GOVERNMENT OF MALAYSIA

THE FEASIBILITY STUDY ON
TRANSPORTATION FACILITIES PROJECTS
IN KLANG VALLEY

FINAL REPORT

HIGHWAY PROJECT

TEXT

JUNE 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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CONTENTS

CHAPTER 1 : INTRODUCTION

1.1 Background

In the Klang Valley Transportation Study (hereinafter refered to as the "KVTS") conducted jointly by Japan International Cooperation Agency (hereinafter refered to as "JICA") with the Government of Malaysia from December 1985 to May 1987, a list of priority transportation facility development projects which included road improvement and construction projects has been proposed.

Subsequent to the acceptance of the proposals by the Government of Malaysia, the Feasibility Study on Transportation Facilities Projects in Klang Valley which includes the Highway Project (hereinafter refered to as "the Study") was commenced on the 29th day of October 1987 by JICA in cooperation with the Government of Malaysia.

Prior to this Report, four official reports, namely Progress Report I (February 1988), Interim Report (September 1988), Progress Report II (January 1989) and Draft Final Report (March 1989) were submitted to the Government of Malaysia. This report forms the Highway Project TEXT VOLUME of the Final Report submitted in July 1989. Supplementary information to those presented in the TEXT volume are compiled in the APPENDIX volume.

This volume of the Final Report contains the final conclusion and recommendations for the Highway Project as well as reporting on all the works done during October 1987 and March 1989.

1.2 Study Objective

This study on the Highway Project has the following objectives:-

(i) To examine the technical, economic and financial feasibility of the Project Roads;

(ii) To prepare the preliminary engineering design for the Project Roads following the results of the technical analysis;

(iii) To prepare a suitable implementation programme for the Project Roads; and

(iv) To transfer the necessary technical know-how and methodologies on the feasiblity study to the Malaysian counterparts in the course of the Study.

1.3 Study Component

The study comprises two specific Project Roads in Klang Valley that is:-

(i) Shah Alam Highway/Southern Part of Middle Ring Road II (MRR-II)
(ii) North-South Expressway Link (N-S Link)

Figure 1.3.1 shows the location of the Project Roads.

1.4 Study Approach

The Study Approach for the Highway Project is illustrated in Figure 1.4.1.

The KVTS forms the basis for the future traffic demand forecasting and initial identification of route location.

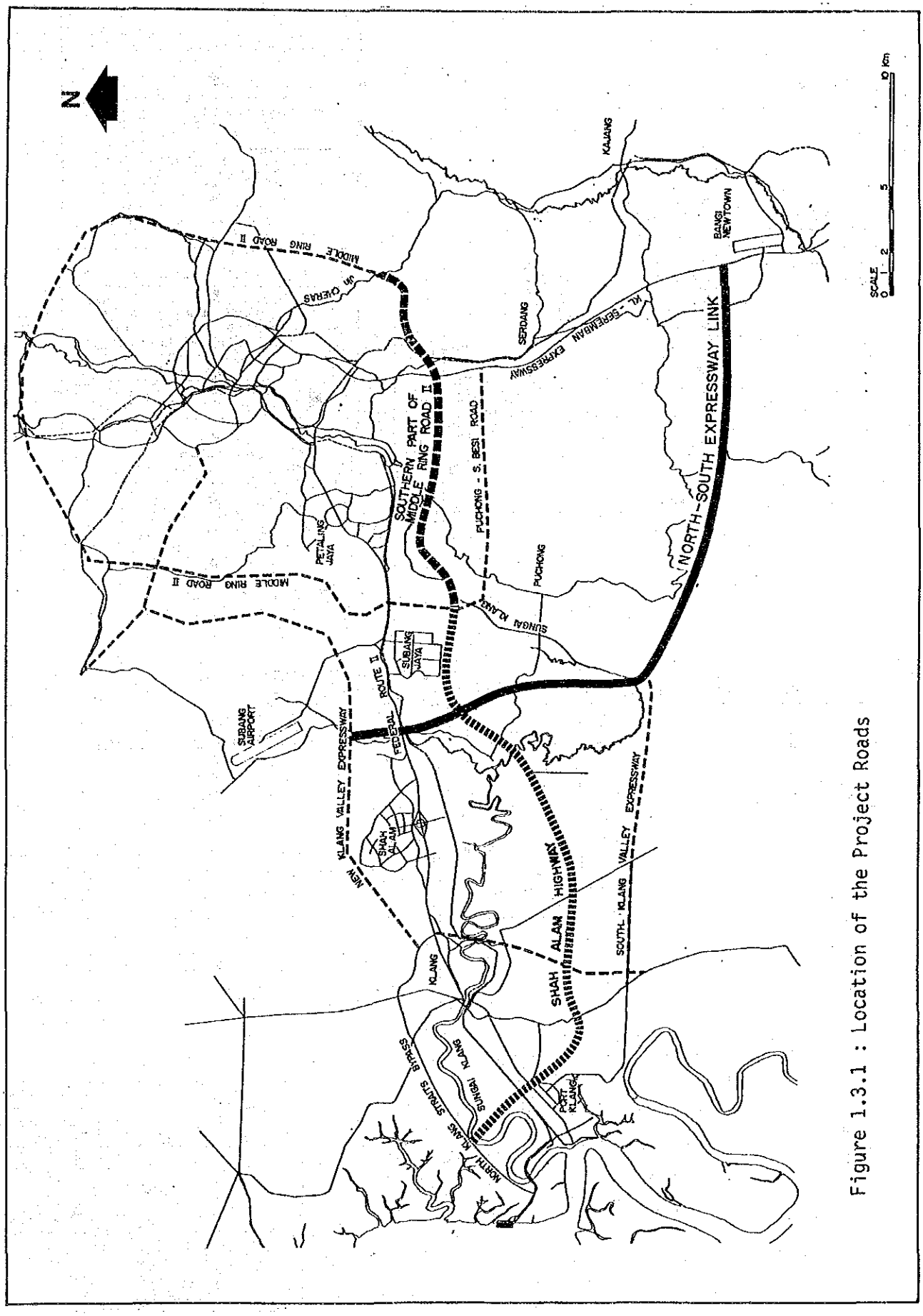


Figure 1.3.1 : Location of the Project Roads

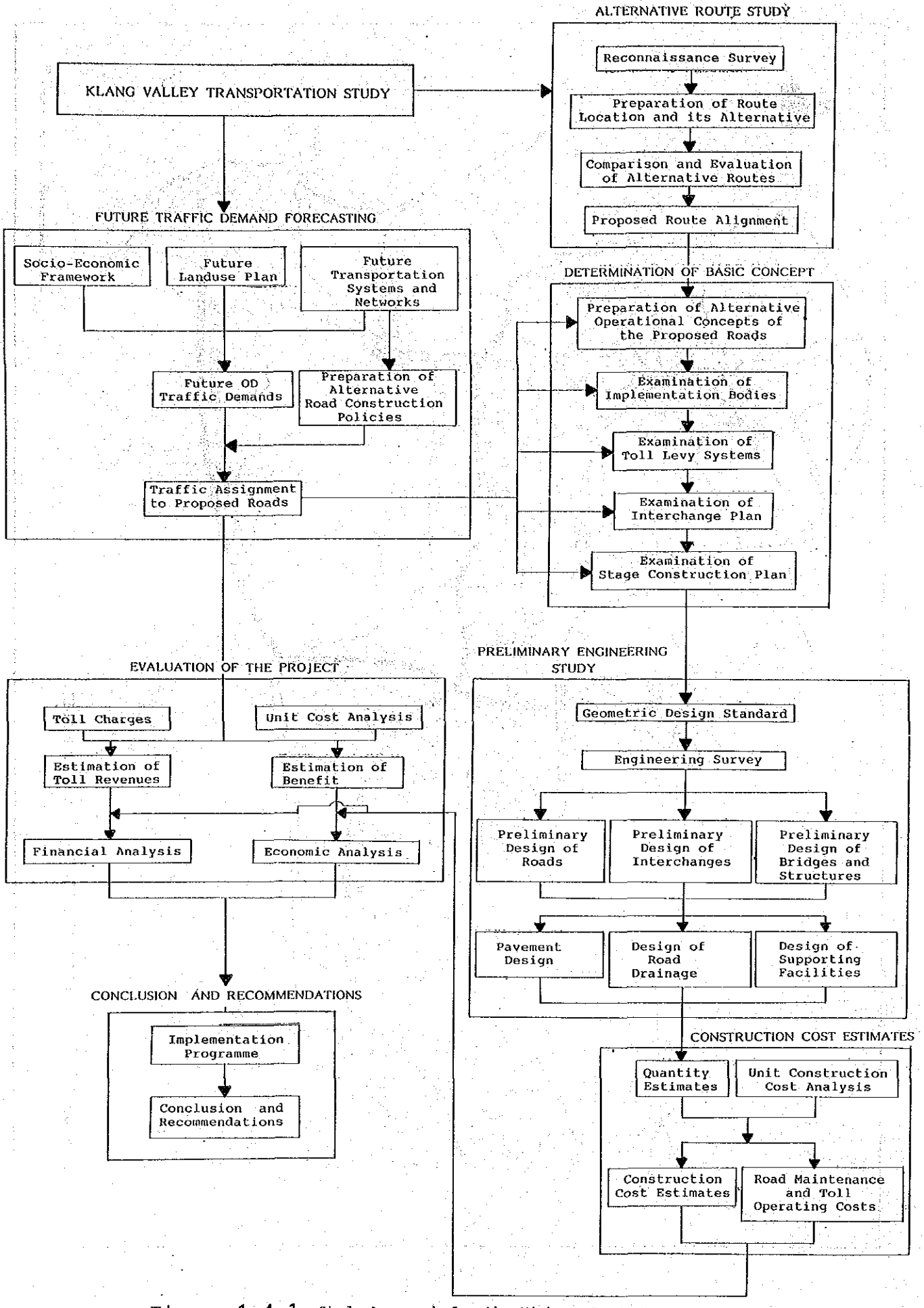


Figure 1.4.1: Study Approach for the Highway Project

1.5 Structure of the Report

Chapter 1 of the TEXT volume introduces the study background, objectives and approach as well as the structure of this report.

Chapter 2 presents the presumption for traffic demand forecasting, the estimated future OD traffic volume and the results of traffic assignment to the future road network in Klang Valley with and without the Project Roads and under conditions of alternative design concepts for the Project Roads.

Chapter 3 discusses the criteria for route selection and then sets out to describe the proposed routes which have been selected after deliberation on technical feasibility and evaluated by means of comparative analysis on alternative routes.

Chapter 4 discusses the formulation of basic design concepts of the Project Roads such as implementation concept, toll levy system, interchange plans and stage construction plans based on the pre-established landuse, population and employment plans, the traffic projection mentioned in Chapter 2 and alternative route study mentioned in Chapter 3.

Chapter 5 describes the results of the preliminary engineering study on the Project Roads based on the adopted basic design concept determined in Chapter 4. The contents of the preliminary engineering study include description of the R.O.W situation, geological analysis, geometric design, interchange plan and design, bridge design, pavement design, hydrological and road drainage study and design of road supporting facilities.

Chapter 6 describes the procedure for cost estimate and subsequently presents the cost estimates for construction, land acquisition, road maintenance and toll operation .

Chapter 7 describes the procedure for evaluation of the Project Roads from the standpoints of economic and financial viability. It presents the results of economic evaluation and financial analysis based on the basic assumptions made by the Study Team.

Chapter 8 describes the established implementation schedule which has been confirmed to be feasible by the economic evaluation and financial analysis.

Chapter 9 presents the overall conclusion and recommendations of the Study Team for the Highway Project.

CHAPTER 2 : FUTURE TRAFFIC DEMAND FORECASTING

2.1 General

The methodology for forecasting future traffic demand basically is as in the Klang Valley Transportation Study 1987. Data inputs for the demand forecasting however have to be adjusted to take into account economy growth rate since 1985 when data used in Klang Valley Transportation Study was collected. The unexpected slow growth in economy between 1985-87 for example has affected the household income level which in turn would affect vehicle ownership hence travel behaviour.

The feasibility study on the proposed highways also call for a further subdivision of traffic zones along the highway corridors. This is necessary in view of the fact that detail trip generation and attraction along the highway corridors are needed to forecast accurate traffic volume on the highways.

2.2 Presumption for Traffic Demand Forecasting

The various presumptions and inputs into the future traffic demand forecasting process briefly discussed above are elaborated below.

2.2.1 Socio-economic Framework

The future socio-economic framework as a result of the increase in future population, size and distribution, economic performance hence household income level is an important determinant in forecasting future traffic demand.

The Malaysian economy has undergone an unexpected slow economic growth during the 1985-86 period that warrants the re-examination of the 1985 base year socio-economic framework used in the Klang Valley Transportation Study.

(1) Population Framework

The population targets for Klang Valley and its distribution by districts and urban centres still hold for this Study because the demographic planning perspectives and policies remain unchanged.

The total population for Klang Valley in 2005 is still targetted at 5.55 million with 2.47 million in Kuala Lumpur, 427,000 people in Klang and Petaling Jaya, 430,000 for Shah Alam, 319,000 for Bangi and 142,000 for Selayang (Figure 2.2.1). The distribution by districts is illustrated in Figure 2.2.3 Population in Gombak District is expected to grow to 746,000 by 2005 surpassing those of Klang District at 677,000 and Hulu Langat District at 630,000.

Table 2.2.1 Future Population Framework, Klang Valley, 1980-2005

	1980	1985	1990	1995	2000	2005
Klang Valley as in Perspective Plan	2,020	-	3,283	-	4,760	-
Klang Valley's Population	2,020	2,534	3,283	3,940	4,760	5,550
Bukit Tinggi Development	-	-	-	-	-	100
Selangor State	1,517	1,822	2,158	2,530	2,939	3,385

Source : Klang Valley Transportation Study 1987

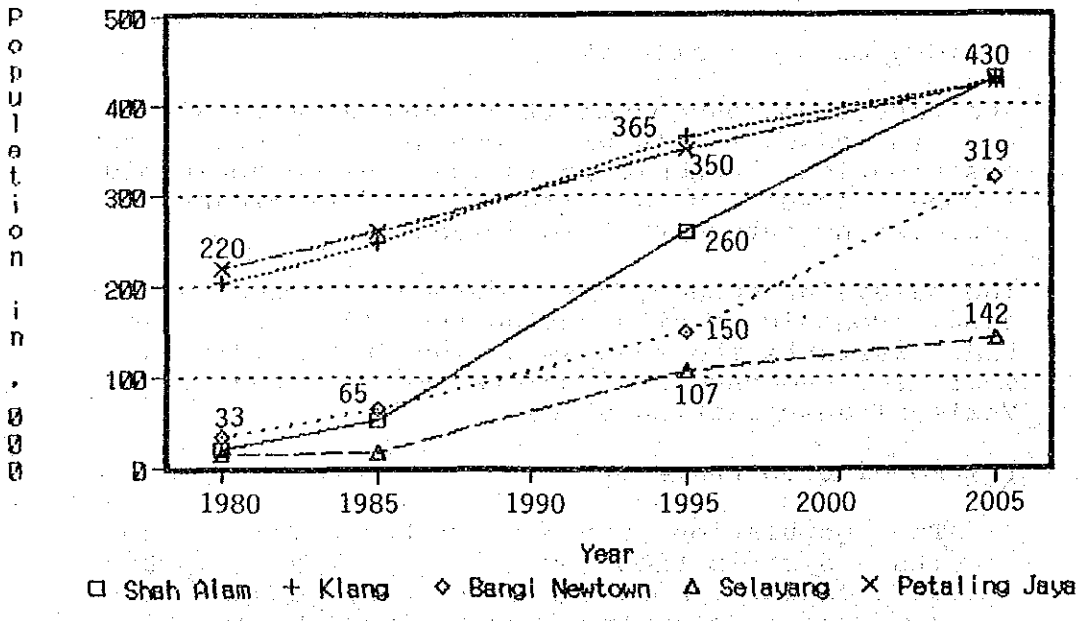
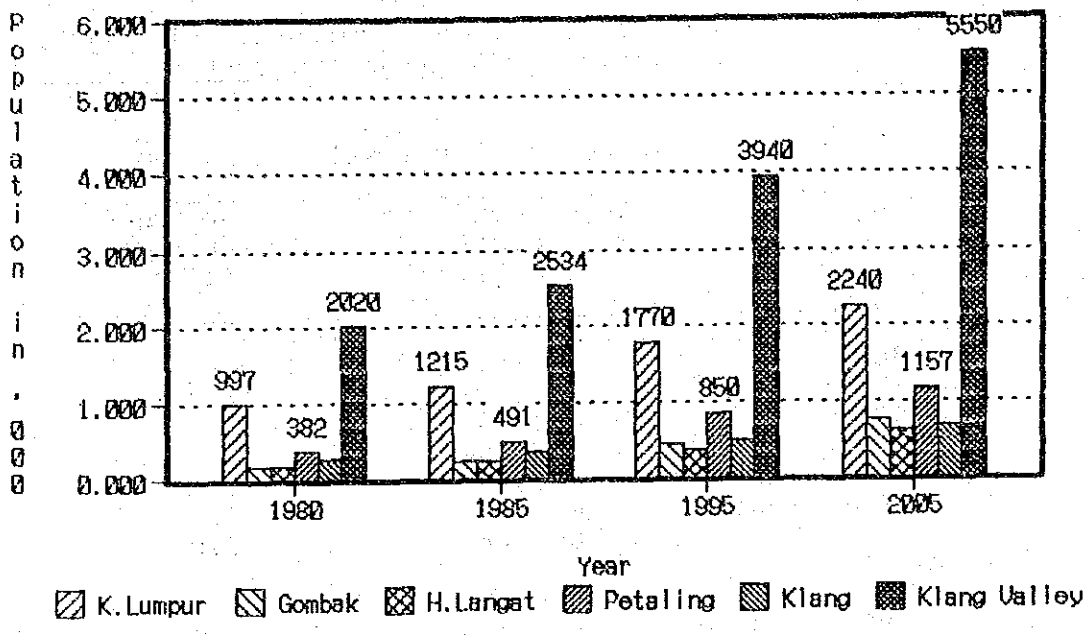


Figure 2.2.1 Population Growth in the Planned Urban Centres, 1980-2005



Data Source : Klang Valley Transportation Study, 1987

Figure 2.2.2 Population Growth in Klang Valley and its Districts, 1980-2005

(2) Economic Framework

The Malaysian economy in 1985 recorded a negative growth of 1.0% but recovered to a positive rate of 1.2% in 1986 and 2.0% in 1987 (Economic Report, 1987/88, Ministry of Finance). The total GDP for 1985 reported in the Fifth Malaysia Plan was revised from M$59,344 million to M$57,150 million. Moreover, the Ministry of Finance has projected the GDP to grow to M$61,360 million by 1988.

With the 1985 Base Year GDP figure being revised and the growth rate for the low estimates adjusted to 3%, the future GDP for 1990, 1995 and 2005 with the three forecasting levels are shown in Table 2.2.2

Table 2.2.2: Estimated Gross Domestic Product, Malaysia, 1985, 1995 and 2000

(In 1978 Constant Prices)

Year		Gross Domestic Product (M$ million)	Average Annual Growth Rate (%)
1985 1)		57,150	
1988 2)		61,360	2.4
1990 3)	Low	65,097	3.0
	Medium	67,649	5.0
	High	68,944	6.0
1995 3)	Low	75,465	3.0
	Medium	86,339	5.0
	High	92,263	6.0
2005 3)	Low	101,419	3.0
	Medium	140,637	5.0
	High	165,229	6.0

Source : 1) Economic Report, 1987/1988
2) Estimated by Ministry of Finance
3) Estimated by the Study Team

Adopting the medium estimates of GDP for 1990, 1995 and 2005, the GRP's for the Federal Territory of Kuala Lumpur and Selangor State are estimated and indicated in Table 2.2.3. Consequently, the GRP for Klang Valley is estimated and shown in Table 2.2.4

Table 2.2.3 : Estimated Gross Regional Product and Share to GDP, 1980-2005

(Unit : in M$ million)

Year	Malaysia	Federal Territory and Selangor State		Federal Territory of Kuala Lumpur		Selangor State	
	GDP	Share to GDP %	GRP	Share to GDP %	GRP	Share to GDP %	GRP
1980 1)	44,702	29.7	13,260	14.0	6,246	15.7	7,014
1985 2)	57,150	30.2	17,235	14.9	8,495	15.3	8,740
1990 3)	67,649	31.6	21,377	15.9	10,756	15.7	10,621
1995 3)	86,339	32.7	28,233	16.7	14,419	16.0	13,814
2005 3)	140,637	34.0	47,816	17.5	24,611	16.5	23,205

Source : 1) Fifth Malaysia Plan
2) Gross Regional Product (GRP) both in Federal Territory and Selangor State in 1985 is amended on the basis of the economic report 1987/88
3) Estimated by the Study Team

Table 2.2.4: Gross Regional Product - Share Of Klang Valley To Kuala Lumpur And Selangor State

(M$ million in 1978 Constant Prices)

Year	Federal Territory of Kuala Lumpur and Selangor State A	Klang Valley Region B	Share of Klang Valley (%) B/A
1985 1)	17,236	15,867	91.9
1995 2)	28,233	26,511	93.9
2005 2)	47,816	45,244	94.6

Source : 1) Economic Report 1987/88
2) Estimated by Study Team

(3) Employment Framework

With the revision on economic projection, employment figures by industry are revised accordingly. The total employment for Klang Valley in 1995 and 2005 by industry are shown in Table 2.2.5.

Table 2.2.5 Estimated Employment By Industry, Klang Valley, 1985-2005

('000)

Industry	Year			Average Annual Growth Rate (%)	
	1985	1995	2005	1985-95	1995-2005
Agriculture	74.4	92.0	106.1	2.1	1.4
Mining	6.9	7.2	8.6	0.4	1.8
Manufacturing	227.5	356.3	490.2	4.6	3.2
Construction	67.9	67.9	84.2	0.0	2.2
Electricity	2.4	4.7	7.7	7.0	5.1
Transportation	184.5	322.2	479.4	5.7	4.1
Wholesale	61.8	98.8	138.0	4.8	3.4
Finance	54.4	96.6	146.0	5.9	4.2
Services	330.2	538.1	763.6	5.0	3.6
TOTAL	1010.0	1583.7	2223.8	4.6	3.5

(4) Vehicle Ownership

Vehicle ownership in Klang Valley has been projected in the Klang Valley Transportation Study, 1987 for 1995 and 2005. Due to the revision of economic framework, these figures have also been revised accordingly. The 1985 figures remained unchanged. The 1995 and 2005 figures have been adjusted with a smaller share in the multi-car group in particular.

The future vehicle ownership pattern used in this study is shown in Table 2.2.6.

Table 2.2.6: Projection of Persons by Vehicle Ownership Group, Klang Valley, 1985-2005

('000 Persons)

Year		Non Vehicle	Motor Cycle	One Car	Multi Car	Total
1985 (Estimated)	No.	599.2	712.2	934.3	288.3	2534.0
	%	23.6	28.1	36.9	11.4	100.0
1995	No.	910.0	1097.9	1459.8	472.3	3940.0
	%	23.1	27.9	37.1	11.9	100.0
2005	No.	1096.9	1439.7	2194.1	819.5	5550.0
	%	19.8	25.9	39.5	14.8	100.0

2.2.2 Corridor Landuse

The existing landuse pattern together with the committed development projects in the southern Klang Valley Region can be seen in Figure 2.2.3.

(1) Southern Part of Middle Ring Road II Corridor

The southern part of MRR II has to pass through many existing built-up areas in Cheras and OUG area. As this is the southern development frontier of Kuala Lumpur Conurbation, the corridor also contains many approved development projects (see Figure 2.2.3). Notably are the Bukit Jalil New Township, Kinrara New Township Development and the Castle Field Housing Development. Other landuse worthy of note in this corridor is tin mining found along the Klang River on the west of Jalan Puchong.

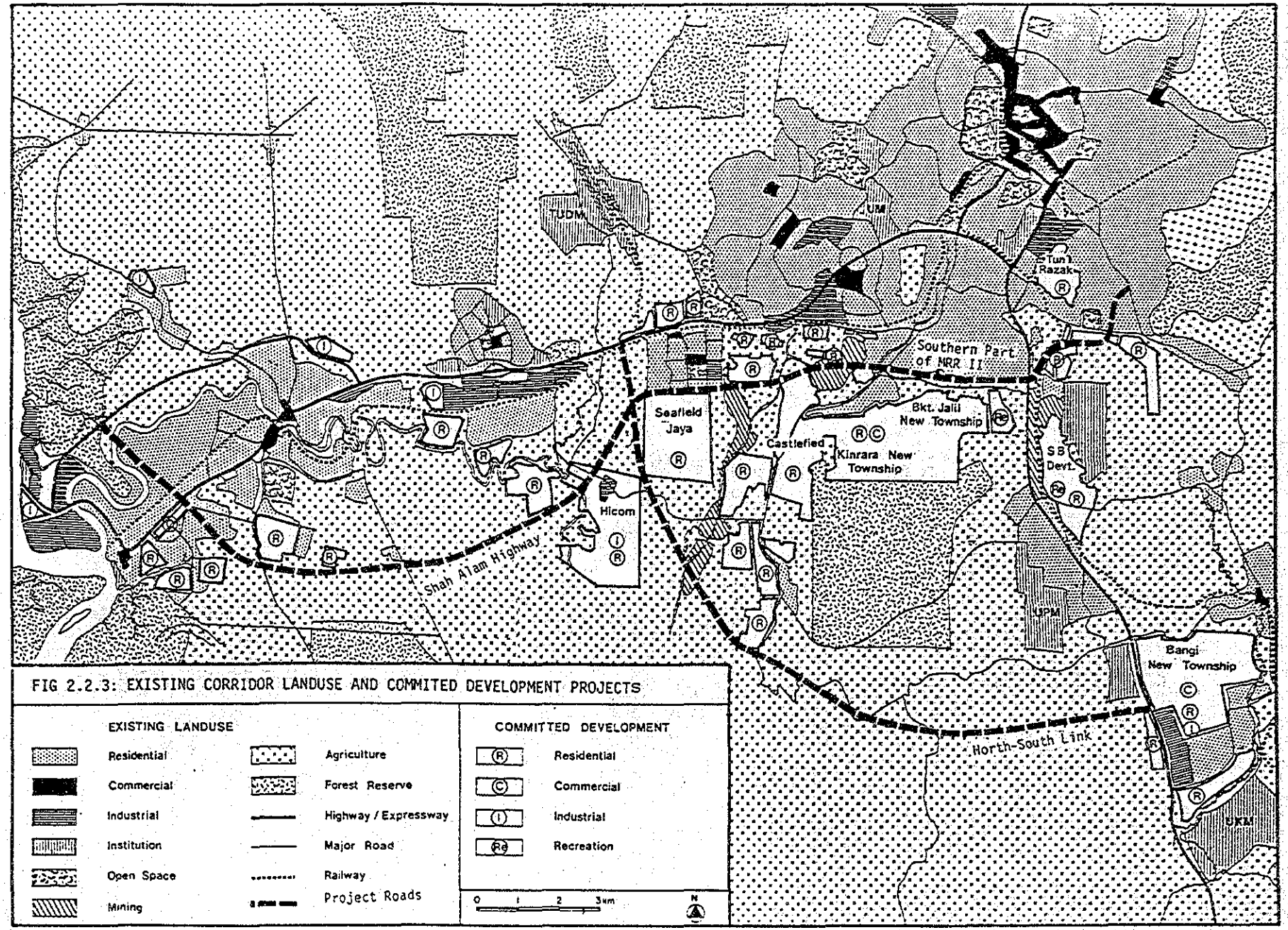


FIG 2.2.3: EXISTING CORRIDOR LANDUSE AND COMMITED DEVELOPMENT PROJECTS

(2) Shah Alam Highway Corridor

Besides the HICOM area, this corridor passes through mainly agricultural area (chiefly oil palm and rubber) to the south of Shah Alam and some existing residential areas in Klang Municipality.

Infact, the planned highway will make use of the existing Jalan Bukit Kemuning road reserve at the section to the south of Shah Alam.

(3) North-South Link Corridor

Landuses along this corridor are chiefly agriculture (mostly oil palm towards Federal Highway while mixed oil palm and rubber plantation towards the Kuala Lumpur-Seremban Expressway), some village settlements along Jalan Puchong and tin mines along Klang River.

New housing development projects however have been approved along Jalan Puchong and lying close to this highway corridor.

(4) Future Corridor Landuse

The future corridor landuse pattern can be seen in Figure 2.2.4. The southern corridor of the Klang Valley when fully developed will encompass the southern section of Shah Alam, southern expansion area of Klang Municipality and the southern Kuala Lumpur Conurbation area including Bukit Jalil New Township.

All these urbanized areas are served by the Shah Alam Highway, MRR II, N-S Link, South Klang Valley Expressway and South Klang Straits Bypass, besides the intra-urban arterials. With this efficient road network system the southern corridor will be endorsed with high potential for new commercial, industrial and recreation development in the future.

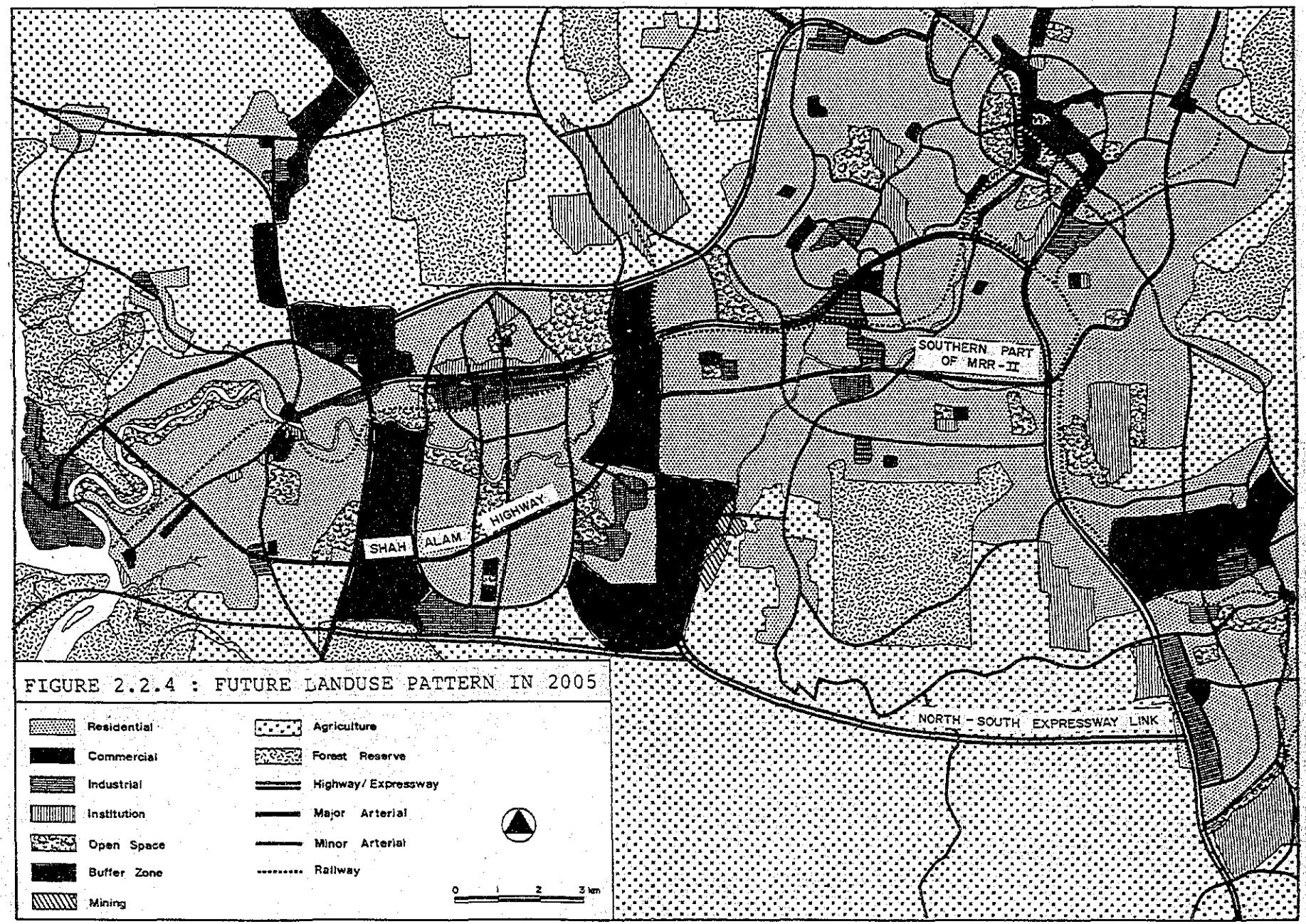


FIGURE 2.2.4 : FUTURE LANDUSE PATTERN IN 2005

2.2.3 Transportation Systems and Networks

The future transportation system and future road and other networks as proposed in the Klang Valley Transportation Study provided the basic transportation system presumption needed for this Feasibility Study.

In the case of persons movement, the future transportation system in Klang Valley will consist of both private and public transport modes. The former is in the form of private cars and motorcycles. Public transport however will be provided by a mass rail rapid transit system, buses and taxis.

Goods mobility will be provided by both trucks and rail transport.

The road network that forms the basic infrastructure for private transport, buses and taxis, trucks consist of a network of expressway and arterials that cater to the needs of interurban and interregional traffic; a system of arterials complemented by secondary roads to cater to intraurban travel; lastly a secondary road system together with the access roads, cycle and pedestrian paths to cater for the local traffic movement within urban cells or neighbourhoods. The expressway, arterial and major secondary road network as proposed in the Klang Valley Transportation Study is depicted in Figure 2.2.5.

Two road network plans, one for 1995 and 2005 are prepared. The road network for 2005 contains all the highways under study and the other roads or road improvements as proposed in the masterplan. The 1995 network however, considers the construction of Shah Alam Highway between Kuala Lumpur-Seremban Highway and HICOM at this stage and other roads or road improvements as proposed for 1995 in the Masterplan.

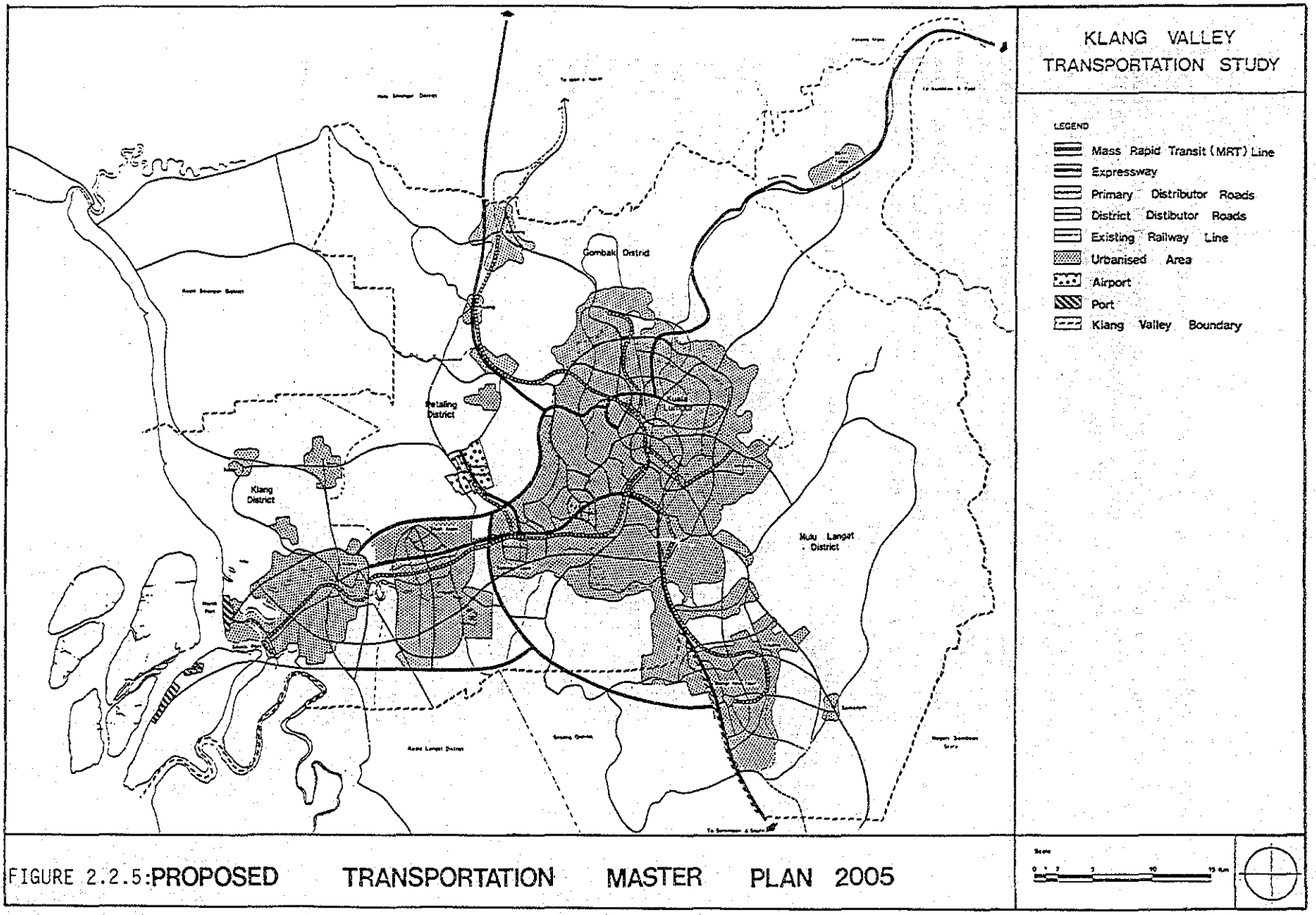


FIGURE 2.2.5:PROPOSED TRANSPORTATION MASTER PLAN 2005

2.2.4 Road Network System

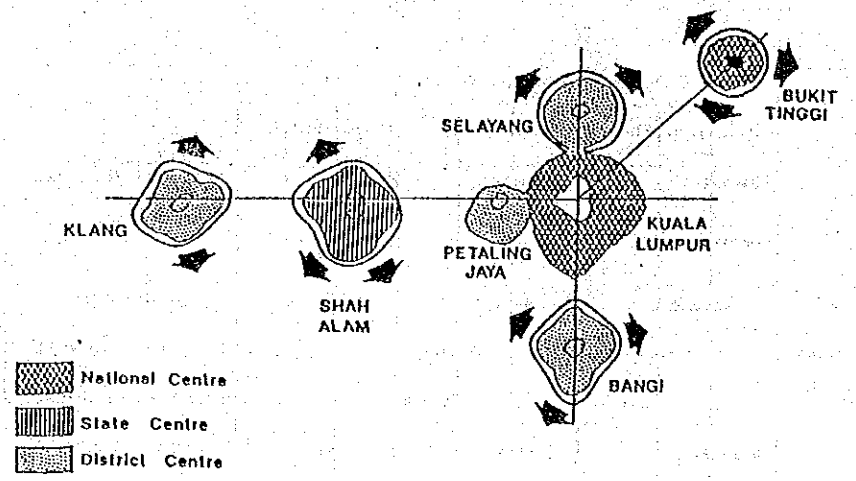
Table 2.2.7 shows the functional classification of roads and their characteristics according to the JKR standard.

Table 2.2.7 : Functional Classification of Roads and Their Characteristics

Area	Functional Classification	Trip Length			Design Volume			Speed			NETWORK
		Long	Med	Short	High	Med	Low	High	Med	Low	
Rural	Expressway	◄═══►			◄┈┈┈►			◄═►			National Network
	National Highway	◄═══►			◄┈┈┈►				◄═══►		National Network
	Primary Road		◄═══►			◄┈┈┈►			◄═►		State Network
	Secondary Road			◄═══►		◄┈┈┈►			◄═►		District Network
	Minor Road			◄═══►			◄┈┈┈►			◄═►	Supporting Network
Urban	Expressway	◄═══►			◄┈┈┈►				◄═►		National Network
	Arterial		◄═══►			◄┈┈┈►			◄═══►		Major Links to Urban Centres
	Collector			◄═══►		◄┈┈┈►			◄═►		Major Streets within Urban Centres
	Local Street			◄═══►			◄┈┈┈►			◄═►	Minor Streets/Town Network

Source : A Guide to Geometric Design of Roads - JKR

The future road network system in the Klang Valley consists of an inter-urban network and an intra-urban network. The planned urban development pattern in Klang Valley produces an urban hierarchy structure with six (6) growth centres as shown in Figure 2.2.6. The roads connecting these growth centres form the inter-urban road network, while those directly serving these growth centres form what we call the intra-urban road network.

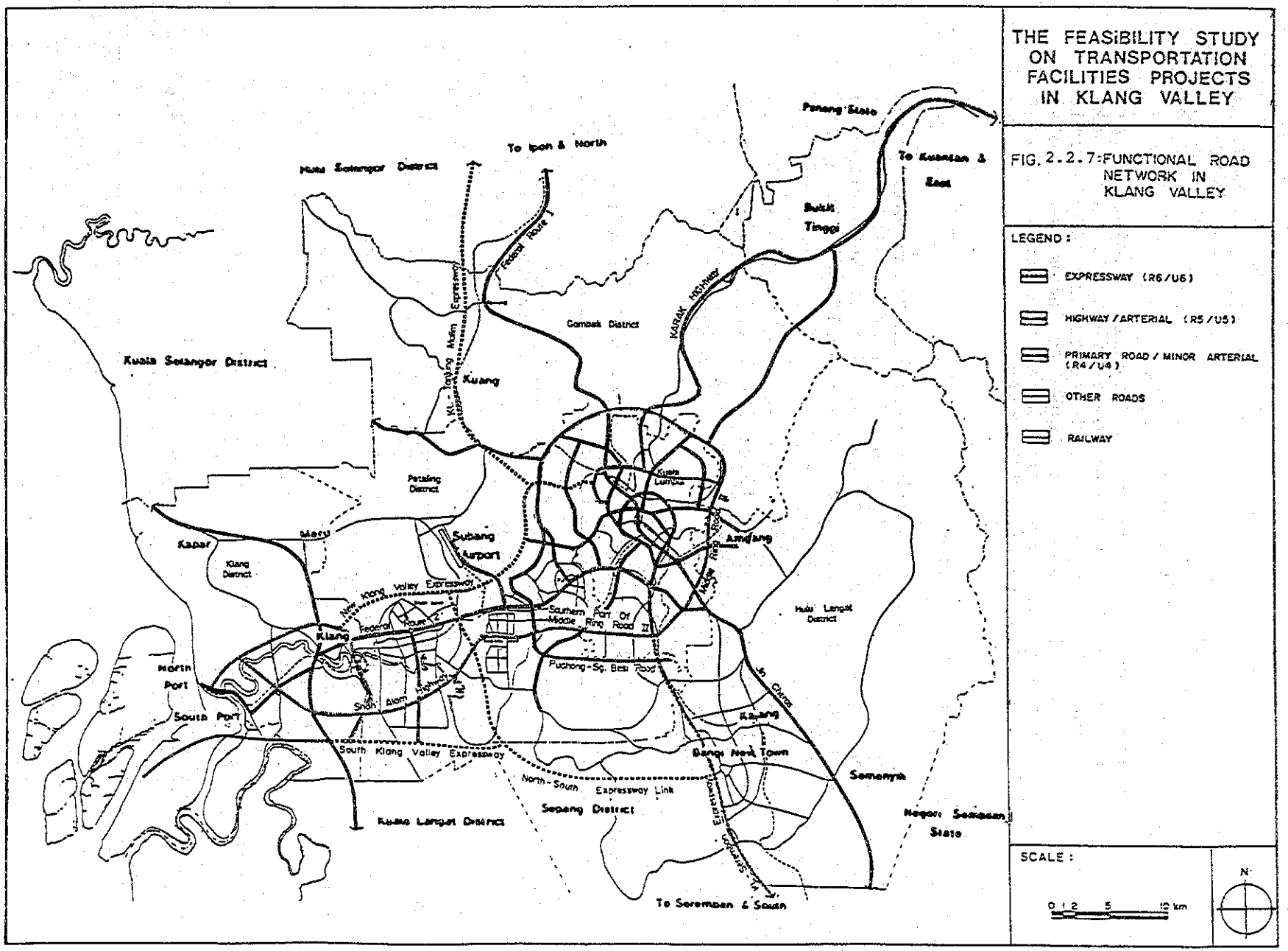


Source: Klang Valley Transportation Study

Figure 2.2.6 : Future Regional Development Pattern

The future inter-urban road network within the Klang Valley is shown in Figure 2.2.7. The proposed six (6) urban centres will be interlinked by expressways and/or highways. The road network proposed for the Kuala Lumpur Conurbation shall be fully developed as a radial and circumferential road network in line with the urban development structure of a polycentric city.

The road network proposed for the Kuala Lumpur-Klang Corridor shall be developed into a multilinear ladder pattern following the east-west axis urban development concept and that for the other corridors in the Klang Valley shall be developed as a simple or multiple linear ladder pattern.


THE FEASIBILITY STUDY ON TRANSPORTATION FACILITIES PROJECTS IN KLANG VALLEY
FIG. 2.2.7: FUNCTIONAL ROAD NETWORK IN KLANG VALLEY
LEGEND :
EXPRESSWAY (R6/U6)
HIGHWAY / ARTERIAL (R5/U5)
PRIMARY ROAD / MINOR ARTERIAL (R4/U4)
OTHER ROADS
RAILWAY
SCALE :
0 1 2 5 10 km
N
To Ipoh & North
Penang State
To Kuantan & East
Hulu Selangor District
Kuala Selangor District
Gombak District
Petaling District
Klang District
Kuala Lumpur
Subang Airport
Hulu Langat District
Kuala Langat District
Sepang District
Banting New Town
Seremban
Negeri Sembilan State
To Seremban & Seaan
Federal Route
KL-Tanjung Malim Expressway
KARAK HIGHWAY
New Klang Valley Expressway
Southern Middle Ring Road
Part Of Road II
Puchong-Sg. Besi Road
Sh. Clarke
North Port
South Port
Shah Alam
South Klang Valley Expressway
North-South Expressway Link
Seremban-Port Dickson Expressway

2.3 Future OD Traffic Volume

The results of the revised traffic projection are presented in this section in the form of total person trips by modes and the future OD traffic volume in 1995 and 2005 in terms of total vehicular traffic desire lines and truck traffic desire lines between "B" zones.

2.3.1 Total Person Trips

The total daily person trips in Klang Valley is projected to grow from 6.4 million in 1985 to 10.3 million in 1995 and 14.6 million in 2005 with an annual growth rate of 4.8% from 1985 to 1995 and 3.6% from 1995 to 2005.

By 2005, the total daily 14.6 million person trip will be made up of 15.3% 'To Work' trips, 10.5% 'To School' trips, 6.9% 'Business' trips, 26.0% 'Private' trips and 41.6% 'To Home' trips (see Table 2.3.1).

Table 2.3.1 Daily Person Trip Production in Klang Valley, 1985-2005

	Year			Average Annual Growth Rate (%)	
Purpose	1985	1995	2005	1985-1995	1995-2005
To Work	936,500 (14.6%)	1,596,700 (15.5%)	2,239,000 (15.3%)	5.5	3.4
To School	678,200 (10.6%)	1,086,600 (10.6%)	1,533,800 (10.5%)	4.8	3.5
Business	402,900 (6.3%)	692,900 (6.7%)	1,013,500 (6.9%)	5.6	3.9
Private	1,701,200 (26.5%)	2,642,500 (25.7%)	3,796,400 (26.0%)	4.5	3.7
To Home	2,706,700 (42.0%)	4,258,500 (41.5%)	6,045,200 (41.3%)	4.6	3.6
Total	6,425,500 (100%)	10,277,200 (100%)	14,627,900 (100%)	4.8	3.6

2.3.2 Mode Share of Total Person Trips

Using the similar methodology as in Klang Valley Transportation Study, modal share of the forecasted total person trips in 2005 is projected as shown in Table 2.3.2.

By 2005, about 80% of the total person trips will be made by motorized modes. About 35% of these are projected to use public transport which is to be supplied by both urban rail and bus transport.

Table 2.3.2 : Mode Share of Person Trips, Klang Valley, 1985-2005

(In '000)

Mode	Year			Average Annual Growth Rate (%)	
	1985	1995	2005	1985-95	1995-2005
Walk/Bicycle	1,775.5 (27.6%)	2,116.3 (20.6%)	2,853.4 (19.5%)	1.8	3.0
Motorcycle	884.3 (13.8%) (19.0%)	1,477.7 (14.4%) (18.1%)	1,957.0 (13.4%) (16.6%)	5.3	2.8
Passenger Car	2,170.8 (33.8%) (46.7%)	3.852.7 (37.5%) (47.2%)	5,705.2 (39.0%) (48.5%)	5.9	4.0
Public	1,596.1 (24.8%) (34.3%)	2,830.5 (27.5%) (34.7%)	4,112.3 (28.1%) (34.9%)	5.9	3.8
Total	6,436.7 (100%) (100%)	10,277.2 (100%) (100%)	14,627.9 (100%) (100%)	4.8	3.6

Note : Upper (%) - % share to all modes
Lower (%) - % share to motorized modes only

2.3.3 Vehicular Traffic

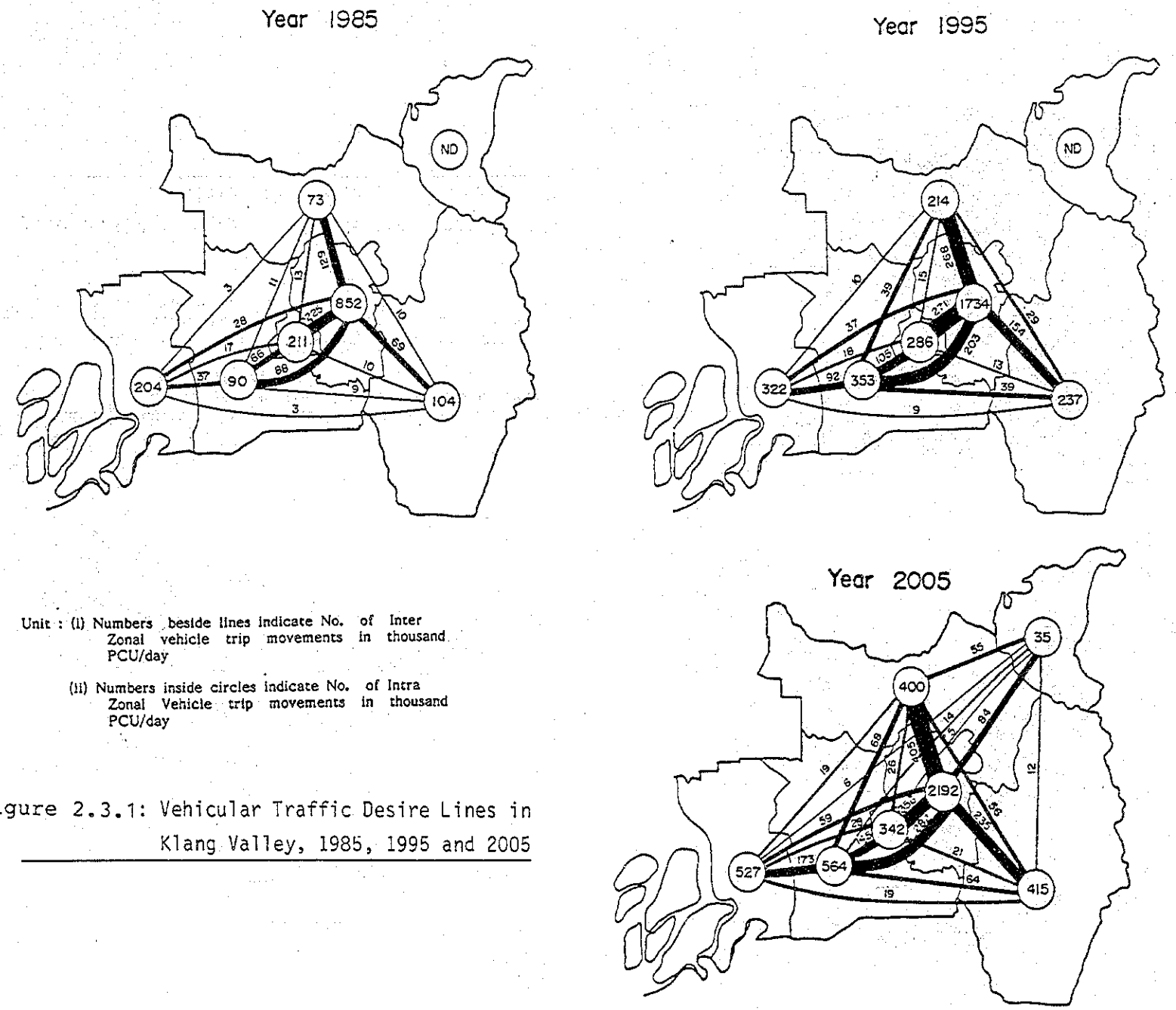
(a) Total Vehicular Traffic

Using similar method as in the Klang Valley Transportation Study, the forecasted person trips are converted into vehicular traffic. The total daily vehicular traffic including the lorry traffic is projected to increase from 2.19 million vehicle trips in 1985 to 4.09 million trips by 1995 and 5.88 million trips by 2005, at an annual growth rate of 4.2% from 1985 to 2005. The total vehicular traffic desire lines by PCU/day in 1985, 1995 and 2005 are shown in Figure 2.3.1. Strong traffic desire lines are found along the Kuala Lumpur-Petaling Jaya-Shah Alam-Klang corridor and Kuala Lumpur-Gombak corridor. The traffic desire between Kuala Lumpur and Petaling Jaya for example is 638,000 PCU per day in 2005.

(b) Lorry Traffic

Lorry traffic has been projected for Klang Valley to 2005 using similar method in the Klang Valley Transportation Study and supplemented by the results of the Cordon-line Lorry Interview Survey conducted in this Study. Lorry traffic in Klang Valley is expected to increase from 314,200 vehicle trips per day in 1985 to 480,800 trips per day in 1995 and 782,900 trips per day in 2005 at a growth rate of 4.7% per annum from 1985 to 2005.

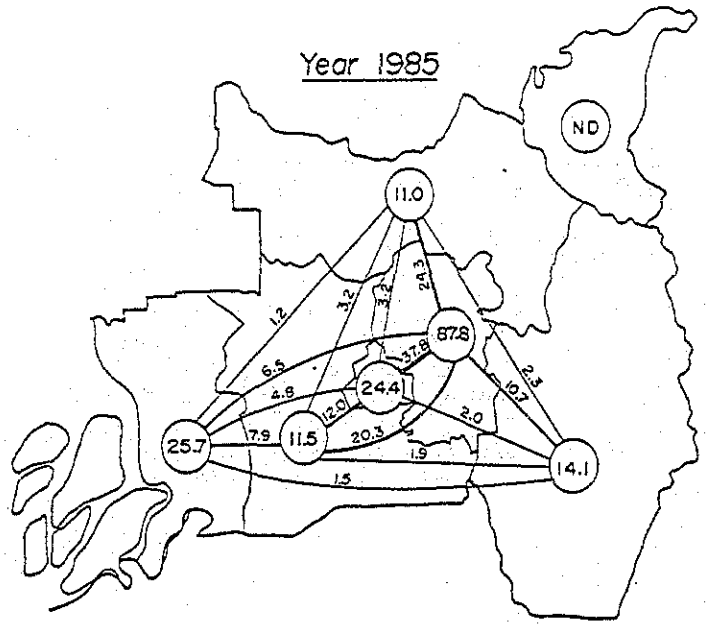
The desire line of lorry trips in 1985, 1995 and 2005 in Klang Valley is shown in Figure 2.3.2.Strong desire lines are indicated in the Kuala Lumpur-Petaling Jaya-Shah Alam-Klang corridor and Kuala Lumpur-Gombak corridor.

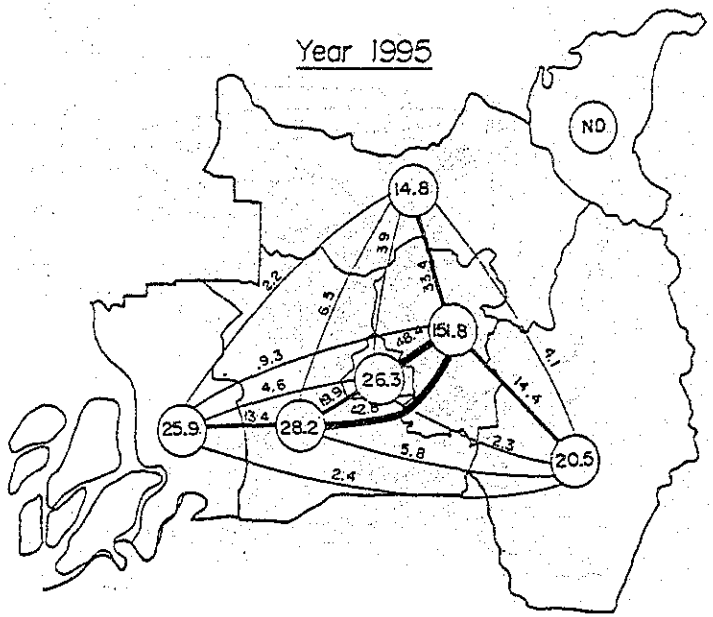


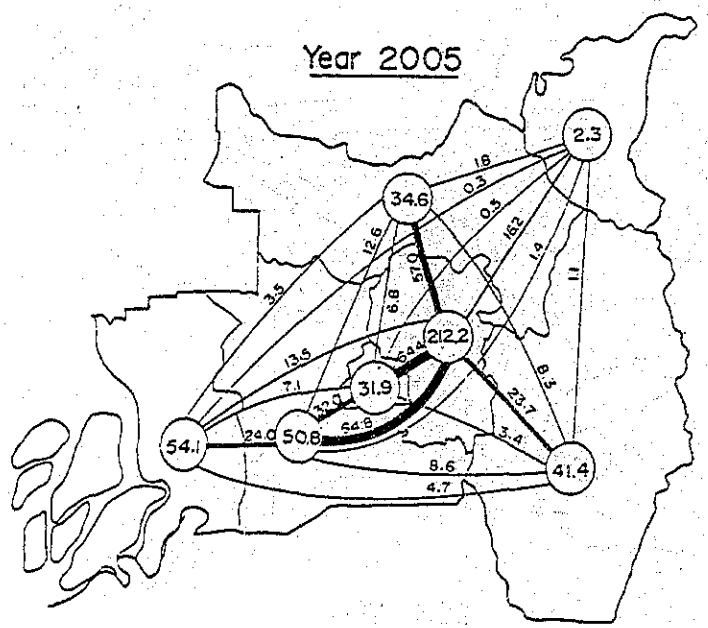
Unit : (i) Numbers beside lines indicate No. of Inter Zonal vehicle trip movements in thousand PCU/day

(ii) Numbers inside circles indicate No. of Intra Zonal Vehicle trip movements in thousand PCU/day

Figure 2.3.1: Vehicular Traffic Desire Lines in Klang Valley, 1985, 1995 and 2005







Unit : (i) Numbers beside lines indicate No. of Inter Zonal vehicle trip movements in thousand vehicle trips/day

(ii) Numbers inside circles indicate No. of Intra Zonal vehicle trip movements in thousand vehicle trips/day

Figure 2.3.2 : Lorry Traffic Desire Lines in Klang Valley in 1985, 1995 and 2005

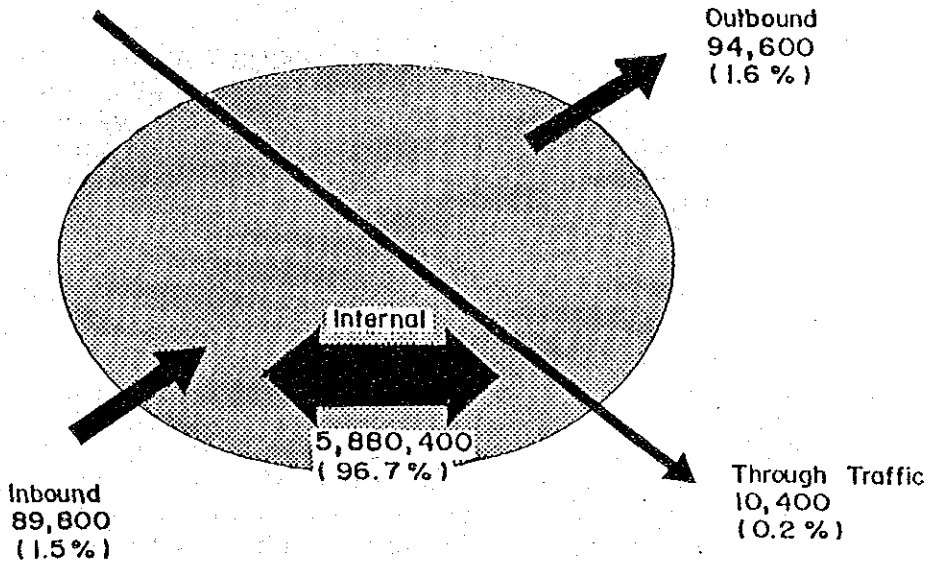
2.3.4 External Traffic

The external traffic is forecasted as in the Klang Valley Transportation Study and the results are shown in Table 2.3.3 and illustrated in Figure below. External traffic constitutes only 3.3% of the total traffic.

Table 2.2.3: External Traffic in Klang Valley, 1985-2005

Directional Flow	1985	1995	2005
Outbound	33,100	67,400	94,600
Inbound	31,500	64,100	89,800
Through Traffic	3,600	7,500	10,400
Total	68,200	139,000	194,800

Unit : Vehicle/day



External Traffic in 2005

2.4 Traffic Assignment to the Proposed Highways

2.4.1 Methodology

The total forecasted traffic volume in the form of total OD traffic volume and duly split into the various travel modes are described in Section 2.3.

The forecasted vehicular traffic in future years are now assigned to the proposed future road network and the results of traffic assignment are therefore the forecasted daily traffic volume on each highway link. Of particular importance, therefore, is the forecasted future traffic volume of the Project Roads examined in this Study.

The task of traffic assignment is carried out with a number of iterative computations using computer. In general, there are several computational methods or models which can be used for executing the traffic assignment to the highway network. The most commonly used models are:-

(a) All or nothing method
(b) All or nothing with capacity limitation method
(c) Traffic diversion curve method
(d) Traffic diversion curve with capacity limitation method

The characteristics of the Project Roads are such that they serve as alternative high capacity routes, possibly as tollways, along the development corridors. As such, the method using traffic diversion curve together with capacity limitation is preferred.

The methodology for traffic assignment in this Study is summarized in the flowchart as shown in Figure 2.4.1. The total forecasted traffic volume in future years is first divided by the number of iterative computations to be made. The divided traffic volume is then assigned to the future road network which includes the Project Roads based on the minimum route search technique using the computed travel speed on each link that are previously determined by the volume-capacity (Q/V) curve. Diversion rate is computed and traffic is finally assigned to the total road network. This is repeated, each time with revised travel speed until all the traffic is assigned.

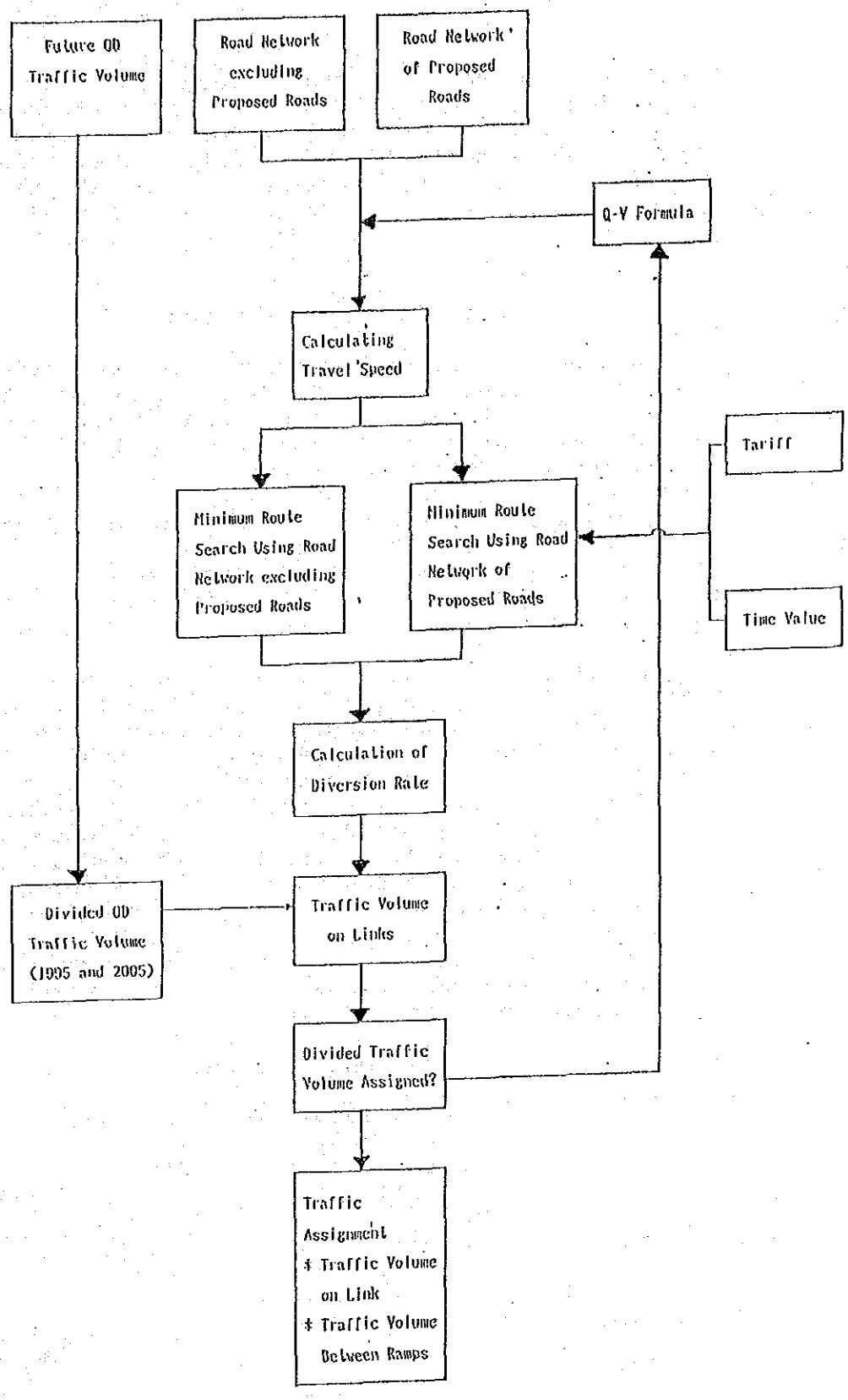


Figure 2.4.1: : Flowchart of Traffic Assignment Using Diversion Curve with Capacity Limit Method

Needless to say, factors such as year of completion, operation (with toll or toll free), design capacity of the Project Roads, etc. would affect the results of the traffic assignment. Therefore, for the traffic assignment task, variations of these factors are utilized to generate alternative cases described below.

2.4.2 Alternative Traffic Assignment Cases

As mentioned above, alternative cases in traffic assignment can be examined by varying the controlling factors. This section described the various alternative cases examined in this Study by varying the following factors:-

(a) Operation system for the Project Roads (With Toll or toll free)
(b) Toll levy system on the Project Roads
(c) Interchange plan on the Project Roads
(d) Stage Implementation Plan

A total of 15 alternative cases are generated for traffic assignment in this Study. Case 1 to Case 8 are alternative cases generated by varying the stage of completion of the Project Roads and operation system for the planning year of 1995 and 2005. Features of these 8 alternative cases are indicated in Table 2.4.1. In the case of "With Toll Levy System on the Project Roads, the above alternative cases assume a toll barrier system applied on Shah Alam Highway/MRR-II and a distance proportional toll tariff for N-S Link. The above cases also assume an interchange plan with 16 interchanges on Shah Alam Highway/MRR-II and 6 interchanges on N-S Link.

Table 2.4.1: Traffic Assignment Alternative Cases

Project Roads	1995		2005	
	Without Toll	With Toll	Without Toll	With Toll
Whole Projects	● Case 1	● Case 3	● Case 2	● Case 4
Shah Alam Highway/ MRR-II		● Case 5		● Case 6
N-S Link		● Case 7		● Case 8

Instead of the toll barrier system for the collection of toll on Shah Alam Highway/MRR-II for the alternative cases above, toll may instead be collected by a combination of on-ramp and toll barrier system. These two types of toll collection methods on Shah Alam Highway/MRR-II are illustrated in Figure 2.4.2.

By substituting the toll levy system on Shah Alam Highway/MRR-II in Case 4 by the on-ramp and barrier toll system, an additional alternative case, Case 10 is generated for the traffic assignment (see Table 2.4.2).

Table 2.4.2: Traffic Assignment Cases by Toll Levy Systems for Shah Alam Highway/ MRR-II

	Traffic Assignment Case in Year 2005
Plan 1-A Toll Barrier System With Toll Location 1	● Case 4
Plan 1-B Toll Barrier System With Toll Location 2	● Case 9
Plan 2 On-Ramp Toll With Barrier System	● Case 10

The number of interchanges on the Project Roads may be varied from the original proposed plan of 22 interchanges (named as Plan 3) to lesser number of interchanges. Two alternative cases are set up here, namely 17 interchanges (named as Plan 2) and 11 interchanges (named as Plan 1). These three alternative interchange plans are shown in Figure 2.4.3.

Case 4 adopts the interchange Plan 3 with a total number of 22 interchanges on the Project Roads. By substituting the interchange plan in Case 4, two more alternative cases, namely Case 11 and Case 12 are generated for the traffic assignment task (see Table 2.4.3).

Table 2.4.3: Traffic Assignment Cases by Interchange Plans

	Traffic Assignment Case in Year 2005
Interchange Plan	
Plan 1 (11 IC Plan)	● Case 11
Plan 2 (17 IC Plan)	● Case 12
Plan 3 (22 IC Plan)	● Case 4

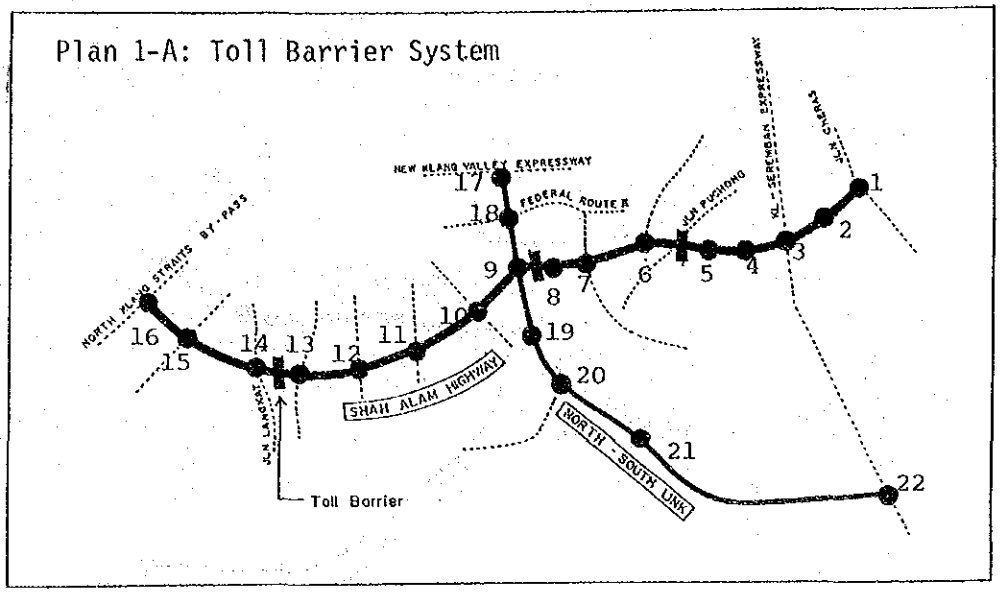
Three stage implementation plans are also set up in order to deliberate the stage wise construction of the Project Roads. Table 2.4.4 shows the generation of three more traffic assignment cases by staging the implementation of the Project Roads.

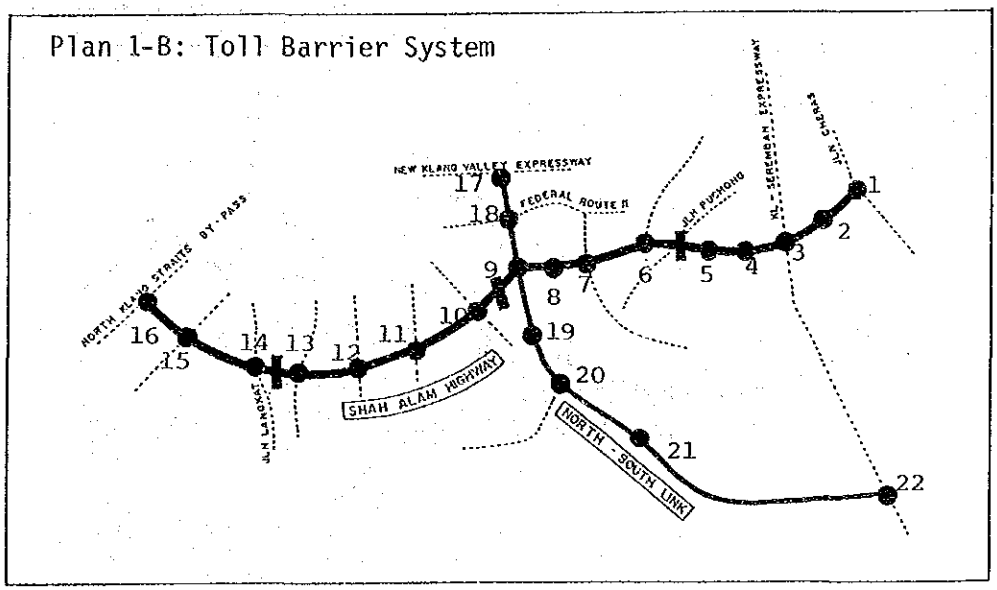
Alt.1 (Case 13) consists of implementing the 4-lane sections of Shah Alam Highway/MRR-II from KL-Seremban Expressway to HICOM and N-S Link from NKVE to Shah Alam Highway. Alt.2 (Case 14) consists of implementing a 6-lane section of Shah Alam Highway/MRR-II from KL-Seremban Expressway to SKSB and a 4-lane section of SKSB to Jalan Langat. Alt.3 (Case 15) consists of implementing a 4-lane section of Shah Alam Highway/MRR-II from KL-Seremban Expressway to HICOM, a 6-lane section of N-S Link from NKVE to Shah Alam Highway and a 4-lane section from Shah Alam Highway to KL-Seremban Expressway.

Table 2.4.4: Traffic Assignment Cases by Stage Implementation Plans

Stage Implementation Plan	SHAH ALAM HIGHWAY/ MRR-II		N-S LINK		Traffic Assignment Alternative
	KL-Seremban Expressway to HICOM	HICOM to Jalan Langat	NKVE to Shah Alam Highway	Shah Alam H'way to KL-Seremban Expressway	
Alt.1	4-lane	-	4-lane (Connecting Road)	-	● Case 13
Alt.2	6-lane	6-lane	4-lane (Connecting Road)	-	● Case 14
Alt.3	4-lane	-	6-lane	4-lane	● Case 15

Note * Section between SKSB - Jalan Langat is only 4-lane





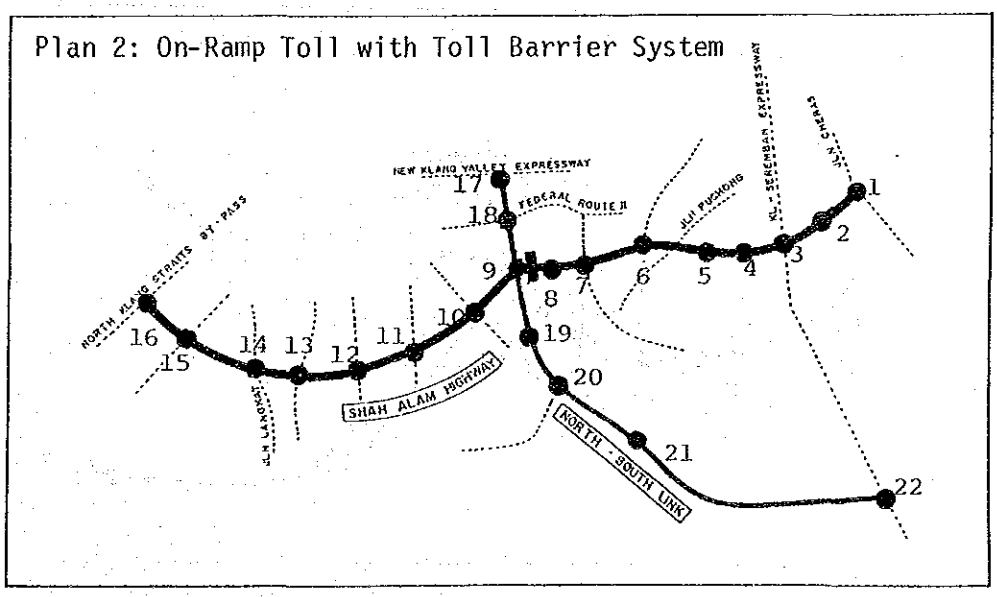
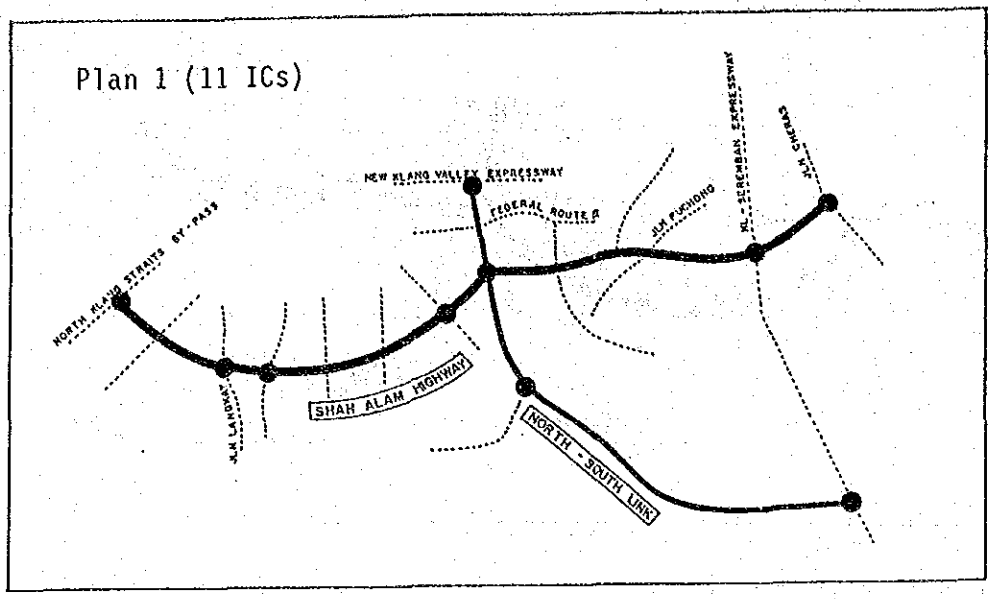
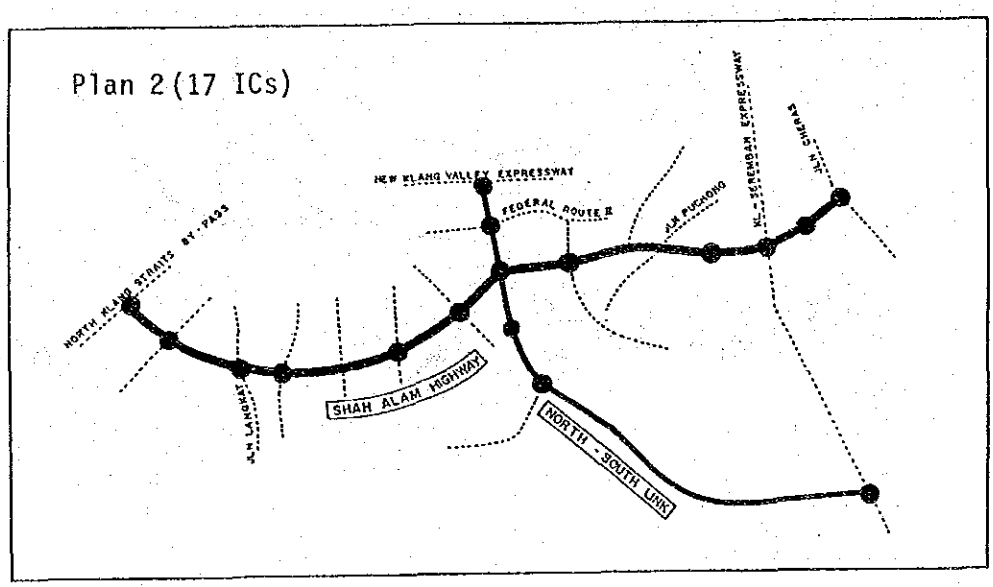


Figure 2.4.2 : Alternative Toll Levy Systems





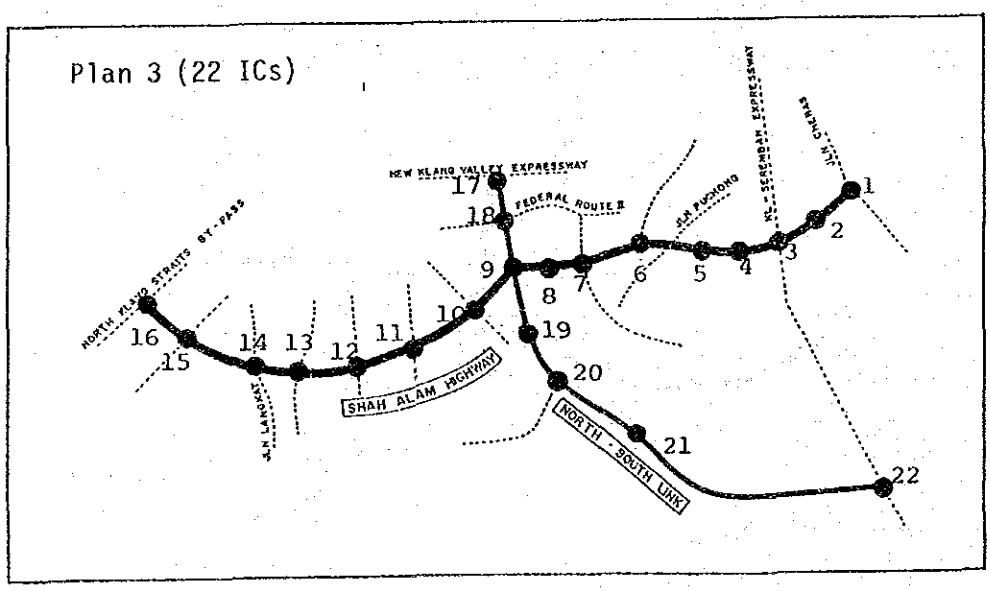


Figure 2.4.3 : Alternative Interchange Plans

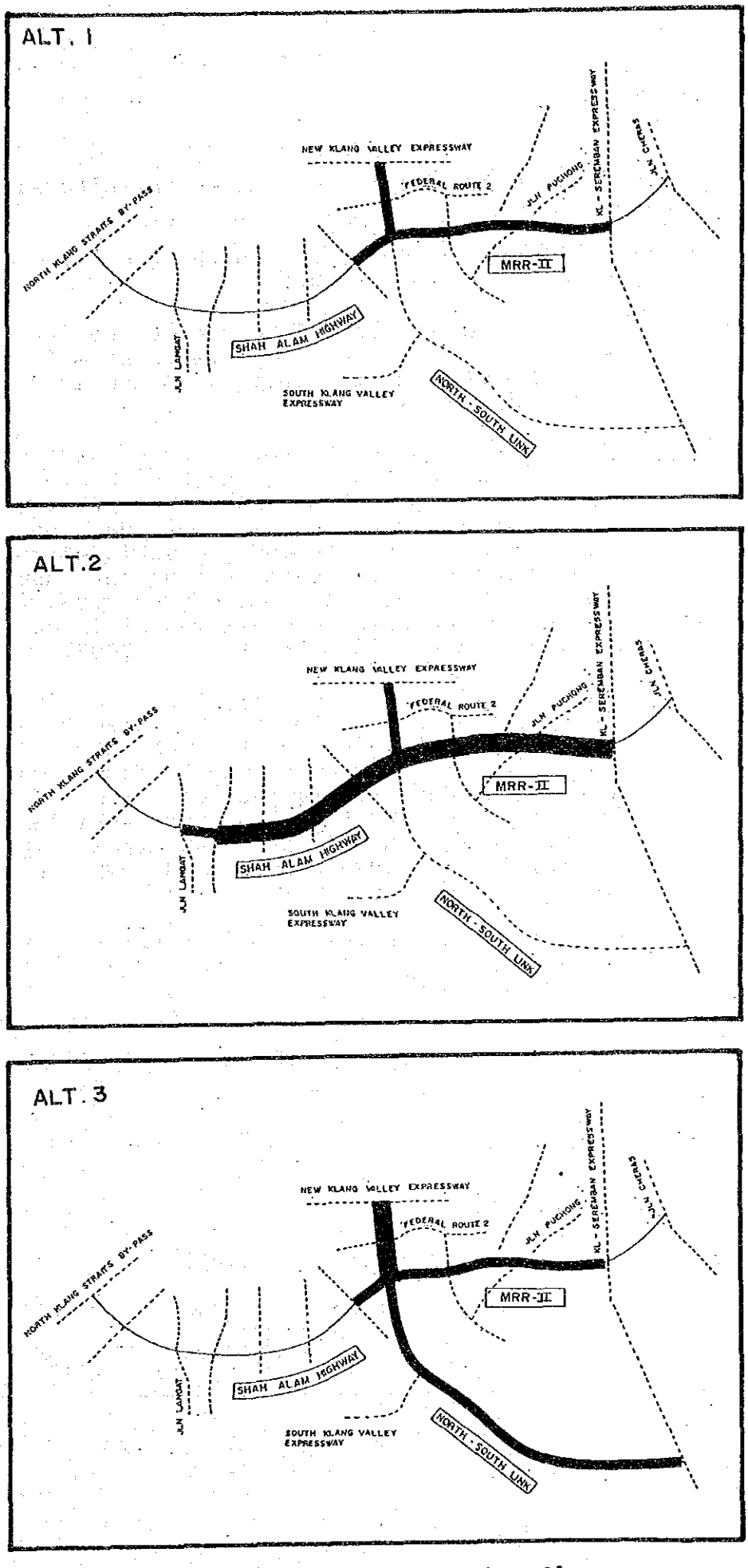


Figure 2.4.4 : Stage Implementation Plans

2.4.3 Results of Traffic Assignment on the Alternative Cases

(1) Assigned Traffic Volume on the Project Roads Under Toll Free System

The assigned traffic volume on the Project Roads in the case of toll free system (Case 1 and Case 2) for the years 1995 and 2005 are discussed below.

Table 2.4.4 shows the total vehicular traffic volume on the Project Roads by vehicle type. In terms of total vehicular trip, there will be some 433,000 vehicles per day on the Project Roads by 1995 and the vehicle volume is estimated to increase by 4.0% per annum to some 640,000 vehicles per day by 2005. The share of motor-car to all vehicles on the Project Roads is 72% in 1995 and 2005.

Table 2.4.5 shows the daily traffic volume on each of the Project Roads (Shah Alam Highway/ MRR-II and N-S Link) in 1995 and 2005. The daily traffic volume on Shah Alam Highway/ MRR-II is expected to increase from 343,000 vehicles in 1995 to 500,000 vehicles in 2005, while that on N-S Link from 170,000 vehicles in 1995 and 221,000 vehicles in 2005.

Table 2.4.4: Daily Traffic Volume on the Project Roads by Vehicle Type (Case of Toll Free System), 1995 & 2005

(Unit: Vehicles)

Vehicle Type	Daily Traffic Volume in the Year		Average Annual Growth Rate (%) 1995-2005
	1995	2005	
Motor-car	311,866	459,124	3.9
Lorry	140,965	160,087	4.3
Bus	15,699	20,906	2.9
Total	432,530	640,117	4.0

Table 2.4.5: Daily Traffic Volume by the Project Roads (Case of Toll Free System), 1995 & 2005
(Unit: Vehicles)

Project Roads	Daily Traffic Volume in the Year 1995	2005	Average Annual Growth Rate (%) 1995-2005
Shah Alam Highway/ MRR-II	343,027	500,106	3.8
N-S Link	169,818	220,834	2.7

Table 2.4.6 shows the traffic statistics on the Project Roads in 1995 and 2005. By comparison, there will be a decrease in the average trip length from 11.1km in 1995 to 10.3km in 2005. However, there will be a slight increase in average travel time from 10.0 to 10.8 minutes as travel speed has lowered due to increase in traffic volume.

Table 2.4.6: Traffic Statistics on the Proposed Roads (Case of Toll Free System), 1995 & 2005

	1995	2005	Average Annual Growth Rate(%) 1995 - 2005
No. of Trips ('000 veh)	432.5	640.1	4.0
Vehicle Kilometers ('000 veh.km)	4,800.8	6,593.0	3.2
Vehicle Hours ('000 veh.hr)	72.1	115.2	4.8
Trip Length (km)	11.1	10.3	-
Travel Time (min)	10.0	10.8	-
Average Travel Speed (km/hr)	66.9	57.2	-

The assigned traffic volume by section on the Project Roads for 1995 and 2005 obtained in Case 1 and Case 2 respectively are shown in Figures 2.4.4 and 2.4.5. If operated as a toll free highway starting from 1995, Shah Alam Highway would carry fairly high traffic volume for sections between Jalan Langat and N-S Link. The highest volume amounting to some 142,000 pcu/day being on the section between N-S Link and HICOM. By 2005, all sections of the Project Roads would have rather high traffic volume.

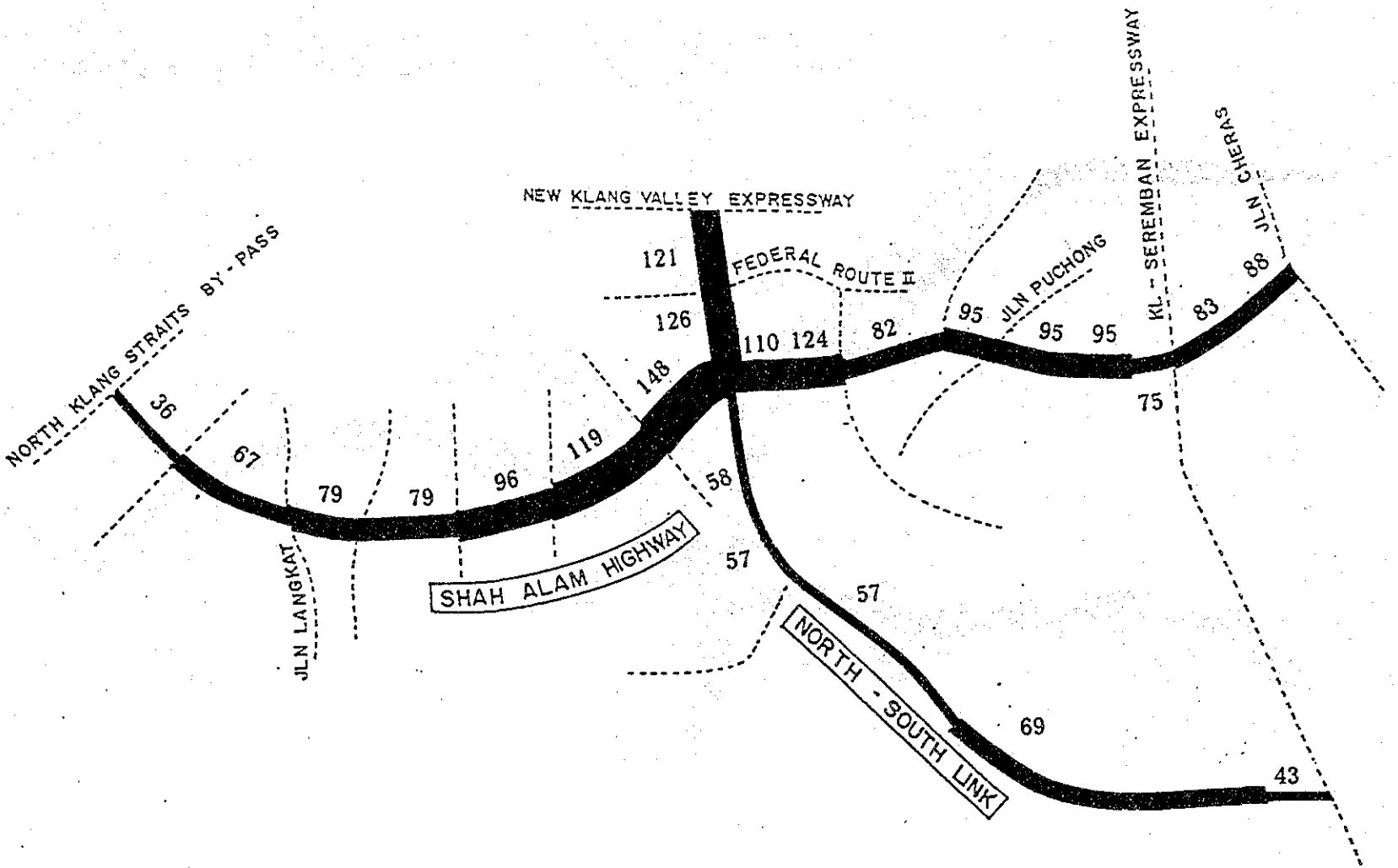


Figure 2.4.4: Assigned Traffic Volume on the Project Roads in 1995 (Toll Free System - Case 1)

(Unit: 1000 PCU/day)

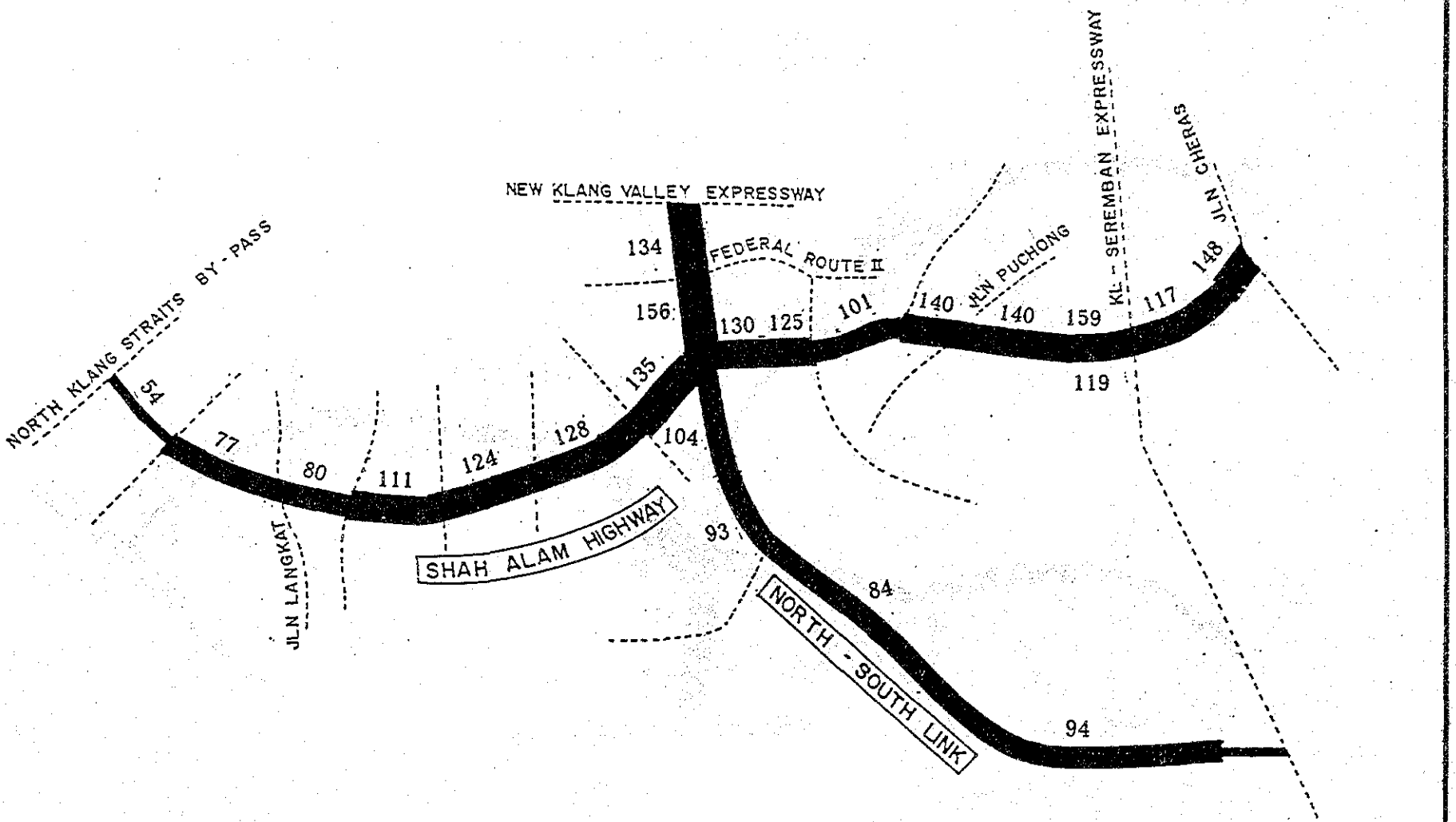


Figure 2.4.5: Assigned Traffic Volume on the Project Roads in 2005 (Toll Free System - Case 2)

(Unit: 1000 PCU/day)

(2) Assigned Traffic Volume on the Project Roads Under With Toll System

When the toll system is applied on the Project Roads, the assigned traffic volume is estimated and discussed below.

Table 2.4.7 shows the estimated daily traffic volume on the Project Roads by vehicle type in 1995 and 2005.

The total daily traffic volume in 1995 amounts to some 300,000 vehicles and is expected to increase by 4.8% per annum to 481,000 vehicles in 2005.

Table 2.4.8 shows the estimated daily traffic volume by the Projects in 1995 and 2005. The daily traffic volume on Shah Alam Highway/ MRR-II is expected to increase from 272,000 vehicles in 1995 and 426,000 vehicles in 2005 with average annual growth rate of 4.6% per annum, while that on N-S Link from 72,000 vehicles in 1995 and 112,000 vehicles in 2005 with same average annual growth rate.

Table 2.4.7: Daily Traffic Volume on the Project Roads by Vehicle Type (Case of With Toll System), 1995 & 2005

(Unit: Vehicles)

Vehicle Type	Daily Traffic Volume in the Year		Average Annual Growth Rate (%) 1995-2005
	1995	2005	
Motor-car	218,319	349,123	4.8
Lorry	72,501	119,897	5.2
Bus	8,822	11,807	3.0
Total	299,642	480,827	4.8

Table 2.4.8: Daily Traffic Volume by the Project Roads (Case of With Toll System), 1995 & 2005

(Unit: Vehicles)

Project Roads	Daily Traffic Volume in the Year 1995	2005	Average Annual Growth Rate (%) 1995-2005
Shah Alam Highway/ MRR-II	271,504	426,331	4.6
N-S Link	71,989	112,426	4.6

The assigned traffic volume by section on the highways can be seen in Figures 2.4.6 and 2.4.7.

Because of the added time value in the case of a tollway, traffic volume on the Project Roads would therefore divert to alternative routes only if these routes offer shorter travel time.

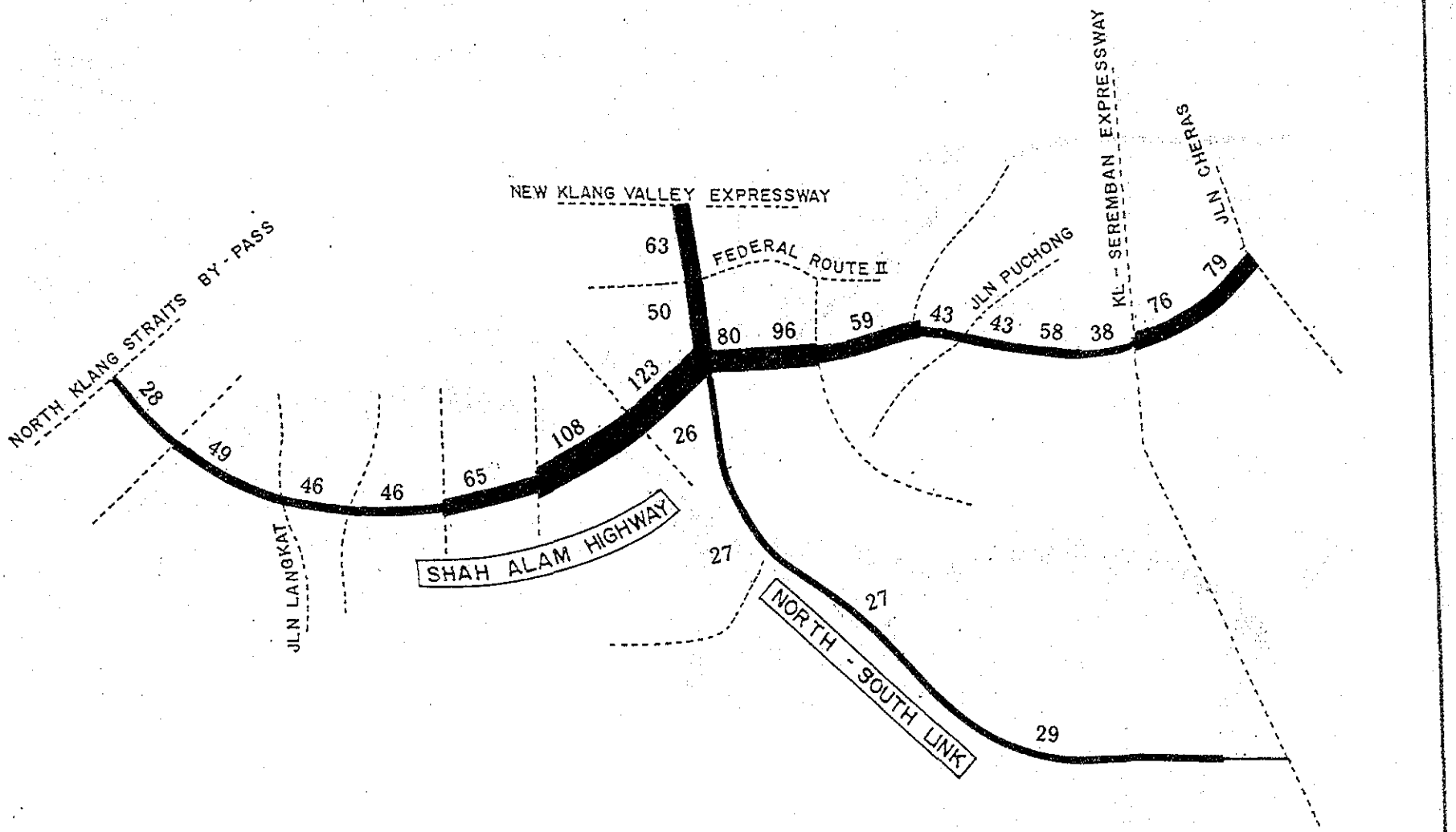


Figure 2.4.6: Assigned Traffic Volume on the Project Roads in 1995 (With Toll System - Case 3)

(Unit: 1000 PCU/day)

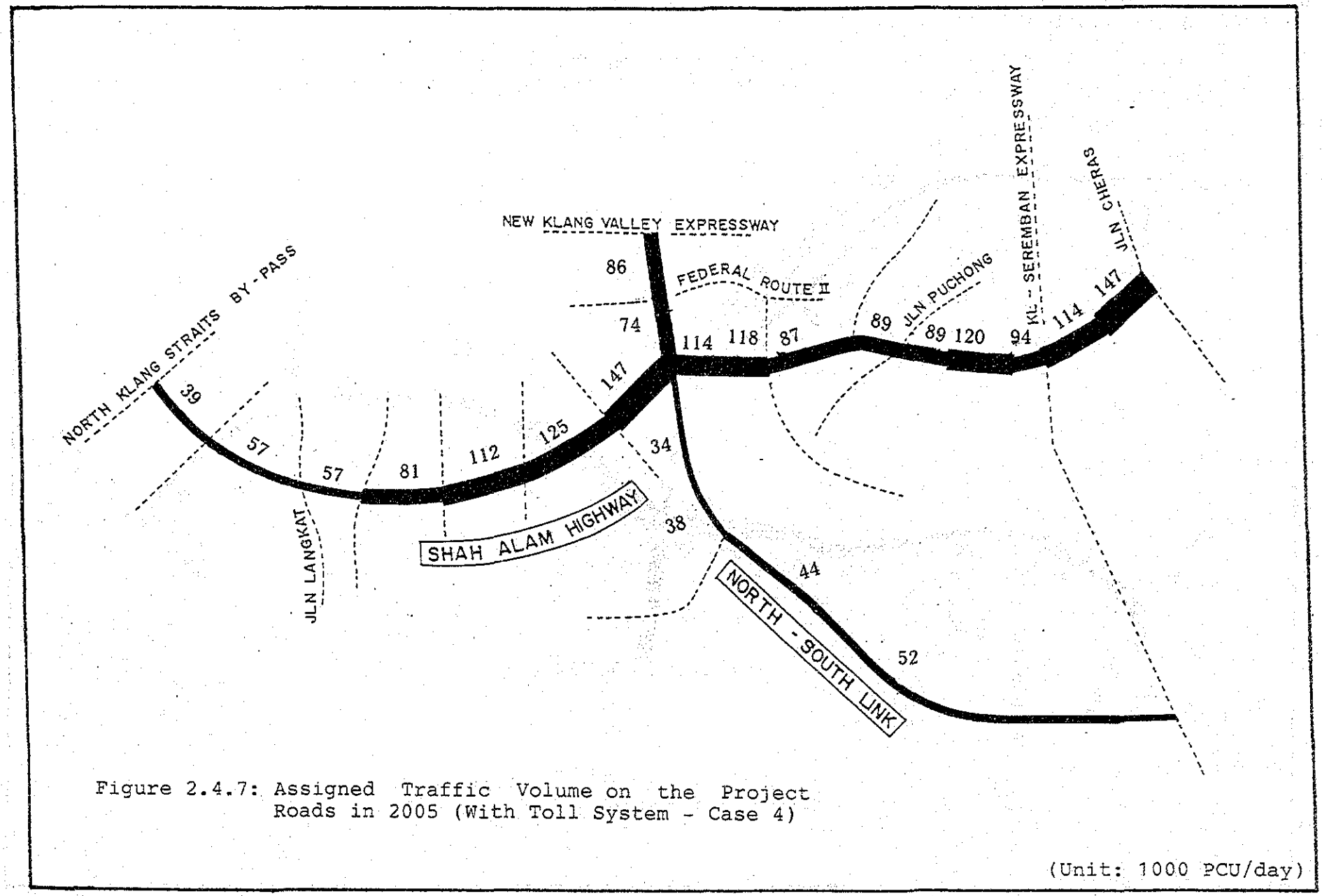


Figure 2.4.7: Assigned Traffic Volume on the Project Roads in 2005 (With Toll System - Case 4)

(3) Comparison of Assigned Traffic Volume With and Without Toll System

Herein, the comparative analysis is made based on the assigned traffic volume on the Project Roads for with and without toll cases.

Table 2.4.9 shows the estimated daily traffic volume on the Project Roads in the case of with and without toll system in 1995 and 2005.

In terms of total traffic volume, in the case of with toll system, the Project Roads are estimated to carry only 69% and 75% in 1995 and 2005 respectively of the corresponding traffic volume if the Project Roads are operated as toll free highways.

Table 2.4.10 shows the comparison of daily traffic volume on each of the Project Roads with and without toll system in 1995 and 2005.

Accordingly, in the case of with toll system, Shah Alam Highway/MRR-II is estimated to carry only 63% and 75% in 1995 and 2005 respectively of the corresponding traffic volume if this highway is toll free. While the traffic volume on N-S Link with toll system is estimated to be 42% and 51% in 1995 and 2005 respectively of the toll free cases.

Thus, the effects of toll levy on the Project Roads to the traffic pattern in the entire Klang Valley Region are shown in Tables 2.4.13 and 2.4.14. Due to the toll levy and hence diversion of traffic to other roads, there is an increase in both the total veh.km and veh.hrs in 1995 and 2005.

Table 2.4.9: Comparison of Daily Traffic Volume on the Project Roads With and Without Toll System, 1995 & 2005

(Unit: Vehicles)

Year	Without Toll System (A)	With Toll System (B)	Comparison (B/A)
1995	432,530	299,642	0.69
2005	640,117	480,827	0.75

Table 2.4.10: Comparison of Daily Traffic Volume by the Project Roads With and Without Toll System, 1995 & 2005

(Unit: Vehicles)

Project Road	Year	Without Toll System (A)	With Toll System (B)	Comparison (B/A)
Shah Alam Highway/ MRR-II	1995	195,406	123,421	0.63
	2005	281,626	211,674	0.75
N-S Link	1995	169,818	71,989	0.42
	2005	220,834	112,426	0.51

Note: Traffic volume on Shah Alam Highway/MRR-II is counted on the three (3) toll barriers

Table 2.4.11: Traffic Statistics on the Project Roads With and Without Toll System, 1995

	Without Toll (A)	With Toll (B)	Comparison (B/A)
No. of Trips ('000 veh)	432.5	299.6	0.69
Vehicle Kilometers ('000 veh.km)	4,800.8	3,175.8	0.66
Vehicle Hours ('000 veh.hr)	72.1	42.9	0.60
Trip Length (km)	11.1	10.6	0.95
Travel Time (min)	10.1	8.6	0.85
Travel Speed (km/hr)	66.9	72.9	1.09

Table 2.4.12: Traffic Statistics on the Project Roads With and Without Toll System, 2005

	Without Toll (A)	With Toll (B)	Comparison (B/A)
No. of Trips ('000 veh)	640.1	480.8	0.75
Vehicle Kilometers ('000 veh.km)	6,593.0	4,808.0	0.73
Vehicle Hours ('000 veh.hr)	115.2	75.3	0.65
Trip Length (km)	10.3	10.0	0.97
Travel Time (min)	10.8	9.4	0.87
Travel Speed (km/hr)	57.2	63.7	1.11

Table 2.4.13: Traffic Statistics on the Entire Road Network in Klang Valley With and Without Toll System, 1995

	Without Toll (A)	With Toll (B)	Comparison (B/A)
No. of Trips ('000 veh)	3,196.4	3,196.4	1.00
Vehicle Kilometers ('000 veh.km)	40,848.2	40,973.0	1.00
Vehicle Hours ('000 veh.hr)	1,314.8	1,353.6	1.03

Table 2.4.14: Traffic Statistics on the Entire Road Network in Klang Valley With and Without Toll System, 2005

	Without Toll (A)	With Toll (B)	Comparison (B/A)
No. of Trips ('000 veh)	4,680.5	4,680.5	1.00
Vehicle Kilometers ('000 veh.km)	63,698.2	63,751.6	1.00
Vehicle Hours ('000 veh.hr)	1,889.7	1,940.2	1.03

(4) Effects on Traffic Flow within the Corridors of the Project Roads

Herein, the effects on traffic flow in the Kuala Lumpur-Klang Corridor when the Project Roads are implemented are discussed.

In this Study, the following four (4) cases are compared:-

(a) The Project Roads are not implemented (Without Project Roads)

(b) The entire length of the Project Roads with toll free system is implemented (Whole Project, Toll Free System)

(c) The entire length of the Project Roads with toll system is implemented (Whole Project, With Toll System)

(d) A minimum package of the Project Roads with toll system is implemented, namely Shah Alam Highway/MRR-II from KL-Seremban Expressway to HICOM: 4-lane and N-S Link from NKVE to Shah Alam Highway: 4-lane (Minimum Package, With Toll System)

The traffic flow across the following three (3) screenlines as shown in Figure 2.4.8 are compared:-

(a) Klang-Shah Alam Screenline
(b) Shah Alam-Petaling Jaya Screenline
(c) Petaling Jaya-Kuala Lumpur Screenline

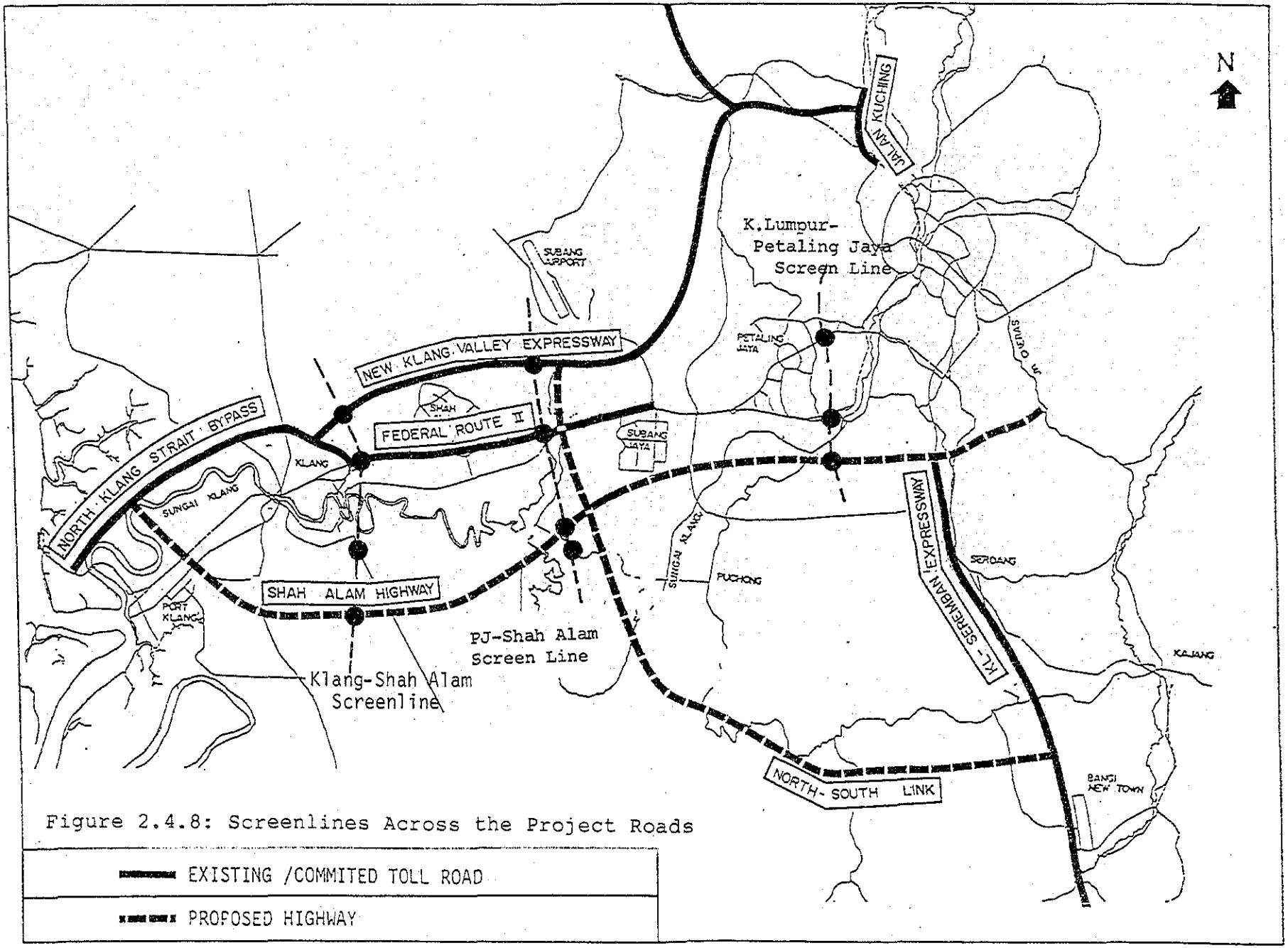


Figure 2.4.8: Screenlines Across the Project Roads

Tables 2.4.15, 2.4.16 and 2.4.17 show the comparison of traffic volume on these screenlines.

For the Klang-Shah Alam Screenline, when the Project Roads with toll free system is implemented, 37% (or 78,700 pcu) of traffic volume on NKVE and Federal Route 2 is expected to be diverted to Shah Alam Highway. On the other hand, when the Project Roads with toll system, only 20% (or 45,900 pcu) of traffic volume on these two roads is expected to be diverted to Shah Alam Highway.

For the Shah Alam-Petaling Jaya Screenline, when the Project Roads with toll free system is implemented, 41% (or 148,000 pcu) of traffic volume on NKVE and Federal Route 2 are expected to be diverted to Shah Alam Highway, while when the Project Roads with toll system is implemented then 31% (or 101,500 pcu) of the traffic volume on both roads is expected to be diverted to Shah Alam Highway.

In the case of comparing the "Minimum Package With Toll System" against the "Without Project Roads Case", it is found that the traffic diversion from NKVE and Federal Route 2 to Shah Alam Highway is negligible across the Shah Alam-Klang Screenline and only 12% across the Shah Alam-Petaling Jaya Screenline.

Taking into account the effects to NKVE and Federal Route 2 where toll concession has been given to PLUS, it is found that in the early stage, Shah Alam Highway/MRR-II should be constructed up to HICOM only and then the highway should be extended stagewise in proportion to increases in traffic volume.

Table 2.4.15: Traffic Volume on Shah Alam-Klang Screenline in 1995

(Unit: '000 PCU)

	Without Project Roads (A)	Whole Project, Toll Free System (B)	Whole Project, With Toll System (C)	Minimum Package, With Toll System (D)	Comparison (B/A)	Comparison (C/A)	Comparison (D/A)
NKVE	95.2	36.0	56.2	83.4	0.38	0.59	0.88
Federal Route 2	131.7	107.6	124.4	143.4	0.82	0.94	1.09
Shah Alam Highway	-	78.7	45.9	-	-	-	-
Jalan Kebun	6.2	3.5	3.9	6.2	0.56	0.63	1.00
Total	233.1	225.8	230.5	233.0	0.97	0.99	1.00

Table 2.4.16: Traffic Volume on Shah Alam-Petaling Jaya Screenline in 1995

(Unit: '000 PCU)

	Without Project Roads (A)	Whole Project, Toll Free System (B)	Whole Project, With Toll System (C)	Minimum Package, With Toll System (D)	Comparison (B/A)	Comparison (C/A)	Comparison (D/A)
NKVE	95.2	36.0	56.2	83.4	0.38	0.59	0.88
Federal Route 2	229.1	160.4	166.6	201.7	0.70	0.73	0.88
Shah Alam Highway	-	148.0	122.5	63.8	-	-	-
Batu Tiga-Jalan Puchong	40.2	17.8	19.7	20.2	0.44	0.49	0.50
Total	364.5	367.2	365.0	369.1	1.01	1.00	1.01

Table 2.4.17: Traffic Volume on Petaling Jaya-Kuala Lumpur Screenline in 1995

(Unit: '000 PCU)

	Without Project Roads (A)	Whole Project, Toll Free System (B)	Whole Project, With Toll System (C)	Minimum Package, With Toll System (D)	Comparison (B/A)	Comparison (C/A)	Comparison (D/A)
Federal Route 2	214.1	185.1	197.8	207.4	0.86	0.92	0.97
Jalan Klang Lama	115.4	78.4	108.2	94.8	0.68	0.94	0.82
Shah Alam Highway/ MRR-II	-	95.0	42.7	41.4	-	-	-
Total	329.4	358.5	348.7	343.6	1.09	1.06	1.04

(5) Assigned Traffic Volume by Alternative Toll Levy Systems

Herein, the results of three (3) traffic assignment cases related to the alternative toll levy systems including alternative location of toll plazas described in Section 2.4.2 and shown in Figure 2.4.3 are examined.

As shown in Table 2.4.18, Plan 1-A (Toll Barrier System with toll plaza location 1) as compared to Plan 2 (a combination of On-ramp Toll System and Toll Barrier System) has the effect of increasing the total traffic volume by 20% and at the same time, decreasing trip length and travel time slightly.

Table 2.4.19 shows the daily traffic volume on Shah Alam Highway and the collectable revenue. The toll system Plan 1-A on Shah Alam Highway has less potential in generating toll revenue compared to other toll systems (Plan 1-B and Plan 2).

Table 2.4.18: Traffic Statistics on the Proposed Highways by Alternative Toll Levy Systems, 2005

	*1 Toll Barrier		*2 On-Ramp With Toll Barrier	Comparison	
	Plan 1-A (A)	Plan 1-B (B)	Plan 2 (C)	(B/A)	(C/A)
No. of Trips ('000 veh)	480.8	478.3	400.7	0.99	0.83
Vehicle Kilometers ('000 veh.km)	4,808.0	4,783.2	4,728.3	0.99	0.98
Vehicle Hours ('000 veh.hr)	75.3	75.7	73.5	1.01	0.98
Trip Length (km)	10.0	10.0	11.8	1.00	1.18
Travel Time (min)	9.4	9.5	11.0	1.01	1.17
Average Travel Speed (km.hr)	63.7	63.3	63.9	0.99	1.00

Notes: *1 Toll Barrier System is adopted for Toll levy system on Shah Alam Highway while closed toll system is adopted on N-S Link

*2 On-ramp Toll with Toll Barrier System is adopted for Toll levy system on Shah Alam Highway and that on N-S Link is the closed toll system

Table 2.4.19: Comparative Table of Tariff Chargeable Vehicles on Shah Alam Highway by Alternative Toll Levy Systems

		Toll Barrier *1		On-Ramp With Toll Barrier *2	Comparison	
		Plan 1-A (A)	Plan 1-B (B)	Plan 2 (C)	(B/A)	(C/A)
Traffic Volume on Shah Alam Highway (veh/day)	*3	329,858	327,174	249,048	0.99	0.76
Tariff Chargeable Vehicle (veh/day)	*4	193,819	214,031	249,048	1.10	1.28
Chargeable Rate		0.59	0.65	1.00	1.10	1.69
Revenue from Shah alam Highway (M$/day)	*5	105,800	116,800	170,000	1.10	1.61

Notes: *1 Three (3) toll barriers are adopted for Shah alam Highway
*2 On-Ramp Toll with one (1) toll barrier is adopted for Shah Alam Highway
*3 Traffic volume on Shah Alam Highway only
*4 Traffic volume in the case of toll barrier system is double counted
*5 Revenue is estimated based on the existing level of tariff

(6) Assigned Traffic Volume by Alternative Interchange Plans

As discussed in Section 2.4.2, three alternative interchange plans (Plan 1, Plan 2 and Plan 3) have been enumerated in examining the variation of assigned traffic volume on the Project Roads in 2005. These alternative interchange plans are taken up for examination as traffic assignment alternative Case 11, Case 12 and Case 4 respectively.

Results of traffic assignment for these 3 alternative plans are shown in Table 2.4.20. The total traffic volume is observed to increase with increasing number of interchanges on the Project Roads. Alternative interchange plan, Plan-3 (Case 4) with a total of 22 interchanges shows an increase in the total traffic volume by 1.73 times over Plan 1 (Case 11) while Plan 2 (Case 12) shows an increase in the traffic volume by 1.35 times over Plan 1.

Table 2.4.20: Traffic Volume on the Project Roads by Alternative Interchange Plans, 2005

	Alternative Interchange Plan			Comparison	
	Plan 1 (A)	Plan 2 (B)	Plan 3 (C)	(B/A)	(C/A)
Traffic Volume ('000 vehicles)	278.2	374.3	480.8	1.35	1.73
No. of Interchanges	11	17	22	1.54	2.00
Traffic Volume/IC ('000 vehicles)	25.3	22.0	21.9	0.87	0.87

Note: (1) It is assumed that the toll barrier system is adopted as toll levy system
(2) It is assumed that both Project Roads are implemented simultaneously
(3) The number of interchanges include both system interchanges and service interchange

The effects of these 3 alternative interchange plans on the traffic statistics of the Project Roads are indicated in Table 2.4.21. An increase in the number of interchanges on the Project Roads causes a decrease in the average trip length hence average travel time. On the entire road network in Klang Valley an increase in the number of interchanges has an effect of decreasing the total veh.km and veh.hrs. (see Table 2.4.22).

On-ramp and off-ramp traffic volumes for each interchange are shown in Table 2.4.23. In Alternative IC Plan 3 for example, all interchanges on Shah Alam Highway/MRR-II are estimated to handle over 10,000 veh/day each, with the highest being 56,000 veh/day.

Table 2.4.21: Traffic Statistics on the Project Roads by Alternative Interchange Plans, 2005

	Alternative Interchange Plan			Comparison	
	Plan 1 (A)	Plan 2 (B)	Plan 3 (C)	(B/A)	(C/A)
No. of Trips ('000 veh)	278.2	374.3	480.8	1.35	1.73
Vehicle Kilometers ('000 veh.km)	3,783.2	4,005.0	4,664.0	1.06	1.23
Vehicle Hours ('000 veh.hr)	50.8	58.0	75.3	1.14	1.48
Trip Length (km)	13.6	10.7	9.7	0.79	0.71
Travel Time (min)	11.0	9.3	9.1	0.85	0.83
Average Travel Speed (km/hr)	74.4	69.0	63.7	0.93	0.86

Table 2.4.22: Traffic Statistics on Road Network in Klang Valley by Alternative Interchange Plans, 2005

	Alternative Interchange Plan			Comparison	
	Plan 1 (A)	Plan 2 (B)	Plan 3 (C)	(B/A)	(C/A)
No. of Trips ('000 PCU)	5,386	5,386	5,386	1.00	1.00
Vehicle Kilometers ('000 veh.km)	64,056	63,600	63.752	0.99	0.99
Vehicle Hours ('000 veh.hr)	2,016	1,973	1,940	0.98	0.96

Notes: (1) These figures are the results of traffic assignment to the entire road network in Klang Valley
(2) These figures are based on daily traffic volume

Figure 2.4.23: Traffic Volume at Interchanges by Alternative Interchange Plans, 2005

Unit: vehicle/day

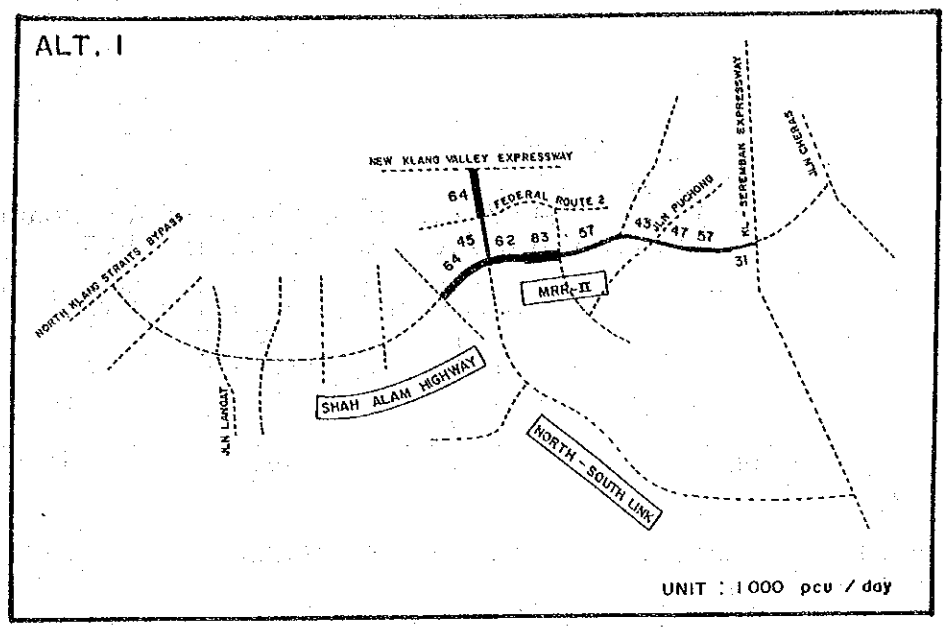
IC No.	IC Plan 1		IC Plan 2		IC Plan 3	
	On	Off	On	Off	On	Off
1	49,614	48,789	55,743	53,794	57,906	56,713
2	0	0	24,889	24,483	23,896	23,873
3	48,830	49,576	53,168	50,702	48,269	50,158
4	0	0	0	0	34,645	33,766
5	0	0	19,926	19,699	29,606	29,528
6	0	0	0	0	29,194	29,112
7	0	0	32,593	32,585	22,192	22,132
8	0	0	0	0	9,512	9,550
9	42,093	41,639	25,927	25,688	28,877	29,053
10	31,822	31,932	30,616	30,716	33,015	33,826
11	0	0	32,411	32,626	29,938	29,223
12	0	0	0	0	24,049	23,979
13	16,668	16,835	12,317	12,374	12,406	13,329
14	14,901	14,995	13,341	13,182	13,791	13,525
15	0	0	14,275	14,315	15,027	14,693
16	15,830	15,992	12,408	12,450	14,008	13,871
Sub-total	219,758	219,758	327,614	327,614	426,331	426,331
17	44,860	44,385	29,757	29,110	33,441	32,617
18	28,770	28,825	16,649	16,794	13,100	12,809
9	41,639	42,093	25,688	25,927	29,053	28,871
19	0	0	3,069	3,665	2,310	2,761
20	9,563	9,619	6,507	6,462	6,454	7,723
21	0	0	0	0	6,818	6,756
22	17,318	17,228	16,669	16,381	21,250	20,883
Sub-total	142,150	142,150	98,339	98,339	112,426	112,426
TOTAL	361,908	361,908	425,953	425,953	538,757	538,757

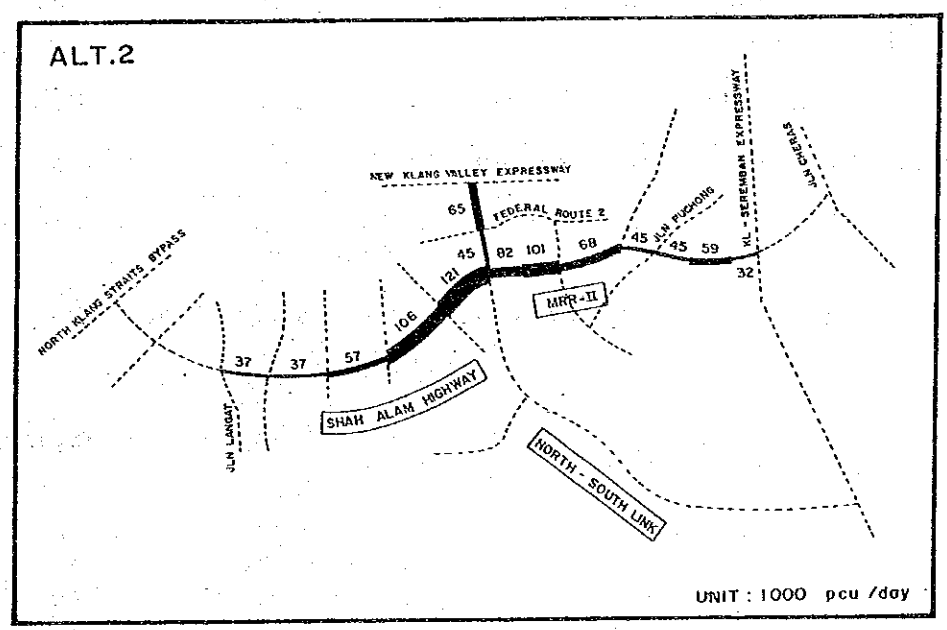
(7) Assigned Traffic Volume by Stage Implementation Plans

Herein, the assigned traffic volume on the Project Roads by the stage implementation plans discussed in 2.4.2 and shown in Figure 2.4.4 are examined.

Figure 2.4.9 shows the assigned traffic volume on the Project Roads in 1995 under the three possible stage implementation plans while the traffic statistics obtained in the traffic assignment are summarized in Table 2.4.24.

The total daily traffic volume in the case of Alt.1 is 140,700 vehicles while that in Cases Alt.2 and Alt.3 are 188,700 and 154,600 respectively. In terms of vehicle.kilometer travelled in each case, Alt.1 has only 1,159,000 vehicles while Alt.2 and Alt.3 have 2,338,000 veh.km and 1,921,000 veh.km respectively. Accordingly, the utilization rate of the Project Roads under the three cases are 85%, 79% and 53% respectively.





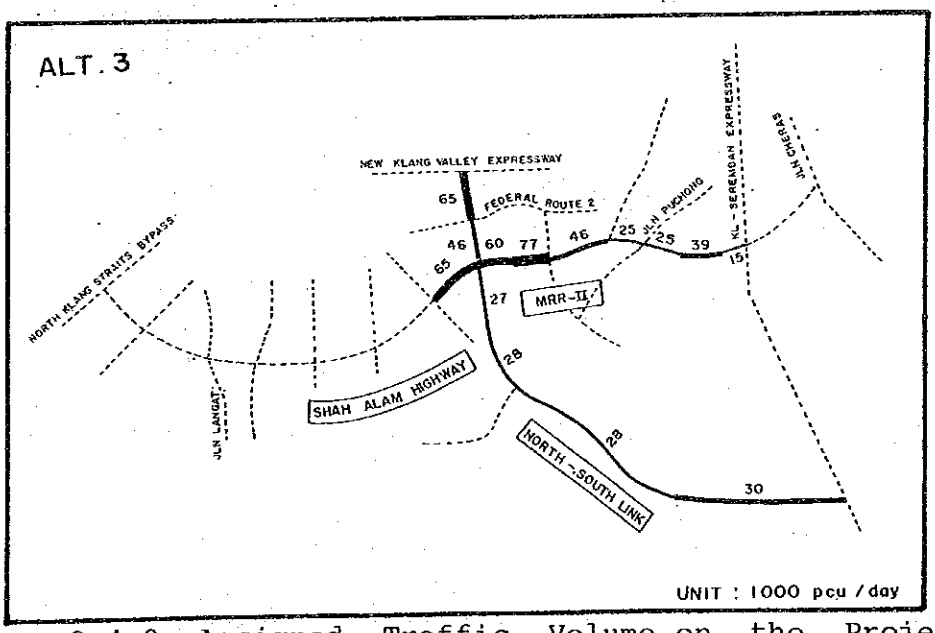


Figure 2.4.9: Assigned Traffic Volume on the Project Roads in 1995 Under Stage Implemebtation Plans

Table 2.4.24: Traffic Statistics on the Project Roads by Stage Implementation Plans in 1995

	Stage Implementation Plans *1 Alt.1 (A)	*2 Alt.2 (B)	*3 Alt.3 (C)
Traffic Volume ('000 veh)	140.7	188.7	154.6
Vehicle Kilometers ('000 veh.km)	1,159	2,338	1,921
Capacity Kilometers ('000 veh.km)	1,370	2,956	3,631
Veh.km/Capacity.km	0.85	0.79	0.53

Notes:*1 Shah Alam Highway: KL-Seremban Expressway to HICOM, 4-lane
N-S Link: NKVE to Shah Alam Highway, 4-lane

*2 Shah Alam Highway: KL-Seremban Expressway to SKSB, 6-lane
SKSB to Jalan Langat, 4-lane
N-S Link: NKVE to Shah Alam Highway, 4-lane

*3 Shah Alam Highway: KL-Seremban Expressway to HICOM, 4-lane
N-S Link: NKVE to Shah Alam Highway 6-lane
Shah Alam Highway to KL-Seremban Expressway, 4-lane

CHAPTER 3: ALTERNATIVE ROUTE STUDY

3.1 Selection of Route

This Study principally adopts the original corridors of the southern part of MRR-II, Shah Alam Highway and N-S Link as proposed by the KVTS.

Based on information gathered through site investigation and examination of maps and aerial photographs, all recent landuse and physical changes are identified and studied, paying special attention to the social environment and technical viewpoints.

The physical constraints for road planning sometimes would limit alternative route study while at times, alternatives are explored in order to avoid these physical constraints.

For the purpose of comparing such alternatives, the following criteria are taken into account in descending order of importance:-

(i) Land Availability
(ii) Impact on the Social Environment
(iii) Future Traffic Demand
(iv) Construction Economy
(v) Road User Benefits
(vi) Development Impact

The proposed routes as shown in Figure 3.1 are combined from each segment which has been deliberated on technical feasibility and selected among alternatives through comparative analysis and evaluation.

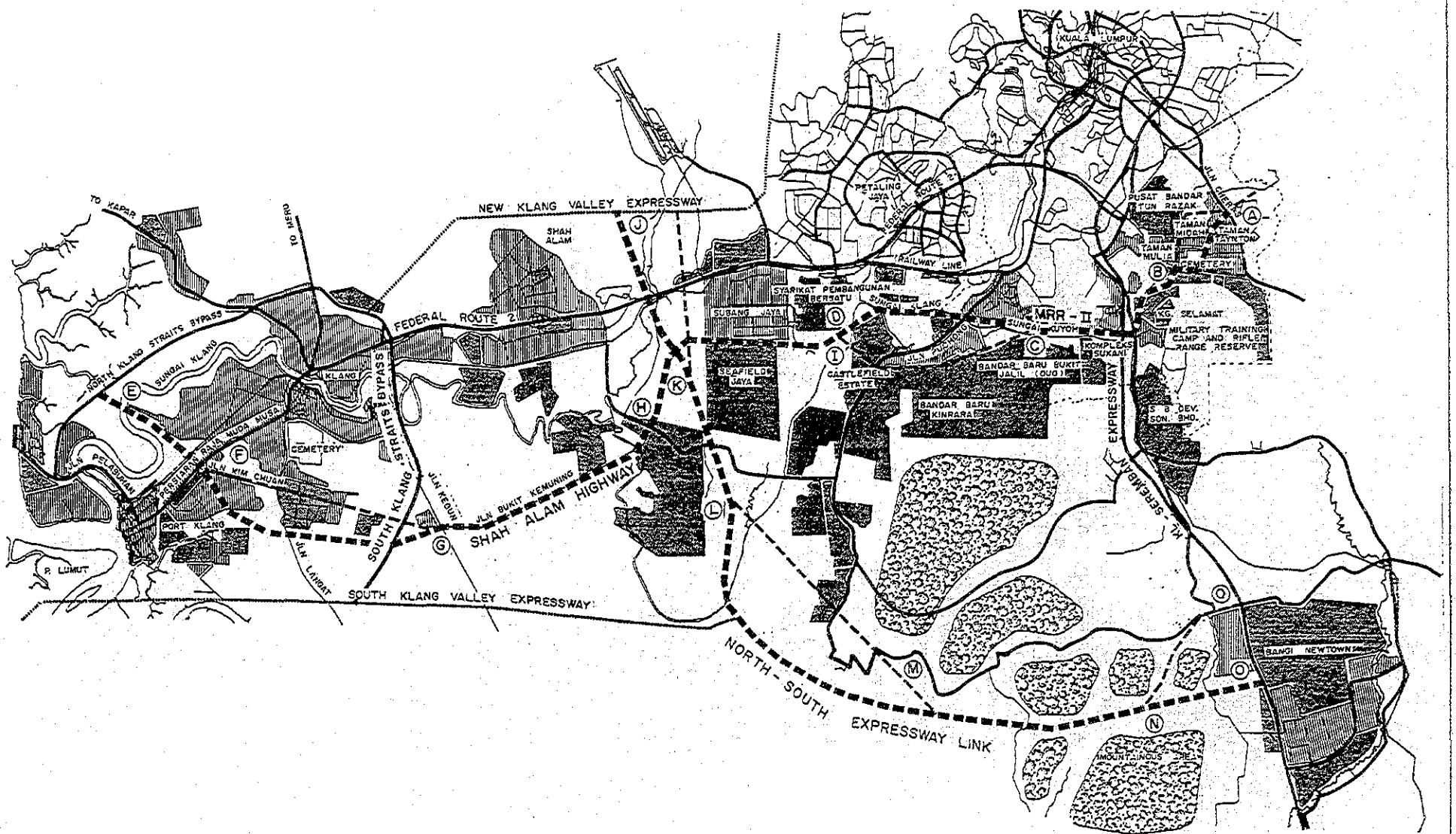


FIG. 3.1 : PROPOSED ROUTE AND ALTERNATIVES

THE FEASIBILITY STUDY ON TRANSPORTATION FACILITIES PROJECTS IN KLANG VALLEY

LEGEND:
- PROPOSED ROUTE
- ALTERNATIVE ROUTE
- PLANNED ROAD
- EXISTING ROAD

SCALE : 0 1 2 4km

N

3.2 Route Description

(1) Shah Alam Highway/MRR-II

Klang District

The western terminus of Shah Alam Highway (i.e. Klang West IC) is located about 250m from the existing toll gate on NKSB. Though the location of Klang West IC violated a part of conceptual town centre of PKNS Port Klang Area Development, PKNS has since then reviewed the town centre plan and its traffic circulation plan taking into consideration the proposed location of Klang West IC.

After crossing Sungai Klang, the alignment of Shah Alam Highway runs along the lee side of an existing dike of Sungai Klang. It is considered in this stretch to maintain the present functions of an inspection road on the dike and the waterway.

In the vicinity of Kim Chuan IC which is located at the intersection with Persiaran Raja Muda Musa, the proposed route runs along the existing road reserve of Jalan Petola and Jalan Kim Chuan because of strict land availability condition.

Several actions are taken to avoid destruction of established shophouses and to minimize acquisition of sports complex land and relocation of structures belonging to existing factories.

Beyond this point up to Klang East IC the proposed route goes into the property of Highlands Estate and avoids any committed housing development area.

Shah Alam Area

In Shah Alam area, the proposed route utilizes effectively the existing road reserve of Jalan Bukit Kemuning. Frontage roads on both sides are proposed to be constructed mainly by the developers of property along the route thereby reducing the need for extensive land acquisition. The proposed route also avoids, wherever possible, the violation of established factories and newly developed residential areas by going into the less expensive agricultural land. However, it is necessary to consider cost of relocating utility facilities located along Jalan Bukit Kemuning.

Subang Area

A major portion between Subang South IC and Jalan Puchong has been reserved for Shah Alam Highway in the approved layout plans of development such as Seafield, Castlefield, Sri Panglima and Nichmurni (Kinrara Development).

Bukit Jalil Area

The proposed route which takes on the name of MRR-II on crossing Jalan Puchong then passes between the northern bank of Sungai Kuyoh and the boundaries of committed developments such as Sunrise, Konsortium Serbaguna, etc.

The construction of frontage roads is proposed in order to maintain accessibility to existing built-up areas.

Sungai Midah Area

The proposed MRR-II between Sri Petaling East IC and Jalan Cheras passes through an area which is developing rapidly.

Two elevated semi-directional ramps are adopted to Sri Petaling East IC of which both north-west and south-east links are to play an important role in dispersing traffic in the southern part of Kuala Lumpur. The land condition also disallows the adoption of a loop for north-west direction, thereby necessitating the configuration of a modified cloverleaf type interchange with semi-directional ramps. The proposed interchange will be able to manage all the turning traffic movements using U-turn facilities even if these two semi-directional ramps are constructed in a later stage.

The proposed MRR-II overpasses by viaduct the existing Jalan Sungei Besi and railway tracks and then runs along a road reserve located between the committed SOBENA Development and railway/LRT reserve.

In the vicinity of Cendekiawan IC, the proposed route manages to pass severe controls described in the approved layout plans of HAR Holding and RUMAH TULIN

available space in the land reserve for Sungai Midah, LLN transmission and local road space so that most of the planned factory blocks shown on the layout plans will not be violated.

Beyond Cendekiawan IC, the proposed route takes on the recommended route for MRR-II prepared by KEMAS CONSULT for the Selangor State Government.

(2) N-S Link

The northern terminus of N-S Link at the intersection with NKVE, i.e. New Klang Valley IC is located about 600m from Montfort Boys' Town in the oil palm estate of Ladang Bukit Jelutong and Razak.

The proposed route runs south along the same corridor of the on-going Jalan TUDM-Shah Alam, passing through Batu Tiga IC at its intersection with Federal Route 2. Through sharing of the same corridor with the arterial road, additional land acquisition for the proposed expressway link is made minimum.

The proposed route intersects with the other project road, i.e. Shah Alam Highway at Subang West IC which is located in a mixed agricultural area. Going further south by about 3km, the proposed route intersects with the existing Jalan Puchong at HICOM East IC in Seafield Estate at the fringe of existing development.

Some 6km southward, just after crossing Sungai Klang, the proposed route intersects with the planned South Klang Valley Expressway at South Klang Valley IC in the oil palm estate of Ladang Hong Kong. Enroute the proposed route avoids disrupting any committed residential or industrial development in a basically agricultural land.

Beyond this point up to Puchong South IC the proposed route passes through ex-mining area with ponds, many of them will be expected to be refilled for future development.

From Puchong South IC, the proposed route runs eastward keeping a necessary distance from a 100m wide reserve for LLN power transmission lines.

The proposed route continues eastward for about 9km cutting across the rolling oil palm estate land of Ladang Raja Alang, etc. before reaching the fringe of Kampung Air Hitam and terminating at the intersection with Seremban Expressway (i.e. Bangi West IC). At this terminus a direct access is provided to the planned Bangi New Town Centre.

CHAPTER 4 : FORMULATION OF BASIC CONCEPT OF THE PROJECT ROADS

4.1 Study Approach

This Chapter presents the formulation of basic concept of the project roads such as implementation concept, toll levy system, interchange plan and stage implementation plan based on the pre-established landuse, population and employment plans, the traffic projection mentioned in Chapter 2 and alternative route study mentioned in Chapter 3.

The formulation procedure is shown in Figure 4.1.1. Based on the characteristics of the project roads identified, the following examinations regarding the basic concept of the project roads will be made:-

(a) Implementation Concept
(b) Toll Levy System
(c) Interchange Plan
(d) Stage Implementation Plan

The outcome of the abovementioned examinations will be the basis for the preliminary engineering study described in Chapter 5.

4.2 Alternative Implementation Concepts

4.2.1 Alternative Implementation Bodies

Any project that is viable for implementation needs an implementation body to see through the project implementation.

With regard to the proposed highway projects, they may be implemented and hence operated by any one of the following bodies:-

(a) Government
(b) Private Sector or
(c) Third Sector (Joint-venture by Government and Private Sector)

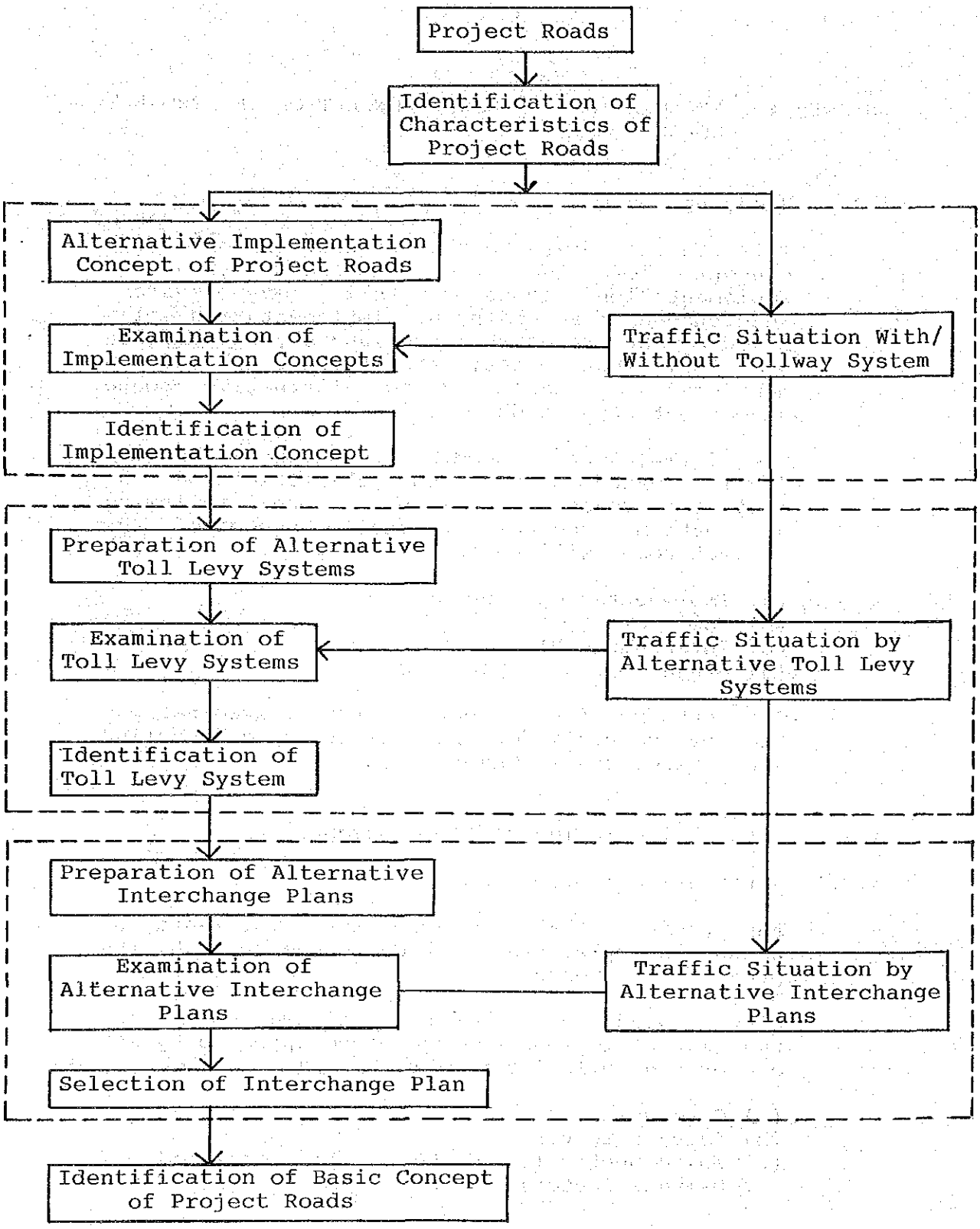


Figure 4.1.1: Procedure for Formulation of Basic Concept of Project Roads

Conventionally, the provision of social infrastructure such as road is the sole responsibility of the Government. Subsequently, it is expected to construct road for public use in the pursue of economic activities that will eventually bring progress to the country. It is undoubtedly that efficient road system constitutes an unquestionable positive incentive for any investment. Hence, any highway project that is viable and able to mitigate the existing congested conditions requires immediate attention. Within the existing Government setup, the relevant bodies responsible for road construction are Federal or State JKR and LLM.

However, due to ever increasing financial burden, the Government is seeking measures to provide these basic infrastructure without its direct involvement. Central to this issue is the privatization concept that has been widely practiced in other countries in the world, whether developed or developing countries. The practice of privatization in most cases achieved better performance in efficiency and profitability compared to Government projects.

As a result, the Government of Malaysia has also accepted this privatization concept as a new policy in national economic management. This concept has been applied to all facets of the public infrastructure or other sectors. For example, the telephone service and Klang Container Terminal have been privatized and the other port services is on the way to privatization. Specific to highway, numerous privatization projects have been carried out such as Jalan Kuching Improvement Project, NKSB, North-South Highway which is now under construction by PLUS, etc.

Regarding the privatization concept, there are two forms depending on the extent to which the project is being privatized. The two forms are Built, Operate and Transfer (BOT) and full privatization schemes. The main feature which distinguishes one from the other is the period of time that the project is granted to the private company.

In principle, under the BOT scheme, a company is given the right to build and operate a highway for a defined period of time, after which the highway is handed back to the Government. In order to recover the construction and operation costs of the project, tariff is charged to users of the proposed highway during the concession period.

Under the full privatization scheme, a company is also given the right to build and operate a highway for an indefinite period of time.

The third sector concept is to establish a joint-venture company by a Government Agency with the private sector to construct and operate the proposed highway project.

If one of the abovementioned three implementation bodies are to implement and operate the proposed highways, it would be relevant that for the case of the toll free system, the implementation body should be JKR; while for the case of with toll system, other forms of implementation body such as LLM, private sector or third sector as shown below are more appropriate.

Implementation/ Operating Body	Toll free System	With Toll System
GOVERNMENT		
JKR	●	
LLM		●
PRIVATE SECTOR		●
THIRD SECTOR		●

Decision on which one of the bodies should be selected is a policy matter to be made by the Government and to determine whether the implementation concept to be adopted should be a "Toll Free System" or a "With Toll System" is a corollory to this decision.

4.2.2 Comparative Analysis of the Project Roads "With" and "Without" Toll System

The comparative analysis of the project roads "with" and "without" toll system is made based on the following viewpoints:-

* Construction Cost
* Operation and Maintenance Costs
* Benefits
* Traffic Situation
* Procurement of Project Cost

Table 4.2.1 shows the comparison of the project roads between the cases of "Toll Free System" and "With Toll System". From this table, the following can be concluded:-

(a) In the case of "With Toll System", the Government may only contribute either land cost or nothing out of the construction costs, while in the case of toll free system, the Government has to contribute the entire amount of the construction cost. This means that the "with" toll system case can reduce Government's financial burden of constructing the project roads. However, the decision to adopt either system is largely depending upon Government's policy.

(b) From the benefits viewpoint, the social and economic benefits in the case of "With Toll System" are expected to decrease slightly compared with those in the case of "Toll Free System". Therefore, even if the toll system concept is adopted to the Project Roads, the social and economic benefits will be decreased slightly only.

In this Study, both concepts (Toll Free System and With Toll System) would be examined and discussed hereinafter.

Table 4.2.1: Comparison of the Project Roads "With" and "Without" Toll

Item	Toll Free System	With Toll System
Construction Cost	* Because of no need to construct toll facilities, the construction cost in this case is slightly cheaper than that of with toll case. Shah Alam Highway/MRR-II .. M$ 660 million N-S Link .. M$ 341 million Total .. M$1,001 million	* Construction cost in this case is slightly more expensive than that of toll free case. Shah Alam Highway/MRR-II .. M$ 673 million N-S Link .. M$ 358 million Total .. M$1,035 million
Operation and Maintenance Costs	* Due to no need collect toll, the operation and maintenance costs in this case are cheaper than that of with toll case. Shah Alam Highway/MRR-II .. M$ 6.8 million N-S Link .. M$ 3.9 million Total .. M$ 10.7 million	* Operation and maintenance costs in this case is more expensive than that of toll free case. Shah Alam Highway/MRR-II .. M$ 8.7 million N-S Link .. M$ 5.9 million Total .. M$ 14.6 million
Benefits	* Considering the functions of the Project Roads road users on the Project Roads in this case can expect to receive more social and economic benefits than that of with toll case. Benefits in 1995 .. M$ 192 million Benefits in 2005 .. M$ 485 million	* Social and economic benefits in this case is slightly smaller than those of toll free case, but differences between with and without toll system are very small. Benefits in 1995 .. M$ 184 million Benefits in 2005 .. M$ 473 million
Traffic Situation	* Traffic volume of this case is 25%-30% higher than that of with toll case. Traffic Volume in 1995 .. 432,500 veh/day * Average travel speed in this case is lower than that of with toll case because traffic volume in this case is higher. Travel Speed in 1995 .. 66.9 km/hr * Average travel length in this case is slightly longer than that of with toll case. Trip length in 1995 .. 11.1 km/trip	* Traffic volume in this case is lower than that of toll free case. Traffic Volume in 1995 .. 299,600 veh/day * Average travel speed in this case is higher than that of toll free case. Travel Speed in 1995 .. 72.9 km/hr * Average travel length in this case is slightly shorter than that of toll free case. Trip length in 1995 .. 10.6 km/trip
Procurement of Project Cost	* All costs come from the Government's fund. Government Development Expenditure .. M$1,001 million Government Expenditure for Operation and Maintenance in 2005 .. M$ 10.7 million	* The project cost will be recovered by toll levied on road users, either entirely or partially. Development Expenditure .. M$1,035 million Government's .. M$ 147 million Private Sector's .. M$ 888 million Private Sector's Expenditure for Operation and Maintenance in 2005 .. M$ 14.6 million