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NO. 53

GOVERNMENT OF MALAYSIA

JB-TRANSPLAN

THE FEASIBILITY STUDY ON ROAD CONSTRUCTION AND IMPROVEMENT PROJECT IN JOHOR BAHRU AND ITS CONURBATION

FINAL REPORT

SUMMARY AND RECOMMENDATIONS

MARCH 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

GOVERNMENT OF MALAYSIA

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PREFACE

The Japan International Cooperation Agency (JICA) has conducted an Urban Transport Master Plan Study for Johor Bahru and its Conurbation and formulated a list of high priority transportation projects. The Government of Malaysia has agreed to that list and requested the Government of Japan to conduct a Feasibility Study on Road Construction and Improvement Project in Johor Bahru and its Conurbation.

In response, the Government of Japan has decided to conduct the feasibility study and entrusted it to JICA. JICA sent to Malaysia a joint survey team comprising Fukuyama Consultants International Co., Ltd. and Cho-dai Consultants Co., Ltd., headed by Mr. Toshio Kimura, from August 1982 to December 1983 under the guidance of the Japanese Supervisory Committee chaired by Prof. Moriyuki Hirose, Meisei University.

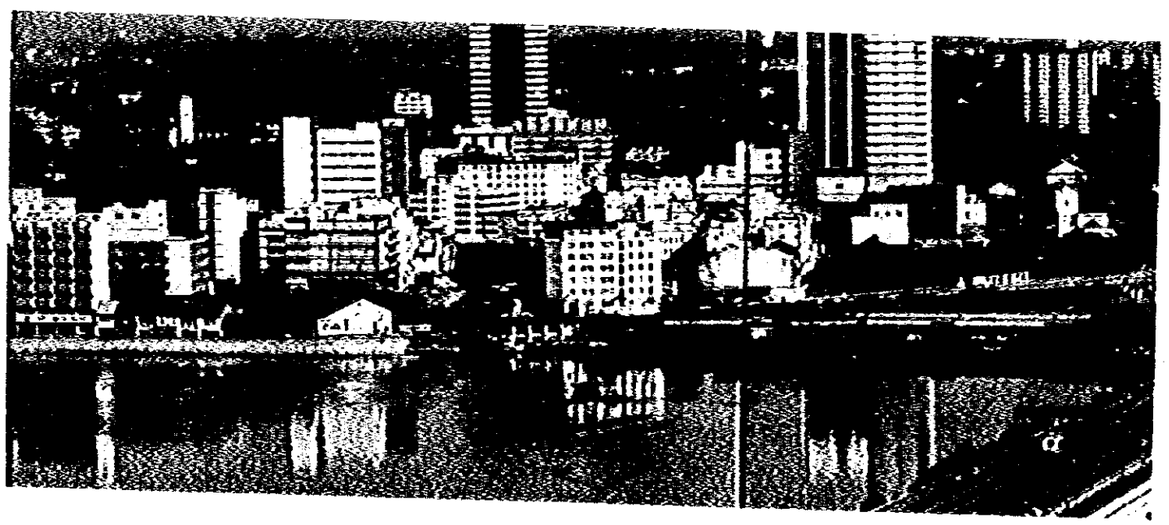
The team held discussions with the officials concerned of the Government of Malaysia on the Project and conducted the study in Malaysia. Subsequently, further studies were made in Japan and this report has been prepared.

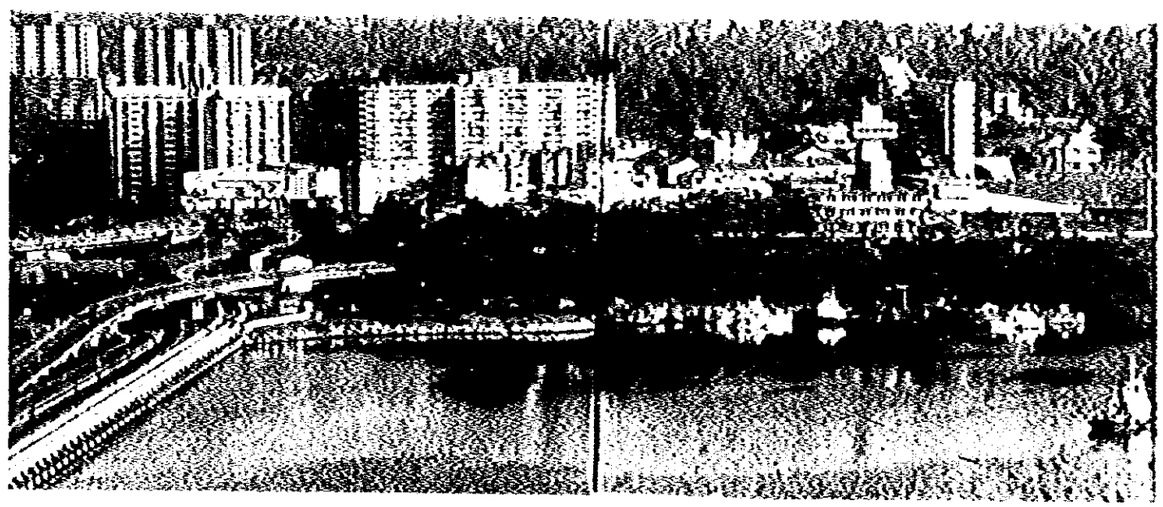
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the team.

March 1984

Keisuke Arita
President
Japan International Cooperation Agency





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JB-TRANSPLAN

THE FEASIBILITY STUDY ON ROAD CONSTRUCTION AND IMPROVEMENT PROJECT IN JOHOR BAHRU AND ITS CONURBATION

RECOMMENDATIONS

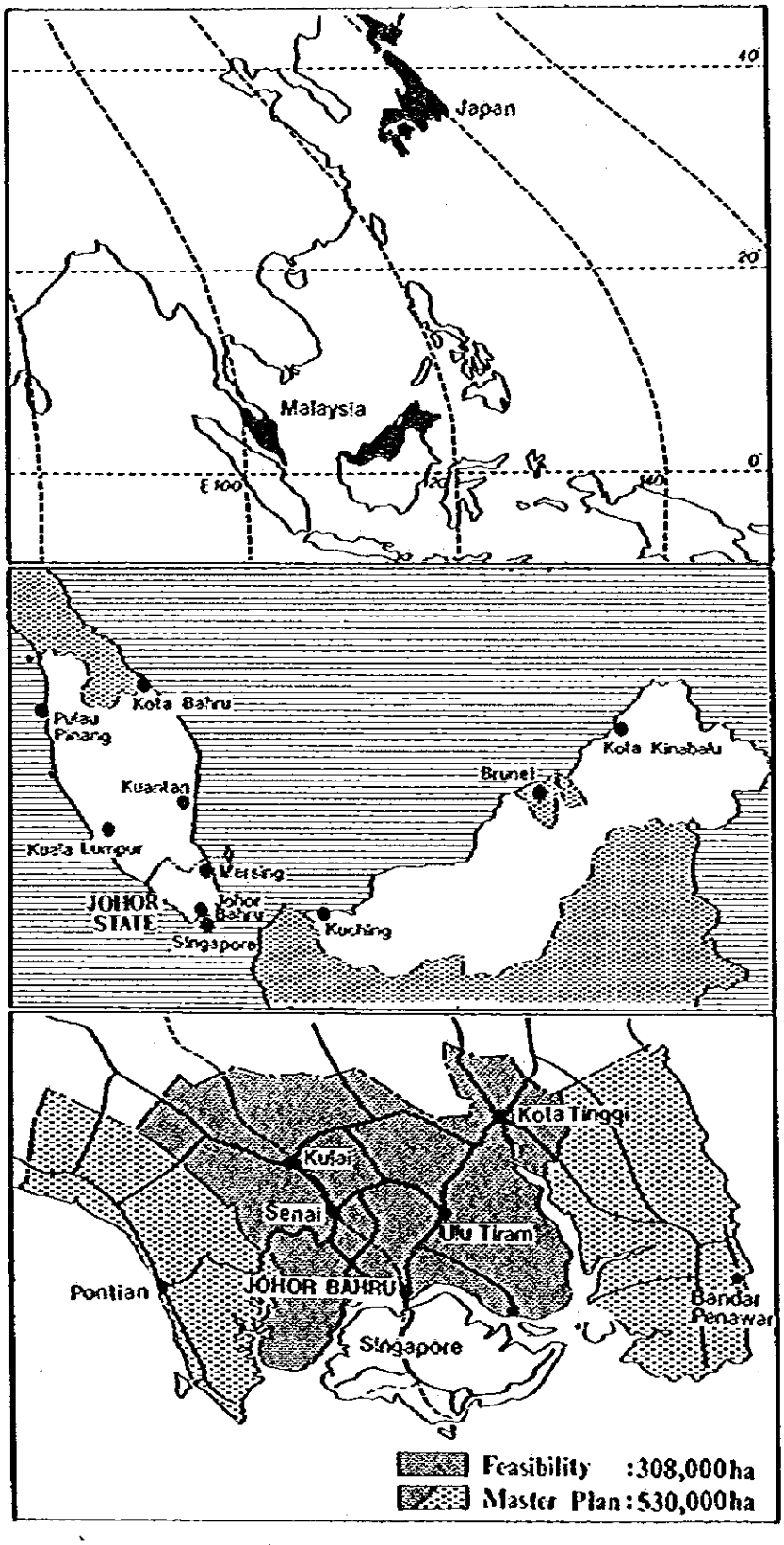


FIG. 1. STUDY AREAS FOR MASTER PLAN AND FEASIBILITY STUDY

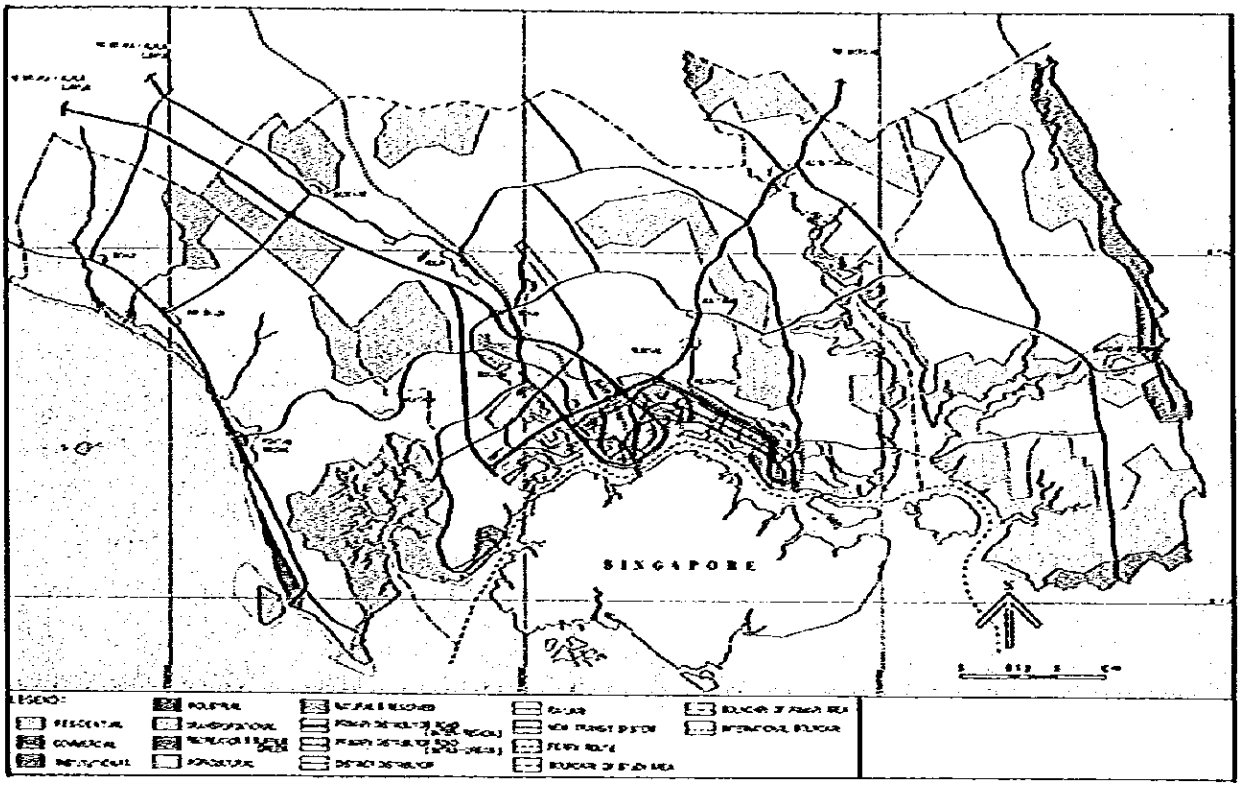


FIG. 2. FUTURE LAND USE AND TRANSPORT NETWORK PLAN — 2000

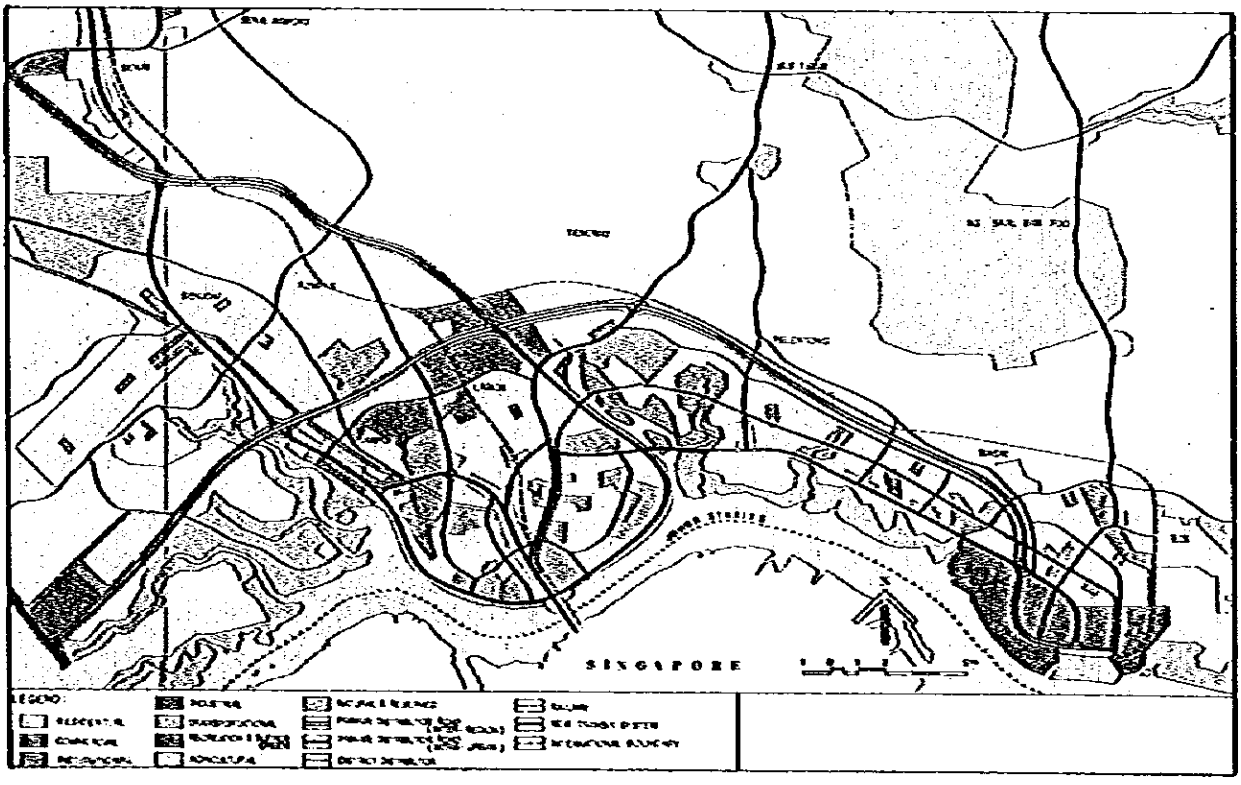


FIG. 3. JB—PG CORRIDOR: FUTURE LAND USE AND NETWORK PLAN — 2000

I. RECOMMENDED PROJECTS

i) Outline

The four road packages investigated in this Feasibility Study are essential to the attainment of an efficient and comprehensive urban transport environment for the Johor Bahru Metropolitan Region (see Fig.4). The proposed Johor Bahru–Pasir Gudang Southern Link would function as the major means of communication along the southern corridor.

The Inner Ring Road and the Toll Expressway Access together with the Causeway Traffic Dispersal Plan would disperse and distribute traffic in an orderly fashion, reduce chronic traffic congestion and hence travel time and cost, and ultimately upgrade the urban transport environment.

In addition, the widening and improvement of Jalan Tebrau is also urgently required in order to upgrade this primary distributor and make it compatible with the Southern Link and to eliminate the possibility of future traffic congestion.

ii) Economic Feasibility

The projects of the original plan have been found to be highly feasible. A rigorous test was made through sensitivity analysis of alternative plans with varied project costs and/or benefits that were outlined in the original plan.

The result of this analysis shows that the Johor Bahru–Pasir Gudang Southern Link, the Long-Term Causeway Traffic Dispersal Scheme and the eastern segment of the Inner Ring Road including the Lorry Route remain economically feasible for all the alternative plans. The Toll Expressway Access Road, however, was found to be economically feasible if the opening year of the road is postponed three (3) years (by 1992).

iii) Project Priority

Economic feasibility and the impact on development, the socio-environment and traffic were weighted in rating the priority of each project package.

The Johor Bahru–Pasir Gudang Southern Link and the eastern segment of the Inner Ring Road as four (4)-lane roads, and the Short-Term Causeway Traffic Dispersal Plan are rated first-priority projects. Second-priority projects include the widening of the Southern Link and the eastern segment of the Ring Road into six (6)-lane roads, and the implementation of the Long-Term Causeway Traffic Dispersal Scheme. The western segment of the Inner Ring Road and the Toll Expressway Access are rated as third-priority projects.

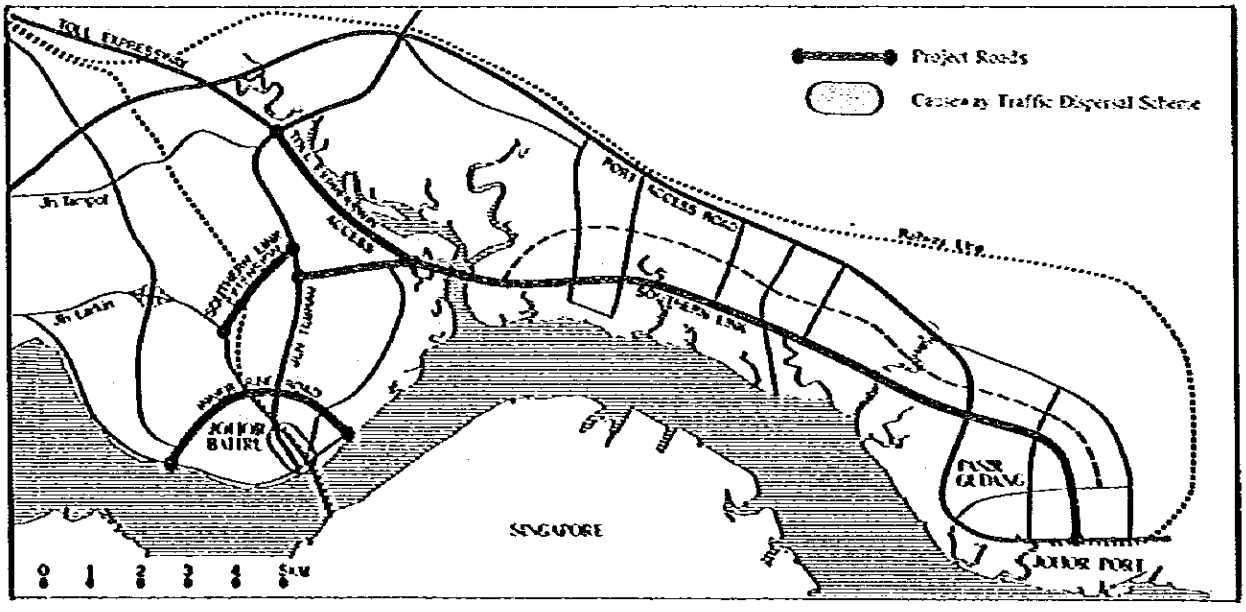


FIG. 4. PROJECT LOCATION OF THE FEASIBILITY STUDY

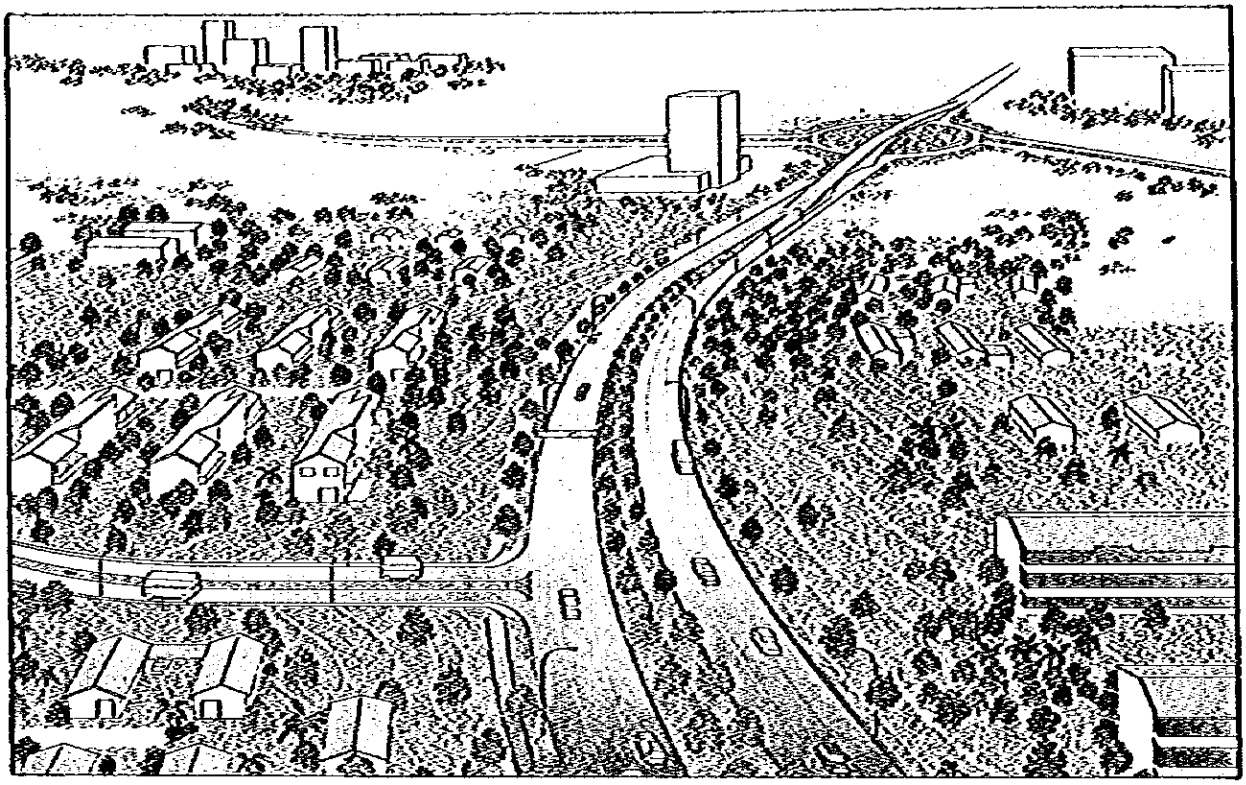


FIG. 5. DESIGN IMAGE OF THE SOUTHERN LINK ROAD

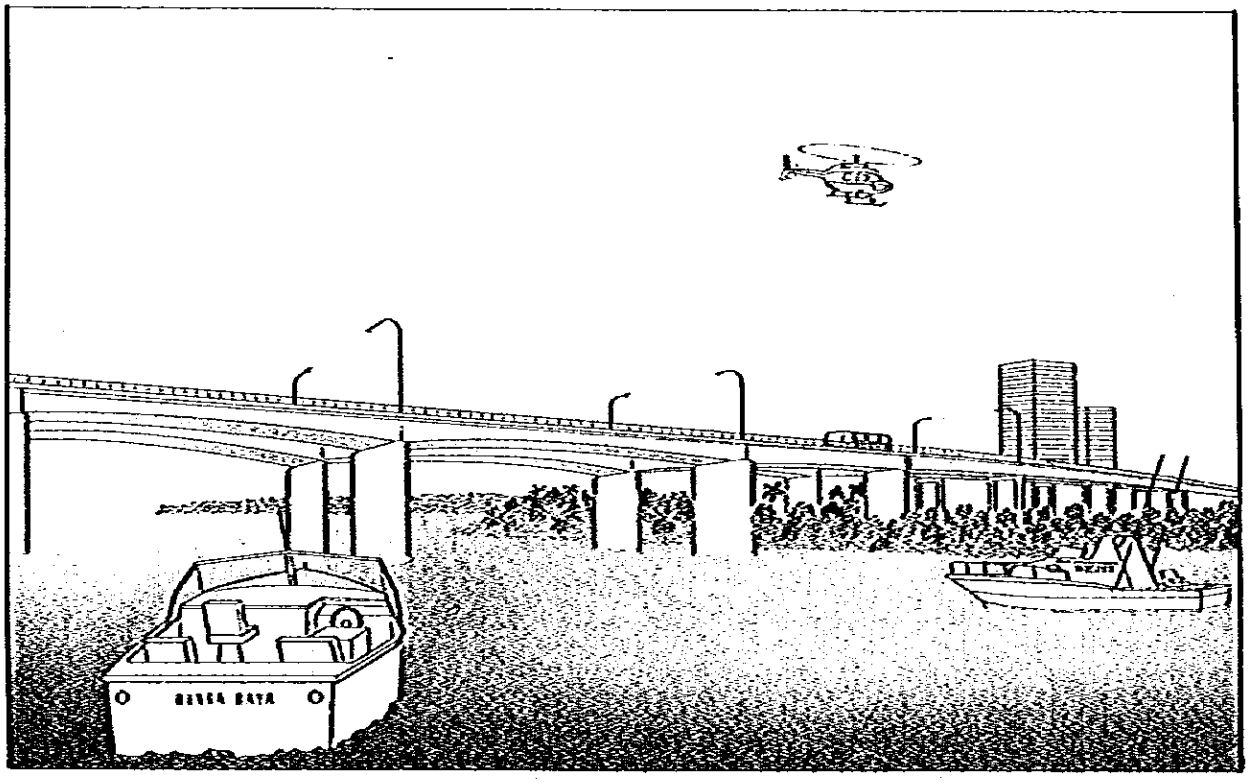


FIG. 6. DESIGN IMAGE OF THE TEBRAU BRIDGE

1. JOHOR BAHRU–PASIR GUDANG SOUTHERN LINK

1. The results of the economic evaluation and technical and environmental studies show that the Johor Bahru–Pasir Gudang Southern Link including the Southern Link Extension is feasible (see Fig. 7).

2. On the basis of the economic evaluation and the traffic study, it is recommended that the carriageway of the Southern Link, which is the section between Jalan Tebrau and Pasir Gudang Port, be constructed as a four (4)-lane road in the first stage and ultimately widened into a six (6)-lane road; a four (4)-lane road is recommended for the carriageway of the Southern Link Extension, encompassing the section on Jalan Kebun Teh between Jalan Larkin and Jalan Tebrau.

3. Based on the technical study, the construction of a high-level bridge with a clearance height of twelve (12) meters for the Tebrau River is recommended.

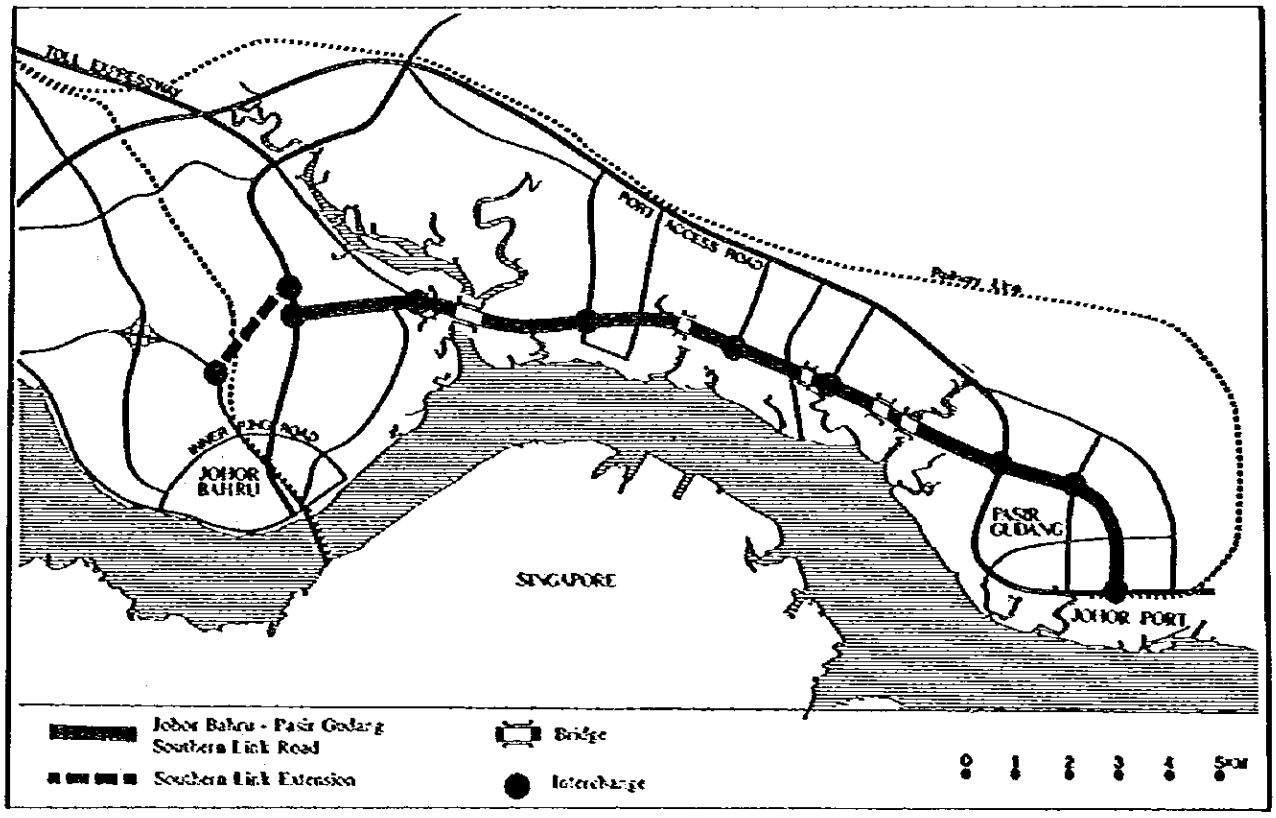


FIG. 7. JOHOR BAHRU—PASIR GUDANG SOUTHERN LINK ROAD

2. CAUSEWAY TRAFFIC DISPERSAL SCHEME

1. On the basis of the economic evaluation and traffic and environmental studies the implementation of both the short-term and the long-term plans of the Causeway Traffic Dispersal Scheme is strongly recommended in order to disperse the causeway traffic as well as traffic in the Central Area.

2. The following are recommended Short-Term Actions (see Fig. 8).
   a. Modification of the one-way system for Jalan Wong Ah Fook and Jalan Tun Abdul Razak.
   b. Upgrading Jalan Wong Ah Fook and covering Sungai Segget (that is, the traffic mall of Jl. W.A.Fook).
   c. Construction and improvement of the roads between Jalan Wong Ah Fook and Jalan Tun Abdul Razak.
   d. Improvement of Tebrau Interchange and the modification of the Southern Interchange.
   e. Improvement and extension of pedestrian facilities such as pedestrian crossings and bridges.
   f. Introduction of an Area/Line Traffic Signal Control system.

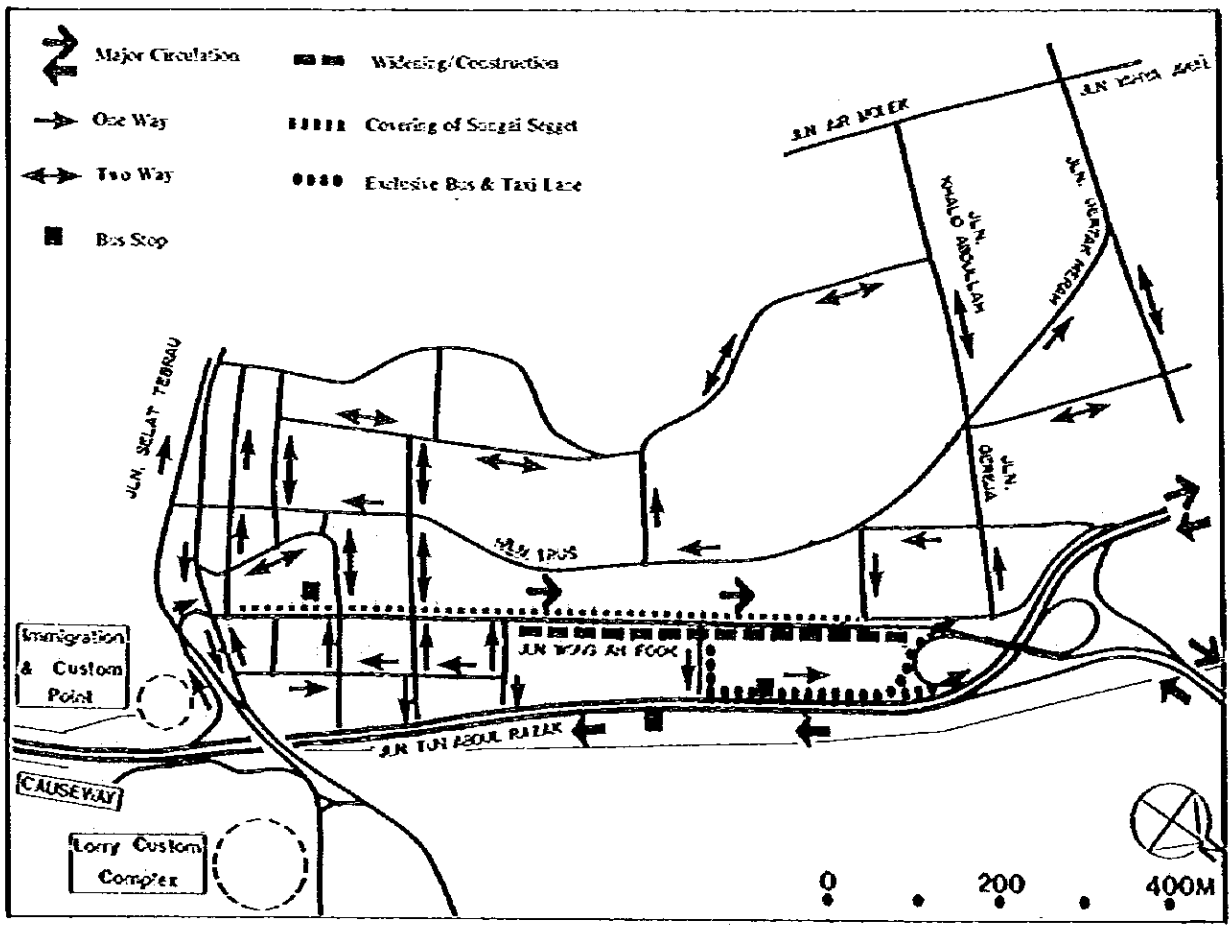


FIG. 8. SHORT-TERM ACTION PLAN FOR THE CAUSEWAY TRAFFIC DISPERSAL SCHEME

3. The following comprise the recommended Long-Term Plan (see Fig. 9).
   a. Road construction and improvement within an area bounded by Jalan Bukit Meldrum, Jalan Selat Tebrau, Jalan Ibrahim and Jalan Ayer Molek.
   b. Construction of the Southern Interchange.
   c. Introduction of an additional one-way system at Jalan Trus and Jalan Duke.
   d. Expansion of Area Traffic Signal Control Scheme.

Overall design image of the causeway traffic dispersal scheme is displayed in Fig. 12 at page 11.

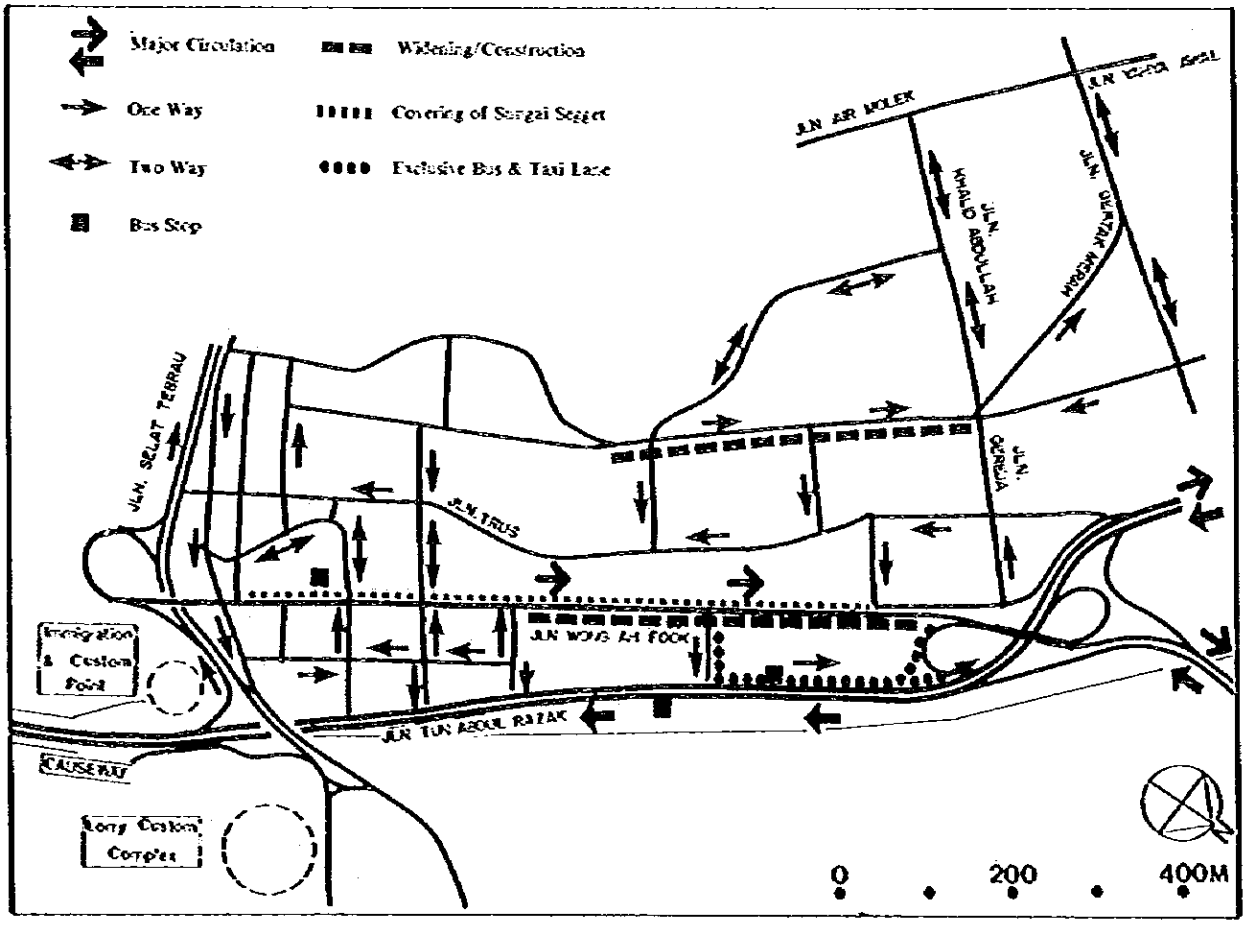


FIG. 9. LONG-TERM PLAN FOR THE DISPERSAL SCHEME

3. TOLL EXPRESS ACCESS ROAD

1. Judging from the economic evaluation and traffic study, the opening of the Toll Expressway Access in 1989 is premature.

   However, the opening of the access to traffic is economically feasible if it is postponed for three (3) years.

2. On the basis of the economic evaluation and traffic study, it is recommended that the carriageway of the Toll Expressway Access be a four (4)-lane carriageway.

   Fig. 10 illustrates the location of the toll express access road.

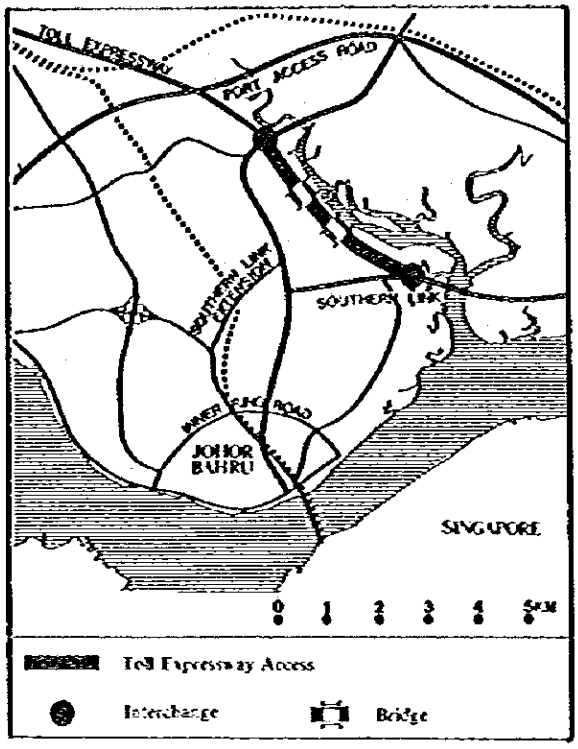


FIG. 10. JOHOR BAHRU TOLL EXPRESSWAY ACCESS ROAD

4. INNER RING ROAD INCLUDING LORRY ROUTE

1. Judging from the results of the economic evaluation and technical and socio-environmental studies, the Inner Ring Road is found to be feasible.

   As for the Lorry Route, the most feasible plan is the one accommodating lorry traffic on the eastern segment of the Inner Ring Road (that is, the section between Jalan Tun Abdul Razak and the lorry custom complex) (see Fig. 11 and 13).

2. Based on the economic evaluation and technical and socio-environmental studies, it is recommended that the carriageway of the eastern segment of the Inner Ring Road be ultimately a six (6)-lane road with the center two (2)-lanes designated as a lorry route; a four (4)-lane road is recommended for the western segment of the Inner Ring Road (that is, the section between Jalan Tun Abu Bakar and Jalan Tun Abdul Razak).

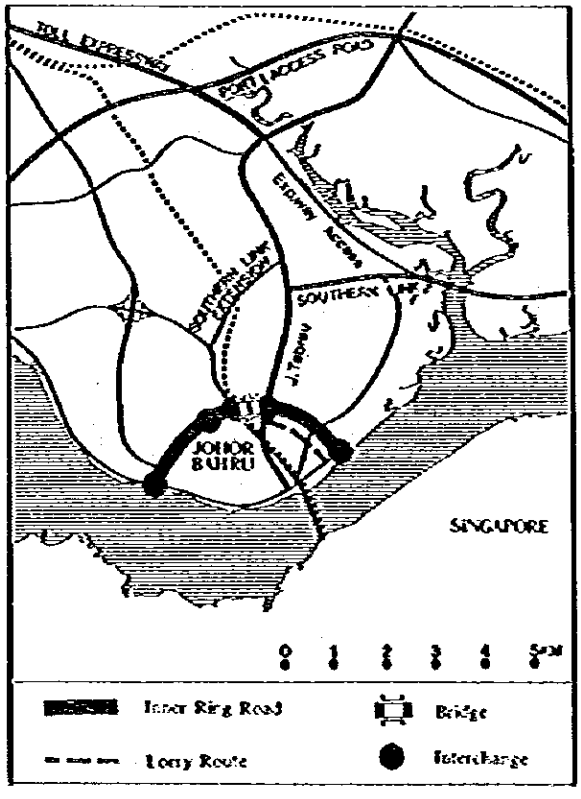


FIG. 11. INNER RING ROAD INCLUDING LORRY ROUTE

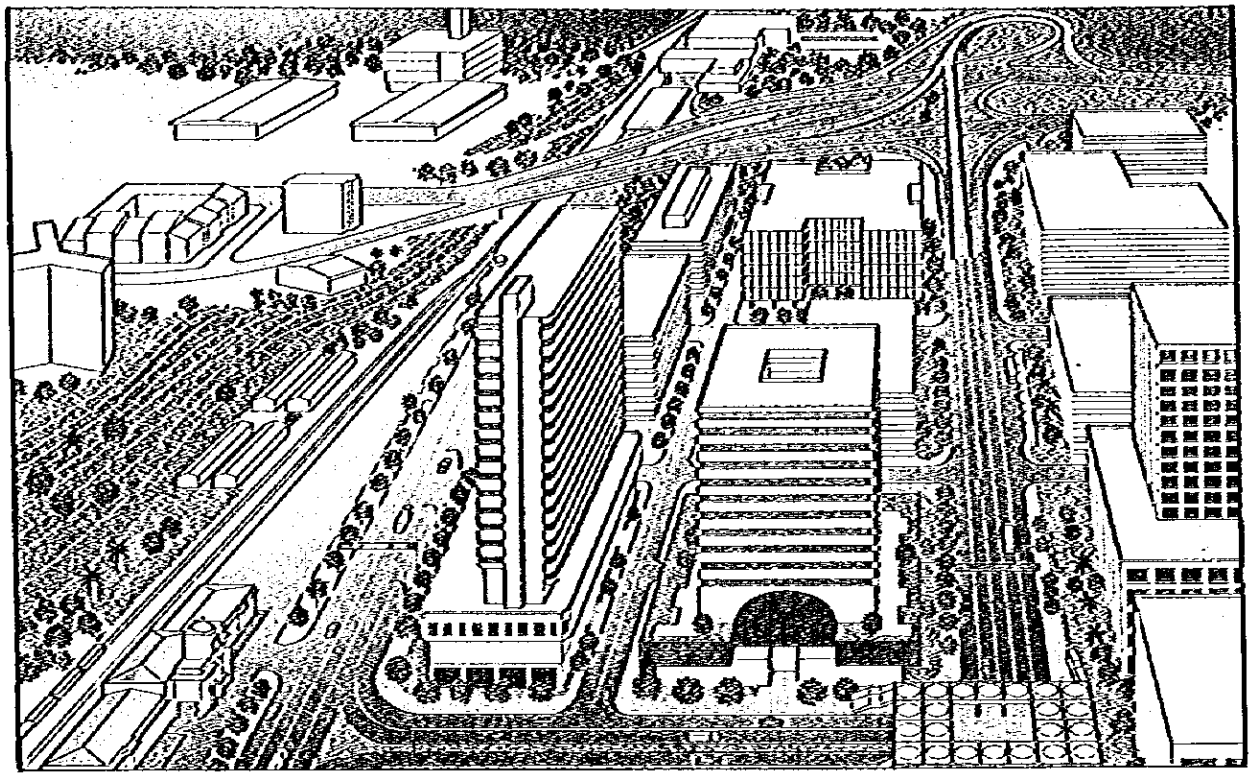


FIG. 12. DESIGN IMAGE OF THE CAUSEWAY TRAFFIC DISPERSAL SCHEME

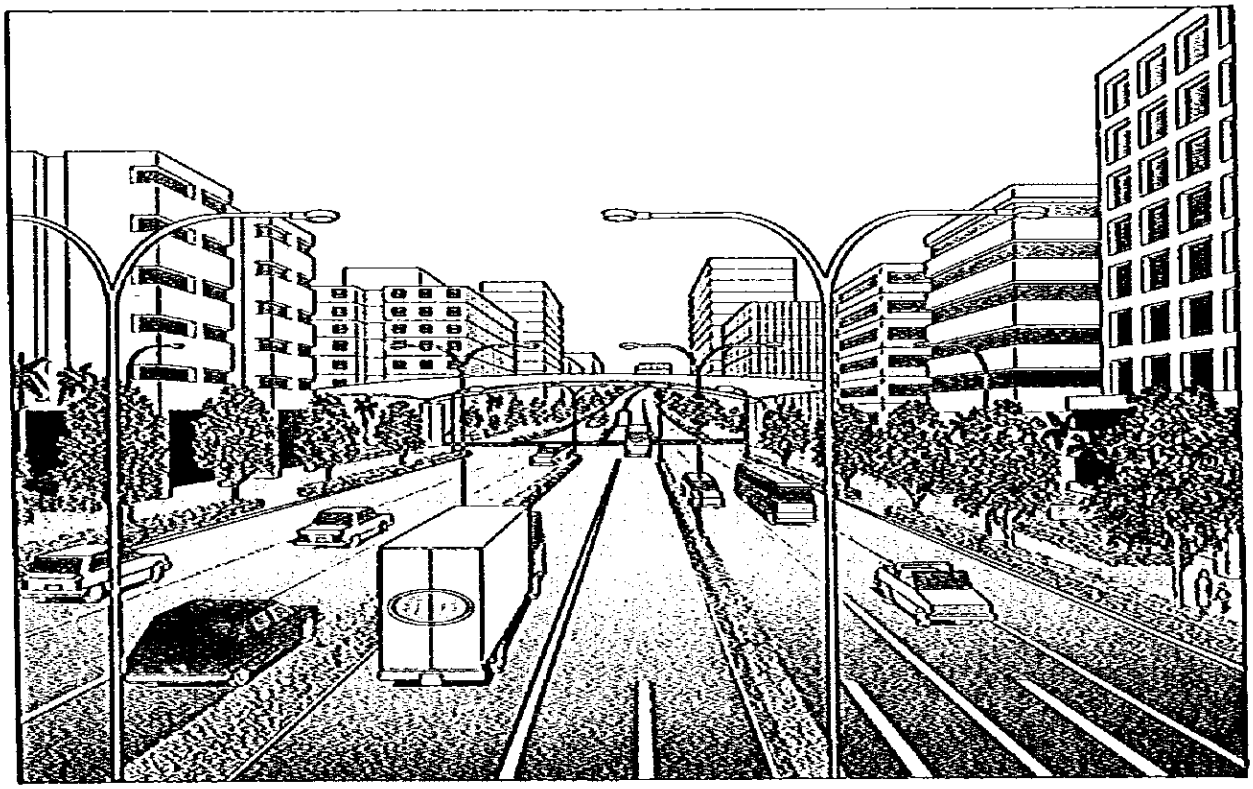


FIG. 13. DESIGN IMAGE OF THE INNER RING ROAD AND LORRY ROUTE (EASTERN SEGMENT)

II. PROJECT COST

The overall project will cost some M$388.6 million at 1983 prices, of which 85.7% or M$333.1 million will be needed for the construction of roadways, interchanges and bridges.

The estimated project cost for each project is shown in the table below (see Table 1).

TABLE 1. SUMMARY OF PROJECT COST

(M$'000)

	Length of Project Road (Km)	Land Acquisition Cost	Construction Cost			Total
			Roadway	Structure	Sub-Total	
Johor Bahru – Pasir Gudang Southern Linkk	20.47	12,042	78,928	107,097	186,025	198,067
Southern Link	18.30	5,931	72,337	100,209	175,546	178,477
Southern Link Extension	2.17	6,111	6,591	6,888	13,479	19,590
Causeway Traffic Dispersal Scheme	(7.46)	3,376	14,498	24,054	38,552	41,928
Short-Term	(3.09)	0	5,317	9,731	15,048	15,048
Long-Term	(4.37)	3,376	9,181	14,323	23,504	26,880
Toll Expressway Access	3.99	4,951	24,802	21,165	45,967	50,918
Inner Ring Road Including Lorry Route	5.50	35,153	23,714	38,862	62,576	97,729
East Segment with Lorry Route	3.25	24,383	14,687	28,205	42,892	67,275
West Segment	2.25	10,770	9,027	10,657	19,684	30,454
Total	29.95	55,522	141,942	191,178	333,120	388,642

Notes: 1) Project Cost is calculated based on the Ultimate Plan.
2) Figures in brackets represent partial length.

III. IMPLEMENTATION PROGRAM

Table 2 shows the overall implementation program for the four project packages in three phases. The Johor Bahru–Pasir Gudang Southern Link and its Extension the Short-Term Action Plan of the Causeway Dispersal Scheme, and part of the eastern segment of the Inner Ring Road are to be implemented in Phase 1 from 1985 to 1990. The widening of the Southern Link into a 6-lane road, the implementation of the Long-Term Causeway Traffic Dispersal Plan and the construction of a part of the Inner Ring Road will take place in Phase 2 from 1991 to 1995. The projects to be implemented in Phase 3 from 1996 to 2000 include the construction of the Toll Expressway Access and the western segment of the Inner Ring Road (see Table 2).

The recommended Phase 1 projects should be engineered in detail as early as possible in order to complete them by 1990.

TABLE 2. OVERALL IMPLEMENTATION PROGRAM

(M$'000)

Project Package	Phase 1 1985 – 1990	Phase 2 1991 – 1995	Phase 3 1996 – 2000	Total Cost
1) Johor Bahru-Pasir Gudang Southern Link				198,067
a) Southern Link – Section between Jalan Tebrau and Port Access.	94,193			
b) Southern Link Extension	13,454			
c) Widening of Southern Link-Section between Jalan Tebrau and Pasir Gudang Port.		44,864		
d) Construction of 8 Grade-separated Interchanges		45,556		
2) Causeway Traffic Dispersal Scheme				41,928
a) Short Term Plan	15,048			
b) Long Term Plan		26,880		
3) Inner Ring Road/Lorry Route				97,729
a) Section between Jalan Tebrau & Jalan Bkt. Meldrum/Lorry Custom Complex.	22,281			
b) Section between Jalan Yahya Awal & Jalan Tebrau		38,741		
c) Widening of the Section as in a)		11,287		
d) Section between Jalan Abu Bakar & Jalan Yahya Awal.			25,420	
4) Toll Expressway Access			50,918	50,918
Total Cost — Cost.	144,967	167,328	76,338	388,642
Total Cost — %	37.3	43.1	19.6	100

* Cost Estimate Based on 1983 Prices.

PHASE I: 1985 — 1990

Projects to be implemented are recommended as follows; (see Fig. 14 and Table 3).

a. Johor Bahru–Pasir Gudang Southern Link:
   - — Construction of the Southern Link, that is, the section between Jalan Tebrau and the planned cloverleaf interchange on the Port Access as a four (4)-lane road;
   - — Construction of the Southern Link Extension as a four (4)-lane road.

b. Implementation of the Short-Term Causeway Traffic Dispersal Scheme:

c. Inner Ring Road including the Lorry Route;
   - — Construction of the eastern segment of the Inner Ring Road with Lorry Route between Jalan Tebrau and Jalan Bukit Meldrum or Lorry Custom Complex as a four (4)-lane road.

PHASE II: 1991 — 1995

Projects listed below should be implemented in Phase II (1991—1995) (see Fig. 15 and Table 4).

a. Johor Bahru–Pasir Gudang Southern Link:
   - — Widening of the Southern Link between Jalan Tebrau and Pasir Gudang Port into a six (6)-lane road;
   - — Construction of Interchanges on the Southern Link and its Extension;

b. Long-Term Causeway Traffic Dispersal Scheme

c. Inner Ring Road including Lorry Route:
   - — Construction of the Inner Ring Road with Lorry Route between Jalan Larkin and Jalan Tebrau as a six (6)-lane road;
   - — Construction of the Inner Ring Road between Jalan Yahya Awal and Jalan Larkin as a four (4)-lane road;
   - — Widening of the Inner Ring Road between Jalan Tebrau and Jalan Bukit Meldrum into a six (6)-lane road.

PHASE III: 1996—2000

Phase III projects are identified as follows: (see Fig. 16 and Table 5).

a. Construction of the Toll Expressway Access as a four (4)-lane road;

b. Inner Ring Road including Lorry Route,
   - — Construction of the western segment of the Inner Ring Road between Jalan Abu Bakar and Jalan Yahya Awal as a four (4)-lane road.

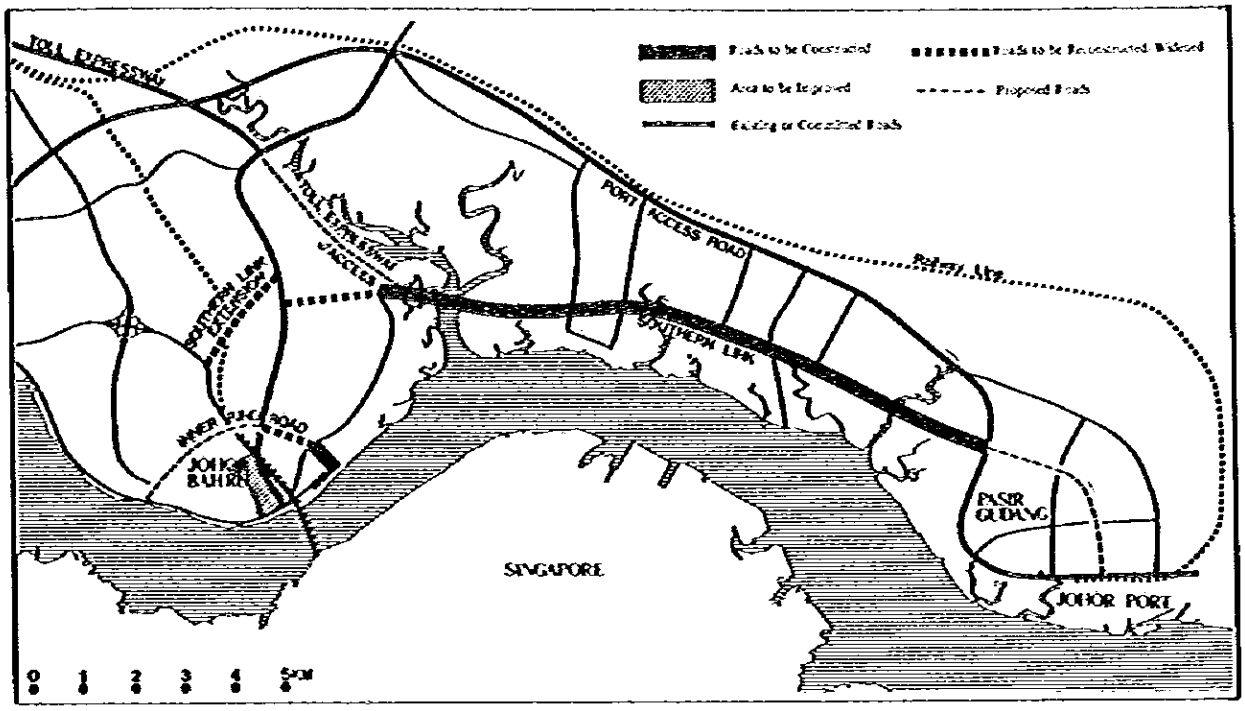


FIG. 14. RECOMMENDED IMPLEMENTATION PROGRAM PHASE I (1985 — 1990)

TABLE 3. INVESTMENT PROGRAM FOR PHASE I

Project	Number of Lane	Total Length (km)	Year						Project Cost (M$'000)
			1985	1986	1987	1988	1989	1990	
1. Johor Bahru – Pasir Gudang Southern Link									
a. Southern Link, section between Jalan Tebrau and Port Access	4	14.53		----------	•••••••••	———			94,193
b. Southern Link Extension	4	2.17			---------	•••••••••••••	———		13,454
2. Short – Term Causeway Dispersal Scheme	–	3.09	--------	———					15,048
3. Inner Ring Road including Lorry Route section between Jalan Tebrau and Jalan Bukit Meldrum/Lorry Custom Complex	4	2.44		--------	••••••••••••	———			22,281
Investment Requirements for Phase	Annual Cost ($'000)		752	12,755	23,605	32,764	41,468	33,632	144,976
	Share in Total (%)		0.5	8.8	16.3	22.6	28.6	23.2	100
	Achievement (%)		0.5	9.3	25.6	48.2	76.8	100	--

Notes: -------- Detailed Engineering
••••••••• Land Acquisition
——— Construction

III. IMPLEMENTATION PROGRAM

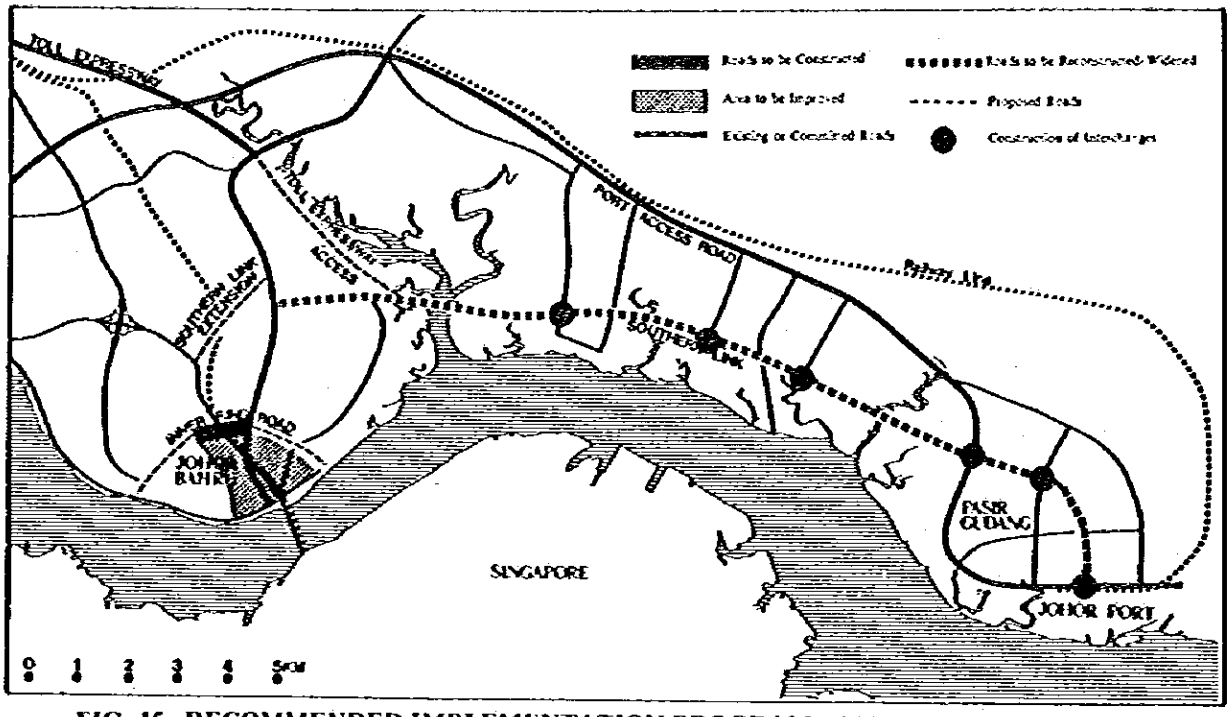


FIG. 15. RECOMMENDED IMPLEMENTATION PROGRAM PHASE II (1991 — 1995)

TABLE 4. INVESTMENT PROGRAM FOR PHASE II

	Number of Lane	Total Length (km)	Year 1991	1992	1993	1994	1995	Project Cost (M$'000)
1. Johor Bahru – Pasir Gudang Southern Link								
a) Widening of Southern Link, section between Jalan Tebrau and Pasir Gudang Port	6	18.30	----	———	———	———	———	44,864
b) Construction of 8 Grade-Separated Interchanges			----	———	———	———	———	45,556
2. Long – Term Causeway Traffic Dispersal Scheme	–	4.37	---- ····	———	———			26,880
3. Inner Ring Road including Lorry Route								
a) Inner Ring Road with Lorry Route section between Jalan Yahya Awal and Jalan Tebrau	4 & 6	1.46	----	····	———	———	———	38,741
b) Widening of Inner Ring Road with Lorry Route section between Jalan Tebrau and Jalan Bukit Meldrum/ Lorry Custom Complex	6	2.44	····	———	———	———	———	11,287
Investment Requirements for Phase 2	Annual cost ($'000)		13,105	45,447	44,515	42,154	22,107	167,328
	Share in Total (%)		7.8	27.2	26.6	25.2	13.2	100%
	Achievement (%)		7.8	35.0	61.6	86.8	100	—

Notes: Same as Table 3

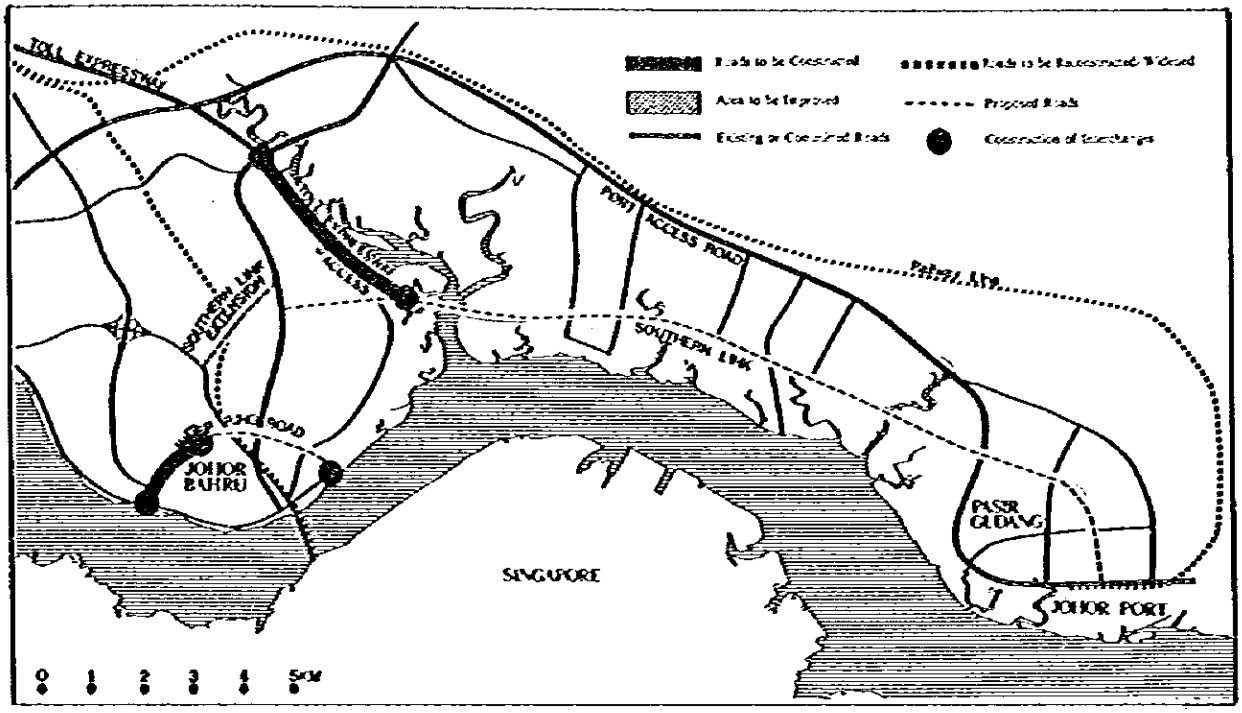


FIG. 16. RECOMMENDED IMPLEMENTATION PROGRAM PHASE III (1996 — 2000)

TABLE 5. INVESTMENT PROGRAM FOR PHASE III

	Number of Lane	Total Length (km)	Year 1996	1997	1998	1999	2000	Project Cost (M$'000)
1. Toll Expressway Access	4	3.99	---	•••	———	———	———	50,918
2. Inner Ring Road, section between Jalan Abu Bakar and Jalan Yahya Awal	4	1.60	---	•••	———	———	———	25,420
Investment Requirements for Phase 3	Annual Cost ($'000)		1,890	13,345	18,395	24,441	18,267	76,338
	Share in Total (%)		2.5	17.5	24.1	32.0	23.9	100%
	Achievement (%)		2.5	20.0	44.1	76.1	100	—

Notes: Same as Table 3

JB-TRANSPLAN

THE FEASIBILITY STUDY ON ROAD CONSTRUCTION AND IMPROVEMENT PROJECT IN JOHOR BAHRU AND ITS CONURBATION

SUMMARY AND MAJOR FINDINGS

INTRODUCTION

i) Background

Since gaining independence in 1957, Malaysia has achieved much, both economically and socially. The goal of urban and regional development policies has been the creation of an environment conducive to well-balanced development. To this end, a rural development program, urban restructuring and modernization are receiving equal attention.

Problems that accompany rapid urbanization are manifest in the capital city of Kuala Lumpur, and similar problems are observable in regional centres: Penang to the north and Johor Bahru to the south. There is an effort being made to develop the East Coast of Peninsular Malaysia and Penang and Johor Bahru, with their large growth potentials, ought to play a major role in promoting regional development. The rapid population increase and centralization of economic activities in Kuala Lumpur have become a matter of concern particularly to national planners. There is an urgent need to control the continuing expansion of Kuala Lumpur while channeling growth to Penang and Johor Bahru.

Johor Bahru is rapidly becoming a large urban centre that might possibly overtake Penang according to its population and economic trends. In order to guide this rapid growth and urbanization, the Johor Bahru Structure Plan was formulated to ensure the provision of adequate basic urban infrastructures and to promote systematic development control. The Johor Bahru Transport Master Plan and the Feasibility Study are intended to further the implementation of the Structure Plan.

ii) Study Objectives

The objective of this study is to suggest an effective transport system and to examine the feasibility of constructing various transport facilities for the Johor Bahru Conurbation by the year 2000. The project packages recommended in the Johor Bahru Transport Master Plan are examined for their economic feasibility and implementation priority.

Hence this study will:

1) re-examine and ascertain the continued existence of relevant planning conditions as suggested in the Transport Master Plan;
2) draw up preliminary technical plans for the projects in accordance with project priorities;
3) propose an implementation program based on the results of the economic analysis and socio-environmental studies of the projects.

iii) Study Approach

There are two parts to the overall study: a Comprehensive Transport Master Plan Study and a follow-up Feasibility Study (see Fig. i).

The Master Plan Study includes;

1) data collection and surveys of existing conditions;
2) analysis of existing conditions and future projections;
3) identification of transport and environmental problems;
4) development and planning proposals.

The follow-up Feasibility Study includes:

1) reexamination of planning conditions as suggested in the Master Plan;
2) additional surveys and investigations necessary for detailed planning;
3) technical and planning studies for each project package;
4) project cost/benefit analysis and project evaluation for implementation.

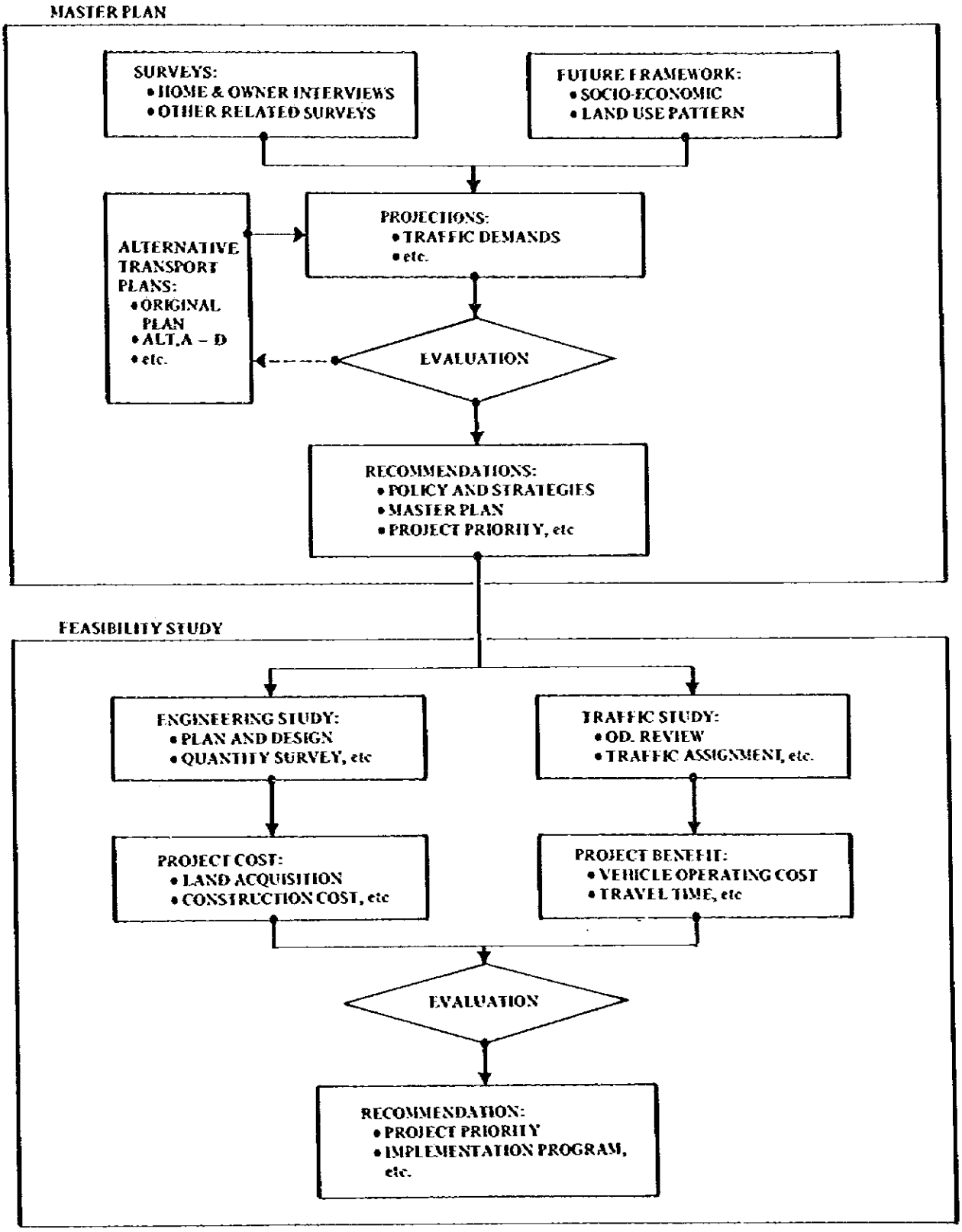


FIG. 1 GENERAL PLANNING PROCESS

iv) STUDY ORGANIZATION

The project was carried out jointly by the Government of Malaysia and JICA in coordination with other agencies. The organizations involved in the project are shown in the chart below (see Fig. ii).

A list of Malaysian and Japanese Government officials concerned and Study Team members is attached in Appendix 1.

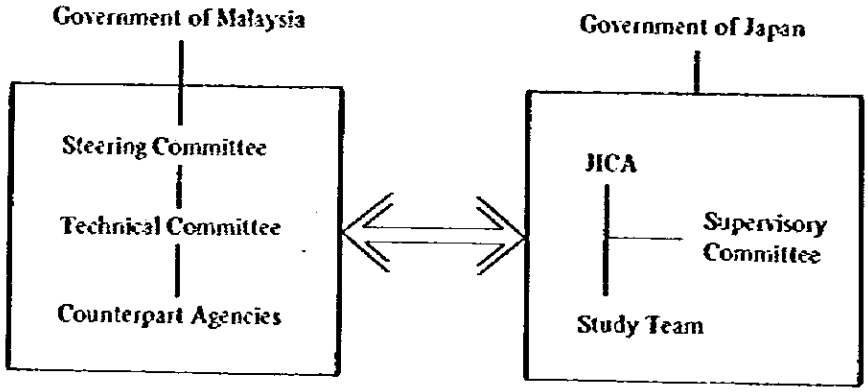


FIG. ii. STUDY ORGANIZATION

PART I
MASTER PLAN

1. PREAMBLE

There were two stages in the Urban Transport Master Plan Study process (see Fig. I-1).

Stage 1 involved the formulation of the future development framework — fore-casting among other things socio-economic requirements, future land use patterns and future traffic demand.

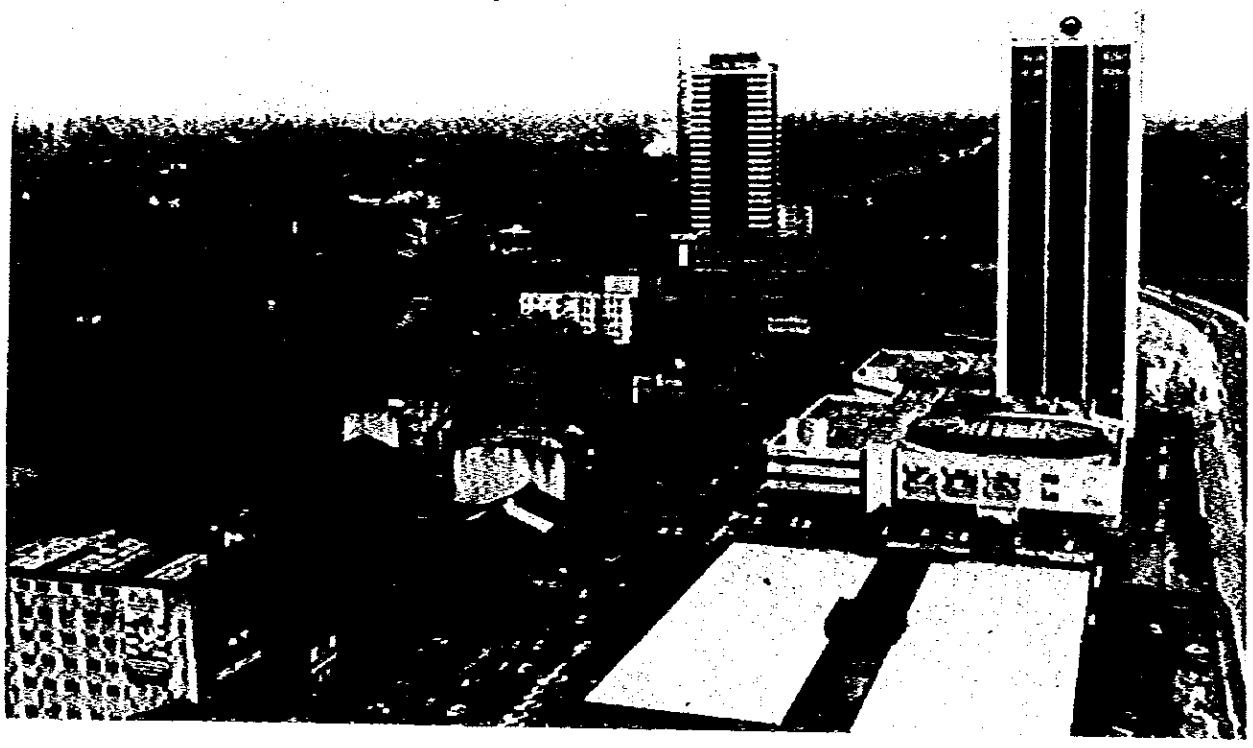
Stage 2 involved the formulation of the future transport master plan and recommendations — a transport policy and strategy for the year 2000, a network concept and plan, a public transport plan and other transport plans, and a phasing and implementation program.

The Master Plan study included 4 major surveys:

1. a vehicle owner interview survey;
2. a home interview survey;
3. a cordonline interview survey;
4. a screenline traffic count survey.

The findings and recommendations of the master plan study point to three basic requirements that must be met:

1. a need to develop a comprehensive transport system between Johor Bahru Town and the new urban area of Pasir Gudang in order to promote the future formation of an urban corridor there;
2. a need to develop new transport facilities and other infrastructures that will control and guide the urbanization pattern of the region;
3. a need to modernize central urban activities in the CBD and to redevelop the transport network system in order to promote the building of a new urban center for the future.



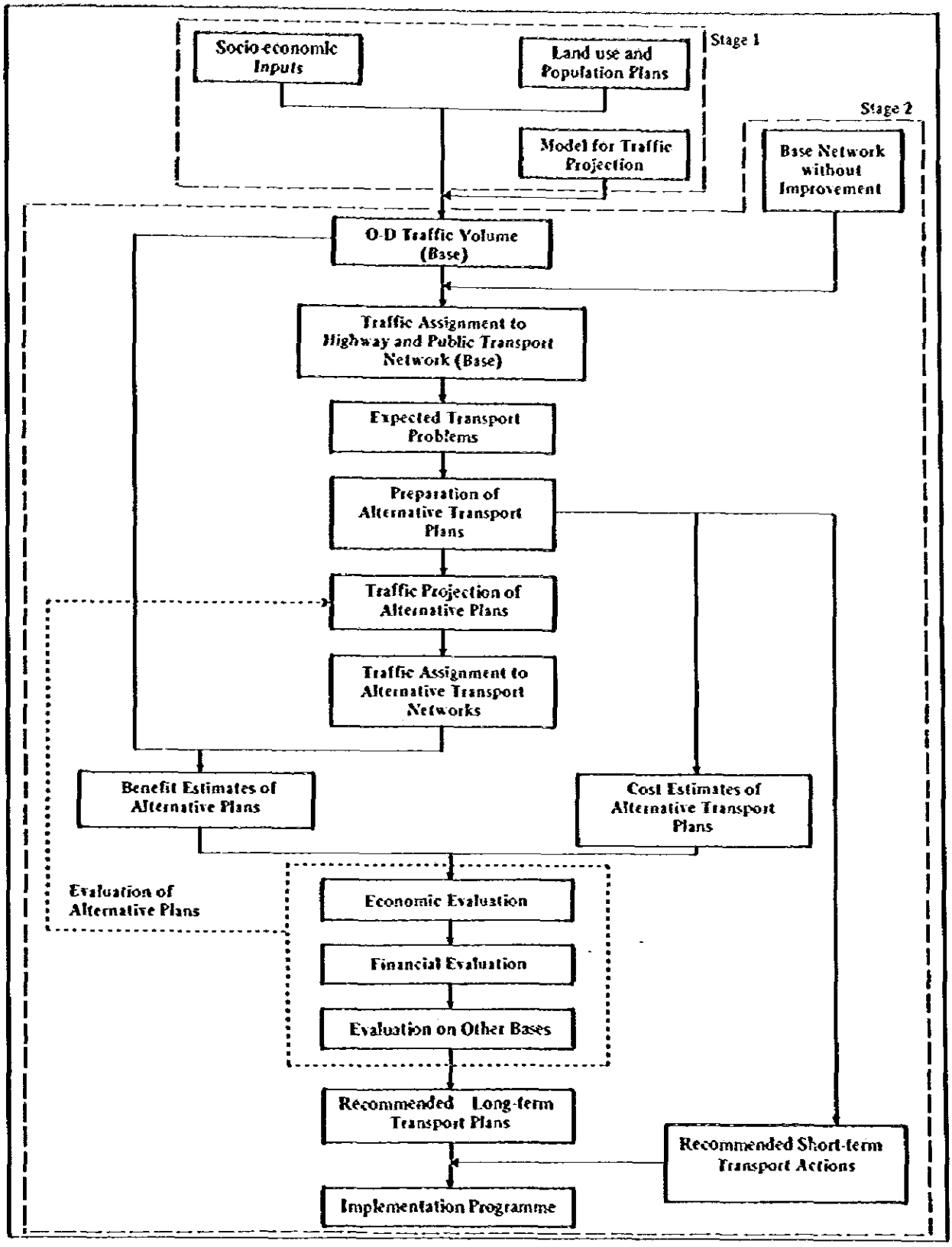


FIG. 1-1. MASTER PLAN PLANNING PROCESS

2. PRESENT CONDITION AND FUTURE PERSPECTIVES

2-1 Socio-economic Framework

This study is based on the expectation that Johor Bahru and its conurbation will be the most developed urban center and nucleus of growth in southern Peninsular Malaysia.

1) By the 1990's Johor Bahru with its conurbation is expected to become the second largest metropolis in Malaysia. By the year 2000, the size of the population in the Johor Bahru region will almost equal that of Kuala Lumpur in 1980.

   Within the Study Area, the projected annual population growth rate is 4.0 per cent from 1980 to the year 2000, which means that the population is expected to increase from 0.62 million in 1980 to 1.35 million in the year 2000 (see Table I-1).

2) The Gross Regional Product in Johor State to grow at an annual rate of 8.0 per cent from 1980 to the year 2000. In terms of value, it is estimated that the Gross Regional Product will thereby expand from M$2,941 million in 1980 to M$6,469 million in 1990 and M$13,687 million in the year 2000 (see Fig. I-2).

3) The projected annual growth rate of employment in the Study Area is 4.6 per cent from 1980 to the year 2000, with employment expected to increase from 219,000 to 533,000 in that interval (see Fig. I-3).

4) The average monthly household income in Johor State is expected to increase from M$766 in 1980 to M$1,876 in the year 2000, and hence, based on 1981 prices, the average annual growth rate of real income will be 4.6 per cent (see Fig. I-4).

5) Based on the projection of household income, the number of vehicles in the primary area is expected to increase from 88,000 in 1980 to 273,000 in the year 2000 (see Fig. I-5).

TABLE I-1. PRESENT AND PROJECTED POPULATION IN THE STUDY AREA

Area	Year	1980 (1) (x 1000)	1990 (x 1000)	2000 (x 1000)
Primary Area	Johor Bahru	417	655	1,000 (2)
	Kota Tinggi	42	53	67
	Total	459	708	1,067
Secondary Area		161	221	283
Study Area – Total		620	929	1,350

Source: Study Team Estimates
(1) 1980 Population Census
(2) Target Population made in the Structure Plan Study

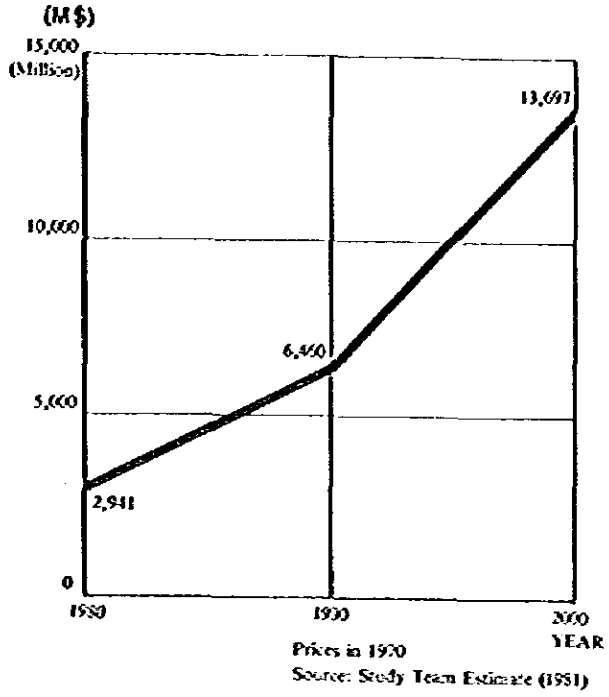


FIG. I-2. GROSS REGIONAL PRODUCT IN JOHOR STATE

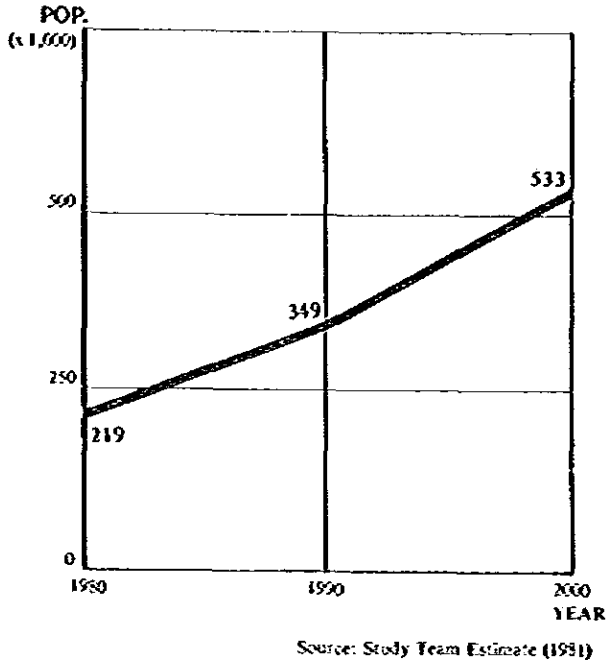


FIG. I-3. EMPLOYMENT NEEDS IN THE STUDY AREA

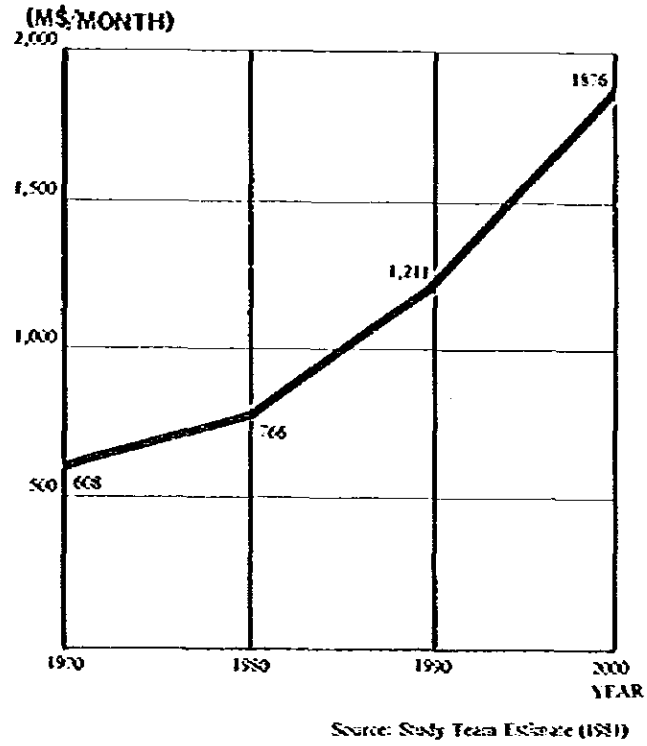


FIG. I-4. HOUSEHOLD INCOME TREND (JOHOR STATE)

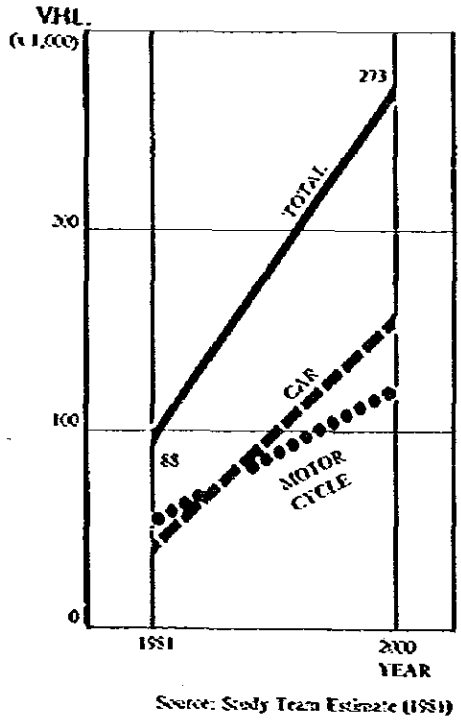


FIG. I-5. PROJECTED NUMBER OF CARS AND MOTORCYCLES (PRIMARY AREA)

2-2 Development Pattern

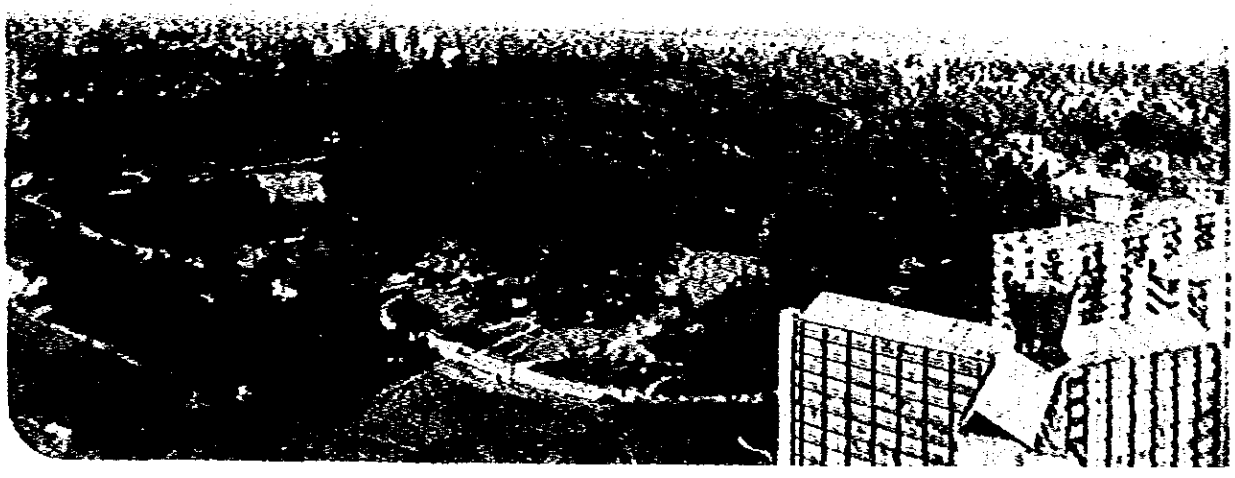
A simultaneous and balanced development of the whole Johor Bahru Metropolitan area appears to be the most likely future development pattern. This is in keeping with the government policy of promoting not only urban growth but rural development as well, especially in the eastern region (see Table I-2).

Metropolitan Johor Bahru is expected to be a major nucleus of growth in the southern part of Peninsular Malaysia, functioning both as a state capital and a dynamic regional, commercial and business center. This implies that a regional network should be established radiating from Johor Bahru to Batu Pahat, Melaka, Kuala Lumpur, Kota Tinggi and the nearby eastern region where the Desaru Recreational Resort is under development.

TABLE I-2. FUTURE LAND-USE PROJECTION

Land Use \ Year	1980(1)	1990	2000
Urban Land (KM^2)	155.7	211.1	265.9
Agricultural Land (KM^2)	2,802.7	2,838.5	2,874.1
Other Land Use (KM^2)	1,749.2	1,658.0	1,567.6
Total Area (2) (KM^2)	4,707.6	4,707.6	4,707.6

Source: Study Team Estimates
(1) Existing Land Use Adjusted by the Study Team
(2) Study Area including Primary and Secondary areas



2-3 Projection of Traffic Demand

With the anticipated rapid growth of population, economic activities and car ownership, the number of trips is expected to increase very rapidly from 462,000 pcu in 1981 to 775,000 pcu in 1990 and 1,425,000 pcu in the year 2000 (see Table I-3).

Future traffic demand is expected to be concentrated in the Johor Metropolitan center and along certain growth corridors, in particular the Johor Bahru - Pasir Gudang corridor (see Fig. I-6).

TABLE I-3. PRESENT AND PROJECTED TRAFFIC VOLUME (1981, 1990 AND 2000)

	1981[1]	1990[2]	2000[2]	Average Annual Growth Rate (%)
Motor Car				
To Work	67,300	104,700	171,200	5.0
Business	26,600	49,600	99,200	7.2
Private	48,900	90,700	180,200	7.1
To Home	89,400	166,600	332,800	7.2
Sub-Total	232,200	411,600	783,400	6.6
Lorry	103,500	197,400	383,900	6.9
Motorcycle	112,000	166,100	257,400	4.5
Total	462,000	775,100	1,424,700	6.1

Note: *1 Excluding Schedule Buses

Source: (1) Origin and Destination Survey in 1981
(2) Study Team Estimate

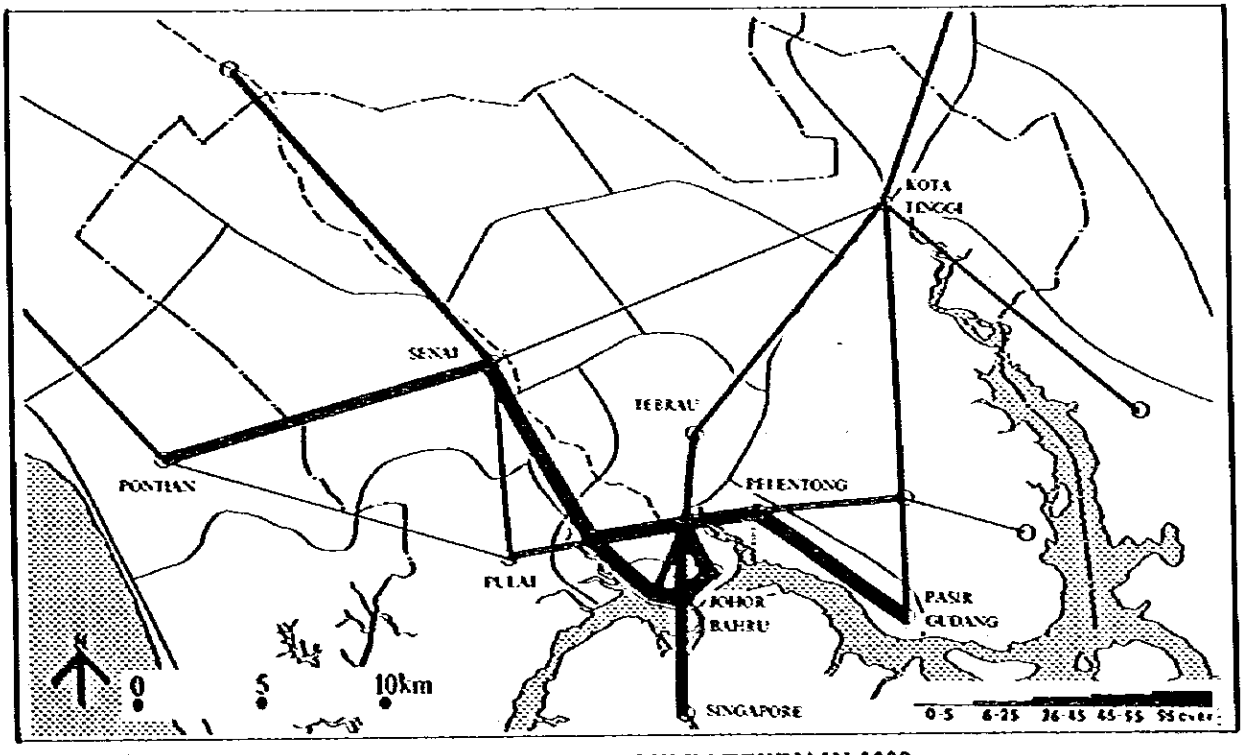


FIG. I-6. TRAFFIC VOLUME PATTERN IN 2000

3 RECOMMENDED TRANSPORT POLICY

3-1 Policy and Strategies

In planning a better urban transport system, the following set of objectives must be kept in mind:

1. maximizing benefits to the urban economy;
2. ensuring the mobility of residents;
3. minimizing resource consumption;
4. providing a safer means of transport;
5. creating and maintaining a high quality of urban environment;
6. maintaining social equity by providing transportation for the urban poor.

The major difficulty hindering the attainment of these objectives in Johor Bahru and its conurbation is the inability of the present transport system to cope with the rapid increase in transport demand resulting from the intensive economic development of the area and the inevitably great alteration of traffic conditions to be brought on by the completion of the Toll Expressway.

The following package of transport strategies is recommended:

1. effective use of existing transport facilities;
2. improvement and expansion of the bus transport system;
3. introduction of innovational bus/public transport system;
4. traffic restraints;
5. traffic engineering and management;
6. road improvement and construction;
7. expansion of monitoring system.

These strategies differ not only in their priority but also in their implementation periods — while some are long-term plans, others are short-term actions. The recommended timing of these transport strategies is shown in Table I-4.

TABLE I-4. TIMING OF IMPLEMENTATION FOR EACH STRATEGY

	Short-term Actions	Long-term Plan
1. Effective use of existing transport facilities	●	●
2 Improvement and expansion of bus transport system	●	●
3 Introduction of innovational bus/public transport system	•	●
4 Traffic restraint measures	•	●
5 Traffic engineering and management	●	•
6 Construction and Improvement of roads	●	●
7 Monitoring system	●	●

● High priority
• Medium priority
• Low priority

3-2 Road Network Concept

To be effective, the future road network must achieve the identified objectives within the framework of future land-use structure, traffic demand and economic growth. The network planned for the Johor Bahru–Pasir Gudang corridor is in essence a combined radial and grid pattern with an East-West spine along the urban corridor (see Fig. I-7).

3-3 Traffic Dispersal and Circulation Concept in The Central Area

Peninsular Malaysia. There is a large volume of regional through traffic in addition to the subregional and intra-urban traffic. Lorries and passenger cars bound for Singapore inevitably have to pass through Johor Bahru for custome and immigration clearance. To avoid disturbing the traffic flow in the CBD of Johor Bahru, a traffic dispersal scheme is deemed necessary (see Fig. I-8). This would involve the introduction of an exclusive bus lane system, parking control and the design of a traffic circulation system.

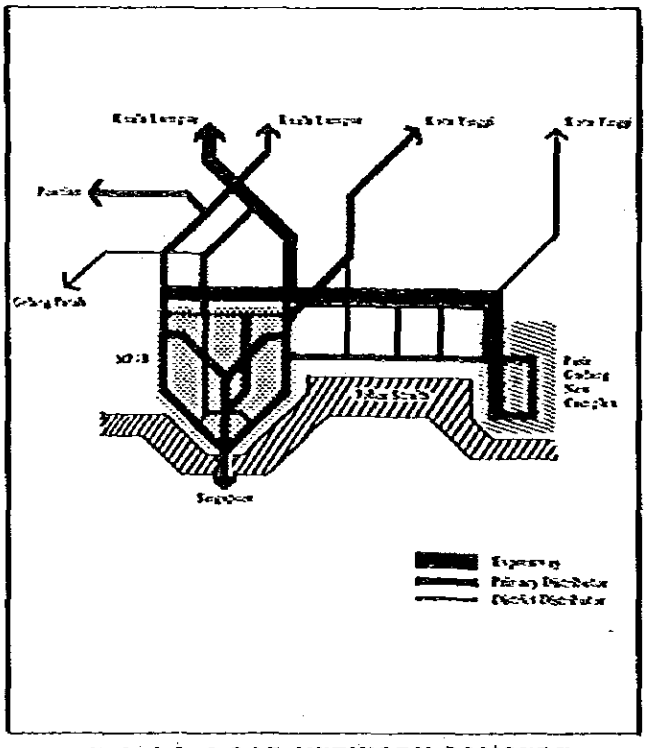


FIG. I-7. ROAD NETWORK CONCEPT IN JOHOR BAHRU—PASIR GUDANG URBAN CORRIDOR

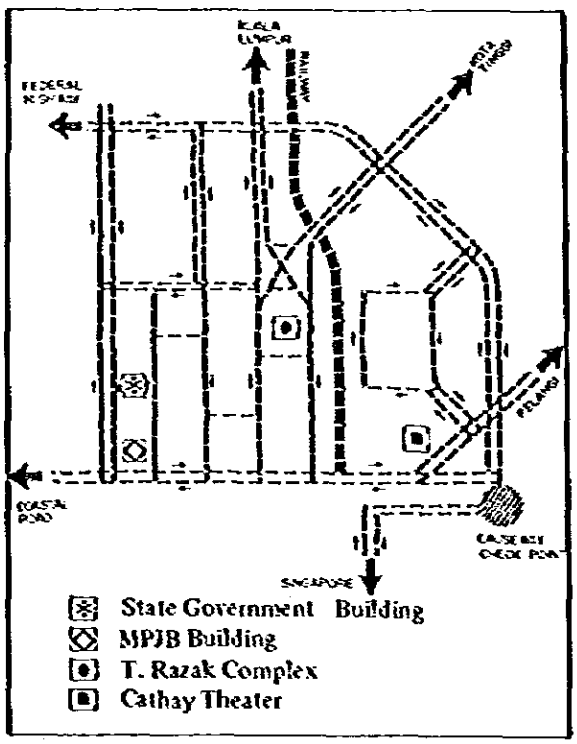


FIG. I-8. TRAFFIC CIRCULATION SYSTEM IN CBD

4 TRANSPORT MASTER PLAN

4-1 Road Construction and Improvement

The recommended plan seeks to make full use of the existing road system to form an adequate road system capable of serving the predicted traffic demands. This is to be accomplished by:

1. construction of new roads;
2. improvement of existing road; (see Fig. I-9)
3. development of grade-separated interchanges and improvement of intersections.

Table I-5, and Figs. I-10, 11 show the roads to be improved or constructed by the year 2000 to meet future traffic demands.

TABLE I-5. RECOMMENDED ROAD PLAN 2000

	Number of Project	Total Length of Project (km)
1 Improvement of Existing Roads	30	210.2
2 Construction of New Roads		136.4
3 Grade-separated Interchanges	19	–
4 Improvement of Intersections	4	–

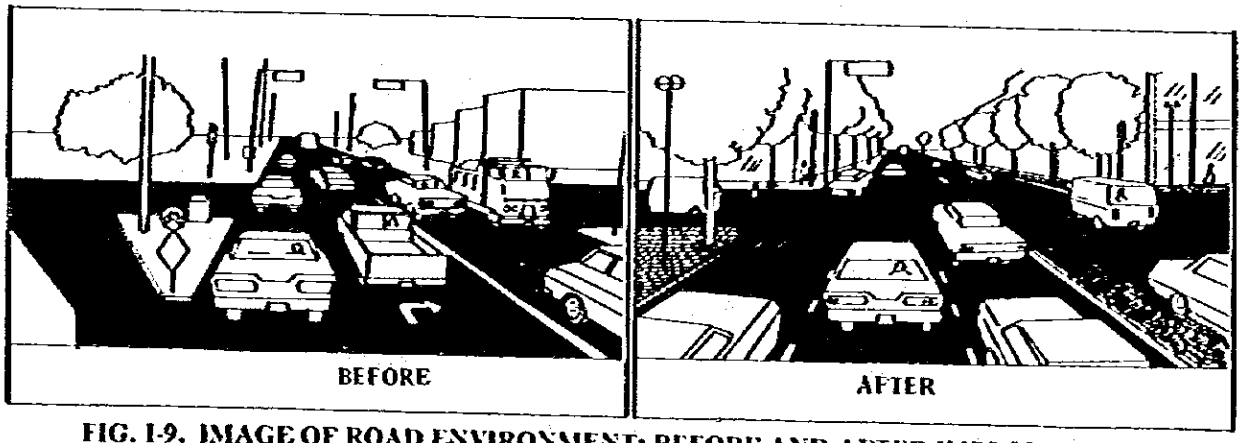


FIG. I-9. IMAGE OF ROAD ENVIRONMENT; BEFORE AND AFTER IMPROVEMENT

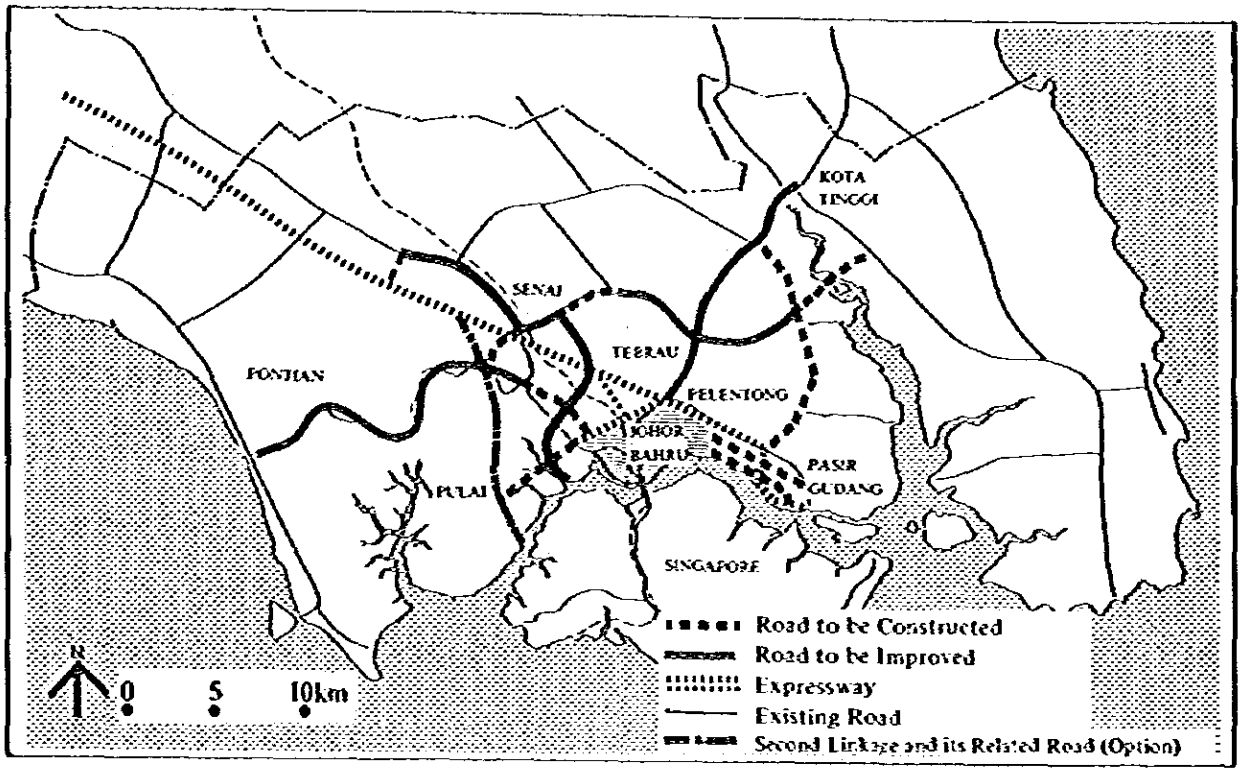


FIG. I-10. RECOMMENDED ROAD NETWORK (STUDY AREA)

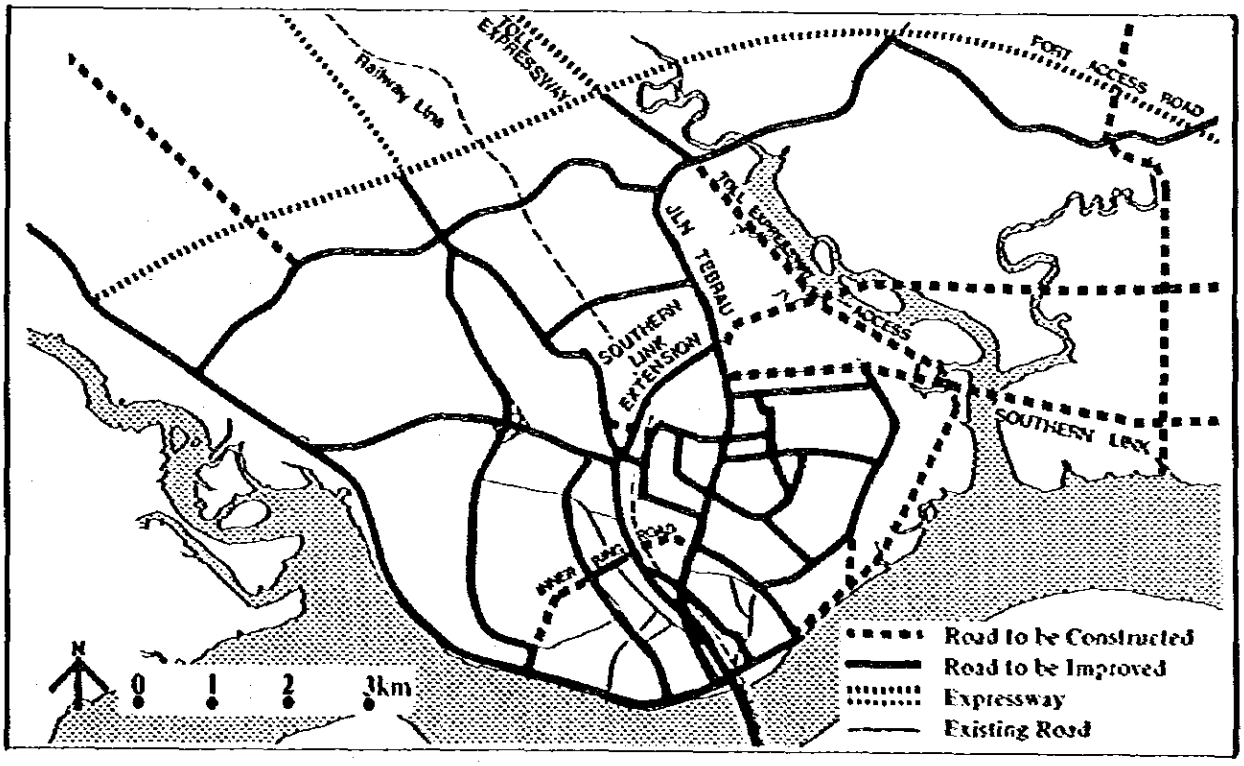


FIG. I-11. RECOMMENDED ROAD NETWORK (MPJB)

4-2 Public Transport Development Plan

The public transport system should be improved and developed in line with the overall transport strategies.

1. Exclusive bus lanes should be introduced on the following roads:
   — Jalan Tebrau
   — Johor Bahru–Pasir Gudang Southern Link (see Fig. I-12).
2. Bus transport services should be improved in the following ways:
   a. reorganization of routes and schedules;
   b. provision of appropriate bus stops and stands;
   c. renovation of and additions to existing bus fleets.
3. An innovative transit system should be introduced between the CBD in Johor Bahru and Pasir Gudang.
4. From the point of view of quality of service and transport economy, a long distance line-haul system should be provided by a scheduled bus system while the mini-bus should be introduced to the routes between regional towns and low-density area; i.e. Kulai, Kota Tinggi and Ulu Tiram based routes.

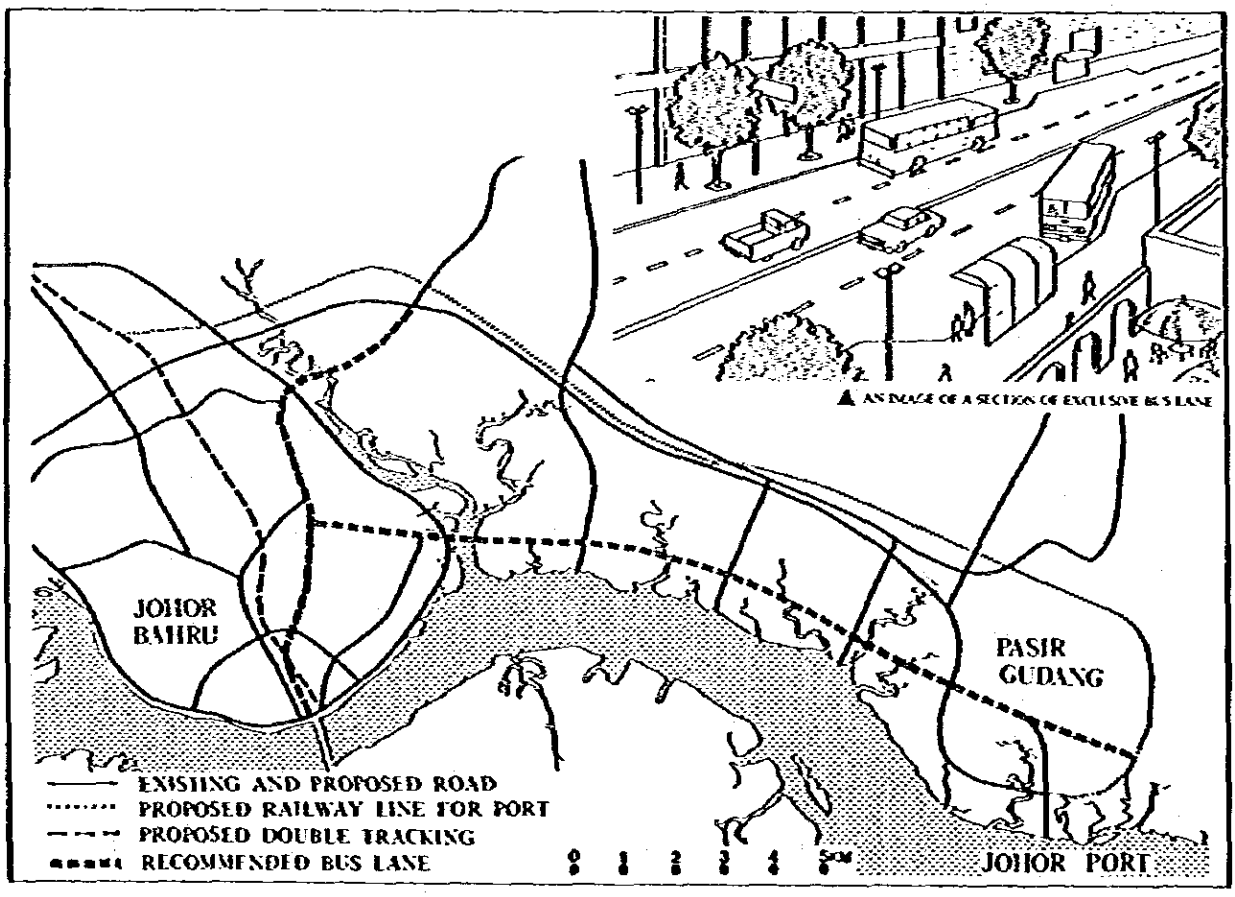


FIG. I-12. RECOMMENDED BUS LANE TO BE INTRODUCED

5. The future demand for railway commuter services will not be sufficient to make double tracking financially viable. However, if the Malayan Railway is to undertake double tracking as a part of a system of nationwide double tracking, commuter services between Johor Bahru and Senai/Kulai should be introduced.
6. Passenger and freight demands for a railway extension to Senai Airport is expected to increase in the future. Therefore, a railway extension from Senai to Senai Airport should be considered within the framework of national development strategies.

The results of careful economic and financial analysis show that the introduction of a new transit system between Johor Bahru and Pasir Gudang is viable. However, this system will be needed after 1995 when the Johor Bahru - Pasir Gudang Corridor will have become highly developed. Therefore, this issue should be re-examined through the monitoring of the increasing traffic volume on roads and the increasing number of residents to be settled in the Johor Bahru - Pasir Gudang Corridor. It is also suggested that land be reserved in this corridor for the eventual introduction of this system (see Fig. I-13).

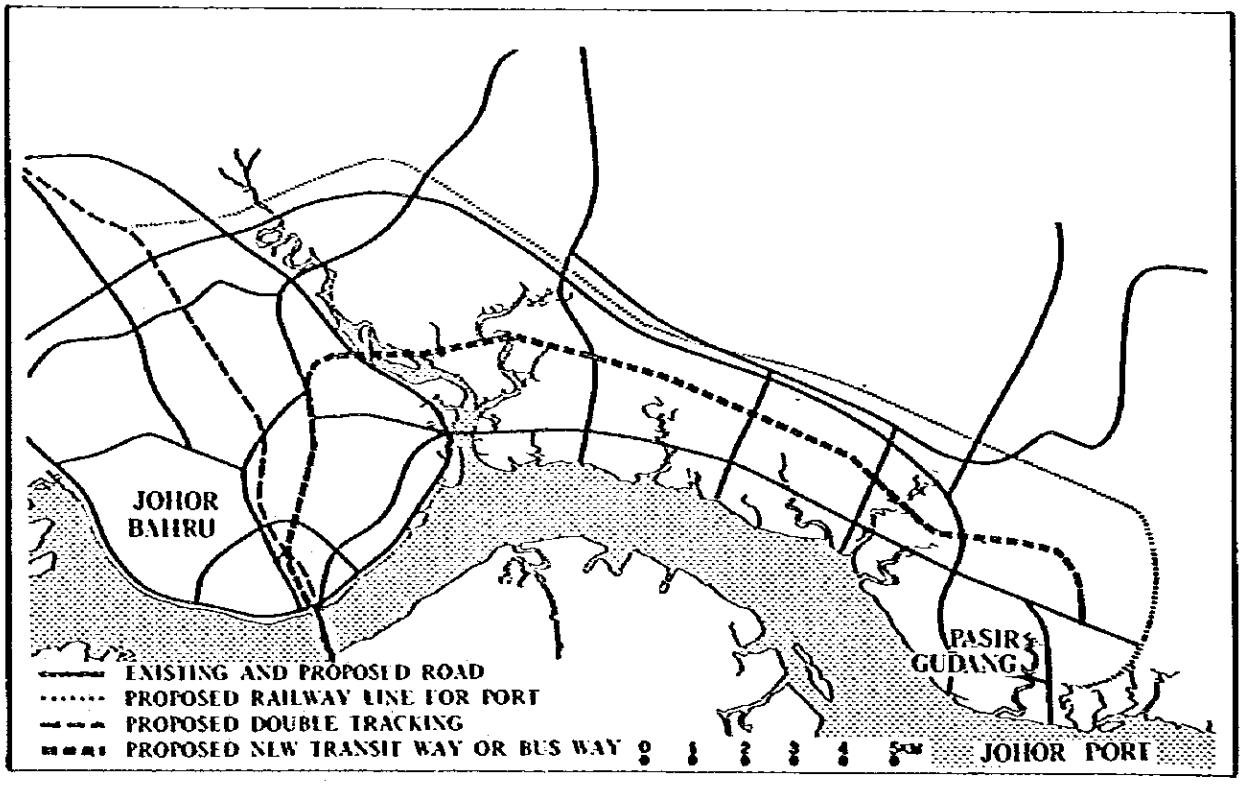


FIG. I-13. LONG-TERM PUBLIC TRANSPORT PLAN

4-3 Transport Terminal Plan

Two types of transport terminals are proposed in the Terminal Plan. Their locations are shown in Fig. I-14.

A. FREIGHT TERMINAL

The major function of a freight terminal is to effect the transfer of goods from one transport mode to another, for example from railway to roadway or from inter-city lorry to intra-city lorry, so as to improve transport efficiency.

The location of the proposed terminal is the Kempas Site, which has an easy access to MPJB and Pasir Gudang via either the trunk roads such as the Toll Expressway and the Port Access or the railway lines.

B. PASSENGER TERMINAL

The main purpose of a passenger terminal is to connect various transport modes in various directions for the passengers' convenience.

The Tebrau Site which is located on the outskirts of MPJB is recommended for a bus terminal, and the Central Market Area, preferably the existing taxi area in the CBD, is recommended for a passenger terminal complex.

The Study Team reviewed the MPJB urban reconstruction project in the Central Market Area and ascertained that this terminal complex plan is compatible with the MPJB proposal.

The proposed passenger terminal complex can function as a transfer center for intermodal passengers using buses, taxis and railway and also as a shopping complex.

The bus terminal at Tebrau will serve mainly inter-regional and intra-regional buses.

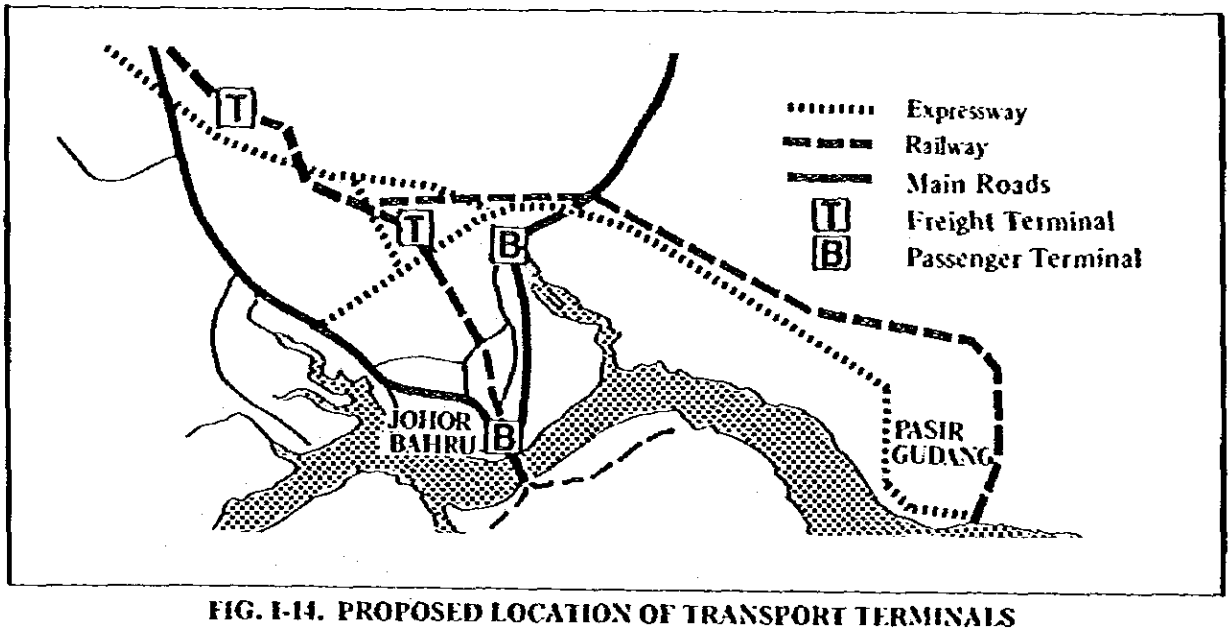


FIG. I-14. PROPOSED LOCATION OF TRANSPORT TERMINALS

4-4 Traffic Management Plan

1. The interim traffic control scheme in the Central Business District (CBD) of MPJB should be implemented at the earliest possible time. The implementation of this control scheme will ensure on effective and smooth traffic flow.

2. In order to ensure an effective and smooth traffic flow, the interim circulation road system in some areas should be established as soon as possible. Based on the circulation plan, the following measures should be implemented:
   a. parking prohibition on primary distributors;
   b. channelization at key intersections;
   c. institution of a one-way system in congested areas.

3. In order to improve the present disorderly traffic caused by mixed traffic, the following measures should be undertaken:
   a. marking of road lane demarcation lines;
   b. separation of lanes by vehicle type, e.g. one for high-speed vehicles and others for motorcycles and bicycles.

4. A traffic signal system is recommended as the most suitable measure for achieving higher traffic capacity on primary distributor roads in peripheral and suburban areas as well as in the CBD (see Fig. I-15).

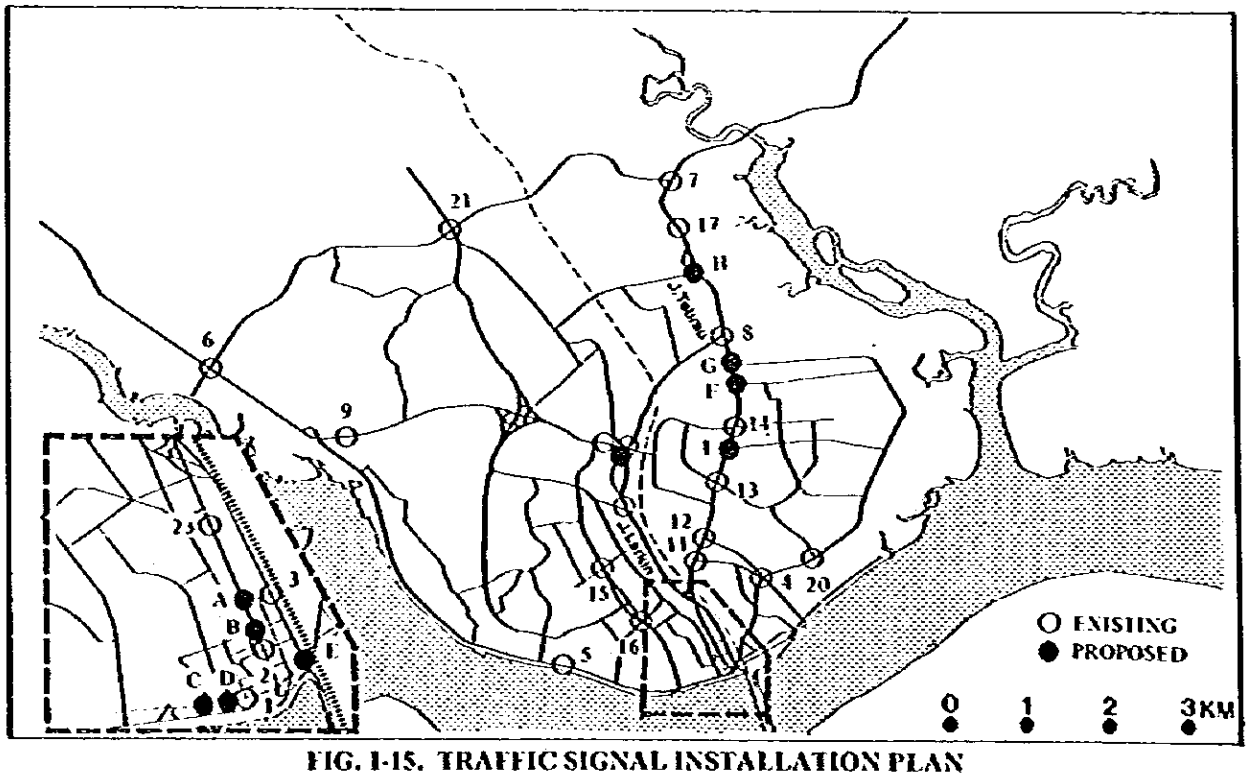


FIG. I-15. TRAFFIC SIGNAL INSTALLATION PLAN

5. In order to improve pedestrian facilities, the following should be installed:
   a. sidewalks;
   b. pedestrian crossings, especially in front of the causeway;
   c. shopping mall;
   d. pedestrian signal lights.

It is suggested that Jalan Wong Ah Fook be opened exclusively to pedestrians as a pedestrian mall even if on a part-time basis (see Fig. I-16).

6. The following traffic facilities should be installed, based on standards.
   a. traffic signs;
   b. lane markings;
   c. traffic signals with improved visibility; the existing traffic signal system should be reviewed.

7. In order to improve the present and future traffic situation in congested as well as newly developed areas, implementation of the following traffic regulatory measures is recommended:
   a. parking prohibition on primary distributor and district distributor roads;
   b. one-way system in congested areas;
   c. adequate traffic signs and marking;
   d. provision of pedestrian facilities.

8. Information boards for roads related to the causeway should be installed at strategic point to improve the information system for causeway traffic which is at present inadequate.

9. In line with the beautification program and implementation of the circulation plan in the CBD, Sungai Segget should be covered in order to accommodate roadway and pedestrian facilities.

10. In order to achieve traffic safety and smooth traffic flow, the following modifications of road facilities should be undertaken:
   a. removal of obstructions on roads in the CBD; i.e. electric poles on Jalan Wong Ah Fook and Jalan Segget;
   b. widening of the roadway at the point where Jalan Tun Abdul Razak and Jalan Tebrau merge.

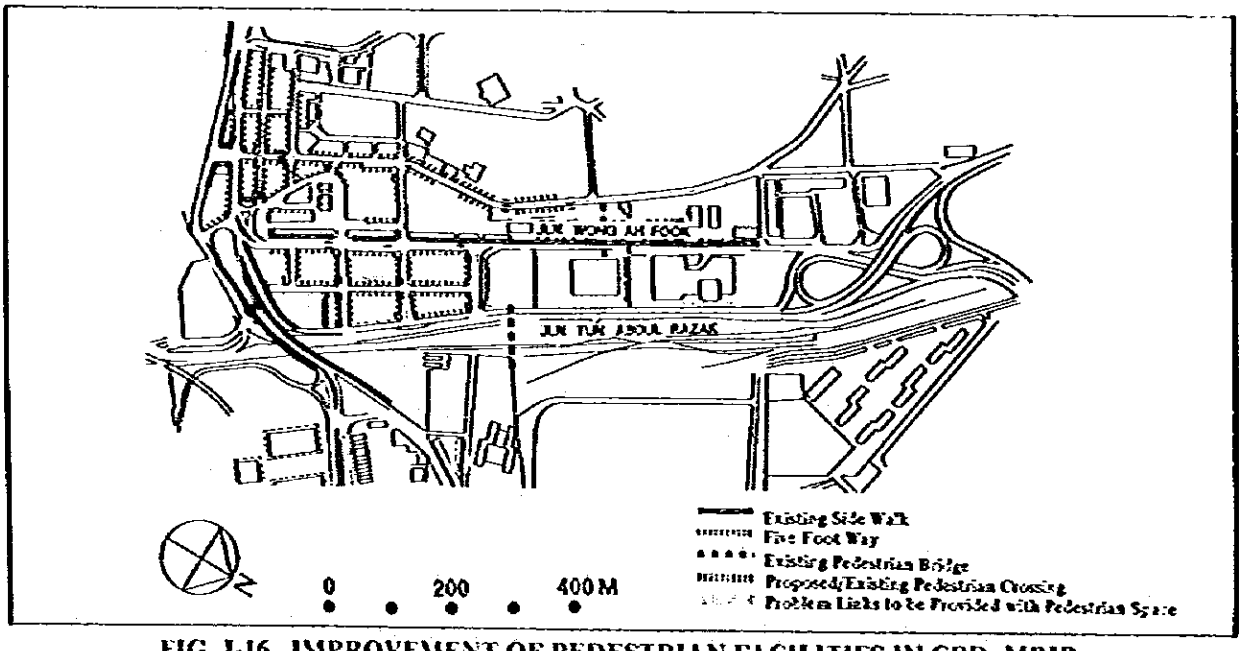


FIG. I-16. IMPROVEMENT OF PEDESTRIAN FACILITIES IN CBD, MPJB

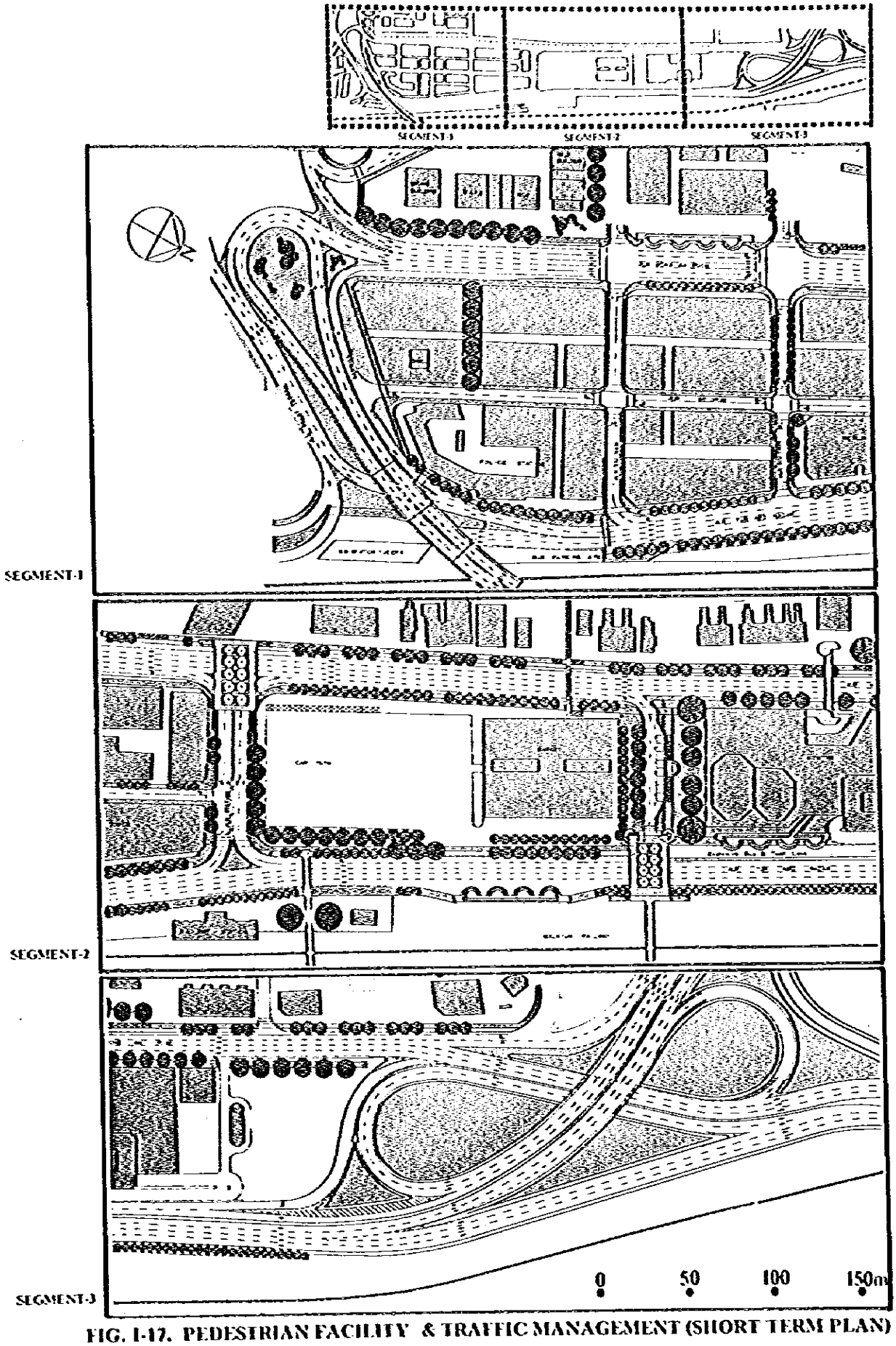


FIG. I-17. PEDESTRIAN FACILITY & TRAFFIC MANAGEMENT (SHORT TERM PLAN)

4-5 Preliminary Causeway Layout Study

The Causeway Renovation Project, which is aimed at reducing traffic congestion at the Johor Entry and Exit Point (JEEP), was formulated by the JEEP Committee and was implemented in October 1983. However, this Renovation Project is expected to meet the traffic demand only until around the year 1987.

The Study Team, therefore, conducted the preliminary causeway layout study on a long-term basis. There are four (4) concepts in the proposed causeway layout plans:

a) Concept A: horizontal expansion.
b) Concept B: second-deck.
c) Concept C: site relocation.
d) Concept D: second linkage.

As the result of a preliminary study of these alternative concepts from the traffic engineering and transport economy points of view; Concept C (site relocation) is found to be better than Concepts A or B. This is because with Concept C the causeway traffic can be dispersed away from the central area of Johor Bahru; the plan based on Concept C is also flexible in its phasing and provides wider spaces for the entry and exit points.

Alternative concept D is to construct a second linkage between Johor Bahru and Singapore at some other point. This too is feasible in terms of traffic engineering and transport economy points of view, but further investigation of its socio-economic, political and environmental implications should be carried out.

On request of the Malaysian Government, the Steering Committee has however finalized that Concept A (horizontal expansion) is to be employed in the Master Plan and Feasibility Study.

5. PROJECT PRIORITY IN THE MASTER PLAN

Based on economic, land-use, traffic and environmental studies, implementation priority should be given to the following plans and projects.

(1) Road Construction and Improvement

a) Widening of Jalan Tebrau into a six (6)-lane road.
b) Construction of Johor Bahru–Pasir Gudang Southern Link, including the widening of Jalan Bakar Batu.
c) Construction of the eastern segment of the Inner Ring Road including the Lorry Route.
d) Construction of the Toll Expressway Access with the East Coastal Road of MPJB.
e) Construction of Senai-Ulu Tiram Road.
f) Upgrading of the East Coast Federal Road between Port Access and Kota Tinggi.
g) Upgrading of Federal Road between Senai and Pontian.

(2) Public Transport Improvement

a) Improvement of bus services.
b) Improvement of bus/taxi transport facility.
c) Fleet improvement.
d) Improvement of fare and pricing policy.
e) Improvement of management and operations.

(3) Urban Transport Terminal

a) Construction of bus terminal and/or integrated passenger terminal.
b) Construction of Lorry Terminal and/or consolidated freight terminal.

(4) Traffic Engineering and Management.

a) Implementation of the Causeway Traffic Dispersal Scheme in the central area of MPJB.
b) Implementation of Circulation Plan in the central area of MPJB.
c) Improvement of pedestrian facility.
d) Improvement of traffic signal system.
e) Construction of off-street parking facilities.
f) Improvement of other traffic management measures.

(5) Causeway Traffic Improvement.

a) Establishment of Long-Term Causeway Plan.

PART II
FEASIBILITY STUDY

1. PREAMBLE

As mentioned in Part I, the Study Team has established a list of high priority transportation projects, namely road construction and improvement, public transport improvement, traffic engineering and management, urban transport terminal and Causeway improvement.

As the Government of Malaysia has agreed with the list, the Study Team has conducted a feasibility study for a package of four (4) listed projects, namely the road construction and improvement projects in Johor Bahru and its conurbation.

The selected projects (hereinafter referred to as "the Project") include the following packages:

a) Johor Bahru – Pasir Gudang Southern Link,
b) Causeway Traffic Dispersal Scheme,
c) Johor Bahru Toll Expressway Access Road,
d) Inner Ring Road including Lorry Route.

The widening of Jalan Tebrau was identified in the Master Plan Study as the most urgent project. Jalan Tebrau was originally proposed as a four (4)-lane dual carriageway by the Public Works Department. However, taking into consideration the large volume of future traffic predicted and the need to improve the quality of the environment along this primary distributor, a six (6)-lane dual carriageway for the section between Tebrau Interchange (Kp 0 km 000 m) and Pandan Bridge (Kp 6 km 770 m) was proposed in the Master Plan Study. The method applied in the feasibility study is illustrated in Fig. II-1.

Subsequent to Steering Committee discussions, it was decided to base the feasibility study on the following premises.

1) Widening of Jalan Tebrau.

The widening of Jalan Tebrau into a six (6)-lane road recommended in the Master Plan Study, is the most urgent and indispensable Johor Bahru project. Consequently, this widening project is expected to be implemented within a few years.

2) Causeway Renovation Plan.

The Causeway Renovation Plan, which is intended to reduce traffic congestion at the entry and exit points, was completed in October, 1983. The Short-Term Causeway Dispersal Scheme will be formulated on the basis of this renovation plan.

3) Long-Term Causeway Plan.

The Long-Term Causeway Layout Plan, formulated by the Study Team, includes four (4) alternative concepts.

a. Concept 'A' — horizontal expansion
b. Concept 'B' — second deck
c. Concept 'C' — site relocation.
d. Concept 'D' — second linkage.

Based on traffic and transport engineering and transport economic studies, Concept 'D' and Concept 'C' were judged superior to the other alternatives. However, the Steering Committee decided to employ Concept 'A' as a premise in the Feasibility Study.

4) Toll Expressway.

The Toll Expressway which connects Johor Bahru and Ayer Hitam is expected to be completed in 1986. It will be a four (4)-lane road with provisions made for expansion to six (6)-lanes.

5) Port Access.

The Port Access is expected to be completed by the year 1984.

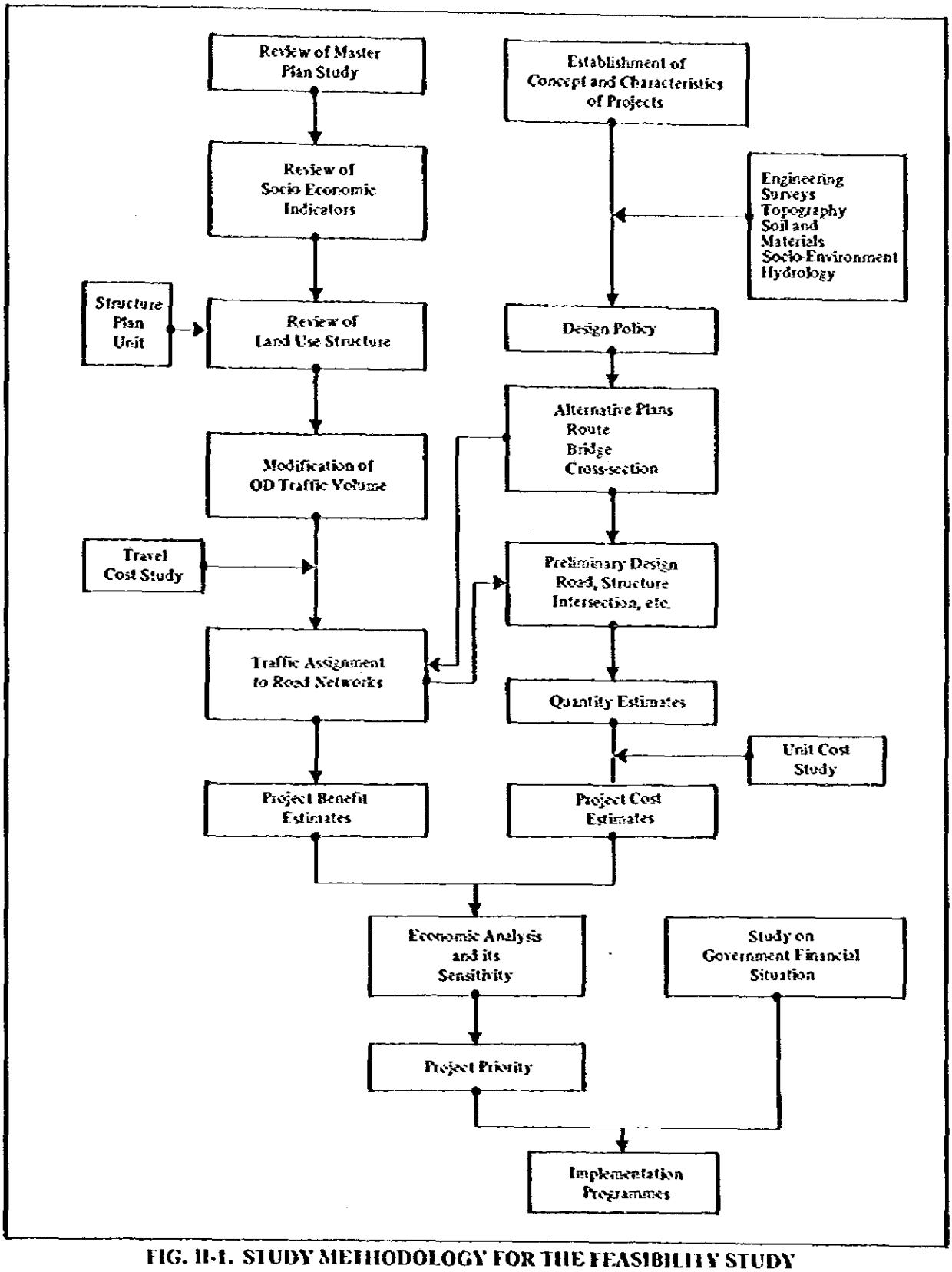


FIG. II-1. STUDY METHODOLOGY FOR THE FEASIBILITY STUDY

2. THE JOHOR BAHRU–PASIR GUDANG SOUTHERN LINK

2-1 Project Characteristics

The Johor Bahru–Pasir Gudang Southern Link as planned in the Master Plan Study is expected to promote on-going and planned development projects alongside the Southern Link, to provide an appropriate communication means between Johor Bahru and Pasir Gudang and to meet present and future traffic demands.

Taking into account the above-mentioned concept, the Southern Link is thus, characterised as an Intra-Urban Primary Distributor.

The Southern Link will be characterized by:

a. partial controlled access;
b. prohibition in principle of at-grade intersections;
c. provision of service roads;
d. prohibition in principle of U-turns;
e. beautiful landscaping.

However, the extension of the Southern Link of Jalan Larkin–Jalan Kebun Teh — can be defined as a District Distributor.

2-2 Alternative Routes

Based on field investigations, topographic and water depth sounding surveys and the socio-environmental survey made along the Project Road, four (4) alternative routes for Section '2' and two (2) alternative routes for Section '3' have been established in this Study.

The alternatives have been evaluated by a comparative analysis of the following factors:

a. topographic condition
b. hydrological condition
c. construction cost
d. impact on housing development
e. flow of traffic

For the Southern Link, it is concluded that Route 'B' for Section'2' and Route 'B' for Section '3' are the most feasible and acceptable (see Fig. II-2).

For the Southern Link Extension, Route 'A' is considered more acceptable and feasible than Route 'B' even though staggered junctions remain at the intersection of Route 'A' with Jalan Tebrau (see Fig. II-3).

FIG. II-3. ALTERNATIVE ROUTES OF SOUTHERN LINK EXTENSION ▶

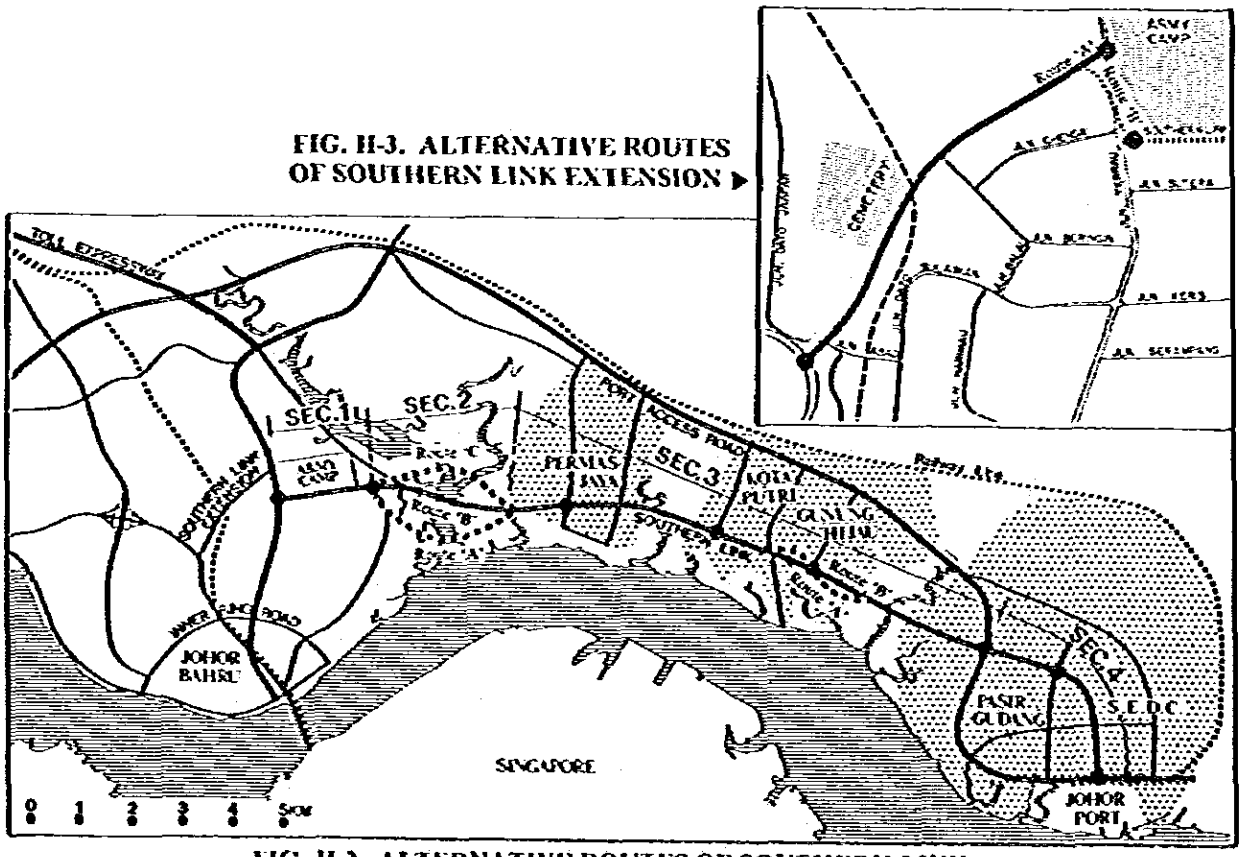


FIG. II-2. ALTERNATIVE ROUTES OF SOUTHERN LINK

2-3 Design Characteristics

(1) Geometric Design Standards

The Malaysian Design Standard, ASSHTO and the Japanese Design Standard are the basis for the design of the Project. The design standards adopted are shown in Table II-1.

(2) Cross-Sectional Design

From the traffic and technical studies undertaken, it is concluded that the carriageway for the Southern Link should be ultimately constructed as a six (6)-lane road with four (4) lanes constructed in the first stage; the carriageway for the Southern Link Extension should be a four (4)-lane road (see Fig. II-4).

II-1. GEOMETRIC DESIGN STANDARDS

	Unit	• Johor Bahru – Pasir Gudang Southern Link	• Southern Link Extension
Design Speed	Km/hr	80	60
Carriage way width	m	3.65	3.25
Median width	m	3.00 – 10.00	2.00
Shoulder width			
Right Shoulder	m	0.50	0.50
Left Shoulder	m	2.00 – 2.50	2.00
Maximum Gradient	%	4	6

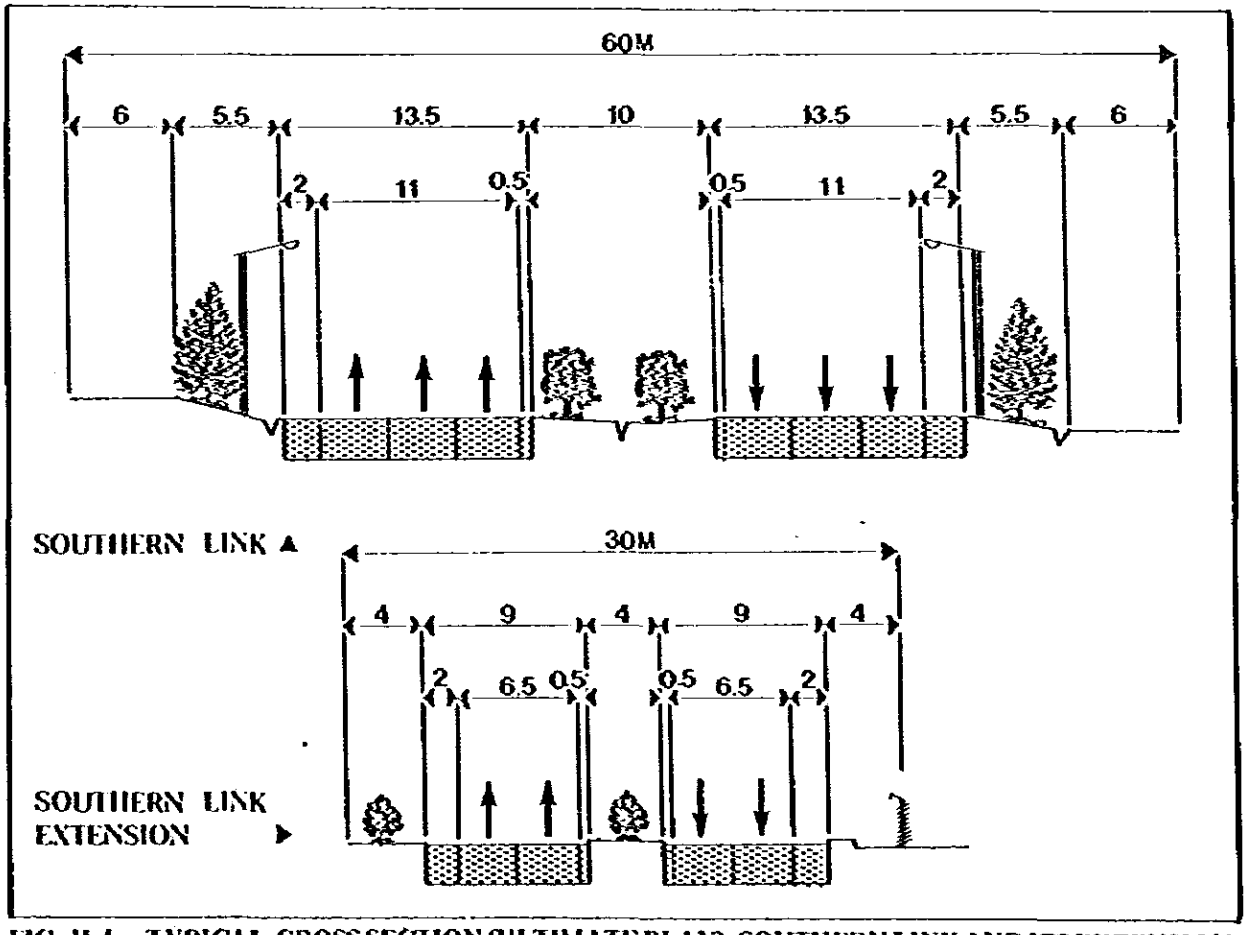


FIG. II-4. TYPICAL CROSS SECTION (ULTIMATE PLAN): SOUTHERN LINK AND ITS EXTENSION

(3) Intersection and Interchange Plan

From the traffic and engineering studies undertaken, it is concluded that eight (8) grade-separated interchanges should be constructed ultimately for the Southern Link and its Extension (see Fig. II-5).

In order to relieve traffic congestion at the intersections of Jalan Kebun Teh with Jalan Larkin and Jalan Datuk Jaafar/Jalan Abad, it is recommended that the intersection improvement plan be implemented as soon as possible.

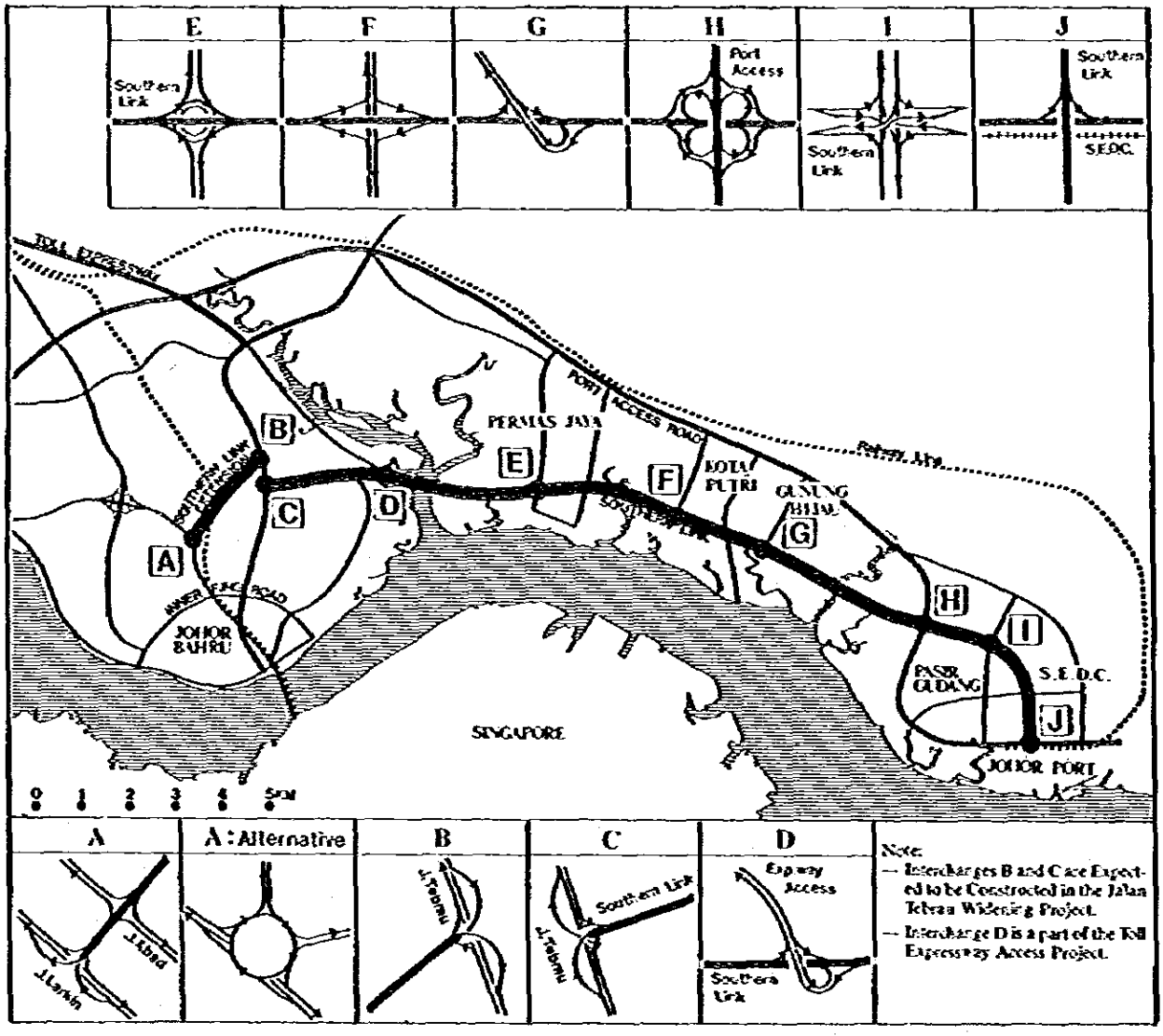


FIG. II-5. INTERCHANGE PLAN ON SOUTHERN LINK AND ITS EXTENSION

(4) Bridge Design

The results of a study of an alternative bridge for Tebrau River show that a precast 3-span continuous box girder bridge with a clearance height of twelve (12) meters is preferable to a low level bridge, due mainly to consideration of navigation for dock repair. The total length of the recommended bridge is 680 meters, of which 60 meters represent the length of the main span.

In addition, the construction of four (4) minor bridges and one (1) minor bridge for the Southern Link and its Extension respectively is recommended (see Fig. II-6).

The standard specifications for bridges and other structures of the Malaysian Design Standard, together with the British Standard and the Japanese Design Standard, are used as the principal guidelines for structural design.

The design live load to be adopted for the design of bridges is used for either the design HA loading or design HA loading combined with the design HB loading of forty-five (45) units.

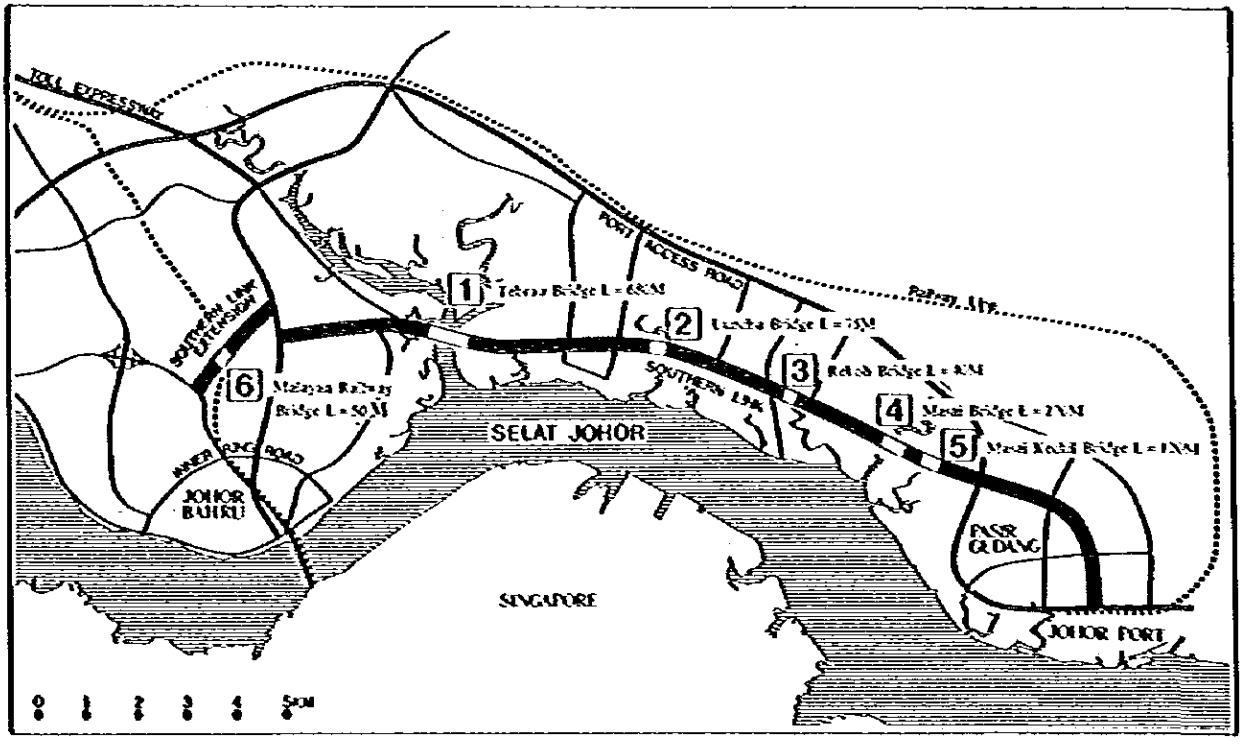


FIG. II-6. BRIDGE PLAN ON SOUTHERN LINK AND ITS EXTENSION

2-4 Project Cost and Economic Analysis

(1) Project Cost

The project cost for the Southern Link as a six (6)-lane road is estimated to be M$178.5 million; as a four (4)-lane road it will cost an estimated M$94.2 million. The project cost for the Southern Link Extension will total M$19.6 million (Table II-2).

(2) Economic Analysis

The economic analysis of the alternative cross-sectional plans is shown in Table II-3.

The economic indicators show that the Four (4)-Lane Plan is economically more feasible than the Six (6)-Lane Plan if this road is opened to traffic in 1989. However, if the opening to traffic is postponed for five (5) years, the economic feasibility of the Six (6)-Lane Plan is greater than the Four (4)-Lane one. Consequently, it is recommended that the Southern Link be constructed as a four (4)-lane road by 1989. The optimum year for expanding the Southern Link from four (4)-lanes to six (6)-lanes is 1994 (see Fig. II-7).

TABLE II-2. SUMMARY OF THE PROJECT COST

(M$'000)

	Plan	Length of Road (km)	Land Acquisition Cost	Construction Cost: Roadway	Construction Cost: Structure	Construction Cost: Sub-Total	Total	In Foreign Currency	In Local Currency
Johor Bahru – Pasir Gudang Southern Link	4 & 6 – Lane	29.47	12,642 (6.1)	78,928 (37.8)	117,097 (54.1)	196,025 (93.9)	208,667 (100.0)	76,650 (36.7)	121,417 (63.3)
Southern Link (ultimate plan)	6 – Lane	15.50	5,931	72,337	100,269	172,606	178,477	71,206	107,271
Southern Link (initial plan)	4 – Lane	14.53	5,931	56,543	31,329	88,252	94,183	36,692	57,591
Southern Link Extension	4 – Lane	2.17	6,188	6,591	6,885	13,479	19,530	5,444	14,165

Notes: 1) Total Project Costs are Calculated Based on the Ultimate Plan.
2) Figures in Brackets are Percentage to the total Project Cost.
3) Figures with * represent partial length.

TABLE II-3. ECONOMIC INDICATORS OF JOHOR BAHRU—PASIR GUDANG SOUTHERN LINK

	Plan 1 4-lane	Plan 2 6-lane
B/C Ratio	3.24	3.08
Net Present Value (M$'000)	187,319	287,185
Internal Rate of Return (%)	32.9	28.2

Notes: 1) Project Life: 20 years
2) Discount Rate: 12%
3) Opening Year: 1989
4) The Southern Link Extension is classified under the Four(4) – Lane Plan.

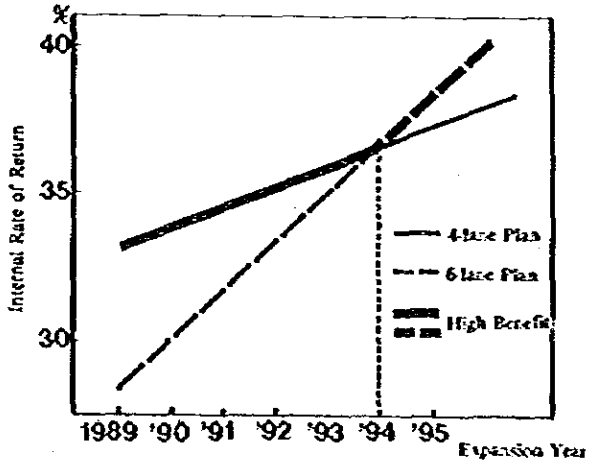


FIG. II-7 OPTIMUM EXPANSION YEAR OF SOUTHERN LINK

3. CAUSEWAY TRAFFIC DISPERSAL SCHEME

3-1 Planning Area

The traffic dispersal scheme proposed here is intended to disperse the Causeway traffic and the central area traffic and to modernize the traffic facilities in the central area of Johor Bahru. The road network considered includes primary and district distributors and major circulating roads within the defined central area — an area flanked by the Inner Ring Road, Jalan Yahya Awal and Jalan Ayer Molek (see Fig. II-8. II-9).

This scheme proposes a Short-Term Action Plan until 1990 and a Long-Term Plan until the year 2000.

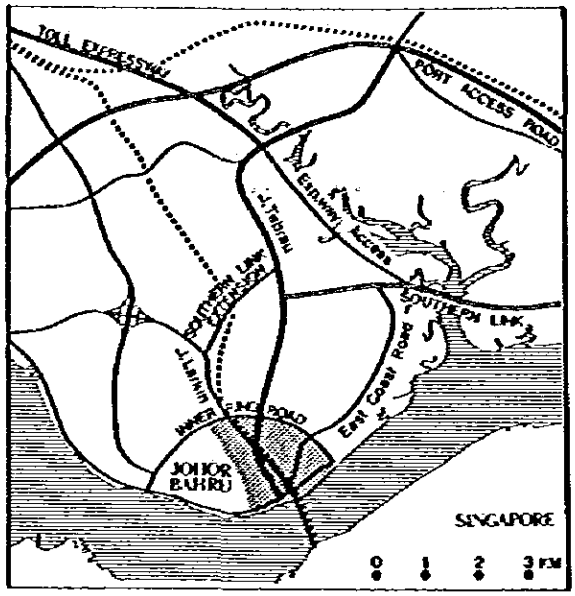


FIG. II-8. PLANNING AREA FOR CAUSEWAY TRAFFIC DISPERSAL SCHEME

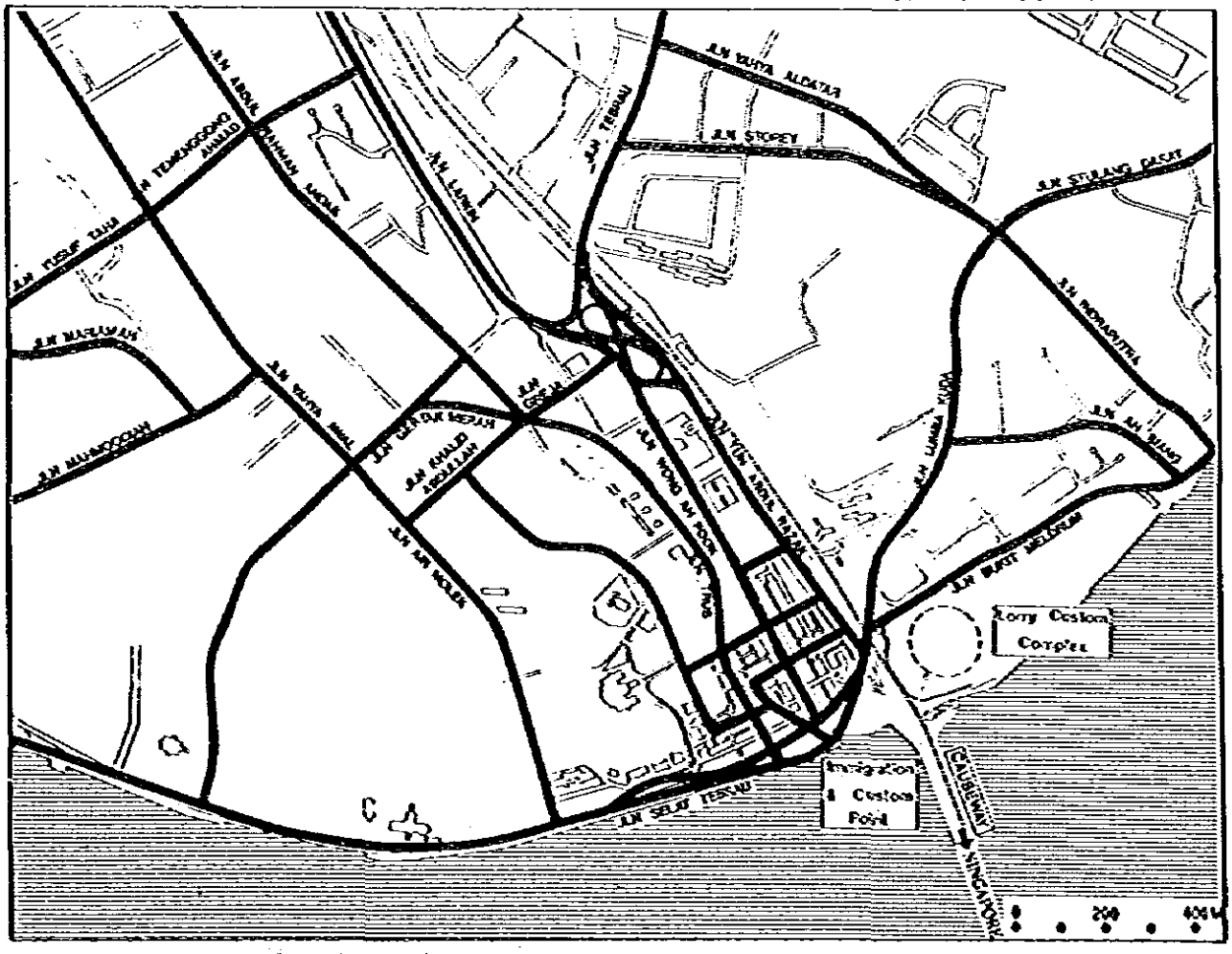


FIG. II-9. ROAD NETWORK FOR CAUSEWAY TRAFFIC DISPERSAL SCHEME

3-2 Traffic Problems

(1) Existing Traffic Problems

The existing traffic problems such as traffic congestion on roads and at intersections, weaving and merging problems and others have been identified in the defined planning area (see Table II-4).

TABLE II-4. EXISTING TRAFFIC PROBLEMS

Categories of Problem	Problem Sections/Intersections
1 Traffic Congestion on Roads	a. Jalan Wong Ah Fook, between Jalan Station and Tebrau Interchange with a congestion degree of 1.27
	b. Jalan Tebrau between Jalan Yahya Aldatar and Jalan Storey with a congestion degree of 1.38
2 Traffic Congestion at Intersections	a. Intersection of Jalan Tun Abdul Razak with Jalan Station
	b. Intersection of Jalan Wong Ah Fook with Jalan Station with a congestion degree of 1.08
	c. Intersection of Jalan Wong Ah Fook with Jalan Segget
3 Weaving Problems	a. Jalan Sekat Tebrau between Causeway Entry Point and Jalan T. Duke.
	b. Jalan Ibrahim between Jalan T. Duke and Jalan Wong Ah Fook
	c. Jalan Sawmill, around the roundabout
	d. Jalan Wong Ah Fook near Tebrau Interchange
	e. Jalan Tebrau between Tebrau Interchange and Jalan Storey
4 Merging Problems	a. Jalan Tun Abdul Razak from Jalan Larkin and Jalan Tebrau.
5 Specific Problems	a. Awaiting vehicles to exit point on Jalan Tun Abdul Razak
	b. Awaiting vehicles to Lorry Custom on Jalan Bukit Meldrum
	c. Adverse effects on Jalan Lumba Kuda and Jalan Ah Siang along the Lorry Route

Notes:
1) Congestion Degree on Roads = Traffic Volume/Road Capacity
2) Congestion Degree on Intersections = Turning Movement of Traffic Volume/Intersection Capacity

(2) Anticipated Aggravation of Traffic Problems in the Future

If specific traffic improvement schemes are not implemented and traffic demand continues to rise, the existing traffic problems that have been identified are certain to become even worse by 1990. The congestion rate on Jalan Wong Ah Fook for example, will reach as high as 1.5 while Jalan Storey, Jalan Lumba Kuda, Jalan Ah Siang and Jalan Trus will have a congestion degree above 1.0. Weaving and merging problems and long queues of vehicles waiting for custom clearance will increase.

These anticipated problems are summarized in Table II-5 and illustrated in Fig. II-10.

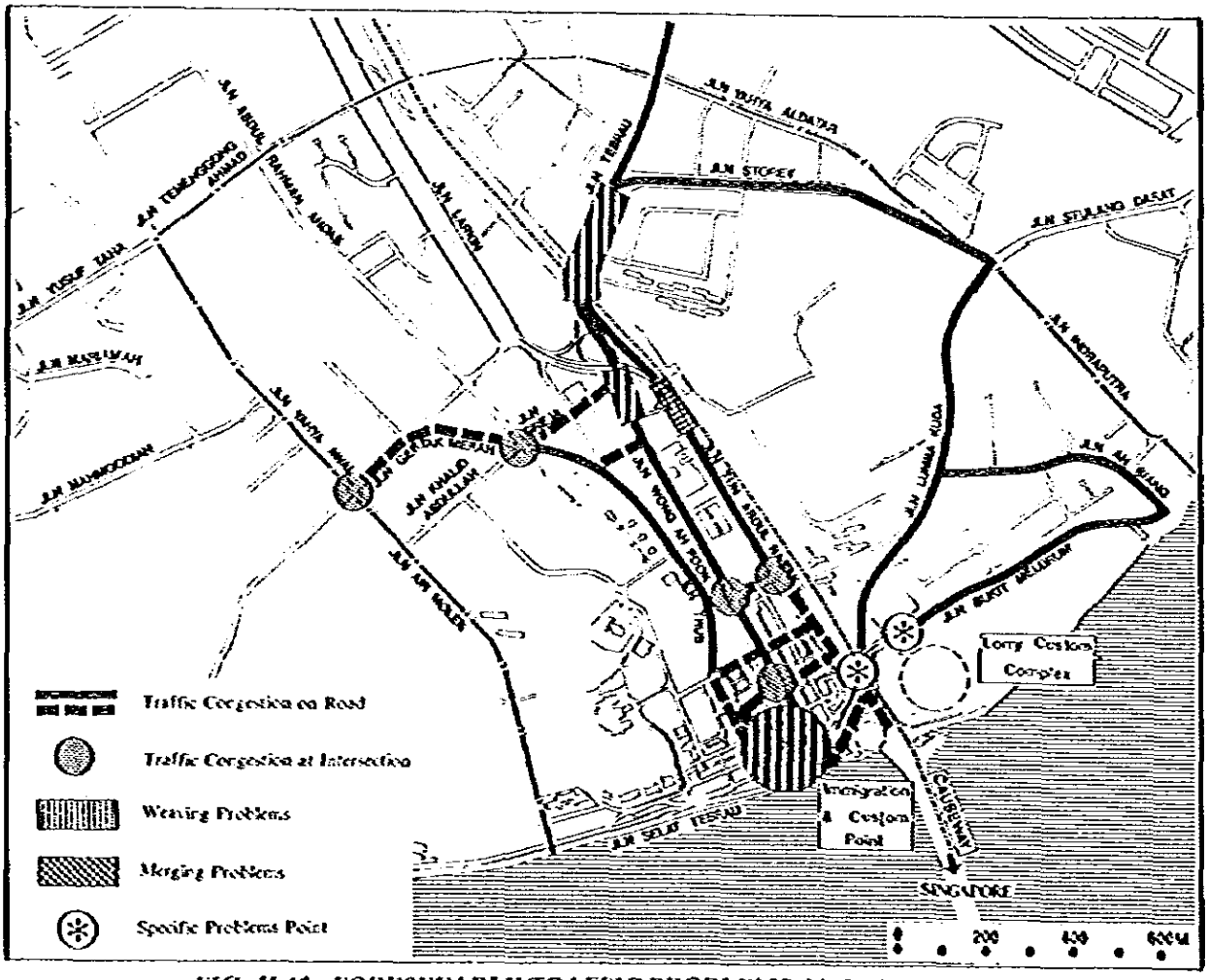


FIG. II-10. FORESEEABLE TRAFFIC PROBLEMS AROUND 1990

TABLE II-5. ANTICIPATED TRAFFIC PROBLEMS AROUND 1990

Items of Problems	Problem Sections/Intersections
1 Traffic Congestion on Roads	a. Jalan Wong Ah Fook between Jalan Ibrahim and Tebrau Interchange with a congestion degree of 1.47
	b. Jalan Tun Abdul Razak between Jalan Station and Tebrau Interchange with a congestion degree of 1.18
	c. Jalan Storey with a congestion degree of 1.10
	d. Jalan Lumba Kuda with a congestion degree of 1.36
	e. Jalan Ah Siang with a congestion degree of 1.10
	f. Jalan Trus between Jalan Md. Noor and Jalan Ungku Puan with a congestion degree of 1.10
2 Traffic Congestion at Intersections	a. Intersection of Jalan Wong Ah Fook with Jalan Station with a congestion degree of 1.36
	b. Intersection of Jalan Md. Noor with Jalan Trus with a congestion degree of 1.16
	c. Intersection of Jalan Ayer Molek with Jalan Gertak Merah with a congestion degree of 1.03
	d. Intersection of Jalan Lumba Kuda with Jalan Storey with a congestion degree of 1.50
3 Weaving Problems	a. Jalan Selat Tebrau between Causeway Entry Point and Jalan T. Duke.
	b. Jalan Ibrahim between Jalan T. Duke and Jalan Wong Ah Fook.
	c. Jalan Sawmill, around the roundabout
	d. Jalan Wong Ah Fook near Tebrau Interchange.
	e. Jalan Tebrau between Tebrau Interchange Jalan Storey.
4 Merging Problems	a. Jalan Tun Abdul Razak from Jalan Larkin and Jalan Tebrau.
5 Specific Problems	a. Awaiting vehicles to exit point on Jalan Tun Abdul Razak.
	b. Awaiting lorries to Lorry Custom on Jalan Bukit Meldrum.
	c. Greater adverse effects on Jalan Lumba Kuda and Jalan Ah Siang along the Lorry Route

Notes: 1) As for Traffic Congestion, same Definitions as Mentioned in Table II-4
2) Traffic Situations are Expected to be the without the Short-Term Actions

3-3 Planning Policy and Strategies

The Causeway Traffic Dispersal Scheme has the following objectives:

a. the provision of a better, safer and more scenic transport environment in the central area of Johor Bahru that will contribute to the creation of a capital in which people can take pride;
b. the improvement of existing road and traffic conditions and operational system for an effective road space usage by the Causeway traffic as well as the Central Area's traffic more effective;
c. the construction of roads and intersections/interchanges to provide the most effective road network.

Traffic engineering and management measures as well as measures for providing infrastructure must be adopted and carried out, bearing in mind these objectives.

The planning policy for the Short-Term Action Plan is to make the maximum use of the existing roads and facilities with the minimum capital investment in dispersing traffic.
For the Long-Term Plan, however, traffic capacity must be increased by the construction of new roads, interchanges and improvements of existing facilities.

To achieve these objectives, the following planning strategies for the Short-Term and Long-Term Plans are formulated.

(1) Short-Term Action Plan

The short-term plan is intended to deal with the traffic situation until 1990, when the widening of Jalan Tebrau will have been completed.

1. Modification of one-way system
   — Convert Jalan Tun Abdul Razak into a four (4)-lane one-way southbound carriageway with contra exclusive bus and taxi lane.
   Jalan Tun Abdul Razak and Jalan Wong Ah Fook will then form a paired one-way system.

2. Upgrading of Jalan Wong Ah Fook
   — Upgrade Jalan Wong Ah Fook to five (5)-lane and four (4)-lane carriageways for the southern section and northern section respectively.

3. Improvement and construction of the connecting roads
   — Improve Jalan Station to a four (4)-lane dual contra flow carriageway.
   — Construct a road connecting Jalan Wong Ah Fook and the contra lane along Jalan Tun Abdul Razak between the Tun Abdul Razak Complex and the Pasar Besar.

4. Improvement of Tebrau Interchange and modification of Southern Interchange.

5. Covering of Sungai Segget.

6. Introduction of Area Traffic Signal Control System.

7. Other traffic engineering and management measures.
   - — Modification of bus stops along Jalan Wong Ah Fook.
   - — Control of on-street parking and construction of off-street parking spaces.

8. Improvement and construction of a section of the Inner Ring Road/Lorry Route — the section between Jalan Tebrau and Jalan Bukit Meldrum/Lorry Custom Complex.

These strategies are schematically illustrated in Fig. II-11.

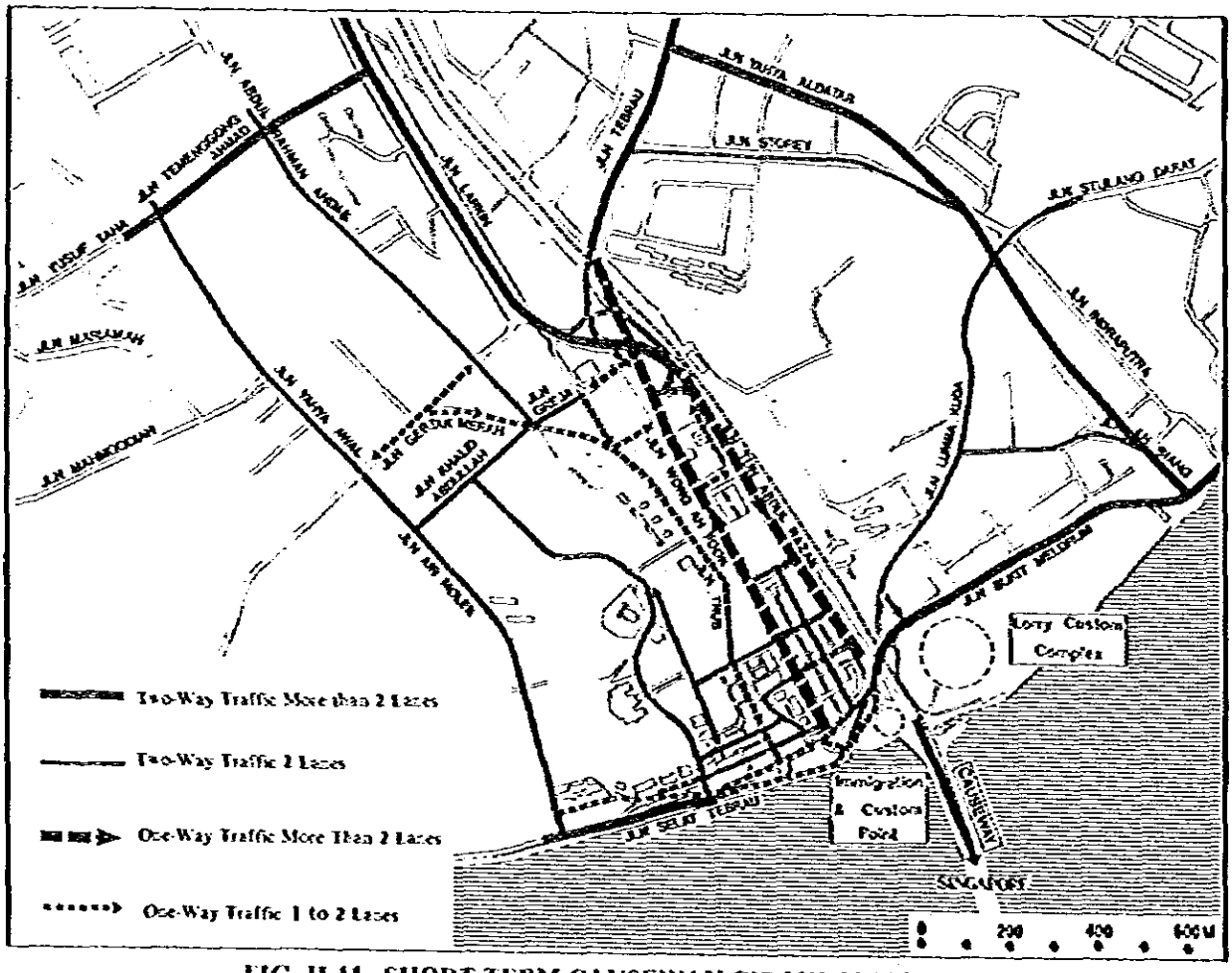


FIG. II-11. SHORT-TERM CAUSEWAY CIRCULATION PLAN

(2) The Long-Term Plan

The Long-Term Plan has been formulated to cope with traffic situations after the year 1990. The Long-Term Plan comprises of road construction and improvement, interchange construction and the implementation of traffic engineering and management measures, as a follow-up of the improvement of the Short-Term Plan.

1. Road Construction and Improvement
   - — Eastern Segment of the Inner Ring Road including Lorry Route.
   - — Jalan Ayer Molek.
   - — Jalan Bukit Meldrum/Jalan Selat Tebrau/Jalan Ibrahim.
   - — Extension of Jalan Duke.

2. Interchange Construction
   - — Southern Interchange

3. Traffic Engineering and Management
   - — Introduction of a one-way system, resulting in the conversion of Jalan Duke and Jalan Trus into a paired one-way system (see Fig. II-12).
   - — Control of on-street parking and construction of off-street parking spaces.
   - — Expansion of the area traffic signal control system.

The long-term dispersal plan in the central area is illustrated (see Fig. 9) in page 9.

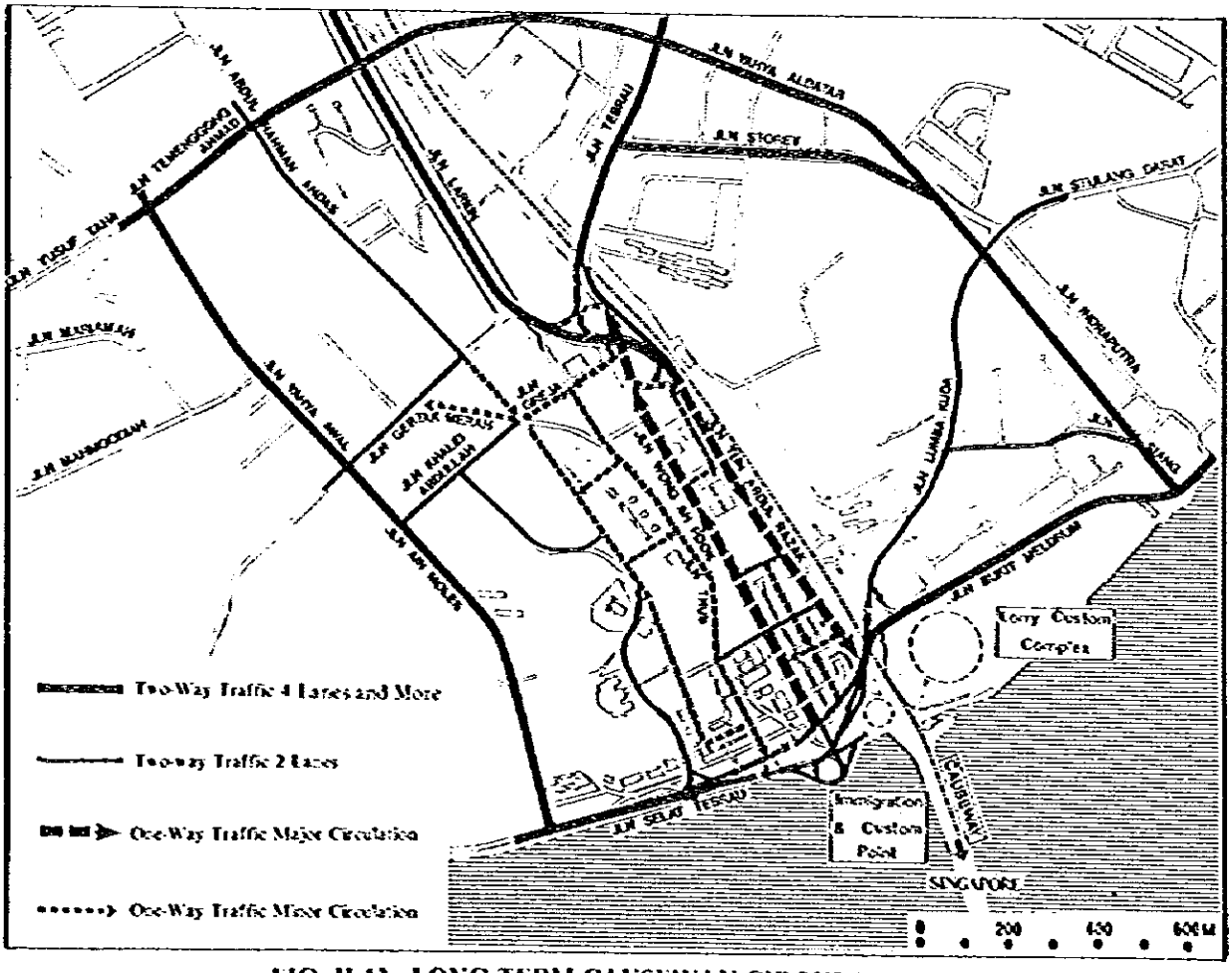


FIG. II-12. LONG-TERM CAUSEWAY CIRCULATION

3-4 Project Cost and Economic Analysis

(1) Project Cost

The project costs for the Short-Term and Long-Term Plans are estimated to be M$15.0 million and M$26.9 million respectively (see Table II-6).

(2) Economic Analysis

The economic indicators, as tabulated in Table II-7, show that both the Short-Term Actions and the Long-Term Plan are economically feasible, although, the Short-Term Actions are relatively more feasible.

TABLE II-6. SUMMARY OF THE PROJECT COST

(in M$'000)

	Length of Road (km)	Land Acquisition Cost	Construction Cost			Total	In Foreign Currency	In Local Currency
			Roadway	Structure	Sub-Total			
Causeway Traffic Dispersal Scheme	7.46	3,376 (8.0)	14,493 (34.6)	24,054 (57.4)	38,552 (92.0)	41,928 (100.0)	16,448 (39.2)	25,480 (60.8)
Short – Term	3.09	0	5,317	9,731	15,045	15,045	6,474	8,574
Long – Term	4.37	3,376	9,181	14,323	23,504	26,883	9,976	16,906

Notes: 1) Total Project Costs are Calculated based on the Ultimate Plan.
2) Figures in Brackets are Percentage of the Total Project Cost.
3) Figures with * represent partial length.

TABLE II-7. ECONOMIC INDICATORS OF CAUSEWAY TRAFFIC DISPERSAL SCHEME

	Short-Term Actions	Long-Term Plan
$B_i'C$ Ratio	4.58	1.65
Net Present Value (M$'000)	34,792	41,627
Internal Rate of Return (%)	43.5	19.0

Notes: 1) Project Life: 20 years
2) Discount rate: 12%
3) Opening Year: 1989

4. JOHOR BAHRU TOLL EXPRESSWAY ACCESS ROAD

4-1 Project Characteristics

The Toll Expressway Access as planned in the Master Plan Study is expected to disperse the traffic coming from and going to the Toll Expressway.

The Toll Expressway Access is therefore defined as an *Intra-Urban Primary Distributor*.

This road will be characterized by:

a. partial controlled access;
b. limited number of at-grade and/or grade-separated intersections;
c. prohibition of U-turns except at limited median openings;
d. beautiful landscaping.

4-2 Alternative Routes

Alternative routes for sections 2 and 3 of the proposed access road, based on the results of related field investigations, land-use survey and traffic study are presented. These alternative routes are evaluated on their technical, socio-environmental and economic performances. The results of this analysis show that Route 'B' of section 2 and Route 'A' of section 3 perform best (see Fig. II-13).

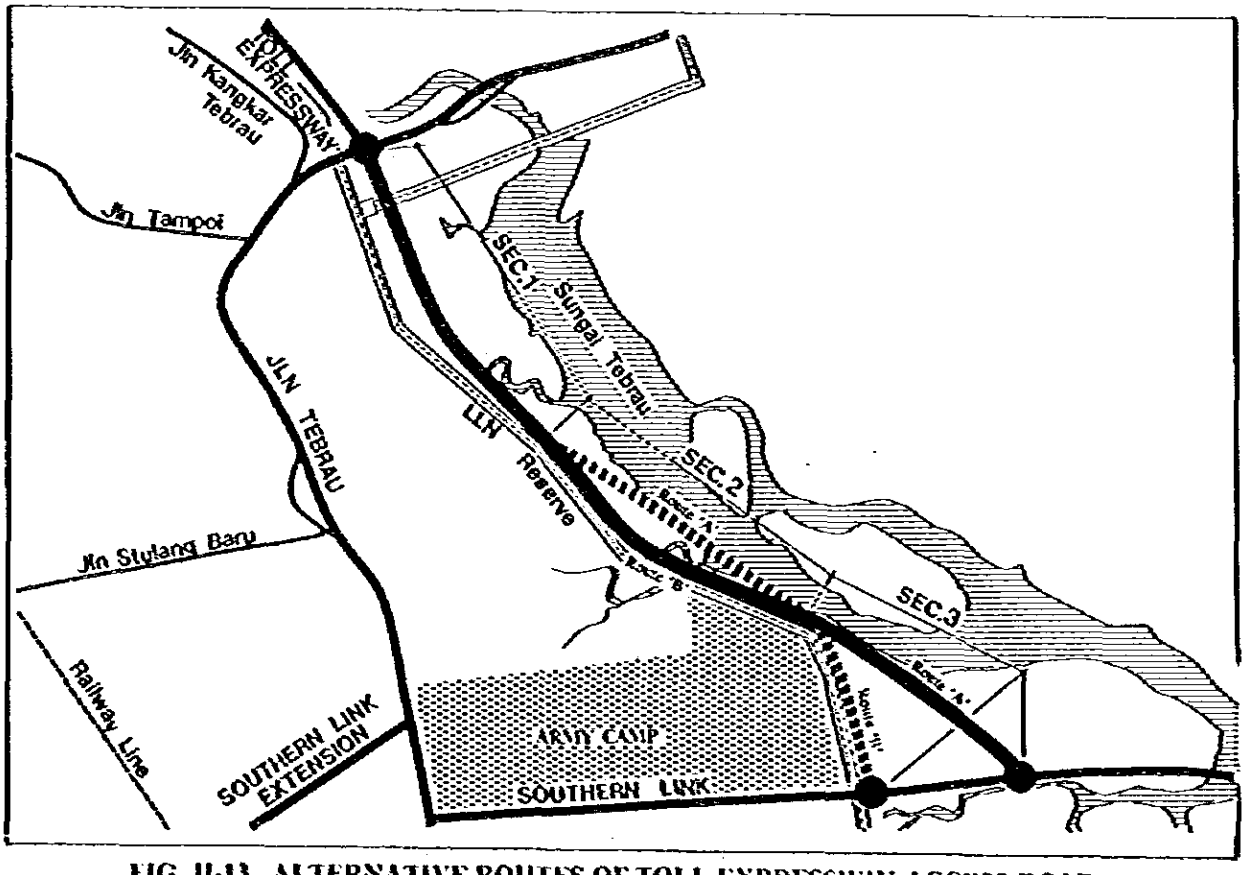


FIG. II-13. ALTERNATIVE ROUTES OF TOLL EXPRESSWAY ACCESS ROAD

4-3 Design Characteristics

(1) Geometric Design Standards

TABLE II-8.
GEOMETRIC DESIGN STANDARDS FOR TOLL EXPRESSWAY ACCESS

Design Speed	km/h	80
Carriageway Width	M	3.5
Median Width	M	–
Shoulder Width		
Right Shoulder	M	0.50
Left Shoulder	M	2.00 – 2.50
Maximum Gradient	%	4

(2) Cross-Sectional Design

The carriageway of this Expressway Access Road is to be a four (4)-lane carriageway and its typical cross section, shown in Fig. II-14, is designed taking into account site conditions and the projected traffic volume.

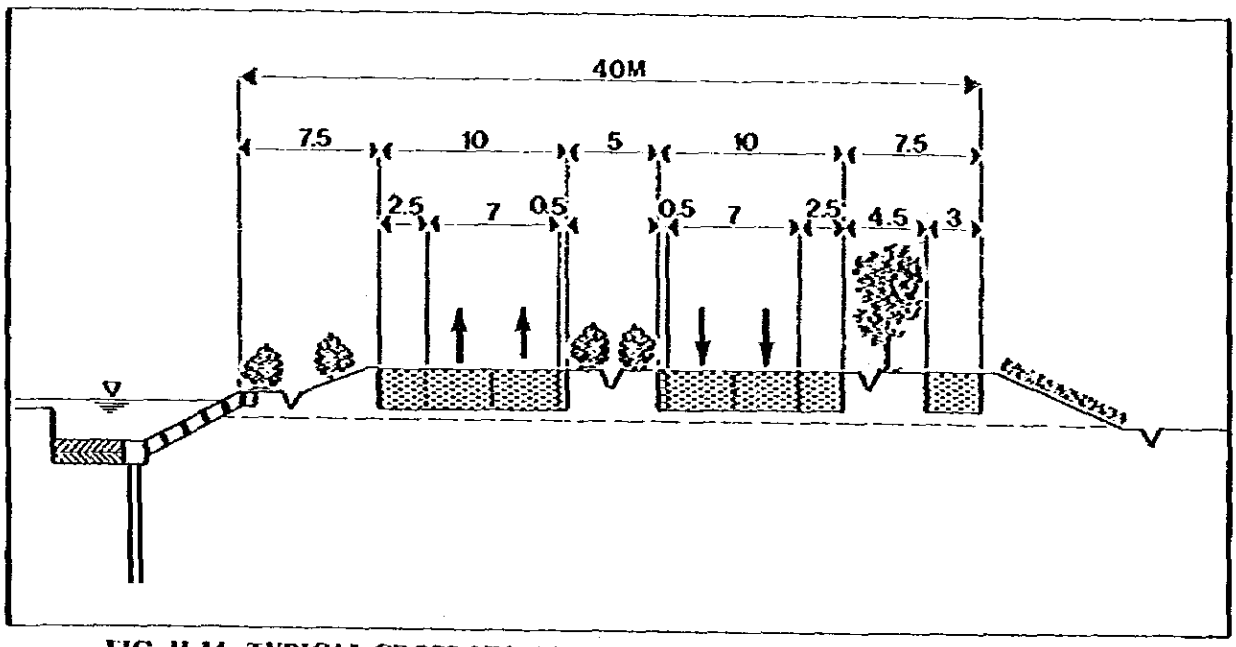


FIG. II-14. TYPICAL CROSS SECTION OF THE TOLL EXPRESSWAY ACCESS ROAD

(3) Interchange Plan

The construction of two (2) grade-separated interchanges for the Access Road is recommended; the one located where the Toll Expressway Access and the Toll Expressway intersect with Jalan Pandan is to be a partial service interchange (see Fig. II-15).

At this interchange, the first stage, which includes the construction of rampways between the Toll Expressway and Jalan Pandan, is expected to be implemented by the Highway Authority of Malaysia in line with the Toll Expressway Project.

The other interchange which intersects the Toll Expressway Access with the proposed Southern Link is to be a three (3)-leg interchange to be so constructed as to make possible its future modification into a four (4)-leg type.

(4) Bridge Design

The Toll Expressway Access has two (2) small bridges with a total length of 30 meters over Sg. Selubong and Sg. Tampoi. A prestressed concrete bridge is recommended.

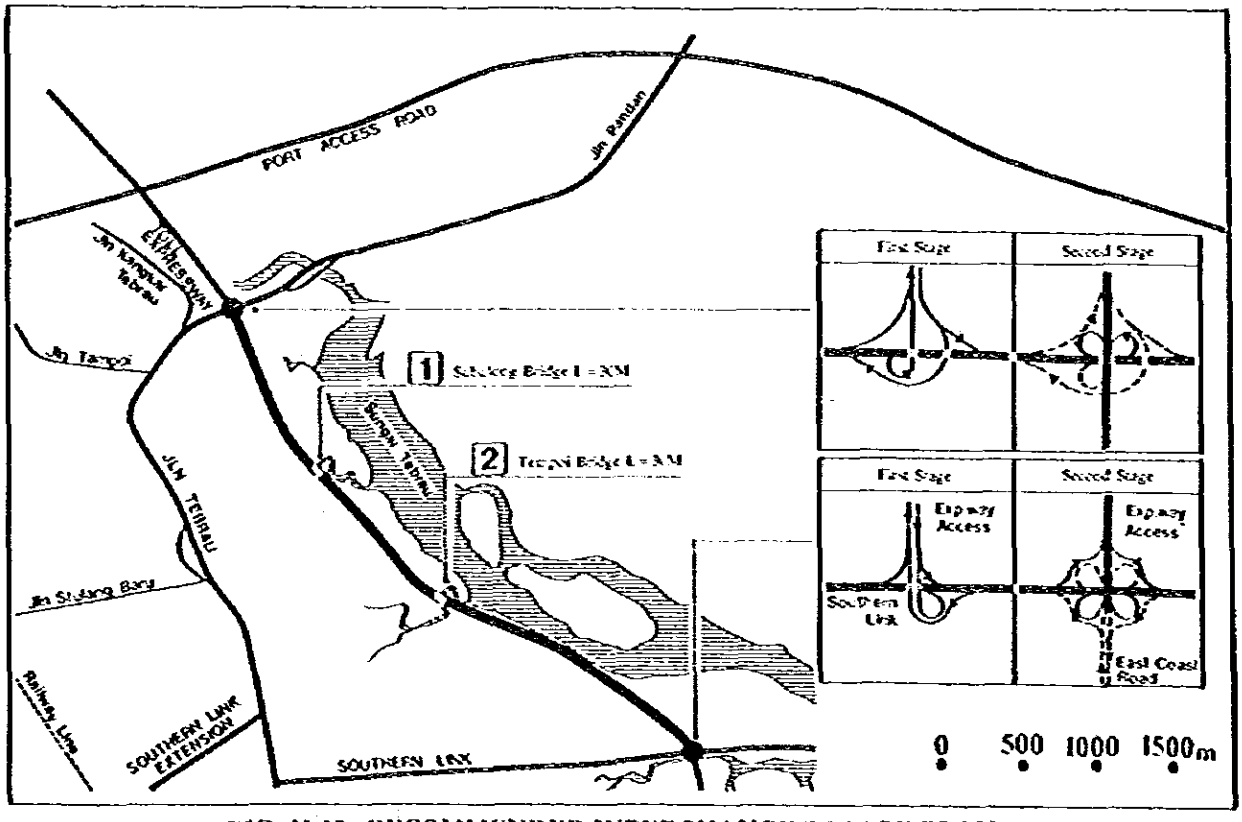


FIG. II-15. RECOMMENDED INTERCHANGE/BRIDGE PLAN FOR THE TOLL EXPRESSWAY ACCESS ROAD

4-4 Project Cost and Economic Analysis

(1) Project Cost

The project cost for the Toll Expressway Access is estimated to be M$50.9 million although the total length of this road is only 3.99 kilometers. This is due to the high cost of constructing an intersection (see Table II-9).

(2) Economic Analysis

The economic indicators show that it will be economically premature to open the Toll Expressway Access to traffic in 1989 (see Table II-10).

However, it will be economically feasible if the opening to traffic is postponed until 1992 (see Fig. II-16).

TABLE II-9. SUMMARY OF THE PROJECT COST

(in M$'000)

	Plan	Length of Road (km)	Land Acquisition Cost	Construction Cost			Total	In Foreign Currency	In Local Currency
				Roadway	Structure	Sub-Total			
Toll Expressway Access	4 – Lane	3.99	4,551 (8.7)	24,852 (48.7)	21,155 (41.4)	45,957 (90.3)	50,818 (100.0)	18,727 (36.8)	32,131 (63.2)

Notes: 1) Total project costs are calculated based on the ultimate plan.
2) Figures in brackets are percentage to the total project cost.
3) Figures with * represent partial length.
4) ( ) = % to the total Cost

TABLE II-10. ECONOMIC INDICATORS OF TOLL EXPRESSWAY ACCESS

	Opening to Traffic in 1989	Opening to Traffic in 1992
B/C Ratio	0.90	1.02
Net Present Value (M$'000)	–2,983	361
Internal Rate of Return (%)	10.6	12.2

Notes: 1) Project Life: 20 years
2) Discount Rate: 12%

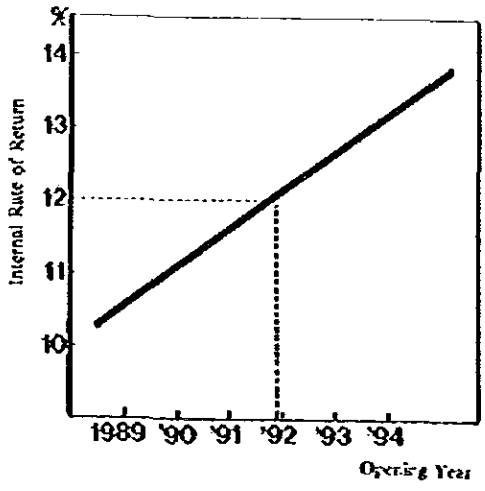


FIG. II-16. OPTIMUM OPENING YEAR OF TOLL EXPRESSWAY

5. INNER RING ROAD INCLUDING LORRY ROUTE

5-1 Plan Characteristics

The Inner Ring Road is planned as a District Distributor in order to collect and distribute the traffic entering and leaving the central area of Johor Bahru as well as to carry causeway traffic.

The road will be characterized by:

a. uncontrolled access, but with restricted traffic crossing at minor intersections; provision for access to and from the Inner Ring Road;
b. provision of grade-separated intersections with major radial roads;
c. prohibition of U-turns except at limited median openings.

In order to reduce adverse lorry traffic impacts in Johor Bahru, particularly its central area, an exclusive lorry route or lane is planned.

5-2 Alternative Routes

(1) Inner Ring Road

The results of field investigations, topographic surveys and traffic and socio-environmental studies have led to the proposal of four (4) alternative horizontal alignments for section '1'; two (2) alternative vertical alignments for section'2'; three (3) alternative horizontal and two (2) alternative vertical alignments for section '3' of the Inner Ring Road (see Figs. II-17, II-18).

These alternatives are evaluated on their technical, socio-environmental and economic performances. The results of this evaluation indicate that Route 'C' for section '1', vertical alignment Plan 'B' for section '2', Route 'B' and vertical alignment Plan B for section '3' are the most feasible and acceptable alternatives.

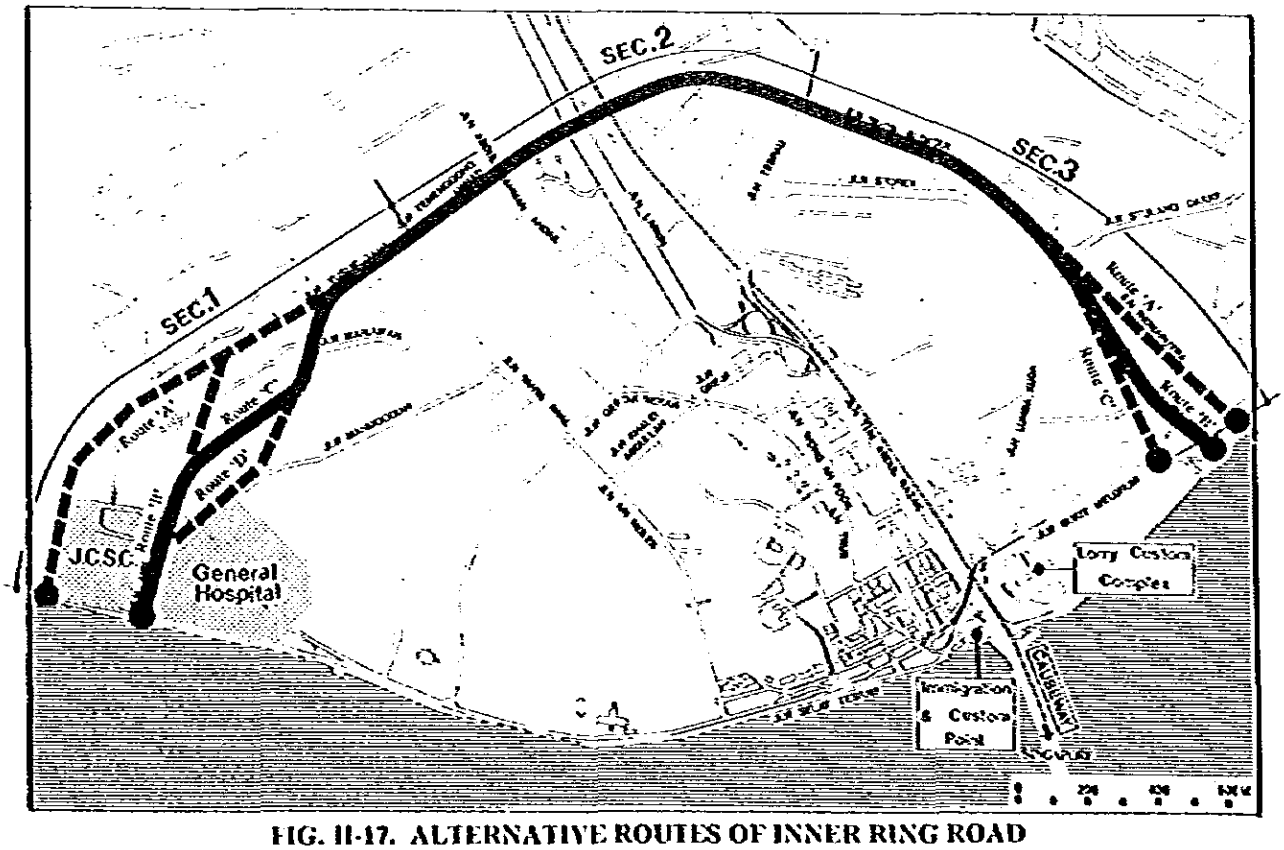


FIG. II-17. ALTERNATIVE ROUTES OF INNER RING ROAD

5. INNER RING ROAD INCLUDING LORRY ROUTE

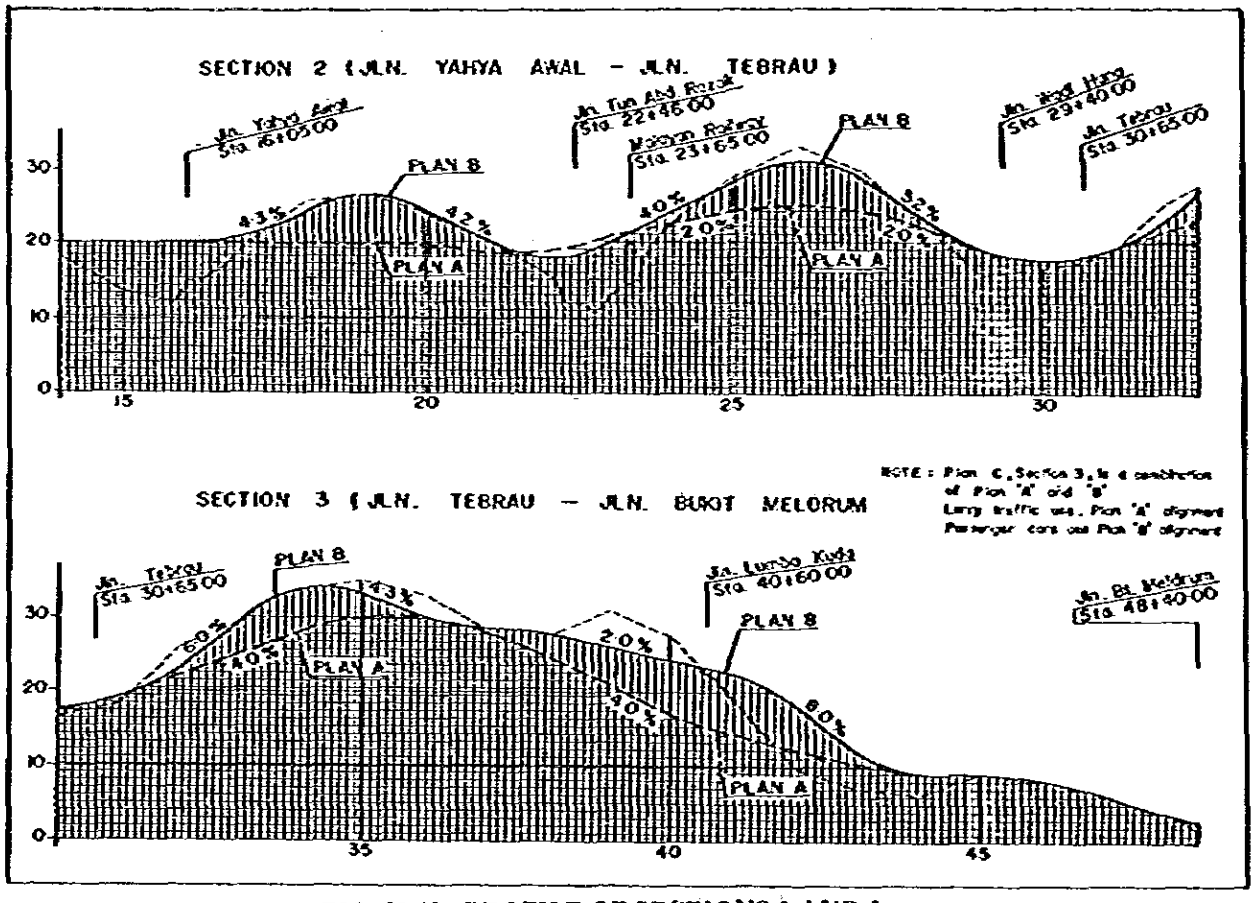


FIG. II-18. PROFILE OF SECTIONS 2 AND 3

(2) Lorry Route

For the Lorry Route, four (4) alternative alignments are proposed for evaluation (see Fig. II-19). A comparative analysis of the technical, socio-environmental and economic performances of these alternatives show that Route 'D' which would accommodate the lorry traffic in the section between Jalan Tun Abdul Razak and Jalan Bukit Meldrum on the Inner Ring Road is superior to the other alignments.

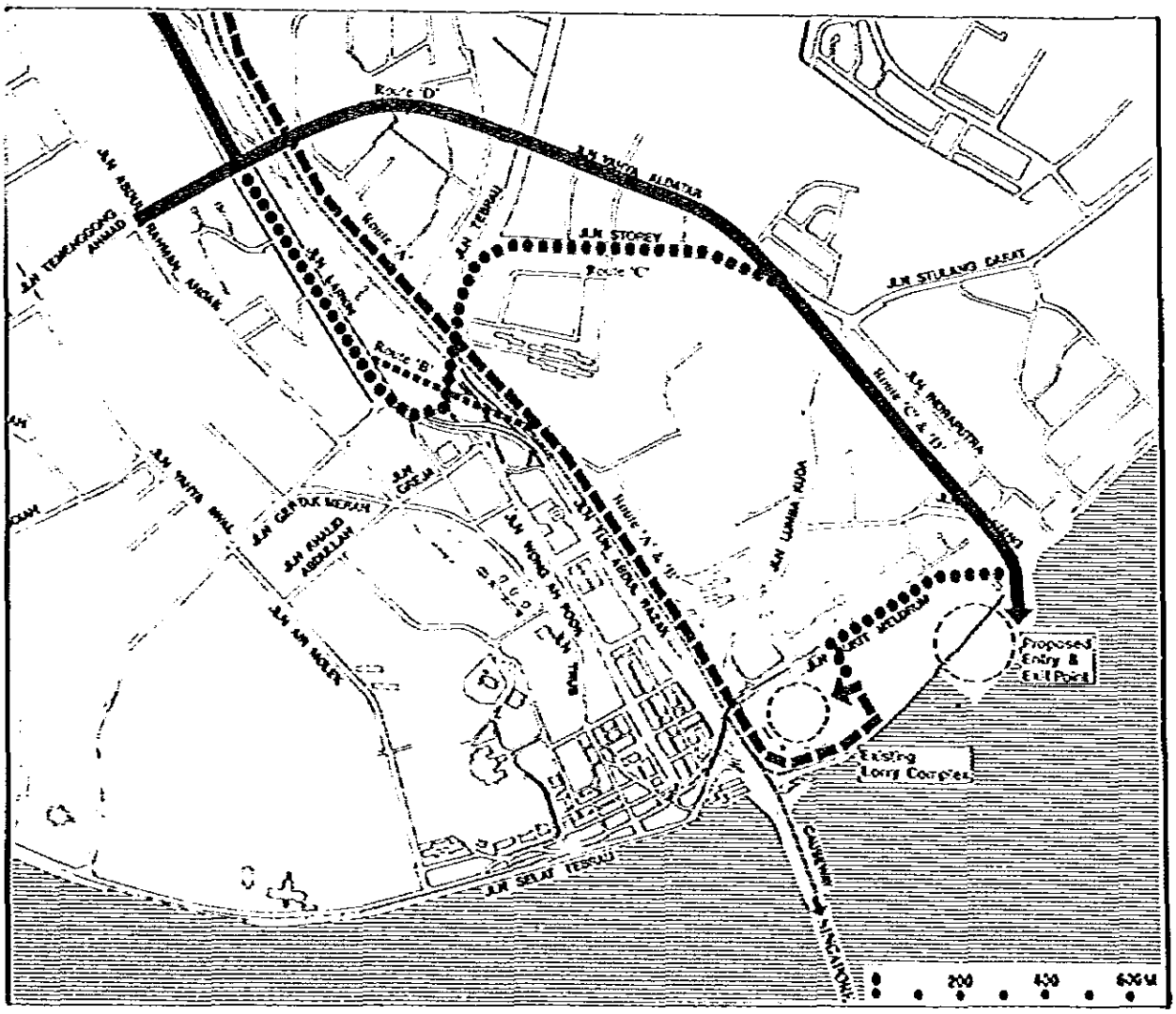


FIG. II-19. ALTERNATIVE ROUTES OF LORRY ROUTE

5-3 Design Characteristics

(1) Geometric Design Standards

TABLE II-11. GEOMETRIC DESIGN STANDARDS FOR INNER RING ROAD AND LORRY ROUTE

	Unit	• Inner Ring Road	• Lorry Route
Design Speed	Km/h	60	40
Carriageway width	m	3.25	3.75
Median Width	m	2.00	–
Shoulder Width			
Right Shoulder	m	0.50	–
Left Shoulder	m	2.00	0.75
Maximum Gradient	%	6	6

(2) Cross-Sectional Design

Several alternative cross sections of the Inner Ring Road including the Lorry Route have been proposed based on the projected traffic volume, the elements of cross-sectional components and socio-environmental aspects (see Fig. II-20). The results of the studies show that the carriageway of the eastern segment of the Inner Ring Road (that is, the section between Jalan Tun Abdul Razak and Jalan Bukit Meldrum/Lorry Custom Complex) should be ultimately a six (6)-lane road with the center two (2) lanes designated as the Lorry Route while the carriageway of the western segment of the Inner Ring Road (the section between Jalan Abu Bakar and Jalan Tun Abdul Razak) should be a four (4)-lane carriageway (see Fig. II-20).

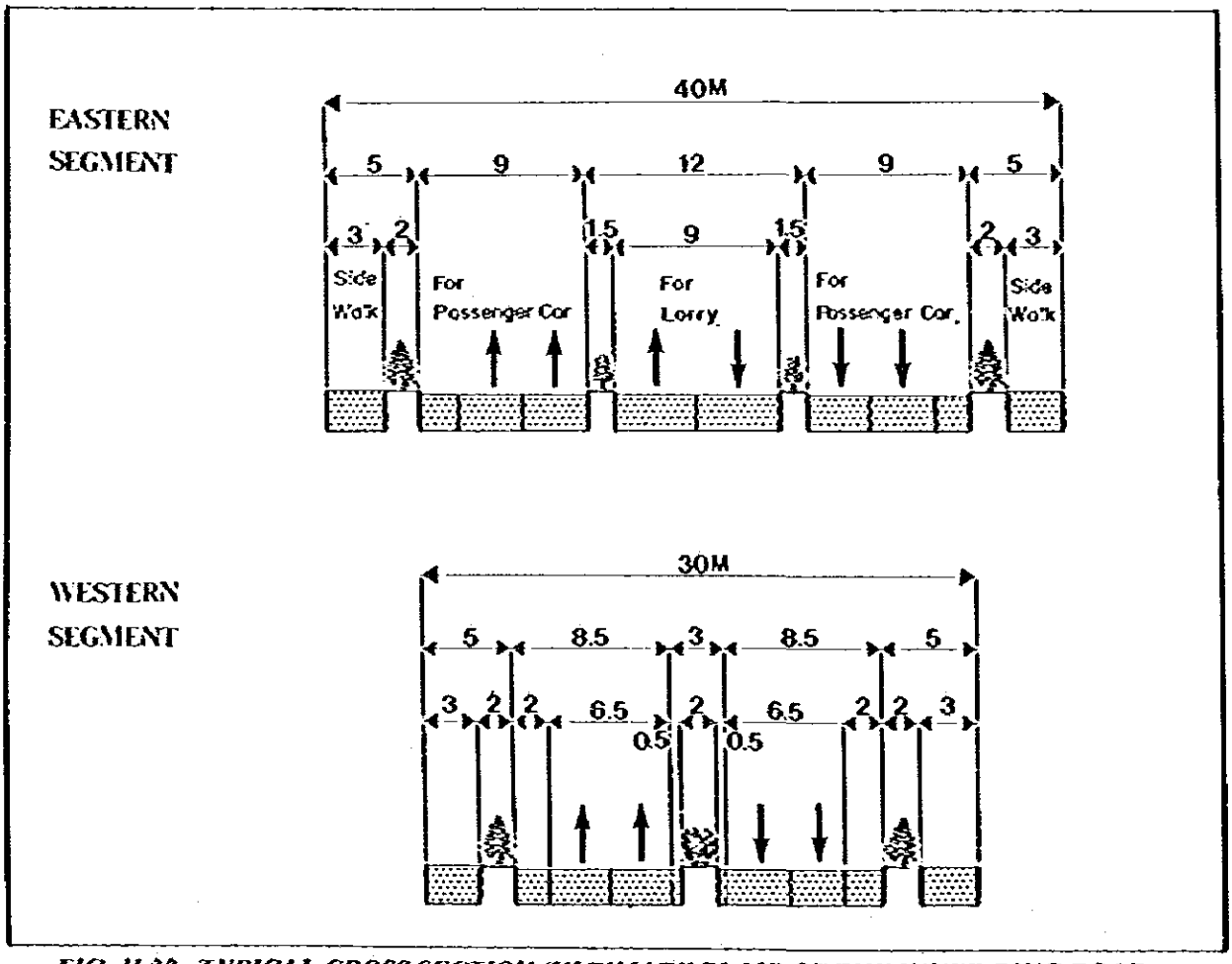


FIG. II-20. TYPICAL CROSS SECTION (ULTIMATE PLAN) OF THE INNER RING ROAD

(3) Intersection and Interchange Plan

Five (5) grade-separated interchanges are to be constructed ultimately for the Inner Ring Road/Lorry Route (see Fig. II-21). The interchange at the junction of the Inner Ring Road with Jalan Tebrau is expected to be constructed as a part of the Jalan Tebrau Reconstruction Project.

(4) Bridge Design

The Inner Ring Road including the Lorry Route has two (2) bridges, one 135 meters long over Jalan Wadi Hana. The most economical pre-stressed concrete bridge type is recommended.

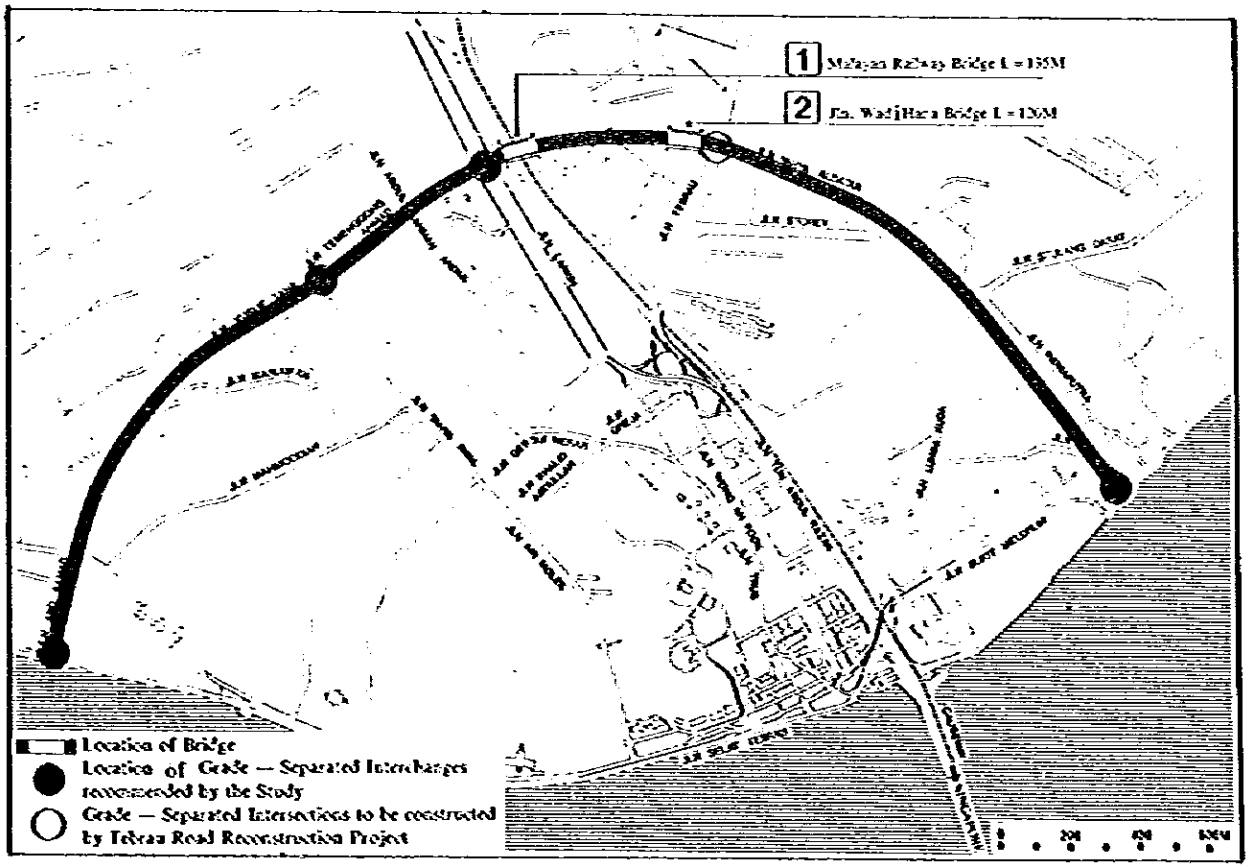


FIG. II-21. LOCATION OF BRIDGES/INTERCHANGES AT THE INNER RING ROAD

5-4 Project Cost and Economic Analysis

(1) Project Cost

The project cost for the Inner Ring Road including the Lorry Route is estimated to be M$97.7 million, of which M$67.3 million is allocated for the eastern segment of the Inner Ring Road with the Lorry Route, and M$30.5 million for the western segment (without the Lorry Route) (see Table II-12).

(2) Economic Analysis

The economic indicators of two (2) alternative cross-section plans — a four (4)-lane situation and a six (6)-lane situation in which two (2) lanes are exclusively for lorry traffic — are shown in Table II-13. The economic indicators show that plans are economically feasible.

The economic analysis by section also shows that eastern segment of the Inner Ring Road including the Lorry Route, for both four (4)-lane and six (6)-lane situations, is more feasible than the western segment. For the eastern segment, the four (4)-lane plan has a higher economic indicator than the six (6)-lane plan (see Table II-14).

These results suggest that the eastern segment should be constructed as a four (4)-lane road at the first stage and expanded to a six (6)-lane at a second stage.

TABLE II-12. SUMMARY OF THE PROJECT COST BY SECTION

(in M$'000)

	Plan	Length of Road (km)	Land Acquisition Cost	Construction Cost			Total	In Foreign Currency	In Local Currency
				Roadway	Structure	Sub-Total			
Inner Ring Road including Lorry Route	4 & 6 – Lane	5.50	35,353 (36.9)	23,314 (24.3)	38,862 (33.7)	62,576 (58.6)	97,929 (100.0)	25,187 (25.8)	72,542 (74.2)
Eastern Segment (ultimate plan)	6 – Lane	3.25	24,383	14,637	28,205	42,922	67,275	17,462	49,813
East Ring Rd Tebrau – J.B. Middle (initial plan)	4 – Lane	2.45	14,978	7,303	0	7,303	22,291	2,543	19,432
Western Segment	4 – Lane	2.25	10,770	9,027	10,657	19,654	30,454	7,725	22,729

Notes: 1) Total Project Costs are Calculated based on the Ultimate Plan.
2) Figures in brackets are Percentage to the total Project Cost.
3) Figures with * represent partial length.

TABLE II-13. ECONOMIC INDICATORS OF INNER RING ROAD INCLUDING LORRY ROUTE

	Plan 1 (4 – lane)	Plan 2 (4 & 6 – lane)
B/C Ratio	1.87	1.73
Net Present Value (M$'000)	37,236	43,363
Internal Rate of Return (%)	21.6	19.0

Notes: 1) Project Life: 20 years
2) Discount Rate: 12%
3) Opening Year: 1989
4) Plan 1: entirely 4 – lane
Plan 2: Eastern Segment 6 – lane;
Western Segment 4 – lane

TABLE II-14. ECONOMIC INDICATORS OF INNER RING ROAD INCLUDING LORRY ROUTE

	Western Segment	Eastern Segment	
	4 – lane	4 – lane	6 – lane
B/C Ratio	1.16	2.47	2.04
Net Present Value (M$'000)	2,932	35,546	42,352
Internal Rate of Return (%)	14.0	26.8	22.5

Notes: 1) Project Life: 20 years
2) Discount Rate: 12%
3) Opening Year: 1989

6. PROJECT EVALUATION

6-1 Framework of the Evaluation

The economic evaluation analysis employs the following three economic indicators:

a) Internal Rate of Return (IRR)
b) Net Present Value (NPV)
c) Benefit Cost Ratio (B/C Ratio)

The evaluation is made on the assumption that the project roads will open to traffic in 1989 and that the project life will be 20 years at a discount rate of 12%. In computing the cost of the projects, tax components, the cost of unskilled labour, the foreign exchange rate and market value of Government land are taken into account. Study process applied in the economic evaluation is illustrated in Fig. II-22.

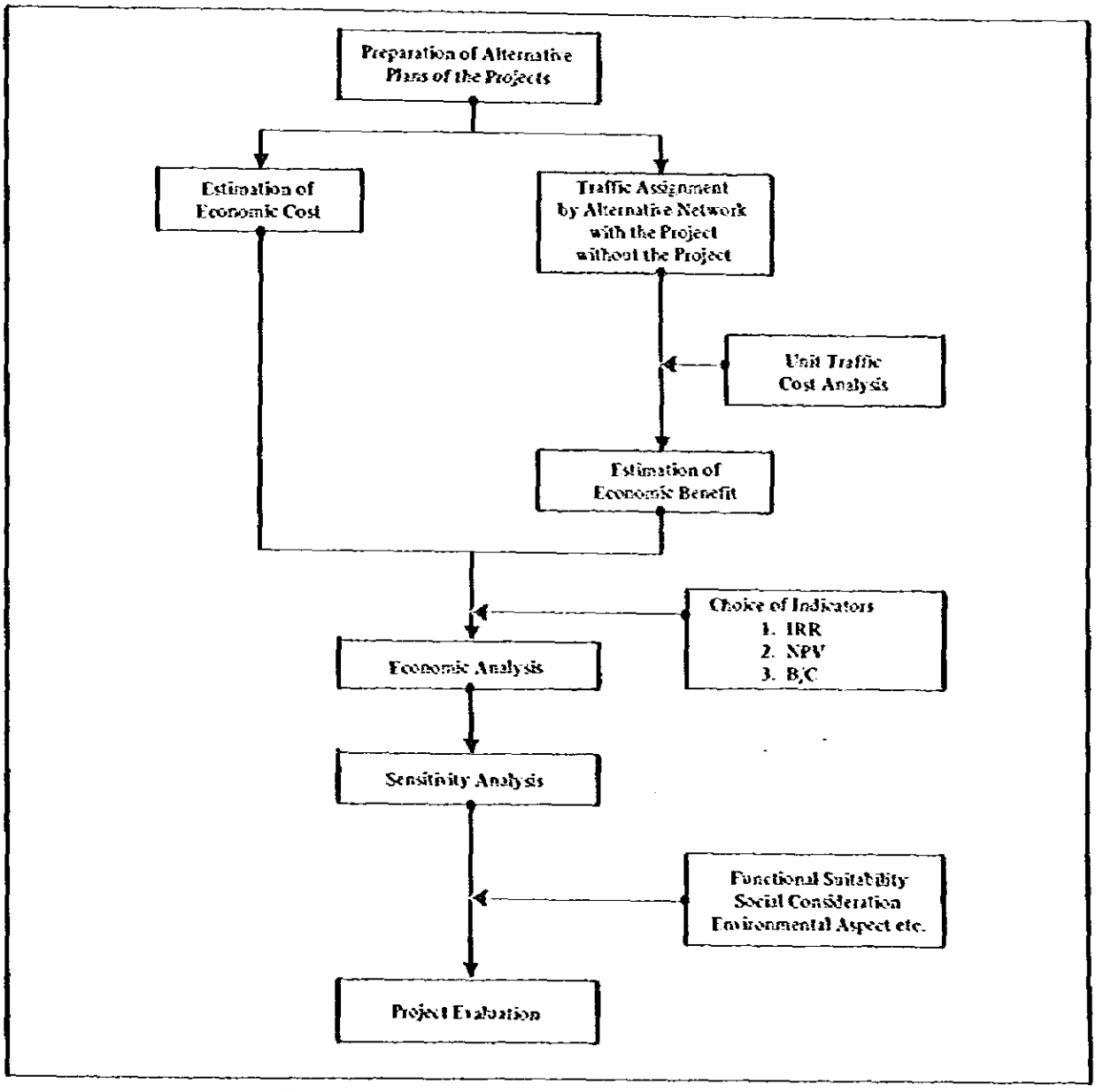


FIG. II-22. PROCEDURE FOR ECONOMIC EVALUATION

6-2 Summary of Economic Analysis

The results of the economic analysis are summarised in Table II-15. Both the 4-lane and 6-lane plans proposed for the Southern Link are feasible, although the former is more feasible than the latter. However, if the opening to traffic is delayed for about 5 years to 1994, the 6-lane plan is superior (see section 2-4).

Similar results are found for the Causeway Traffic Dispersal Scheme, with the short-term plan more feasible than long-term plan. On the other hand, the Toll Expressway Access Road is not feasible, because it would be premature to open it to traffic by 1989. The Inner Ring Road shows favorable economic indicators for both alternative plans. Further analysis for the eastern and western segments shows that a 4-lane or 6-lane road for the eastern segment is more feasible than the western 4-lane road (see section 5-4).

TABLE II-15. SUMMARY OF ECONOMIC ANALYSIS

Project		B/C Ratio	Net Present Value (M$'000)	Internal Rate of Return (%)
Johor Bahru – Pasir Gudang Southern Link	Plan 1 4 – lane	3.24	187,319	32.9
	Plan 2 6 – lane	3.08	287,185	28.2
Causeway Traffic Dispersal Scheme	Short Term Plan	4.58	34,792	43.5
	Long Term Plan	1.65	41,627	19.0
Toll Expressway Access	Plan 1	0.90	–2,983	10.6
The Inner Ring Road	Plan 1 (4 – lane)	1.87	37,236	21.6
	Plan 2 (4 & 6 lane)	1.73	43,363	19.0

Notes: 1) Project Life: 20 years
2) Discount Rate: 12%
3) Opening Year: 1989
4) Eastern Segment – 6 lanes, Western Segment – 4 lanes

6-3 Sensitivity Analysis

A sensitivity analysis is undertaken to see how the economic feasibility of the Project is affected by changes in socio-economic indicators, project costs and project benefits.

As mentioned in Part I, the economic growth target set in the Fourth Malaysia Plan may not be attained due to the recent worldwide economic recession. Therefore, the sensitivity analysis assumes the bleakest economic framework projected, by which the original economic target is attained about (7) years after the year 2000. This means that other socio-economic targets such as population, employment and household income will also be delayed for seven (7) years.

The various benefit and cost factors used in the sensitivity analysis include a 20% increase of the total project cost and/or a 20% decrease of the project benefit.

The results of the analysis are shown in Table II-16. It is found that both the four (4)-lane and six (6)-lane plans for the Johor Bahru-Pasir Gudang Southern Link, the Long-Term Causeway Traffic Dispersal Scheme and the Eastern segment of the Inner Ring Road including the Lorry Route remain economically feasible in all the cases examined. However, the Toll Expressway Access can be economically justified when the opening year of the road is set at after 1992.

TABLE II-16. SUMMARY OF SENSITIVITY ANALYSIS

Project Package / Case	Johor Bahru – Pasir Gudang Southern Link		Causeway Traffic Dispersal Scheme (Long-Term)	Toll Expressway Access	Inner Ring Road including Lorry Route	
	Plan 1 4 – Lane	Plan 2 6 – Lane			Western Ring 4 – Lane	Eastern Ring 6 – Lane
1. Original Plan	3.24	2.87	1.65	0.90	1.16	2.04
2. 7 years delay in Socio Economic target Attainment	2.66	1.98	1.41	0.72	0.93	1.71
3. 20 percent Increase of Project Cost	2.70	2.57	1.34	0.75	0.97	1.70
4. 20 percent decrease of Project Benefit	2.59	2.47	1.32	0.72	0.93	1.64
5. 20 percent increase of the Project Cost and 20 percent decrease of the Project Benefit	2.16	2.06	1.10	0.60	0.77	1.36
6. 20 percent increase of the Project Cost and 7 years delay in Target Attainment	2.21	1.65	1.17	0.63	0.78	1.43

Notes: 1. Project Life: 20 years
2. Discount Rate: 12%

Sensitivity Analysis for Long-Term Causeway Relocation Plan

Another brief sensitivity analysis for the Long-Term Causeway Traffic Dispersal Scheme and the eastern segment of the Inner Ring Road including the Lorry Route is made assuming that the Causeway Site Relocation Concept, proposed in the Preliminary Causeway Layout Plan*, is implemented.

The results of the economic analysis are shown in Table II-17, which indicates that even if the Site Relocation Concept is adopted, the Long-Term Dispersal Scheme and both plans for the eastern segment of the Inner Ring Road including the Lorry Route are still economically feasible.

TABLE II-17. ECONOMIC INDICATORS OF LONG-TERM CAUSEWAY LAYOUT PLAN

	Long-Term Causeway Traffic Dispersal Scheme	Eastern Segment of the Inner Ring Road including Lorry Route	
		4 – lane	6 – lane
B/C Ratio	1.72	2.97	2.05
Net Present Value (M$'000)	49,810	47,779	48,164
Internal Rate of Return (%)	19.0	30.8	22.6

Notes: 1) Project Life: 20 years
2) Discount Rate: 12%

* The Preliminary Causeway Layout Plan was formulated by the Study Team in February, 1983.

6-4 Project Priority

The projects were screened out by comparative weighting in terms of development, traffic and socio-environmental factors as well as the results of the economic evaluation, and given priority into three ranks in the following order (see Tables II-18, II-19).

(1) First Priority

a. Construction of the Johor Bahru–Pasir Gudang Southern Link as a four (4)-lane road,
b. Construction of the eastern segment of the Inner Ring Road with the Lorry Route as a four (4)-lane road,
c. Implementation of the Short-Term Causeway Traffic Dispersal Scheme.

(2) Second Priority

a. Widening of the Southern Link into a six (6)-lane road,
b. Widening of the eastern segment of the Inner Ring Road with the Lorry Route into a six (6)-lane road,
c. Implementation of the Long-Term Causeway Traffic Dispersal Scheme,

(3) Third Priority

a. Construction of the western segment of the Inner Ring Road
b. Construction of the Toll Expressway Access

TABLE II-18. COMPARATIVE WEIGHTING OF THE PROJECTS

	1	2	3	4	5
	Economic Analysis	Development Consideration	Socio-Environmental Consideration	Traffic Aspect	Summation
1. Johor Bahru – Pasir Gudang Southern Link					
– 4 – Lane Plan	3	3	0	1	7
– 6 – Lane Plan	2	3	0	0	5
2. Causeway Traffic Dispersal Scheme					
– Short-Term Action	3	2	1	2	8
– Long-Term Plan	2	1	1	1	5
3. Toll Expressway Access	0	1	0	0	1
4. Inner Ring Road including Lorry Route Eastern Segment					
– 4 – Lane Plan	3	2	0	2	7
– 6 – Lane Plan	2	2	0	1	5
Western Segment	1	1	–1	0	1

Notes: The Rating of each Aspect is as Follows:

a. Economic Analysis
3: Highly feasible.
2: Feasible
1: Fairly feasible
0: Least feasible

b. Development Consideration
3 Significantly effective
2 Moderately effective
1 Lowly effective

c. Socio-Environmental Consideration
1 Net benefit
0 Balance
–1 Net disbenefit

d. Traffic Aspect
2 Urgently required
1 Fairly urgent
0 Not urgent

TABLE II-19. SUMMARY OF ECONOMIC INDICATORS BY PROJECT AND ITS PRIORITY

Project	Plan	Economic Indicators			Priority of Project
		Net Present Value (M$ million)	B/C Ratio	IRR %	
Johor Bahru – Pasir Gudang Southern Link					
Southern Link and its Extension	4 – Lane	187,319	3.24	32.9	1
Southern Link and its Extension	6 – Lane	287,185	3.08	28.2	2
Causeway Traffic Dispersal Scheme					
Short – Term Action		34,792	4.58	43.5	1
Long – Term Plan		41,627	1.65	19.0	2
Toll Expressway Access	4 – Lane	–2,983	0.90	10.6	4
Inner Ring Road including Lorry Route					
Eastern Segment with Lorry Route	4 – Lane	35,546	2.47	26.8	1
Eastern Segment with Lorry Route	6 – Lane	42,352	2.04	22.5	2
Western Segment	4 – Lane	2,932	1.16	14.0	3

Notes: 1) Opening to traffic is assumed to be in 1989.
2) Discount rate is 12%
3) Project life is 20 years

7. PROJECT IMPLEMENTATION PROGRAM

7-1 Program Structure

Judging from the priority of the Project and the financial standing of the Government, the Project should be implemented according to the following schedule. The details by phase are illustrated in Tables II-20 to II-22.

(1) Phase I: 1985 — 1990

1. Johor Bahru–Pasir Gudang Southern Link
   a. Construction of the Southern Link, encompassing the section between Jalan Tebrau and the planned cloverleaf interchange on the Port Access as a four (4)-lane road.
   b. Construction of the Southern Link Extension (Jalan Kebun Teh) as a four (4)-lane road.
2. Implementation of the Short-Term Traffic Dispersal Scheme
3. Construction of the Inner Ring Road with the Lorry Route, encompassing the section between Jalan Tebrau and Jalan Bukit Meldrum or the Lorry Custom Complex as a four (4)-lane road.

(2) Phase II: 1991 — 1995

1. Johor Bahru–Pasir Gudang Southern Link
   a. Widening of the Southern Link, encompassing the section between Jalan Tebrau and the Pasir Gudang Port, into a six (6)-lane road.
   b. Construction of eight (8) grade-separated interchanges
2. The Long-Term Causeway Traffic Dispersal Scheme.
3. The Inner Ring Road including the Lorry Route.
   a. Construction of the Inner Ring Road with the Lorry Route (i.e. the section between Jalan Tun Abdul Razak and Jalan Tebrau) as a six (6)-lane road.
   b. Construction of the Inner Ring Road (i.e. the section between Jalan Yahya Awal and Jalan Tun Abdul Razak) as a four (4)-lane road.
   c. Widening of the Inner Ring Road with the Lorry Route (i.e. the section between Jalan Tebrau and Jalan Bukit Meldrum or Lorry Custom Complex).

(3) Phase III: 1996 — 2000

1. Construction of the Toll Expressway Access.
2. Construction of the section of the Inner Ring Road between Jalan Abu Bakar and Jalan Yahya Awal.

7. PROJECT IMPLEMENTATION PROGRAM

TABLE II-20. RECOMMENDED IMPLEMENTATION PROGRAM FOR PHASE I

Project	Number of Lane	Total Length (km)	Year 1985	1986	1987	1988	1989	1990
1. Johor Bahru – Pasir Gudang Southern Link								
a. Southern Link, section between Jalan Tebrau and Port Access	4	14.53		----------	•••••••••	———		
b. Southern Link Extension	4	2.17			---------	••••••••••••	———	
2. Short – Term Causeway Dispersal scheme	–	3.09	--------	———	———	———		
3. Inner Ring Road including Lorry Route section between Jalan Tebrau and Jalan Bukit Meldrum/Lorry Custom Complex	4	2.44		--------	••••••••••••	———		

TABLE II-21. RECOMMENDED IMPLEMENTATION SCHEDULE FOR PHASE II

	Number of Lane	Total Length (km)	Year 1991	1992	1993	1994	1995
1. Johor Bahru – Pasir Gudang Southern Link							
a) Widening of Southern Link, section between Jalan Tebrau and Pasir Gudang Port	6	18.30	--------	———	———	———	———
b) Construction of 8 Grade–Separated Interchanges	–	–	--------	———	———	———	———
2. Long – Term Causeway Traffic Dispersal Scheme	–	4.37	-------- •••••••••	———	———	———	
3. Inner Ring Road including Lorry Route							
a) Inner Ring Road with Lorry Route section between Jalan Yahya Awal and Jalan Tebrau	4 & 6	1.46	--------	•••••••••	———	———	———
b) Widening of Inner Ring Road with Lorry Route section between Jalan Tebrau and Jalan Bukit Meldrum/Lorry Custom Complex	6	2.44	•••••••••	———	———	———	———

TABLE II-22. RECOMMENDED IMPLEMENTATION SCHEDULE FOR PHASE III

	Number of Lane	Total Length (km)	Year 1996	1997	1998	1999	2000
1. Toll Expressway Access	4	3.99	--------	•••••••••	———	———	———
2. Inner Ring Road, section between Jalan Abu Bakar and Jalan Yahya Awal	4	1.60	--------	•••••••••	———	———	———

Notes: ------- Detailed Engineering
••••••• Land Acquisition
——— Construction

7-2 Investment Program

(1) General Investment Program

Based on the implementation schedule, the investments requirements for the Projects are estimated for detailed engineering service, land acquisition and compensation, and construction of roadway and structure. They are divided into foreign and local currency and are presented in 1983 prices. Overall investment cost of all the projects requires $388,642,000, of which $144,976,000, $167,328,000 and $76,338,000 are allocated to phase I, phase II and phase III respectively (see Table II-23). Annual investment costs by phase in detail is illustrated in Table II-24.

(2) Toll System for the Tebrau Bridge

Since the Johor Bahru–Pasir Gudang Southern Link is to be an Intra-Urban Primary Distributor, the road, which is to be principally constructed by the Government's Development Fund, should be toll-free for traffic.

The economic evaluation recommends that the Southern Link should be implemented as soon as possible. After it has been implemented, development along the Johor Bahru–Pasir Gudang Corridor will almost certainly be promoted.

However, because of the Government's financial situation, the early implementation of the Southern Link appears difficult.

In this Study, therefore, toll application on the Tebrau Bridge of the Johor Bahru–Pasir Gudang Southern Link is examined to determine whether or not the capital cost of the Tebrau Bridge can be reimbursed and how long reimbursement may take.

According to a preliminary financial analysis on toll application on the Tebrau Bridge, the capital cost is expected to be reimbursed within (10) years of the opening of the Bridge to traffic.

The Study Team suggests that the possibility of toll application on the Tebrau Bridge be further examined as one source of capital when this road project is implemented.

TABLE II-23. TOTAL INVESTMENT REQUIREMENTS BY PHASE

Phase	Detailed Engineering Service	Land Acquisition and Compensation Cost	Construction Cost			Total
			Roadway	Structure	Sub-Total	
Phase I 1985 – 1990	3,929	27,019	73,674	40,354	114,028	144,976
Phase II 1991 – 1995	4,475	15,157	33,580	114,116	147,696	167,328
Phase III 1996 – 2000	1,890	13,345	30,236	30,867	61,103	76,338
Total	10,294	55,521	137,490	185,337	322,827	388,642

(In Thousand $ at 1983 Prices)

TABLE II-24. ANNUAL INVESTMENT REQUIREMENTS BY PHASE (M$'000)

Year	Detailed Engineering Service	Land Acquisition and Compensation Cost	Construction Cost			Total
			Roadway	Structure	Sub-Total	
1985	752					752
1986	2,130	4,993	1,010	4,622	5,632	12,755
1987	1,047	15,916	2,020	4,622	6,642	23,605
1988		4,073	16,539	12,152	28,691	32,764
1989		2,037	26,841	12,590	39,431	41,468
1990			27,208	6,368	33,576	33,576
Total	3,929	27,019	73,674	40,354	114,028	144,976
1991	4,172	3,376		5,557	5,557	13,105
1992	303	11,781	5,947	27,416	33,363	45,447
1993			8,933	35,582	44,515	44,515
1994			9,350	32,804	42,154	42,154
1995			9,350	12,757	22,107	22,107
Total	4,475	15,157	33,580	114,116	147,696	167,328
1996	1,890					1,890
1997		13,345				13,345
1998			6,048	12,347	18,395	18,395
1999			12,094	12,347	24,441	24,441
2000			12,094	6,173	18,267	18,267
Total	1,890	13,345	30,236	30,867	61,103	76,338

Note: The Construction Cost Includes the Cost of Construction Supervision.

APPENDIX 1

LIST OF MALAYSIAN AND JAPANESE GOVERNMENT OFFICIALS CONCERNED AND STUDY TEAM MEMBERS

APPENDIX 2

WIDENING OF JALAN TEBRAU INTO SIX (6)-LANES

APPENDIX 3

ALTERNATIVE ROUTE STUDY OF EASTERN PART OF INNER RING ROAD INCLUDING LORRY ROUTE

APPENDIX 1. LIST OF MALAYSIAN AND JAPANESE GOVERNMENT OFFICIALS CONCERNED AND STUDY TEAM MEMBERS

1-1 LIST OF MALAYSIAN MEMBERS OF THE STEERING AND THE TECHNICAL COMMITTEE

(1) STEERING COMMITTEE

- **MASTER PLAN**

Chairman	Y.B. Tan Sri Ishak bin Pateh Akhir	Economic Planning Unit, Prime Minister's Department
Chairman	Mr. Ali Abdul Hassan	Economic Planning Unit, Prime Minister's Department
	Mr. Ismail bin Mohamed	Economic Planning Unit, Prime Minister's Department
Secretary	Mr. Annuar bin Khabar	Economic Planning Unit, Prime Minister's Department
	Mrs. Faridah Mohd. Ali	Economic Planning Unit, Prime Minister's Department
	Mr. Elaguppillai Balasubramaniam	High Planning Unit, Ministry of Works and Utilities
	Mr. Ghazali bin Bujang	Highway Planning Unit, Ministry of Works and Utilities
	Mr. Shigeru Komae (Colombo Plan Expert)	Highway Planning Unit, Ministry of Works and Utilities
	Mr. Yoon Shee Leng	Public Works Department
	Mr. Shamsuddin bin Che Mat	Ministry of Transport
	Mr. Megat Amir Nordin	Road Transport Department
	Mrs. Teh Zawahir	Town and Country Planning, (Federal)
	Dr. Shahir bin Nasir	State Planning Unit (Johor State)
	Mr. Zainnudin bin Mohamad	Town and Country Planning (Johor State)

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Economic Planning Unit (EPU)

Y.B. Tan Sri Dato' Sallehuddin bin Mohamed	– Director General
Mr. Ali Abul Hassan bin Sulaiman	– Senior Director, Infrastructure and Public Utilities Section
Miss Siti Hadzar bte Mohd. Ismail	– Deputy Director, Infrastructure and Public Utilities Section
Mr. Lim Boon Kang	– Director, Technical Section
Mr. Ismail bin Mohamed	– Principal Assistant Director Infrastructure and Public Utilities Section
Mr. Annuar bin Khabar	– Assistant Director, Infrastructure and Public Utilities Section
Mrs. Farida bte Hj. Mohd. Ali	– Assistant Director, Infrastructure and Public Utilities Section

APPENDIX I.

Ministry of Transport		
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Road Transport Department (Headquarters)		
Mr. Megat Amir bin Nordin	–	Director, Public Service Vehicles Division
Ministry of Works		
Mr. Lamien bin Sawiyo	–	Assistant Secretary, Development Division
Ministry of Foreign Affairs		
Mr. Hassanuddeen bin Abd. Aziz	–	Assistant Secretary
Highway Planning Unit (HPU)		
Mr. Elaguppillai Balasubramaniam	–	Director
Mr. Ong Eng Poe	–	Deputy Director
Mr. Shigeru Komae	–	Colombo Plan Expert
Public Works Department (Headquarters)		
Mr. Chew Swee Hock	–	Senior Engineer, Design Section
Mr. Han Joke Kwang	–	Senior Engineer, Design Section
Implementation and Coordination Unit (ICU)		
Mr. Lim Wen See	–	Director, Infrastructure Division
Mr. Annies bin Mohd. Ariff	–	Senior Engineer, Infrastructure Division
Town and Country Planning Department (Headquarters)		
Mrs. Teh Zawahir	–	Director, Urban Division
Mr. P. Gunasilan	–	Senior Assistant Director, Urban Division
Directorate of National Mapping		
Mr. Abdul Majid bin Abdul Hamid	–	Deputy Director, Topographical Survey Division
State Economic Planning Unit, Johor		
Dr. Shahir bin Nasir	–	Deputy State Secretary/ Director
Mr. Abdul Latif bin Yusof	–	Assistant Director
Public Works Department, Johor		
Mr. Edward Cheah Bian Siew	–	Director
Town and Country Planning Department, Johor		
Mr. Zainuddin bin Mohammed	–	Director
Minicipal Council, Johor Bahru		
Mr. Mohd. Noh bin Ibrahim	–	Engineer

APPENDIX 1.

(2) TECHNICAL COMMITTEE

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Chairman	Dr. Shahir bin Nasir	Deputy State Secretary, (Johor State)
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Secretary	Mrs. Zainee bte Abdul Jalil	State Planning Unit, (Johor State)
	Y.B. Dato Hj. Abd. Kadir bin Hj. Samon	State Land and Mines, (Johor State)
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	Y.B. Dato Abdul Razak bin Abdullah	Town Council; MPJB
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	Mr. Edward Cheah Bian Siew	Public Works Deparment, (Johor State)
	Mr. Yoon Shee Leng	Public Works Department, (Federal)
	Mr. Zainuddin bin Mohamad	Town and Country Planning, (Johor State)
	Mr. Ghazali bin Bujang	Highway Planning Unit Ministry of Works and Utilities
	Mr. Hiroshi Nakajima (Colombo Plan Expert)	Highway Planning UNit Ministry of Works and Utilities
	Mr. Ghazali bin Hj. Rasid	Road Transport Department, (Johor State)
	Mr. Harun bin Baba	Development Office, (Johor State)

• FEASIBILITY STUDY

Technical Committee, Government of Malaysia

State Secretary Office, Johor

Y.B. Dato' Suleiman bin Mohd. Noor	– State Secretary

State Economic Planning Unit, Johor

Dr. Shahir bin Nasir	– Deputy State Secretary/ Director
Mr. Abdul Latif bin Yusof	– Assistant Director

State Development Office

Mr. Harun bin Baba	– State Development Officer

Municipal Council, Johor Bahru

Y.B. Dato' Ishak bin Mohd. Yusof	– Deputy Chairman
Mr. Mohd. Noh bin Ibrahim	– Engineer

Land and Mines Department, Johor

Y.B. Datin Paduka Fatimah bte Abdullah	– Director

Police Department, Johor

Y.B. Dato' Jaafar bin Abdul	– Chief Police Officer
Mr. A. Savapathy	– Chief of Traffic Division

Economic Planning Unit (EPU)		
Mr. Annuar bin Khabar	–	Assistant Director
Highway Planning Unit (HPU)		
Mr. Elaguppillai Balasubramaniam	–	Director
Mr. Ong Eng Poe	–	Deputy Director
Mr. Shigeru Komae	–	Colombo Plan Expert
Public Works Department (Headquarters)		
Mr. Han Joke Kwang	–	Senior Engineer
Public Works Department, Johor		
Mr. Edward Cheah Bian Siew	–	Director
Town and Country Planning Department, Johor		
Mr. Zainuddin bin Mohamad	–	Director
Road Transport Department, Johor		
Mr. Abdul Rahman bin Ismail	–	Director
Structure Plan Unit, Johor		
Mr. Lee Kee Teck	–	Project Manager

1-2 MEMBERS OF JAPANESE SUPERVISORY COMMITTEE

• MASPTER PLAN

Supervisory Committee, JICA, Government of Japan

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	Mr. Takeshi Shiina	Ministry of Construction
	Mr. Hiroshi Yamano	Urban Development Public Corporation
	Mr. Yasutake Inoue	Ministry of Construction
	Mr. Taro Kaji	Ministry of Construction

• FEASIBILITY STUDY

Supervisory Committee, JICA, Government of Japan

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	Mr. Tsuyoshi Hayakawa	Urban Development Public Corporation
	Mr. Tetsuo Matsumura	Ministry of Construction
	Mr. Yasuyuki Tanaka	Ministry of Construction
Coordinator	Mr. Nobuyoshi Iwasaki	Japan International Cooperation Agency

APPENDIX 1.

1-3 MEMBERS OF STUDY TEAM

• MASTER PLAN

Japanese Expert

Team Leader	Mr. Kokuro Hanawa	Traffic Engineering and Management
Project Coordinator	Mr. Toshio Kimura	Transport Economy
	Mr. Hideaki Hoshina	Land Use Planning
	Mr. Toshisada Katsurada	Transport Planning
	Mr. Koji Saito	Road Planning
	Mr. Hiroitsu Yamakawa	Public Transport Planning
	Mr. Seiichiro Yamazaki	System Analysis
	Mr. Susumu Nigo	Traffic Engineering
	Mr. Tadashi Heida	Commodity Flow
	Mr. Masato Ohno	Environmental Analysis

Malaysian Counterpart

Mrs. Aishah bte Othman	Transport Planning. Highway Planning Unit
Mr. Noharuddin bin Nordin	Transport Planning. Road Transport Department

• FEASIBILITY STUDY

Team Leader	Mr. Toshio Kimura	Transport Economy
	Mr. Hideaki Hoshina	Landuse Planning
	Mr. Toshisada Katsurada	Transport Planning
	Mr. Koji Saito	Highway Planning
	Mr. Kokuro Hanawa	Traffic Engineering and Management
	Mr. Mikio Higai	Bridge Engineering
	Mr. Michimasa Takagi	Highway Design
	Mr. Hikaru Nishimura	Traffic Engineering
	Mr. Hiroshi Nakamura	Traffic Engineering
	Mr. Junji Yasui	System Engineering
	Mr. Katsumi Ichikawa	Geotechnical Engineering

APPENDIX 2. WIDENING OF JALAN TEBRAU INTO SIX (6)-LANES

1. Introduction

The widening of Jalan Tebrau into a four (4)-lane dual carriageway proposed by JKR comprises the following three (3) packages:

Package 1: Pandan Bridge and its approaches section
Kp: 6 K 770 — 7 K 040 Length: 0.280 km
Package 2: Pandan Bridge to the intersection with Jalan Masai
Kp: 7 K 040 — 9 K 420 Length: 2.380 km
Package 3: Tebrau Interchange to Pandan Bridge
Kp: o K 000 — 6 K 770 Length: 6.770 km

Package 1 has already been constructed and as for both Package 2 and Package 3, the detailed engineering design has been completed recently. However, in the understanding that the projected future traffic demands, as indicated in the Masterplan and Feasibility studies following the construction of the Toll Expressway and the development of the Johor Bahru — Pasir Gudang Corridor, will surpass the capacity of the proposed four(4)-lane Jalan Tebrau, a six(6)-lane carriageway was recommended in the Master Plan Study. As interest in the widening of the Package 3 section into a six(6)-lane carriageway was shown by the Government agencies concerned, the possibility of widening Jalan Tebrau was examined in the Progress Report (I) (November, 1982). In the Report, it was concluded that the widening of Jalan Tebrau into a six(6)-lane carriageway is technically and socially possible within the reserved fourty(40) meters right-of-way.

The Draft Final Report of the Feasibility Study on Road Construction and Improvement Project in Johor Bahru and its Conurbation has already been submitted to the Government in November, 1983. The Study stressed that it is necessary to upgrade the road system in the Central Area of Johor Bahru simultaneously with the widening of Jalan Tebrau into a six(6)-lane carriageway.

This report, therefore, deals with the preparation of the implementation programme of the Jalan Tebrau reconstruction project with the traffic dispersal project in the Central Area of Johor Bahru.

2. Traffic and Social Requirements

1. The roads in Johor Bahru are not sufficiently developed in contrast with the urbanization and the growth of town.
2. Jalan Tebrau in particular is over-loaded by heavy traffic volume which is due to the high density housing developments along the road. (See Fig. 1)

3. Plan and Design of Jalan Tebrau

1. Jalan Tebrau is planned as an Intra-Urban Primary Distributor. This road will have the following traffic functions:
   a. Collecting and distributing traffic which originates and terminates in the surrounding developed areas.
   b. Dispersing in-coming traffic from the existing and planned major roads.
   c. Carrying through traffic to the CBD from the East and North.
2. The typical cross-section adopted for Jalan Tebrau as a six(6)-lane road is illustrated in Fig. 2

APPENDIX 2.

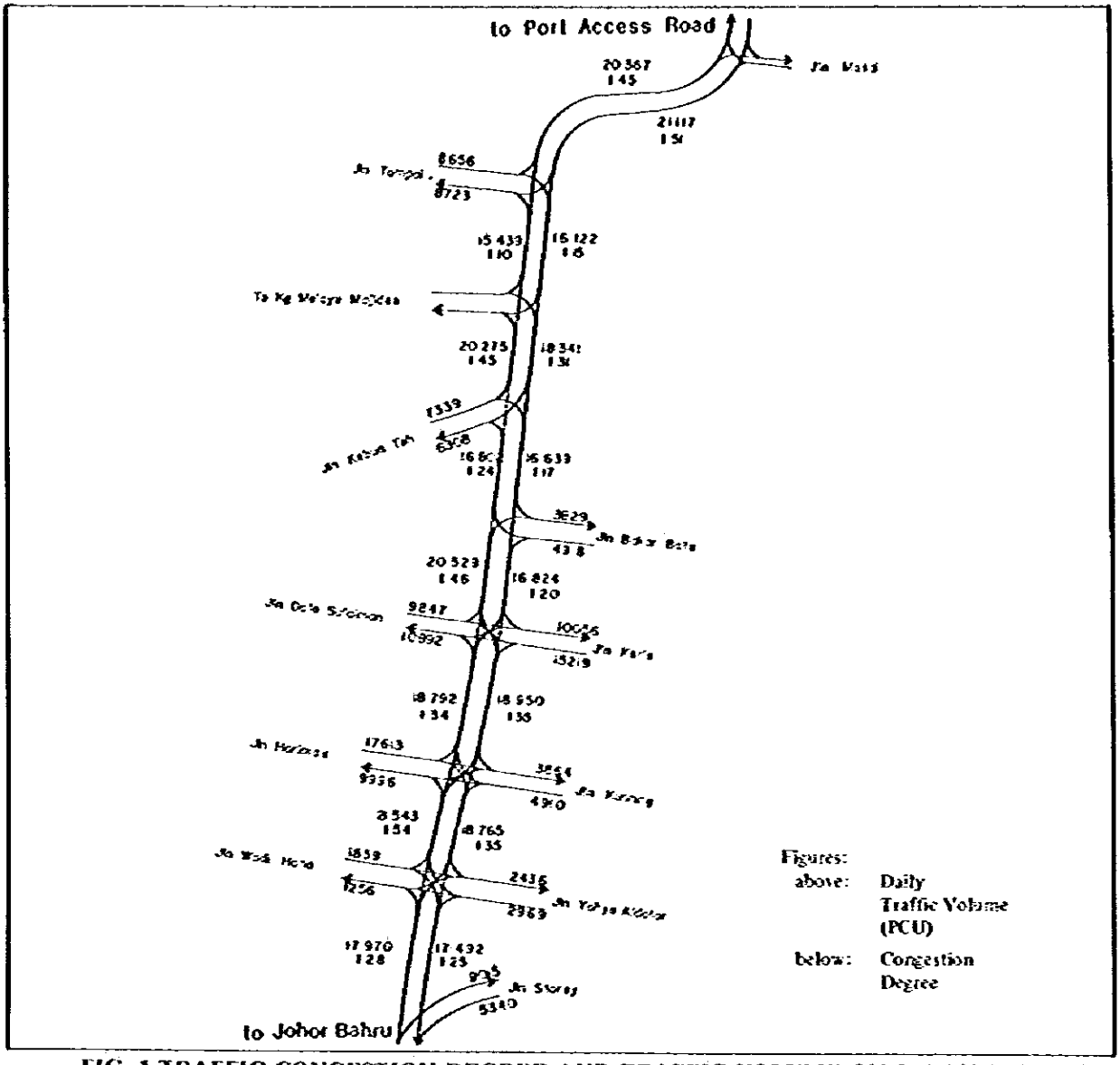


FIG. 1 TRAFFIC CONGESTION DEGREE AND TRAFFIC VOLUME ON JALAN TABRAU

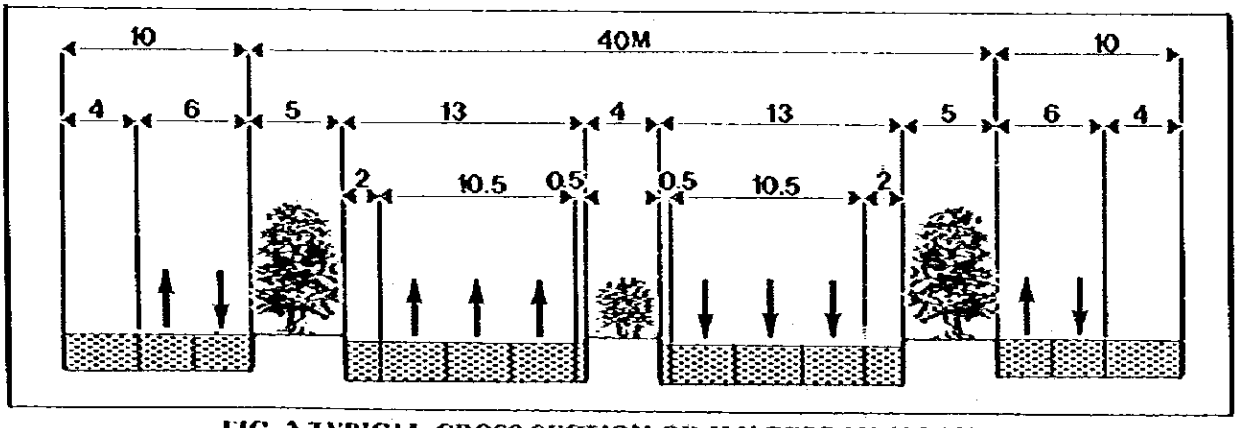


FIG. 2 TYPICAL CROSS-SECTION OF JLN TEBRAU (6-LANE)

3. Planting will be provided at the median and along the carriageway.
4. An overbridge for pedestrian crossing will be provided on Jalan Tebrau around the developed area.
5. Only left turning egress and ingress are allowed at intersections with minor roads. Median openings provided for U-turns are meant for traffic entering from such minor roads.
6. Public utilities will be provided beneath service roads or sidewalks.
7. Six(6) grade-separated interchanges including the Toll Expressway interchange and five(5) signalized intersections are recommended to be constructed. (See Fig. 3)

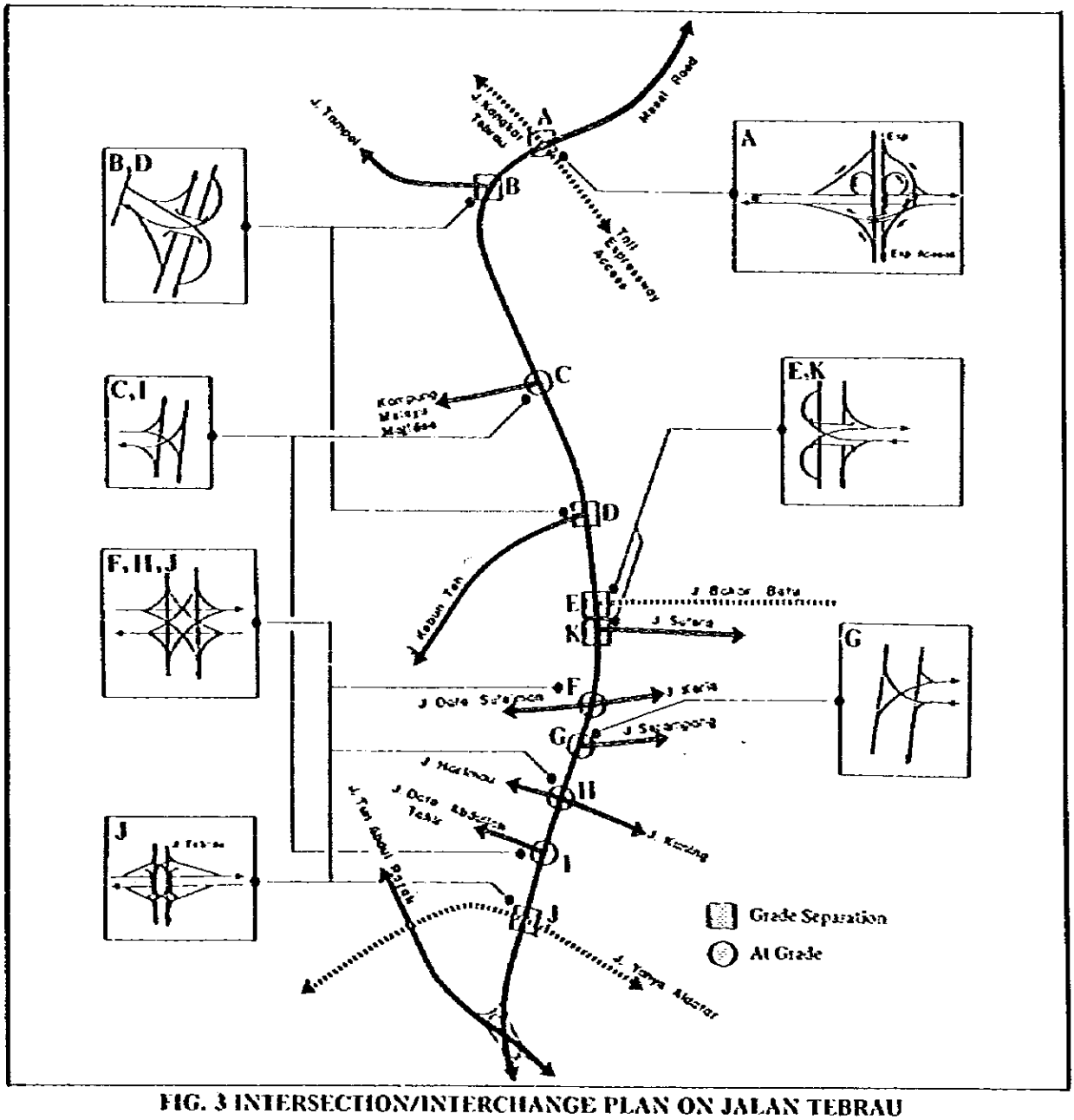


FIG. 3 INTERSECTION/INTERCHANGE PLAN ON JALAN TEBRAU

APPENDIX 2.

8. The coordinated traffic signal system is to be introduced in order to minimize travel time as well as vehicle operating cost on Jalan Tebrau.

9. Service roads should be provided alongside of Jalan Tebrau. Bus exclusive lanes should be constructed for bus stops in order to avoid disturbance of through traffics. (See Fig. 4)

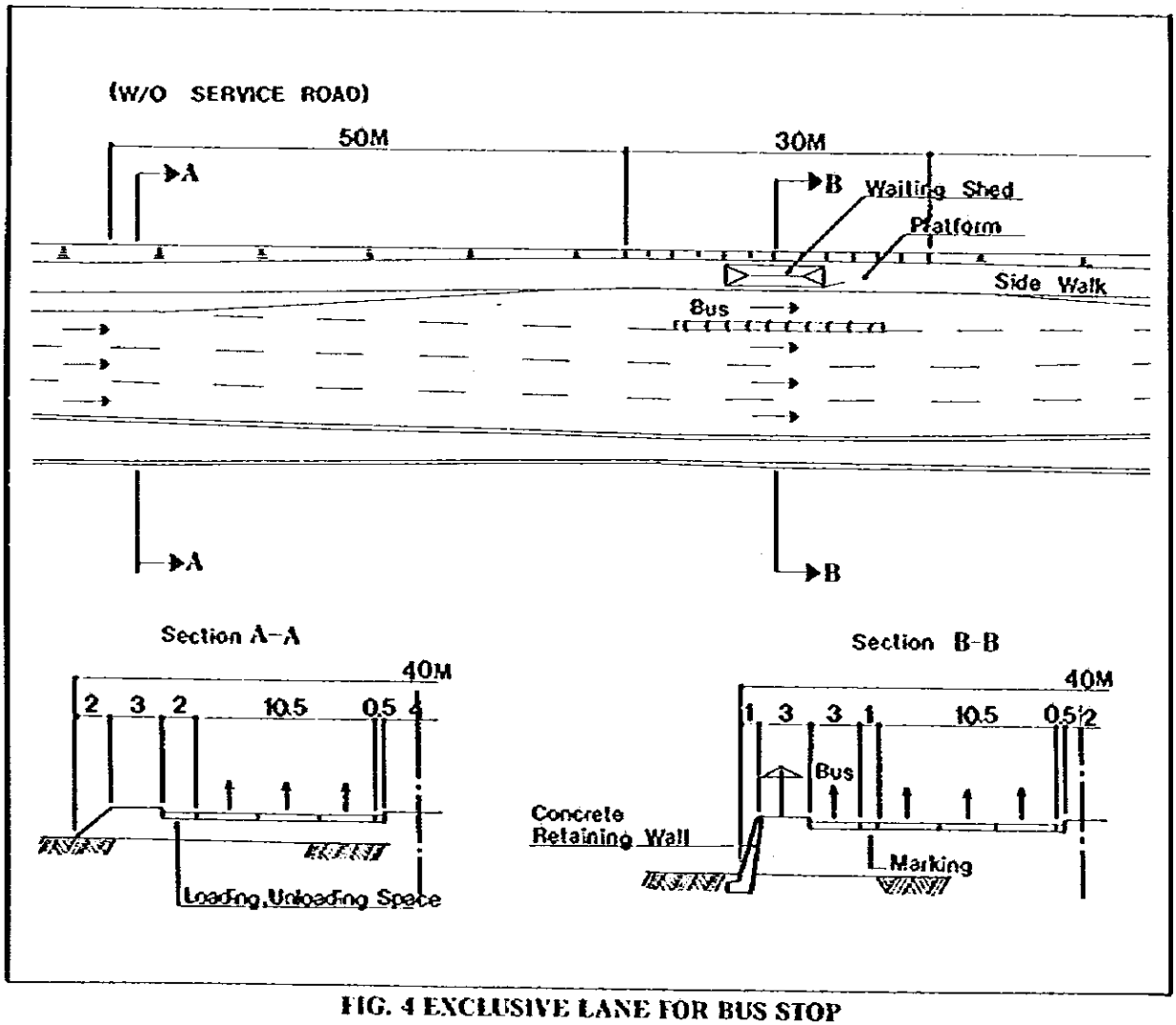


FIG. 4 EXCLUSIVE LANE FOR BUS STOP

4. Project Cost Estimates

The project cost comprises the following:
a. Land Acquisition and Compensation
b. Construction of Road, Bridge and Interchange
c. Transfer of Public Utilities

These components are quoted in:
a. Foreign Currency
b. Local Currency
c. Tax

The project cost for the reconstruction project of Jalan Tebrau into a six(6)-lane road including the short-term traffic dispersal scheme is shown in Table 1.

The total project cost is estimated at M$108 million, while the construction cost is estimated to be M$97.7 million and the land acquisition and compensation cost estimate is M$10.3 million.

TABLE 1 CONSTRUCTION COST ESTIMATES (In thousand M$ at 1983 prices)

(in M$'000)

		Length (m)	Land Acquisition	Construction Cost					Total	In Foreign Currency	In Local Currency
				Road	Inter Change	Bridge	Utility	Total			
Jln Tebrau											
Package 2	Pandan Bridge – Jln Masai	3,100	2,450	12,450	1,200	1,300	3,060	17,950	20,360	7,400	12,950
Package 3	Tebrau IC – Jln Mariman	1,600	4,200	8,850	7,550	0	1,580	18,183	22,350	7,431	14,859
	Jln Mariman – Jln Bakar Batu	1,750	0	7,400	6,350	0	1,730	15,430	15,430	6 358	9,072
	Jln Bakar Batu – Toll Expressway	3,450	3,700	13,850	11,300	2,690	3,420	31,120	34,820	12,822	21 998
	Sub-Total	6,800	7,900	30,000	25,400	2,690	6,730	64,730	72,630	26,671	45,959
Total		9,900	10,300	42,450	26,600	3,990	9,790	82,690	92,990	34,071	58 919
Short-Term Traffic Dispersal Plan		3,090	0	5,317	0	9,731	0	15,048	15,048	6,474	8,574
Grand Total		12,990	10,300	47,717	26,600	13,631	9,790	97,738	108,038	40,545	67,493

Notes: (1) Construction cost includes detailed engineering cost.
(2) Plan and design of the short term dispersal plan are mentioned in chapter 3 in this report.

5. Economic Indicators

Judging from the results of the economic analysis, the reconstruction project of Jalan Tebrau is economically highly feasible.

The sensitivity analysis shows that the project is still highly feasible even with a 20 per cent increase of the project cost and/or a 20 per cent decrease of the project benefit.

TABLE 2 ECONOMIC INDICATORS

DISCOUNTED BENEFIT (M$ '000)	319,913
DISCOUNTED COST (M$ '000)	91,929
B/C RATIO	3.48
NET PRESENT VALUE (M$ '000)	227,984
INTERNAL RATE OF RETURN (%)	38.5

Notes: 1) Opening year is assumed to be 1988
2) Discount rate adopted is 12%

APPENDIX 2.

TABLE 3 RESULT OF THE SENSITIVITY ANALYSIS

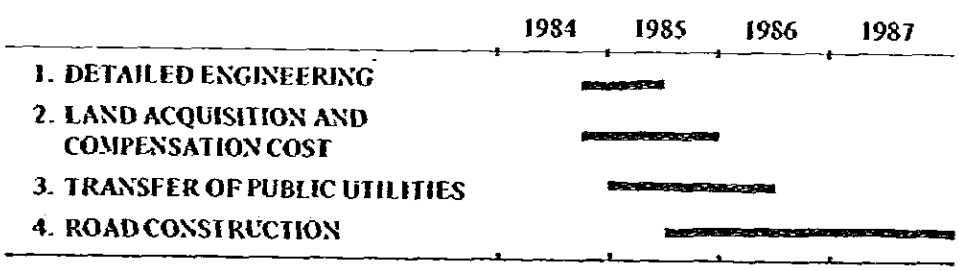
	B/C Ratio	Net Present Value (M$'000)	Internal Rate of Return (%)
ORIGINAL PLAN	3.48	227,984	38.5
20% INCREASE OF PROJECT COST	2.90	209,598	32.0
20% DECREASE OF PROJECT BENEFIT	2,78	164,001	30.8
20% INCREASE OF PROJECT COST and 20% DECREASE OF PROJECT BENEFIT	2.32	145,616	25.9

Notes: 1) Opening year is assumed to be 1988
2) Discount rate adopted is 12%

6. Implementation Programme

The implementation programme is established as follows:

TABLE 4 RECOMMENDED IMPLEMENTATION PROGRAMME



Based on the above-mentioned schedule, the annual funding requirements are established as follows:

TABLE 5 ANNUAL FUNDING REQUIREMENTS (In thousand M$ at 1983 prices)

	Land Acquisition	Detailed Engineering	Transfer of Utilities	Construction				Total	In Foreign Currency	In Local Currency
				Road	Interchange	Bridge	Total			
1984	1,717	586						2,303	243	2,060
1985	8,583	2,346	6,330	9,257	10,321	6,611	26,189	43,448	14,463	28,935
1986			3,166	18,514	10,321	6,612	35,447	38,613	16,018	22,595
1987				18,514	5,160		23,674	23,674	9,821	13,853
Total	10,300	2,932	9,496	55,781	25,802	13,224	85,310	108,038		

APPENDIX 3. ALTERNATIVE ROUTE STUDY OF EASTERN PART OF INNER RING ROAD INCLUDING LORRY ROUTE

Based on the filed investigation and the land use and traffic studies conducted, five (5) alternative routes for the Inner Ring Road or the Lorry Route have been established and presented in Fig. 5.

These alternative routes are evaluated by a comparative analysis of the technical, socio-environmental and construction cost standpoints.

The results of the comparative analysis are shown in Table 6. Consequently, the following conclusions can be arrived at:

a. Routes 'A' and 'B' are not recommended as they accommodate only for lorry traffic and interfere with the development plan of the Malayan Railway as well as the urban development plan of the eastern part of the Central Area formulated by the Structure Plan.

b. Route 'C' is the cheapest plan among the alternatives. However, the implementation of 'C' will involve a duplicate investment when the construction of the Inner Ring Road is completed.In addition, route 'C' presents weaving problems at the section between Tebrau Interchange and Storey Intersection.

c. Route 'E' is also not recommended as this interferes with the development plan of the Malayan Railway as well as the urban development plan of the eastern part of the Central Area.

d. Route 'D' is the most preferable route among the alternatives even though this has social problems of dislocating people on this route and the construction cost is comparatively expensive.

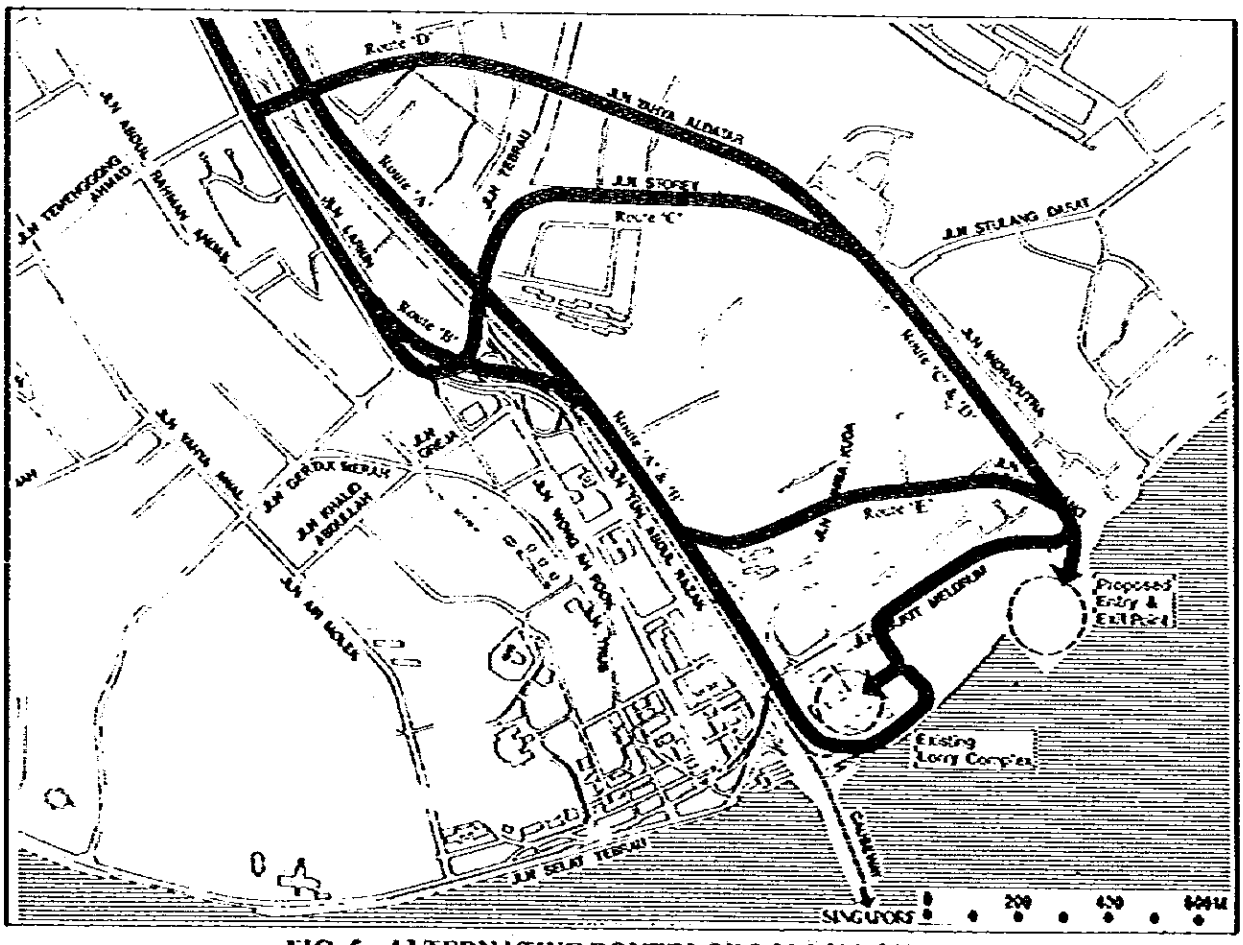


FIG. 5 ALTERNATIVE ROUTES OF LORRY ROUTE

APPENDIX 3.

TABLE 6 COMPARISON OF ALTERNATIVE ROUTES OF EASTERN PART OF INNER RING ROAD INCLUDING LORRY ROUTE

		'A'	'B'
Outline	Length	7,870 m	2,670 m
	Plan	Construction of Exclusive Lorry Way from Kempas to Lorry Complex utilizing KTMS reserve	Construction of Road from Tebrau Interchange to Jalan Bukit Meldrum
Technical Aspect	Major Structure	• Construction of New Interchange on Port Access Road • Reconstruction of 5 existing roadway bridges across Malayan Railway	• Construction of Via-duct over Tebrau Interchange • Reconstruction of one (1) roadway bridge
	Traffic Problem	No specific problem	No specific problem
	Network Configuration	This route will not form part of the Inner Ring Road.	This route will not form part of the Inner Ring Road.
	Impacts on Existing Urban/Transport Facility	• Two (2) water – pipelines are affected • Five (5) roadway bridges are affected	• One (1) water – pipeline is affected • One (1) roadway bridge is affected
	Flexibility	Not flexible (Served mainly for Lorry Traffic)	Not flexible (Served mainly for Lorry Traffic)
Socio-Environmental Aspect	Number of Housing Units affected	522 units (Mostly squatter Houses)	18 units
	Impacts on Urban Environment	• Environmentally more preferable than the others • Reduction of Traffic Congestion on the existing Lorry Route	• Environmentally more preferable than the others • Reduction of traffic congestion on the existing Lorry Route
	Impacts on Urban Development Plan in Eastern Part of Central Area	• Disruption of urban expansion toward eastern part of Central Area	• Disruption of urban expansion toward eastern part of Central Area
	Impacts on KTM Development Plan	• Interfere with KTMS Development Plan	• Interfere with KTMS Development Plan
Construction Cost	Construction Cost	M$ 14,500,000	M$ 10,100,000
	Land Acquisition and Compensation cost	26,000,000	6,300,000
	Total Cost	40,500,000	16,400,000
	Recommendation	Not Recommended	Not Recommended

APPENDIX 3.

'C'	'D'	'E'
3,350 m	2,980 m	2,680 m
Widening of Jln Storey into 4 – Lane	Construction of Linkage Between Jln Larkin and Jln Tebrau and widening of Jalan Yahya Aldatar	Construction of new road from Tebrau Interchange to Jln Ah Siang
• An overpassing bridge on Jln. Tebrau • Improvement of Tebrau interchange	• Construction of 2 major interchanges	• Construction of via-duct over Tebrau Interchange • Widening of Jalan Ah Siang
Weaving problem between Tebrau interchange and J. Storey	No specific problem	No specific problem
This route would be formed as Inner Ring Road	This route is the most preferable as part of the Inner Ring Road	This route is able to form part of the Inner Ring Road but rather inappropriate
• Some houses affected	• Some houses affected • 1 water-pipeline is affected	• One (1) pipeline is affected
Flexible	A little flexible between Jalan Larkin and Jalan Yahya Awal	Flexible
24 units	58 units	29 units
Environmentally some problems, but can be mitigated	• Environmentally some problems, but can be mitigated • Socially some problems such as people's dislocation	• Environmentally not preferable
None	None	• Disruption of existing community and urban expansion
None	None	• Interfere with KTMS Development Plan partially
M$ 9,200,000 6,350,000 15,550,000	M$ 20,300,000 15,550,000 35,850,000	M$ 11,960,000 9,600,000 21,560,000
Not Recommended	Recommended	Not Recommended