URBAN TRANSPORT STUDY

IN

GREATER METROPOLITAN AREAS

OF

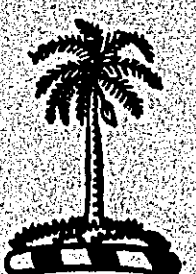
GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM

MALAYSIA

ENVIRONMENTAL STUDY

OUTER RING ROAD PROJECT (PHASE II)

TECHNICAL REPORT - 02



MARCH 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

GOVERNMENT OF MALAYSIA

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I. SUMMARY OF THE ENVIRONMENTAL STUDY

1. OBJECTIVE OF THE STUDY

As is mentioned in the Inception Report in April 1980, the purpose of the environmental study is to minimise the unexpected environmental and social conflicts which may presumably be generated by the Outer Ring Road. It also aims to involve the study of the socio-cultural needs in the future development of George Town. It is intended to consider the desirable qualities of the environment.

The study consists of three major objectives which are:

(1) To assess the road side environment in terms of environmental protection.

(2) To set up planning measures in order to mitigate environmental disturbances if and when they are forseeable.

(3) To define the conceptual role of the road and the design policy for the strategic sections in order to meet the social demand.

Prelimimary evaluation for development suitability of land has been carried out at the beginning of the environmental consideration in this feasibility study. The possible routes for the Outer Ring Road were selected after the examination of site conditions, segment by segment. Development suitability shown in Fig. 1.1 summarizes the result of the site evaluation, and Fig. 1.2 explains the definition of terms in terms of the name of alternative routes and its location. The detailed assessment of road side environment, the planning of the mitigation measures and the analysis of the social demands are required for each of the selected alternative routes.

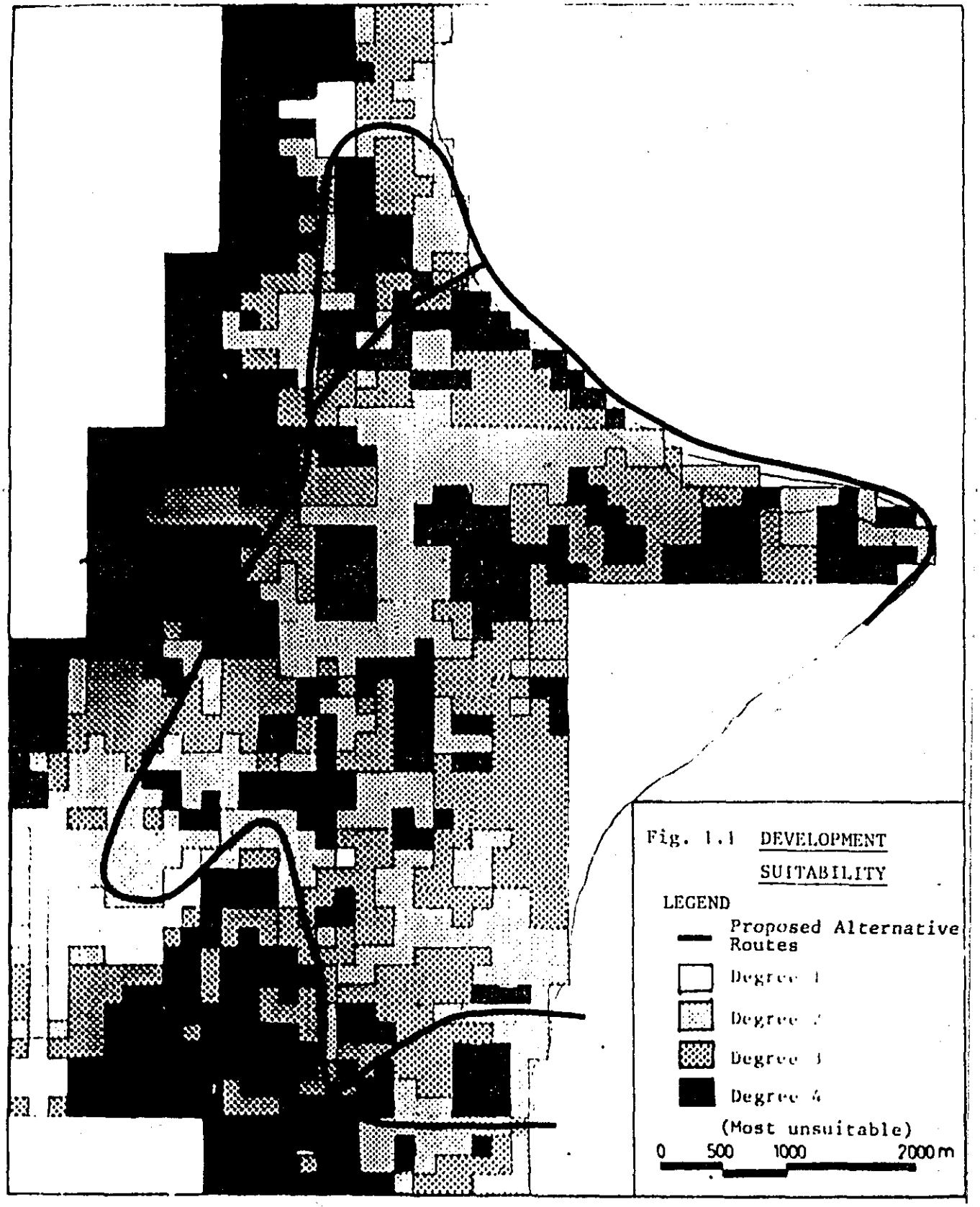


Fig. 1.1 DEVELOPMENT SUITABILITY
LEGEND
Proposed Alternative Routes
Degree 1
Degree 2
Degree 3
Degree 4
(Most unsuitable)
0 500 1000 2000 m

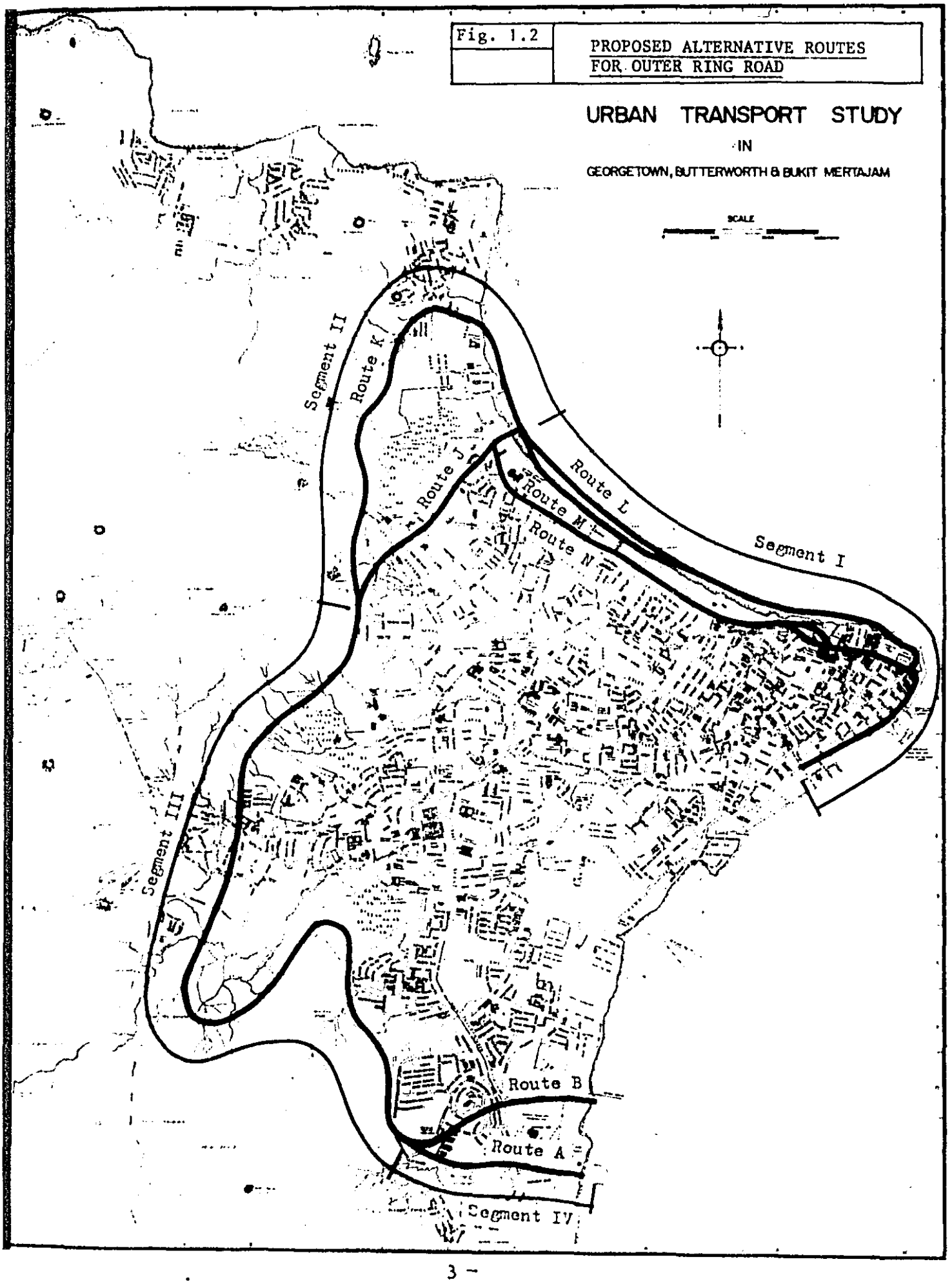


Fig. 1.2
PROPOSED ALTERNATIVE ROUTES FOR OUTER RING ROAD
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
Segment II
Route K
Route J
Route L
Route M
Route N
Segment I
Segment III
Route B
Route A
Segment IV

2. STUDY APPROACH

The study approach taken in this study consists of four major concepts as shown in Fig. 1.3. The evaluation of development potential is the first necessary step taken in order to eliminate unsuitable route location and to select a more preferable alternative route location for the Outer Ring Road.

The assessment of road side environment is processed in the environmental mitigation policy which comprises three steps; identification of types of road side environment, analysis of types of environmental problems, and formulation of mitigation policy for the problems.

The planning of mitigatin measure comes after the mitigation policy. The study approch for the mitigation measure comprises two steps; first, the examination of alternative mitigation measures, and then the design of typical mitigation measures.

The definition of the conceptual role and the design requirement of roads is to be carried out in the socio-cultural context of the roads in George Town. It comprises the analysis on the implication of road and environment, socio-cultural potentials of George Town, and socio-cultural requirements of the Outer Ring Road.

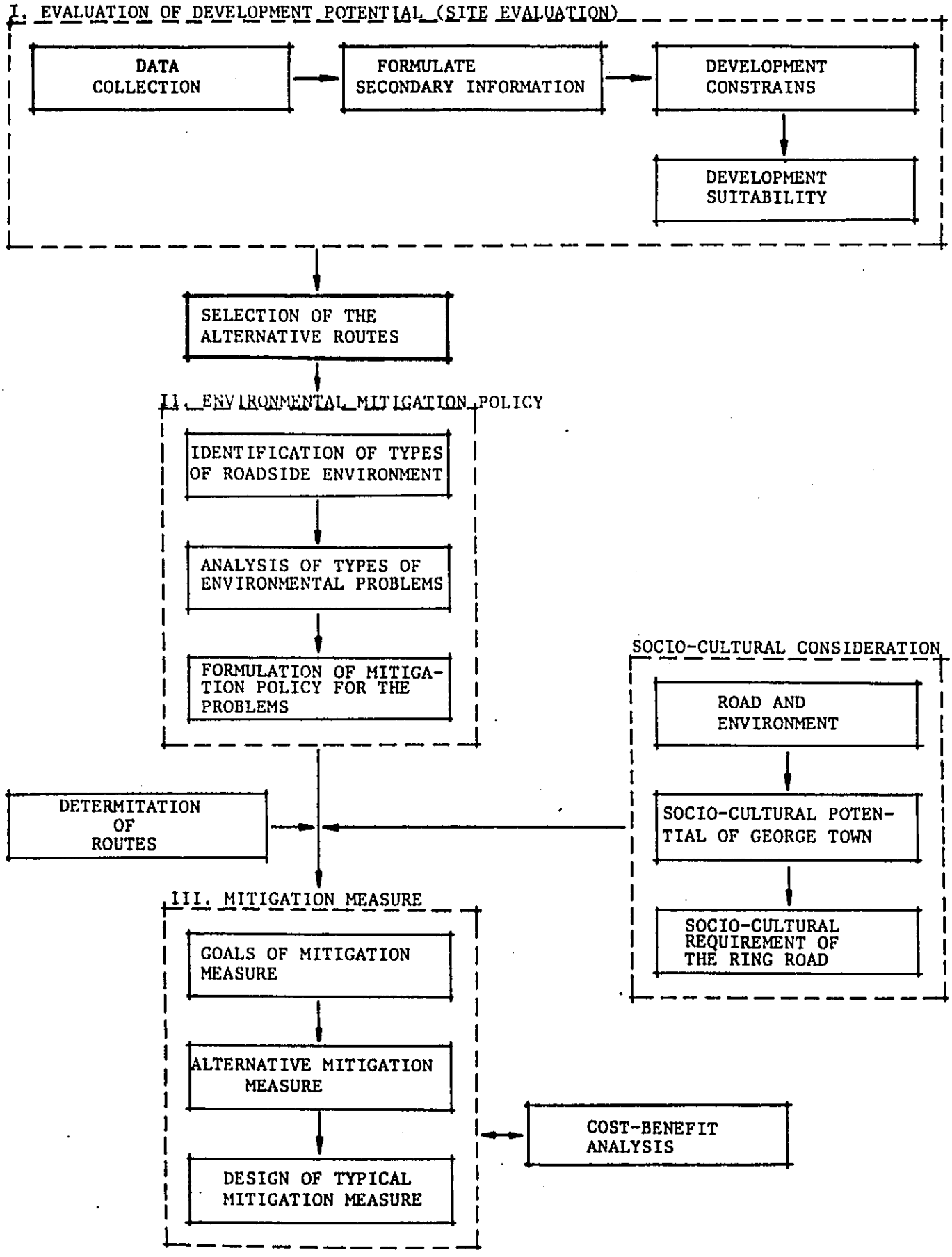


FIG. 1-3 FRAMEWORK OF STUDY APPROACH

The coverage of the environmental study in this chapter is focused on socio-physical aspects of the environmental effects on George Town by the Outer Ring Road.
However, socio-economic aspects which are the main objectives of this feasibility study are discussed in detail only in a later study.

The socio-physical impacts appear to imply both the physical and social phenomenon. The conceptual structure of the impact is shown in the basic framework of environmental impact.
(See Fig. 1.4)

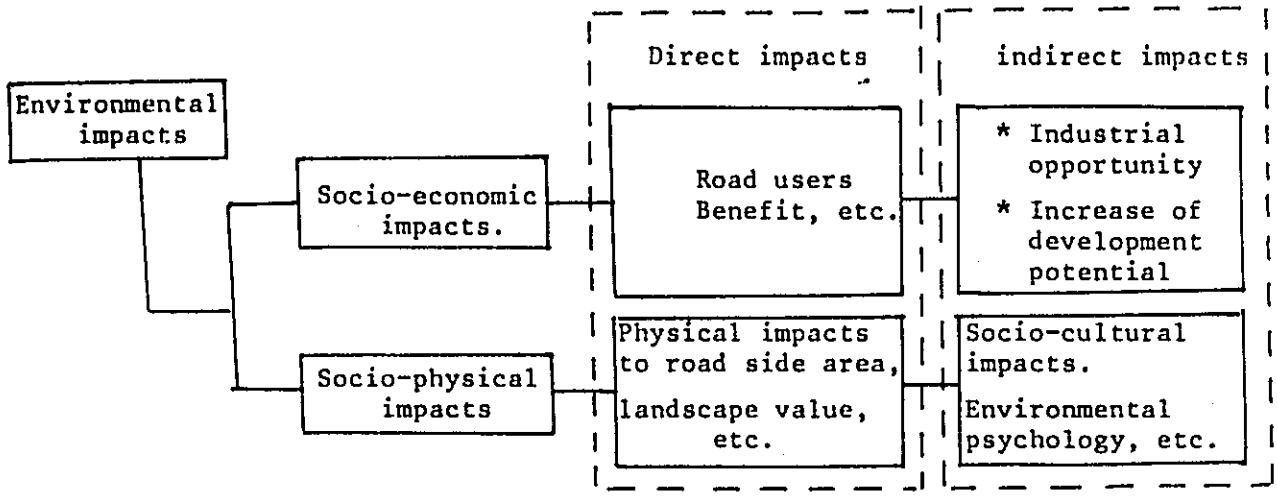


Fig. 1.4 BASIC COMPOSITION OF ENVIRONMENTAL IMPACTS

3. CONCLUSION

The environmental impacts of the Outer Ring Road is basically discussed from two aspects:-

1) Direct impacts
2) Indirect impacts

1) Direct impacts

It is essentially the physical impacts to the surrounding environment along the Outer Ring Road. The air pollution which is only expected to spread out to the regional scale could possibly be mitigated by strong north-south winds blowing in George Town. It means that the direct impacts on the environment must preferably be assessed in the zone area limited to along the Outer Ring Road.

The characteristics of the direct impacts have generally been discussed from three aspects:-

i) The impacts by vehicular traffic mainly comprises noise, air pollution, and vibration, and the noise problem may be the predominant impact in the study area. It was concluded that the road side space generated by planning minor access roads and/or by implementing the building line by-law which is a minimum of 6.0m (20') from the road reserve, can functionaly be effective as a buffer zone. Therefore, in newly developed residential areas, it is proposed that minor access roads should be planned along the Outer Ring Road, which can provide 12.0m (40') width of space to the building lots. In existing residential area, buildings within 6.0m (20') from the reserve of the Outer Ring Road are considered for compensation.' In a particular segment of the Outer Ring Road, which is the North Coastal Area, a buffer zone with a width of 10m to 50m is proposed between the road reserve and the building lots.

ii) The impacts by the structure of the road are found predominantly to generate landscape disturbance and community segregation. Compensation for houses within 6.0m (20') from the proposed road reserve, planning of the landscape and of pedestrian crossing systems are proposed.

iii) The impacts from construction work may be noise, vibration and dust from construction sites, disturbance by heavy lorry traffic, and social impacts on construction workers. The need for careful planning for the construction stage plan and for a comprehensive labour management programme is strongly urged.

In addition to the above general impacts and mitigations, the landscape design on the North Coastal Area is proposed for implemention to the whole stretch of the section.

2) Indirect Impacts

The indirect impact involves the socio-economic impacts and the socio-cultural impacts. The socio-cultural impacts, a section of the socio-physical impacts, are mainly to be analysed in this chapter.

The socio-cultural impacts are generally invisible and takes time before they become evident. Moreover, it can only be discussed in a wider context. There is, so far, no quantitative analysis method established to reflect the socio-cultural impacts in the feasibility studies, but it will have to be tackled later. The road as a physical element is generally the most endurable infrastructure of environments, and has strong potential to control the future image of George Town especially where they have strong socio-cultural identities in her history.

The Outer Ring Road in George Town will be expected to serve as a main approach to the built up area from the airport, sea and the other major centres. It is also considered to form the decisive edge of the town in combination with the topographical feature.

These imply that the role of the Outer Ring Road in the environment should presumably be programmed to satisfy the following conditions:-

1. The Outer Ring Road is planned to be an intra-urban primary road in the total hierachical system. The clear functional and spatial differentiation can be effective in setting up the legibility of the urban environment which is necessary for a better human environment.

2. The Outer Ring Road itself forms the physical edge of George Town in combination with the topographical periphery. Therefore, it will be one of the essential visual elements which will identify the territory of George Town and can help to effect psychological stability of environment.

3. The winding road running at a level of 30m (100') to 60m (200') above sea level can provide various views of the town from the road, so it can be expected to create a new tourist attraction for Penang as a parkway road system.

4. The parkway road system is connected with the coastal road off Gurney Drive, and the coastal road itself composes an important section of the total parkway system. Therefore, it is desirable that the plan of the road should involve the development of recreational space along the route.

5. The Outer Ring Road can contribute to an improvement of the quality of existing landscape of George Town by means of emphasizing vegetation and landscape design. Road side vegetation along the Ring Road is expected to become one of the landscape infrastructure in the town.

II Environmental Mitigation Policy

The formulation of environmental mitigation policy is designed to take three major stages;

1. Identification of road side environment.
2. Environmental impacts analysis by the proposed road.
3. Formulation of the environmental mitigation policy.

The environmental mitigation policy is to indicate appropriate guidelines for designing the mitigation measures which will be diversified according to the varying problems in the difficult types of environment.

The environmental mitigation policy has essentially two major aspects; conservation of natural and ecological environment, and protection from pollution and disturbances on urban activities. It is the objective of the study in this chapter to identify the nature of mitigation and to propose necessary actions to be taken.

1. Road Side Environment

The environmental impacts by building roads are to be diversified depending on the type of surrounding road side environment. The physical environment is composed of many elements and the following elements are selected as important indicators in the analysis of the road side environment of the proposed alternative routes.

1) Topography
2) Existing Land Use
3) Future Land Use
4) Other facilities to be affected

1.1 Topography

The topographical feature of George Town is shown in Fig. 1.1 "COUTOUR AND WATER CHANNELS". The main area of the town is built on flat land less than 25 feet high above sea level. For areas above 100 feet, the slope becomes very steep, so that it forms a type of barrier for further expansion of urban area in the west. It can be said that the town of George Town is topographically isolated from its hinterland by the sea and the steep chain of hills.

Sungai Pinang is the only major natural water channel which covers the wide catchment area of George Town. The map of the natural water channels shows that sewage and drainage systems are well developed in the northern half of the town.

The topographical feature along the proposed routes are shown in Fig. 1.2. It is observed in the map that flat low-land and reclamation area are predominant features in segment I. In segment II the routes run in plains of less than 20^{o} in grade and in reclamation area. In segment III the route runs halfway up steep hills of more than 20^{o} in grade. Moreover, there is a considerable number of large boulders above the route level where the route is planned. Two alternative routes also run in plain land in segment IV. It may be concluded from the above observations that segment II especially, contains diverse topographic characteristics and requires intensive removal of soil which may result in a change of the landscape of the peripheral environment of George Town.

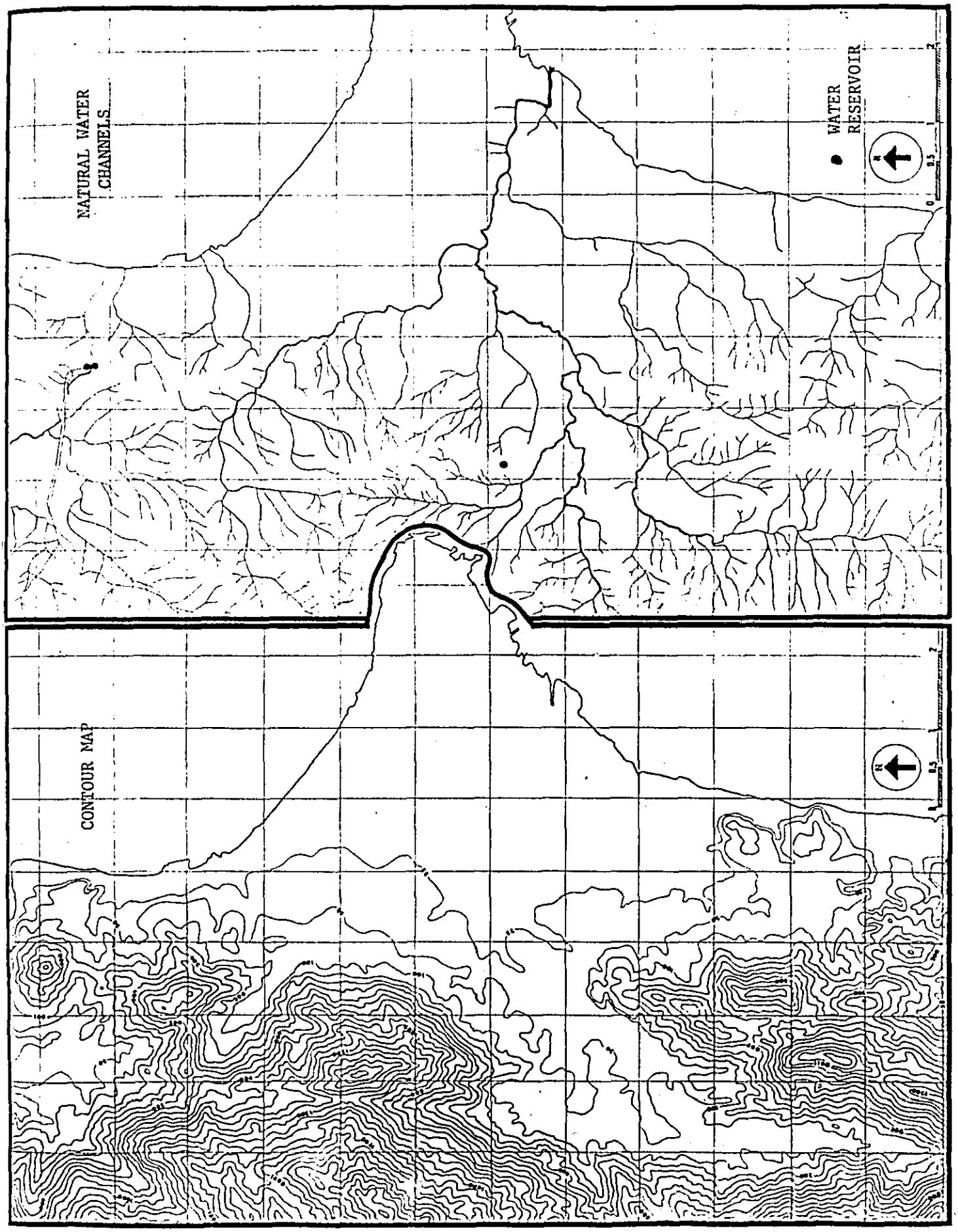


Fig. 1.1 CONTOUR AND WATER CHANNELS

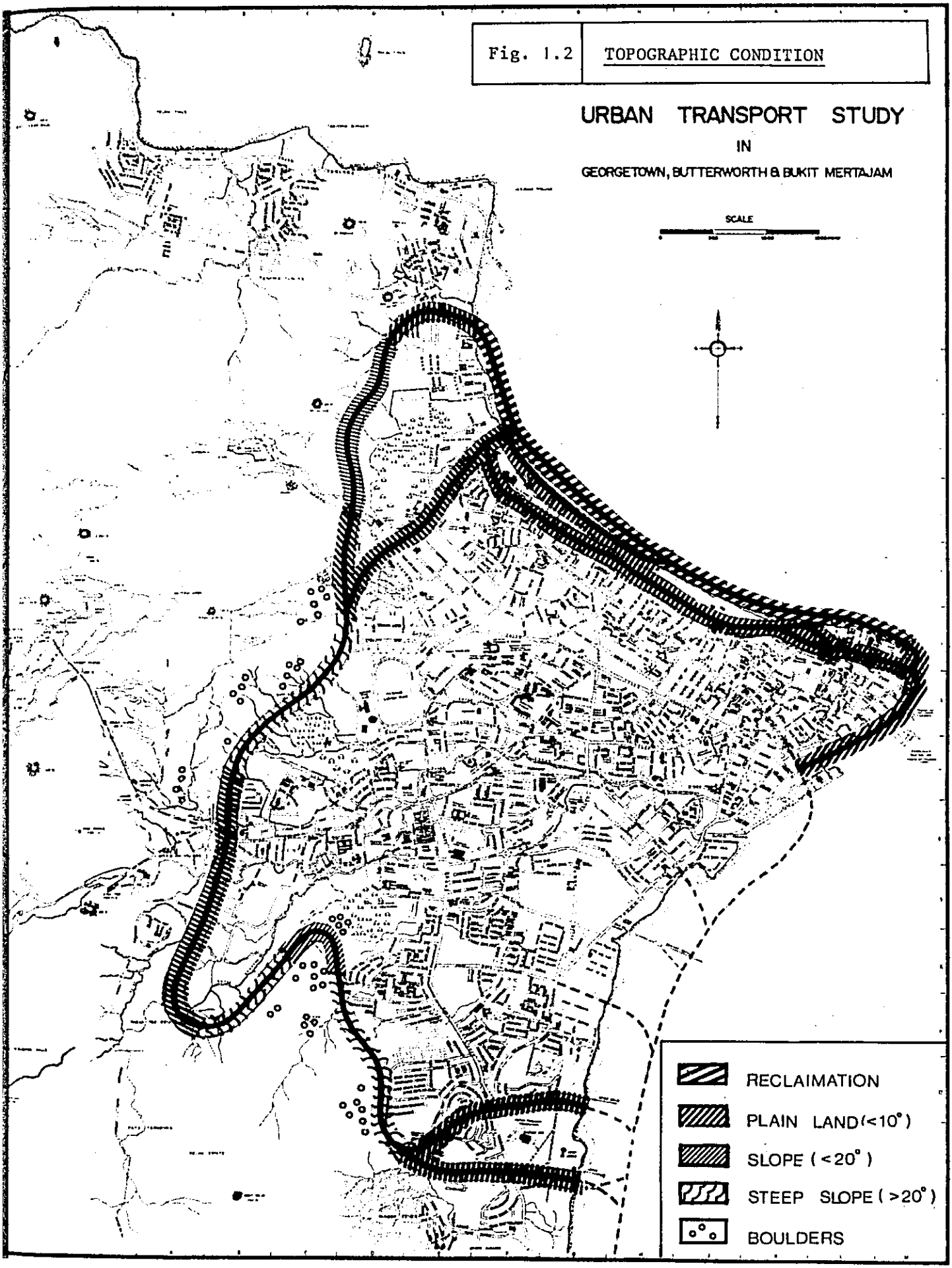


Fig. 1.2
TOPOGRAPHIC CONDITION
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
RECLAIMATION
PLAIN LAND (<10°)
SLOPE (<20°)
STEEP SLOPE (>20°)
BOULDERS

1.2 Existing Land Use

Various types of land use are observed along the proposed alternative routes. (See Fig. 1.3)

1) Residential Use :

Residential land use appears in every segment of the routes, but the types of residences vary in the segments. High and middle high class housing is mainly located along Route M and Route J, middle class housing appears along Route K and Route A & B. There are proposed middle high class housing schemes as well as existing middle class ones in segment III. High class houses are located in a small portion of segment III.

2) Institutional Use :

The institutional land use such as schools and government buildings, can be seen along Route A & B, Route J and Route M. Schools in particular and other institutional buildings are densely located along Route J, and Route M which is the extension of Jalan Northam.

3) Commercial Industry :

They can be mainly observed along Route M, Jalan Weld Quay near the ferry terminal. It can also be seen along parts of Route J and K.

4) Another predominant feature of the land use pattern is that natural and hill land covers a large proportion of segment III and Route K and the reclamated off-shore area in Route L and Route K. Cultural land marks such as the fortress and religious facilities can be seen along almost in every route.

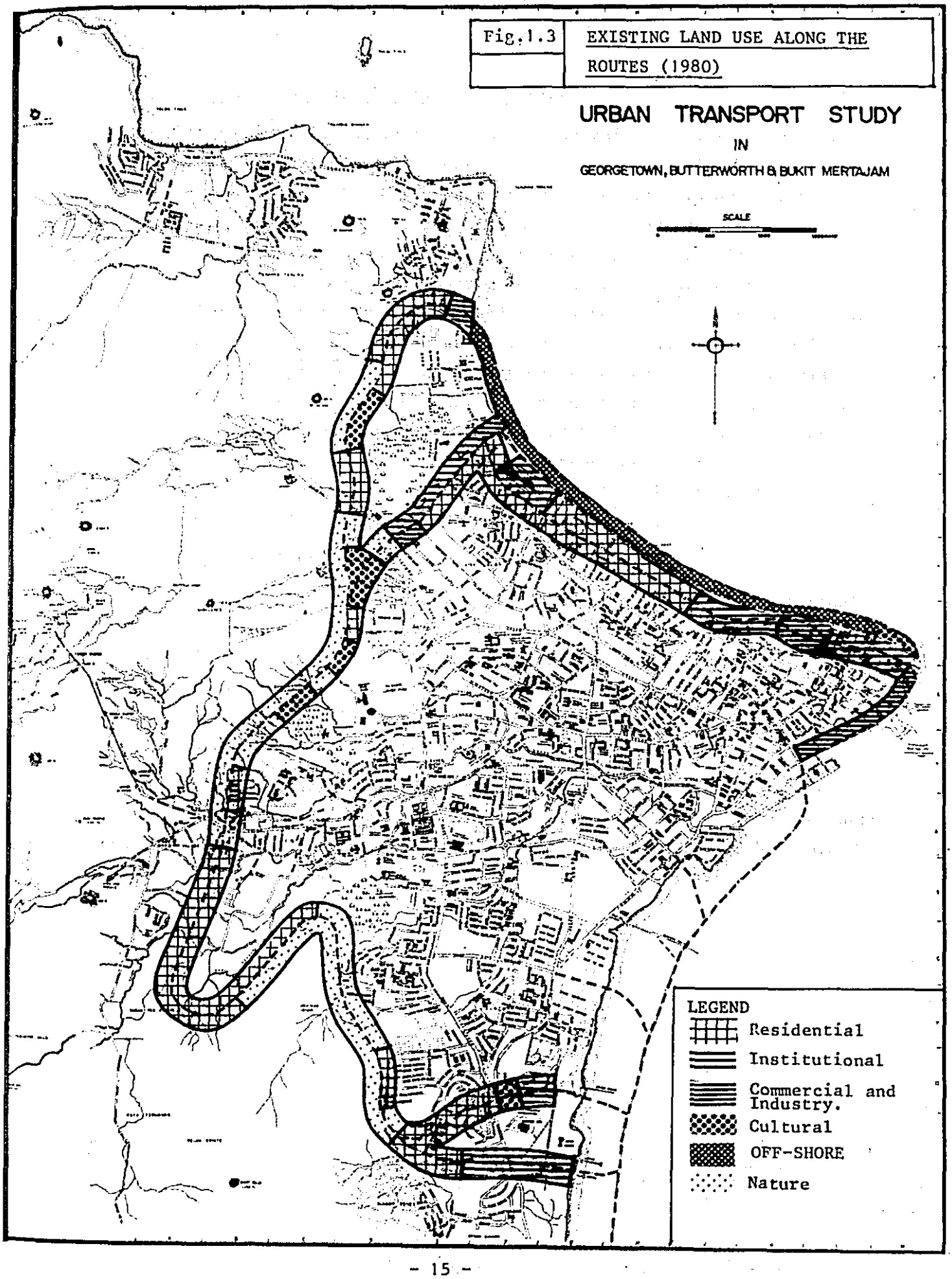


Fig.1.3
EXISTING LAND USE ALONG THE ROUTES (1980)
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
LEGEND
Residential
Institutional
Commercial and Industry.
Cultural
OFF-SHORE
Nature

1.3 Future Land Use (Interim Zoning Plan):

There is the interim zoning plan which is so far controlling the future land use of George Town, even though it is only effective until the structure plan of the town is authorized. The interim zoning plan itself is going to be reviewed to adjust to the recent development behaviour, but nevertheless it can be still considered as a significant guideline in general for the future development control. The land use pattern defined by the interim zoning plan is shown in Fig. 1.4. It says that transitional use of land is applied in a large portion of segment I and particularly affects Route M. The meaning of transitional use suggests a mixed development of housing, commerce and business in future. There are not many differences of land use pattern between the interim zoning plan and the existing one, but some of the hill land areas along segment III are already planned for housing development.

1.4 The Facilities to be Affected by the Road:

The environmentally sensitive facilities such as historical buildings, schools, hospitals, landscape assets are investigated in Fig. 1.5. The map clearly shows that there are many environmentally sensitive facilities along Route J and Route M and N. Schools, colonial type of detached houses, and religious buildings are the majority of the facilities concerned.

Recreational potentials such as beaches and seashore landscape assets should also be considered. They are locate along the north coastal zone of George Town and will also be affected by Route K and Route L & M.

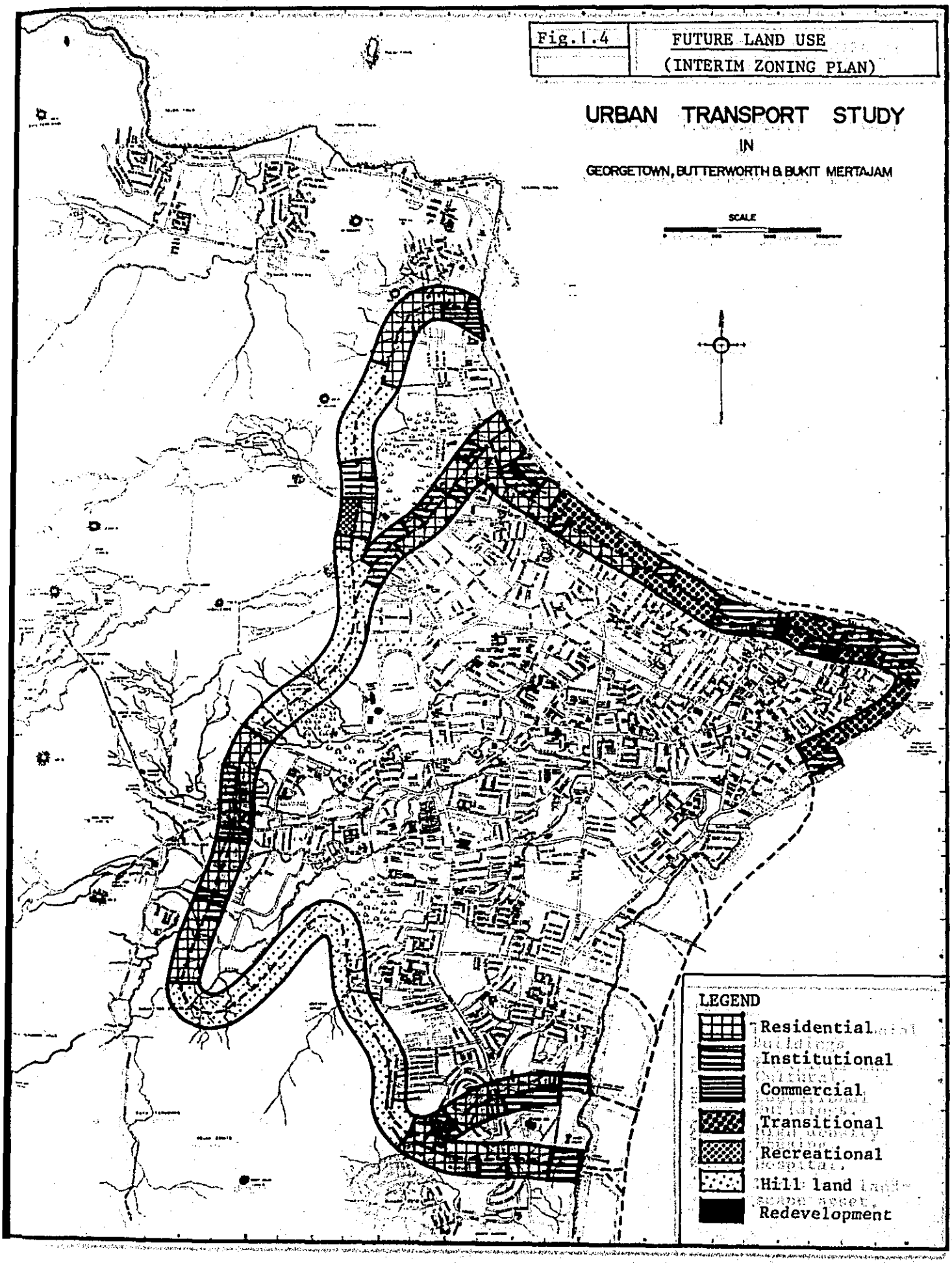


Fig.1.4
FUTURE LAND USE
(INTERIM ZONING PLAN)
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
LEGEND
Residential
Institutional
Commercial
Transitional
Recreational
Hill land
Redevelopment

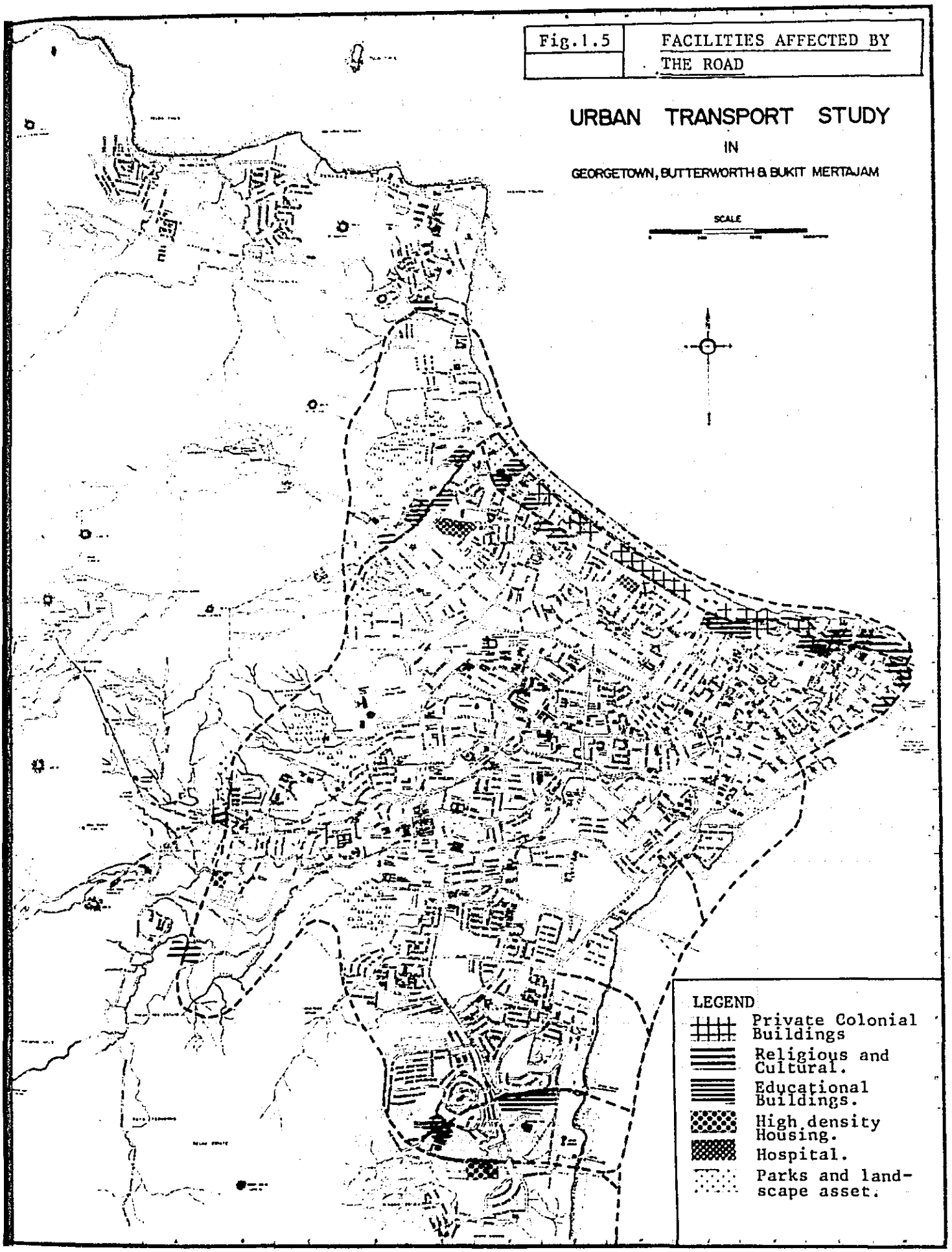


Fig.1.5
FACILITIES AFFECTED BY THE ROAD
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
LEGEND
Private Colonial Buildings
Religious and Cultural.
Educational Buildings.
High density Housing.
Hospital.
Parks and land-scape asset.

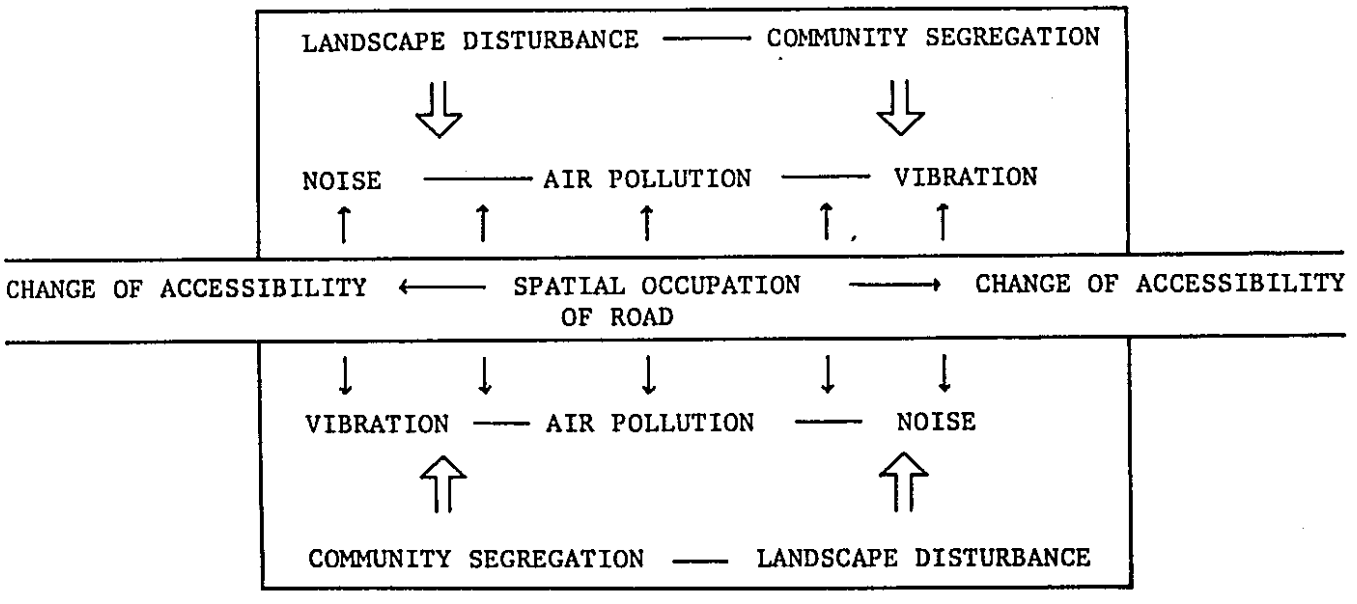
2. Environmental Impacts

This chapter aims to analyse the impact of the road on the environment along the routes. The basic framework of the study is to be discussed and a detailed analysis is to be carried out according to major categories of the environmental impact identified, route by route.

Finally, the conclusion of the analysis provides a summary of the environmental impact which may be taken into careful consideration. The discussion on the mitigation policy is to be developed in the following chapter based on the environmental impacts revealed here.

2.1 The Structure of Environmental Impacts

The basic structure of the environmental impacts in relation to the road projects is considered to consist of three components; the impact by vehicular traffic, by road structure and by construction work. The diagram shown in Fig. 2.1 displays a general framework of the implication of the environmental impacts.



SOURCE : OECD

Fig. 2.1 GENERAL FRAMEWORK OF THE ENVIRONMENTAL IMPACTS

1) Traffic noise, vibration, air pollution and disturbance to pedestrians will be generated by vehicular traffic flow and the degree of the impact mainly depends upon the traffic volume, mechanical condition and road condition.

2) Landscape disturbance, community segregation and radio wave disturbance are basically caused by the spatial structure of road. The type of disturbances are varied by the structural pattern and the width of the road.

3) The disturbances by road construction work should also be taken into careful consideration even though these may only occur during the construction stage.

2.2 The Impacts of Vehicular Traffic

Noise, air pollution and vibration caused by vehicular traffic has various impacts on the environment. In urban areas, they affect the human body, physically and psychologically, the durability of buildings and so forth. In rural or country areas, they are a nuisance to the agricultural fields, forest reserves and to the other types of nature.

It is intended to analyse the intensity of the impacts on the environment along the proposed alternative routes. The factors which result in the intensity of noise, air pollution and vibration are traffic volume, travel speed, vehicular configuration, mechanical conditions, road conditions, climatic conditions and topographic conditions.

The predominant factors for the air pollution is the mechanical performance to reduce the contents of hydrocarbons, nitrogen oxide, nitrogen dioxide in exhaust fume, and it is fortunately expected not to take long time until the anti-pollution vehicles will be developed much more in future. Therefore, it is realistic to presume that the extention of air pollution by exhaust fumes can be much reduced by the year 2000.

Vehicular traffic can also bring vibration to the surrounding environment. The vibration problem is mainly caused by heavy lorries, heavy buses and so on. The proportion of heavy vehicles is forecasted to contribute less than 10% in the total volume of traffic.

It means that vibration will not become so high to be considered a serious environmental problem. Moreover, it can be reduced by 10-15% of the vibration level only by means of restricting lorry and bus traffic to drive on the central lane of roads.

Traffic noise is also one of the major environmental problems, particularly in the urban area. The major factors relating to traffic noise are traffic volume, vehicle composition, running speed, percentage of traffic in the predominant direction of flow condition of vehicles and condition of road. Traffic volume and the condition of road are the main generators of noise and the other are the secondary factors to decide the noise level. Therefore, the traffic volume and the condition of road can be main indicators of the intensity of noise potential.

The map of traffic volume for the year 2000 in Fig. 2.2 shows forecasted volumes at typical sections on alternative routes. The routes are divided into 33 sections. 22 sections out of 33 pass through residential and institutional areas where the impact of noise should be taken into careful consideration.

Traffic Volume (1000 p.c.u)	Average Noise Level		
	At road shoulder	10m from shoulder	20m from shoulder
15 - 25	70	64	62
25 - 35	72	66	64
35 - 45	74	67	65
45 - 55	75	68	66

Table 2.1 FORECASTED AVERAGE NOISE LEVEL (in decibels)

Average noise levels by traffic volume are forecasted and shown in Table 2.1. The forecasted intensity of noise level by year 2000 is shown in Fig. 2.3. Level 1 in the map means that it is forecasted to have around 68 db at 10m away from road shoulder and is considered highest intensity of noise.

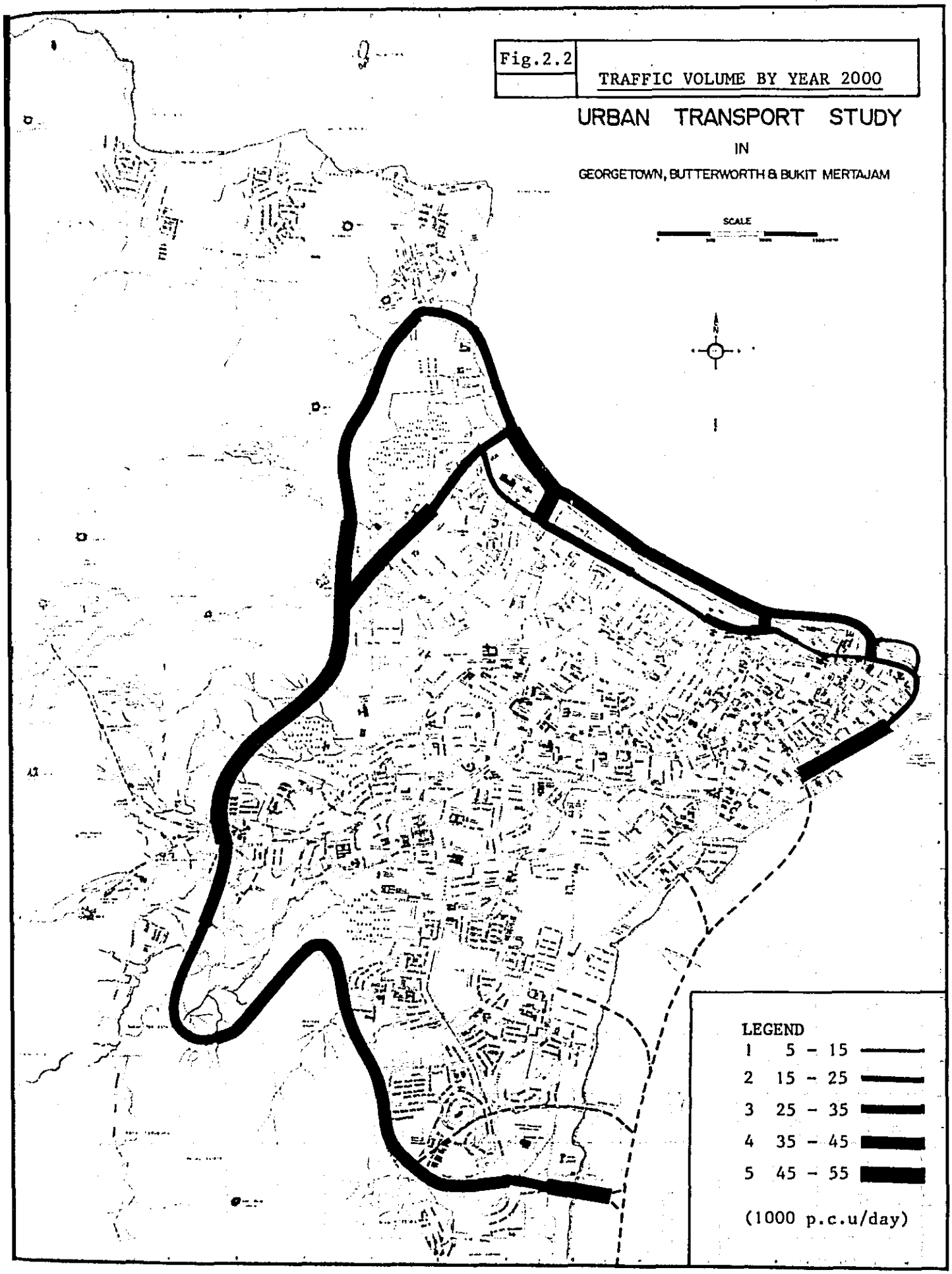


Fig.2.2
TRAFFIC VOLUME BY YEAR 2000
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
N
LEGEND
1 5 - 15
2 15 - 25
3 25 - 35
4 35 - 45
5 45 - 55
(1000 p.c.u/day)

Table 2.2 TRAFFIC VOLUME (1000 p.c.u/day)

ROUTES		Year	1 PLAN 1/ PLAN 3	2	3	4	5	6	7	8	9	10	TOTAL MIN	TOTAL MAX
SEGMENT I	ALT.L	1985	28.1/ 26.8	25.1/ 25.1	26.6/ 26.1	15.4/ 14.8	4.2/ 4.9	16.6/ 10.5	34.0/ 35.9	*	*	*	4.7	35.9
		2000	45.9/ 42.6	78.8/ 39.9	46.3/ 43.6	28.4/ 76.1	8.8/ 9.1	22.2/ 21.5	56.4/ 56.2	*	*	*	8.8	56.4
	ALT.M	1985	20.1/ 26.8	25.1/ 25.1	26.6/ 26.1	15.4/ 14.8	4.7/ 4.9	16.6/ 17.5	34.0/ 35.9	*	*	*	4.7	35.9
		2000	45.9/ 42.6	38.8/ 39.9	46.3/ 43.6	28.4/ 25.1	8.8/ 9.1	22.2/ 21.5	56.4/ 56.2	*	*	*	8.8	56.4
	ALT.N	1985	10.2/ 13.5	16.5/ 16.1	12.9/ 12.0	19.5/ 19.4	14.2/ 14.4	11.7/ 11.9	16.6/ 17.5	34.0/ 35.9	*	*	11.7	35.9
		2000	21.2/ 22.4	25.8/ 28.8	19.8/ 21.5	26.7/ 22.3	19.7/ 17.5	14.1/ 19.8	22.3/ 21.5	56.4/ 56.2	*	*	14.1	56.4
SEGMENT II	ALT.J	1985	30.7/ 20.3	16.0/ 9.9	*	*	*	*	*	*	*	*	9.9	30.7
		2000	59.5/ 26.1	16.0/ 15.2	*	*	*	*	*	*	*	*	15.2	59.5
	ALT.K	1985	-/ 16.3	-/ 3.3	-/ 11.0	*	*	*	*	*	*	*	3.3	16.3
		2000	-/ 33.3	-/ 31.5	-/ 37.7	*	*	*	*	*	*	*	31.5	37.7
SEGMENT III		1985	23.3/ 26.3	14.9/ 16.3	13.3/ 15.2	5.8/ 6.2	*	*	*	*	*	*	6.2	26.3
		2000	48.1/ 53.5	38.4/ 40.3	29,3/ 32.6	39.6/ 41.0	*	*	*	*	*	*	29.3	53.5
SEGMENT IV	ALT.A	1985	13.7/ 18.4	23.4/ 17.5	*	*	*	*	*	*	*	*	13.7	23.4
		2000	44.6/ 42.8	51.3/ 49.3	*	*	*	*	*	*	*	*	42.8	51.3
	ALT.B	1985	*	*	*	*	*	*	*	*	*	*	*	*
		2000	*	*	*	*	*	*	*	*	*	*	*	*

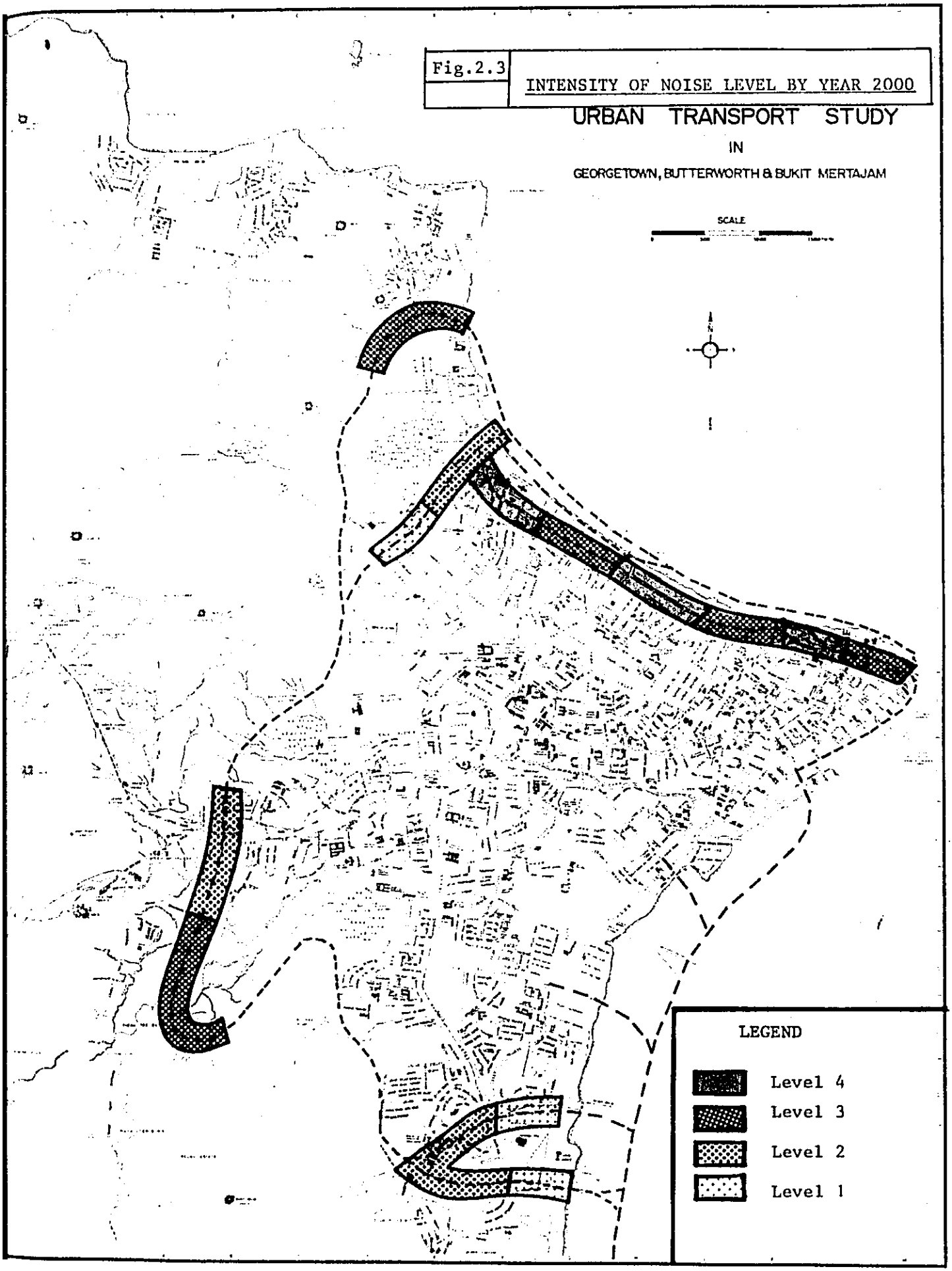


Fig.2.3
INTENSITY OF NOISE LEVEL BY YEAR 2000
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
LEGEND
Level 4
Level 3
Level 2
Level 1

Road consitions and topography can be other potential factors to generate noise. Slope on the road requires for accelerating engine, intersections with traffic signals where vehicles take stop and start, will potentially generate higher level of exaust fume. The road and topographic conditions as shown in Fig. 2.4 and Table 2.3 suggest that there are higher intensity of the impacts from segment II to segment IV.

Segment I; 3 alternatives, Alternative Route L.M.N, show almost same potential, but only Alternative L has extra factors of interchange which has 4% grade slope.

Segment II; Alternative J has less variety on the components of potentials but higher intensity in all 3 indicators than Alternative K.

Segment VI; Remarkably higher intensity shown here in terms of exhaust fumes and its settlings.

Segment IV; Both alternative plans show almost same performance, but Alternative A might be slightly better because of less density of intersections.

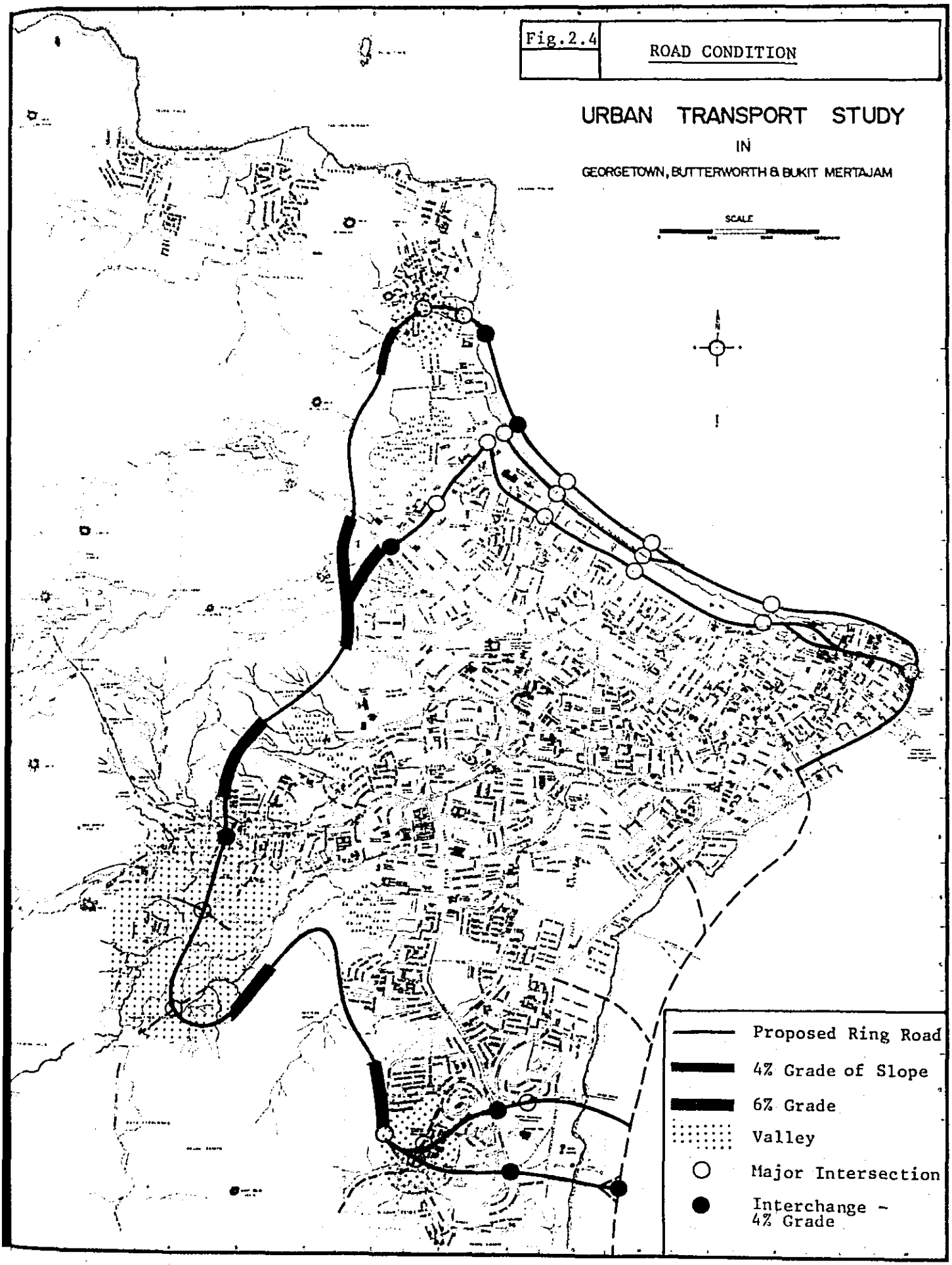


Fig.2.4
ROAD CONDITION
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
N
Proposed Ring Road
4% Grade of Slope
6% Grade
Valley
Major Intersection
Interchange - 4% Grade

ROUTE		GRADE-OF ROAD (% OF TOTAL LENGTH) 4% GRADE	6% GRADE	INTERCHANGE (K.M PER UNIT)	MAJOR INTER-SECTION (K.M PER UNIT)	VALLEY AREA (% OF TOTAL LENGTH)	INTENSITY OF IMPACT
SEGMENT I	ALT.L 6600	0	0	6.6	1.7	0	3 alternatives show almost the same potential but only Alternative L has more intensity of the problems on interchange which has 4% grade slope in its structure and may generate extra exhaust fume.
	ALT.M 6500	0	0	0	1.6	0	
	ALT.N 6500	0	0	0	1.6	0	
SEGMENT II	ALT.J 2900	0	21	1.45	1.0	0	Alternative J has less variety on the components of potentials but higher intensity in all 3 indicators than Alternative K.
	ALT.K 5000	10	18	5.0	1.7	12	
SEGMENT III 8000		0	0	8.0	2.7	33	Remarkably higher intensity shown here in terms of exhaust fumes and it settlings.
SEGMENT IV	ALT.A 3000	0	0	3.0	3.0	23	Both alternative plans show almost the same performance, but Alternative A seems slightly better than Alternative B.
	ALT.B 2600	0	0	2.6	2.6	23	

Table 2.3 COMPARISON ON THE POTENTIAL INTENSITY OF THE PROBLEMS TO BE GENERATED BY VEHICULAR TRAFFIC

2.3 The Impacts of Road Structure

There are varieties of the types of
but they can essentially be classified into four patterns; the ground level, the embankment, the viaduct and the depressed. Each of them has particular effects on the physical environments. These effects for the environments are analysed and tabulated in table 2.4. Environmental factors to be considered in the analysis are;-

1. Effects on roadside landuse
2. Effects on environmental protection
3. Landscape and visual effect
4. Safety of traffic

The selection of the desirable type of structure cannot be based only by environmental considerations but usually involves comprehensive evaluation of function, cost efficiency, geographical factors, landuse and other criteria. The selected types of road structure for the proposed routes are displayed in fig 2.5. The possible impacts by road structure are summarised in table 2.5 route by route.

Typical type of impacts which may be caused by the proposed road structure are generally;

1. Segregation of in and off shore area
2. Pedestrian crossing problem
3. Landscape disturbance
4. Community segregation

ENVIRONMENTAL ASPECTS	CRITERIA \ TYPE OF ROAD STRUCTURE	A GROUND	B ENBANK-MENT	C VIADUCT	D DEPRESSED
SPACE USE & COMMUNITY	1. ACCESSIBILITY FOR ROADSIDE DEVELOPMENT				
	2 POSSIBILITY OF MULTI-PURPOSE USE OF SPACE				
	3 CONVENIENCE ON CROSSINGS				
	4 COMMUNITY SEGREGATION				
POLLUTION	5 NOISE AND VIBRATION				
	6 AIR POLLUTION				
	7 DISTURBANCE ON RADIO & T.V. WAVES				
	8 NECESSITY OF BUFFER ZONE				
LANDSCAPE	9 DISTURBANCE ON VISTA				
	10 PLANTING SUITABILITY				
	11 DISTURBANCE ON UNDERGROUND VAIN				
UNDERGROUND UTILITIES	12 CONVENIENCE ON DRAINAGE SYSTEM				
	13 CONVENIENCE ON UNDER-GROUND INFRASTRUCTURE				
COST & MAINTENANCE	14 COST INTENSITY				
	15 MAINTENANCE INTENSITY				

HIGH LEVEL
MEDIUM
LOW

Table 2.4 INTENSITY OF ENVIRONMENTAL PERFORMANCE

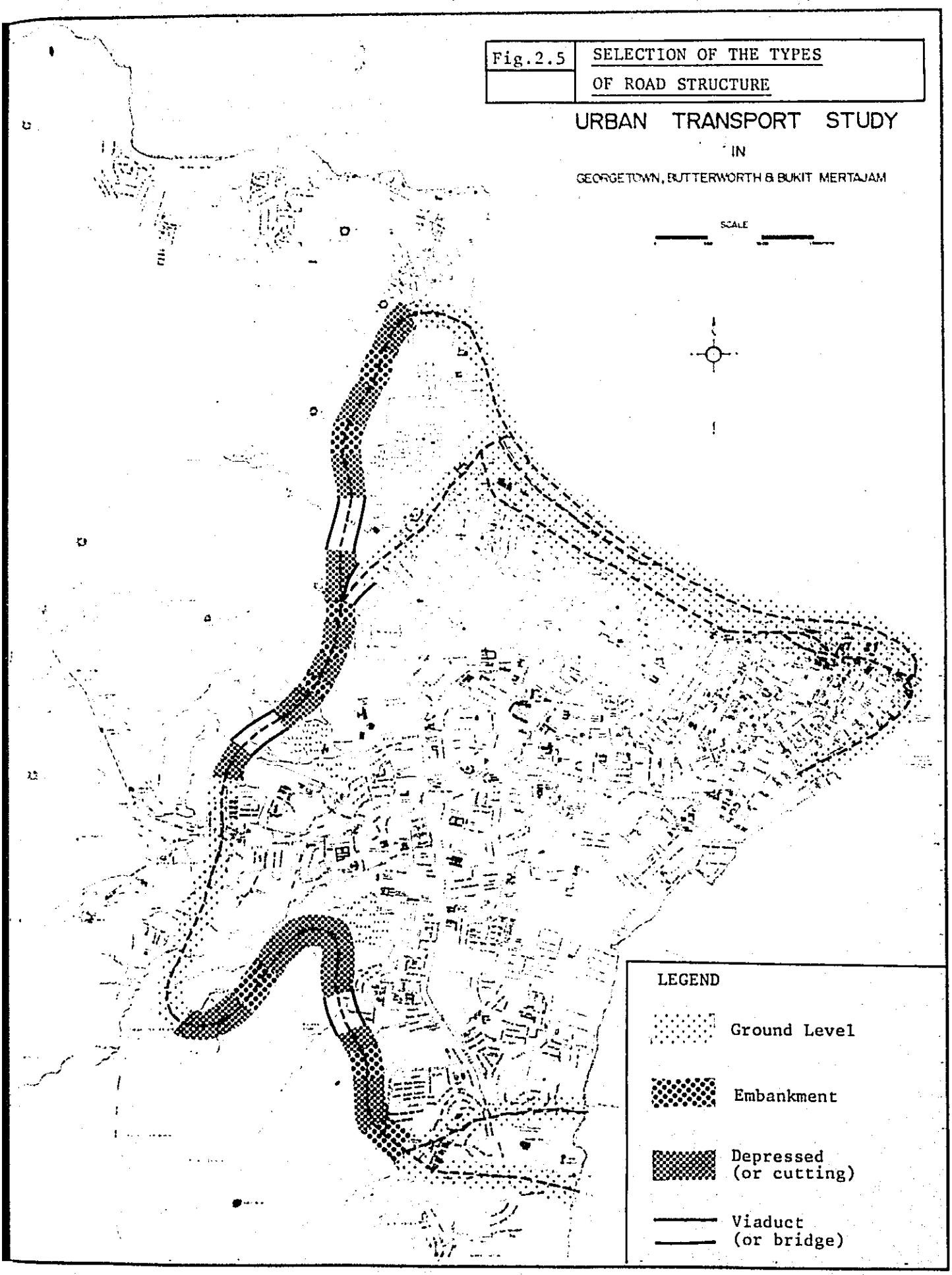


Fig.2.5
SELECTION OF THE TYPES OF ROAD STRUCTURE
URBAN TRANSPORT STUDY
IN
GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM
SCALE
LEGEND
Ground Level
Embankment
Depressed (or cutting)
Viaduct (or bridge)

Table 2.5 THE POSSIBLE IMPACT BY ROAD STRUCTURE

ROUTES		ROAD STRUCTURE				TOPOGRAPHY		LANDUSE		POSSIBLE IMPACTS BY ROAD STRUCTURE
		GRAND LEVEL	EMBANK-MENT	VIADUCT	DEPRESSED	PLAIN	SLOPE	URBAN	NATURAL	
SEGMENT I	ALT.L	●				●		●	●	* SEGRAGATION ON IN AND OFF SHORE AREA / LANDSCAPE. * PEDESTRIAN CROSSING IN CENTRAL AREA.
	ALT.M	●				●		●	●	* SEGRAGATION OF IN AND OFF SHORE AREA. * LANDSCAPE * PEDESTRIAN CROSSING.
	ALT.N	●				●		●		* PEDESTRIAN CROSSING PROBLEM. * LANDSCAPE PROBLEMS.
SEGMENT II	ALT.J	●		●		●		●		* PEDESTRIAN CROSSING PROBLEM. * LANDSCAPE DISTURBANCE
	ALT.K	●	●	●	●	●	●	●	●	* PEDESTRIAN CROSSING PROBLEM. * COMMUNITY SEGRAGATION. * LANDSCAPE PROBLEM IN HILL LAND AND SEA SHORE.
SEGMENT III		●	●	●	●	●	●	●	●	* PEDESTRIAN CROSSING PROBLEM. *LANDSCAPE PROBLEM *COMMUNITY SEGREGATION
SEGMENT IV	ALT.A	●				●		●		* COMMUNITY SEGRAGATION. * PEDESTRIAN CROSSING PROBLEM.
	ALT.B	●				●		●		* PEDESTRIAN CROSSING PROBLEM

2.4 The Impact of Construction Work

The impact of construction work, so called construction nuisance, can be discussed from three aspects of the phenomena; the impact on the surrounding area of the construction site, the impact from the intensive volume of heavy lorry traffic and the social problems in related to construction workers.

1) The Impact on Construction Site

Construction sites and building sites, more or less, generate noise, vibration and dust to the surrounding areas and buildings. It should be understood that the impacts of construction often become quite serious in densely populated district and high class residential areas.

The residents may, for instance, complain about the noise which may disturb the calm atmosphere in the mansion house area. The dust may blow into houses and the vibration may affect the structure and cause cracks on walls of historical building assets. Those noise, dust and vibration can be generated by the construction work on the site itself and frequent in and out traffic of heavy lorries too. It is therefore important to select an appropriate construction method which can minimise disturbances observed in the different surrounding areas.

Table 2.6 shows comparative discussions on the intensity of the impacts of construction work among the alternative routes. Land use sensitive to construction work is classified in three categories; the residential, the institutional and the commercial and industrial use.

ROUTE		SENSITIVE LANDUSE TO CONSTRUCTION WORK				POSSIBLE IMPACTS CONSTRUCTION
		RESIDENTIAL	INSTITUTIONAL	COMMERCIAL & INDUSTRIAL	OTHER	
SEGMENT I	ALT.J		⊙	●	* HISTORICAL ASSETS * RECLAMATION	* MAJOR SECTION IS RECLAMATION AREA, SO THAT THERE IS DISTURBANCE TO RECREATIONAL ACTIVITIES AND WATER MAY BE MUDDY * DISTURBANCE TO DAYTIME TRAFFIC IN THE CENTER. * DISTURBANCE TO COLONIAL BUILDINGS AND FORTRESS/CLOCK TOWER.
	ALT.M	●	⊙	●	* HISTORICAL ASSETS * RECLAMATION	* DISTURBANCE TO HOUSES AND RECREATION ALONG GURNEY DRIVE. * DISTURBANCE TO DAYTIME TRAFFIC. * DISTURBANCE TO COLONIAL BUILDINGS & ASSETS
	ALT.N	●	●	●		* DISTURBANCE TO MIDDLE & HIGH CLASS HOUSES. * DISTURBANCE TO SCHOOLS & CLUB HOUSES. * DISTURBANCE TO DAYTIME TRAFFIC. * DISTURBANCE TO COLONIAL BUILDINGS & ASSETS
SEGMENT II	ALT.J	●	●	⊙		* DISTURBANCE TO MIDDLE CLASS HOUSES. * DISTURBANCE TO
	ALT.K	◐		⊙	* HILL LAND * RECLAMATION	* DISTURBANCE TO SEA WATER BY RECLAMATION. * DISTURBANCE TO MIDDLE CLASS & SQUATTER HOUSES.
SEGMENT III		●		◐	* HILL LAND	* DISTURBANCE TO HIGH & MIDDLE CLASS HOUSES.
SEGMENT IV	ALT.A	◐	◐			* DISTURBANCE TO NEIGHBOURHOOD
	ALT.B	●	●			* DISTURBANCE TO NEIGHBOURHOOD. * DISTURBANCE TO SCHOOL.

● MAJOR : ◐ INTERMEDIATE : ⊙ MINOR

2) The Impact from Lorry Traffic

The construction of roads require large amounts of earth work and transport of soil, gravel, cement and other paving materials. This requires the intensive use of heavy lorries which in turn may cause noise, vibration, dust and air pollution to the surrounding environment along the transport routes. Fig. 2.6 shows construction sites where it produce dumping materials, soil, rocks, etc., and traffic routes for the dumping.

The first area which will be affected by lorry traffic may be along Gottlieb Road where there are many schools and residents close to the road. The second area will be along Green Lane and Scotland Road where attention should be given.

3) The impact from construction workers

In this project, it is planned that hundreds of labourers will be engaged in construction work, reclamation work and the building of new roads, for almost three years. These labourers will be necessary to form a community in themself for three years. Therefore, the planning of bunkhouse should be carefully done in order not to create any social conflicts with existing communities in the town. On the other hand, the labourer community can stimulate local commercial and service activities; for instance, it will be an attractive market for retailers. This means that community planning for labourers should be an important section of the labour management programme.

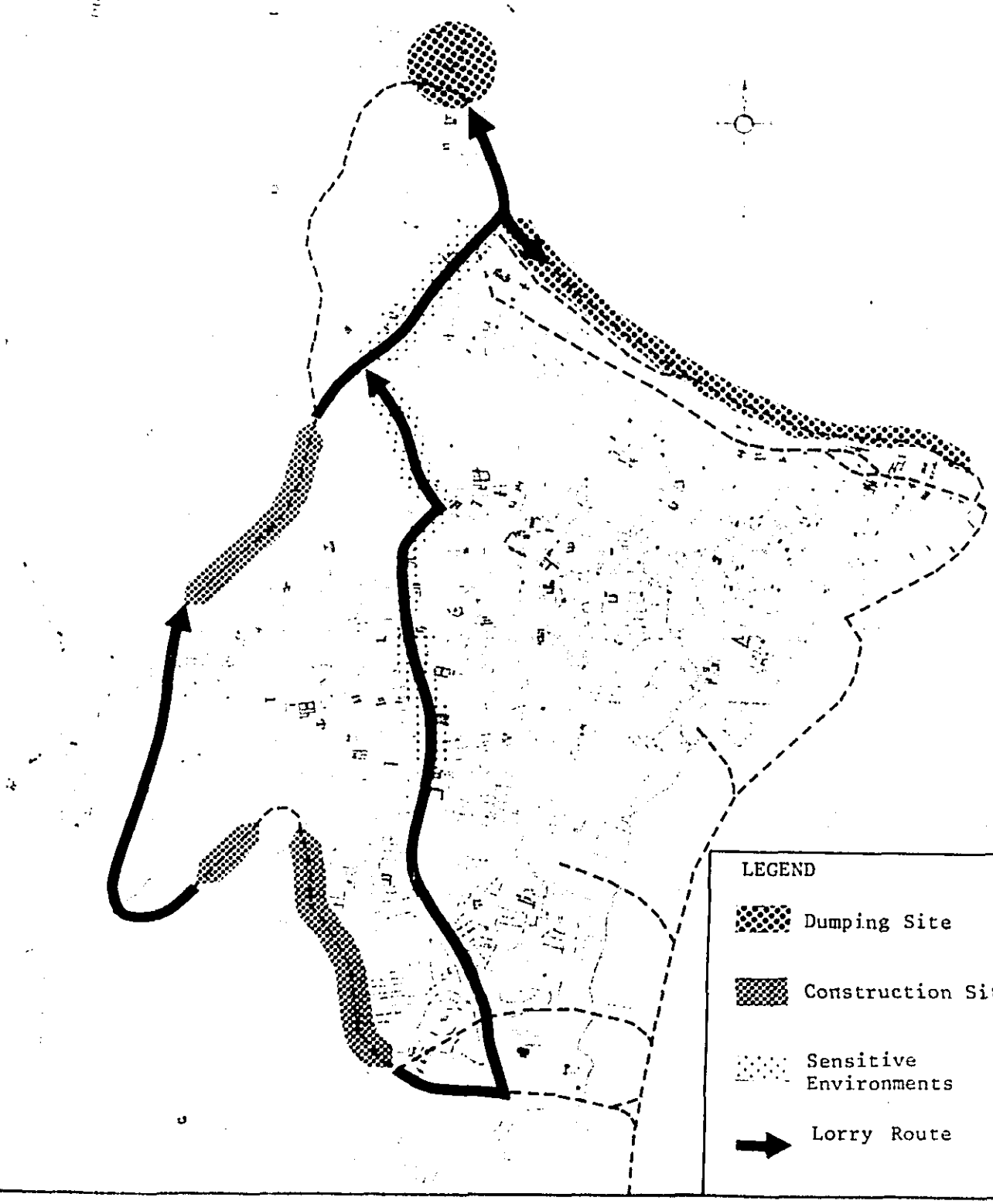
Fig.2.6	MATERIAL DUMPING AND TRANSPORT ROUTES

URBAN TRANSPORT STUDY

IN

GEORGETOWN, BUTTERWORTH & BUKIT MERTAJAM

SCALE



2.5 Conclusion of the Analysis

The environmental impacts along the alternative routes were analysed in terms of vehicular traffic, road structure and construction work. General conclusions which summarise the findings in these three aspects are shown segment by segment in this chapter.

Segment I : Alternative L, and M have similar impacts to the road side environment in general, but Alternative L may be superior than Alternative M in the sense that Alternative L can allow Gurney Drive road to maintain existing traffic and recreational functions, and also buffer zone of 50 meters in width of Alternative L may provide positive potential for the environmental mitigation design. Alternative N may be considered to give complex of the impacts such as noise, air pollution, disturbance on townscape and pedestrian crossing to the residential and institutional environment.

Segment II : Alternative K has the landscape-oriented impacts predominantly and Alternative J may require the mitigation for the impacts to the residential and institutional environment. The intensity of the impacts along Alternative J may be serious.

Segment III: There is no alternative route in this segment. Predominant features of the environmental impacts are landscape disturbance and community disturbance. Noise and vibration by construction work near Jesselton Crescent should be taken into careful consideration.

Segment IV : Community disturbance may be observed along Alternative B which runs through the middle of a housing estate. Alternative A has less number of houses and schools which will be affected by the route.

3. Environmental Mitigation Policy

3.1 General Approach

The environmental mitigation policy aims to give appropriate directions to formulate desirable mitigation measures against the presumable environmental problems. Different emphasis in different stages of the planning can be put on the mitigation policy in general.

Stage 1 indicates the time when evaluation of alternative routes takes place, stage 2 is the time to design the cross section of road and in stage 3 traffic management is to be considered.

Stage 1 : Route selection essentially involves environmental factors in its set of criteria. The purpose of the stage of mitigation policy is to select the routes which can relatively minimize the potential environmental disturbance. The site elevation has been carried out for the purpose of screening possible alternative routes.

Stage 2 : The design of cross section should also have environmental criteria to mitigate problems which are still possible to take place along the routes selected by the site evaluation.

It is the purpose of the policy in this stage to minimize the dependency on the traffic management and control for mitigation. It means that it is desirable to apply spacial mitigation measure as much as possible for the solution.

Stage 3 : It is considered that traffic control measures should be applied in the operation and maintenance stage. Exclusive lane system for heavy vehicles, for instance, can be introduced if necessary.

3.2 The Environmental of Mitigation Policy

As it is investigated in the previous analysis, predominant problems identified along the routes are summarised as follows:

1. Noise disturbance
2. Landscape disturbance
3. Community segregation
4. Disturbance on Gurney Drive attraction
5. Disturbance on fortress, clock tower and institutional facilities.

There is so far no legislative goals of noise mitigation in the form of quantitative standard, but it has been discussed and will be set up in the environmental law of Malaysia which is expected to be formulated. Therefore, all the disturbance on noise landscape, community, Gurney Drive attraction and cultural assets are to be discussed on its qualitative requirement for the mitigation policy.

1) Policy for Noise

Noise problems are used to take place in urbanized area, particularly in residential and institutional area. The road reserve with 12.0m (40') in width which minor service road is built in legally required when the route as main arterim road is planned in new housing estates. When considering pedestrian side walk with 4.5m in width and building line with 6.0m (20') is accumulated approximately 22.5m, the distance from main carriage-way to buildings which can be considered as buffer zone and it can work much effectively for reducing noise level. In existing housing area, it is expected to have approximately 10.5m of distance which comprises pedestrian side walk and building line and effects as buffer zone. Therefore, further action should be taken in to consideration only when it become necessary to do so.

2) Policy for Landscape

There are two types of landscape policy; natural landscape policy and urban landscape policy. It will be necessary to have two policies for the natural landscape. One is to minimize the amount of soil and rocks to remove, and minimize cutting work in hill land. Another is to minimize the visual disturbance of the sea along north coastal line as for the urban landscape policy, it should be considered to minimize removing road side trees and to make master plan of landscape in the whole town area. The landscape master plan involves vegitation plan for road side trees, landscaping for road reserve and the other public open space and also pedestrianization plan in the town.

3) Policy for Community

The policy to mitigate community disturbance should have two aspects; noise, air pollution and vibration problems and spatial segregation of neighbourhood community.

For the first, the basic policy has been stated in the "Policy For Noise". It should be recommended to give compensation for those houses which presumably locate within 6.0m (20') zone from the new road.

For the second, it should be carefully planned to provide safety pedestrian crossing system. In order to maintain convenience of pedestrian movement. The landscape of road space should fundamentally be important in residential area.

4) Policy for Gurney Drive

The Gurney Drive road presents many attractions to residents and tourists. Dragon boat race is annually held in July, night market is used to appear regularly once a month for a week or so, people are crowded at open garden restaurants every evening until midnight. These attractions should be carefully preserved. Seashore zone along the north coastal line is also one of tourism resources in Penang, so that visual resources should be preserved.

Firstly, the height of road should be planned at the level as lowest as possible in order to keep the condition to provide easy view of the off-shore from the land.

Secondly, promnade zone between the new road and off-shore should be planned carefully for the mitigation of the landscape disturbance.

Thirdly, buffer zone should also be provided between the new road and private properties in order to mitigste noise, air pollution and other environmental disturbances.

5) Policy for Cultural and Religious Assets

Clock tower and fortress in the town are historical assets in George Town, therefore they should be conserved. The alignment of the new road should be decided not to disturb the structure of them. The disturbance from heavy traffic may not take place, since they locate almost the edge of the sea-shore where only the small amount of the future traffic volume is forcasted.

III. Environmental Mitigation Measure

1. Framework of Mitigation Measure

It is analysed in the previous chapter what policy should be necessary for the environmental mitigation along the proposed routes. The mitigation measure is to be formulated based on the policy by focusing on the spatial and physical mitigation measure. The mitigation measures are planned for the typical road sections which appear along the routes selected for the Outer Ring Road.

Physical mitigation measures are much depending upon the structural type of roads, but the physical measure to be applied as foundamental components can be varied in 4 alternatives.

1) Buffer zone
2) Vegitation
3) Embankment
4) Buffer wall

All these components can also be combined together if necessary. The combination of mitigation measure and the road strucuture is to be discussed and finally the typical plan of the mitigation measure are proposed.

Tables 1.1 and 1.2 show possible combination pattern of the components and section types of roads, and the necessary considerations on environmental requirement in hill land area are shown in Fig. 1.3 in which viaduct type of section is considered to need less environmental treatment in hill land area.

2. Combination of Mitigation Components

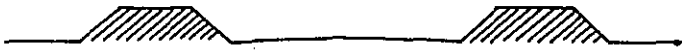
There are theoretically 10 sets of combination patterns of the components.

A. Buffer Zone/Planting.

When the buffer zone is more than 10.00m in width, noise mitigation and landscape effects are easily achieved.

B. Buffer Zone/Bank.

The higher the bank is, the more effective noise mitigation can be achieved.

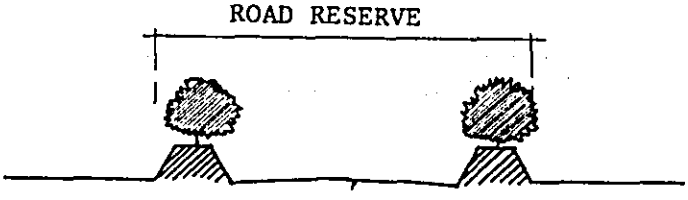


C. Buffer Zone/Wall.

The wall can mitigate the noise but will distrub the landscape.

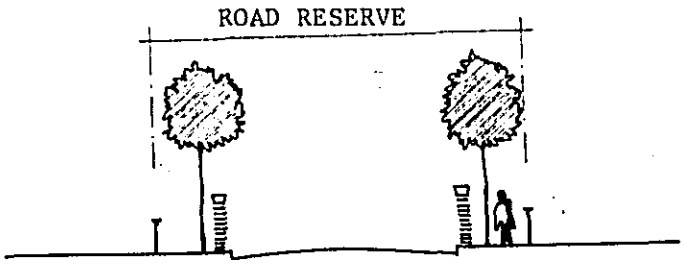
D. Planting/Embankment.

Being effective when a sufficiently wide buffer zone cannot be provided. Shurubs can also be planted.



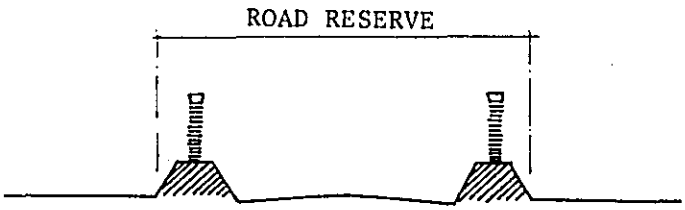
E. Planting/Wall.

Effective for noise in narrow road reserves but more than 2m height of wall creates unusual landscape.



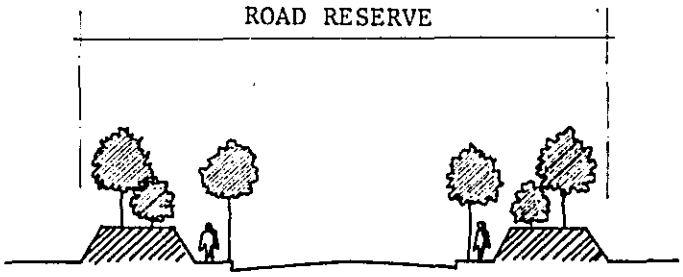
F. Embankment/Wall.

Effective for noise. More effective than pattern D and has a lower wall than E.



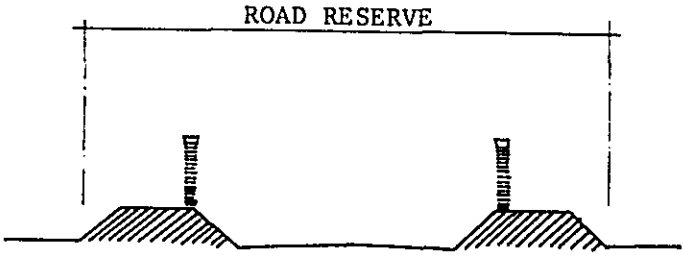
G. Buffer Zone/Planting/Embankment.

Very effective for noise mitigation and road landscape. More than 10.00 width is expected for the zone.



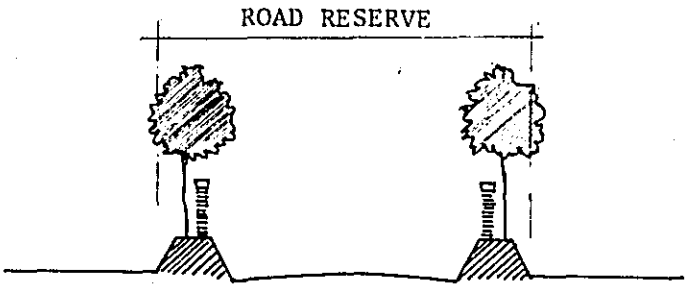
H. Buffer Zone/Embankment/Wall.

Highly effective for noise reduction, but has less landscape beauty.



I. Planting/Embankment/Wall.

Effective for narrow road reserves which do not need pedestrian sidewalks.



J. Planting/Buffer Zone/Embankment Wall.

Most effective set of the components in terms of affecting noise, landscape and the other requirements.

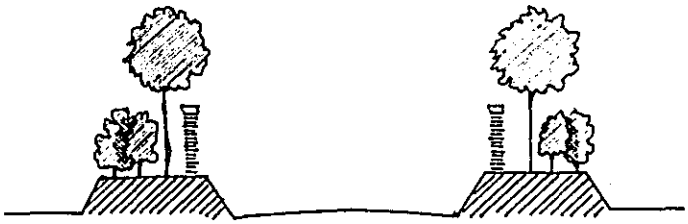


Table 3.1 COMBINATION OF COMPONENTS AND SECTION TYPES - 1;

FLAT LAND AREA

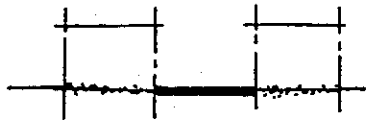
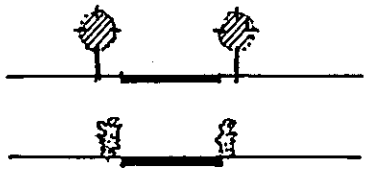
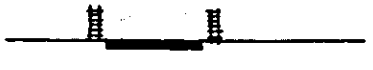
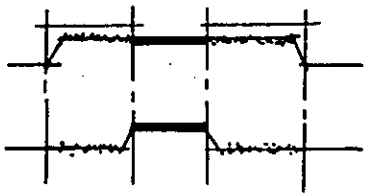
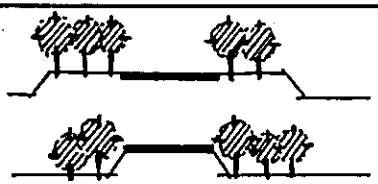
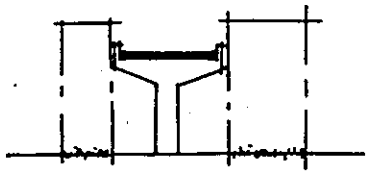
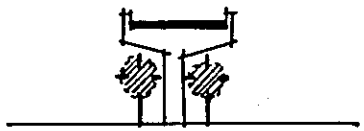
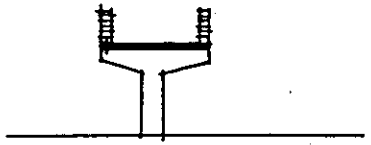
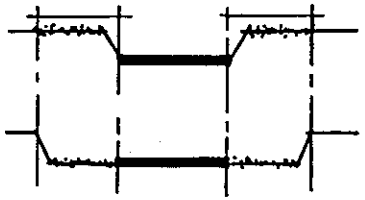
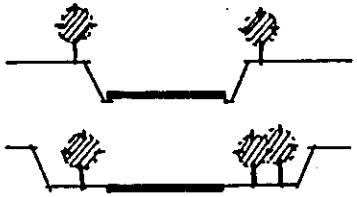
COMPONENTS / SECTION TYPES	BUFFER ZONE C.W.	VEGETATION CARRIAGEWAY	BANK C.W.	VERTICAL WALL CARRIAGEWAY
				
				
				
				

Table 3.2 COMBINATION OF COMPONENTS AND SECTION TYPES - 2;

HILL LAND AREA

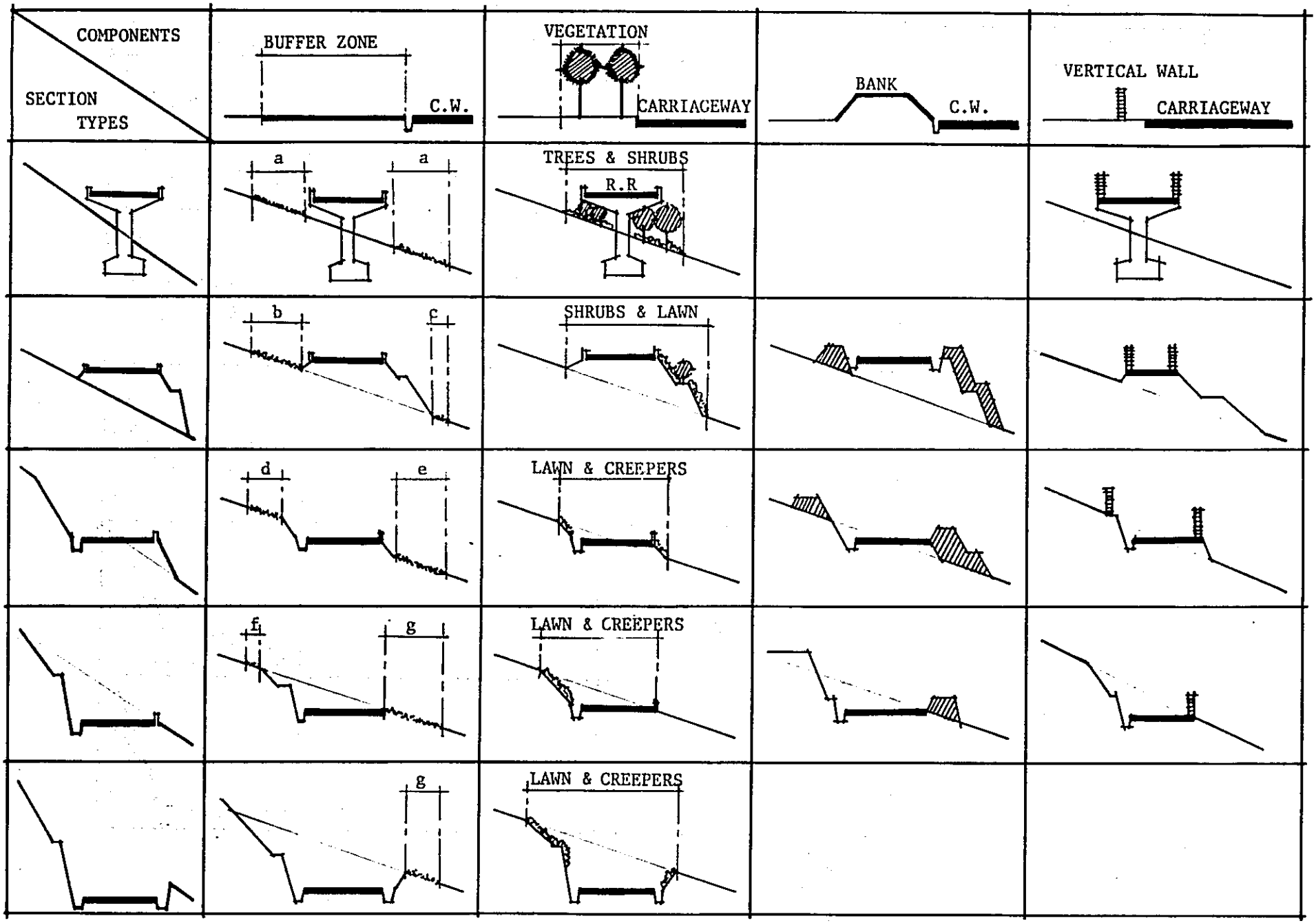
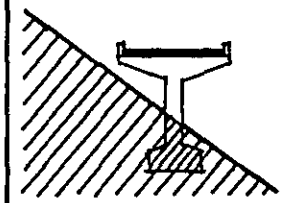
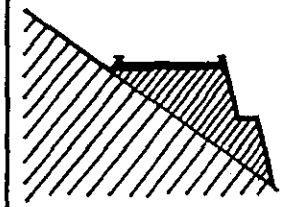
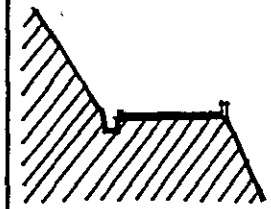
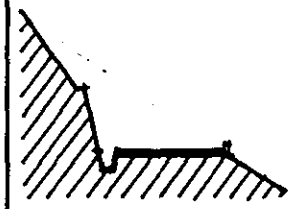
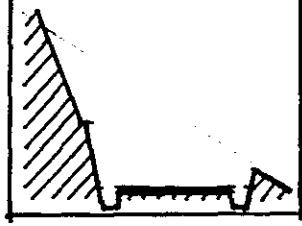


Table 3.3 ENVIRONMENTAL REQUIREMENT BY SECTION TYPES IN HILL LAND AREA

ELEMENTS / SECTION TYPES	CUTTING SURFACE	EMBANKMENT SURFACE	BOULDER	RUNNING WATER CONTROL	VISUAL EXPOSURE	
					ON ROAD	OFF ROAD
			●			●
		●	●	●		●
	●	●	●	●	◐	●
	●		●	●	◐	●
	●		●	●	●	◐

● NEED MAXIMUM CARE

◐ MEDIUM CARE

2. TYPICAL MITIGATION MEASURE

Based on the analysis in the framework of mitigation measure in the previous chapter, the typical mitigation measures are proposed at the typical cross sections of the Outer Ring Road. The location of the typical cross sections are shown in Fig. 1.1.

Section A : Residential area without service road (30.00m)

Section B : Residential area with service road (47.00m)

Section C : Enbankment (20.00m +)

Section D : Bridge (20.00m)

Section E : Cutting section (24.00m +)

Section F : Improvement of Jalan Gottlieb and Bagan Jermal (30.00m)

Section G : Grade separation section (40.00m)

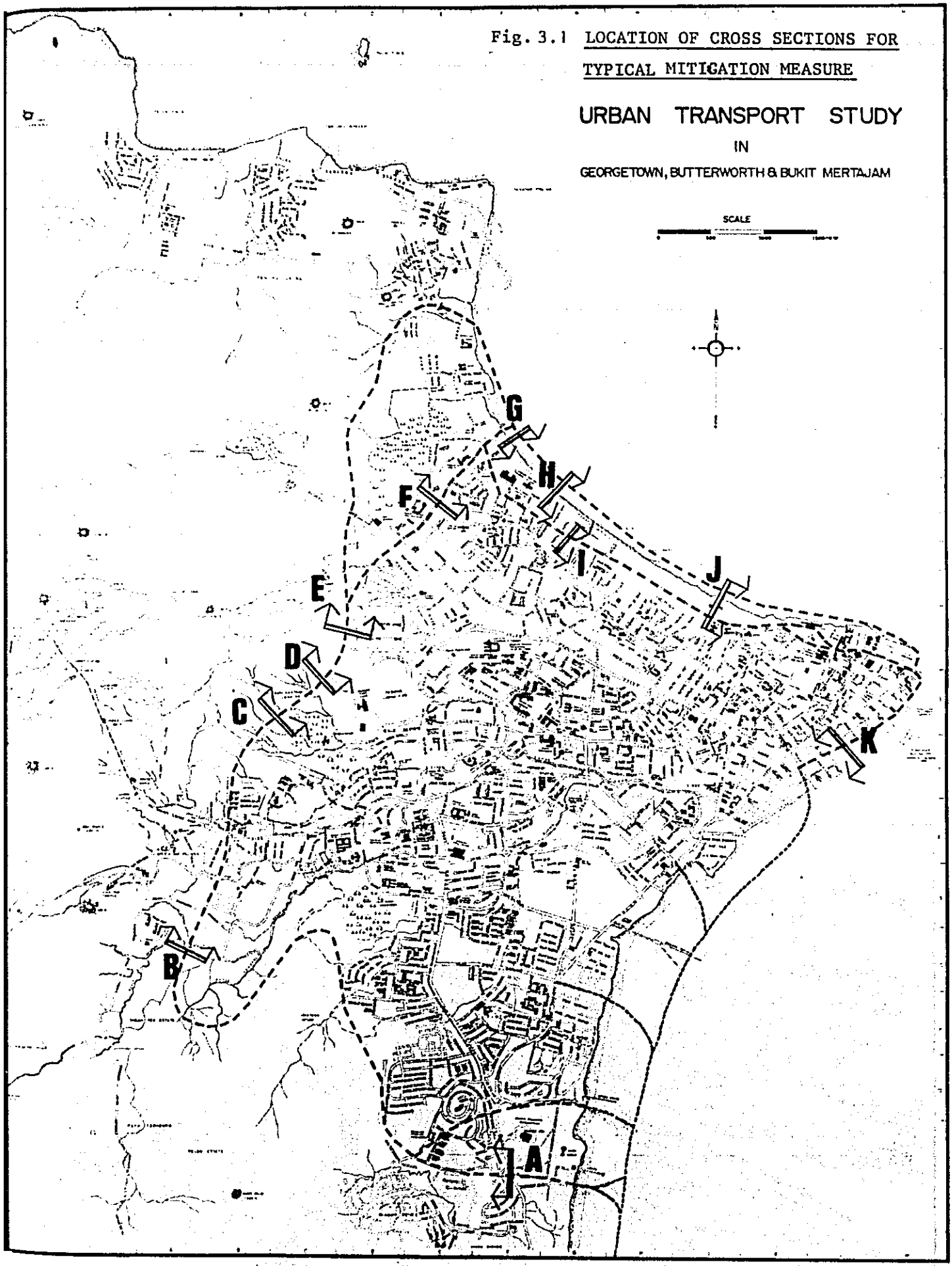
Section H : Improvement of Gurney Drive (41.00m)

Section I : Improvement of Jalan Northam and Kelawai (30.00m)

Section J : Off Gurney Drive Road (31.00m + 60.00)

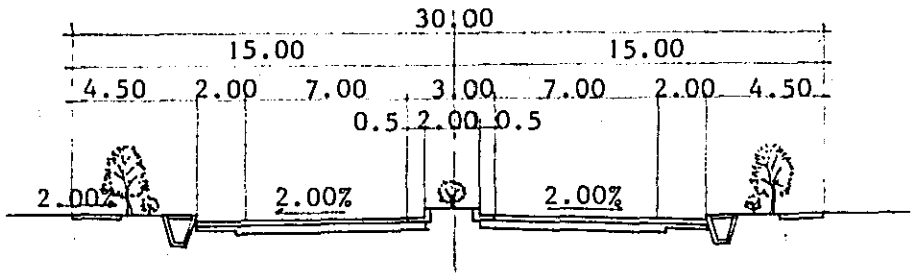
Section K : Improvement of Weld Quay (20.00m)

Fig. 3.1 LOCATION OF CROSS SECTIONS FOR TYPICAL MITIGATION MEASURE



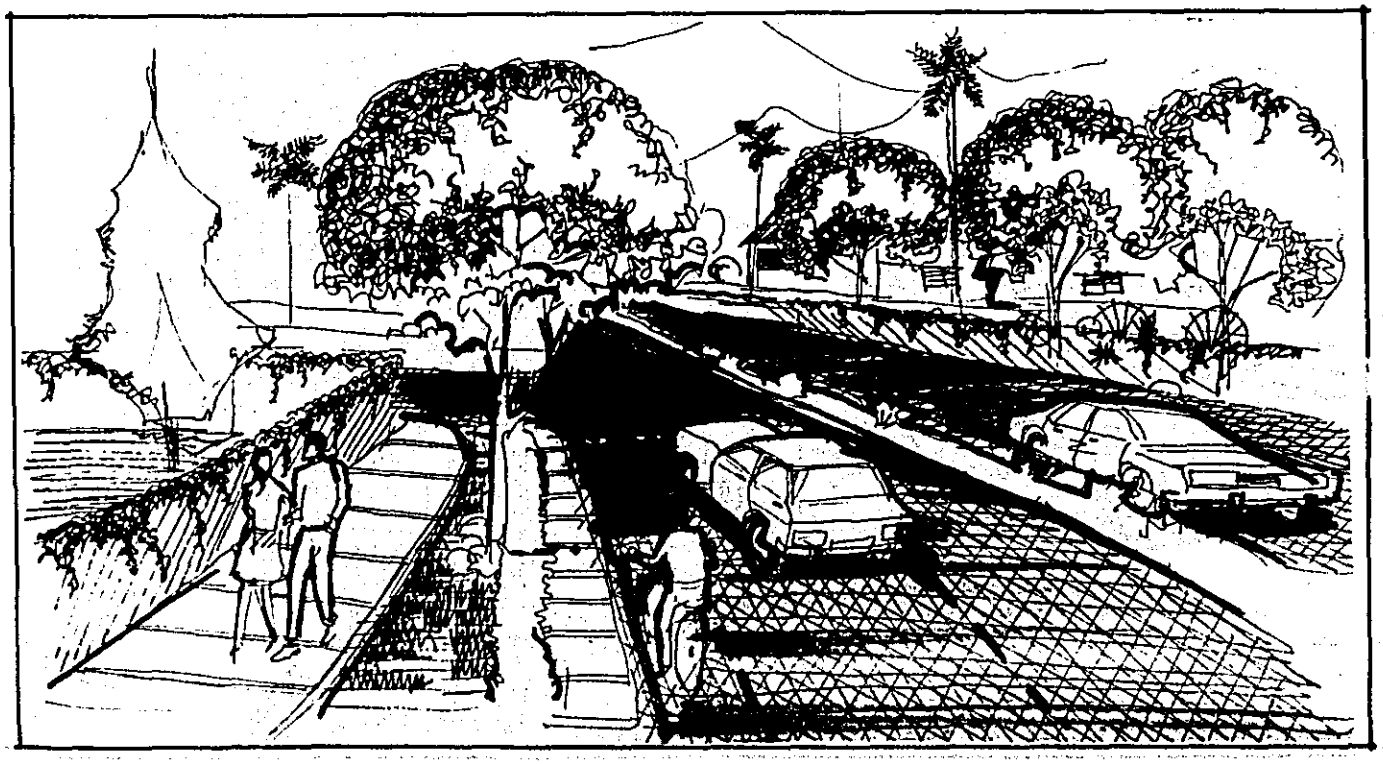
SECTION A

RESIDENTIAL AREA WITHOUT SERVICE ROAD



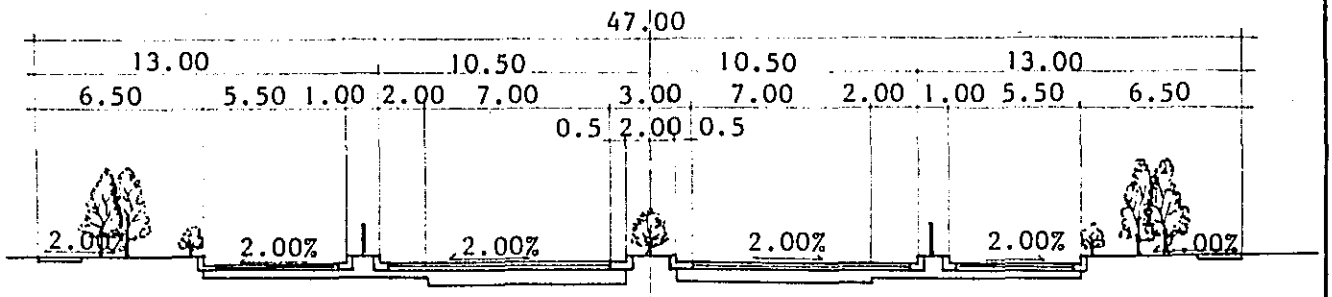
MITIGATION MEASURE

1. Buffer Space : Side walk + Building Line : 10.50m
2. Landscape :
   (1) Road side trees
   (2) Hedges between side walk and carriage-way
   (3) Planting in median
   (4) Pedestrian side walk
   (5) Street furniture
3. Safety Facilities :
   (1) Lighting
   (2) Pedestrian crossing with signal at major intersection
   (3) Traffic sign boards
   (4) Design for the handicaped



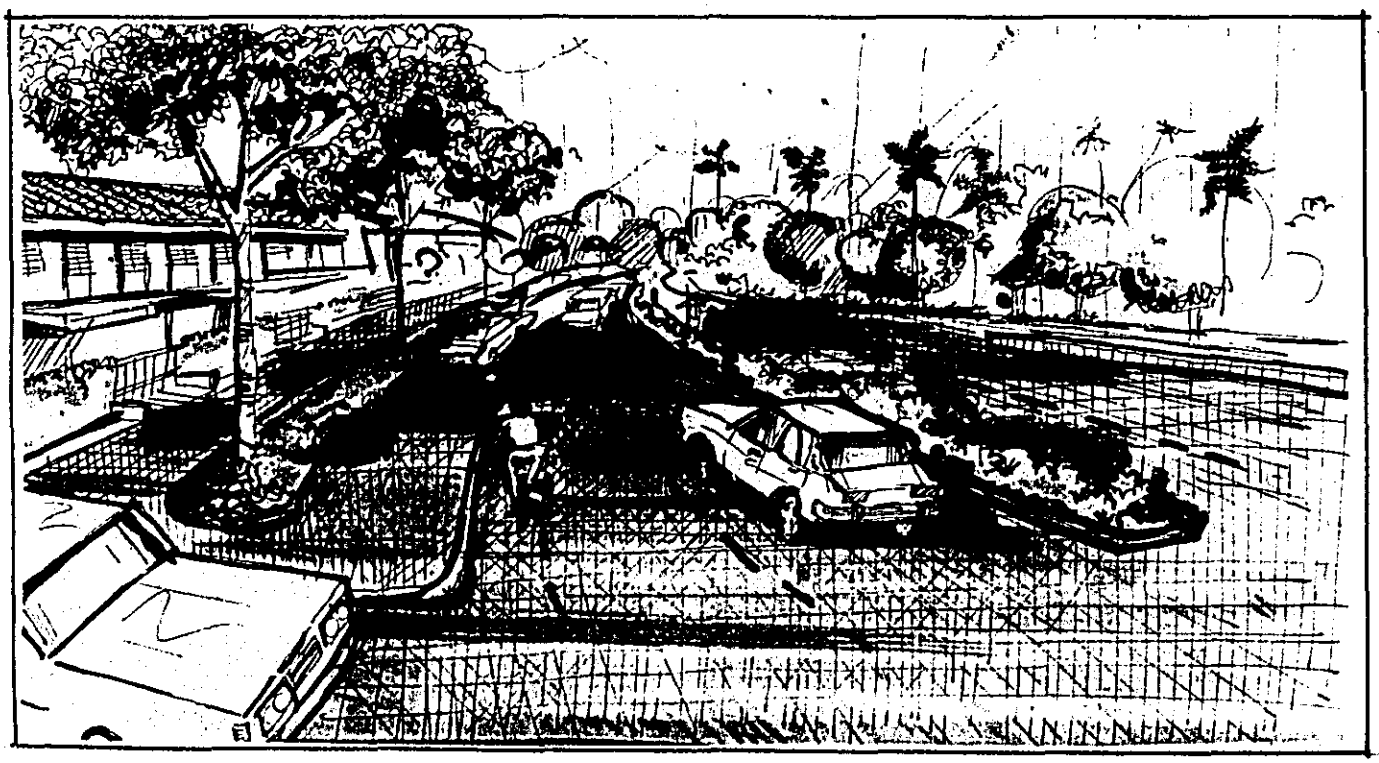
SECTION B

RESIDENTIAL AREA WITH SERVICE ROAD

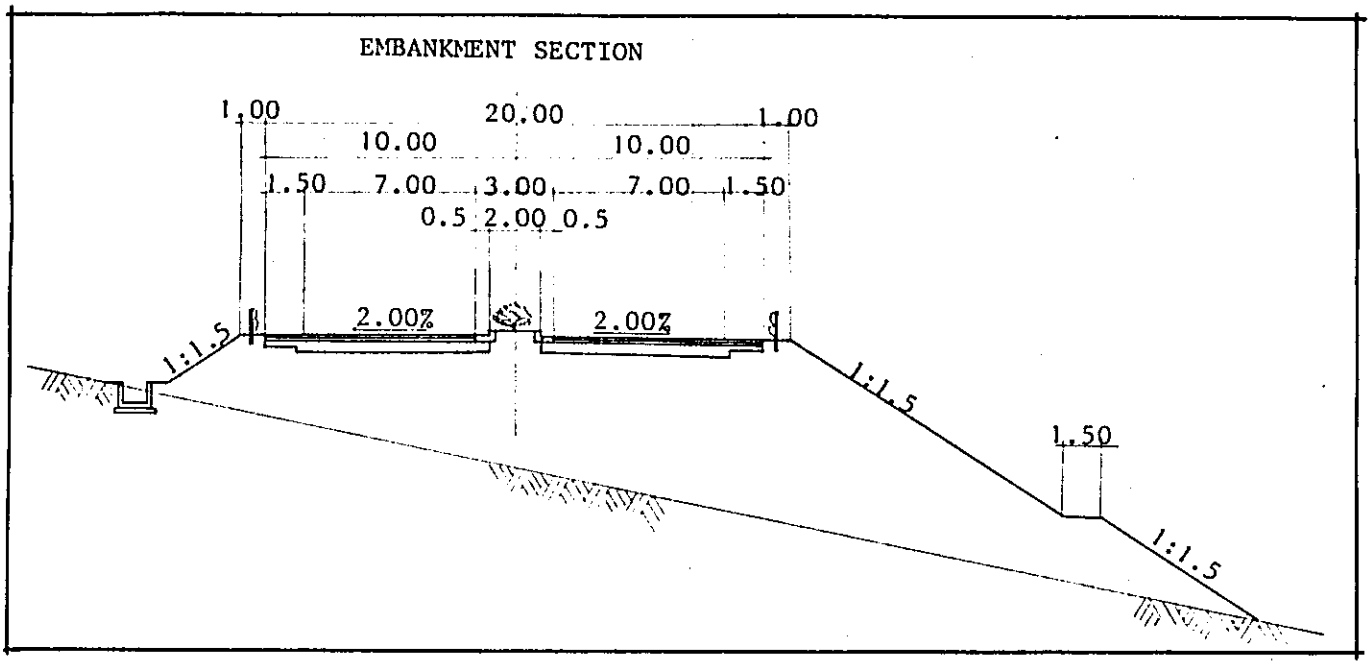


MITIGATION MEASURE

1. Buffer space : Service road reserve + building line
   = 13.00 + 6.00 = 19.00m
2. Landscape :
   (1) Road side tree in service road reserve
   (2) Hedges for property limits
   (3) Planting in median
   (4) Pedestrian side walk
   (5) Telephone boots, postage stand, etc.
   (6) Sign boards control
3. Safety Facilities
   (1) Lighting
   (2) Pedestrian crossing with signal at major intersection.
   (3) Traffic sign boards control
   (4) Design for the handicaped

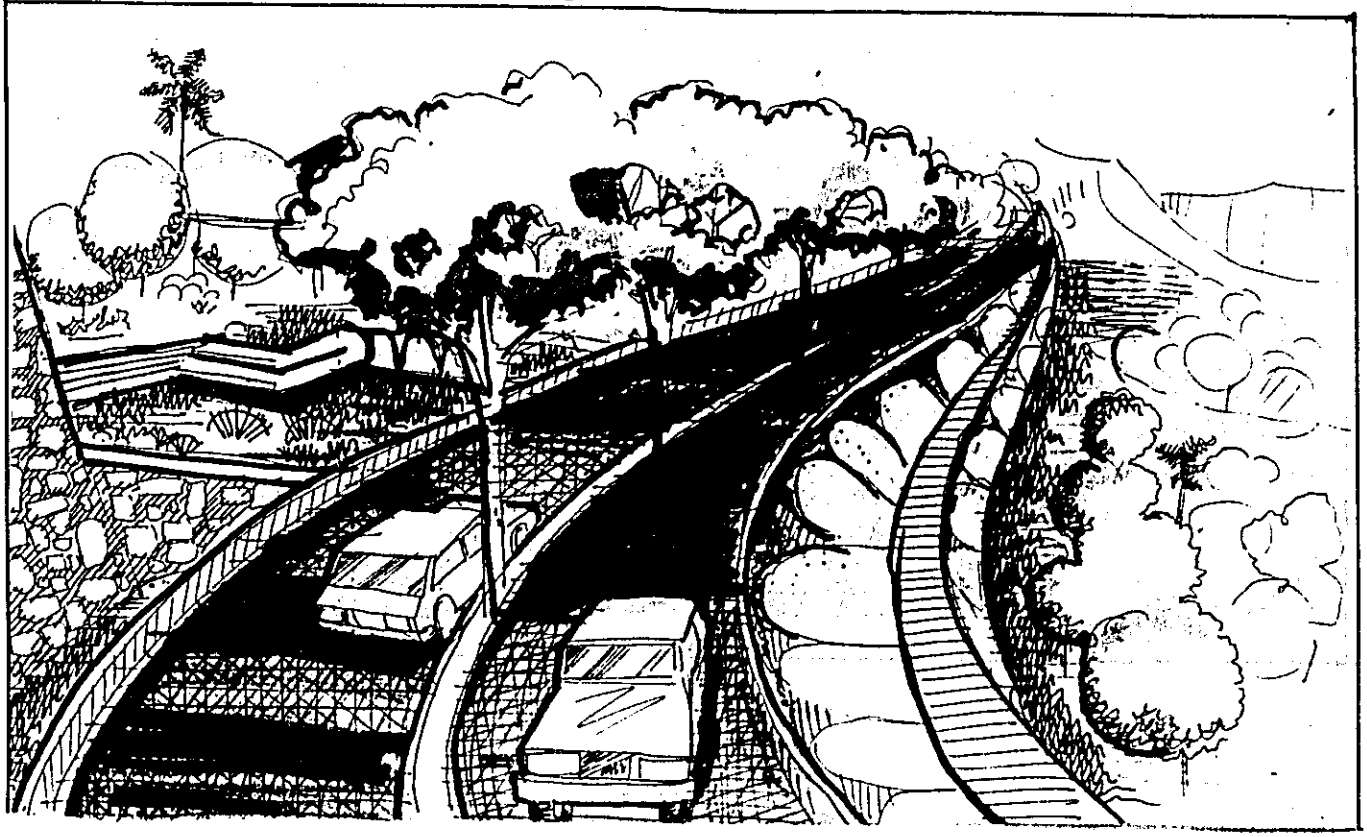


SECTION C



MITIGATION MEASURE

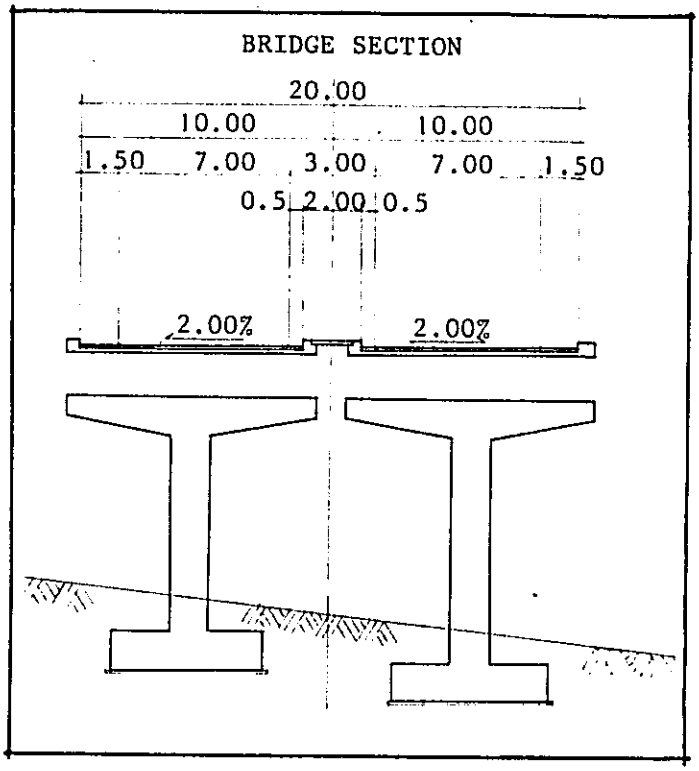
1. Landscape :
   (1) Turfing and local material for the embankment
   (2) Planting on road shoulder and median
   (3) Planting on the step of embankment
   (4) Design of panolamic view spots with paragola, etc.
2. Safety Facilities :
   (1) Lighting
   (2) Guard Rail
   (3) Parking spots
   (4) Traffic sign boards control

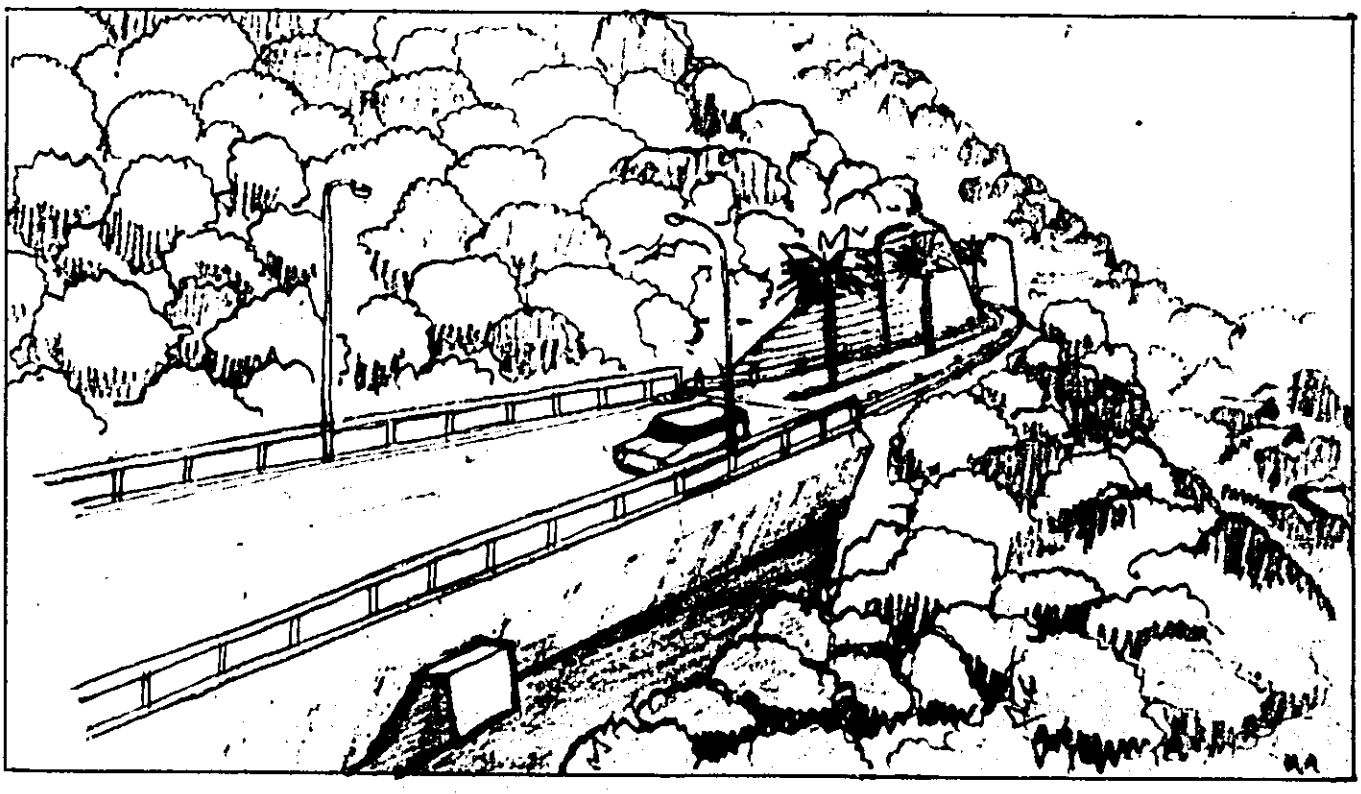


SECTION D

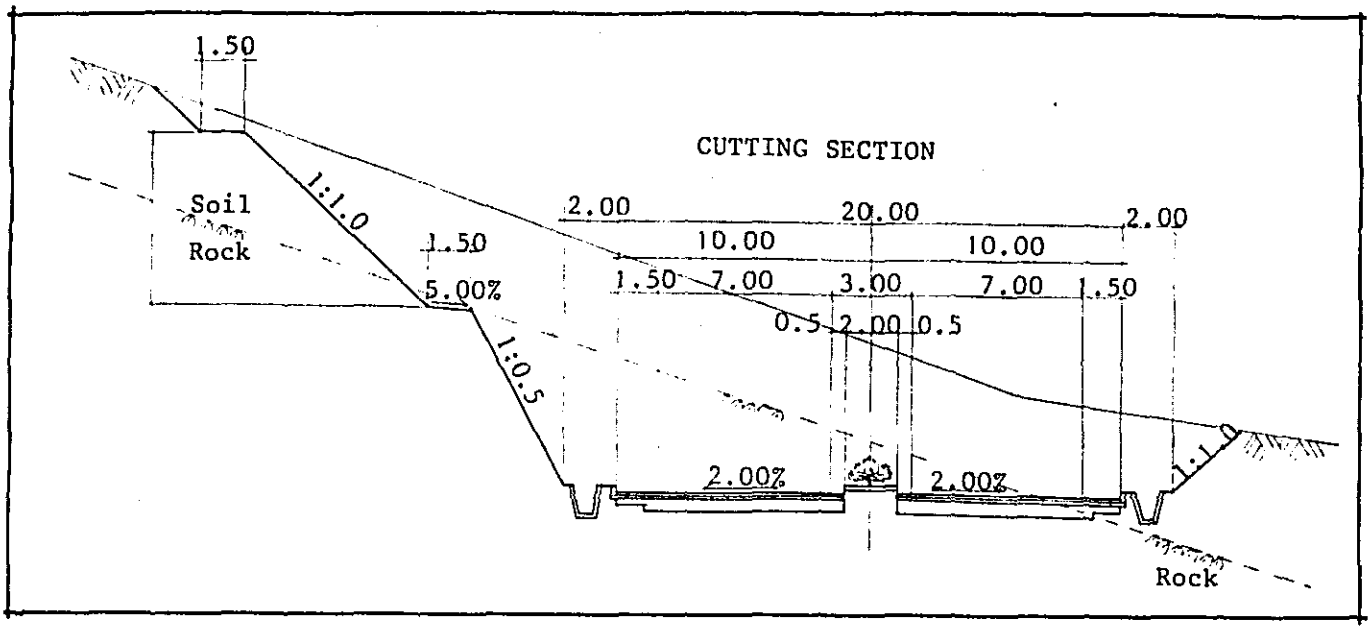
MITIGATION MEASURE

1. Landscape
   (1) Design of the bridge
   (2) Planting below bridge
   (3) Planting on median
2. Safety Facilities
   (1) Lighting
   (2) Guard Rail
   (3) Traffic Sign Control





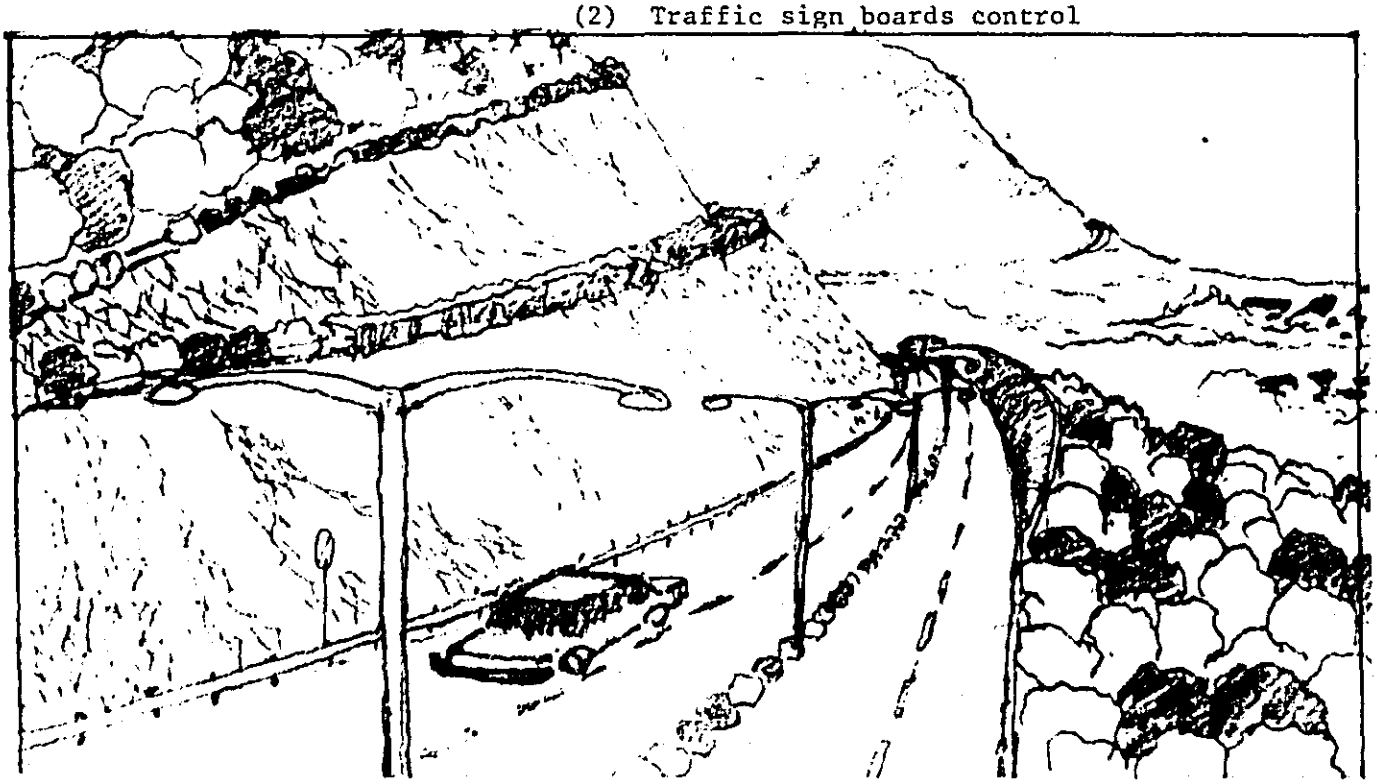
SECTION E



MITIGATION MEASURE

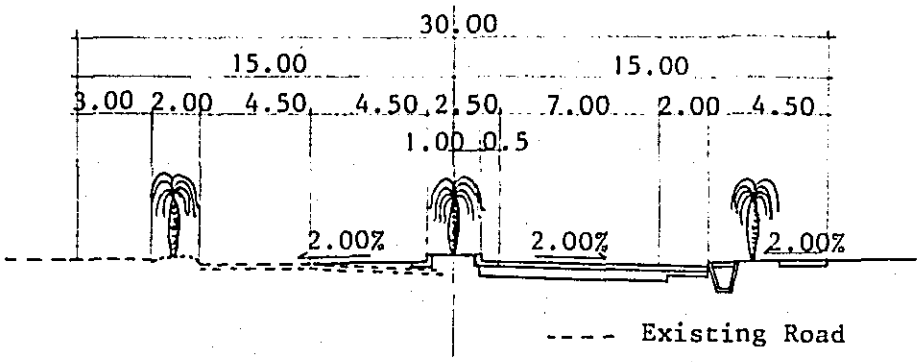
1. Landscaping
   (1) Planting on the median
   (2) Planting on the steps of cutting surface
   (3) Cover cutting surface by creepers
   (4) Road side planting

2. Safety Facilities
   (1) Lighting
   (2) Traffic sign boards control



SECTION F

IMPROVEMENT OF EXISTING JALAN GOTTLIEB & BAGAN JERMAL

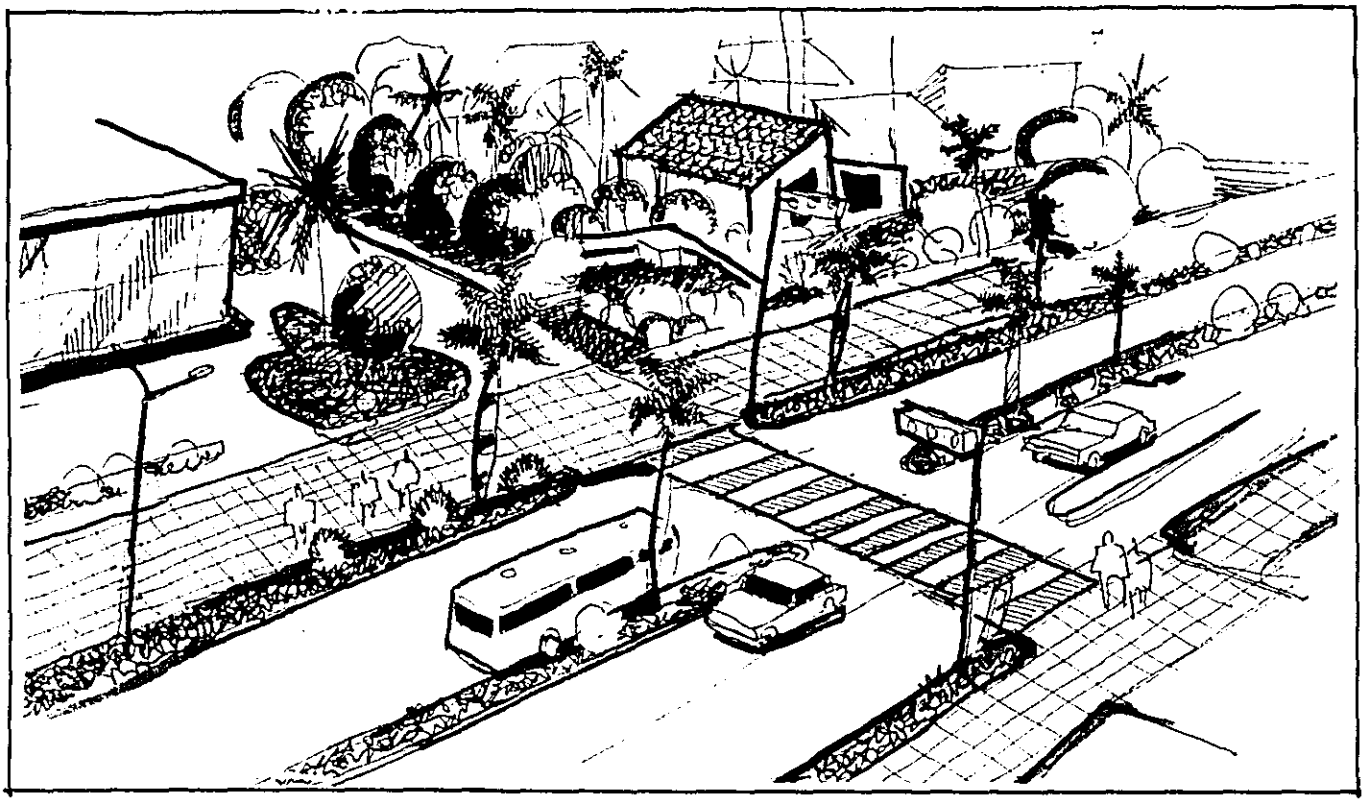


MITIGATION MEASURE

1. Buffer Space : Planting zone + pedestrian side walk + building line;
   (2.00 + 3.00 + 6.00 = 11.00m)
   (4.50 + 6.00 = 10.50m)

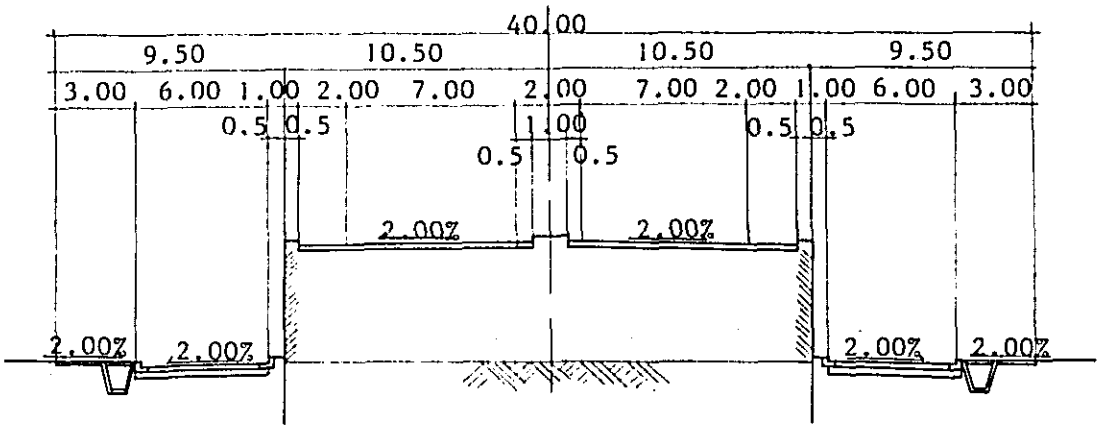
2. Landscaping :
   (1) 3 lanes of road side trees (Royal palm tree)
   (2) Hedges for property limits.
   (3) Pedestrian side walk
   (4) Telephone boots, postage stand, etc.
   (5) Sign boards control
   (6) Small pocket park

3. Safety Facilities :
   (1) Lighting control
   (2) Pedestrian crossing with signal at major intersection
   (3) Design for handicaped.



SECTION G

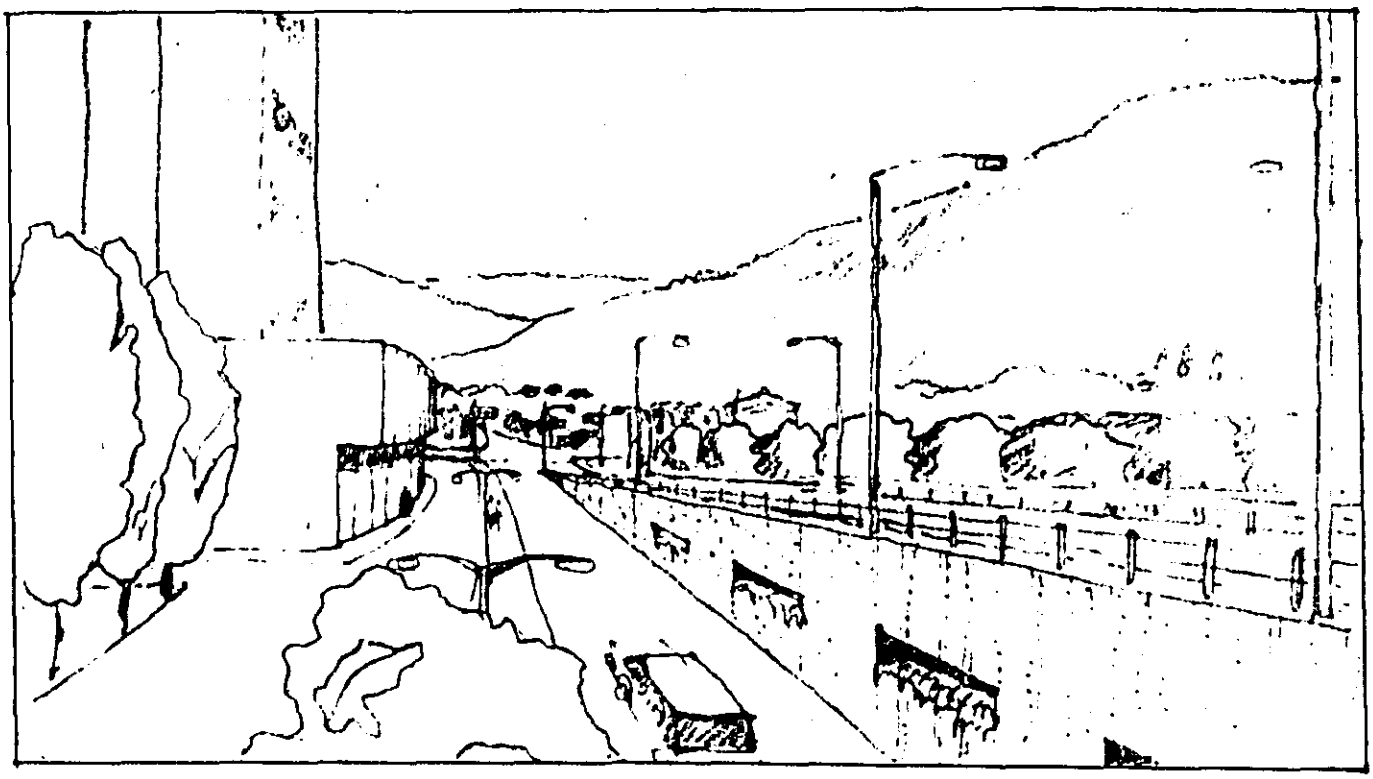
GRADE SEPARATION SECTION



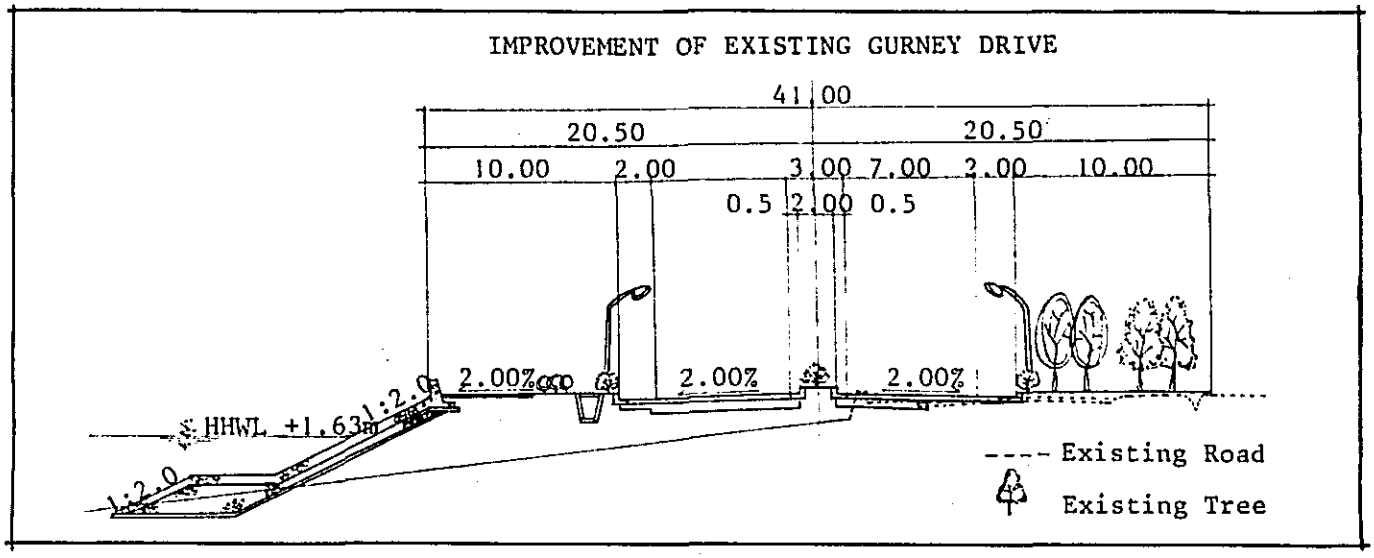
MITIGATION MEASURE

1. Landscape
   (1) Design of retaining wall

2. Safety Facilities
   (1) Lighting
   (2) Guard Rail
   (3) Traffic Sign Control



SECTION H

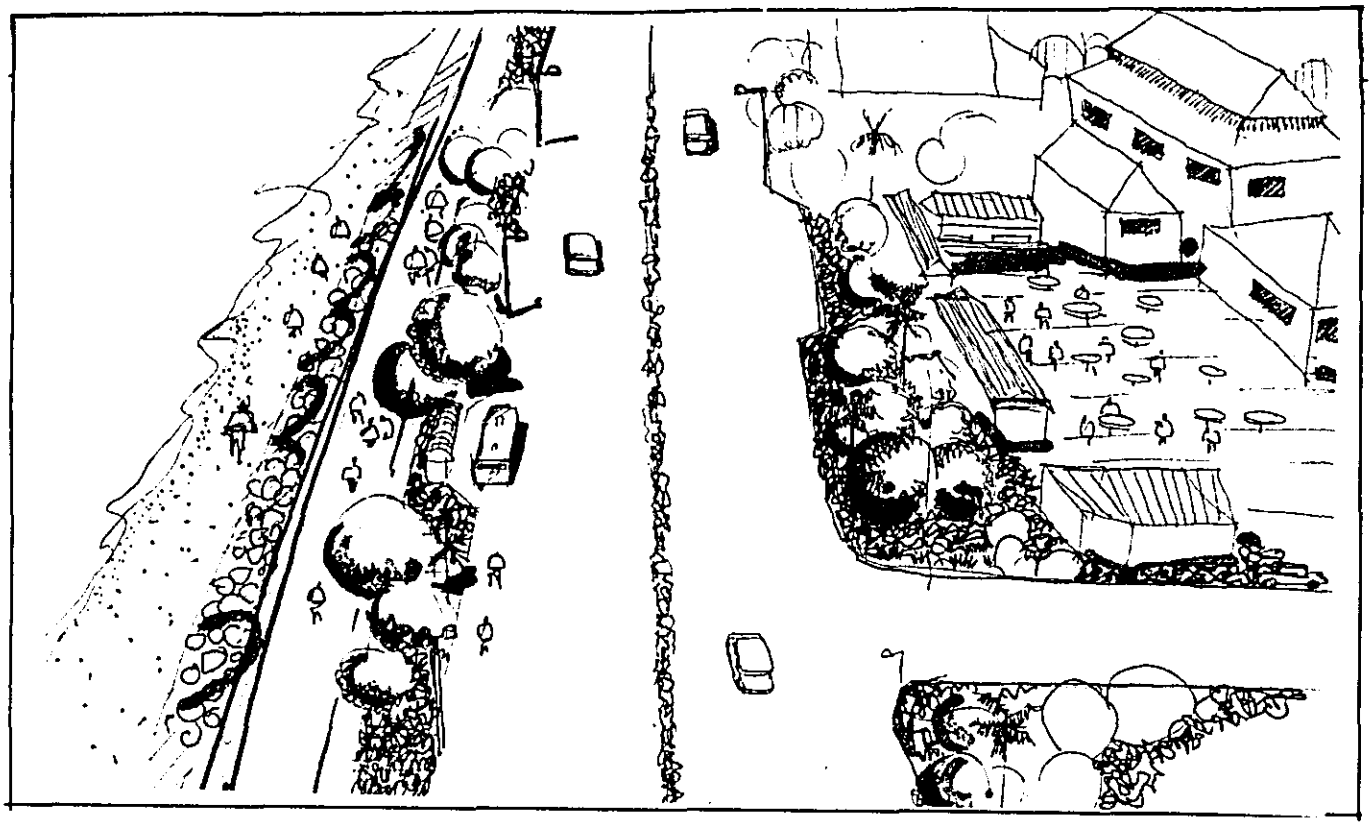


MITIGATION MEASURE

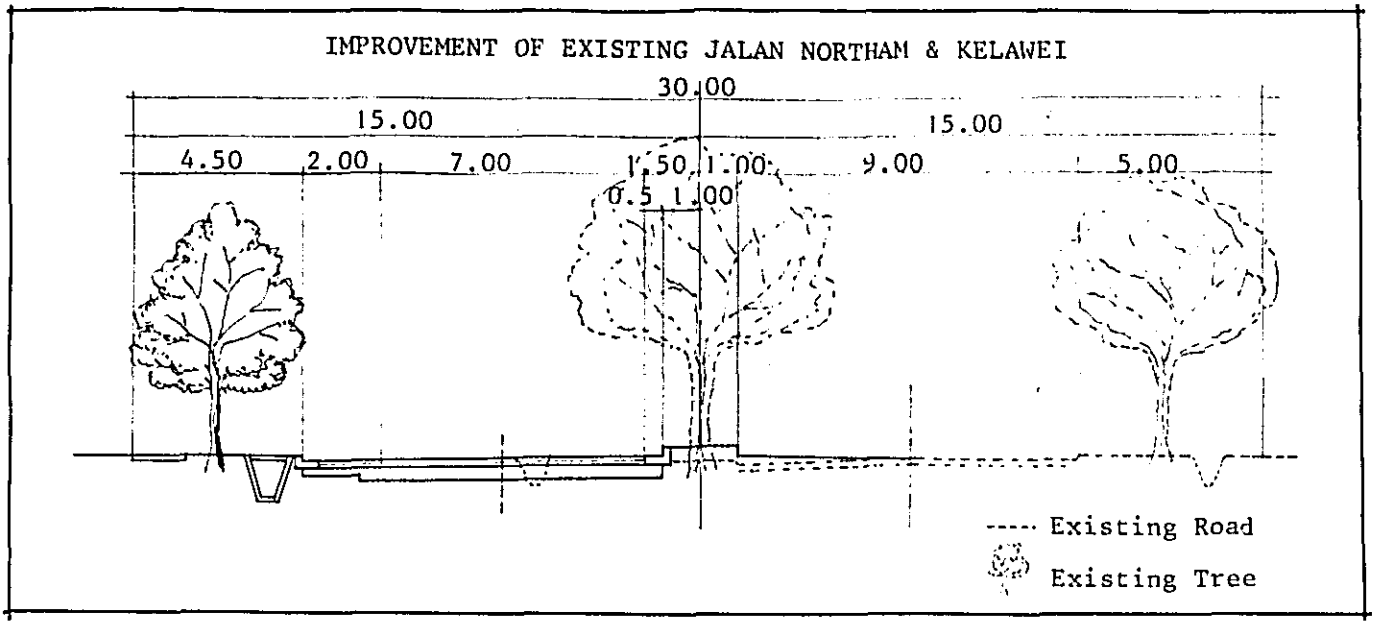
1. Buffer Space — Green Belt + Building Line
   10.00m _ 6.00 = _ 16.00m

2. Landscaping
   (1) Planting road side tree
   (2) Hedges for property limits
   (3) Planting in median
   (4) Pedestrian prominade along seashore
   (5) Parking bays / Bas bays
   (6) Small pocket park
   (7) Telephone boots, postage stands and other street furnitures
   (8) Sign board control

3. Safety Facilities
   (1) Lighting
   (2) Pedestrian crossing with signal
   (3) Design for the handicaped
   (4) Police bos or rescue station
   (5) Traffic sign board control



SECTION I



MITIGATION MEASURE

1. Buffer Space

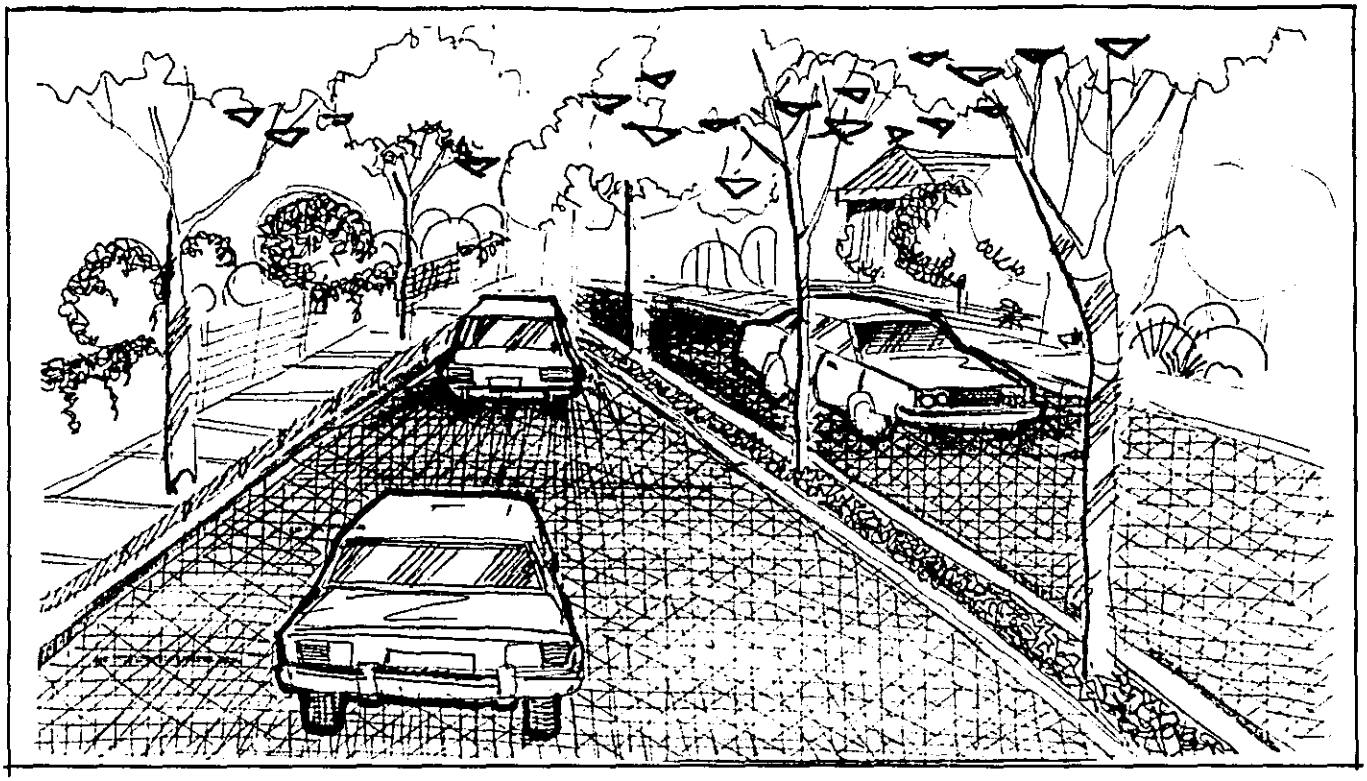
Side walk + Building Line
4.50 -5.00 + 6.00 = 10.50 - 11.00m

2. Landscaping

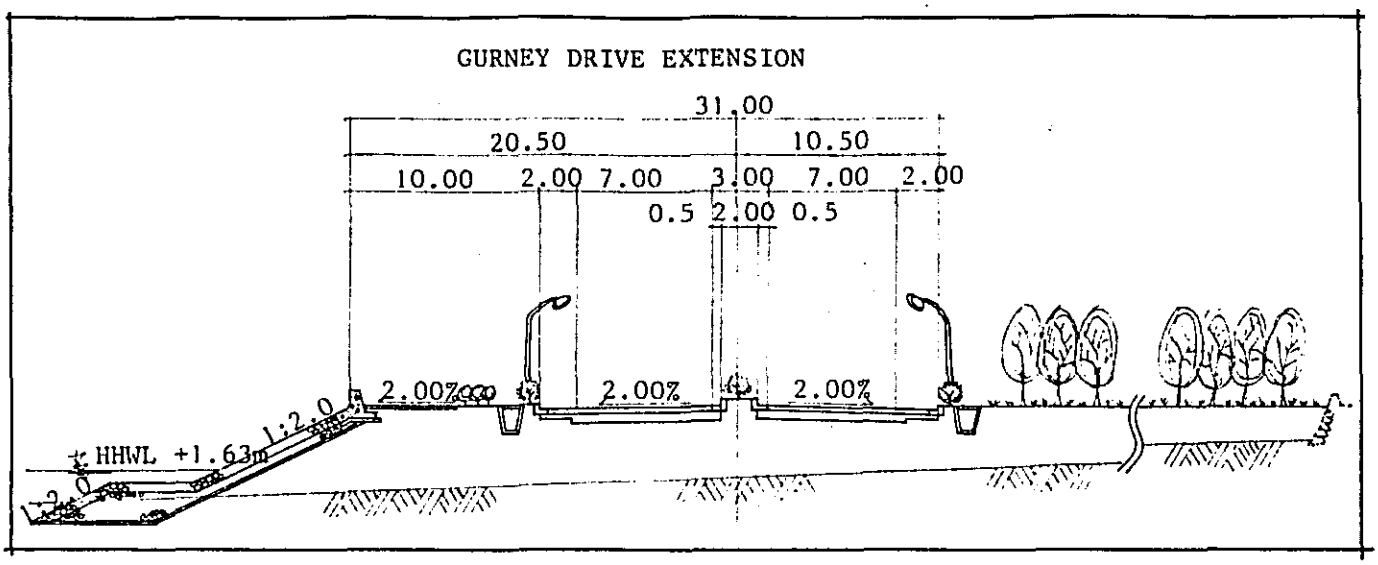
(1) Planting road side trees
2 lanes : Existing
1 lane : Newly planned
(2) Promoting hedges for property limits
(3) Pedestrian side walk
(4) Telephone boots, postage stands, bus bay etc.
(5) Sign board control

3. Safety Facilities

(1) Street Lighting
(2) Pedestrian crossing with signal at major intersection
(3) Design for the handicaped
(4) Traffic sign boards control



SECTION J



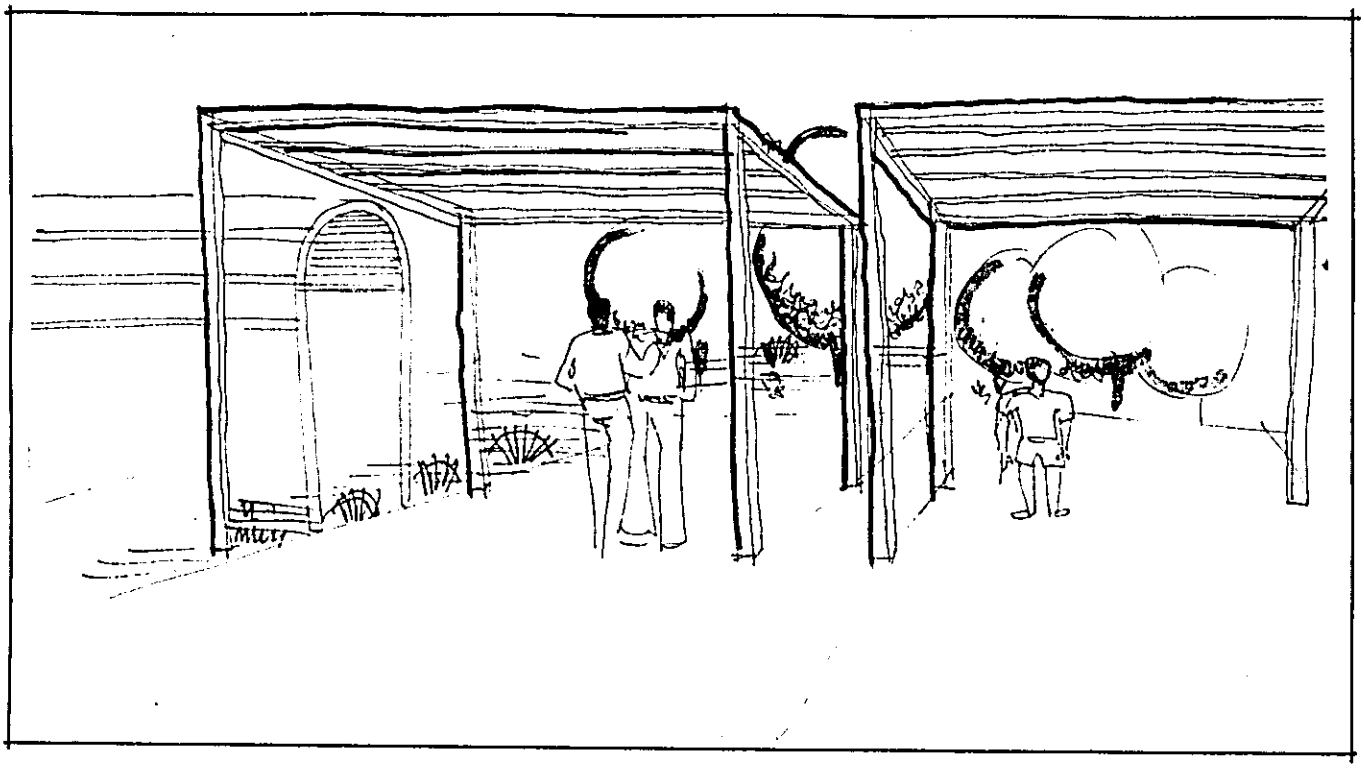
MITIGATION MEASURE

1. Buffer Space — Green Belt + Building Line

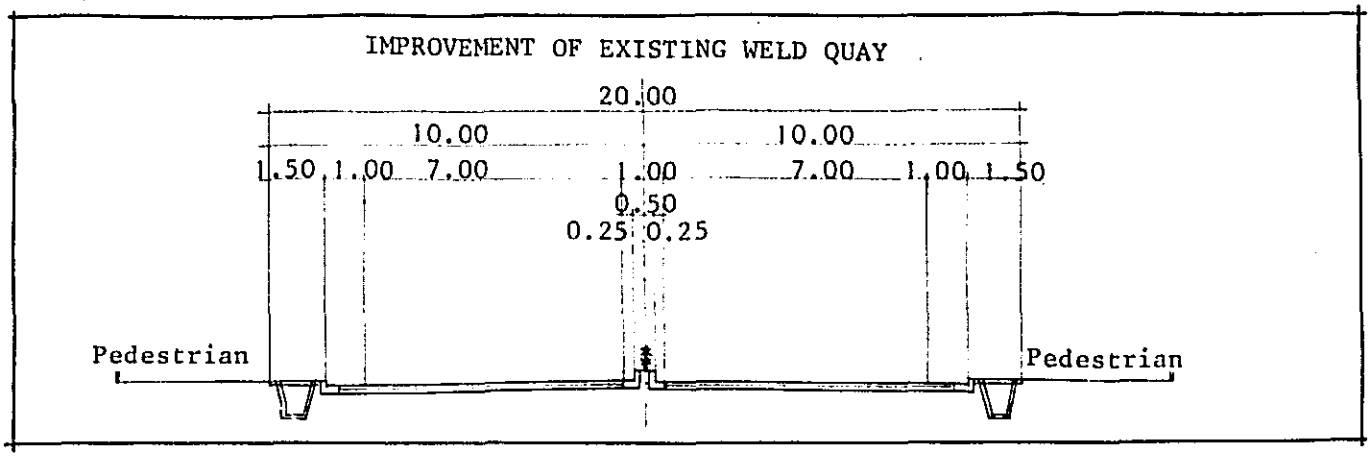
   40.00 -60.00m + 6.00 = 46.00 - 66.00m

2. Landscaping
   - (1) Vegitation in Green Belt
   - (2) Design of park and recreation
   - (3) Pedestrian promnade along seashore
   - (4) Parking bays / Bus bays
   - (5) Telephone boots, postage stands and other street furniture
   - (8) Sign board control
   - (9) Promoting hedges for property limits

3. Safety Facilities
   - (1) Lighting
   - (2) Pedestrian crossing with signal / bridge and zebra zone
   - (3) Design for the handicaped
   - (4) Police box or rescue station
   - (5) Traffic sign board control



SECTION K



MITIGATION MEASURE

1.	Landscaping	(1) Control the space use of the five foot way
		(2) Design of pocket park
		(3) Building design control
		(4) Control advertising boards
		(5) Design of street furniture
2.	Safety Facilities	(1) Lighting
		(2) Pedestrian crossing with signal/bridge & zebra zone
		(3) Design for the handicaped
		(4) Police box or rescue station
		(5) Traffic sign board control