Chapter 8 PRELIMINARY ENGINEERING STUDY

8.1 Engineering Key Issues

In order to develop better quality highways, highway planning will play a significant role and a more comprehensive and sufficient planning theory will be required.

The PEIA study was conducted to assess environmental impact of the project road and provided significant issues for engineering study comprehensively and collaboratively, in terms of physical, biological and sociological aspects.

Four key issues Topography, Environment, Development and Road Network identified in Chapter 7 are translated in Engineering Key Issues. Figure 8-1 shows the Engineering Key Issues translated.

The Engineering Key Issues should be examined and summarized into design concepts which will be applied to the preliminary engineering design. The preliminary engineering design will be conducted based on the design standards and criteria, also taking into account of those design concepts.

The seven major engineering key issues are identified. Buffer zones, traffic safety and environmental harmony are for environmental preservation in developed areas and forest areas, respectively.

Tunnels, bridges and slopes should be studied from the standpoint of topography and environment. Structures such as tunnels and bridges will minimize the destruction of nature and prevent slope failures.

With regard to the toll collection system, the big issue, in terms of road users, traffic flow and efficiency, is the management of several privatized companies operating in the same network system. The plan of the system will be significant to design of interchange.

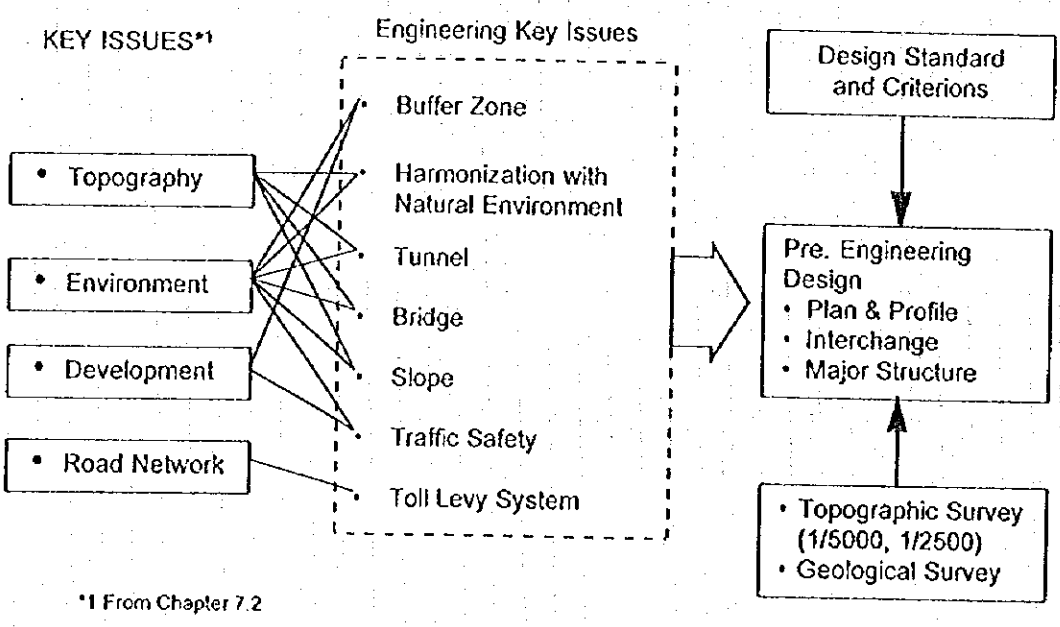


Figure 8-1 : Identification of Engineering Key Issues for the Preliminary Engineering Study

8.2 Design Standard and Capacity

Geometric and Bridge design standards for the KLORR are prepared based on the JKR design standards/guidelines. The geometric design standard for the KLORR is shown in Table 8-1 applying U6 and R6 according to the landuse pattern. The standard cross section for the expressway is shown in Figure 8-2.

Table 8-1 : Geometric Design Standard and Capacity for the KLORR

				JICA (The KLORR)	
Design Control & Criteria	1	Design Standard		U6	R6
	2	Access Control	-	FULL	
	3	Area Type		F	R.M.
	4	Design Speed	km/hr	100	80
Cross Section Elements	5	Lane Width	m	3.65	
	6	Shoulder Width	m	3.00	
	7	*1 (Structure >100m)	m	1.00	
	8	Median Width (Minimum)	m	4.00	
	9	Median Width (Desirable)	m	-	
	10	Marginal Strip Width	m	0.50	
	11	Minimum Reserve Width	m	60	
Elements of Design	12	Stopping Sight Distance	m	255	150
	13	Passing Sight Distance	m	Not Applicable	
	14	Minimum Radius	m	500	230
	15	Minimum Length of Spiral	m	See Table	
	16	Maximum Superelevation	Ratio	0.10	
	17	Maximum Grade (Desirable)	%	3	5
	18	Maximum Grade	%	5	6
	19	Crest Vertical Curve (K)	-	(R) 12,000	6,000
	20	Sag Vertical Curve (K)	-	(R) 5,000	3,000
Overhead Clearance			m	5.40 (5.20 + 0.20)	
Design Daily Capacity (veh/day/lane)				11,700	8,600

Note : F=Flat
R.M.=Rolling Mountain

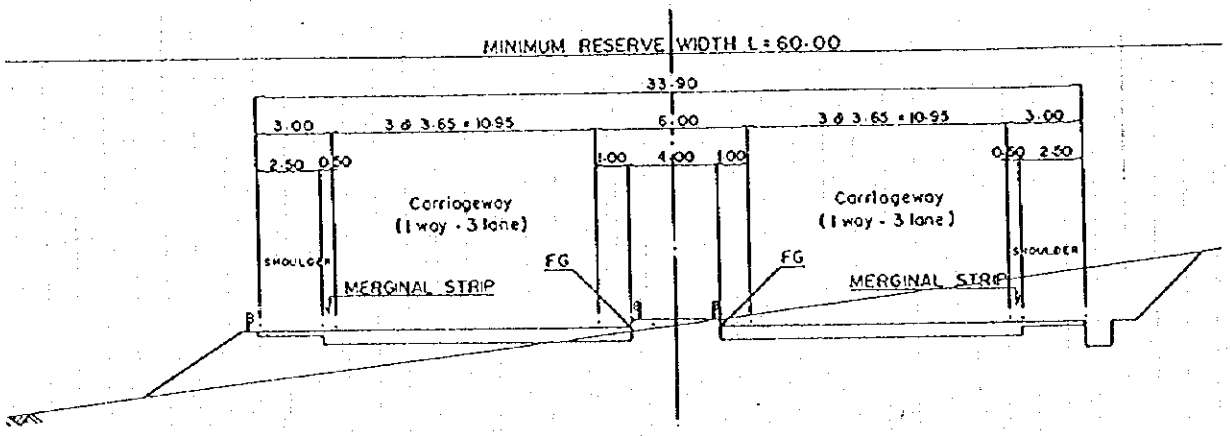


Figure 8-2 : Standard Cross Section for the KLORR

8.3 Basic Design Policy

8.3.1 Environmental Presentation

A buffer zone between carriageways and adjacent properties is an important countermeasure for environmental mitigation, especially traffic nuisances such as noise, air pollution and vibration. The type of buffer zone will be determined from the land use of roadside areas.

Table 8-2 and Figure 8-3 show the type of buffer zones by land use. Five types of buffer zones are proposed for different land uses and road side conditions. The widths of the buffer zones are examined based not only on the influence of traffic nuisances, but also urban landscaping with reference to the National Landscape Guideline - JPBD.

Based on the analysis shown in Table 8-3, eleven sections are proposed where buffer zones should be provided. The locations and type of the buffer zones are shown in Figure 8-4.

PEIA Study has identified environmental sensitive areas and potential impacts. On the selection of an optimum alignment for the KLORR, environmental preservation and minimization of the adverse impacts have been examined. However, some adverse impacts should be considered carefully in the preliminary engineering study, especially for the flora and fauna. For harmonization with natural environment it is examined to prepare a environmentally friendly engineering design. Figure 8-5 shows some examples for wildlife conservation, mitigating the effects by planting trees and plants.

Since the landscape planting technique has not been well established the following points are taken into consideration :

(a) Planting of native spaces
(b) Transplanting useful existing tress
(c) Conservation of scientifically important plants
(d) Conservation and recycling of the top soil, etc.

Table 8-2 : Roadside Land Use and Buffer Zone Type

• Residential Area

Type of Urban Areas	Roadside Conditions	Type of* Crossing Section	Right of way and (one side width of BZ) (m)
Existing Urban Area	General Types	A	80 (23.05)
	Crossing Urban Area (with service road)	B	100 (21.05)
Approved Urban Area (Structure Plan / Local Plan)	With Service Road	B	100 (21.05)
	High Level Environmental Residential Area	C	120 (31.05)
Future Developed Area	With Service Road	B	100 (21.05)

• Industrial Area (Commercial Area)

Type of Urban Areas	Roadside Conditions	Type of* Crossing Section	Right of way and (one side width of BZ) (m)
Existing Urban Area	General Type	D	60 (13.05)
Approved Urban Area (Structure Plan / Local Plan)	With Service Road	E	80 (11.05)
Future Developed Area	With Service Road	E	80 (11.05)

• Open Space Area

Type of Urban Areas	Roadside Conditions	Type of* Crossing Section	Right of way and (one side width of BZ) (m)
Open Space	-	D	60 (13.05)

Note : * Reference to Figure 8-3

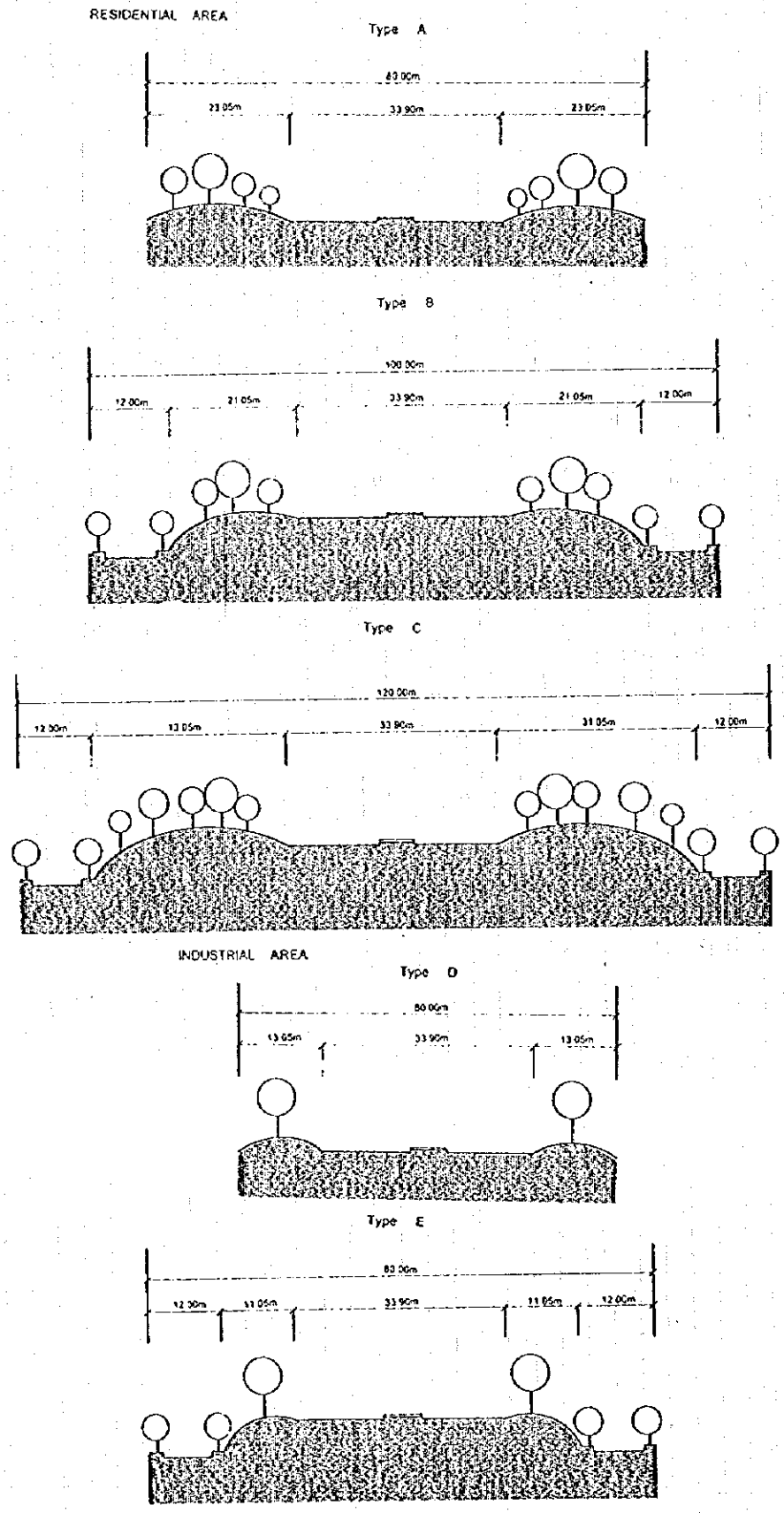


Figure 8-3 : Types of the Buffer Zones

Section *1		Density of Building		Land use Pattern				Infrastructure Development		Land use on the Development Plan *2					Distance from Interchange		Area Classification	Bufferzone Type *4
		High	Low	Residential	Commercial	Industrial	Others	Sufficient	In Sufficient	Residential	Commercial	Industrial	Others	Not Available	Close	Far		
1	In	●		●				●		●					●		a-1-1	C
	Out	●		●				●		●					●		a-1-1	C
2	In		●	●					◆					●		●	a-2	A
	Out		●	●					●					●		●	a-2	A
3	In	●		●				●		●						●	a-1-1	C
	Out	●		●				●		●						●	a-1-1	C
4	In		●	●					●			○		●	●		c-1	E
	Out		●	●					●			○		●	●		c-1	E
5	In		●				●	●				○		●	●		c-1	E
	Out		●				●	●				○		●	●		c-1	E
6	In		●					●	●	○				●		●	a-1-1	B
	Out		●				●		●	○				●		●	c-2	B
7	In		●				●		●	○				●		●	c-2	B
	Out	●		●				●		○				●		●	a-1-1	B
8	In		●	●					●	◆						●	a-1-1	B
	Out		●	●					●	◆						●	a-1-1	B
9	In		●				●		●					●	●		a-2	D
	Out	●					●	●					●		●		a-1-1	A
10	In		●				●		●					●	●		a-2	D
	Out	●					●	●					●		●		a-1-1	A
11	In		●				●		●					●			b-4	D
	Out		●				●		●					●			b-4	D

*1 See Figure 8-10

*2 ● Existing Situation
as Proposed by the Study Team

*3 See Table 8-9

Table 8-3 : Roadside Conditions and Buffer Zones for the KLORR

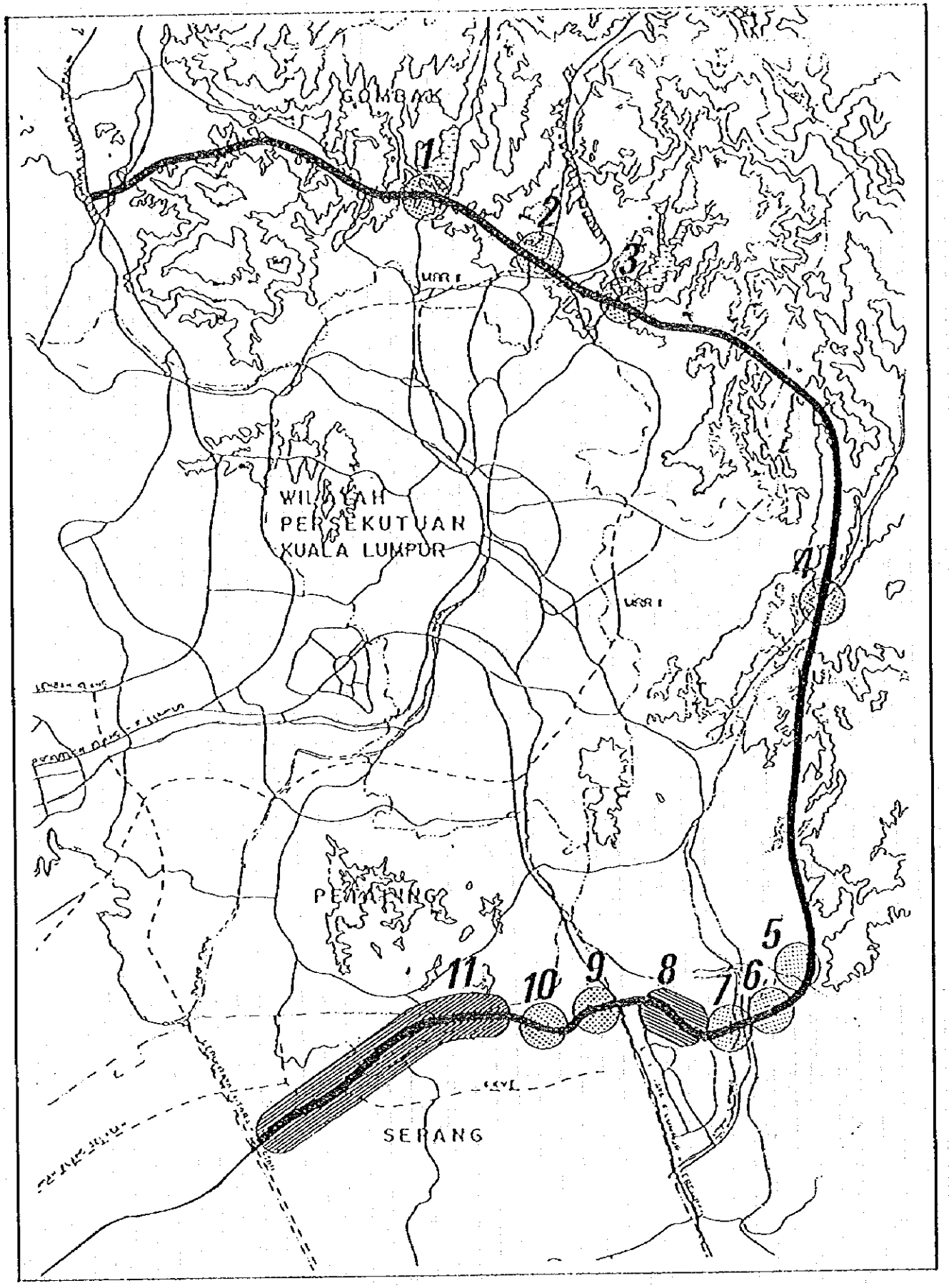
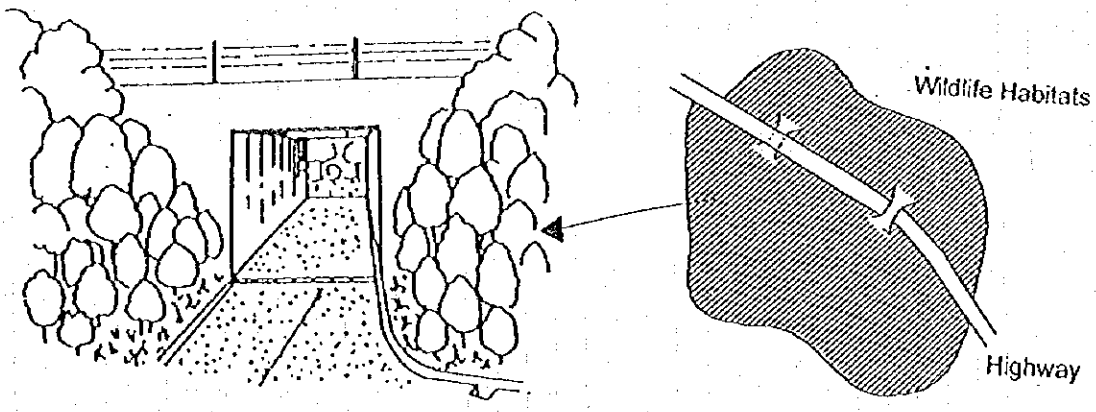
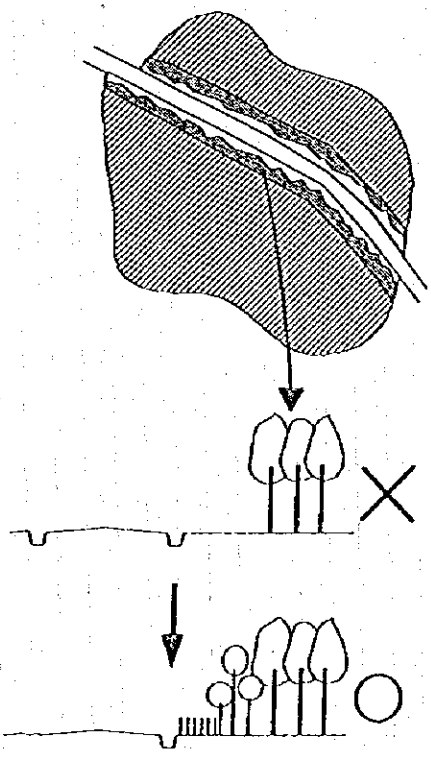


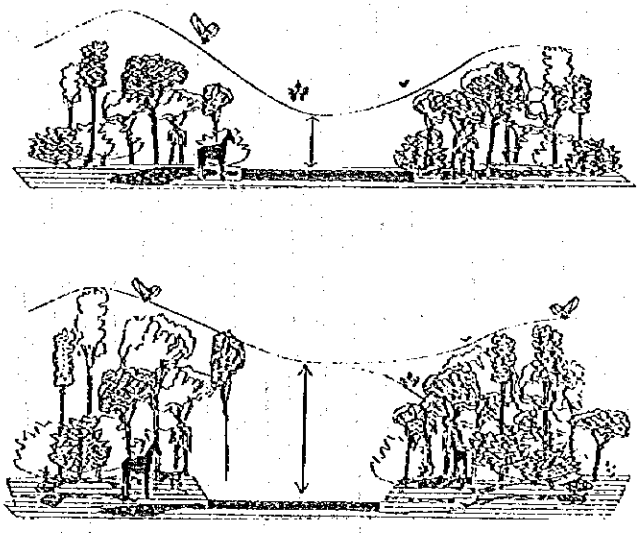
Figure 8-4 : Analysis Section for the Position of the Buffer Zones



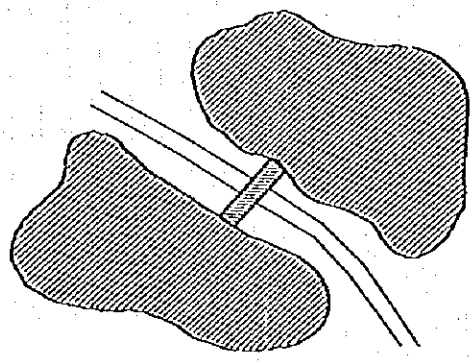
● Mammals Trails



● Edge Recovering with Planting



● Measures for Birds And Flying Insects



● Wildlife Corridor with Planting

Figure 8-5 : Mitigation Measures for Wildlife

8.3.2 Major Structures

1) Geological Condition

The general geological condition of the study area is shown in Figure 8-6. The general geology of the study area comprises of various lithology ranging from igneous, sedimentary to metamorphic rocks. The main geological features are:

(1) Dinding Schist
The oldest lithology in the study area is Dinding Schist which consists of quartz mica schisthornblend schist, metavolcanics and quartz. This rock formation has undergone regional metamorphism and are highly weathered. The reddish color of the schist is due to the occurrences of sericite of forum oxide along the foliation planes.

(2) Kuala Lumpur Limestone
The Kuala Lumpur Limestones found in the Federal Territory, Batu Caves and Ampang area are calcareous rocks which are finely grained limestone with colours ranging from grey to buff. In fact, almost all of the Kuala Lumpur Limestones have been metamorphosed and altered to marble. Two types of marbles crystalline marble and dolomite are encountered.

(3) Kajang Formation
The Kajang Formation which consists of interbedded schist, shale and slate, only outcrops in the northwestern and southern parts of the study area. Minor intercalation of marble are found in the schist. This indicates that the Kajang Formation is younger than Kuala Lumpur Limestone.

(4) Granite and its Differentiates
Granite is the most common type of rock and covers more than half of the Study Area. Tectonics and igneous activities have led to the formation of the Main Range granite and associated mineral deposits containing tin and tungsten. The Main Range granite batholith builds a massive mountain range which forms the backbone of the Peninsular Malaysia and dominates from Thailand in the north to Malaka in the south. The granitoid in Klang Gate area was intruded by quartz dykes through hydrothermal processes and have formed the Quartz Ridge.

(5) Alluvium
These recent deposits comprise river and coastal alluvium. The river alluvials are mostly tin bearing in the valley of Sg. Langat and Sg. Klang and their many tributaries draining from the Main Range. The lowest alluvial deposits consist mostly of beds of gravel which give way to layers of sand and clay, adobe which are generally superficial swamp deposits or peaty soil.

2) Selection of Tunnel Route

The rock of the tunnel route consists mainly granite and was heavily weathered in tropical weather condition. In some area there are fault lines running northwest to south east. In such condition the following examination criteria for tunnel routing were established.

(1) Avoid places where eccentric loading would be generated, select the tunnel route symmetrically with the lay of the land to the tunnel centerline so as to bear uniform loads.

(2) The route of the tunnel should have sufficient length from the heavy weathered rock, the tunnel route should have enough distance from the foot line of the mountain to prevent serious tunnel deformation, settlement or collapse.

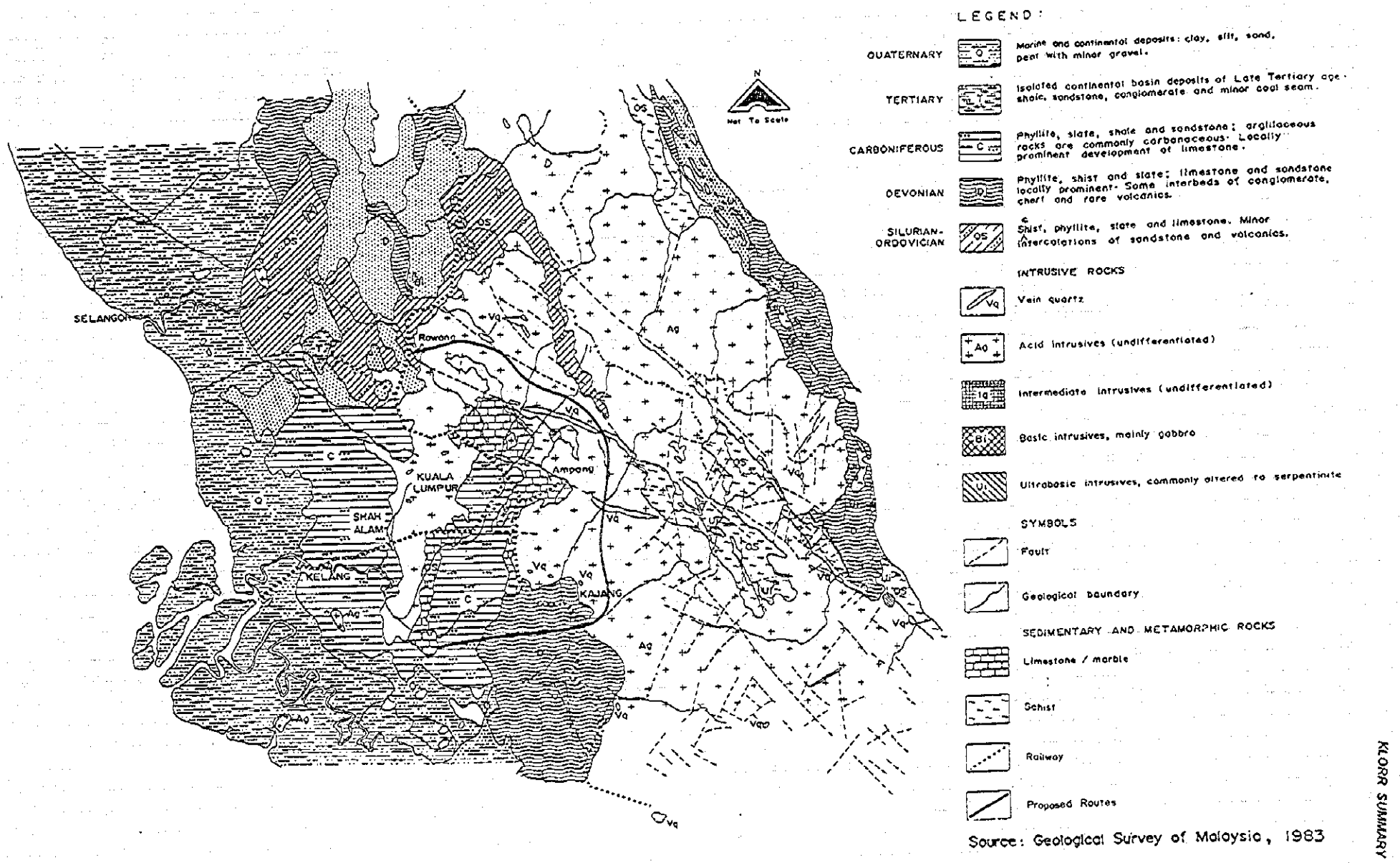


Figure 8-6 : Geological Condition in the Study Area

(3) The tunnel route should be free from active faults. If the route cannot avoid active faults, the route should not run parallel to the active fault lines located near or inside the tunnel. The active faults, apt to include rock crushed strata, sometimes bring about serious water spouts from the ground.

(4) The route center line of the tunnel mouth should be perpendicular to the contour line of the topography, to prevent the collapse of tunnel mouth.

(5) The route should not pass through limestone areas to prevent circumstances that lead to sinkhole problems.

(6) The slope of the tunnel in longitudinal line should be gentle, because a steep slope would reduce traffic capacity and interfere with smooth traffic flow. Also, emission of car fumes inside the tunnel would increase. Taking necessary drainage slope into consideration, it should be 0.5 to 2% (special 3%).

A typical cross section for the tunnel is shown in Figure 8-7.

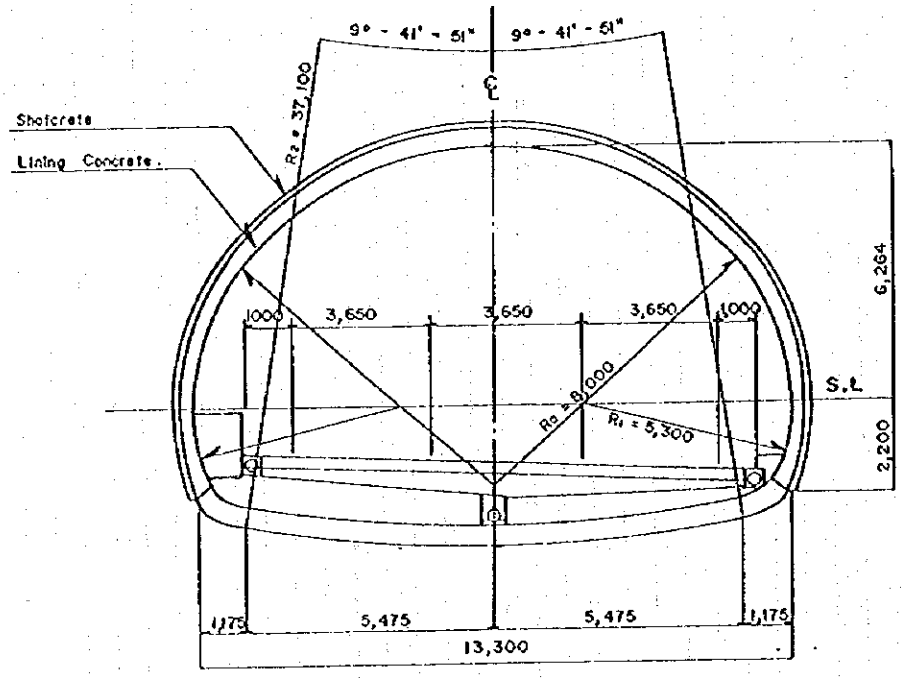


Figure 8-7 : A Typical Cross Section of the Tunnel

2) Bridges

There are various locations where bridges have to be considered while selecting the KLORR route. The following are very general consideration for selecting the bridge site :

(1) The span of bridge should be the minimum which can be achieved by selecting the best site among various possible sites for a particular bridge. The construction will become difficult and cost will increase with the increase in span of bridge.

(2) The bridge site should be selected such that very high abutment and piers would be avoided. The construction of high abutments and piers is difficult and the cost increases as well.

Therefore, generally, bridge of short span of 20 to 35m and low pier of 10 m, "I" or "T" shaped girder prestressed concrete is adopted, and for long span of 60 to 100 m and

high pier of more than 15m, the Dywidag post tensioning method is employed.

Type of bridge to be employed in this project are classified into four types, i.e. bridges for crossing a small stream or a narrow path of the embankment area, crossing medium stream or passing through developed area, crossing steep-walled valley and crossing roads by loop line bridges inside the interchange.

3) Cutting Slope

Due to the unusually rapid pace of development for housing and industrial estates, cutting slopes at hilly areas are often faced with the problems of rockfalls and landslides.

The rock mass around Kuala Lumpur area has already suffered from heavy weathering under the severe tropical climate. Most of surface layers have changed to soil and remaining rocks have many open cracks and joints. This is aggregated by rain water seeping into the cracks of rocks, causing frequent rockfall and landslides.

Selection of Cutting Area is similar to tunnel route selection. The following evaluation criteria for drawing alignment were established, taking into consideration of the suitable cutting area in conformity with the present soil conditions.

- Avoid excavation in steep and heavily weathered places.
- Avoid excavation in weathered sedimentation areas.
- Select the cutting places which are well drained.
- Avoid the cutting in active fault zones.
- Intersect perpendicularly the road route with the contour line.

8.3.3 Traffic Safety

Traffic safety aspect was considered in designing the KLORR. Drivers' interview survey was conducted on the Karak Highway and the N-S Expressway to collect following information of awareness of the drivers and to reflect it to the design of the KLORR.

(1) Highways designed under high design standard are more acceptable to drivers from the stand point of traffic safety and comfort
(2) Anxiety about roadside slope slippage in heavy rain
(3) Awareness of the drivers in steep slope
(4) Difficult to drive through sharp curve on down slopes
(5) Karak tunnel is worse than Ipoh tunnel

Suggestions for the design of the KLORR are made as follows, from the standpoint of traffic safety.

(1) Eliminate drivers' anxiety
It is normal and natural that the high percentage of drivers felt anxiety in the rain in the slope section. It is recommended that the length and height of roadside slopes on the KLORR should be as small as possible.

(2) Keeping constant speed
It is important to keep a constant speed of traffic flow not only for accident prevention but also for comfortable driving. Changing speed is one cause of accidents.

(3) Facilitate steering
In order to keep a constant speed, it is noted that the curved section after the straight section should be designed smoothly.

(4) Pay more attention to tunnel design
Several aspects were pointed out driving in the tunnel, such as visibility, air ventilation

and emergency systems. According to the survey results, the following items should be considered :

- Design of tunnel entrance : Usually, speed is reduced just before the tunnel entrance. There are many reasons, but anxiety and feelings of oppression are some. The design of tunnel entrance should be well considered.
- Gentle vertical alignment : The vertical alignment is recommended to be designed at less than 2%, if possible around 1%, to make traffic flow smooth and to minimize the speed difference, especially for lorries.
- Provision of Emergency Refuge : It is required to provide emergency refuge for broken down vehicles in a tunnel. The interval of space should be at least 1,000 m.

8.3.4 Toll System

The toll collection systems used in Malaysia for the existing toll expressways and highways are close system and open system. Considering the length of the KLORR, toll charge to be fair, to minimize stops at toll gate and to make common tolling area with the existing toll expressways, a close toll system is recommended for the KLORR.

The KLORR will connect by three system interchanges with North-South Expressway operated under close toll system and with KL-Karak Highway operated under open toll system.

In the case of connection with North-South Expressway, it is recommended to introduce the same price operation for through-traffic and also the trip-length base operation for traffic which has a terminal of trip in the KLORR.

In the case of connection with KL-Karak Highway

- To move the existing toll barrier to the northern side of the interchange with the KLORR.
- To install the toll gates separately for every directional traffic at the rampways to issue a ticket and to collect toll fee which is different by directional traffic.

8.4 Plan and Profile

Preliminary Engineering Design on the 1/5,000 topographical map was conducted for the 88.91km long expressway, applying U6 or R6 design standard according to the landuse and topographic condition along the project road. Due to the mountainous terrain, 35 % of the total length were bridge and tunnel sections. Summary of the design is shown in Table 8-4.

Table 8-4 : Summary of the Preliminary Engineering Design

Section	Unit	Section 1	Section 2	Section 3	Total
Length	m	22,830	37,580	28,500	88,910
(Cut and Embankment)	m	13,220	22,580	22,390	58,190
(Bridges and Viaduct)	m	6,050	9,270	6,110	21,430
(Tunnels)	m	3,560	5,730	-	9,290
Right of Way	m	60	60	60 ~ 100	
Number of Lanes	lane	5	6	6	6
Geometric Design Standard	-	R6 (M)	R6 (M)	U6 (I)	-
Design Speed	km/hr	80	80	100	80 ~ 100
Minimum Radius	m	800	800	800	600
Maximum Grade	%	4	4	3	3 ~ 4
Type of Pavement	-	Asphalt Concrete			

1) Horizontal Alignment

Table 8-5 shows the results of the horizontal design by frequencies of usage of horizontal radius by its class. In Section 1 and Section 3 tendency of usage of radius is almost the same, around 40% of radius are of 1,000 to 2,500 m and around 50% are more than 5,000 m. Whereas in Section 2, reflecting steep mountain conditions, the usage of small radius less than 1,000 became larger than other two sections.

Table 8-5 : Frequency of Radius

Class of Radius	Section 1		Section 2		Section 3	
	Length	%	Length	%	Length	%
Less than 1,000m	998	4.4	6,077	16.2	1,530	5.3
1,000 to 2,500m	8,877	38.9	6,630	17.6	11,633	40.7
2,500 to 5,000m	1,509	6.6	2,065	5.5	2,017	7.1
More than 5,000m	11,446	50.1	22,808	60.7	13,320	46.9
Total (m)	22,830	100.0	37,580	100.0	28,500	100.0

2) Vertical Alignment

Table 8-6 shows frequency of gradient of the vertical alignment. This results also depicts the nature of the KLORR. In Section 1 which reflects hilly terrain, reduction of cutting depth and filling by 1.5 to 3.0% are most frequently used. In Section 2, the gradients used are in wide range and because of mountainous terrain the section with gradient more than 3% are 16.5%. In Section 3, because of gentle hilly terrain condition, 86% of length are with gradient of less than 1.5%.

Table 8-6 : Frequency of Gradient

Class of Gradient	Section 1		Section 2		Section 3	
	Length	%	Length	%	Length	%
Less than 0.5%	3,100	13.6	8,300	22.0	8,600	30.2
0.5% to 1.5%	0	0.0	9,300	24.7	15,900	55.8
1.5% to 3.0%	19,130	83.8	13,780	36.8	4,000	14.0
More than 3.0%	600	2.6	6,200	16.5	0	0.0
Total	22,830	100.0	37,580	100.0	28,500	100.0

8.5 Interchange Plan and Design

Connection of expressway with other road is provided only through interchange. It is not an exaggeration to say that the function of the expressway depends fully on the planning of interchange. The planning of interchanges on the KLORR is conducted by considering the followings:

1) To Formulate Expressway/Highway Network

One of the most important function of the KLORR is to formulate nation wide expressway and highway network. In KL Metropolitan Area expressways and highways are forming radial direction network. To connect them with each other and to formulate nation wide network is a primary important function.

As for traffic function, to connect them will perform bypass function for inter city traffic which come from the north, south and east of the Peninsula. Therefore, interchanges are planned to connect both of the north and south sections of the North-South Expressway and KL-Karak Highway. These interchanges will be system interchanges of class A and B.

2) To Serve Generating Traffic in Area

Interchanges are planned to connect the primary roads and to serve generating traffic in the region. They are both north and south sections of the Federal Route 1 and some of the State Roads. As they pass through the area where high volume of traffic are generated, to connect with them will serve generating traffic demands effectively.

In the east section where the existing roads are few, new roads are proposed to improve accessibility such as Ampang Bypass and East West Link Expressway for the alternative Routes A and B. For the alternative Route C which pass through Ulu Klang the proposed extension of NKVE is proposed to extend further to connect the KLORR.

3) Accessibility to Development Area

Interchange areas are planned to serve generating traffic in the development area. In the southern area three interchanges are planned to serve development of Putra Jaya and KLIA projects. In the eastern area the interchange to connect the proposed extension of Ampang Bypass and E-W Link Expressway will serve generating traffic demand in Hulu Langat, if it is to be developed

Interchanges of the KLORR with other roads are studied and thirteen interchanges are identified based on the future highway network configuration. There are three types of interchanges, namely, System Interchange Class A -- interchange of expressway with other expressway, System Interchange Class B -- interchange of expressway with highway and Service Interchange -- interchange with ordinary road. Table 8-7 shows the proposed interchanges with the classification.

Table 8-7 : Proposed Interchanges and their Classification

IC No.	Location	Connecting Road	Classification of the Connecting Road	Classification of Interchange
1	Rawang	North - South Expressway	Expressway	System (A)
2	Templer Park	Federal Route 1 (Jln. Ipoh)	Highway	System (B)
3	Batu Dam	State Road B23 (Jln. Ulu Yam)	Primary	Service
4	Gombak	KL - Karak Highway	Highway	System (B)
5	Ulu Langat	Ampang Elevated Highway Extension	Highway	System (B)
6	Ulu Langat	State Road B52 (Jln. Ulu Langat)	Primary	Service
7	Ulu Langat	East - West Link Extension	Highway	System (B)
8	Kajang	Federal Route 1 (Jln. Semenyih)	Highway	System (B)
9	Kajang	KL - Seremban Expressway	Expressway	System (A)
10	Putra Jaya	Putra Jaya Urban Motorway	Urban Motorway	System (B)
11	Putra Jaya	Damansara Puchong Road	Primary	Service
12	Putra Jaya	Putra Jaya Service Road	Primary	Service
13	Kuala Langat	North-South Central Link Expressway	Expressway	System (A)

Interchange locations are determined predominantly by the alignment of the proposed expressway, but sometimes they are adjusted due to the limited land availability for interchanges, constraints from nearby existing or committed interchanges and difficult terrain conditions and so on. Figure 8-8 shows interchange location and configuration.

The location and type of interchange with the North-South Expressway or the KL-Seremban Expressway are planned and designed taking into account of existing and committed interchanges, which are located within short intervals. For those interchanges, several alternative interchange plans are prepared and evaluated for comparison.

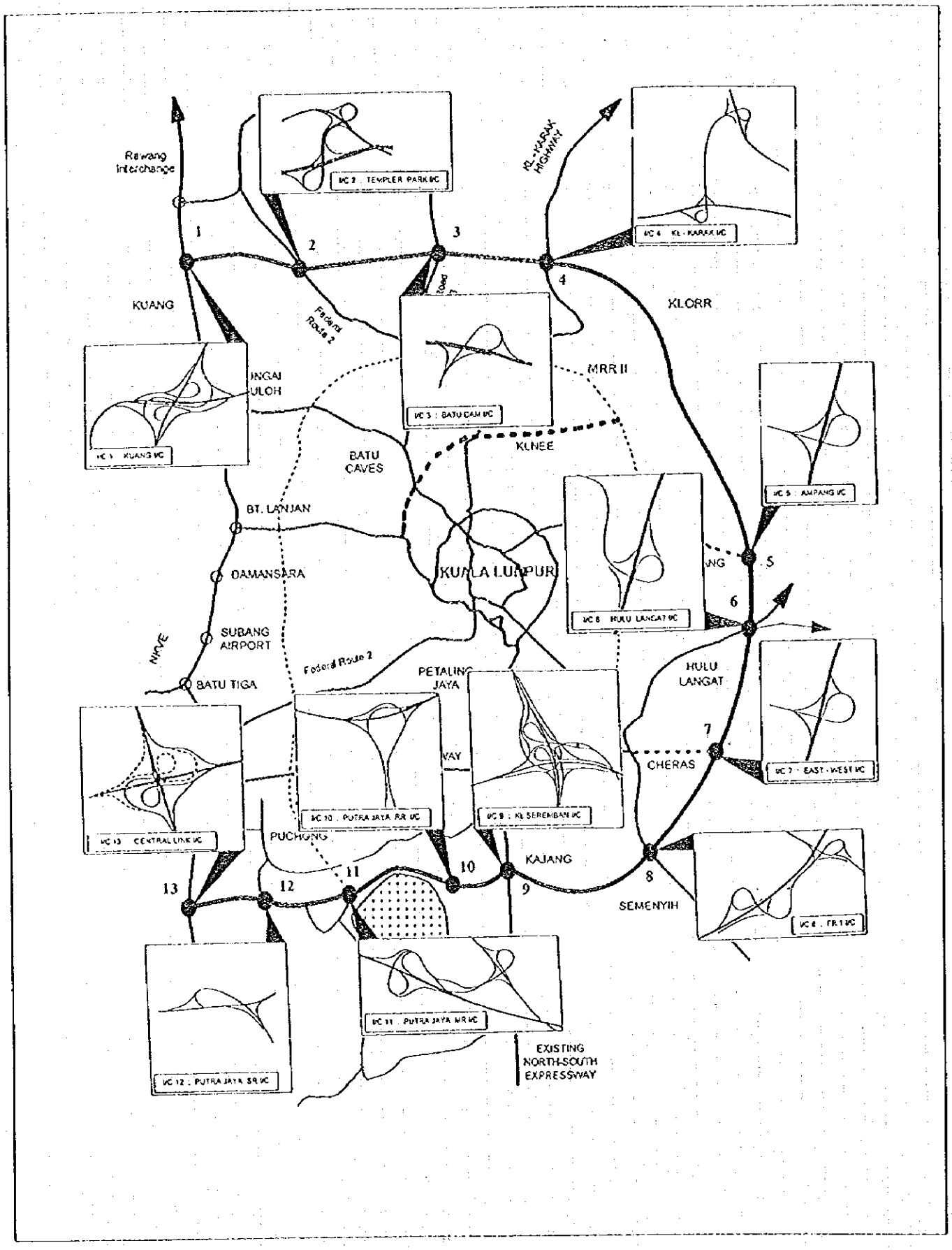


Figure 8-8 : Location and Configuration of Interchanges

Chapter 9 FUTURE ENVIRONMENT AND MONITORING

9.1 Major Environmental Impact and Mitigation for the Preferred Route Alignment

Although an optimum alignment and design have been examined taking into account of the environmental conditions in the project corridor, some unfavorable impacts will be unavoidable.

Major environmental impacts and mitigation measures for the preferred route alignment are assessed, such as soil erosion and water pollution in the construction phase, impacts to the flora and fauna and so on.

The comments from DOE (Department of Environment) include the followings :

1) Detail geological and geotechnical study are required in the mountainous areas identified as high risk soil erosions and slope failures.
2) Land developments should follow the Development Guidelines for the hilly areas prepared by Town and Country Planning Department.
3) The project implementation may cause soil erosion followed by some short-term localized flooding at the upstream of existing stream.
4) The proposed highway will pass through five forest reserves and park areas. The indirect impacts of the loss of forest will create a chain of deterioration on the existing environment, especially flora and fauna, due to the disruption of vital role played by the forests. An action plan to preserve the flora and fauna should be prepared.
5) The proposed road alignment passes through the water catchment areas and crosses some rivers and streams where there are municipal water intake points. Proper mitigation measures including monitoring system should be prepared.
6) The project implementation will cause relocation and resettlement of the people including Orang Asli. The resettlement should be done with the related authorities.
7) Vibration generated by the tunneling work will have effect on the structures such as Batu Dam and other surrounding buildings. Detail impacts and countermeasures should be examined and prepared.

Although the preliminary engineering study is conducted based on the environmental considerations, some sensitive issues will require a detail study such as the detail geological and geotechnical study for the slope stability, tunnel construction method, etc. in the implementation of detail engineering study.

9.2 Environmental Management Programme

The Environmental Management Programme (EMP) is formulated to provide an overall quality control for the proposed Project. It is required to ensure that the recommended procedures or actions in the PEIA Report are carried out accordingly. The programme covers the followings:

1) Design Guidelines

The Design Guidelines cover rules and regulations contained in the Environmental Quality Act, to regulate drainage design, atmospheric emission, noise and waste water discharge.

2) Construction Guidelines

To make environmental impacts minimum the following construction activities are regulated.

i) Minimize damage and interference
ii) Traffic management plan

iii) Fire service access
iv) Restoration of existing facilities
v) Cleaning up
vi) Safety measures
vii) Soil erosion control
viii) Pollution control

3) Operation and Maintenance Guidelines

During operation and maintenance phases, emission of air and noise as well as sewage water discharge should comply with regulations.

9.3 Monitoring Programme

The objective of the environmental monitoring programme is to act as an early warning sign against pollution or undesirable impact to the environment. With early detection, appropriate remedial action can be expeditiously carried out to prevent further deterioration of the environment.

A regular monitoring programme for water, air and noise has to be drawn up because the success and efficiency of mitigation measures against these residual effects may vary, resulting in uncertainties in the degree of impacts on the environment. Monitoring programmes should also extend to traffic flow, aquatic life (with assistance from the Department of Fisheries), forest activities and wildlife (with assistance from Perhilitan). The frequency of monitoring and the parameters to be measured are shown in Table 9-1 and the location of the monitoring are shown in Figure 9-1.

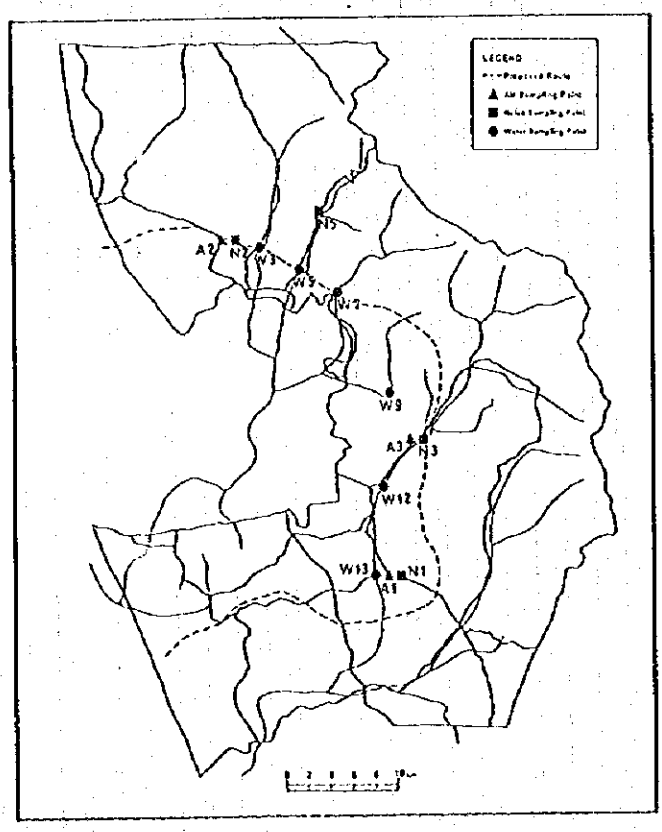


Figure 9-1 : Location of the Environmental Monitoring

Table 9-1 : Environmental Monitoring Programme

Environmental Impact	Parameter	Frequency		Location	
		Construction Phase	Operational Phase	Sampling Site	Land use
Air Quality	TSP (Total Suspended Particles) NOx, SOx, CO and HydroCarbon Wind Direction and Speed Temperature and Relative humidity	3 months	6 months	A1 : Kajang Town A2 : Templer Park A3 : Hulu Langat	Commercial Area Residential Area Rural Area
Noise	24-Hour sound level meter reading	3 months (Earthwork Stage : monthly)	6 months	N1 : Kajang Town N2 : Templer Park N3 : Hulu Langat N5: Karak Highway	Commercial Area Residential Area Rural Area Traffic Zone
Water Quality	pH, 5-day Biochemical Oxygen (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Oil & Grease (O&G) and E-coli count, Temperature and Dissolved Oxygen (DO)	3 months (Monthly for TSS during the Earthworks Stage)		W3 : Sg. Batu W5 : Sg. Gombak W7 : Sg. Kelang W9 : Sg Ampang W12 : Sg Langat W13 : Sg Langat	Residential Area Near Settlements Residential Area Recreational park Rubber Plantations Residential Area

9.4 Roadside Development for the Environmental Preservation

Environmental countermeasures for expressways are generally implemented within ROW (Right of Way) such as buffer zones, noise barriers and so on to sources of nuisances such as vehicular traffic. The countermeasures, however, should not be examined only from the standpoint of road construction. It is important to restructure and to provide a favourable land use pattern along expressways.

Basically, there are two strategies to promote favourable conditions along expressway corridors. One is to control the construction of houses, schools and hospitals which are sensitive to vehicular traffic nuisance. The other is to redevelop the corridors for commercial or industrial areas which are not very sensitive to traffic pollution. The residential areas can be provided behind the commercial or industrial areas.

The construction of expressways may deteriorate natural and social environments, but at the same time it will provide better accessibility and stimulate urbanization in the areas. The KLORR may provide adverse environmental impacts in some existing developed areas. Future urbanization pressure generated by the KLORR will change the existing land use. It is recommended that urban development plans should be prepared or reviewed to provide a preferred roadside land use pattern.

The construction of urban trunk roads will encourage the expansion of urban areas. Road side areas especially interchange areas are suitable for development of industries and residential areas and should be cordoned by the buffer zone. Figure 9-2 and Figure 9-3 show a roadside development plan for the area of Kajang and Bangi, respectively.

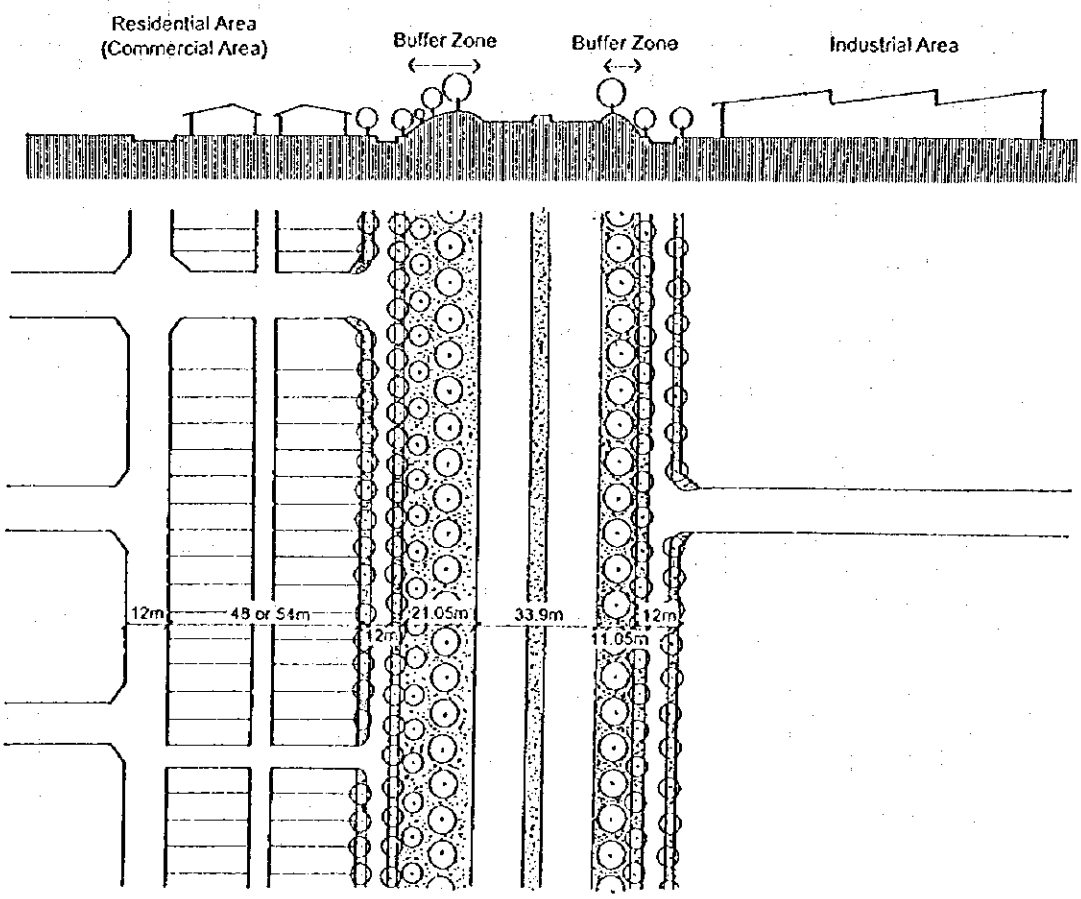


Figure 9-2 : An Example for the Provision of the Buffer Zone and Block Shape Arrangement

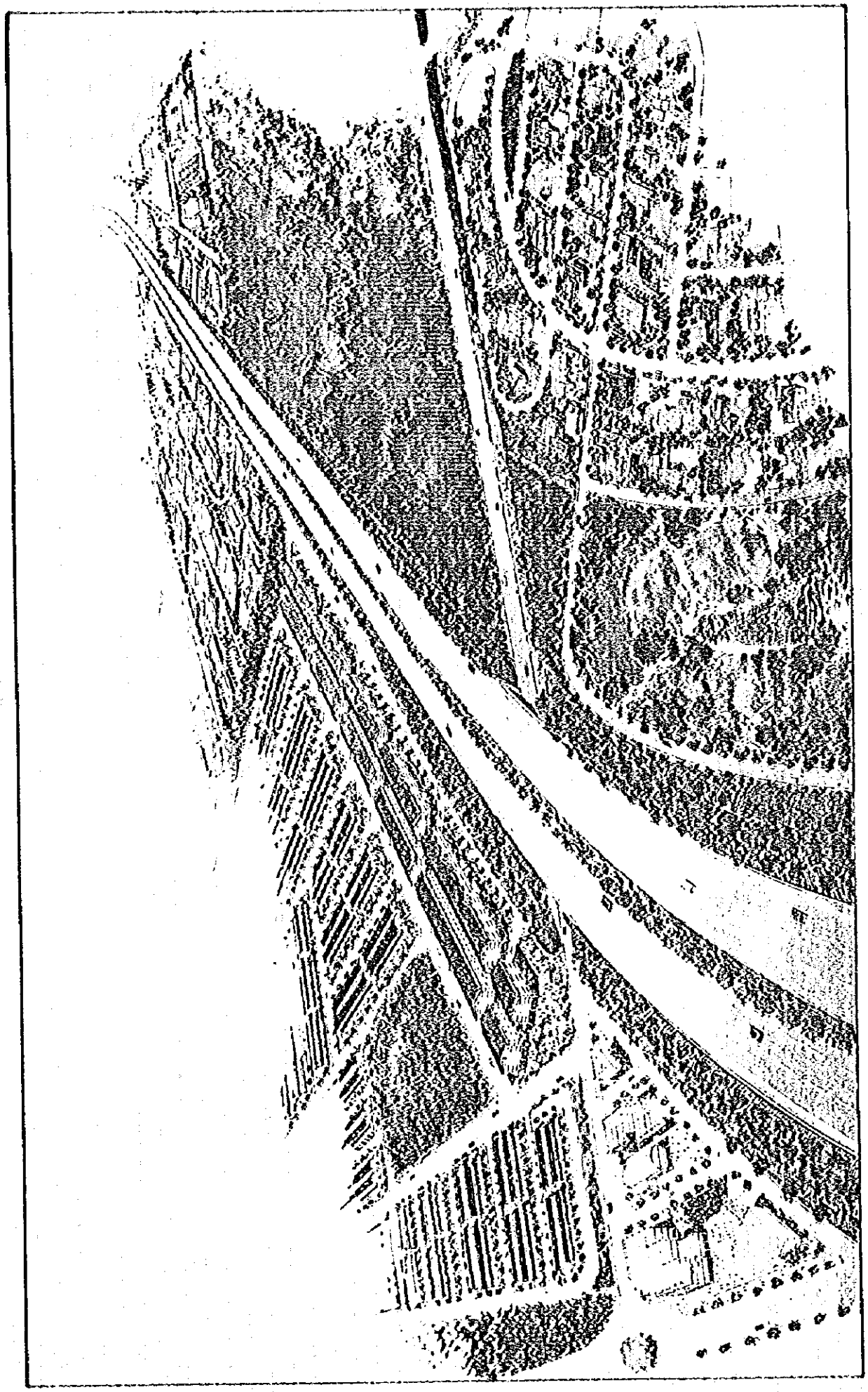


Figure 9-3 : Artist's Impression of the Road Side Area Development

Chapter 10 MAINTENANCE, OPERATION AND TRAFFIC SAFETY

10.1 Maintenance

Maintenance and repair are essential works to keep the roads and associated facilities in an initially constructed or later improved conditions. This will ensure smooth and comfortable traffic flow on the expressway contributing to traffic safety.

The maintenance work on the KLORR will be divided into three components, like other expressways or highways. They are:

1) Routine Maintenance

Routine maintenance tasks include daily inspection of roads, structures and other related facilities. Objects of inspection cover pavements, embankments, bridges, tunnels, slopes, fences, guardrails, signboards, etc. This daily inspection is aimed at early detection of any defects, damages, wear and tear of structures and facilities on the expressway. The results of the inspection are reported for follow-up maintenance work, if necessary.

2) Periodical Maintenance

Periodical maintenance involves a detailed inspection, checking and testing the condition of various facilities at certain fixed time intervals. As the name suggests, the maintenance is performed in fixed time cycles, such as yearly or half-yearly, monthly or weekly depending on the type of facility and maintenance items. Defects or damages are promptly reported for repairs or remedies. Periodical maintenance also covers the tasks of cleaning the pavements, signboards, guardrails and other facilities such as the upkeep of vegetation along the expressway, cleaning tunnel walls and painting.

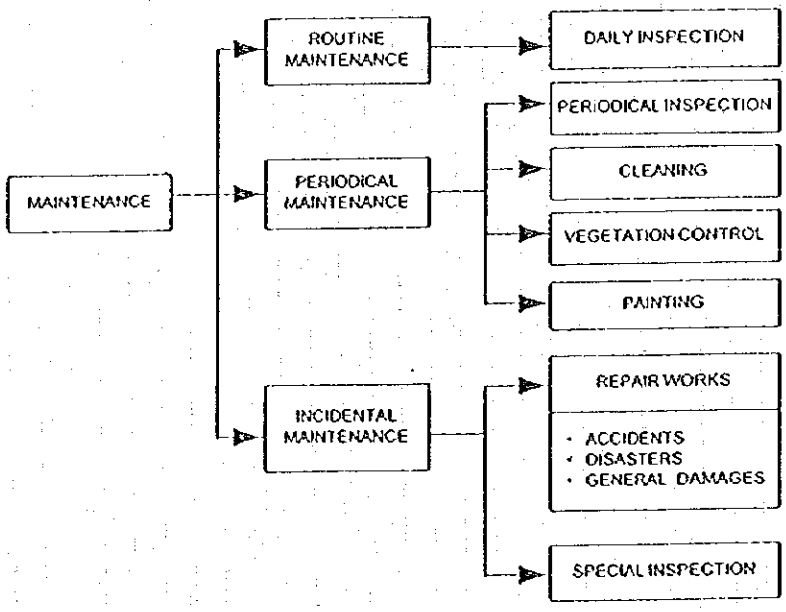


Figure 10-1 : Types of Maintenance Works

3) Incidental Maintenance

Incidental maintenance is work carried out to restore the expressway and related facilities to their normal functioning conditions after they have been damaged during road accidents or natural disasters such as landslides, avalanches, etc. Figure 10-1 shows the types of maintenance works.

10.2 Traffic Control and Surveillance

The KLORR will be an expressway operated with full access control. The traffic on it will be of high speed and high volume. To operate this kind of road properly, a suitable traffic control and surveillance system should be introduced in order to maintain smooth traffic flow, to rescue those who are involved in accidents and to restore it immediately to a normal condition.

As traffic volume increases, the occurrence of incidents or accidents on the expressway will affect traffic not only on the expressway itself but also on its connecting roads. The traffic control and surveillance system aims to detect these occurrences and minimize the influence of the incidents by presenting adequate information to drivers and controlling traffic flow.

The traffic control and surveillance plan for the KLORR is proposed as shown schematically in Figure 10-2.

10.3 Operation of the KLORR as a Toll Road

The KLORR will be operated as a toll highway under a privatization scheme. It is proposed that the toll system of the KLORR be a "closed-system". This means toll booths at entrances and exits are needed to be installed.

The main tasks of the toll road operation are:

(1) Issuance of tickets to road users at the entrance booths.
(2) Collection of toll fees at the exit booths.
(3) Maintenance and repair of toll operation facilities and equipment.
(4) Record of road users' trips.
(5) Distribution of revenue to concession companies.
(6) Agreement among concession companies.
(7) Management of the whole toll road operations.

The details of special and important tasks are as follows:

(1) Record of trips

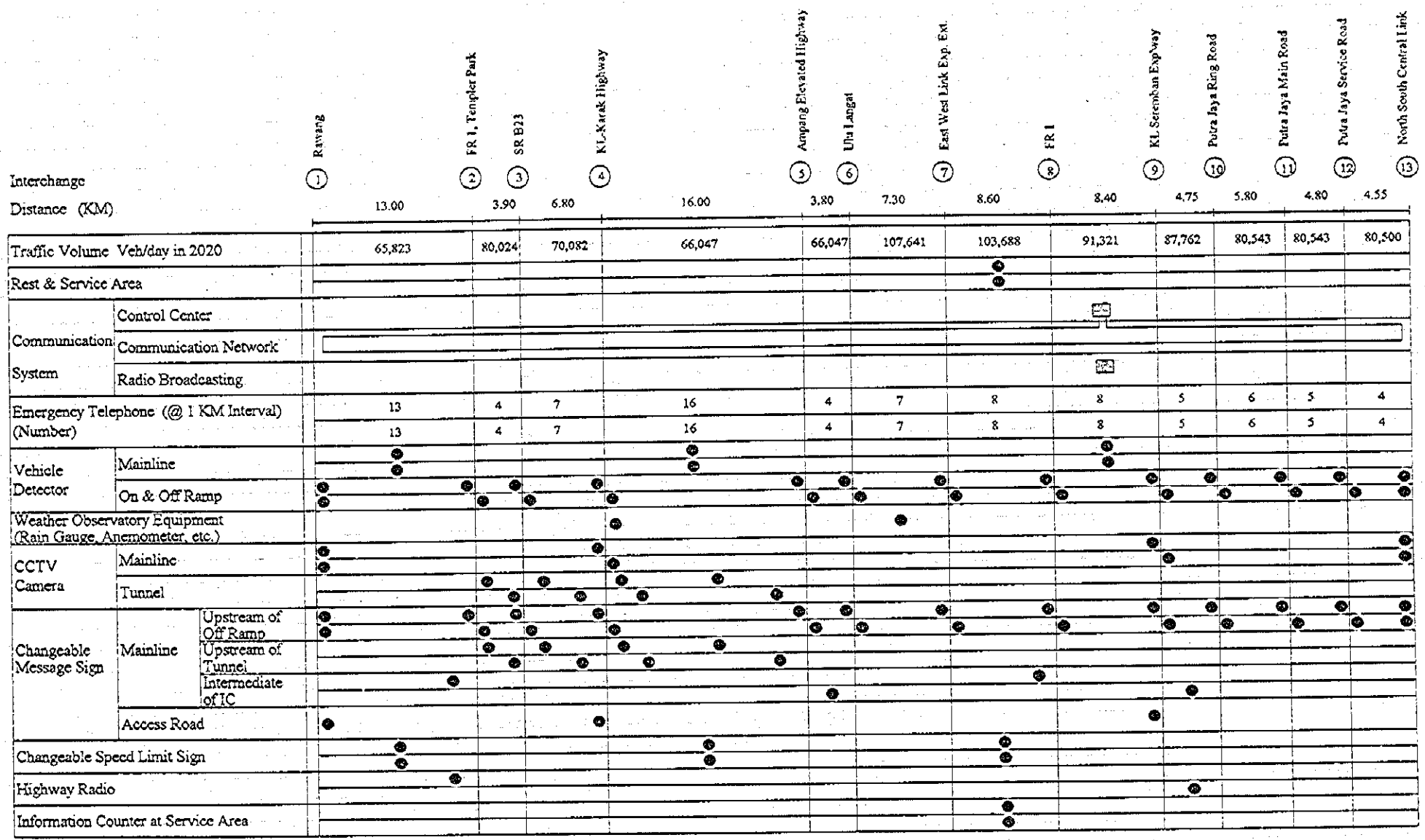
Daily records of every vehicle trip should be stored at the exit toll booths. The collected toll revenue for the day will be tallied against the trip records. If the difference between them is considerable, an investigation would follow.

Trip records of length and toll fees should be stored commonly by the concession companies which manage the KLORR and the other connected toll expressways.

(2) Agreement among concession companies

An agreement should be made among concession companies which manage connected toll expressways regarding the distribution of collected toll revenues based on trip records.

Figure 10-2 : An Example of Traffic Control and Surveillance Plan for the KLORR



10.4 Improvement of Traffic Safety Environment

In order to reduce the number of accidents, it is important and necessary to consider the amelioration of the traffic environment from both engineers and road users' standpoints. The driver interview survey was conducted to obtain users' opinion and observations.

Based on the results of the interview survey, the following improvement plan is proposed.

1) Installation of Equipment for Hazard Control

Anxiety about roadside landslides, especially in a rainstorm, is one of the greatest concerns for drivers during their journey in the mountain area.

It is important to predict a hazardous situation before it happens, based on quantity data obtained by automatic measuring equipment such as:

- Automatic Observation Equipment for Landslide
- Rain Gauge
- Anemometer of Streamer

Most drivers on the expressway request information on weather conditions and traffic regulations before they arrive at the location. Therefore, it is necessary to provide an information system such as changeable message signs, radio systems and so on, to convey up-to-date information to drivers

2) Safety Improvement for Tunnel Section

The survey results about the KL - Karak Highway indicate fears of drivers for tunnel safety. For the new tunnels which are to be constructed, safety measures should be upgraded.

The poll on drivers' opinions and observation of tunnel safety on the N-S Expressway showed better results than that on the KL - Karak Highway survey. Safety measures for the KLORR tunnels are expected to be provided on the same level as those provided for the Ipoh Tunnel or better one.

(1) Inside Tunnel

To maintain the service level of the KLORR, the same improvements to the Ipoh Tunnel should be considered as follows:

- Provide guide signs to indicate escape route(s)
- The condition of the existing guide signs will be improved such as larger and higher-visibility signs.

(2) Outside Tunnel

Same as for both the Genting and Ipoh tunnels, it is strongly advised to have guidance and warning signs installed in front of the tunnel entrance.

When an accident, fire or vehicle breakdown occurs inside the tunnel; it is very important to make other drivers aware of it in order to prevent any further accident and to minimize damage.

To prohibit any further drivers from entering the tunnel when an accident occurres inside the tunnel is of upmost importance.

3) Safety Measurement in Hazard Sections

(1) Steep Slopes and Sharp Curves

The survey results show that steep slopes and sharp curves are hazardous sections on highways and expressways. In fact, drivers are of the opinion that the most hazardous points are on sharp curves and down slope sections.

A high priority improvement plan advises that safety measures need to be set up on sharp curves and downward slope sections on the KLORR.

(2) Long Straight Sections

It is known that the long straight sections of an expressway / highway are the "black spots". The monotonous environment in these long straight sections is inclined to lead drivers to unconscious driving and sometimes even to hypnosis. Unconscious driving on these sections results in short headway driving which is the main cause of rear-end collisions.

4) Improvement of Traffic Information Dissemination to Road Users

It will be useful and important to present traffic information to drivers not only to keep effective traffic flow, but also to provide a valuable service on the KLORR. The traffic information guide for the KLORR is mainly used for traffic management especially in the urban areas.

CHAPTER 11 PROJECT COST ESTIMATES

11.1 Construction Cost

The implementation of the project will be carried out under the staged construction plan and the cost of each road section is estimated in 1995 prices as follows :

Table 11-1 : Construction Cost of each Section

Unit : million RM

Section	Length (m)	Construction Cost	Land Cost*	Engineering Cost	Environmental Protection Cost	Total of Costs
Section 1-1	10,490	520.2	29.5	26.0	5.2	580.9
Section 1-2	12,340	687.2	69.7	34.4	6.9	798.2
Section 2-1	23,000	1,042.7	183.9	52.1	10.4	1,289.1
Section 2-2	14,580	605.2	42.7	30.3	6.1	684.3
Section 3-1	10,200	352.1	55.3	17.6	3.5	428.5
section 3-2	18,300	737.2	83.4	36.9	7.4	864 .9
Total	88,910	3,944.6	464.5	197.3	39.5	4,645.9

Note : * Land Acquisition and Compensation

The direct costs of construction of structures including foreign and local portion are estimated as shown in Table 11-2. The amounts are slightly higher than the costs estimated in alternative route study shown in Table 7-1. Structures such as tunnels and bridges are required in view points of environmental protection as follows:

1) Tunnel

Although the length was reduced, number of tunnel increased so as not to make the cutting slope too high.

2) Bridge

As bridges were designed to cross streams on 1:5,000 map which could not see by mosaic photograph at alternative route study, the number of the bridges increased so as not to make embankment too high.

Table 11-2 : Direct Construction Cost for Structures

Unit : million RM

Description	Quantity	Foreign	Local	Total
General	L.S.	67.3	127.2	194.5
Road Work	58,190m	270.2	322.4	592.6
Bridge	21,430m	712.6	684.6	1,397.2
Tunnel	9,290m	638.3	318.6	956.9
Interchange	13 locations	252.4	505.5	757.9
Miscellaneous		3.1	2.4	5.5
Total		1943.9	1960.7	3,944.6

11.2 Maintenance, Operation and Monitoring Cost

1) Toll Operation

The toll operation work consists mainly of toll management and toll collection. The cost estimates are made for the following items :

- Supervision of tollway operations

- Maintenance and repair of tollway facilities and equipments
- Traffic control and provision of information during the occurrence of incidents on the road
- Administration

As for the toll collection aspect, manpower is required everyday.

2) Environmental Monitoring

The environmental quality monitoring programme for the KLORR consists of the following items :

- Air quality monitoring programme
- Noise quality monitoring programme
- Water quality monitoring programme

The estimate includes the cost of data collection and analysis for each programme and also the cost of an additional laboratory test, site inspection and audit survey.

3) Cost of Maintenance, Operation and Monitoring

The summary of maintenance costs for every year and for every five years, the toll operation costs and the environmental monitoring costs are as follows:

Table 11-3 : Total Cost of Maintenance, Operation and Monitoring

(RM in Thousand)

Road Maintenance (per year)	RM	10,800
Toll Operation (per year)	RM	7,556
Environment Monitoring (per year)	RM	213
Total for each year	RM	18,569
Heavy Repair (every five years)	RM	11,730

4) Maintenance and Operation Cost of Each Section

The maintenance and operation cost of each section are shown in Table 11-4.

Table 11-4 : Maintenance and Operation Cost of Each Section

(Unit : RM in Thousand)

Section	Length (m)	Annual Cost		Total of Annual Cost	Per 5 year Cost Maintenance
		Maintenance	Operation & Monitoring		
Section 1-1	10,490	1,076	1,037	2,113	1,694
Section 1-2	12,340	1,266	1,215	2,481	1,588
Section 2-1	23,000	3,370	1,538	4,908	1,798
Section 2-2	14,580	2,133	973	3,106	1,991
Section 3-1	10,200	1,046	1,064	2,110	3,372
section 3-2	18,300	1,909	1,942	3,851	1,287
Total	88,910	10,800	7,769	18,569	11,730

Chapter 12 PROJECT EVALUATION

The Scheme for the KLORR has been formulated in the previous chapters. There is no alternative plan regarding the main features such as alignment, cross section etc., thus the objective of the project evaluation in this chapter is to examine the economic and financial viability of the formulated scheme.

The sensitivity analysis for economic evaluation is made for the changes in various economic conditions including the GRDP growth rate of Selangor State.

12.1 Economic Evaluation

The economic evaluation is made for the following project cases.

(a) The proposed scheme as a whole based on the condition that the project is implemented during the years from 1997 to 2001 as shown in Figure 12-2.

(b) The proposed scheme by section based on the same schedule assumed above. The section 2 is subdivided into two segments, since the section length is relatively long and requires large amount of construction cost.

Section 1 : The section from the North-South Expressway in the North to the KL-Karak Highway

Section 2 : Segment 1 : The section from KL-Karak Highway to the Hulu Langat Road
Segment 2 : The section from the Hulu Langat road to the Federal Road No.1 in the South

Section 3 : The section from the Federal Road No.1 to N-S Central Link

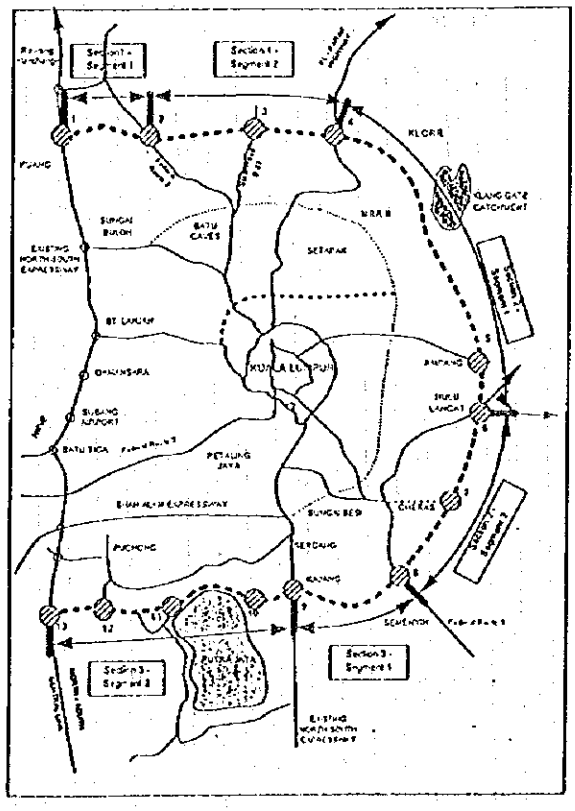


Figure 12-1 : Segments of the KLORR

(c) The proposed scheme as a whole according to the implementation schedule is finally proposed in this study.

For the evaluation, the following conditions are assumed.

(a) The life of the project is assumed to be thirty (30) years
(b) The discount rate is 12 % per annum.
(c) The implementation schedule is tentatively assumed as follows :

The schedule is prepared by assuming that the project would be implemented within the shortest period, and that the required period be one year for detailed design and four years for the construction.

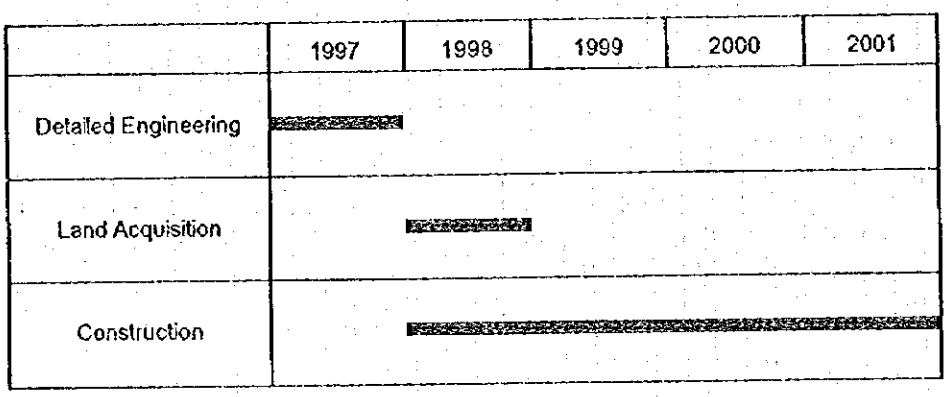


Figure 12-2 : Tentative Construction Schedule

Among the various benefits derived from the implementation of the road network plan, the following factors are counted as the economic benefits.

(a) Saving in vehicle operating cost
(b) Saving in travel time cost
(c) Reduction of traffic accident

Table 12-1 shows the estimated benefits in 2003, 2010 and 2020. The benefits are interpolated by assuming a constant annual growth rate for the intermediate years and assumed to remain at the same level as that in 2020 for the years after 2020.

Table 12-1. : Estimated Economic Benefits

(RM Million)

	Benefit	2002	2010	2020
Whole Length of the KLORR	VOC Saving	334.9	1,632.8	3,256.5
	Time Saving	193.5	836.5	1,498.0
	Accident Saving	0.5	3.5	3.5
	Total	529.0	2,472.9	4,788.0

The economic feasibility of the KLORR as a whole is evaluated based on the assumed schedule. The result of the economic indicators is shown in Table 12-2.

It is found that the KLORR project is highly economically feasible.

Table 12-2. : Evaluation Indicators for Whole Length

Benefit-cost Ratio (B/C)	3.05
Net Present Value (NPV) (RM Million)	5,498.5
Internal Rate of Return (IRR) (%)	22.7

The evaluation results of the KLORR by section are shown in Table 12-3, which indicates that the B/C ratios in all the sections are higher than 1.0 except for the segment 1 of the section 2. These sections are economically feasible even if they are implemented individually.

The highest B/C ratio is found in the cases of Section 3, which is the southern part of the KLORR, where impressive development projects like Putra Jaya are on going. The second highest is the segment 2 of the Section 2, the south eastern part of the KLORR. As a result, the section 3 should be given the highest priority for the implementation .

After the completion of the section 3, the section 2 segment 2 is given the higher priority than the other sections, considering that the additional implementation of section 2 segment 2 has the higher evaluation indicators than the other cases.

Table 12-3 : Economic Evaluation Indicators by Section

	B/C	NPV (RM Million)	IRR (%)
Section 1	1.62	484.1	16.2
Section 2 Segment 1	0.51	-366.7	7.2
Segment 2	4.38	1,331.5	25.4
Section 3	5.45	3,329.2	29.0
Section 3 + Section 1	3.30	3,538.5	23.0
Section 3 + Section 2 Seg. 1	2.85	2,774.6	21.4
Section 3 + Section 2 Seg. 2	5.16	4,775.5	28.0

12.2 Financial Analysis

12.2.1 Base Case Evaluation

Base case aims to evaluate whether the project cost can be reimbursed by the levied toll under the given conditions which are examined from the existing privatization projects.

(The conditions)

Implementation Schedule

Based on the economic evaluation, the highest priority is given to the Section 3, followed by the Segment 2 of Section 2. Taking into account the development schedule of the related projects such as two ambitious projects of Putra Jaya, KLIA at the south, as well as the highway projects like Middle Ring Road II, KL-Karak Highway and East Coast Expressway etc., the implementation schedule of the Outer Ring Road is set up as shown in Figure 12-3 as the base case.

Out of the whole project, the Segment 2 of Section 3 might be included in the South Klang Valley Expressway (SKVE) project, which is on going as an another privatization project, hence, the case excluding this section is also additionally examined.

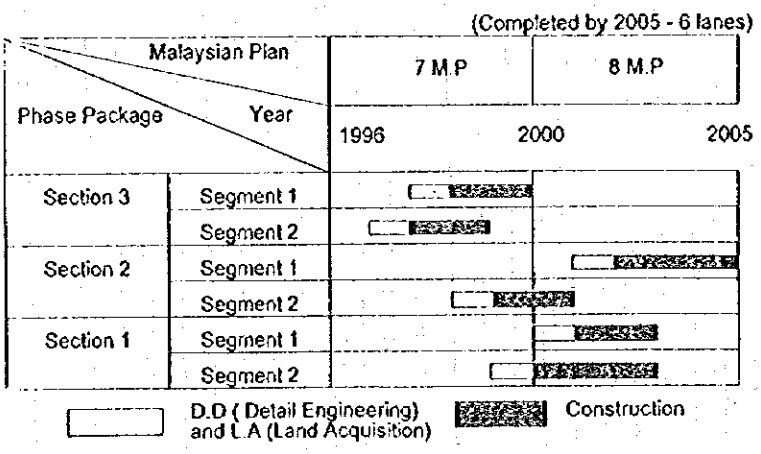


Figure 12-3 : Implementation Schedule for Base Case

Toll Rate

The toll rate for the Outer Ring Road is assumed to be set as shown in Table 12-4 as the base case, the growth rate of which is following the case of the North - South Expressway and North - South Central Link.

Table 12-4 : Toll Rate of Project Road

Year	Base Case[1)]
2000	12.6 M¢/km

Note : 1) Base Case : Following the concession agreement for North - South Expressway the toll rate in 2000 is obtained from 10.0M¢/km in 1996 x 1.06^4 = 12.6 M¢/km, the toll rate is raised every 10 yrs at 6% per annum after the year 2000.

2) Above figure is applied to passenger cars. For the other vehicles, the same growth rate is applied to the current rates.

Traffic Volume

The traffic volume for the base case based on the implementation schedule is summarized as shown in Table 12-5.

Table 12-5 : Traffic Volume on Outer Ring Road

(veh/day)

Section	Year						
	2000	2001	2002	2004	2006	2010	2020
IC 13 - IC 12	10,900	21,100	29,100	46,300	56,900	69,000	84,700
IC 12 - IC 11	10,900	21,100	29,100	46,300	56,900	69,000	84,700
IC 11 - IC 10	10,900	20,800	29,200	46,400	57,100	70,000	80,800
IC 10 - IC 9	11,400	20,000	28,900	45,300	58,500	76,100	93,500
IC 9 - IC 8	-	22,800	51,900	51,900	67,100	79,000	92,300
IC 8 - IC 7	-	-	47,200	60,800	72,600	86,000	100,900
IC 7 - IC 6	-	-	51,000	60,800	81,000	93,300	119,000
IC 6 - IC 5	-	-	-	-	76,000	81,000	90,000
IC 5 - IC 4	-	-	-	-	12,500	22,000	50,600
IC 4 - IC 3	-	-	-	19,000	29,500	46,000	71,100
IC 3 - IC 2	-	-	-	36,500	44,300	56,700	80,900
IC 2 - IC 1	-	-	-	17,800	24,700	41,800	66,500

Concession Period

The concession period is significantly sensitive for the financial viability. The project requires a huge amount of project cost and rather long period for its construction, therefore it is tentatively assumed to be as follows in this Study.

a) 30 years including construction period
b) 35 years including construction period
c) 40 years including construction period
d) 45 years including construction period

Equity Share and Long Term Loan

Because of the large amount of investment, the equity share (equity to loan allocation ratio) is supposed to be comparatively low if exclusively prepared by the private sector. Hence, the equity loan allocation plan is assumed as follows :

Table 12-6 : Financial Plan

Financial Resources	Share
Equity	20%
Commercial Loan	60%
Government Loan	20%
Total	100%

Table 12-7 : Long Term Loan Conditions

Loan Conditions	Loan Type	
	Commercial Loan	Government Loan
Annual Interest Rate	11%	6%
Draw down	Pro-rate to the Costs during construction period	-
Maximum Lending Period	15 years	15 years
Grace Period	5 years	5 years
Repayment	Uniform Amount including interest portion	Uniform Amount including interest portion

Short Term Loan

The lending period of short-term loan is assumed to be one year and the interest rate is 9% per year.

Land Acquisition

The land acquisition and compensation cost will be paid by the government at the initial stage. However, all the costs are assumed to be reimbursed to the government by the concession company after the repayment of long-term loan.
It is also assumed that the reimbursement is made during three years.

Inflation Rate

The inflation rate for the financial analysis is assumed to be 4% per annum for both the foreign and local portion of the construction and operation / maintenance costs.

Tax

The total tax is set at 30% of the net profit before tax, taking into account the corporate income tax.

(Results of the Evaluation for Base Case)

Table 12-8 shows the evaluation indicators for the base case by alternative concession period. Other conditions applicable to all the cases are exactly those as denoted in the previous section.

From the results, the following findings are pointed out.

1) The FIRR is lower than 11% in any case, even for the 45 years concession period, therefore the financial return of project is not sufficient under the given conditions.

2) As for the case "Excluding Section 3 Segment 2", it is found that the FIRR is further lower and less profitable compared to the "Whole Project" case.

Table 12-8 : Financial Evaluation Indicators for Base Case

Case	Financial Evaluation Indicators	Concession Period (yrs)			
		30	35	40	45
Whole Project	Financial Internal Rate of Return (FIRR)	6.89%	8.57%	9.64%	10.38%
	B / C Ratio	0.61	0.70	0.81	0.89
	Net Present Value (NPV) (RM'million)	-1,268.0	-941.0	-637.0	-347.0
	Return on Equity (ROE)	4.89%	7.82%	9.46%	10.50%
	Debt Service Coverage Ratio (DSCR)	0.87	0.87	0.87	0.87
Excluding Section 3 Segment 2	Financial Internal Rate of Return (FIRR)	5.89%	7.56%	8.85%	9.76%
	B / C Ratio	0.52	0.61	0.70	0.79
	Net Present Value (NPV) (RM'million)	-1,454.0	-1,165.0	-885.0	-614.0
	Return on Equity (ROE)	3.67%	6.41%	8.41%	9.67%
	Debt Service Coverage Ratio (DSCR)	0.71	0.71	0.71	0.71

Note: DSCR is defined as follows : DSCR = (Bt - Ct) / (Lt + It)

Bt : Revenue in year t
Ct : Operating Cost in year t
Lt : Repayment of principal portion of loans
It : Repayment of interest portion of loans

12.2.2 Alternative Cases

Since the base case is not financially desirable, some alternative conditions are assumed by either reducing the construction cost and debt service or increasing the revenue. The alternative conditions are as follows:-

(a) Staging of Construction
(b) Reduction of Implementation Length
(c) Application of Higher Toll Rate

As a result of the financial analysis, the cases where high profitability, higher than 11% of FIRR, can be expected are summarized in Table 12-9.

Table 12-9 : Case with Higher Profitability

Case	Conditions	
	Toll Rate	Concession Period
1) Reduction of Implementation Length (Section 3 + Segment 2 of Section 2)	M¢12.6	40 years or more
2) Higher Toll Application (1)	M¢18.9	35 years or more
3) Higher Toll Application (2)	M¢25.2	30 years

As for the first case, the half of the project can be realized by privatization, but the another half will not be implemented for long period, say two decades at least, since the government budget is not sufficient to carry out.

This situation will not be consistent with the government perspectives of the KL metropolitan region.

In the second and third cases, a higher toll rate should be applied on the KLORR. The second case is the one that the concession period of more than 35 years is assumed. On the other hand, the third case is the one that the concession period is confined within 30 years based on the existing privatization scheme. Accordingly the toll rate for the second case is M¢18.9/km, while for the third case it becomes a higher rate i.e., M¢25.2/km. A higher toll application may be justified by the following reasons.

a) Benefit Principle

Based on the benefit principle, the beneficiaries should pay for the project cost. The KLORR is designed so as to have the capability to offer a congestion free travel above design speed of 100 km/hr with controlled access, which provides the users operational freedom.

The road users are the primary beneficiaries of the project, therefore, should pay for the cost in terms of toll charge.

b) Toll Rate on Other Highways

In case of other highways, a higher toll rate can be found according to the concession agreement. In case of the Shah Alam Highway, the toll rate for the section from KL-Seremban Expressway to the N-S Central Link will be RM3.20 in the year 2001, which is equivalent to M¢16.8/km.

In case of the Dedicated Highway, the toll rate is calculated to be about M¢21.0/km.

c) Benefit from KLORR

Excluding the time benefit and accident benefit, since they might differ by individuals, the benefit received by the KLORR users are estimated as shown in Table 12-10.

Table 12-10 : Benefit received by the KLORR users

(unit : RM)

	2000	2005
Running Cost Saving	2,041	76,114
Fixed Cost Saving	46,124	1,112,487
Total	48,165	1,188,601
Total veh-km on ORR by ORR users	186,592	3,696,767
Benefit per vehicle per km	0.258	0.322

The average benefit received by the ORR users is estimated at M¢25.8/km for the year 2000 and M¢32.2/km for the year 2005 in 1995 prices.

Although it may be possible to apply a higher toll rate as mentioned above, should not be excessively high compared to the other toll ways.

The toll rate would be, therefore, desirably limited to approximately 1.5 times the base case.

It is also noted that the concession period should be extended to be longer than the existing privatization condition in case that relatively longer construction period is required for construction of tunnels and long bridges.

As a consequence, a higher toll rate, M¢18.9/km which will be 1.5 times the base case should be applied in 2000 for realizing stable operation.

As for concession period, at least 35 years are required taking into account the long construction period. In practical sense, longer concession period say 40 years will be required in order to make the project sufficiently attractive to the private sector.

12.3 Sensitivity Analysis

The sensitivity analysis is made for the following factors.

1) Higher growth rate of GRDP in Selangor
2) Changes in the estimated project cost
3) Changes in the estimated traffic volume

1) Higher growth rate of GRDP in Selangor

The traffic forecast in this study has been made on the basis that the average annual growth rate of GRDP in Selangor is 7.0% for the period from 1995 to 2020. However, the target growth rate for Selangor state is 7.8% per annum as commented in the third Steering Committee Meeting. Hence, the influence of the higher growth rate in Selangor to the project is examined as a sensitivity analysis. As a result of traffic demand analysis, the influence of the higher economic growth on the traffic demand is found to be about 3% increase in 2010 and about 12% increase in 2020. (See Appendix for more detail).

Table 12-11 shows the FIRR changes due to the difference in GRDP growth rate in Selangor.

Table 12-11 : FIRR Changes Due to Difference in GRDP Growth

	Concession Period (years)	Original Case (GRDP Growth 7.0%)	GRDP Growth 7.8% Case
Base Case	35	8.57%	9.39%
	40	9.64%	10.40%
	45	10.38%	11.07%
Toll Rate 1.5 times Base Case	35	11.10%	12.12%
	40	12.05%	12.97%
	45	12.65%	13.55%

In general, compared to the original case, the FIRR is pushed up by applying the higher GRDP growth rate.

Hence, it suggests that the following options may be possible for the privatization if the higher economic growth rate is promising.

a) Application of the toll rate of 1.5 times Base Case, i.e. 18.9 ¢/km for 35 years concession
b) Application of lower toll rate, i.e. about 16 ¢/km for 40 years concession.

2) Changes in estimated project cost

The KLORR particularly passes through a mountainous area, which may involve more uncertain factors.

Hence the following cases are examined in the sensitivity analysis.

a) 20% increase of Project Cost
b) 20% decrease of the Project Cost

Figure 12-4 shows the FIRR changes due to the changes in the estimated cost for the alternative toll level cases.

In any case, 20% increase of the project cost reduces the FIRR by as much as about 1.2% point, whereas 20% decrease of the project cost will push up the FIRR by about 1.6% point.

In case of 20% increase of the project cost, the conditions for privatization will become more severe ; even for the case of 1.5 times higher toll than the Base Case, the project is not so profitable. Accordingly, the toll level should be further raised to 2.0 times the Base Case in order to privatize the project since the application of longer concession period may be difficult.

In case the project cost is decreased as much as 20%, the FIRR for the Base Case also exceeds 11.0%, therefore, the toll rate of about 15 ¢/km may bring about sufficient revenue to privatize.

3) Changes in estimated traffic volume

In order to examine the influence of the traffic volume changes, the sensitivity test is made for the following cases.

a) 20% increase of the traffic volume
b) 20% decrease of the traffic volume

Figure 12-5 shows the FIRR changes due to the changes in traffic volume on the project road for the alternative toll level cases.

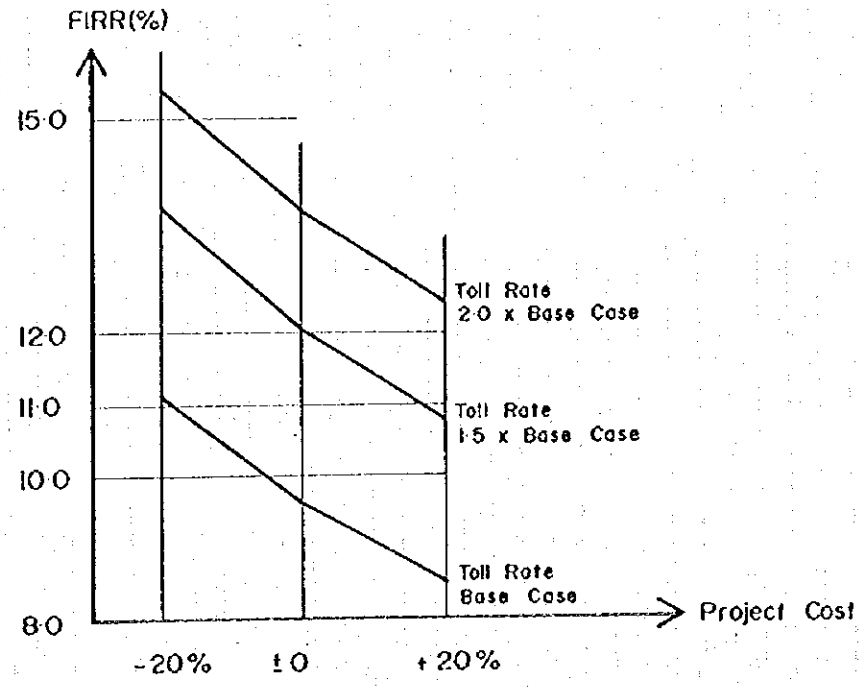


Figure 12-4 : FIRR Changes Due to Project Cost Change

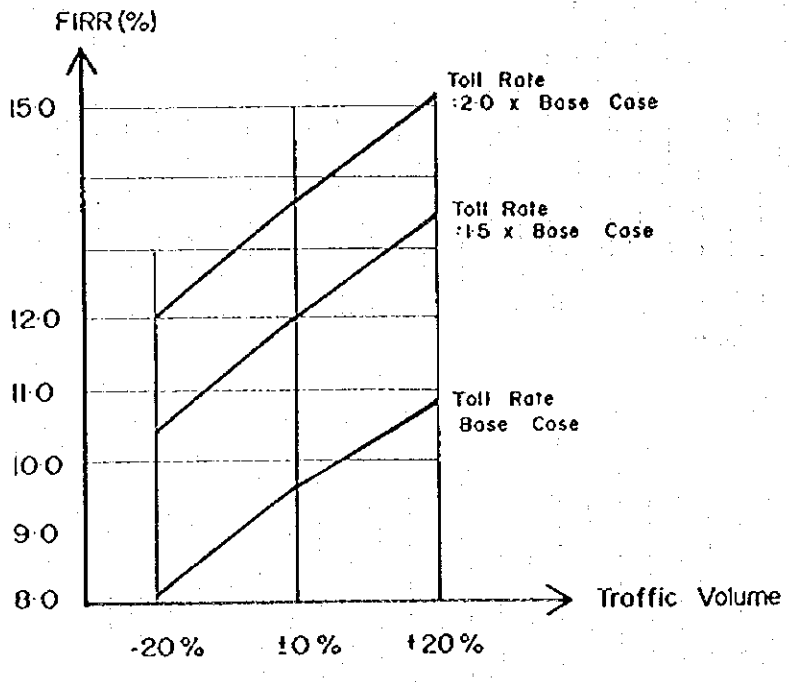


Figure 12-5 : FIRR Changes Due to Traffic Volume Change

Chapter 13 IMPLEMENTATION PLAN

13.1 Examination of Development Allocation to Highways

In estimating the development allocation to highways, it is assumed in the HNDP Study that the percentage share of the highway development funds in the future will be maintained at the same level as the Sixth Plan Period.

The Table 13-1 shows the calculation result of the development allocation to highways.

Table 13-1 : Estimation of Development Allocation to Highways

(RM Million)

Plan Period	Allocation to Highways	Development Funds	% Share
1971 - 1975 (2MP)	663	9,793	6.8
1976 - 1980 (3MP)	1,577	24,987	6.3
1981 - 1985 (4MP)	3,543	46,320	7.6
1986 - 1990 (5MP)	4,850	35,300	13.7
1991 - 1995 (6MP)	6,299	55,000	11.5
1996 - 2000 (7MP)	9,344	81,254	11.5
2001 - 2005 (8MP)	12,637	109,887	11.5
2005 - 2010 (9MP)	16,987	147,709	11.5

Note : 1. The figures are expressed in current prices for 1971 - 1990 and 1991 prices for 1991-1995 and 1995 prices for 1996-2010.

Sources : TMP, FOMP, FMP, SMP.

The allocation to Selangor state is estimated by further assuming that the average percentage share of Selangor in the period from 4MP to 6MP can be applied.

As a result, the development allocation for highways to Selangor is estimated as RM486 million in 7MP period and RM657 million in 8MP period as shown in Table 13-2.

Table 13-2 : Estimation of Development Allocation to Selangor in 1995 Price

(RM Million)

	Allocation to Selangor	Allocation to Highway	% Share
1996 - 2000 (7MP)	486	9,344	5.2
2001 - 2005 (8MP)	657	12,637	5.2
2006 - 2010 (9MP)	883	16,987	5.2

Note : The % share of Selangor is assumed 5.2 %, which is the average of that for the period from 4MP to 6MP.

13.2 Implementation Plan

Based on the analyses for determining the section priority and assessing the financial viability, the implementation schedule of the KLORR is proposed as follows. The scheduling of each sections is also shown in Table 13-3.

Conditions For Privatization

Whether or not the KLORR is implemented as a privatized project is a policy matter of the Government. If it is privatized, BOT system will be applied and the ORR is to be operated as a toll road. The conditions for the case of privatization are as follows :

Table 13-3 : Proposed Implementation Schedule

	Total Length (km)	No. of Lanes	Project Cost (RM million)	1997	1998	1999	2000	2001	2002	2003	2004	2005
Section 3 Segment 2 North South Expressway at South-N-S Central Link	18.30	6	854.9									
Section 3 Segment 1 Federal Route 1 at South-North South Expressway	10.20	6	428.5									
Section 2 Segment 2 Hulu Langat Road-Federal Route 1 at South	14.58	6	684.3									
Section 1 Segment 1 and 2 North South Expressway at North-KL-Karak Highway	22.83	6	1,379.1									
Section 2 Segment 1 KL-Karak Highway-Hulu Langat Road	23.00	6	1,289.1									
TOTAL	88.91	6	4,645.9	120.3	445.2	807.0	643.1	537.0	546.2	845.1	351.0	351.0

Note : E-W Link Extension is scheduled to be completed in 2001.
Among Elevated Bypass is scheduled to be completed by 2005.

Detail Engineering
Land Acquisition
Construction

1) Project

Total Length	:	88.91 km
Total Project Cost (in 1995 prices)	:	RM4,645.9 million
of which Contruction Cost (Including Environmental Cost)	:	RM3,984.1 million
Detail Engineering	:	RM197.3 million
Land Acquisition Cost	:	TM464.5 million

2) Finance

Debt equity ratio is assumed as 80 : 20 in the analysis, however, it is more desirable to increase the equity to 25 % of the initial investment if possible, in order to realize more stable operation. In this case, the financial composition will be as follows :

		(in 1995 prices)	
Equity	:	RM1,045.35 million	(25%)
Commercial Loan	:	RM2,299.77 million	(55%)
Government Support Loan	:	RM836.28 million	(20%)

3) Toll Rate : In the year 2000:M¢18.9 per km will be applied. The toll will be raised every 10 years with the increase rate of 6 % per annum.

4) Concession Period : 40 years including the construction period is applied. If the toll is higher than M¢18.9 per km, the concession period can be reduced.

5) Government Support

As a government soft loan, 20% of the initial investment, i.e., RM836.3 million is expected during the period from 7MP to 8MP. Taking into account the development funds described in the section 13.1, it is difficult to expect further more amount of government loan.

In addition, the land acquisition cost is assumed to be tentatively paid by the government as an advancement, it will be reimbursed at the later stage by the concession company.

Chapter 14 CONCLUSION AND RECOMMENDATION

14.1 Necessity of the Project Road

Rapid economic growth in Malaysia targeting to achieve a developed nation status by 2020 has been stimulating urbanization and motorization. Especially the Klang Valley Region including Kuala Lumpur has played a significant role as the administrative and economic growth pole. Putra Jaya project and KLIA project located outside the present Klang Valley region are creating new development pressures in the region, forming the Greater Klang Valley Region.

The rapid economic expansion followed by the urbanization and motorization in the region justify the necessity of the KLORR expressway to form a favourable network configuration both inter and intra region. As revealed by the economic evaluation, the tremendous amount of economic benefit derived by the project road will contribute to the national economy.

It can provide bypass route for the traffic which does not have origin or destination in Kuala Lumpur or is intending to detour the central congested area. It can contribute to minimize wasteful problems such as traffic congestion, road bottlenecks and air and noise pollution.

14.2 Conclusion

Klang Valley region including Kuala Lumpur will continue to expand rapidly till year 2020. In the Study, it is estimated that population of Kuala Lumpur will increase 2,408 thousand population by 2020, 3.9 times that of 1995 and for Selangor it will increase by 2.2 times to 5,937 thousand population in 2020.

GDP will increase of Kuala Lumpur by 3.9 times to RM60,895 million in 2020 and that of Selangor state by 5.4 times to RM131,751 million. Traffic demand also increases to 2,597 thousand trips in 2020, 1.8 times bigger than in 1995 in Kuala Lumpur for Selangor state it will increase to 4,377 thousand trip.

In the Study corridor there are many environmentally sensitive areas. The impact by the development of the project road to these areas and their mitigation measures are studied in the PEIA Study. The PEIA was approved by DOE, however, a request was made to study further the impact of water quality, soil erosion and geology.

The three alternative routes were set up and studied. The route B was selected as the most preferable route through environmental, technical and economical evaluations. The preliminary design was conducted for the route on the topographical map of 1:5,000. Thirteen interchanges are designed to connect with existing expressways and highways.

14.3 Evaluation of the project

The economic indicators for the whole section of the project road are found as follows:

I)	Cost/Benefit Ratio	3.05,
ii)	Net Present Value	RM 5,498.5 million,
iii)	Internal Rate of Return	22.7%.

This means the project road is highly feasible from the view point of national economy. The financial evaluation, however, indicates that it will be necessary to charge higher toll rate than the existing project to make it financially feasible.

14.4 Recommendation

14.4.1 Implementation Plan

It is recommended to implement the KLORR with the priority given to those section that has higher economic benefit. Section 3 segment 2 has the highest priority followed by the segment 1 of the same section and section 2 segment 2. The proposed implementation schedule is shown in Chapter 13 Table 13-3.

The financial plan for the privatization of the KLORR is shown in Table 14-1. To amortize the loans, toll rate should be 18.9 MCents/km in 2000, and it will be raised up by 6% every 10 years.

Table 14-1 Financial Plan

Items	Amount (million RM)	Share
Equity	1,045.35	25
Commercial loans	2,299.70	55
Government soft loans	836.28	20
Total	4,181.33	100

14.4.2 Recommended Action

Following actions are recommended while implementing the KLORR project.

(1) To reserve a ROW (Right of Way) for the project including environmental preservation areas such as buffer zones.

(2) To prepare/review the land use plans along the project, introducing preferable developments for the expressway corridor. In addition, natural preservation areas such as forest reserves and water catchment areas should be controlled from any development.

(3) To conduct a detail geological and geotechnical study and prepare environmental preservation countermeasures for the soil erosion and slope failure, as well as for the vibration caused by the tunnel construction as commented by DOE.

(4) To formulate a common tolling system with other privatization concession company to avoid undesirable influence on traffic flow and users' comfort on the expressway network system.

(5) To review and prepare an urban primary/expressway road network development plan in line with the KLORR including the proposed Ampang Bypass extension and East-West Link extension.

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