CHAPTER 2. RECOMMENDED FIRST STAGE CONSTRUCTION AND IMPLEMENTATION PROGRAM

2.1 Integrated Project

The components in the stage I of Phase I are summarized as follows with the reasons stated in 1.2.2 of the previous Chapter 1. The components are anticipated to support the regional development in an integrated system.

2.1.1 Project Components of the Stage I Construction

i) The road component is composed of the construction of the two road sections. They are the construction of the Coastal Road (3.8 km) on the reclamation area, Blocks I through III, and of C-5 (8.6 km) linking the Coastal Road with the Manila North Expressway. They will be constructed as divided 4-lane roads.

ii) The reclamation component is composed of the development of the Blocks I, II and III (565 ha. in total). For the first ten years, the Block I will be utilized as the solid waste disposal area. After the area is filled up, the Block will serve as residential and park areas. The Blocks II and III will primarily be developed as industrial zones including a POL tank firm area and commodity distribution centers.

iii) Intersections constructed for the above item i) will not be grade-separated initially. It is proposed that they will be improved to grade-separated facilities at a later stage. The construction of the grade-separation structures is scheduled for the period of 1995-1997. The resurfacing of the pavement of the Project Roads is proposed simultaneously at that time.

2.1.2 Cost of the Stage I Construction

The cost of the components for Stage I Construction is summarized in Table V-2-1.

Table V-2-1 COST OF STAGE I CONSTRUCTION

(Unit: ₱ million)

Project Component	Foreign Currency Component	Local Currency Component	Taxes	Total
Construction of the Coastal Road and C-5				
In 1979 prices	329	290	80	699
In current prices based on 1979 prices 1/	607	534	148	1,289
Development of Reclamation Area (Blocks I - III)				
In 1979 prices	793	392	182	1,367
In current prices based on 1979 prices 1/	1,498	740	344	2,582
Construction of Grade Separation Structures and Overlay				
In 1979 prices	63	54	17	134
In current prices on 1979 prices 1/	227	194	61	482
Total in 1979	1,185	736	279	2,200
Total in current prices based on 1979 prices 1/	2,332	1,468	553	4,353

2.1.3 Benefit-Cost Analysis with Sensitivity Test

The economic benefit-cost analysis of the above Stage I of the integrated project was conducted with viability results as follows:

Description	Present Worth in ₱ million i = 15%	Benefit Cost Ratio at i = 15%	Internal Rate of Return
Integrated Implementation Program	582.3	1.52	22.6

The sensitivity of the Internal Rate of Return was examined for the following assumptions:

i) If the cost is increased by 20%: IRR = 19.0%
ii) If the benefit is reduced by 20%: IRR = 18.3%
iii) If the benefit is reduced by 33%: IRR = 15.3%
iv) The combination of i and ii: IRR = 15.2%
v) The combination of i and iii: IRR = 12.4%

Note: 1/ The price escalation is assumed at 10% p.a. upto 1989 and 5% p.a. thereafter.

Financial analysis with sensitivity tests were also performed and the favorable results are shown below:

Description	Net Surplus in ₱ million Discounted by 15%	Internal Rate of Return
Integrated Program	453.4	More than 60%

The Net Surplus in ₱ million and Internal Rate of Return will vary according to the following assumptions:

i)	If the cost is increased by 20%	: PW= 164.8	IRR = 33.3%
ii)	If the benefit is reduced by 20%	: PW= 74.1	IRR = 24.2%
iii)	If the benefit is reduced by 33%	: PW=-172.5	IRR = 0.2%
iv)	The combination of i and ii	: PW=-214.6	IRR = -0.4%
v)	The combination of i and iii	: PW=-461.2	IRR =-16.7%

The above results of the sensitivity tests indicate that the financial performance of the reclamation project managed by the proposed public corporation is very easily affected by the change in the program of the operation.

2.1.4 Conclusion

The implementation program of Stage I Construction was found to be feasible technically, economically and financially. Noting the long period of implementation and the considerable amount of the funds to be invested, it is recommended that the Government should consider the implementation of Stage I of the Project at the earliest possible time.

2.2 Funding Requirements

The total cost to implement the Stage I Construction is summarized in Table V-2-2. Funds to cover the cost will be obtained from normal appropriations from the Governmental budget, the borrowing from foreign countries through either bilateral or multilateral government agreements, borrowing from domestic and commercial sectors, bond issues of the reclamation corporation, etc.

Table V-2-2 COST OF PROGRAM IMPLEMENTATION

- STAGE I -

(₱ million in 1979 prices)

Project Component	Foreign Currency Portion	Local Currency Portion	Taxes	Total
Coastal Road	166.2	104.0	39.4	309.6
C-5	162.7	186.1	40.9	389.7
Reclamation of Blocks I-III	677.4	245.2	146.7	1,069.3
Reclamation of Blocks II & III	79.6	105.6	24.8	210.0
Infrastructure for Block I	36.1	41.0	10.9	88.0
Grade separation and overlay	62.7	53.6	17.5	133.8
Total of Stage I	1,184.7	735.5	280.2	2,200.4

The following categorization is shown to indicate a tentative approach.

i) Contribution of Government agencies through an appropriation from governmental income and/or borrowings from foreign sources. If the cost of the construction of the roads and infrastructure is to be covered by this contribution, the amount can be summarized as follows:

(₱ million in 1979 prices)

Foreign Currency Portion	Local Currency Portion	Taxes	Total
507.3	490.3	133.5	1,131.1

ii) Borrowings from foreign and domestic sources of the private sector. If the cost of the reclamation for Blocks 1 - III is to be covered by this type of borrowing, the total amount can be summarized as follows:

(₱ million in 1979 prices)

Foreign Currency Portion	Local Currency Portion	Taxes	Total
677.4	245.2	146.7	1,069.3

The extent of price escalation during the years of implementation is hard to forecast since it is affected by fluctuating international and domestic economies. The cost including price escalation which is assumed as shown in the previous sub-section 2.1.2 is based on a conversion ratio of constant prices into the current prices of approximately 2.0. It is suggested that the funds required in actual disbursement should be determined by considering price escalations in the coming decade. These projection should also be reviewed periodically by examination of the changes in price level.

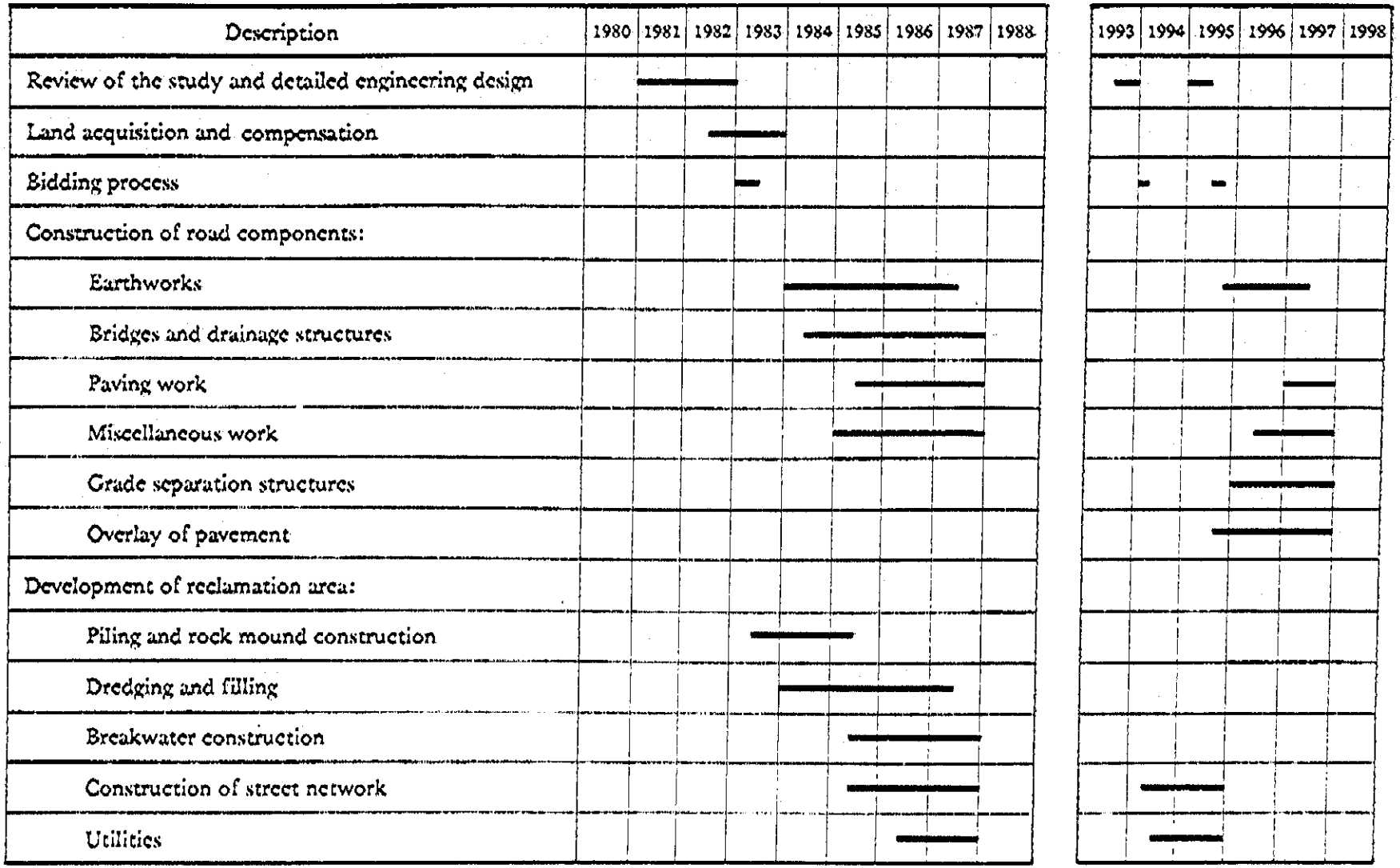
2.3 Time Schedule

Before beginning construction, it is necessary to carry out pre-construction preparatory works such as a review of the Study, detailed engineering design, land acquisition and compensation, and financial preparation. The period required for all such preparatory procedures is estimated to be about 3 years.

In more specific terms, a review of the Study and detailed engineering design will take about twenty four months and, assuming that at the same time, negotiations on financial preparation are successful, land acquisition can begin. During the period required for land acquisition and compensation to be completed, the contract for construction can be approved and awarded. Mobilization for construction can begin after the contract is awarded. It is assumed that process after the completion of the detailed engineering design will take aobut eithteen months.

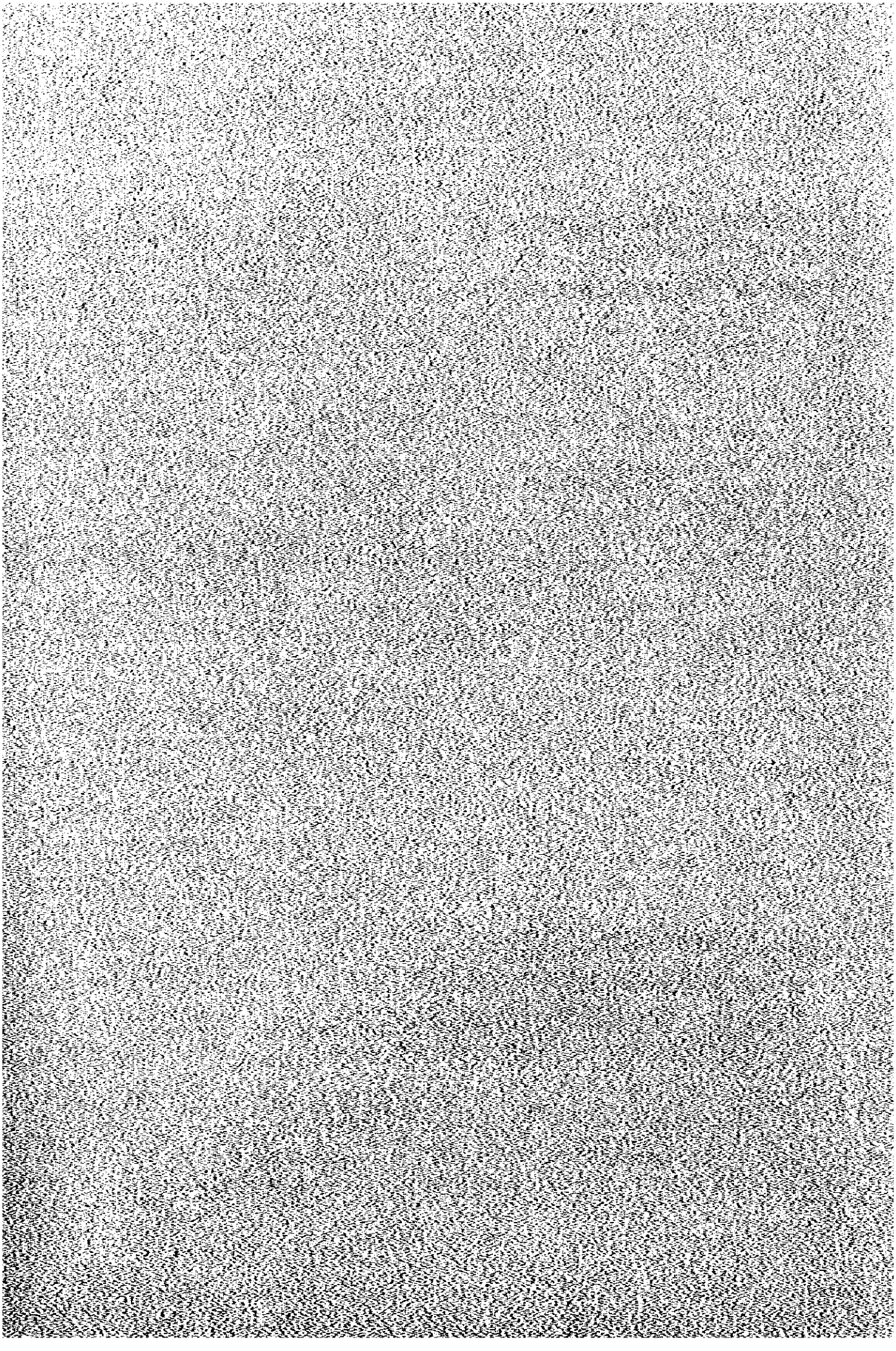
According to the stage construction approach and the project components discussed in the foregoing, it is judged desirable that the Stage I construction be executed in accordance with the time schedule shown in Fig. V-2-1.

Fig. V-2-1 TIME SCHEDULE OF THE STAGE I CONSTRUCTION



Note: The schedule in the years from 1993 - 1998 is for the construction of the street network and utilities on Block I, and grade separation and overlay for the project roads.

VOLUME II : GENERAL STUDY OF MANILA-BATAAN COASTAL ROAD (PHASE - II)

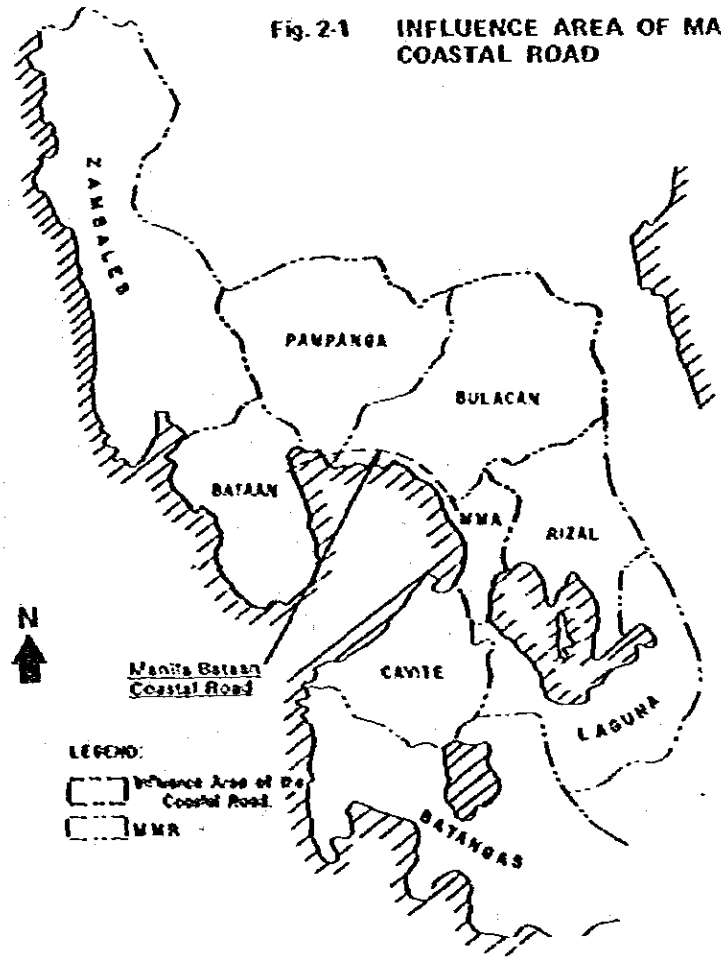


CHAPTER 1. INTRODUCTION

The general study deals mainly with socio-economic and technical aspects of the Manila-Bataan Coastal Road (hereinafter called the Road) and involves the following basic activities, among others:

- Identification of possible influences on the regional economy resulting from the construction of the Road, particularly the extension from C-6 to Bataan. For this purpose, the development potentials of the project influence area including the Bataan Peninsula will be 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.

Fig. 2-1 INFLUENCE AREA OF MANILA BATAAN COASTAL ROAD



CHAPTER 2. SOCIO-ECONOMIC CHARACTERISTICS OF INFLUENCE AREA

2.1 Influence Area

The influence area of the Road covers MMA and the provinces of Bulacan, Pampanga and Bataan. They are included in Manila Metropolitan Region (MMR). Fig. 2-1 presents the boundary of the influence area together with MMR.

2.2 Population

Table 2-1 shows the trend in population by province in MMR from 1960 to 1975. In 1975, the population of MMA was 5 million, Bulacan 900,000, Pampanga 1,040,000 and Bataan 260,000.

Population annual growth rate was 4.0% for Bataan and Bulacan, 2.8% for Pampanga and 4.6% for MMA during the period 1970-1975. If changes in population by municipality is taken, the range of annual growth rate among the municipality increases as shown in Appendix II-1.

The provinces of Bulacan, as well as Cavite & Rizal, which surround MMA, showed a higher rate of population growth during 1970-1975 than that during 1960-1970. Major towns in the influence area such as Guiguinto, Marilao, San Jose, Mabalacat, Porac, Balanga, Limay and Mariveles had high population growth during the past 15 years. This indicates the expansion of urbanized area of MMA and the development of core cities in and around the metropolis.

Table 2-1 TREND OF POPULATION BY PROVINCE IN MMR

Description	Population			Average Annual Rate of Increase		Population Density per square kilometer
	1960	1970	1975	'60-'70	'70-'75	1995
				(per cent)		
Philippines	27,087,685	36,684,486	42,070,660	3.1%	2.8%	140.0
Zambales	213,442	343,034	416,280	4.9	3.9	11.20
Bataan 2/	145,323	216,210	263,269	4.1	4.0	191,60
Pampanga 2/	617,259	907,275	1,042,164	3.9	2.8	477.80
Bulacan 1/ 2/	514,346	737,995	899,529	3.7	4.0	342.90
Rizal	173,958	307,328	414,192	5.9	6.2	316.30
MMA 2/	2,462,489	3,966,695	4,970,006	4.9	4.6	7,814.50
Cavite	378,138	500,180	628,321	3.2	3.8	487.70
Laguna	472,064	699,736	803,750	4.0	2.8	456.90
Batangas	681,414	926,308	1,032,009	3.1	2.2	326.00
MMR	5,658,433	8,624,651	10,469,520	4.3	4.0	580.00
MMR/Phil.(%)	20.9	23.5	24.9			
Manila-Bataan Study Area	3,739,417	5,828,175	7,174,968	4.5	4.2	1,052,90
Manila-Bataan/ Area/Phil.	13.8	15.9	17.1			

Source : NCSO, Integrated Census, 1975

Notes : 1/ Excluding Valenzuela which is in MMA.
2/ Inside the Manila-Bataan Study Area.

2.3 Employment by Sector

Appendix II-2 presents the employed persons by sector and by province. The percent share of the primary sector (agriculture and fishery) is 32% in Pampanga, 40% in Bataan and 28% in Bulacan. The secondary sector (processing a & manufacturing) is 33% in Bulacan, while in Pampanga and Bataan, 25% and 22%, respectively. The figures for Bulacan indicate a development of the secondary sector which could be the result of the urbanization of MMA.

2.4 Family Income

Average family income by province and by selected municipality in 1975 is shown in Appendix II-3. The average family income of ₱10,469 in MMA was nearly two times larger than that in Bataan or Bulacan, which were ₱4,632 and ₱5,806 respectively. From these figures, a relationship between the average income and the percent share of tertiary employment was plotted in Fig. 2-1. It is found that the income level is more when the percent of tertiary employment is larger. Usually, the development of the secondary (manufacturing & processing sector) sector is accompanied by the growth of the tertiary sector.

It is expected that the industrialization and urbanization of Bulacan, Pampanga and Bataan will bring about the growth of the tertiary sector and higher family income in these province.

Fig. 2-2 AVERAGE FAMILY INCOME AND TERTIARY EMPLOYMENT, 1975

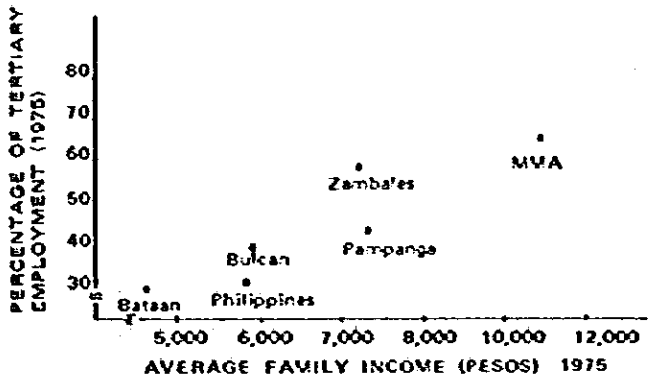


Table 2-2 SUMMARY STATISTICS FOR LARGE MANUFACTURING 1/ ESTABLISHMENTS BY MMR, 1974

Province	Number of Establish-ments	Employment (Average for the Year)	Value of Gross output 2/	Census Value Added 2/	Value of Gross output per Establish-ment 2/	Census Value added per Establish-ment 2/	Value of Gross out-output per Employee 2/	Census Value added Employ-ee 2/
Bataan	6	2,707	3,181,050	389,924	530,175	64,987	1,175	144
Bulacan	196	27,743	1,942,864	561,884	9,913	2,867	70	20
Pampanga	26	3,146	228,434	166,338	8,786	6,398	73	53
Zambales	4	713	19,138	8,603	4,785	2,151	27	12
Manila	318	39,314	3,632,351	1,140,046	11,422	3,585	92	29
Batangas	23	3,640	3,831,541	1,237,087	166,589	53,786	1,053	340
Cavite	11	580	372,835	36,855	33,894	3,350	643	64
Laguna	46	11,243	1,327,609	513,709	28,861	11,168	118	46
Rizal	1,487	245,736	20,019,247	6,366,853	13,463	4,282	81	26
Philippines	2,843	454,200	46,656,177	15,296,208	16,411	5,380	103	34

Source: NCSO, Annual Survey of Establishments "MANUFACTURING" 1974.
Notes: 1/ More than 20 employees.
2/ In ₱1,000

2.5 Establishment Activities

Salient features of large manufacturing establishments (more than 20 employees) in the provinces of the influence area in 1974 together with other provinces in MMR are shown in Table 2-2. The number of establishments is least in Zambales and Bataan; however, the average gross output per establishment or per employee is largest in Bataan. Factories with high productive technology in the Export Zone and Limay are included in these figures.

Wholesale and retail establishments are concentrated in Manila. Pampanga, Bulacan and Bataan have the least number of establishments in terms of total gross receipts, and gross receipt per establishment and per employee. The data by province in MMR for 1974 are shown in Appendix II-4.

Appendix II-5 and II-6 present similar data in construction and mining quarrying sectors in 1974. These activities in the provinces of Bataan, Pampanga and Bulacan were of modest scale.

2.6 Fishery

The statistics in 1970 indicated that the number of persons in Bulacan and Bataan engaged in marine fishery including fishing in Manila Bay were approximately the same with those engaged in inland fishery. While, in Pampanga those in inland fishery (river, fishpond, lake and swamp fishing) far out-numbered those in marine operation. The fish products from Bulacan were chiefly sold in Navotas and Malabon where the products are marketed in Metro Manila.

Due to the characteristics of the fishery production cycle in brackish and fresh water, temporary workers increased by 100%-200% over the number of regular workers during peak harvest periods (two or four

harvests a year). Out of families engaged in work related to fisheries, those solely dependent on fisheries were 70% in Bataan, 20% in Bulacan and 60% in Pampanga. This indicats that fishermen in Bataan and Pampanga had less work opportunity in other sectors. (See Tables 2-3 and Appendix II-7 thru II-8).

In 1960, 11,000 hectares were utilized as fishpond areas. In 1975 a total of 36,000 hectares of brackish water fishpond produced 33,000 tons of fish and other fauna, averaging 0.9 tons per ha. The price per ton at the fishery site was estimated at ₱4,900 per ton in 1975. The data are shown in Appendix II-9. The table also presents the areas in the provinces as 17,000 hectares in Pampanga, 17,400 in Bulacan and 1,100 in Bataan.

Table 2-3 NUMBER OF PERSONS DIRECTLY ENGAGED IN FISHING, 1970

Province	Marine		Inland	
	Number of Operators Reporting	Persons Directly Engaged in Fishing	Number of Operators Reporting	Persons Directly Engaged in Fishing
Philippines	203,621	499,865	81,680	215,479
Zambales	1,455	3,576	792	2,018
Bataan	2,256	6,962	882	4,384
Pampanga	1,121	3,493	6,095	13,312
Bulacan	1,646	4,220	1,654	6,173
Rizal	2,290	14,647	2,714	6,791
Manila	513	3,167	2	51
Cavite	2,194	9,284	723	3,045
Laguna	187	486	3,505	9,720
Batangas	3,356	13,754	800	2,370

Source: NCSO, Census of fisheries, 1971.

Approximately 80 percent of the produce was milkfish, followed by tilapia, crabs, etc. Fishponds particularly in Bulacan, were badly affected by the contamination of household and industrial wastes and affluents in MMA. However, Bataan and Pampanga have still open areas for the development of new fishponds.

2.7 Bataan Export Processing Zone

The government of Philippines maintains a trade policy to restore the balance in trade. The target is incorporated in the development plan for 1978, 1982 and 1987, as shown in Appendix II-10. In order to augment the export industry which would in turn encourage the growth of Philippine economy, an export processing zone was put up in Mariveles in the Bataan peninsula for which the government has implemented a number of supporting policies.

1/ Export Processing Zone Authority in Manieks, August 1979.

2.7.1 Development Progress

According to the Annual Report[1/] the construction of the zone started in 1970 and the first export was registered in 1973 with the annual amount of only $120,000. The production increased to $44.7 million in 1977 and $76.4 million in 1978. The amount in 1978 registered 2.1% of the total export and 6% of the total manufactures export of the Philippines.

The land use classification of the BEPZ is shown in Table 2-4, where net industrial lots are 375 ha out of the total 1,209 ha. The size of establishments in the zone are shown by the number of employees in Table 2-5. The distribution in the number of employees is compared to that of the whole country. The establishments employing less than 49 person amount to only 12% in the zone, while those in the same category amounted to more than 96% in the whole country in 1975-76.

The number of employment was 15,000 for the factory workers and 10,000 for the service sector and others in 1978.

Table 2-4 LAND USE CLASSIFICATION OF THE BATAAN EXPORT ZONE, 1978

Phase	Industries	Hectares
I	Light & labor-intensive industries	56
II	Automotive & medium industries	82
III	Shipbuilding & heavy industries	207
	Total	345
Housing & community		374
Green & open areas		490
	Grand Total	1,209

Source: Export Processing Zone Authority, Mariveles, August 1979.

Table 2-5 PERCENT DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS BY SIZE

Employees	Philippines (1975)[1/]		BEPZ (1976)[2/]	
1-19	52,997	(93.2%)	2	(6.3%)
20-49	2,018	(3.5%)	2	(6.3%)
50-99	775	(1.4%)	6	(18.8%)
100-199	464	(0.8%)	8	(25.0%)
200-499	386	(0.7%)	8	(25.0%)
500-999	134	(0.2%)	1	(3.0%)
1000-	111	(0.2%)	5	(15.6%)

Source: 1/ NCSO, Listing of Establishment 1975, Table A2.
2/ Provincial development staff, Road Network Development Plan CY 1976 to CY 1996 (Bataan Province 1978-draft)

2.7.2 Transport Accessibility

At present, most of the raw materials and all products are transported to and from abroad. Quite often they are transhipped at the international port of Manila, because the amount of shipment is not sufficient to pay for stopping ocean-going vessels at the port of Mariveles where the pier is under expansion.

Domestically supplied resources are power energy, water and manpower. The workers are living in and around the zone with some as far as Balanga, 50km north of the zone. Presently, business trips to and from Manila are modest. (See 3.2 of Part III, Vol. I)

The country looks forward to the gradual achievement of import substitution for raw materials; however, it is likely that it will take time to accomplish. Accordingly, transport of materials from Manila and other places in the country is quite modest in relation to the produce of the zone.

2.8 Further Descriptions of Bataan Province

2.8.1 General

Of the total land area of 1,373km^2, 80.9% is occupied by mountains, hills, and uplands. Cultivated land narrows as it extends south from the plain in the delta of Pampanga river basin on the eastern side of the peninsula facing Manila Bay. A number of small rivers cross the plain, supplying water for the irrigation of crop fields and raising river fishes.

Bataan Expressway is virtually completed passing through the uplands and hilly area, generally 1-2km away from the existing road, along the sea shore of the Manila Bay from San Fernando to Mariveles. The developed road network links the populated towns in the plain field, mostly along the shore of Manila Bay. On the western side of the province facing the South China Sea, the terrain becomes hilly and the population is sparse.

As of 1979, the total population in the province was 304,000. The average population growth rate during the period from 1960-1975 was 4%. This rate was approximately equal to that of MMR. However, the population density was the lowest among the provinces of the MMR.

The provincial capital is Balanga, which is 125kms from Manila and had a population of 40,000 as of 1979.

Electricity is distributed by Bataan Electric Corporation (BATELCO) which is supplied from the National Power Corporation. Most of the municipalities are already provided with water supply network in the central area. In other places, wells and springs are utilized for household consumption.

2/ Provincial development staff of Bataan Province, Road Network Development Plan CY 1976 to CY 1996. (Bataan Province 1978 - draft)

2.8.2 Agricultural Production[3/]

Bataan is basically an agricultural province, with rice being the chief product. The cropping composition of the cultivated area in 1976 is shown below. Production of fresh vegetables for consumption in MMA are to be developed yet.

Rice and palay	28,200 has	(81%)
Vegetables	2,500	(7%)
Sugarcane	3,400	(10%)
Corn	700	(2%)
Total	34,800	(100%)

2.8.3 Fish Production

In 1976, 8,000 persons were engaged in fishpond and municipal fisheries. Brackish fishponds occupied 3,700 hectares, 14% of the plain area of the province. Fishpond productions were sold in the municipalities of Abucay and Orion. In 1976, fishponds yielded 4,000 tons of fish while some 1,000 tons were produced from municipal fishing. Most of the production was locally consumed.

2.8.4 Manufacturing

Manufacturing establishments are mostly located in Bataan Export Zone and Limay. Establishments in the export zone are referred to in the previous Sub-Section 2-7. In Limay, there are four chemical plants and a thermal power plant, employing 1,600 persons. The zoned area extending over 400 hectares, is designated as the second industrial estate of Bataan. The outputs from the zone will be sent to both foreign and local markets. In Samar, a pulp and paper plant is operating employing 500 persons.

In 1975, there were 440 cottage industries with a total of 1,118 workers in 12 municipalities. The average number of workers per house was 2.5 persons. These industries were categorized into 20 groups such as needlecraft, wood-bamboo craft, ceramics, metal and poultry-piggers.

2.8.5 Others

The service sector meets the requirements of the people in a traditional manner. As elsewhere in the Philippines, the chain stores or Sari-Sari are predominantly seen in every town. Tourism facilities have not been developed yet, although potential beach and inland resort areas are already identified.

Sand, gravel and rocks are produced in a limited scale. No commercial mineral resources are found in the province.

3/ Provincial development staff of Bataan Province, op. cit.

CHAPTER 3. INITIAL ENGINEERING STUDY

3.1 Basic Data

Topographical maps to a scale of 1:50,000 were mainly used in this study. The route selection was performed also utilizing hydrographical maps and aerial photo mosaics to a scale of 1:25,000 of the Pampanga Delta Area flown in 1967.

To study the sub-surface soils conditions along the corridor the following data were used:

- Sub-surface soils survey conducted for R-10 Road project, 1974, by JICA; and
- Sub-surface soils survey conducted for Manila-Bataan Coastal Road, 1970, by BPW.

3.2 Alternatives

Three alternatives were studied based on technical and environmental considerations.

The locations of the alternatives are shown in Fig. 3-1.

3.2.1 Alternative 1

This alternative is very similar to the one selected by the MPH several years ago. The road mainly consists of a causeway which was planned 0.5-2 km off-shore from the existing coast lines. The location of this route was selected at the minimum water depth of about one fathom at the mean lower low water level to ensure the accessibility to the constructional floating rigs.

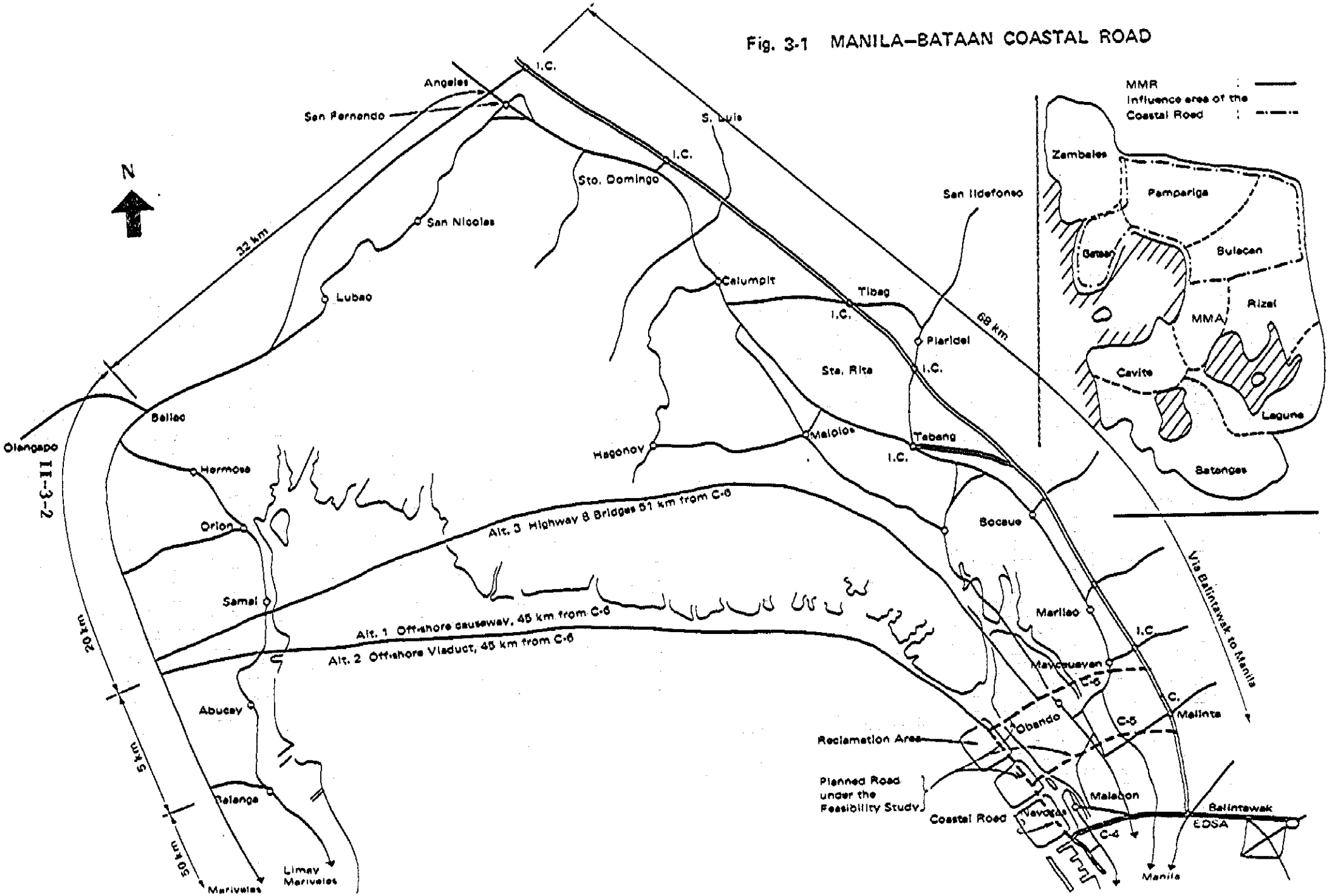
The planned route starts at the end of the phase-I construction of the Manila-Bataan Coastal Road and runs to the northwest and west parallel to the existing coastal line.

Several bridges were considered to provide openings in front of the mouths of major rivers of the region.

From the north fringe of the town of Mabatang, this alternative primarily consists of the improvement of existing first class road up to the existing Bataan expressway, which is the west terminus of the coastal road.

The approximate total length of this alternative route would be 45.0 kilometers and consist of the following categories of construction:

Fig. 3-1 MANILA–BATAAN COASTAL ROAD



- Causeway, new construction ..... 36.0 km
- Road passing through wet lands, new construction ..... -
- Road passing through rice paddy areas, new construction 2.0
- Bridge/viaduct, new construction 3.3
- Improvement of existing road on dry land 3.7

Total ..... 45.0 km

3.2.2 Alternative 2

The route of this alternative is identical with the location of of Alternative 1.

To avoid environmental destruction especially to fishery and other marine resources, adoption of a viaduct was considered in lieu of a causeway.

The approximate total length of this alternative route would also be 45.0 kilometers and consist of the following categories of constructions:

- Bridge/viaduct, new construction ..... 39.3 km
- Road passing through wet lands, new construction ..... -
- Road passing through rice paddy areas, new construction 2.0
- Improvement of existing road on dry lands 3.7

Total ..... 45.0 km

3.2.3 Alternative 3

This alternative differs from the other two which were primarily planned at offshore areas. Inland areas, bordering the rice paddy area and fishpond area, were chosen for alternative 3 for the sub-corridor of the proposed new alignment, considering the following factors:

- Avoidance of the disturbance of existing fishponds;
- Better access to the existing road network; and
- Future development for Pampanga delta area.

The Road starts at about 3 kilometers north of the junction of C-6 and the Coastal Road, and runs to the northwest parallel to the existing national route No. 369 up to near Malolos town.

From there, the route will head westward parallel to the existing national route No. 314 for about 8 kilometers where it will meet the town of San Nicolas.

The total length of viaduct across the floodway from the Candaba Swamp is approximately 3 kilometers according to the past development study.

The next 4 kilometers to the Pampanga river crosses through existing rice paddy areas frequently inundated during rainy seasons.

From the point of Pampanga River crossing, the construction of a viaduct was proposed up to the coast line since the areas are predominantly covered by fishponds and drainage difficulties are anticipated.

The adoption of a causeway across Pampanga Bay is not justifiable because of the problems associated with siltation and flooding A total length of about 18 kilometers of viaduct is proposed in this study.

The approximate total length of this alternative route will be 51.0 kilometers and consists of the following categories of construction:

- Road passing through wet land, new construction	21.0 km
- Road passing through rice paddy areas, new construction	7.8
- Bridge/viaduct, new construction	18.5
- Improvement of existing road on dry land	3.7
Total	51.0 km

3.3 Geometric Design Criteria

3.3.1 Terrain Conditions

All the alternative routes pass through very flat areas on land and shallow areas offshore, except the portions passing through rolling terrain in the vicinity of the junction with the existing Bataan expressway.

3.3.2 Geometric Design Standards

In as much as favorable terrain is predominant, deviations from the common MPH design standards are not expected. Brief notes for each item of geometrical design criteria are presented below:

A. Design Speeds

The design speeds adopted for the future extension section of Manila-Bataan Coastal Road for all alternatives are 120 km/h and 100 km/h for the flat and the rolling terrain areas, respectively.

B. Lane Width

The 12-foot lane width was adopted throughout the entire stretch of high quality type of the Road.

C. Shoulder Width

A 3.0 meter wide exterior shoulder is recommended for the entire stretch of the coastal road on the basis of ultimate construction which would be 4 lanes.

As for the interior shoulder, a constant width of 1.5 meters is recommended.

The project will be executed on a staged construction basis. Therefore, the 2-lane 2-way operation would be needed initially and the available shoulder width on each side would become 2.25 m.

D. Median Width

Since it was found that a foundation treatment cost (i.e., foundation replacement, construction of sand drain piles) is rather high in the area, a conservative median width of 5 meters is recommended.

3.4 Bridge Design Criteria

In general, all bridge design will be done in accordance with the pertinent provisions of the Standard Specifications for Highway Bridges (12th Edition, 1977), adopted by the American Association of State Highway and Transportation Officials (AASHTO). The design live load to be adopted for the design of bridges will be HS 20-44.

Load during earthquakes were considered by modifying the MPH standard.

3.5 Drainage Criteria

The adoption of a design storm frequency of 50 years is recommended for bridges, 25 years for culverts.

Recommended clearances above design flood/mean sea levels for various types of drainage structures are as presented in Table 3-1.

Table 3-1 RECOMMENDED CLEARANCE ABOVE DESIGN FLOOD/MEAN SEA LEVELS

Structure	Clearance in Meter
Major bridges and viaducts	2.0 (3.0)1/
Other bridges	1.5
Large box culverts	0.5
Pipe culverts	Nil
Minor culverts	Headwater limited to 1.2 times height to inlet opening
Viaduct offshore	- (3.0)1/

Note: 1/ Figures in brackets show clearance above the mean sea level.

3.6 Design Features

Design features for the major items of the Road required to be evaluated by alternatives from a technical standpoint are described below.

3.6.1 Number of lanes

Ultimately, the coastal road will consist of a divided 4-lane highway for its entire stretch. In all coastal road sections, a smaller number of lanes will be required initially.

Construction of the Road requires large expenditure of funds as it is not desirable both technically and economically to construct all the lanes of the road at one time. Therefore, a construction program on a staged basis has to be planned in the future in order to optimize the investment-benefit relationship.

3.6.2 Intersections

There are relatively few roads crossing or connecting with the Road. It is recommended that intersections with these roads be made at grade in all alternatives.

3.6.3 Pavement Design

As a portland cement concrete pavement is assumed in this general study, a 25-centimeter portland cement concrete pavement is proposed.

3.6.4 Bridge, Viaduct and Culvert Design

In selecting the type of superstructures of bridges and viaducts, the following are deemed to be generally preferable from economical and technical points of view:

- Intermediate span (not total, but individual span) bridges and viaducts ranging approximately from 20 to 30m and shall be of prestressed concrete beam type;

- Short span bridges range approximately from 7 to 20m and shall be of prestressed concrete hollow slab type; and

- Reinforced concrete box or pipe culverts shall be used in minor rivers and channels whose widths are less than 7m. The adoption of reinforced concrete pipe culverts in multiple rows will offer more economical solution and convenience in the construction.

Regarding soil conditions in the areas, the results of the geological evaluation and sub-surface soils survey indicate that a soft alluvial silty sand stratum exists up to about 25-30m below the sea bottom or the riverbed.

Construction costs for substructures and bridge foundations will therefore be comparatively larger and requires study to determine an optimum span length to minimize the total viaduct construction cost.

The study for concrete viaducts also has been made aiming at the selection of an advantageous substructure construction method which will avoid the pollution of fishery and other marine resources.

The following summarize the outlines of the findings:

- Adopted general view of viaduct is as shown in Appendix II-11;

- Considering pollution during the construction, adoption of cast-in-place concrete by using reverse circulation drill is recommended. Drilled soils should be sedimented in the barge and hauled to a disposal place;

- Pile bent type piers will be adopted to avoid pollution caused by excavation for footing construction and to obtain a better aesthetic appearance; and

- The optimum span length which will minimize the total construction cost was found to be about 20m. (See Appendix II-12 cost comparison).

3.7 Hydrology

3.7.1 Site Investigations

The site investigations were aimed at identifying the effects foreseen by the Road construction and also aimed at establishing preferable construction type (i.e. causeway, viaduct, enbankment, etc.) for the Road from a point of view of hydrology.

3.7.2 Description of Rivers in the Project Area

The Pampanga River basin in the plains of Central Luzon drains to the south through a system of natural and man-made channels and finally discharges into Manila Bay through an extremely wide and complex delta.

In addition to the above mentioned river, there are other rivers which have a total watershed area including the Pampanga River that exceeds 12,000km^2:

- Rivers drained from Mt. Santa Rosa;
- Orani and Pasag Rivers systems; and
- Binangbang, Pamarawan and Bulacan Rivers systems.

The average mean annual rainfall observed in these watershed areas ranges from 1,800 to 2,200mm. Since the area is tropical, the rainfall is characterized by heavy showers. In such a shower, the rate of precipitation may reach about 400mm in low land areas and 600mm in mountain areas for a maximum 24-hour period of 25-year frequency.

Among the rivers mentioned above, the Pampanga River is the largest with a watershed area of about 10,500km^2 and main stream length of about 260km.

Presence of gradual or intermittent uplifts are evident in the area due to the formation of terraces on loosely compacted which were deposited recently along the Pasig River. In the uplift process, river erosion results in the transportation of the relatively older deposits, redepositing them in the flood plains and the stream channels.

According to the Hydrogeologic Map of Central Luzon, the central plains of the area consists of alluvial deposits, and the mountainous areas are covered by volcanic pyroclastic rocks. The amount of soil supplied by the mountainous areas is therefore considered to be relatively large.

3.7.3 Sedimentation

Results of the bed load analysis conducted in the past project indicated that the wider and shallower Pasig River has a tendency to experience greater siltation than the narrower and

deeper course of the Pampanga and other rivers. The behavioral composition of the samples collected from the Pasig River is more indicate properties of a silt while that of the Pampanga River is more that of a sand.

According to the Pampanga delta area development study, an approximate average volume of 12,900,000m^3 of sediment is being deposited annually throughout the courses of Pampanga and other rivers (total watershed area = 8,200km^2), and in the bay as the flood waters rush out.

3.7.4 Effects of the Construction of the Road with Causeway Scheme

Should the causeway type be adopted for the coastal road, the major problem concerned would be the silting. As shown in Fig. 3-1, several openings for river and tide flows are provided. The total length of these openings are determined based on the total width of river mouths flowing into the bay.

Although larger openings might be provided compared with the existing total widths of river mouths, the occurence of a stagnation area would be unavoidable in the area between the existing shore line and the causeway.

On the other hand, a large volume of soil would be continuously transported through river courses and would be deposited in these stagnation areas.

The annual amount of sediment is estimated to be 500-2,000m^3 per cubic kilometer of watershed and the total annual volume of transported soils is estimated to be for the order of 6-24 million cubic meters. Therefore there is a possibility that the areas between existing shore-line and causeway will be filled up with the deposited soils after the completion of the construction, with such filled-up areas have a tendency to spread out towards the river mouths.

3.7.5 Effects of the Construction of the Road with Viaduct

Local deposit and scour around piers will be ignored. Head loss of the flood flows shall be minimized by adopting longer spans in front of river mouths.

3.7.6 Effects of the Construction of the Road with Embankment

From a view point of hydrology, the inland route passes through the following land use categories:

- Rice paddy area;
- Fishpond area; and
- Pampanga floodway.

Considering the possibility of future improvement of river courses, the bridges crossing major rivers in rice paddy areas shall be planned as wide as 1.2-1.5 times the existing river width.

The maximum flood levels based on the 50-year frequency of storm in the rice paddy areas are assumed to be plus 1.0m above the top elevation of existing river dikes. Except for small streams and channels, future dredging must be considered to determine the bottom elevation of substructures. The maximum dredging depth is considered to be about 2m.

There is very wide floodway in Pampanga delta. According to the past development study, the width of this floodway is estimated to be about 3km. It is necessary to adopt the viaduct for the entire width of the said floodway to avoid adverse effects on flood water dissipation.

3.8 Manila-Bataan Coastal Road and Fisheries

A well-planned Coastal Road will provide better access to the consuming cities and in doing so, provide better conditions to the regional fisheries and give the fishpond industry a good chance to modernize. However, should be coastal road be planned without paying attention to the effects on fisheries, the pollution caused by the construction would cause problems.

3.8.1 Effects of the Construction of the Road on Coastal Fishery

When the road is constructed by the causeway scheme, the construction inevitably entails dredging. It could be said that dredging results in disturbance to the sea bed soils during the construction by more or less expelling very fine particles of mud to the adjoining areas of offshore. Therefore, careful study must be done in the planning of dredging and filling, especially for the locations and design of spillways.

3.8.2 Effects of the Construction of the Road on Fishponds

The fishponds in the region are characterized by "brackish water fishponds". This means that all fishponds are always linked with Manila Bay and are concerned with controlling salinity concentration at optimum levels.

If the inland coastal road is planned with the above mentioned situation in mind, no serious problem need exist from the viewpoint of fisheries. However, to minimize the effects on the fishponds in the region, it is preferable that the road alignment be located near the boundaries of existing fishponds and rice paddy area.

If the coastal road is planned offshore, the major problems concerning the fishponds will be the effects on floods and the

interference of free brackish water flows between the bay and fishpond area. Therefore to prevent adverse effects on the fishponds, it is recommended that extensive hydrological study shall be made during the feasibility study.

3.8.3 Provision of Approach Ramps for Fishery and Fish Carrier Boats

The facilities for the access of fishery and fish carrier boats, and the approach ramps should be planned for the offshore road at sufficient intervals. Such approach ramps can also be utilized as emergency and temporary parking by disabled cars and spectators.

3.9 Comparison of Alternatives

The comparison of characteristics of each alternative has been undertaken based on the result of engineering studies and past experiences on similar projects.

Table 3-2 shows an outline of the characteristics of each alternative for the Road.

Table 3-2 COMPARISON OF CHARACTERISTICS OF ALTERNATIVES

(reference: Section 3.2 and Fig. 3-1)

Item for Comparison \ Alternative	Alternative 1	Alternative 2	Alternative 3
1. Effects on ecology (food chains)	Careful studies are required.	Negligible adverse effects are anticipated.	Negligible adverse effects are anticipated.
2. Effects on water quality.	Same as above	Same as above	Same as above
3. Possible flood and interference of brackish water flow.	Same as above	None	None
4. Land acquisition and compensations.	Large: Compensation for serious damages to fishery resources is required.	Comparatively small: Compensation required only for small fish traps.	Comparatively large: Requires land acquisition and compensation for crops, buildings and fisheries.
5. Accessibility to delta.	Fair: requires feeders	Same as Alternative 1	Good
6. Preservation of fisheries	Careful studies are required	Good: approach ramps will facilitate transportation of fishery products	Fair
7. Total length of road	45.0 km	45.0 km	51.0 km
8. Ease of staged construction	Difficult	Easy	Very Easy
9. Construction cost excluding land acquisition and compensation	Smallest	Comparatively large	Same as alternative 2
10. Maintainability	Bad: requires periodic dredging	Good	Fair

CHAPTER 4. FUTURE ECONOMY OF THE INFLUENCE AREA

4.1 Bataan Province

4.1.1 General

The development staff of Bataan Province forecast that the population will grow at 4% p.a. during 1976-1986 and 2.7% p.a. during 1986-1996, while the Study Team estimated that the growth rate will be 3.8% p.a. for 1979-1990 and 3.3% for 1990-2000 (See Appendix I-1).

Although former forecast is less for the second half of the period, it is considered that the growth potentials in terms of population in the province will continue at more than 3% p.a. The rate should not change drastically from 4% to 2.7% because urbanization will develop in Mariveles, Limay and Balanga and the province will be more incorporated in the expanding economy of MMA.

4.1.2 Agriculture and Fisheries

A. Agriculture

The provincial staff estimated that 6,000 hectares of explorable land exists on which gradual development can be expected.[4/]

The classification of cropping on new land for the coming 20 years is planned as follows:

Rice and palay	5%
Root crops	5%
Feed grains and corn	10%
Vegetables	20%
Permanent crops & fruits	60%

The Study Team considers that the above target represents an addition of 17% to the cultivated land area over 20 years. It is a realistic target considering the existence of the huge market of MMA in which population, income and food consumption will grow steadily in coming decades. The above areal expansion and changes in cropping composition on the existing farmland, together with the improvement in land productivity should result in higher income for persons engaged in agriculture.

B. Fisheries

Due to the terrain and shore restraints, the province has less potential in terms of the expansion of its fishponds.

Source: 4/ Provincial development staff of Bataan Province, op. cit.

According to the estimate of the provincial staff, a maximum addition of 8%-10% can be expected, which means that the area for fishponds will increase from 3700 to 4000 hectares in future.

4.1.3 Manufacturing and Service Sectors

New location of factories particularly around Baranga will be encouraged in addition to the development of the export zone and Limay industrial area. The Baranga area is listed as one of the growth center outside MMA which is expected to develop as a satelite urban area with industrial and commercial activities[5/] Terrain conditions, water supply and sewage system are yet to be explored. These infrastructure should be improved and prepared for the location of new establishments.

The Five-Year Development Plan, 1978-1982 identified the several industrial projects listed below in Bataan. Although the extent of progress depends on a number of related factors, it is clear that progress in industrialization will be seen for the coming decades in the province.

Petro-chemical project	in Limay
Steel-plate mill project	in Limay
Nuclear plant	in Morong

4.2 Pampanga Province

4.2.1 General

The Road traverses the southern part of the province where the fishponds and rice fields are predominant. The location is approximately 25 km away from San Fernando, the most populated town of the province.

4.2.2 Agriculture and Fisheries

A. Agriculture

As industrialization develops in the northern part of the province along the McArthur Highway and the Manila North Expressway, agricultural production in the southern part may be influenced to encourage production changes and emphasize items such as rice and sugar into fresh vegetables and fruits production. The changes will accelerate when the Road together with approach roads are completed.

Source: 5/ Metro Manila Commission, Budget and General Appropriations Ordinance, 1978

Furthermore, technical advice, cooperative organization, marketing systems and financing are to be explored and incorporated in the development plan of the agriculture for the southern part of the province.

B. Fisheries

Specifically for production of fishponds, the impact of the Road is seen as decisive. At present, the marketing and transporting follows the traditional system: some consumed locally, some shipped to Manila. No warehouse storage has been established in the area.

Improvement in cold storage, ice plant, and shipment yard, changes in cooperative organization, marketing system, and financing should be incorporated in the development program of the fishery sector.

4.2.3 Manufacturing and Service Sectors

In Pampanga province, establishments are located in the area along the McArthur Highway and Manila North Expressway, the latter, serving as a tollway connecting MMA and the populated cities in the province. Urbanization has been strengthened in the towns along these trunk roads.

The industrial growth cores in the province as identified by the Metro Manila commission are San Fernando and Angeles. Population and industrial and commercial establishments are concentrated in these urban centers, largely due to their accessibility to and from MMA.

In the Five-Year Development Plan 1978-1982, the industrial estate project is planned for San Fernando. However, the implementation is still behind schedule because of unfavorable economic restraints that prevailed in 1970's.

4.3 Bulacan Province

Bulacan Province is situated at the north of the MMA. Changes in the population and industrial composition are heavily influenced by the development of the MMA. The development of housing and factory areas was studied and is shown in Chapter 2 of Part III.

The proposed Coastal Road would pass through the western edge of the province in the midst of fishponds and less populated areas. No Radical change in land use pattern in this area is likely to occur even if the Coastal Road is constructed.

Influences of the Coastal Road on fishponds and agricultural production will be quite same as in the southern part of Pampanga Province. The produce will be located much more closely to the consumption demand of the MMA.

The Manila North Expressway, together with the McArthur Highway serve the development of the regions situated north to the NMA.

The Bataan Highway which was completed in 1977 promotes the efficient movement of goods and passengers among the population cores in Bataan, such as Mariveles, Balanga and Manila. The highway is connected to McArthur Highway and the North Expressway at San Fernando in Pampanga.

If The Coastal Road is constructed, it will provide a shortcut between Manila and the Bataan peninsula. The connection will assist in the development of the provinces of Bataan, together with Zambales and Pampanga. The McArthur Highway and the North Expressway will benefit by the reduction in traffic congestion since traffic will be diverted to the proposed Coastal Road.

CHAPTER 5. IMPACT OF THE COASTAL ROAD ON THE INFLUENCE AREA

5.1 Bataan Province

i) If the Road is completed, the development of the secondary and tertiary sector will be able to absorb the surplus labor as well as accept migrants from other regions. Locational advantages of the three development cores (viz. Mariveles, Limay and Balanga) will be strengthened.

ii) The distance between Manila and Balanga will be reduced from 125km to 50km by completion of the coastal road. The reduction in transport cost will increase the income of farmers and encourage them to increase the productivity and to change their traditional product lines into those which are more profitable due to rapid and easy transport to the huge urban market of Manila.

iii) Annual production of fish per hectare from fishponds is now estimated at one ton on the average. The study team considers that the fishpond productivity can be doubled by applying an innovative production system similar to that found in other countries. This would include the introduction of export or oriented species, improvement of feeding methods, development of the cooperative system, marketing and financing.

iv) Since the growth of population and rise in income level is foreseen in the country, the protein intake will be accelerated and the fishery output will become a more vital source of protein than it is today.

5.2 Pampanga Province

i) Considering the road network in the province, the addition of the Road, even if it is connected by access roads to San Fernando and other municipalities, will have a modest influence on the activities and new location of industrial and service establishments in the province. McArthur Highway and the Manila North Expressway have had and will continue to have a decisive role for the development of provincial industries and urbanization.

ii) For agriculture products, the Road will provide a shorter route to the market of Manila. As in the case of the Bataan Province, part of the traditional production of rice and sugarcane in the area would change into production of vegetables for daily consumption in the urban market. It is to be noticed that the Road and Pampanga river and agriculture development projects should be incorporated together in order to serve regional development.

iii) Another 700-1,000 hectares in the province are believed to be

available for fishponds expansion. New development of the fishponds and introduction of a new production system, (as described for Bataan province), will be encouraged if the Road is provided. Increases in the supply of fishery product will meet the ever growing demand of MMA. Metro people will also be benefited by the increased supply of protein from these fishponds.

5.3 Functional Role of the Road

Fig. 3-1 shows the transport system as a triangle composed of Manila North Expressway, Bataan Expressway, and the Road. The Manila North Expressway, together with the McArthur Highway serve the development of the regions situated north to the MMA.

The Bataan Highway which was completed in 1977 serves for efficient movement of goods and passengers among the populated cores in the Bataan, such as Mariveles, Balanga and Manila. The highway is connected to McArthur Highway and the North Expressway at San Fernando of Pampanga.

The Road, if it is constructed, will provide a short and convenient route between the Manila and the Bataan peninsula the connection will assist in the development of the provinces of Bataan, together with Zambales and Pampanga. The McArthur Highway and the North Expressway will be benefited by the reduced congestion of traffic since there will be a traffic diversion to the proposed Coastal Road.

5.4 Recommendation

Since the daily traffic between MMA and Bataan and Olongapo was 1,900 in 1979 (See Sub-sections 3.2.3 of Part III), the traffic volume is too small to consider the economic viability of the immediate construction of the Road. The construction cost will be high because of its unfavorable conditions in the delta area of the Pampanga River.

Therefore, it is recommended that a long-range overall development plan of the region (Bataan, Pampanga and Zambales) be considered. The plan would cover not only the industrial sector but also agriculture fishery sectors and urban re-development in these provinces. The role of the Road should be evaluated in terms of its importance in the transport network which will support the development of the region.