are closed, an approach road which will run parallel with the Manila North Expressway should be necessary between the C-5 and the Malinta-Novaliches Road;
- To reflect the above changes of the study condition, traffic flows and traffic cost should be further studied.

CHAPTER 7. PRELIMINARY ENGINEERING

7.1 General

This study is concerned with the work undertaken for the preliminary design for the construction of the Coastal Road and its Related Roads (C-5 & C-6), and deals only with the engineering aspects of the project. The economic feasibility of these roads is detailed in Chapter 10.

The purpose of the study is to carry out the Preliminary Engineering to a degree of accuracy that will permit estimates of principal quantities for construction with an accuracy of ± 20% of the final quantities. The principal quantities for construction will include embankment, common excavation, base and sub-base materials, surfacing materials, number and size of principal drainage structures, bridges, and major structures.

The preliminary engineering design of major bridges and other major structures also included determination of the approximate span lengths, types of superstructure, and types of foundations.

Engineering investigations including topographical and soils and materials surveys were undertaken by the Team. This was accomplished by hiring local consultants.

Using as input the construction cost estimates based on the preliminary engineering design, together with other data and costs, an economic analysis was undertaken. In connection with the calculation of the cost benefit figure, the road project was divided into the Coastal Road, C-5 and C-6 for each alternative road plan to determine the optimum priorities for staged construction. For those studies and tests which cover the economic analysis, see Chapter 10 Economic Analysis.

7.2 Basic Data

7.2.1 Aerial Mosaics

Aerial photos of the project area flown in 1977, and working mosaics of the area to a scale of 1:4,000 were used in the study to establish the alignment of the Project Roads.

7.2.2 Topographical Survey

Topographical Survey and soundings as well as setting out of the road centerline on the ground were conducted by Acre Surveying and Development along the alignment approved by the MPH for further preliminary engineering.

Profile levels were established at 200 meter intervals along the centerline of the proposed roads, these leveling included the taking of additional elevations at top and toe of slope for fishpond and rice paddy dikes as well as at abrupt changes in terrain conditions.

Cross-sections were taken at 200 meter intervals along the centerline of the proposed road, and additional cross-sections were established at abrupt changes in terrain conditions.

7.2.3 Soils and Materials Survey

The Survey was carried out during July, August and September 1979, as preparatory work, prior to the preliminary engineering.

The field work and laboratory testing was executed by a local consultant, Development and Technology Consultants, Inc. The study team planned and supervised all the field work and laboratory testing.

7.3 Design Standard

7.3.1 Road Design Standards

A. General

Because flat terrain is predominant, major deviations from a common MPH design standard, derived from AASHTO standards is unlikely.

Brief descriptions for each item of geometric design criteria and other standards and the reasons for making certain modifications to the common MPH design standards are presented below.

B. Terrain Condition

The entire route of the project roads pass through flat land or a shallow offshore area.

C. Design Speed

The summary of surrounding conditions of the Project Roads is as follows:

Description	Conditions
i) Degree of development in direct influence zone	
Coastal Road	Developed reclaimed area
C - 5 Road	Mostly developed urban area
C - 6 Road	Suburban area

ii) Design speed of existing related roads

Manila North Expressway	120 km/hr
R - 10	64 km/hr
C - 4	80 km/hr

The following design speed for each Project Road has been recommended on the basis of characteristics and functions of the roads described before and the surrounding conditions shown above:

Road	Design Speed (Flat Terrain)
Coastal Road	80 km/hr
C - 5	80 km/hr
C - 6	100 km/hr

These speeds were established to the greatest degree possible to satisfy the needs of nearly all users throughout the life time of the roads. Since the terrain is flat, a high volume, high speed road can be constructed with reasonable effort.

D. Right-Of-Way Width

Right-Of-Way widths assigned to the project should anticipate all practical future expansions. The widths recommended for the Project Roads are as follows:

RECOMMENDED RIGHT-OF-WAY WIDTH

Project Road	Number of Lane (Ultimate Construction)	Recommended Right-Of-Way Width (m)
Coastal Road	Through lane - 2x2 lane Frontage road - 2x2 lane	70
C - 5	Same above	50
C - 6	Same above	70

E. Lane Width

No modifications are made to the common MPH standard. The following presents the recommended lane widths for the Project Roads:

RECOMMENDED LANE WIDTH

Project Road	Recommended Lane Width for Throughfare (m)
Coastal Road	3.50
C - 5	3.50
C - 6	3.65

F. <u>Shoulder Width</u>

The right shoulder of 2.5 m is adopted for the Coastal Road and C-5, however this width was reduced to 1.5 m in the developed areas along C-5. A right shoulder width of 3.0 m is adopted for C-6 based on the Common MPH Standards for an expressway.

A width of 0.75 m for the Coastal Road and C-5, and a width of 1.25 m for C-6 are adopted for the left shoulder based on the Common MPH Standards.

Recommended right and left shoulder widths for the Project Roads are as follows:

Project Road	Shoulder Width (m) Left	Right
Coastal Road	0.75	2.50
C - 5	0.75	2.50 in undeveloped area 1.50 in developed area
C - 6	1.25	3.00

G. <u>Median Width</u>

A median width of 4.5 is recommended for the Coastal Road and C-5 to allow for U-turn maneuvering at limited median openings in order to provide adequate regional service.

A median width of 7.5 m, however, is adopted for C-6 based on the Common MPH Standards for expressway.

H. <u>Cross Slope of Pavement</u>

A pavement cross slope of 2.5 percent is recommended considering bad weather conditions.

I. <u>Maximum Superelevation</u>

The outside edge of the road will be rotated with respect to the inside edge along the horizontal curves. In areas subject to flooding, care must be taken so that the lowest elevation of the roadway will maintain the required freeboard above the water surface.

A lower value of superelevation is recommended to assure more comfort to the highway users.

J. <u>Minimum Horizontal Radii</u>

The largest radius of curvature compatible with the topographic conditions should be used whenever possible.

In view of the relatively flat predominative terrain, the use of larger horizontal radii is recommended for the alignment design.

Tables III-7-1 and III-7-2 present recommended design criteria as well as the common MPH standard.

K. Other Road Design Elements

1) Frontage Road

Frontage roads for the Coastal Road and C-5 are adopted for use by buses and jeepneys and also for local traffic. A one-way two-lane frontage road is recommended on both sides of the thoroughfare in the developed areas.

On the other hand no frontage road will be provided during the initial stage in the area where the existing land use is predominently for fishponds and rice paddies.

A lane width of 6.0 m is adopted to give ample space for stalled or disabled vehicles.

The interconnection between thoroughfare and frontage road is made by mean of the opening of an outer separator.

In contrast with the frontage road mentioned above the frontage road for C-6 is an independent facility for inter-local traffic and is separated from the expressway.

In view of the undeveloped conditions of the areas along C-6 and the large investment cost necessary for the construction, the construction of a frontage road is not considered in this Project.

However, the future construction of the frontage road for C-6 is taken in account in determining the Right-of-way width to be reserved.

The recommended frontage road design standards are summarized below.

RECOMMENDED DESIGN STANDARD FOR FRONTAGE ROAD

Project Road	Traffic Management	Lane Width in meters	Shoulder in meters Left	Right
Coastal Road	One-way two-lane	2x3.00	-	0.50
C - 5	One-way two-lane	2x3.00	-	0.50
C - 6	Two-way two-lane	2x3.00	0.75	0.50

ii) <u>Outer Separations</u>

The width of 10 m minimum outer separations for the Coastal Road and C-6 is recommended considering the future expansion of through lanes.

A 3.00 m outer separation width for C-5 is recommended to reduce land acquisition and compensation costs.

iii) <u>Sidewalk</u>

Sidewalk is provided only in the developed areas, along with the provision of a frontage road, while no sidewalk will be provided in the area where existing land use for fish ponds and rice paddies is predominant at the initial stage.

A sidewalk width of 3 m for the Coastal Road and C-5 and 2 m for the C-6 are recommended.

Table III-7-1 ROAD DESIGN CRITERIA
(Applicable for the Coastal Road and C-5)

Item	Unit	Recommended Design Criteria	Common PMH Standard
Design Speed	km/h	80	80 (50 mph)
Reserved R.O.W. Width	meter	Coastal Road 70 C-5 50	50 or 60
Lane Width	meter	3.50	3.50
Shoulder Width: Right	meter	2.50 1.50	3.05 (10 ft.) 1.83 (6 ft.)
Left	meter	0.75	0.61 (2 ft.)
Median Width	meter	4.50	4.27 (14 ft.)
Cross Slope of Pavement	%	2.50	2.50
Type of Pavement	-	Asphalt concrete & cement concrete	Asphalt concrete & cement concrete
Maximum Superelevation	%	6	10
Minimum Radius	meter	260	253.9 (833 ft.)
Maximum Gradient	%	4	4
Stopping Sight Distance	meter	110	106.7 (350 ft.)

Minimum Vertical Curve Length Crest Sag		In accordance with Appendixes I-32 and I-33	
Frontage Road	meter	6.50	6.50
Sidewalk Width	meter	3.00	1.83 (6 ft.)
Outer Separation	meter	Coastal Road 11.0 C-5 3.0	2.44 (8 ft.)

Table III-7-2 ROAD DESIGN CRITERIA
(Applicable for C-6 Recommended)

Item	Unit	Recommended Design Criteria	Common MPH Standard
Design Speed	km/h	100	96 (60 mph)
Reserved R.O.W. Width	meter	70	
Lane Width	meter	3.65	3.65 (12 ft.)
Shoulder Width: Right Left	meter meter	3.00 1.25	3.05 (10 ft.) 1.22-1.83(4-6ft.)
Median Width	meter	7.50	7.31 (24 ft.)
Cross Slope Pavement	%	2.50	2.50
Type of Pavement	-	Asphalt Concrete & cement concrete	Asphalt Concrete & cement concrete
Minimum Radius	meter	450	430 (1,412 ft.)
Maximum Gradient	%	3	3
Stopping Sight Distance	meter	160	144.8 (475 ft.)
Minimum Vertical Curve Length Crest Sag		In accordance with Appendixes I-32 and I-33	
Frontage Road	meter	7.25	7.25
Sidewalk Width	meter	2.00	1.22-3.66(4-12ft.)
Outer Separation	meter	10.45	7.32-12.19 (24-40 ft.)

L. Summary of Road Design Standards

Tables III-7-1 and III-7-2 present the recommended design criteria applicable for the Project and the corresponding Common PMH Standards. Where feasible, highest values than the minimum listed in the tables will be utilized.

7.3.2 Pavement Design Standards

The methods for the flexible and rigid pavement design in the Study is based on the "AASHTO Interim Guide for Design of Pavement Structures, 1972".

7.3.3 Bridge Design Standards

The Standard Specifications for Highway Bridges (12th Edition, 1977), adopted by the American Association of State Highway and Transportation Officials (AASHTO) were used as principal guideline for the structural design of the bridges. In cases not covered by these standards, the MPH and Japanese Government standards were used.

The design live load to be adopted for the design of bridges will be HS 20-44. The highway live loadings shall consist of standard trucks and of live loads which are equivalent to truck trains.

Based on consideration of the poor soil conditions which exist along the western end of McArthur Highway, it is recommended that the seismic coefficient be 0.15 in this preliminary engineering stage and 0.10 for the eastern end of McArthur highway where the soil conditions are better.

7.3.4 Drainage Criteria

The rational method with peak flow curves is used for this study.

A design storm frequency of 50 years is recommended for bridges and 25 years for culverts.

The recommended freeboard above design flood levels for various design flood discharge is presented in Table III-7-3.

Table III-7-3 RECOMMENDED FREEBOARD ABOVE DESIGN FLOOD LEVELS

Design Flood Discharge (m^3/sec)	Freeboard (m)
Smaller than 200	0.6
From 200 to 500	0.8
From 500 to 2,000	1.0
From 2,000 to 5,000	1.2

7.4 Analysis of Road Capacity

The analysis of road capacity was made by using the HIGHWAY CAPACITY MANUAL 1965, U.S. DEPARTMENT OF COMMERCE, BUREAU OF PUBLIC ROADS and the "Japan Road Design Standard".

A. Throughfare Capacity

There are several cases of the staged construction of Project Roads. Table III-7-4 summarizes the road capacity for each case.

B. Interchange

i) Ramp Capacity

There are three kinds of ramp elements as follows:

- the ramp terminal with a major road;
- the ramp itself; and
- the ramp terminal or at-grade intersection with minor road.

Among these, the ramp capacity will be limited by its smallest element; generally the capacity of ramp itself is much larger than those of the others.

The capacity of 1200 vehicles (PCU)/hour/lane was adopted for the ramp capacity in this project based on the HIGHWAY CAPACITY MANUAL.

ii) Determination of the Number of Traffic Lanes at A Toll Gate of the Manila North Expressway/C-5 or C-6 Interchanges

The number of traffic lanes to be provided at a toll gate was determined from the traffic volume (interval of arrival), the service time per vehicle, and also the service level provided (planned length of waiting queue).

The above factors were decided based on the Japan Expressway Public Corporation DESIGN MANUAL, Vol. 4.

Basic Hourly Traffic Volume (D.H.V.)

D.H.V. = ADT x K x D

where:

ADT : Average Daily Traffic Volume

K : Peak Hour Rate = 10%

D : Single Direction Concentration of Traffic = 60%

Table III-7-4 DESIGN TRAFFIC CAPACITY ANALYSIS

Item		Design Speed (Km/hr.)	Lane Width (M)	Lateral Clearance		Heavy Vehicles		Coefficient of Adjustment					Basic Capacity (P.C.U/hr.)	Possible Capacity (Veh./hr.)	Design Level	Adjustment of Design Level	Design Capacity (Veh./hr.)	Peak Factor (%)	Rate of Direction (%)	Design Daily Volume (Veh./day) Per Lane	Remarks
				Left	Right	% of H.V	Passenger Car Equivalent	Lane Width	Lateral Clearance	Heavy Veh.	Condition of Sight	Total									
				(M)	(M)	PT	ET	γ_L	γ_C	γ_T	γ_I		C_B	C			C_D	K	D	ADT	
Coastal Road & C-5	4 Lane, 2 Way	80	3.5	2.5	1.0	22	1.74	1.00	0.98	0.86	1.00	0.84	2,500	2,100	2	0.9	1,890	10	60	63,000	
	2 Lane, 2 Way (Un-divided)	60	3.5	2.5	2.5	22	2.04	1.00	1.00	0.81	1.00	0.81	2,500	2,025	2	0.9	1,823	10	60	18,000	
C-6	4 Lane, 2 Way	100	3.65	3.0	1.25	22	1.74	1.00	0.99	0.86	1.00	0.85	2,500	2,125	1	0.8	1,700	10	60	57,000	
	2 Lane, 2 Way (Un-divided)	60	3.65	3.0	1.25	22	2.04	1.00	1.00	0.81	1.00	0.81	2,500	2,025	1	0.8	1,620	10	60	16,000	

$$\gamma_t = \frac{100}{100 - P_T + E_T \cdot P_T}$$

$$C_D = C_B \cdot \gamma_L \cdot \gamma_C \cdot \gamma_T \cdot \gamma_I$$

ADT (Multiple Lanes)

$$= \frac{5000 \cdot C_D}{K \cdot D}$$

Where

P_T : Percentage of Heavy Vehicles

E_T : Passenger Car Equivalent of Heavy Vehicles.

γ_L : Coefficient of Adjustment for Lane Width

γ_C : Coefficient of Adjustment for Lateral Clearance

γ_T : Coefficient of Adjustment for Heavy Vehicles

γ_I : Coefficient of Adjustment for Condition of Sight

C_B : Basic Capacity (P.C.U/hr.)

C_D : Design Capacity (Veh./hr.)

K : Peak Factor (%)

D : Rate of Direction (%)

Service Time Per Vehicle

For one entry - 14 sec.
For one exit - 6 sec.

Service Level

Length of the average waiting queue - One vehicle

Based on the above assumed values, the results of calculation are shown in Table III-7-5.

Table III-7-5 HOURLY TRAFFIC VOLUME AND TRAFFIC LANES

(Handling Capacity per Hour)

No. of traffic lanes	Average service time	
	6 sec.	14 sec.
1	300	128
2	852	364
3	1,422	609
4	1,922	852
5	2,580	1,105
6	3,168	1,356
7	3,780	1,617
8	4,368	1,872

The toll plaza facilities to be provided by others in the year of opening are as follows:

Installation Criteria of Facilities

Facilities	Target Year
Land for toll plaza	20 years after opening
Earthworks of toll plaza, toll island, traffic lane pavement, toll plaza building	10 years after opening
Toll booth and toll receiving machine	5 years after opening

Based on the above factors and criteria, the number of traffic lanes required for 20 years after opening are shown as follows:

Interchange	Number of traffic lanes	
	Entrance	Exit
Manila North Exp/ C-5	4	9
Manila North Exp/ C-6	3	5

iii) Weaving Section Length

According to the HIGHWAY CAPACITY MANUAL, the length of weaving section was calculated in relation to the traffic volume and is shown in Appendixes I-34 and I-35.

In this calculation, the weaving influence factor (K = 3) is used for operation of moderate traffic volumes and simple weaving.

The number of lanes was calculated by using the following formula.

$$N = \frac{V_{w1} + KV_{w2} + Vo_1 + Vo_2}{SV}$$

where:

- N : Number of lanes
- V_{w1} : Larger weaving volume, VPH
- V_{w2} : Smaller weaving volume, VPH
- Vo_1, Vo_2 : Outer flows, VPH
- SV : Capacity per lane on approach and exit roadways
- K : Weaving influence factor

The length and the number of lanes required for weaving sections are shown as follows:

REQUIREMENT FOR THE YEAR 2008

Weaving Section	Required Length (m)	Number of Lanes
Manila North Exp/ C-5 C - D RAMP	200	2
Manila North Exp/ C-6 F - H RAMP	100	2

C. Intersection Analysis

Both the regional roadway system and the Project Roads will require planning of at-grade intersections for initial stage except for the C-5/McArthur Highway Intersection and SanRoque-Malinta Road intersection.

In the initial stage, the locations of the intersections, which are planned on the Project Roads or on the existing roads connected with the on-off ramps of interchanges, are listed in Table III-7-6.

Table III-7-6 LIST OF INTERSECTIONS (CROSSING ROAD)

Project Road	Intersection on the Project Road	Intersection on the existing road
Coastal Road	1. Arterial street on the reclamation block I	-
	2. Arterial street on the reclamation block III	-
	3. Arterial street on the reclamation block IV	-
C - 5	4. Mervill Road	-
	5. Polo-Malabon Road	-
	6. National Highway 369	-
	7. Polo-Calookan Road	-
	8. SanRoque-Malinta Road	-
		9. McArthur Highway
C - 6		10. National Highway 369
		11. McArthur Highway

Capacity, speed and safety on most urban arterial streets depend primarily on the number, type and spacing of the intersecting streets. The layout and traffic control devices used for the at-grade intersections are the key elements for the safe and efficient operation of the arterial streets. Since at-grade intersections play such a vital part in the urban transportation system, the importance of their design and operation should not be under-estimated. According to the traffic demand, all intersections will require control by traffic signals.

Since capacity analysis is one of the most important considerations in the design of signal-controlled intersections, the calculation of the capacity of each intersection and the procedure adopted are on the basis of the "Japan Road Design Standard".

Among these intersections six intersections were analyzed (See Appendix I-36) for the year of 1998 (10 years after opening to traffic).

i) Basic Elements

The basic elements used for the analysis of at-grade intersections are as follows:

Traffic capacity per lane

Through lanes	= 1,800 veh(PCU)/Green hour
Right-turn and left-turn lanes	= 1,200 veh(PCU)/Green hour

Other elements

Peak factor	= 10%
Percentage of heavy vehicle	= 22%

(Except the section from McArthur Highway to Manila North Expressway which is 14.5%)

Rate per direction at peak hour = 60%

The pattern of traffic movements at the intersections and the volume of traffic on each approach, including pedestrians, during one or more peak periods of the day are indicative of the type of traffic control devices necessary, the widths of pavements required, including auxiliary lanes, and, where applicable, the degree of channelization needed to expedite the movement of all traffic. The arrangement of the lanes, traffic islands, pedestrian crossings and other facilities are shown as Appendixes I-37 and I-38. These are two important and typical types of intersection.

ii) Description of Intersections

C-5/McArthur Highway Intersection

The McArthur Intersection is recommended to be grade separated and to be widen from the existing two lanes to a 4-lane carriageway in the initial stage (1988).

Based on projected traffic volume made in Chapter 3, the traffic demand (27,230 veh/day) in 1988 exceeds two-lane capacity (18,000 veh/day). The intersection plan was made for the year 2003 when its traffic demand will correspond to four-lane carriageway capacity.

Substantial improvement for the existing McArthur Highway is assumed to be limited to a four-lane carriageway road due to the existing road side development and usable space for road extension. If expansion to a six-lane carriageway is possible, provision of adequate capacity will be extended for more than 20 years.

The throughway of the McArthur Highway is designed to pass under the intersection bridge due to the large traffic demand even in the initial stage. Except the improvement work necessary for the intersection, the cost for the extension from a two-lane to a four-lane carriageway will not be included in this project.

<u>Other Intersections (Traffic Analysis are not shown)</u>

The Mervill road intersection and the arterial street intersection in the reclamation block I will be grade separated by 1998 to meet traffic demand.

The intersection at the SanRoque-Malinta Road is grade separated in the initial stage to avoid traffic congestion due to the adjacent McArthur Highway Interchange ramps.

The intersections in the reclamation blocks III and IV are at-grade within project life due to low traffic demand.

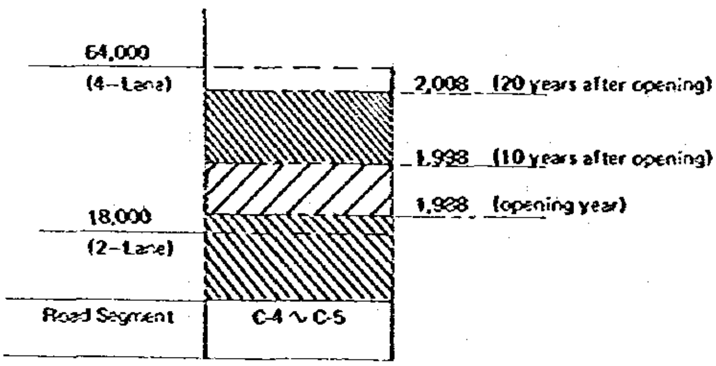
D. Determination of Number of Throughfare Lanes

Based on the analysis of throughfare capacity, four lanes are required for the Coastal Road and C-5 in the initial stage (see Fig. III-7-1).

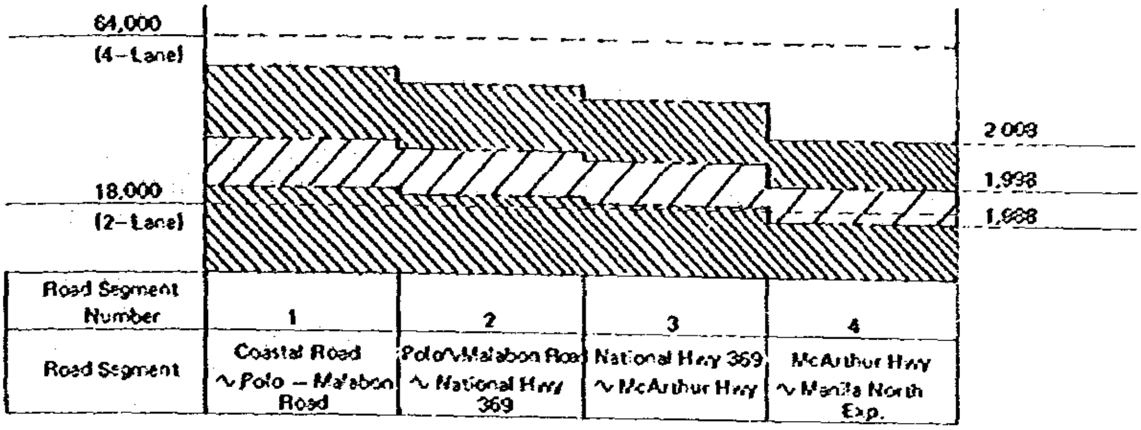
Fig. III-7-1 TRAFFIC FLOW VOLUME BY SEGMENT (ROAD PLAN 3)

Traffic volumes in veh/day for two-way

COASTAL ROAD



C - 5

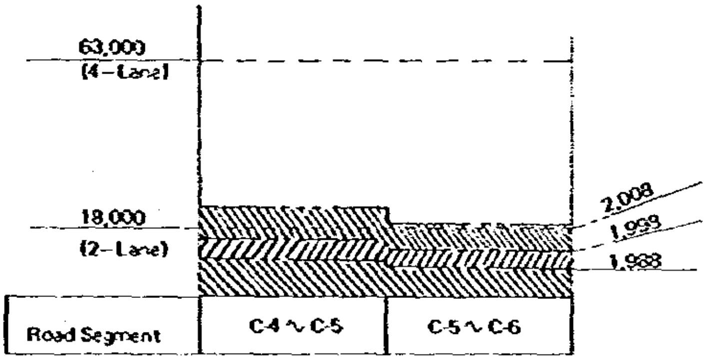


Note: Traffic volumes in veh/day for two-way.

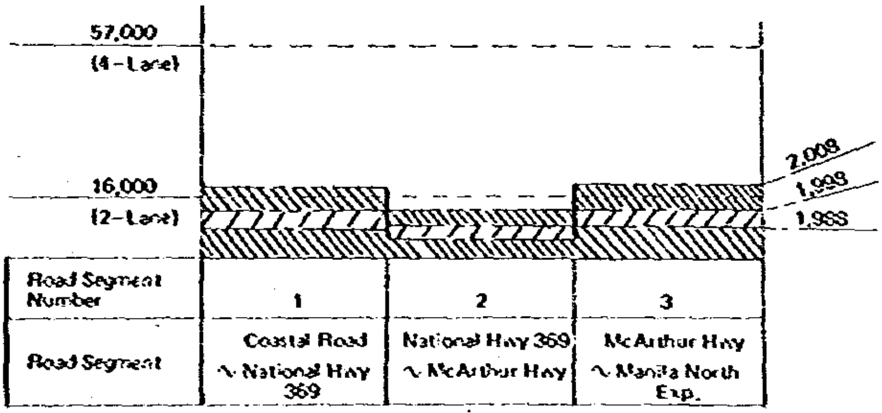
In case of the construction of C-6 without the C-5, two lanes are required as shown in Fig. III-7-2.

Fig. III-7-2 TRAFFIC FLOW VOLUME BY SEGMENT (ROAD PLAN 5)

COASTAL ROAD
(Two-way, veh/day)



C - 6



Note: Traffic volumes in veh/day for two-way.