APPENDIX L.

ECONOMIC EVALUATION FOR URGENT FLOOD MITIGATION PROJECT

1. GENERAL

The technical aspects of the urgent flood mitigation project have been discussed in the previous papers. Construction time schedule and financial cost have been presented as well.

It is therefore possible here to conduct an economic evaluation to examine investment efficiency of the urgent flood mitigation project and then to allow for variation in cost and benefit assumption by use of sensitivity analysis.

Economic evaluation consists of three (3) major components, which are;

- Estimation of benefits (reduction of flood damage potential)
- Estimation of economic costs for the project, and
- Economic analysis

2. PROJECT BENEFITS

2.1 Benefits of Flood Mitigation Project

Benefits of a flood mitigation project is defined as difference of flood damage potential between the case of "with the project" and "without the project". This is equivalent to the magnitude of reduction in flood damage and can be calculated quantitatively based on the results described in the Appendix G.

Besides this damage reduction benefit, although not estimate in monetary terms in this report, a flood mitigation project generates the benefits as listed below:

i) Enhancement of land use

ii) Improvement of sanitary condition

iii) Multiplier effects of public investment

2.2 Estimation of Project Benefits

There are two steps in the estimation process; annual damage reduction by flood frequency for the feasibility study area, and average annual damage reduction.

First, annual damage reduction is measured. In Appendix G, damage potential for each cell of grid is calculated by return period. Total annual damage potential in the feasibility study area is obtained through summing up the cells of grid located in the area (upperstream from the Sulaiman Bridge) as shown below:

ANNUAL FLOOD DAMAGE POTENTIAL IN THE STUDY AREA

(1000M$, 1988 price)

Year	1988			2005		
Return period	10-yr	30-yr	50-yr	10-yr	30-yr	50-yr
• General property damage	153,859	211,770	222,573	201,784	282,143	297,943
• Public property damage	46,157	63,530	66,772	60,535	84,644	89,383
• Indirect damage	8,998	12,284	12,760	11,894	16,429	17,144
Total	209,014	287,584	302,105	274,213	383,216	404,470

In economic evaluation, all outputs (benefits), as well as inputs, should be expressed in terms of Accounting Prices. Since above mentioned flood damages are estimated at market prices, these figures are converted to economic benefits through multiplying the following Conversion Factors:

	Conversion Factor*	
General property damage	0.97	} (for all tradeable goods)
Public property damage	0.97	
Indirect damage	0.80	(for non-tradeable goods)

*; Source: "National Parameters for Project Appraisal in Malaysia, Volume I" Government of Malaysia, January 1986

The re-evaluated annual flood damages are given below.

	10-year	30-year	50-year
1988	201,213	276,868	290,873
2005	263,964	368,927	389,422

(in 1,000M$)

Secondly, average annual damage reduction is calculated. Annual damage in the year 1988 and 2005 by flood probability is weighted by frequency of flood and their aggregation up to the design flood frequency makes the average annual damage reduction.

Calculation function is as follows;

$$D = \sum [(N_{m-1} - N_m) \times (L_{m-1} + L_m)/2]$$

where
- D : average annual damage
- N_m : excess probability for discharge level m
- L_m : amount of probable flood damage at applicable discharge level m
- m : ordinal number for discharge level corresponding to return period

In estimating the reduction of average annual damage for the feasibility study area, 35-year return period is adopted as an maximum frequency up to which annual damage is accumulated because this return period (flood frequency) is corresponding to the design frequency of this urgent flood mitigation project. The annual damage potential for

35-year return period is obtained by interpolation between 30-year and 50-year return period.

Calculation is done as follows:

$$D_{1988} = (1/5 - 1/10) \times (0 + 201,213)/2 + (1/10 - 1/30) \times (201,213 + 276,868)/2 + (1/30 - 1/35) \times (276,868 + 280,369)/2 = 27,191 \text{ (1000M\$)}$$

$$D_{2005} = (1/5 - 1/10) \times (0 + 263,964)/2 + (1/10 - 1/30) \times (263,964 + 368,927)/2 + (1/30 - 1/35) \times (368,927 + 374,051)/2 = 35,886 \text{ (1000M\$)}$$

Benefit of the project is assumed to increase exponentially between the year 1988 and 2005, and keep constant after the year 2005.

Flow of the average annual damage reduction at the selected years are shown together with the annual benefit of drainage plan in Kampung Baru area as follows:

(1000M$, 1988 price)

Items	1988	1995	1996	2005
Average Annual Damage Potential	27,191	30,481	30,983	35,886
Benefit of Drainage Plan in Kampung Baru Area			1,747	1,913
Total			32,730	37,799

3. ESTIMATION OF ECONOMIC COSTS

3.1 Conversion Factors

Project costs at 1988 market prices are shown in Appendix K. In economic evaluation, Accounting Prices or shadow prices are used to replace market prices because the latter fail to represent adequately scarcities of certain resources (e.g. foreign exchange) or surpluses of other resources. Market prices also, as it well known, will include indirect taxes or hidden subsidies, which are transfer payments and not resource costs.

A Conversion Factor to convert a Market Price (MPs) into a Accounting Price (AP) is shown by the following equation.

$$\text{Conversion Factor} = AP/MP$$

Conversion factors of every cost item are selected from "National Parameters for Project Appraisal in Malaysia, 1986" and presented as below:

Cost Item	Conversion Factor
Direct Construction Cost	0.91
Land Acquisition & Compensation	0.88
Government Administration	0.82
Contingency	0.88

3.2 Economic Construction Costs

Construction costs at market price distributed according to the disbursement schedule, are multiplied by the conversion factors listed above. And economic costs are gained. Distribution flow of economic costs is shown Table L-1.

Consequently, economic construction cost is estimated at 176.33 (million M$) which is about 90% of construction cost at market price.

3.3 Operation, Maintenance and Replacement Costs

The annual operation and maintenance cost is assumed at 1,763 (1000M$) which is 1.0% of the total economic construction cost, and enrollment is expected to start from the first year after the completion of construction works.

As for the replacement cost, facilities such as gates, pumping equipments, stop logs and trash racks are assumed to be replaced by new ones at the same prices as the present level every 15 years after completion of construction. Total replacement cost is equivalent to 3,308 (1000M$).

4. ECONOMIC EVALUATION

4.1 Assumptions

The assumptions used in this evaluation are;

i) The benefit increases exponentially between 1988 to 2005. Beyond the year 2005, it is assumed constant.

ii) The benefit is assumed to be realized from the year 1997 as the Retention Pond and the Diversion Channel is planned to be completed in 1996.

iii) Evaluation period is set at 50 years.

iv) The residual value of the equipments and facilities are not reckoned in this evaluation.

v) Opportunity cost of capital is set at 13.0%.
(Source; National Parameters for Project Appraisal in Malaysia, 1986)

4.2 Results of Economic Evaluation

Total cash flow of economic costs and benefits are summarized in Table L-2. Results of the economic evaluation is shown in Table L-3.

Three indicators prove the high validity of the project in terms of investment efficiency.

Economic Internal Rate of Return (E.I.R.R) is 15.7%, enough high compared with the opportunity cost of capital in Malaysia (=13.0%). B/C (=1.24) shows simple comparison of size of benefit and cost, and shows sufficient level to justify the project. Magnitude of Net Present Value (N.P.V) of the project reaches 32.576 million M$, and shows enough amount of net return.

4.3 Sensitivity Analysis

Sensitivity test is carried out under the various assumptions by changing the original cost and benefit.

Results are summarized in Table L-4.

These results show that the project is economically feasible even if the cost goes up by 20% or the benefit comes down by 10%.

4.4 Privatization of the Batu Retention Pond

Among the urgent flood mitigation works, the multipurpose Batu Retention Pond is very attractive for private sector participation, hence private funds, for the construction and subsequent operation and maintenance of the pond facilities. This is because the pond area and the surrounding park area is planned to include open door sports and other recreational facilities having revenue generating potential.

A similar case of such a private sector participation in the Tone River Basin in Japan is described below for illustrative purpose.

Watarase Retarding Basin, Japan

The Watarase Retarding Basin is located at 60 km from Tokyo in the middle reaches of the Tone River. This retarding basin with a total area of 3,300 ha is planned, in addition to flood mitigation and water supply, as an area with various recreational facilities in harmony with natural environmental conservation facilities. Accordingly, the planned facilities of this project, named "Watarase Retarding Basin Acclimation Plan", will consist of eight (8) sub-divided zones, such as grass-lands, preservation of historic spot, children place, multi-purpose water-front, lake, nature observation, sports, and camping zones. These zonal separation of the facilities are illustrated, diagramatically, in Fig. L-1. Of these planned facilities the lake zone, basic facilities of flood mitigation, is already completed. For the implementation of the rest of these facilities, the Watarase Retarding Basin Acclimation Promotion Foundation is instituted.

Watarase Retarding Basin Acclimation Promotion Foundation

This Promotion Foundation is instituted to conduct the necessary studies and investigations for identifying the most appropriate and effective use of the river reserve of this retarding basin and to improve the riverine environmental condition. The other responsibilities of the foundation include, securing the necessary finance from the concerned organizations including private sector for the implementation of the project facilities and to be the central organization responsible for the subsequent operation and maintenance of the facilities. The private finance for the project is expected to be obtained from a loan by NTT (Nippon Telegraph and Telephone Corporation) and other private organizations.

5. SOCIAL IMPACT

The major social impacts of the project are as follows:

i) Land use of the flood prone area will be enhanced. The estimated flood prone area in the case of 35-year return period is 1,150 ha (in the feasibility study area).

ii) Environment of people's public health and amenities will be improved. The beneficial people in 2005 is estimated to be 107,000 persons (35-year return period).

Table L-1 CALCULATION OF ECONOMIC COSTS

PHASE -1

(Unit : Million M$, 1988 price)

	1990		1991		1992		1993		1994		1995		Total
COST AT MARKET PRICE	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
(1) Direct Cost													
- River Improvement	-	-	2.00	2.59	2.30	3.01	2.47	3.03	4.72	5.63	3.37	5.13	34.25
- Retention Pond	-	-	3.10	9.30	2.40	7.19	2.07	5.89	-	-	-	-	29.95
- Diversion Channel	-	-	0.20	0.85	0.90	3.59	1.20	4.86	1.50	4.70	-	-	17.80
- Drainage Plan	-	-	-	-	-	-	-	-	1.10	1.67	2.20	3.28	8.25
Sub total of (1)	0	0	5.30	12.74	5.60	13.79	5.74	13.78	7.32	12.00	5.57	8.41	
	0		18.04		19.39		19.52		19.32		13.98		90.25
(2) Land Acquisition	-	8.59	-	14.08	-	13.41	-	13.03	-	13.03	-	-	62.14
(3) Government Administration	-	-	-	1.08	-	0.88	-	0.88	-	0.88	-	0.70	4.42
(4) Engineering Service	-	-	1.08	-	0.88	-	0.88	-	0.88	-	0.70	-	4.42
(5) Contingency	-	-	1.20	4.80	1.20	4.80	1.30	5.20	1.36	5.44	1.32	5.26	31.88
Sub total of (2) - (5)	0	8.59	2.28	19.96	2.08	19.09	2.18	19.11	2.24	19.35	2.02	5.96	
	8.59		22.24		21.17		21.29		21.59		7.98		102.86
Grand total	0	8.59	7.58	32.70	7.68	32.88	7.92	32.89	9.56	31.35	7.59	14.37	
	8.59		40.28		40.56		40.81		40.91		21.96		193.11
ECONOMIC COST													
(1) Direct Improvement													
- River Improvement	-	-	2.00	2.36	2.30	2.74	2.47	2.76	4.72	5.12	3.37	4.67	32.51
- Retention Pond	-	-	3.10	8.46	2.40	6.54	2.07	5.36	-	-	-	-	27.93
- Diversion Channel	-	-	0.20	0.77	0.90	3.27	1.20	4.42	1.50	4.28	-	-	16.54
- Drainage Plan	-	-	-	-	-	-	-	-	1.10	1.52	2.20	2.98	7.80
Sub total of (1)	0	0	5.30	11.59	5.60	12.55	5.74	12.54	7.32	10.92	5.57	7.65	
	0		16.89		18.15		18.28		18.24		13.22		84.78
(2) Land Acquisition	-	7.56	-	12.39	-	11.80	-	11.47	-	11.47	-	-	54.69
(3) Government Administration	-	-	-	0.89	-	0.72	-	0.72	-	0.72	-	0.57	3.62
(4) Engineering Service	-	-	1.08	-	0.88	-	0.88	-	0.88	-	0.70	-	4.42
(5) Contingency	-	-	1.20	4.22	1.20	4.22	1.30	4.58	1.36	4.79	1.32	4.63	28.82
Sub total of (2) - (5)	0	7.56	2.28	17.50	2.08	16.74	2.18	16.77	2.24	16.98	2.02	5.20	
	7.56		19.78		18.82		18.95		19.22		7.22		91.55
Grand total	0	7.56	7.58	29.09	7.68	29.29	7.92	29.31	9.56	27.90	7.59	12.85	
	7.56		36.67		36.97		37.23		37.46		20.44		176.33

Table L-2 FLOWS OF ECONOMIC COSTS AND BENEFITS FOR URGENT PROJECT

(Unit : 1000 M$)

	Year	Economic Construction Costs	Operation & Maintenance Costs	Replacement Costs	Total Economic Costs	Economic Benefits
1	1992	7,560			7,560	
2	1993	36,670			36,670	
3	1994	36,970			36,970	
4	1995	37,220			37,220	
5	1996	37,460			37,460	
6	1997	20,440			20,440	33,258
7	1998		1,763		1,763	33,795
8	1999		1,763		1,763	34,340
9	2000		1,763		1,763	34,895
10	2001		1,763		1,763	35,457
11	2002		1,763		1,763	36,029
12	2003		1,763		1,763	36,609
13	2004		1,763		1,763	37,200
14	2005		1,763		1,763	37,799
15	2006		1,763		1,763	37,799
16	2007		1,763		1,763	37,799
17	2008		1,763		1,763	37,799
18	2009		1,763		1,763	37,799
19	2010		1,763		1,763	37,799
20	2011		1,763		1,763	37,799
21	2012		1,763		1,763	37,799
22	2013		1,763		1,763	37,799
23	2014		1,763		1,763	37,799
24	2015		1,763		1,763	37,799
25	2016		1,763		1,763	37,799
26	2017		1,763	3,308	5,071	37,799
27	2018		1,763		1,763	37,799
28	2019		1,763		1,763	37,799
29	2020		1,763		1,763	37,799
30	2021		1,763		1,763	37,799
31	2022		1,763		1,763	37,799
32	2023		1,763		1,763	37,799
33	2024		1,763		1,763	37,799
34	2025		1,763		1,763	37,799
35	2026		1,763		1,763	37,799
36	2027		1,763		1,763	37,799
37	2028		1,763		1,763	37,799
38	2029		1,763		1,763	37,799
39	2030		1,763		1,763	37,799
40	2031		1,763		1,763	37,799
41	2032		1,763		1,763	37,799
42	2033		1,763		1,763	37,799
43	2034		1,763		1,763	37,799
44	2035		1,763		1,763	37,799
45	2036		1,763		1,763	37,799
46	2037		1,763	3,308	5,071	37,799
47	2038		1,763		1,763	37,799
48	2039		1,763		1,763	37,799
49	2040		1,763		1,763	37,799
50	2041		1,763		1,763	37,799

Table L-3 RESULTS OF ECONOMIC EVALUATION

Evaluation Indicator	
E.I.R.R. (%)	15.7%
B/C Ratio	1.24
Net Present Value (1000M$)	32,576

Table L-4 RESULTS OF SENSITIVITY ANALYSIS

	Assumption	E.I.R.R	B/C	N.P.V
1)	Original case	15.3 %	1.21	28,056 (1000M$)
2)	Cost: +10%	14.1	1.10	14,424
3)	Cost: +20%	13.1	1.01	791
4)	Benefit: -10%	14.0	1.09	11,618
5)	Benefit: -20%	12.6	0.97	-4,820
6)	Cost +10% & Benefit -10%	12.9	0.99	-2,014
7)	Cost +20% & Benefit -20%	10.7	0.80	-32,085

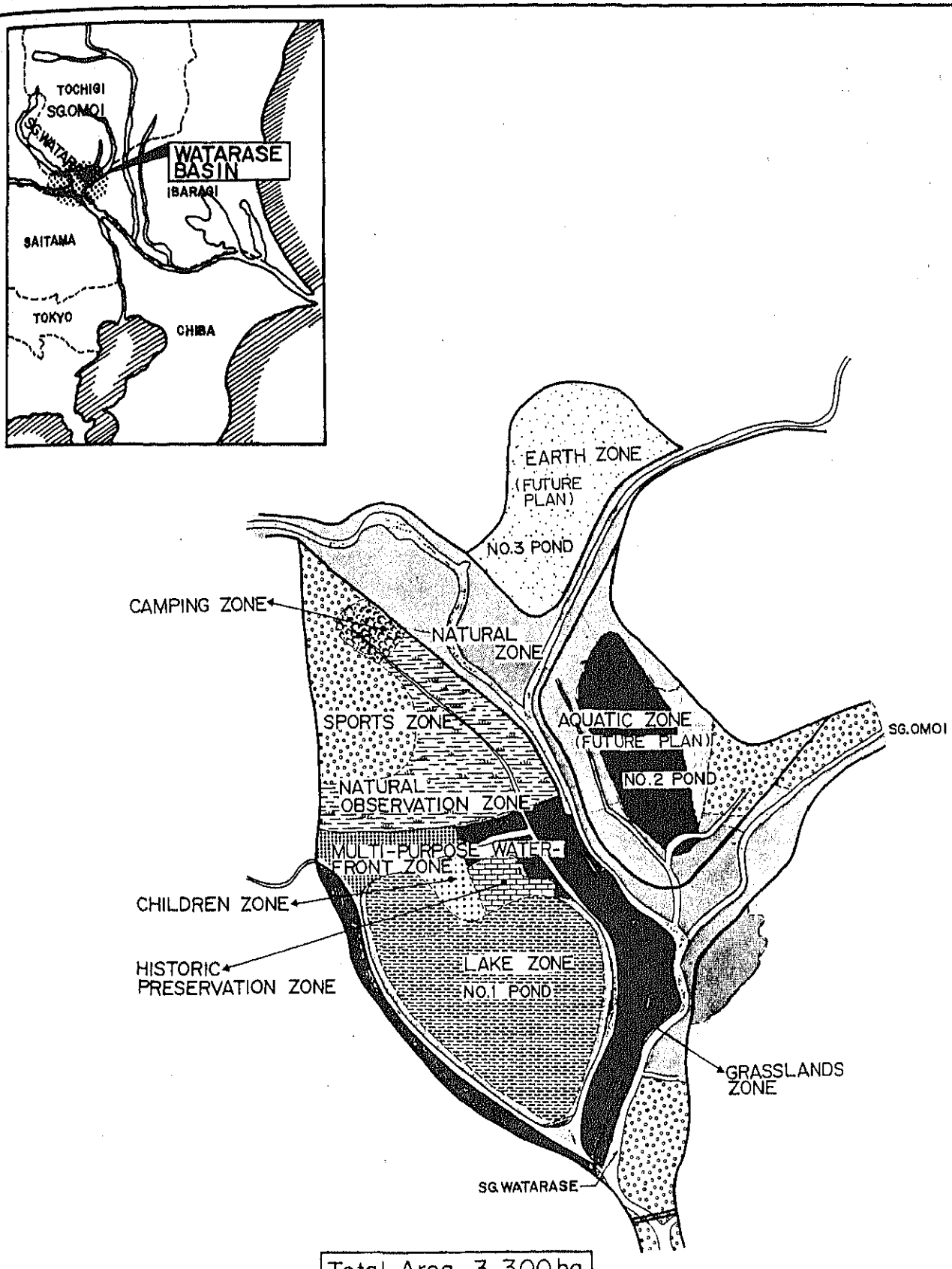


FIG. L-1 **WATARASE RETARDING BASIN ACCLIMATION PLAN - JAPAN**

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA

APPENDIX M: OPERATION AND MAINTENANCE PLAN FOR URGENT PROJECT

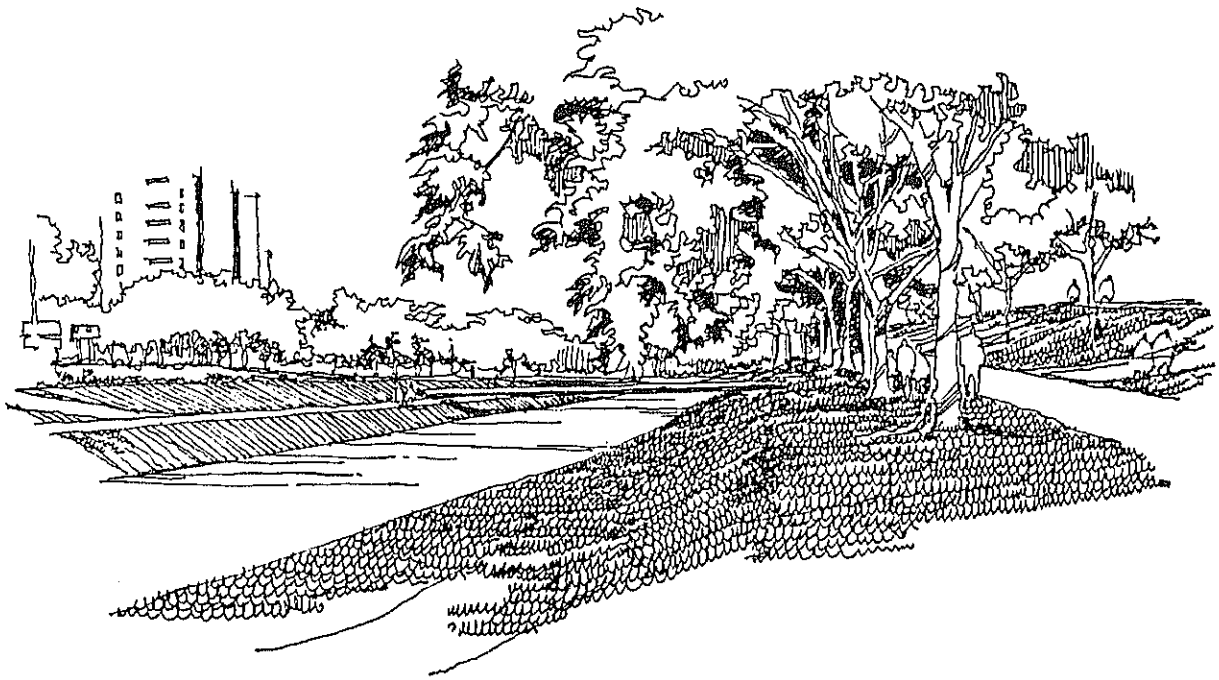


TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX M. OPERATION AND MAINTENANCE PLAN FOR URGENT PROJECT

1. REQUIRED OPERATION AND MAINTENANCE WORK

The activities of operation and maintenance (O/M) for the major flood control facilities are as follows:

(1) O&M of Klang Gates Dam and Batu Dam
(2) O&M of sluice gates in Kampung Baru Area
(3) O&M of tidal gates in the Klang town reaches
(4) Periodical dredging in the Klang River and its tributaries
(5) Periodical removal of floating debris by screening
(6) Clearing of river banks and leveling of maintenance road surface
(7) (O/M) of flood forecasting and warning system

These activities are conducted by several agencies such as DID, DID Selangor, City Hall, etc. However due to budget constraints and lack of coordination these flood control activities are still at rather an unsatisfactory level.

Also in the urgent project, the several new facilities for flood mitigation are to be constructed. They are the Batu Retention Pond, Gombak Diversion Channel, water gates, drainage sluice gates and pumping station. Hence in order to ensure the expected beneficial effects of both the existing and proposed flood mitigation facilities, the following O&M works are strongly recommended to be undertaken by the relevant agencies.

(1) O&M of the existing two dams
(2) O&M of water gate of the regulation pond in the Batu River
(3) O&M of maintenance sluice gate for maintaining an acceptable water quality in Batu retention pond.
(4) O&M of outlet gate in the Batu Retention Pond
(5) Periodical removal of flotable debris retained on the screens of the regulation pond

(6) Maintenance of temporary pond area and pond water surface of the Batu Retention Pond to ensure their intended service

(7) Periodical dredging of the Regulation Pond if necessary

(8) Clearing of river reserve of the Gombak Diversion Channel and the three rivers

(9) O&M of sluice gate and pumping station in Kampung Baru area

(10) Land use control, in cooperation with the agencies concerned, to maintain the existing ex-mining ponds as retention ponds along the selected tributaries

Operation and Maintenance of these flood control facilities require the provision of the following equipments.

(1)	Trucks for garbage transportation	:	2 nos.
(2)	Motor boats for pond inspection	:	2 nos.
(3)	Supervision vehicles	:	2 nos.

2. OPERATION AND MAINTENANCE OF GATES AND PUMPING STATION

(1) Pumping Station in Kampung Baru Area

The sluice gate at the end of trunk drainage is kept open under normal circumstances and shall be closed only when the water stage of the Klang River rises beyond an elevation of 28.2 m. This is necessary because the lowest ground level of Kampung Baru is about 0.5 m lower than the design high water level of the River.

After closing the gate, and when the water level in the underground pond has risen to a certain level the pump shall be operated to drain the inner water. Under normal circumstances the underground pond shall be kept empty to store the coming storm water. The garbage retained on the screen shall be removed periodically.
The gate and pump should be operated automatically.

(2) Batu Retention Pond

Under normal circumstances the water-gate at Batu river is set so as to allow a free passage of river discharge up to 20 m^3/s. Even when the discharge exceeds 20 m^3/s, under normal flooding conditions, due to the orifice action of the gate, the discharge at downstream will not exceed so much beyond 20 m^3/s. However, a portion of the excess discharge will then be stored in the Batu retention pond. Hence this pond will be useful under normal flooding conditions. In case of excess flooding, no water to be allowed for storage in the retention pond and the water-gate should be fully opened to allow a complete free passage of river discharge.

The release of water stored in the retention pond has to be regulated by taking into consideration the effect of any release of water from the Batu Dam at further upstream as well, so that the discharge in the river will not exceed the allowable design discharge of 40 m3/s.

The gates, which will be installed in the retention pond and in the Batu River, shall be operated automatically.

3. REQUIRED ORGANIZATION FOR CONSTRUCTION

The required organization for construction of the proposed urgent flood mitigation works is shown in Fig. M-1. Such an organization is recommended to be created by reorganizing the existing organizational structure of DID. In addition, as the retention pond is planned for multipurpose usage, this execution works are to be co-ordinated between DID and City Hall.

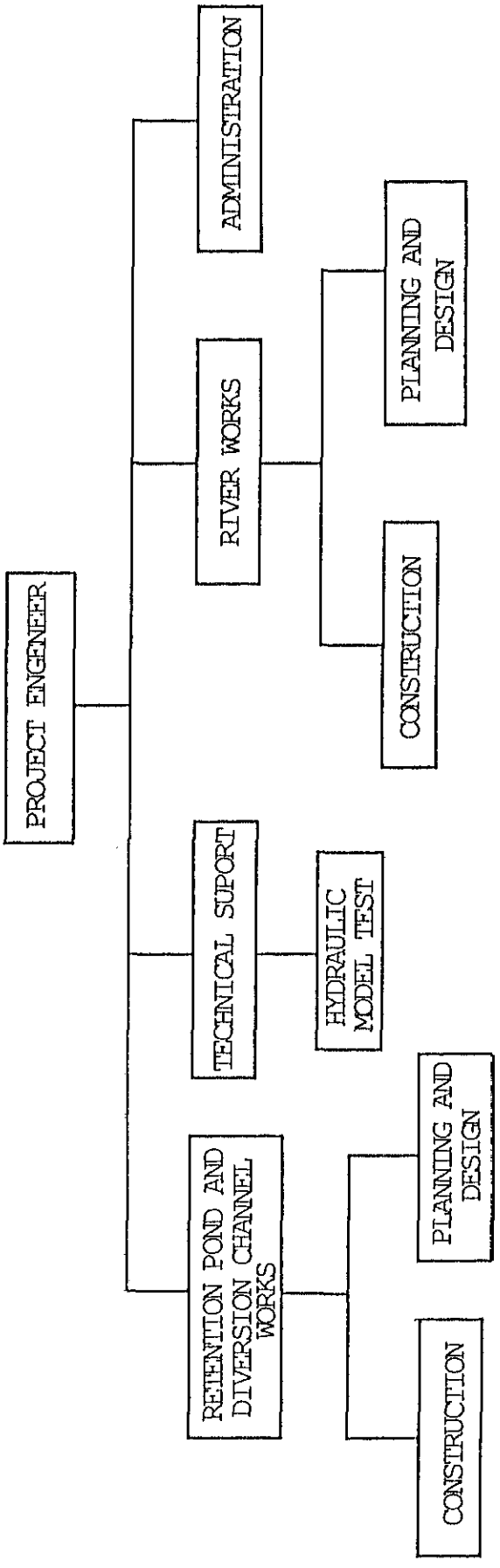


FIG. M-1 REQUIRED ORGANIZATION FOR PROPOSED URGENT PROJECT

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA

APPENDIX N: ENVIRONMENTAL ASPECT

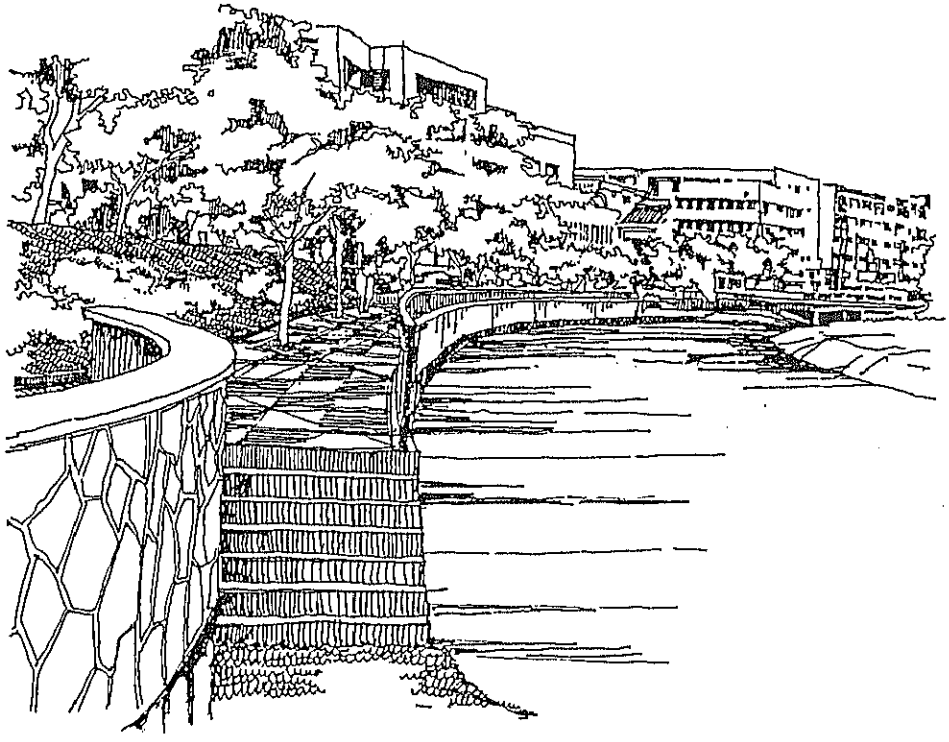


TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF FIGURES

APPENDIX N. ENVIRONMENTAL ASPECT

1. INTRODUCTION

The objectives of the environmental study are:

i) Review of existing data concerned with vegetation and relevant environmental conditions of the Klang River basin.

ii) Review of investigated data of existing river and watershed environmental conditions associated with vegetations, waterfront and recreational activities aesthetic aspects of the Klang River system incorporating existing ex-mining area into the flood mitigation, master plan.

iii) General approach study for preparation of conceptual environmental improvements of the river channels, retention ponds and diversion channels to enhance the aesthetic values of the surrounding areas.

In this report on environmental aspect, general overviews are described mainly through site investigations, review of relevant data and discussion with various goverment authorities.

2. EXISTING ENVIRONMENTAL CONDITIONS

Existing environmental conditions of the study area in the Klang Valley have various aspects to be shown natural resources background woven with human dynamic activities by urbanization, industrialisation, mining forming and other developments factors etc. throughout ages up to present time.

This section outlines the existing environmental condition within the study area.

2.1 Environmental Features of the Klang River System

In general the Klang River system is comprised of several major tributaries; the Batu River, Gombak River, Sg. Ampang at upstream and Sg. Kerayong, Sg. Rasau at mid-stream and Sg. Damansara at the down stream reaches of the Klang River. (See Fig. N-1)

2.1.1 Klang River

From the Klang Gates Dam, the main stream of the river flows down through the forest reserve and reaches the new housing development site at Taman Melawati. The clear water running in gives way to silt-laden water before the river continues down to nearby the Zoo Negara.

The stream flow increases moderately through Ulu Klang, industrial area before reaching Kuala Ampang, where the Klang River meets the Sg. Ampang. Clusters of squatter huts are observed along the river banks. The unsettled banks are generally overgrown with wild plants and trees. Some stretches along the river are used for utlity service yards and dumping of rubbish by squatter settlers. These sights are mostly abscured by the overgrown vegetations and trees.

The strengthened river flows down and reaches the Federal Territory of Kg. Datuk Keramat, before reaching the urban area. At this point, the river banks are mostly covered with grassy surfaces, but riverside scape is hardly visible because the river is situated away from major traffic roads and hidden by buildings and their environs.

Further downstream, the river reaches to the central commercial district of Kuala Lumpur and meets with the Gombak River at the junction of Jln. Pasar Busar and Tun Perak Road. In this area, revetment of the river bank has recently been completed.

The stretch from Jln. Munshi Abdullah to Kinabalu Street has been well organized with pedestrian walkway installed bullusters on the top of the revetment. In this area, the river comes to be exposed as a facade of the urban scape.

Channelization continues to the bridge at Brickfields Street, and from this point grassy banks starts to the down stream with rather clean and maintained conditions.

Further downstream to Kg. Pantai Dalam, Kg. Kerinchi and the Puchong Weir, many squatter huts exist along the river reserve, with rural villages and oil palm plantation coming into view. The river banks are fully covered with tall grown grasses, shrubs and trees that are almost difficult to see through, the flow is turbid and floating debris are often observed.

From the Puchong Weir to down stream the river widens and naturally grown vegetations cover through entire river banks. Within this area, tidal effects may be observed, rubber and oil palm plantations are located along the river banks, adjoining new housing development site at Damansara confluence vicinity and tin mining areas.

At the vicinity of Klang town, the river widens and salinity tolerable vegetations are inhabiting on the gentle slope of the silty sand banks of the river.

Further downstream in the estuarine area, the river meanders gently through colonies of mangroves growing on shallow mounds with gentle slopes.

At the estuarine, the water front is clearly covered with mangrove forest and its vegetation colonies, these are formed rich seaside greenery scape in corporation with mangrove covered islands and some navigation boats in the Strait area.

2.1.2 Major Tributaries

Batu River: From Batu Dam, the main stream of Batu River flows down through steep valley covered with rather mature nautral vegetations and looks stable conditions. However, squatter settlements are found along the river reserves at further downstream nearby Batu Caves. Among

the naturally grown vegetations banana, fruits trees and coconut palms are planted.

Most parts of the river are hidden by these mixed vegetations and huts of the squatter settlements. Only at the points of bridges and vacant reserve spaces, the stream flow can be observed. Such conditions of river side environment stretches up to Kg. Batu where the Sg. Jinjang joins the Batu River.

Through Taman Segambut, the industrial area, and Kg. Kasipillay the river banks are covered with grasses. These grass covered banks continued to the central commercial business district of Kuala Lumpur where confluence with the Klang River takes place.

In this area, newly completed river revetments with some hanging ornamental planting, landscaping elements are exposed as aesthetic urban scenery.

Gombak River: Lower highland at the upstream reaches of the Gombak River is in environment of rather well maintained rural conditions. Open viewed riverside scapes are sequentially continued along a road and forests. Some rural settlements are incorporated with surrounding landscape without much disturbance.

The river flows down to Kg. Sungai Merali, at this area squatter huts are often located along the river banks are covered with bushy grass with shrubs and occasional fruits trees, bananas and papayas and some banks are vertically erroded and roots of vegetations are exposed.

The Gombak River further reaches down to meet with Batu River at nearby Putra World Trade Centre.

Sg. Ampang: Within Belachan some outdoor recreation facilities are quite amiably allocated and shallow flow of stream is surrounded by stony banks.

Near Bukit Belachan some outdoor recreation facilities are installed and younger groups, families enjoy in doing picnic and water play under cool pleasant atmosphere.

When the river passing Ampang, the stream becomes changing into muddy flows and many rubbish and debris are suspended among the roots and stemes of vegetation which exposed by errosion.

While the river passing Ampang, it becomes widen and reaches to Klang River at Taman Keramat.

2.2 Vegetations

In general two types of vegetations can be observed in the Klang River basin. In the north, upstream of the river system, predominant vegetation is lowland evergreen forest which is represented by Dipterocraps and Shorea species at the lower slope of mountains.

The forest consists of three succesive layer from complex type of canopy with diversified flora species. This type of forest has partialy been distributed by logging and very few of the vergin forest areas remain in pockets in the forest reserves adjacent to other forests.

Towards the south west of the river system, swamps and low-lying forest consist of mangrove and peat swamps, reparian fringes and other miscellaneous. Mangrove vegetations have colonized at mudflats of the estuarine area. Their representative species are Avicennia, Rhizophora and Bruguera. (See Fig. N-2, N-3)

(1) Reparian Fringes

A large number of vegetations exist along the estuarine banks, river margins of the Klang River system. Vegetational compositions are quite enormously varied depends on tidal influence, water flow, terrain character, soil conditions and elavation.

Under saline influence, marine alluvial mangrove swamp forests flourish at estuarine area. Further upstream in the brackish water area, stemless palm; Nipa fruticans is usually found on the bank. The trees Antocarpus pendunculariS, Brownlowia argentana, Cerbera odollam, Ficus retusa, Instia retusa and stemmed palm Oncosperma filamentosa etc. are frequently observed.

Further upstream of the river the trees Elaeocarpus obtusus, Illex cymosa and Nauclea maingayi are characteristic species. Beyond the tidal affected area, Calophyllum spp. Terminalia phellocarpa, Tristania smatrana, Vatica Spp., Donax grandis, Rattans are commanly observed.

On the foothills, the streams become narrow with faster flow and stony riverine. There are the small to medium sized trees now predominate, Sarraca Spp. is a characteristic species.

Dipterocarpus hasseltii and several species of Shoreas are commonly found. Non-woody plants, such as Donax grandis and bamboos such as Dendrocalamus pendulus, Gigangtochloa spp. are commanly observed.

As for secondary species Anthocephalus cadamba, Eugenia densiflora and non-woody species such as Calamus spp., Donax grandis, Mikania scandens, Musa Spp., Saccharum Spp. and many Zingiberaceae can be found.

(2) Ex-mining Area

In the extremely degradated areas are left after mining, various species of sedges are obesrved as common pioneer species in the wet areas. The sedges Cyperus iria and Fimbristylis miliacea are the most common species on newly exposed mud, and Cuperus digitatus, Phragmites karkad on the fairly wet area.

On the dry land area, secondary vegetation species are observed, as pioneer species; the creeping grass Ischaemum muticum, and creeping sensitive plants Minosa pudica are commanly observed.

In old mining area, the sedge Fimbristylis cymosa, the herbs Hyptis suaveolens, and trees Alstonia angustiloba, A.scholaris and Ixonanthes reticulata are often observed.

The giant grass Saccharum arundinaceum and small tree Glochidion obscurum are sometimes found along canals adjacent old ex-mining ponds.

(3) Flowering Plant in Early Succesion in Secondary Forest

In early plant succesion, a variety of herbs, climbers, shrubs, small and large trees of flowering plants are found as pioneer species.

Representative flowering plants families are as follows: Amaranthaseae, Compositae, Dillieniaceae, Euphorbiaceae, Gramineae, Labiateae, Leguminosae, Malvaceae, Melastomaceae, Rubiaceae, Tilianceae, Urticaceae, and Verbenaceae.

(4) Gregarious Plant

Gregarious plants are quite commonly found in most areas in the Klang River basin. The most frequently encountered species are as follows. Ferns: some species of Genera Asplenium blechnum, Davillia and others. Stagomosses, Selaginella, gingers, Aroids, bananas.

(5) Exotic Plants for Important Component of Seral Vegetation

The exotic plants most commonly observed in the Klang River basin forming important component of Seral Vegetation are Eupathorium dodratum, Clitoria Eaurifolis, Mimosa Sp., Lantana aculeata and Passiflora foetida.

2.3 Wildlife, Birds and Fishes

Regarding the forest resources many kinds of wildlife and birds still remained within the Klang Valley but their population tend to reduce rapidly under pressure of human development activities.

However, in urbanized area and developed lands, wildlife and birds are still in existence.

In Selangor State the fully protected animals consists of 43 species in first priority wildlife protection under the Protection of Wildlife Act and 37 species in second priority, while the protected wild birds listed 78 species. Among the birds species listed, approximately 20 species are commonly observed in urban areas. (See Tables N-1, N-2 and N-3)

Insects which are mainly butterflies are also protected with 29 species listed in the State.

On the upstream of the Klang River system, water reservoirs have been built adjacent to natural forests. Species of small mammal such as various species rats, tree shrews and several species of squirrels are found inhabiting in these forest, also species of reptiles such as water monitor, cobra and python are found.

However in vicinity of these forests sighting of wild animals such as leopards, tapirs, tigers, siamang, white handed gibbons and serows have been reported.

Very few species of fishes are generally believed to be still inhabiting in the Klang River system in spite of frequent floods and polluting the water quality of the river. The most common fish species observed are the Cyprinds.

Some species of wildlifes are found inhabiting the abandoned tin mining and resembles areas. Several species of rats, snakes are commonly observed. Birds species, such as yellow paint bull, whistling ducks etc. are observed because of abundance of fishes and grasshoppers in these areas.

Some fishes, shellfishes and tortoise are inhabiting in the ponds.

Common birds observed in secondary forest, parks and in some urban areas are as follows: Little Malay Dove, Turtole Dove, Magpie Robin, Common Myna, White Headed Munica, Black Headed Munica, Spotted Municas, Common Bulbul, Longtail Parakeet, Hanging Parakeet, Blue Rump Parrot and Weaver Finch.

2.4 Riverside Life Styles and Recreation Activities

Through Klang River system various types of activities can be observed. However, only very few reparian areas are exposed to public activity.

(1) Upperstream Area

The upstream reaches of the tributaries of the Klang River are very attractive for people to visit. At the areas nearby Klang Gates Dam, the Gombak River around Mimaland, the Sg. Ampang within forest reserve, visitors and family groups go picnic, rest and do water play etc., at weekends under the circumstance of rich natural environmental resources as well as the clear water flows.

In some villages along the upstream reach of Gombak River, the stream is utilized as a natural beneficial resources in adequate manner by the rural village people, and ocasional fishing is observed.

(2) Squatter Area in Upstream to Mid-stream Reaches

The stream and riverine are of vital importance to the dwellers of the squatter area. This riverine space has become an important utility space for discharge space for their daily waste and rubbish. The river itself also supports the livelihood of its dwellers, banana, papaya and other fruit trees are occasionally planted on the river banks.

(3) Mid-stream Reach at Kuala Lumpur Central District

At the central commercial business district, the river is channelized with recently completed walkways and the adjoining plaza has become quite an attractive place to visit, with pedestrian strolling, groups of people sitting, chatting and resting while observing riverside scapes of urban area.

Urban amenties are expected to improve to cater for citizens seeking recreation through the well organized enclaves.

In some areas downstream from the central district, the berms of the wide banks have been planted with rows of trees. Bicyclers and motorcyclists and joggers are enjoy to pass on the service access along the berm area.

Certain stretches of the river has been dredged to improve flow along these stretches.

(4) Downstream

Most area of the river banks are covered with densely foliaged vegetations and some trees, and very few access to the water front is observed.

The water reserve widens but with almost no contact and utlization of the stream by people dwelling nearby.

In this area, the river flows relatively slow and these seem that human interaction with the river is scarece.

(5) Estuarine Area

The river further widens and slows down as it enters the estuary. The transportation of timber is a rather major activity in this area. Junks are used to carry timbers to the sawmills located a little upstream of the estuary, during high tide period.

Fishing is carried out by small size fishing boats, while on the silted banks recreational fishing are sometimes observed. The number of fishing boats are quite few now because of reducing fish population caused by increased pollution affects.

3. ENVIRONMENTAL DEGRADATION AND PROBELMS

In view of the increasing socio-economic development, human activities have encroached on and degraded the environmental qualities in the Klang Valley especially in the metropolitan area.

The Klang River system which serves as the conduit of natural drainage for the region has been loaded with a diversed variety of pollutants.

Perennial flooding is one of the worst environmental scourge to the inhabitants of the region. Flooding will be considered in various environmental degradation agents in the following sections.

3.1 Environmental Degradation

3.1.1 Erosion and Siltation

Tin mining, rubber plantation and rapid urbanization, especially the large scale development of housing infrastructure works have been excessively stripped the ground surface of its vegetation resulting in severe soil erosion. The eroded soil when washed into the river causes siltation and choking of the river. This is the big reason behind the frequent floods along the Klang River basin.

The barren urban development lands constitutes big source of erosion and siltation.

As a control measure, regrass of the exposed surface has been decreed by the local goverment act, however, it seems not to have produce effective results to date, because during the developments of

the land , barren lands are still exposed until the stage of regrassing is reached on completion of project.

Also suspended soils discharged from tin mining areas causes siltation to occur in the river and degrades the river flow.

3.1.2 Solid Waste and Floating Debris

In general, effective management for sewerage and solid waste through the Klang River system has not been carried out and as a result, the solid waste which flows into the river posses a serious probelm.

These solid wastes are floated down in the stream until the tidal effects prevent their discharge into sea. They then concentrate, forming bank sludge deposits.

These solid wastes are observable everywhere through the river system except in the central commercial business district of Kuala Lumpur. While, during rainfall, these solid wastes rises up as floating debris in the high water with increased velocity.

Major components of these floating debris are plastic or paper receptacles and cans, wrapping materials and straps, roots and stems of vegetations, twigs of trees and shrubs, and even segments of lumbers and wooden product.

These floating debris cause clogging of the river flows at high water levels as they accumulate and span across the river.

3.1.3 Screening Operation of Floating Debris

To avoid these floating debris clogging up the river, there are six operation sites for screening and removals of floating debris along the river at present.

On the upstream of the confluence at Jln. Pasar Busar, three trash screens have been installed acrossing the Batu River, Gombak River and Klang River and these are operated by the City Hall.

The installed screening equipment are in the form of manually operated plastic drums floating across the river. These drums are tied together by wire ropes. The amount of trash collected per day comes to approximately 10 tons. The screening efficiency of the manual system is approximately 30% of whole trash volume to be collected. The uncaptured debris continue to flow downstream.

The other three screening sites are located on downstream reaches, one for near Shah Alam and two for in Klang town. Aqua tractors are provided at these sites which collect total of approximately 40 tons of trash a day for these 3 sites.

With the introduction of the aqua tractor system, the screening effeciency improves to about 60% but during high flow periods, the screening efficiency comes down to about 40%.

3.1.4 Squatter Area

Along the Klang River and the surroundings of ex-mining areas many squatter areas have been located.

In the Klang Valley Region, approximately 350,000 people have settled in these squatter areas constituting approximately 15% of total population of the region.

Especialy within the Federal Territory, along the zones of 30 m from river fringes approx. 1,300 squatter huts are settled and the total areas reach approx. 14.2 km in riverside along. The City Hall has been managing the relocation programe of the squatter huts but still there are many difficulties to be faced. (See Table N-4)

The squatter areas are generally underserviced and poses serious social problems. The sanitary conditions in a squatter area are in most

unacceptably poor. There are no proper paving and drainage systems. The sullage water flow hapharzardly over the unpaved ways, frequently across the backyard of the houses, finally drains into the river.

The City Hall has been trying to conribut the management of garbage collections but adequate garbage pick up and collection system have a lot of problems to be executed at present time.

Most of these squatter areas are surrounded by natural vegetation such as grass, shrubs and trees which shields them from view from the main road. As such, they are hidden away from public. The environmental aspects of a squatter area are getting worse with time, the continuous accumulation of rubbish and wastes are piled along the river. Such rubbish heaps often flounder under its own weight and tumbles into the river.

Most of the wastes and floating debris in the Klang River have their origins in these areas. In some of the worse areas, these debris are flushed from the area whenever it rains.

The vegetation growths around the squatter areas are also not being properly maintained. The random growth of these vegetations also generate to the degradation of the river banks in that they obstruct the smooth flow of the river when water level rises.

3.2 Water Quality and Pollution

Owing to the increasing socio-economic activity, growth of urbanization and industrialization, and other diversified human activities, the Klang River basin has reached a considerably polluted stage in that the river system has been affected directly by many sources of pollution which directly discharged into the water course.

At the present, the Klang River appears to be considerably polluted at the strentch from Kuala Lumpur onwards down to the sea. The levels of pollution normally worsens in the dry season when the volume of water flow reduces.

According to the Klang Valley Environmental Improvement Project (KVEIP) report 1987, the present water quality in the Klang River system is critical for low flow conditions in the dry months. (See Table N-5 and Figs. N-4, N-5, N-6 and N-7)

(1) BOD and DO

The DO decreases correspondently with increase in the level of BOD in the river. The Do level starts off at 7 to 8mg/l at the upstream reaches near to the reservoir. The DO level reaches a low of 1.6mg/l.

Further down to the Puchong Drop, the DO level improves to over 2mg/l at the pond aeration after the weir, but it again decreases to less than 1mg/l when the river reaches at estuary.

The river is sometimes barely aerobic during low flow in dry months.

(2) Other Pollutants

Levels of other pollutants such as COD, suspended solids, chloride and hardness, ammonia and nitrate, total dissolved solids, etc vary in a similiar manner as that presented for BOD.

(3) Major Causes of the Water Pollution

There are several major causes to the heavy pollution of the river. The main reason is that the transport capacity of the flow in the river is insufficient to carry away the heavy pollution load caused by urbanization and industrialization. Another reason is that treatment plants are not capable of removing all of the waste constituents in sewage flows and the remaining residual wastes exceeds the assimilative capacity of the limited river flows.

(4) KVEIP Recommendation for the Water Pollution

The Klang Valley Environmental Improvement Project (KVEIP) which was conducted recently has recommended that a system of interceptors is installed along the river for diverting the polluted water for disposal after proper treatment into the marine water. It is suggested that this Interceptor Sea Outfall (ISO) system will ensure that the waste effluent will not permeate the ecologically sensitive riverine, estuarine and near shore shallow marine water. However, the ISO system has been discussed by the government authority recently and it is decided not to realize at present time.

Another recommendation is the implementation of an Industrail Waste Permit System (IWPS). Under this system every industry producing significant liquid, solid waste is required to apply for a goverment permit. Other recommendations of the KVEIP study are the implementation of a regional solid waste disposal scheme and controlling within the allowable limit of suspended solids discharged from tin mining areas.

4. ENVIRONMENTAL APPROACH TO FLOOD MITIGATION

4.1 Introduction

There are many environmental factors related to the study on flood mitigation in the Klang River basin. The growing trend of urbanization and sociol-economic development increases the propensity for floods in the urban and suburban areas.

In the urban areas and it's vicinity, the growth of population has caused many housing development schemes and related urban facilities and further increase of such developments can be foreseen.

With continuing urbanization, the ground surfaces will become more impermeable as more and more grassed and natural ground are replaced by impermeable areas. As a result, the storm water run-off coefficient takes on a much higher value than before. Thus, the discharge of storm

water from its catchment, into the river has reached a critical stage at which the capacity of the river is insufficient.

In this section two conceptual environmental approaches to mitigate flooding are proposed. One approach is to use the ex-mining ponds as retention ponds where the flood water is temporarily diverted into and another approach is to provide diversion channels to divert the flood waters away into other stretches of the Klang River.

4.2 Retention Ponds and Green Park Environs

In utilizing the ex-mining areas and ponds as functional retention ponds, the flood water is deverted into ponds and is retained during peak hours at critical points of downstream of the river. After the peak hours the retained water is gradually discharged back into the river again, so that peak flow at the critical points can be decreased.

To provide sufficient retention capacity, the volume of the ponds required would be quite large. The retention ponds may be formed into two functions, one is permanently water filled pond and another is an occasional pond only filled with diverted water during critical hours at heavy rainfalls, and it will be vacant during other times.

The large expanded temporary pond area and it's surroundings are provided as the space for sports and diversified recreational activities to the public.

The green park area of the retention pond shall be landscaped for rehabilitation of the barren land by regrassing and reforesting the ex-mining areas. Sufficient wildlife and birds can then be reintroduced into the reforested park area to regenerate a natural ecological flourishings for citizens and birds and some beneficial environmental spaces for recreational activity purposes.

4.3 Diversion Channel

A series of diversion channels shall be necessary to divert the flood waters from the upper reaches into other downstream reaches of the Klang River to avoid the flood waters from the central area of Kuala Lumpur.

The diversion channel should be provided with sufficiently wide reserves for enhancing the environmental and aesthetic values of their surrounding areas as well as serving as a green belt within the urban area.

The channel reserve shall be provided with neat bank slopes and regurarly planted shadowy trees on the flat tops of the berms.

Functionated access ways for channel maintenance's and pedestrian walk may run parallel along the channel. Bridge crossings will be well landscaped at selected nodal points. Appearance of these bridges shall be such that they merge aesthetically into the background greeneries.

These nodal points may be developed into small plazas for amenity to the vicinity populace.

5. WATERFRONT ENVIRONMENT

5.1 Significance of Conservation and Improvement of Waterfront Environment.

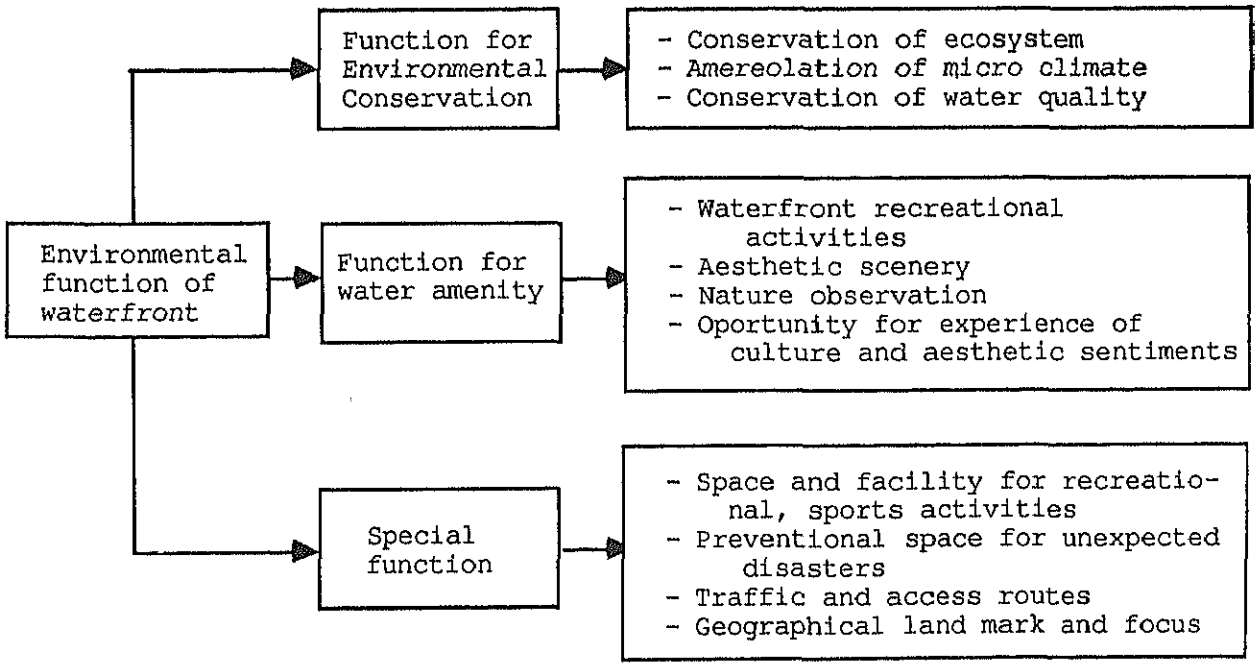
Conservation of waterfront environment comes to be inseparably related with a conservation of water quality and management of water quality control for whole watershed. Also conservation and improvement of waterfront environment are definitely important to be connected with understanding the relationship between the moderns in their lives and the water as a precious environmental resource.

Contemporary meanings for conservation and improvement of the waterfront environment are to be corresponded to diversified people's demand for effective utilization of waterfront openspace such as aesthetic scenery composed waterfront elements, conservation of natural ecosystem, waterfront activities, nature observation, field research study and education. Also in accordance with the improvement of people's life standard, peoples are getting to have leisure time and it tends to be increased.

People are tending to desire to have more qualitatively and mentally fulfilled their life styles, and they try to find charming, attractive natural resources among their living environments. Also they are trying to find opportunities for doing sports, recreational activities, strollings and amiable communications.

5.2 Environmental Functions of Waterfront

Waterfront environment may poses significant functions and effectiveness for the people's lives as well as natural livings, the following is the view of inventory of them.



6. ENHANCEMENT OF RIVERINE LANDSCAPE AND REHABILITATION

With the exception of the upstream forest reserve, a few areas along the central business district and at the vicinity of the estuary, the view along the Klang River is rather squalid and unsightly.

The river which flows through a region should be representative of the charm of the corresponding area such as city, town and rural area, and it should be recongized as a characteristic facade of each area.

6.1 Strategic Approach for Improvement and Rehabilitation

Within the forest reserves along some down stream reaches where recreational activities may be expected, some improvement of river banks are to be introduced for water plays and other water related recreational activities. For this purpose, river reserves shall be cleared to expose as an urban openspace. In residential area, pedestrian ways and resting plazas with some focal gardening shall be effective to rehabilitate the riverside zone.

In the commercial area, diversified form of pedestrian ways, plazas, resting places, etc. are inevitably important to recover the urban riverine life, as it is done in the vicinity of the Jln. Pasar Busar. Incorporated improvement with private sector perticipation may become quite effective and also may be necessary, especially where river reserves are limited, in highly urbanized areas.

For industrial and mining area, selected screened greeneries or reforested buffer zone are very effective to protect and ameliorate the riverine environment. In the recreational area, the river reserves could be used for diversified recreational uses such as sports and gamefields, multipurpose open spaces; jogging and cycling courses may also be incorporated. The former river course including its surroundings, which is formed due to the shortening and diversification of the river course should be rehabilitated as a recreational park, which also serves as a flood plain.

In the agricultural area and buffer zone, some recreational trails with grass covered land and some potential riverine ecological conservation areas shall be spacially organized. Estuarine mangrove vegetation colonies shall be conserved to the maximum as a nature reserve. Some observation trails may be installed in these areas for educational recreation, and other research activities. (See Fig. N-8, N-9)

6.2 General Guideline

6.2.1 General Guideline for Improvement of the Riverine Landscape

(1) Improvement of River Revetments as Means of Improving Riverine Landscape

For ongoing and planned implementation of revetments, consideration of prospected activities on the corresponded riversides area and aesthetic space solutions shall be undertaken.

(2) Clearing of River Reserve

Most of the river reserve are left without maintenance and many squatter settlements have sprung up on them, for further prevention of environmental degradation, intensive cares and maintenance of the river reserve shall be carried out.

(3) Improvement of the River Reserve

Smoothing the bank areas, grading and grassing of ground surfaces are generally required. Some vegetations, trees and shrubs should be allowed to remain for environmental conservation and aesthetic reasons.

Some shadow providing trees shall be introduced. The planting of such trees should be rugulary planted with appropriate intervals, so as not to disturb the view of the river.

Walkways and recreation activity spaces along revetment or on the river reserve shall be provided in corresponded adjacent land use area or areal characteristics.

(4) Provision of Observation Plazas and Resting Core Areas

In order to expose and emphasize the view of riverine landscape, at strategically selected points, observation plazas and resting core areas shall be introduced. Consideration should be taken for easy access from nearby road and provision of carparking space.

These areas shall be served as aesthetic focal points for the riverine zone through the river.

(5) Provision of Walkways on Bridge Brinks

Bridges have always served as nodal points for viewing the riverine landscape. Most of the people may admire to find the riverine landscape when crossing a bridge, so that sufficient space for walkways should be allocated for pedestrians to take leisure strolls across the bridge.

(6) Conservation of Natural Vegetations

Significant mangrove forests and colonies exist at estuarine areas. These areas are commercially valuable as well as important from the ecological and environmental point of view.

Minimum improvement for maintenance access and educational, research trails may be necessitated for provision.

Well balanced natural vegetations are seen at the upstream banks in the forest reserve areas. In these area, very few improvement works could be provided to allow pedestrian trails to the water margin together with small spaces for observation.

(7) Riverside Walkway Improvement in Conjunction With Nearby Development at Central Business District

In the Central Business District, with the completion of the riverine facade are exposed to appear the view for the citizens and visitors.

Within this area, riverside reserves are definitely limited. Further development shall be considered for taking the contribution increasing the length of riverside walkways, and adding more plazas and landscaping to strengthen this area as the hub for urban amenity.

(8) Harmonized Design and Characteristics Allocation for Riverine Facilities and Structures

Major design items are these revetment, balusters and balustrades, fence, pavings and steps, plant containers, lighting poles and other outdoor furniture.

Harmonized design approaches with nearby building's styles and design characters or townscape are very important, especially when the adjacent buildings have been declared as historical architectures and monuments.

Proper selection of species of large grown type trees should be made to project a characteristic silhouette in both the urban and rural areas. These can then be used later to establish a splended riverine landscape.

(9) Consideration for Pedestrian Walkway and Mall Network to Link Up with Adjacent Plaza, Parks through Riverside Area

This network of pedestrian walkway and mall linking up the chain of parks and plazas will provide many opportunities for recreational activities. People and visitors can find it easier to understand the environmental and social values of riverine life. (See Fig. N-10, N-11)

6.2.2 General Guideline for Basic Coordinations with Other Authorities

Resettlement of squatter huts, and recovery of the original river reserves along the riverside areas where recognized as flood plains shall be managed.

Whole connected tributaries which discharge into the Klang River should be provided with appropriate screening means or system and these should be kept on maintaining regularly.

Provision of garvage, solid waste collection, disposal location and their transportation system shall be adequately managed and tried to avoid pollution to the river.

Sedimentation ponds shall be provided by legally for the certain scale of development of housing, industry site, etc.

Appropriate anti-pollution system for each type of industries shall be recommended to be equipped and superintendency of them shall be programmed.

Existing relevant regulations shall be enforced through co-ordinating agency to carry out each strict superintendent management for protecting water quality of the rivers.

Environmental education and public awareness for conservation of riverine quality shall be programmed and emphasized through maximum use of public relation medias.

7. GENERAL VIEWS FOR ENVIRONMENTAL ASSESSMENT TO THE PROPOSED PROJECT

In the course of implementation of the proposed scheme for flood mitigation, construction of retention ponds with surrounded park areas, diversion channels at upper stream stretches and river improvement which wided the river bed and provided levels at down stream stretches could be the main objectives.

The following environmental impact should be considered and the necessary environmental protection measures to be undertaken.

7.1 Positive Environmental Impact

As an important environmental benefit, the effective flood mitigation and rehabilitation of barren land into green park land is contributed to positive side, and regenerating urban natural resources with proper ecosystem may be sited accordingly. In addition increases of recreational opportunity and improvement of aesthetic landscape of the riverside areas, improvement of water quality through screening and sedimentation of floating debris and suspended solids in the retention ponds, and improvement of riverine hygienic conditions could also be realized.

7.2 Negative Environmental Impact

As negative environmental impact factors, temporary erosion and siltation effects when large scale earthworks such as retention ponds, diversion channels and river banks are implemented, could be sited. To minimize these negative effects, appropriate implementation methods and environmental care must be considered. Some project areas where squatter huts and residential house are located should be relocated. These social environmental impacts also should be amicably solved.

As other possible negative environmental factors, vector borne diseases such as malaria, filariasis and dengue fever could become more prevalent as the vector mosquito would have access to more stagnant

water ponds for their breeding. Hence it may be necessary to consider suitable mitigatory measures against possible mosquito breeding, etc.

8. ENVIRONMENTAL IMPROVEMENT OF THE PROPOSED URGENT WORKS

The growing trend of urbanization and its accompanying socio-economic development have exacerbated the problems for flood in the urban area.

In this section, schemes for environmental improvement of the proposed urgent flood mitigation projects are considered in conjunction with their hydrological aspects.

There are four projects; river channelization of the Klang, the Gombak and the Batu Rivers from Sulaiman bridge to their upper stretches, the construction of retention ponds and the construction of the diversion channel and drainage work of Kampung Baru.

8.1 Riverfront Land Use and Condition of Improvement

According to the proposed plan for river improvement, top priority has been assigned to the following stretches.

Klang River (K9) : Tun Perak bridge to Sultan Ismail bridge

Gombak River (G4) : Jln. Belonkong to the inlet of proposed diversion channel

Batu River (B2,B3) : Kolam Air Empat bridge to the inlet of proposed Batu retention pond

Existing condition on riverside land use for these stretches together with the proposed river improvement works are shown in Fig. N-12. The hatched sections in this figure are denoting stretches for which riverside improvement had been completed.

In what follows the completed riverside improvement works are summarized below.

For Klang river, 6% of commercial area, 16% of institutional area and 100% of railroad reserve have been improved, but as a whole riverside improvement amounts to only 8% of total area.

For Gombak river, 91% of institutional area, 36% of commercial area, 27% of residential area and 100% of openland have been improved, and as a whole the improvement amounts to 24% of total area.

For Batu river, 5% of residential area, 11% of openland, 77% of commercial area and 100% of institutional area have been improved, and as a whole the improvement amounts to 10% of total area.

8.2 Riverside Improvement Scheme

Besides the existing riverside improvement works, the following improvement schemes will be considered in accordance with each land use pattern along the above rivers.

(1) Residential Area

This type of land use pattern occupies most of the relatively flat areas adjoining the river reserve. Gentle terrains shall be provided with pedestrian walks interspersed with small focal plazas amongst shady trees and flowering plants. On steeper terrained areas which are not suitable for providing with pedestrian paths, simple turfed surface will be adopted for slope stabilization improvement.

(2) Low Density Residential and Agricultural Areas

A typical example of this is the Malay Reservation land located in the upper stretches of the Gombak River. The rural landscape character will be preserved to blend in with the adjoining village forests and crop fields.

Gentle bank slope will be covered with green turfs interspersed with foliaged trees planted in a sequential manner to mesh in with the village groves. These will sense as pedestrian walks as well as catering for the light local traffic.

Some open space may be connected with river reserve area to cater for community sports and recreation activities.

(3) Housing Development Areas

This type of land use pattern can mostly be seen along several stretches of the the Klang and the Gombak Rivers. In these areas, riverside improvement shall be in harmony with the character of the new townships.

To cater for the especially diversified activities of the residents at all ages, water front access, pedestrian walks, plazas with children's play ground and rest areas with seatings for elderies surrounded by shady trees and flowering plants will be provided.

(4) Institutional Areas

Most of the institutional areas in the central district have already been improved, however some portions along the Klang River is still in the unimproved state. For such areas, promenades with plazas on court yards furnished with gardening, street lightings and outdoor furnitures may be considered.

(5) Commercial Areas

Approximately 50% of these areas had been improved with works of most acceptable quality. The rest of these areas will be improved to match the existing works. Commercial areas are always crowded with people seeking diversified activities and need be provided with urban amenities of high quality.

Good quality pavings with baluster and balustrade of the revetment, street lightings, planting boxes and shady trees and seatings will be properly distributed throughout entire areas.

Schemes in which the private sector can be drawn into participate in improving the river side space should be devised by the public sector.

(6) Industrial Areas

Most of the industrial sites within these areas have enclosures going right up to the riverfront. In such instances, the river reserve must be recovered and regrassed to provide access to the waterfront.

River reserve of the industrial areas should be neatly improved with turf greens and open landscaping. Paved walkways are of importance so that people are encouraged to walk through these areas.

For screening purposes, hedges will be provided to high degraded part of some facilities in cooperation with the affected enterprises.

(7) Railroad and Facility Area

This area has been adequately improved to a standard acceptable as urban riverside scape.

(8) Park and Garden Areas

These areas shall be interlinked with pedestrian walkways interspersed with plazas. The walkways shall be linked with shady trees to ameliorate the atmosphere of the park area.

(9) Cemetery Areas

These areas are always surrounded by a solid enclosure which is completely closed to the river front and the atmosphere is solemn and calm. To preserve this atmosphere, the river side area should be clean,

turfed and planted with shady trees which are suitable to maintain the solemn nature of the environment.

(10) Openland for Development

This land category existed at a stretch of the Batu River and has a rather flat terrain with some good vegetation. The area may be developed as housing estate or as public openspace in the future. As an interim measure, pedestrian walkways surrounded by turfed landscaping and supplemented by shady trees can be implemented.

(11) Openspace Area

The river side at Gombak River has already been improved. For the Klang and Batu River, the wide open landscapes can be enhanced with grass turfing interspersed with some flowering shrubs and planting of trees at selected locations.

(12) Greenery Area

This area is sited at the upper reach of the Klang River. It permeates a calm and rich natural environment. Therefore simple pedestrian walkway with neat grass turfing will be sufficient for improvement. Some flowering tree plantings may serve as focal gathering points for residents living in the vicinity.

8.3 Environmental Development of Proposed Retention Pond

8.3.1 Present Land Use and Environmental Conditions

The proposed site for the retention pond is an ex-mining area on the west side of Batu river. Within this ex-mining area, two housing development projects on the west side and a industrial development site on the north-east side have been alienated by the government.

The remaining areas have been earmarked for a metropolitan park and other residential developments; however land alienation for these schemes has not yet been finalized.

Most of the site is occupied for waste mining ponds and barren land as a result of recent mining activities. The landscape is dotted with large ponds separated by vast empty space. Earthwork has commenced for the housing development project on the west side. (See Fig. N-13)

The most common vegetation are various species of sedges and some shrubs which sprouted on the barren land as pioneer plants.

8.3.2 Proposed Retention Pond and Its Environs

The proposed retention pond comprised a permanent pond portion and a temporary pond portion to receive the flood waters so as to function as flood mitigation measure for the downstream reaches of the river.

The temporary pond is ordinary utilized as a recreation and sportsfield by citizens. However, after a heavy downpour the temporary pond will be filled by the excessive run-off from upstream. The retaining of this water in the temporary pond alleviates the flood conditions that could be generated downstream. (See Figs. N-14 and N-15)

The filling of the temporary pond area may happen once a 2 years to 20 years at the lowest portion, once a 50 years at second lowest portion and once a 100 years at higher portion of the area in accordance with the rainfall characteristics. (See Figs. N-16, N-17 and N-18)

The area surrounding the temporary pond may be utilized as a park area serving the needs of neighborhood as well as citizens for outdoor recreation and sports activities.

Within the park area, ground level is rather flat because of cut and fill balance of total earthwork volume but diversified form may be projected in accordance with pond morphology. A network of pedestrian

walkway, maintenance roads and parking spaces, sports courts and fields, plazas and gazebos, resting areas and seatings, also security facilities, beneficial facilities such as toilets, Kiosk and park operation facilities, culture and sports facility complex as well as compound lighting will be provided.

Inside the pond area, some water sport and recreation facilities may be provided to cater for the needs of water sport enthusiasts. In the provision of these facilities, the consideration should be taken of the change in water levels between the permanent and temporary ponds after an influx of flood waters.

8.3.3 Establishment of Natural Environment

Along the perimeter of the park area, a buffer zone of greenery will be established by reforestration and plantings. A variety of indigenous trees and shrubs may be introduced to regenerate the natural environment from the existing barren land condition.

Inside the park area, a suitable mix of shady trees, flowering shrubs and plants will be grown at strategical locations for enhancement of the park landscape.

The reestablishment of the natural environment may encourage wild birds and small animals to inhabit the present barren land. To serve this purpose, berry and fruits bearing plants should be introduced within the buffer zone and also at some portion of the park area.

For the planting of trees and shrubs in the park area, the park should be planned in the manner of a botanical garden so as to serve the dual purpose of beautification and educational for the enlightenment the citizenry.

8.3.4 Consideration on Floating Debris and Suspended Solid

At the inlet region of retention pond, a sedimentation pond will be provided to screen off the floating debris, suspended solid and to retain silt out of the water.

Flood water will be introduced into the sedimentation pond in which its flow velocity will be reduced to allow the settlement of the silt. Two sets of log boom will be installed in this pond to screen off the floating debris according to their size.

In this manner, the screened and settled water introduced into the retention pond will be of a more satisfactory quality when compared with the incoming water.

The trapped debris and solid waste which collect in the sedimentation pond can be cleared after the peak flood has passed.

Maintenance facilities with workshop or repair yard will be provided facing the pond for collecting, piling up and loading of these garbage and silt. This yard should be hygienically maintained and surrounded by rows of trees for sheltering it from outside areas.

8.4 Environmental Development of Proposed Diversion Channel

8.4.1 Present Environmental Condition of the Proposed Channel Route

The proposed diversion channel beings at an upper stretch of Gombak river within the Malay Reservation land, and extend westward through residential, agricultural and openland areas before meeting Batu river at its proposed retention pond.

The proposed route through the Malay Reservation land encounters mostly low density residential areas set amidst a mosaic pattern of village forests, agriculture land and open grass land.

The proposed route might pass through forest and land area, skirting the fringers of some residential quarters, then through a mix of forested and agricultural land, open areas of at ex-mining land, before finally reaching the Batu river at the proposed retention pond. (See Fig. N-19)

8.4.2 Proposed Diversion Channel and its Environment

The proposed diversion channel may be likened as a corridor of water and green belt connecting the Gombak River and Batu River. The channel will be supplied with a shallow flow all the time, the reserve of the channel will be neatly landscaped with grass turfing and lined with rows of trees.

Along some stretches with limited open space, the channel will be of concrete revetment construction, with some strategic areas aesthetically treated.

Pedestrian walkways will be provided along the channel and at some strategic locations, small plazas will be built to enhance waterfront landscape. Also some access to the waterfront may be provided in order to project amenity for vicinity peoples. Special care will be paid to areas where the channel passes through forests and groves in order to blend these natural resources into an overall landscaping scheme.

8.4.3 Landscaping of Diversion Channel

The group of trees which makes up the village forest is quite attractive and enhance the scenery of the area, while the houses area scattered in random without any discernible pattern.

The channel route shall be related with due consideration to the existing distribution of houses, also consideration will be taken to avoiding a large scale destruction of the forest trees.

Small bridges, pedestrian paths, plazas and some street furniture will form an improvement for maintaining the rural ambience. Meanwhile, hygienic considerations may also be incorporated. (See Fig. N-20)

9. PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED URGENT WORKS

9.1 Introduction

In the course of implementing the proposed scheme for the urgent works for flood mitigation, preliminary environmental impact assessment study has been carried as follows. However the scheme of this project has not properly large enough scale to meet with the prescribed "Schedule of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987".

(1) Project Title

"The Urgent Flood Mitigation Project on Upper Klang River Basin"

Preliminary environmental assessment is not mandatory and is done voluntarily. The project is a part of the Master Plan of the flood mitigation on Klang River Basin.

(2) Project Initiator

The initiator of the project is the Malaysian Government, Economic Planning Unit and the Execution Body is the Drainage and Irrigation Department.

The study is made by the JICA in accordance with the overseas cooperation program of Japanese Government. JICA entrusted the study to Pacific Consultants International and Nippon Koei Co. under the direction of Advisory Committee.

(3) Background and Need of the Project

The Klang River often floods and damages properties and crops over a wide area. The heaviest flood recorded in 1971 inundated a total of 140 square kilometers, causing an estimated total damage of M$36 million (1980 price level) with nearly 180 thousand people affected as a result. The latest incidents took place in December, 1985 and February, 1986 in which ten thousand people in total were evacuated from the central part of Kuala Lumpur.

The existing flood mitigation program has been established with an aim at protecting Kuala Lumpur from heavy floods by providing an adequate capacity of means to mitigate floodwaters of the same scale as the 1971 flood.

In the original flood mitigation assessment in 1973, a rather static approach was taken with the 1971 land use and flood conditions as a datum. The intensity and extent of future urban development were not taken into consideration. Since then, the rapid progress of urban development has reduced the retention capacity of rain water in the catchment area, especially by housing development encroaching into abandoned tin mines that function as retarding ponds.

The Gombak Dam Project, which was proposed as one of the three flood mitigation dams, has been cancelled in Dec. 1986, and, at the moment, river channel improvements has been completed only in certain sections in the central part of Kuala Lumpur.

In the lower reaches, future expansion of urban areas in Shah Alam and Klang is expected to take place in the low-lying flood prone areas; and sound flood mitigation measures will be required to support this potential development.

In consideration of the above, a review and modification of the existing flood mitigation program, which was established based on the record flood of 1971, was obviously required.

Under such situation, the Government of Malaysia requested technical assistance for the Project to the Japanese Government.

In response to the Malaysian Government request, the Japanese Government undertakes the study, thus the master plan for flood mitigation of whole Klang River Basin is formulated and the urgent flood mitigation project is selected and a feasibility study is carried out.

9.2 Project Description

In the course of proposed urgent works for flood mitigation, the improvement of the rivers, development of retention pond, diversion channel and drainage works of Kampung Baru are identified, and each of the works is as follows.

(1) River Improvement

River improvement work mainly composes of widenings of the river bed, provision of revetments, improvement of river reserves and related works of channelization for the Klang, the Gombak and the Batu Rivers.

Objective area of the river improvement is totally 12.65 km in length and each details is as follows.

Klang River	:	3.06 km in length,	Tun Perak bridge to Sultan Ismail bridge
Gombak River	:	3.50 km in length,	Jln. Belonkong to the intake of the diversion channel
Batu River	:	6.09 km in length,	Kolam Air Empat bridge to Batu retention pond

The types of channel sections is generally adopted the existing river improvement plan and for some of the portions where the designed discharge capacity is critical, new sections are provided.

The river reserve width is designed incorporated with the 100 year discharge of flood flow volume and become 60 m width in maximum.

(2) Batu Retention Pond

The Batu Retention Pond is located in an ex-mining area bordering the western bank of the Batu River lying between 6.0 km point and 8.4 km point along the Batu River.

The area of the retention pond has totally 113.4 ha approximately and it composed following sub-areas. (See Fig. N-16)

Total area	113.4 ha
Maximum retention pond area (Permanent pond area 30.6 ha included)	67.0 ha
Sedimentation pond	5.6 ha
Park land area	40.8 ha

The depth of retention pond is approximately 23 m in maximum at main portion of the pond and minimum depth of 3 m is for minor portion of the pond. The design storage volume for 100 year period is approximately 2.7 million tons and maximum design storage capacity has 4.1 million tons. (See Fig. N-18)

As for flood water control equipment, outlets gate and sliceway are provided, and for sedimentation of silt and screening floating debris, an operation and maintenance yard, log booms are provided along the sedimentation pond.

Park land area (40.8 ha) and temporary retention pond area (36.4 ha) are provided sports and game field, recreation facilities through landscaping and planting. (See Fig. N-14)

(3) Diversion Channel

The Batu diversion channel is to be located along the route connecting the 9.9 km point of the Gombak river to the 7.4 km point of

the Batu river. The length of the diversion channel is 3.2 km with 4.5 m difference between the elevation of these two points.

The channel route passes through the original ex-mining area and agricultural land, some border of residential areas Karak highway and low density residential area of Malay Reservation land near the Gombak River. (See Fig. N-19)

The diversion channel has a design capacity of up to 60 m^3/s and 12 m to 40 m of channel width with maximum 60 m of channel reserve, the channel structure is mainly open cut type but in some critical area where space is not wide enough or case of crossing the highway, a box culvert type is to be provided. (See Fig. N-20)

Major facilities of this diversion channel are a channel intake, overflow weir and water gates beside diversion channel structure.

(4) *Drainage Work of Kampung Baru*

Kampung Baru area is infamous flood prone low lying area with catchment of 0.73 km^2 and sited at right bank of the Klang River 2 km upstream from the confluence with the Gombak River. About 35 ha area is always affected by inundation of inner water.

For solving the inner water problem, the pumped drainage system with underground pondage is proposed as the countermeasure, and this inner drainage work is as follows.

- Rainfall run-off from the basin is collected and introduced by the drains into a underground pondage.
- Run-off water is stored in the underground pondage which is constructed under existing road area.
- Stored water is drained by pumps into the Klang River.

Major inner drainage facilities are consisted of an underground pondage (about 400m x 20m x 5.5m in depth), inlet structure, pump

station, outlet tank, outlet culvert and gate structure also interval drainage system.

9.3 Existing Environment

In accordance with the proposed urgent works for flood mitigation, objective areas for the works are segmentally distributed along the Klang, Gombak and Batu Rivers. Each areal existing environment is as follows.

(1) Area for River Improvement

3 objective urgent project areas are located at upper reach of the Klang and Batu Rivers in Kuala Lumpur and the Gombak River in Selangor state near Federal Territory boundary.

a) Klang River

Objective area is an interval of 3.06 km in length from Tun Perak bridge to Sultan Ismail bridge and the area is a part of the representative central district of Kuala Lumpur. Commercial and institutional facilities are mainly lined along the left bank of the river, while on the right bank, residential area is dominated most of the portion beside commercial area. The river bank looks rather maintained by cutting grass in comparing with other upper stretch of the river. Water quality is quite turbid and solid wastes are often observed to and at the water margin.

b) Gombak River

Objective area is located at Gombak Malay Reservation and it has an interval of 3.5 km in length from Jln. Belonkong to the intake of the proposed diversion channel. The river is winding through the Malay Reservation area where is a low lying land as a flood prone area and often affected by flash flood.

Most of the river reserve vicinity is a grassy open land, piecemeal of agriculture area, and some low density residential area are connected to these areas.

In some places along the water margin, shrubby groves are remaining, water quality is rather good and some small fishes are often observed within shallow stream.

c) Batu River

Objective area is located from Kolam Air Empat bridge to Batu Retention Pond and total 6.09 km in length. Most of the river reach have irregularly formed river bed with rather limited narrow river reserve except vicinity of Batu ex-mining area.

Most of the river side areas up to Batu ex-mining area are lined series of residentials and industrial facilities which are rather decrepitude looks, so that it is not so easy to approach the river side area.

While the river along the Batu ex-mining area is rather openly flowed through flat area of open glass lands, various size of ex-mining ponds, and some residential areas.

Course weeds and tall grasses are fully grown along the river banks and have not been properly maintained. Water quality looks rather dark but not so much turbidity as compared with the objective area of the Klang River. (See Fig. N-7)

(2) Area for Retention Pond

Proposed Batu retention pond area is located within an ex-mining site with a residual pond. Topographically the ground profile in the neighborhood of the pond changes quite irregularly as a result of earlier mining activities. Further out, the environs have a rather smooth undulating terrain.

Most of the area is barren land with sedges and hardy shrubs growing as pioneer vegetation at some locations. There are hardly other biological features as a consequence of the greatly detrimental open cast mining activities.

The area has been used as an illegal dump yard with piles of construction debris strewn along the inner access road. There are no residence and squatter huts within the proposed area, though there are some squatter settlements some distance away from the proposed area along the Batu river.

The existing pond has about 55.7 ha of water surface with and approximately 35 m in depth of the deepest point. The water quality looks quite clean and some small fishes can be observed at pond margin. On the south there are shallow swamp of about 9.2 ha is sited and fully covered with aquatic plants. (See Fig. N-14)

(3) Area for Diversion Channel

Proposed Batu diversion channel is sited from Gombak river at 9.9 km point to Batu river at 7.4 km point and the total length of its route is 3.2 km. The route of the diversion channel crosses the land from east to west way where Karak highway is located in the center of the channel route. From the Gombak river to Karak highway, approximately 0.6 km of the route across Malay Reservation area, where village grove, some agricultural land and residences are existed. Fringe of remaining grove areas of 0.6 km is to be involved to the channel route. And approximate 0.25 km of the route passes along the existing road at a residential area, in this area box culvert type channel is to be provided as well as for crossing of Karak highway.

From Karak highway to the Batu River, most of area of the route is a series of disturbed shrubby groves, piecemeal agricultural land, swamp margin and grass land of ex-mining area. Some parts of the route are facing residential area along local road.

Some groups of trees and fruits plants are located within the village grove of the Malay Reservation and these are significantly represented scenery of the area. However most of the other areas of the route have not specific character by rather disturbed environmental conditions. (See Fig. N-19)

(4) Area for Drainage Work of Kampung Baru

Kampung Baru area with a catchment of 0.73 square kilometers is one of the infamous flood prone low lying areas in the Kuala Lumpur. This area is located on the right bank of the Klang River at 2 km upstream from the confluence with the Gombak River and often inundated by flash flood.

About 35 ha of the area is lower than the design flood level after completing all Klang river improvement works, so that the low lying area of the Kampung Baru will be inundated by inner water forever.

The proposed objective site for the drainage work, mainly underground pondage, is approximately 400 m x 20 m within the right of way of Jln. Sungai Baru and at the wide area of the road for a pump station site.

The environs of the objective work site are almost residential houses and some commercial stores along Jln. Sungai Baru. The other environs of the objective site are always through a bank of the Klang River and rather well maintained condition of grass bank berms and slope with trees and some shrubs.

9.4 Residual Significant Impacts

Most of the residual significant impacts occur during construction period especially when earthworks will be commenced and some of the residual impacts may arise during operation period. These items are as follows.

(1) Siltation

The main source of siltation comes from the disturbance of the soil during dredging or excavation operations, however it will not pose a serious threat to the river environment.

Practically, small amount of fine soil sediments will be expected to carry away by the power shovel during the implementation stage. Existing siltation process in the river will not be seriously worsen by the increase in sediment load.

(2) Erosion Control

Through engineering studies on the structure of river bank revetment and erosion protection by sod surfacing, these erosion control measures will ensure that both surface and bank erosion will be minimized during implementation.

(3) Earth Moving by Motor Lorry

Proposed earthwork volume for diversion channel project will be estimated approximately 400,000 m^3, and approximately 65,000 motor lorry will be required during the implementation period. All of the earth volume will be moved to the proposed Batu retention pond area. Traffic congestion by motor lorries may be occurred between 2 proposed project sites.

Traffic accidents, disturbance of local traffic currency, generation of noise by these motor lorries, air pollution by dust will be increased during the implementation period and these environmental impact will affect community people at the area where partially covers.

(4) Aquatic Fauna

The increase of turbidity in the water body during construction period may cause some impact to the aquatic fauna in and around the project area. However, these impacts are rather temporarily, so that it

is not considered that the proposed urgent work may cause serious damage to the aquatic fauna in comparing with present status.

(5) Aesthetic Condition of Retention Pond

Since the proposed retention pond is function for diverting flood water into it, this flood water may always cause temporary aesthetic disturbance of the water surface scenery. The quality of flood water is always poor because of its condition of muddy, turbid with many floating debris of non point origin.

As the flood water reaches the temporary retention pond area, it will mix with the settled water within the permanent pond causing a rapid degradation of the water quality at aesthetic point of view.

Mostly these condition will be occurred at the period of heavy flash flood and monsoon flood, it may be occurred approximately several times a year or so.

(6) Eutrophication of the Water of Retention Pond

The retention pond has relatively high possibility of eutrophication caused by in-flow flood water. Eutrophic retention pond affect aquatic ecosystem by shortage of dissolved oxygen and cause serious problems related to operation of the retention pond.

(7) Public Health

The environment of the retention pond area will be quite improved in comparison with present condition. The consideration of the principal impacts from impounding of large water body by causing flood water in-flow will be the possibile to generate vector borne diseases affects such as mosquitoes biting.

However the proposed retention pond area is not these malaria and filariasis endemic area and free from water-borne parasitic diseases.

The presence of large body of water may provide an aquatic habitat favorable to mosquitoes. These hosts may breed in retention pond margin.

(8) Social Impact concerned Land Acquisition

The land acquisition area reguired for river improvement becomes about 3.9 ha for Klang river, 11.0 ha for Gombak river and 9.6 ha for Batu river, and most of these areas are the private lands as for obtaining sufficient width of river reserve of maximum 60 m.

While the diversion channel project needs about 19.5 ha of the private owned land for obtaining maximum 60 m width of the channel reserve area.

These land acquisition may directly affect local peoples to relocate their places and sometimes need compensation for them.

9.5 Mitigating and Abatement Measures

In this section mitigation measures have been considered on the residual significant environmental impacts described, and these considerations are as follows.

(1) Earth Moving by Motor Lorry

In the project site facing residential area where earthwork will be implemented, the traffic route of motor lorries shall be considered to provide within reserve area of the division channel (approx. 35 m to 60 m) during earthwork period and avoid traffic accidents and disturbance of local traffic.

Noise and air pollution will not so much be expected to mitigate but through construction management, most aptitude cares of noise and dust control must be taken by on site direction to operators to minimize friction and disturbance to the community life.

(2) Aesthetic Condition of Retention Pond

As for the aesthetic degradation causing by flood water retention, a sedimentation pond is provided at a location just before retention pond inlet in order to sediment silt and heavy suspended solid together with screening flow-in floating debris by installing a set of log boom.

Most of the silt, heavy suspended solid and floating debris will be treated in this sedimentation pond, so that the turbid flood water will be purified and flow into the retention pond through the weir.

In-flowed water from the sedimentation pond is still turbid condition, but the retention pond has more than 20 m in the depth that is quite functioned to stabilize more residual silt or suspended solid of the water accordingly.

After discharging of the retained flood water, few days are probably needed to become a stable clean water condition.

(3) Eutrophication of Retention Pond

For eutrophication of retention pond, several mitigation measures can be considered to reduce generation of aquatic plants and algae. The retention pond has quite large depth of water body more than 20 m, and this status may affect cool and stable water temperature condition for controlling these generation of aquatic flora species.

And for controlling the generation of these aquatic flora and algae, herbivorous fish fauna species shall be introduced to the retention pond. Furthermore during stilled water condition of the pond when flood water is not flow-in, a maintenance water flow will be introduced.

At the upper reach point of the retention pond, a water inlet from the Batu river shall be provided the maintenance water into the pond area. This maintenance water will circulate and activate the water of the retention pond.

(4) Public Health

The flourishing of aquatic flora and habitat will favor mosquito breeding but this condition is really related to the stilled water condition, to eutrophication of the water, the high water temperature and shallow water depth and too few opportunities to maintain to keep clear the banks of the pond.

(5) Social Impact concerned Land Acquisition

The land acquisition is always faced some difficulties by sticking on the ownership of individual private assets, concessions and devotions for objective owners and dwellers of each community and or place.

The social significance of mitigation measures against flood damage by the project of river improvement and diversion channel, and also beneficial environmental impact to the community area and peoples with contribution by the project shall be effectively promulgated through aptitude public relations. Under these circumstance, it shall be definitely needed and effectively made a mutual understanding and consensus between objective land owners also dwellers and the project implementation body.

These procedure of land acquisition and compensation for objective areas and assets will be able to minimize mutual frictions and difficulties as social impacts.

9.6 Beneficial Impact

The beneficial impact by the urgent works will mainly be flood mitigation of the central area of Kuala Lumpur where is threatened by frequent floods and impoundings. And another important plus point for any flood mitigation project is that the accompanying river rehabilitation works normally improve the riverine landscape from its existing barren condition.

Further beneficial environmental impact can be divided with the opening up of new parklands through regeneration of the barren ex-mining area around the retention pond with aesthetic landscaping of the retention pond surroundings.

A self perpetuating natural ecosystem may be reintroduced into this area, to further increase recreational opportunities.

Improvement of water quality through screening and sedimentation of floating debris and suspended solids at the sedimentation pond beside retention pond will result in some improvement of river water quality, since water discharging from the retention pond back into the river system has been cleared of most of its suspended loads and other major parameters.

The important in the riverine landscape that can result from the implementation of the flood mitigation project may be gleaned from the finished channelized stretch within the central district of Kuala Lumpur.

9.7 Summary of Conclusions

The scheme of this urgent projects for flood mitigation is not properly large enough scale project to meet with the schedule of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987.

However the environmental impacts will be always caused directly or indirectly by the project activities, so that the consideration of preliminary environment impact assessment has been considered.

The main objective of this study is to identify the exact locations and order of priorities of the urgent projects. The purpose of this section is to describe the preliminary environmental impact associated with the implementation of these projects.

One of the most significant environmental impact is the temporary increase in suspended solids (Turbidity by mud) caused by rivers dredging and widening to implement the channelization works.

However, this temporary pollution is not so serious for the riverine fauna when implementation is carried during construction stages. This is because there is a rather poor range of fish fauna inhabiting the objective rivers and all these are hardy species quite well adopted to the present muddy conditions.

Construction vehicles will cause noise and dust pollution in the surrounding areas while traffic congestion may be generated in the residential areas having narrow access to the river bank. This matter is of importance as traffic access, safety operation and attention to the needs of the residents inhabiting the project area will minimize friction and disturbance.

Some of the river reserve areas with private ownership land will be more problematic as resisting of these dwellers would be necessary. Effort for acquisition will have to carried out with the cooperation of

the City Hall and government agencies so that it can be executed smoothly before construction work actually commences on site.

Another social impact which needs careful consideration concerns land acquisition and compensation of land under private ownership along part of the diversion channel. These lands are located in a Malay Reservation area. The fine subdivision of land ownership of such land may cause difficulty in land acquisition.

Some of the monitoring programs for hygienic condition and vector control for the retention pond after intake and discharge of the flood water may be recommended for the safety use of the temporary retention pond area as park land.

Generally quite large beneficial impact will be arisen through the urgent works, there will be clean river side environment with more aesthetic condition, more opportunities for recreation and sports space, urban greenifications and improvement of water quality beside flood mitigation. (See Fig. N-21)

REFERENCE

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Table N-1

FULLY PROTECTED ANIMALS IN SELANGOR (PROTECTION OF WILDLIFE ACT NO. 76/1972)

Common Name	Scientific Name	Local Name	Abundant	Rare	Ulu Gombak Forest	Rubber Estate	Lime stone clife	Bushes	Mash Land	Mining Pool	River
1. Javan Rhinocerog	Rhinoceros sondaicus	Badak raya									
2. Sumatran Rhinoceros	Didermoceros sumatrensis	Badak kerbau									
3. Tapir	Tapirus indicus	Badak cipan, Badak tampung		•	•						
4. Banteng	Bos banteng	Banteng, sapi hutan									
5. Siamang	Hylobates syndactylus	Siamang			•						
6. Agile Gibbon	Hylobates agilis	Wak-wak									
7. White-handed Gibbon	Hylobates lar	Ungka		•	•						
8. Scaly Ant Eater/Pangolin	Manis javanica	Tenggiling	•		•	•		•			
9. Malayan Wild Dog	Cuon alpinus	Serigala, anjing hutan									
10. Clouded Leopard	Neofolis nebulosa	Harimau dahan									
11. Marbled Cat	Felis marmorata	Kucing dahan		•	•		•				
12. Flat-headed Cat	Felis planiceps	Kucing hutan									
13. Golden Cat	Felis temminokii	Kucing tulap									
14. Linsang	Prionodon linsang	Linsang		•	•						
15. Binturung/Bear Cat	Arctictis binturong	Binturong									
16. Slow Loris	Nycticebus coucang	Kongkang, kera duku		•	•						
17. Otter Civet	Cynogale bennettii	Musang memerang									
18. Derby's Banded Civet	Hemigalus derbyanus	Musang belang									
19. Yellow-throated Marten	Martes flavigula	Mengkira		•	•						
20. Weasel	Mustela nudipes	Pulasan		•	•						
21. Long-tailed Porcupine	Trichys lipura	Landak padi									
22. Serow	Capricornis sumatrensis	Kambing gurun	•								
23. Selangor Pigmy Flying Squirrel	Petaurillus kinlochii	Tupai terbang terkecil		•							
24. Red-cheeked Flying Squirrel	Hylopates spadiceus	Tupai terbang pipi merah		•	•						
25. Grey-cheeked Flying Squirrel	Hylopetes lepidus	Tupai terbang pipi kelabu		•							
26. Whiskered Flying Squirrel	Petinomys genebarbis	Tupai Terbnag berjambang		•	•						
27. White-Bellied Flying Squirrel	Petinomys setosus	Tupai Terbang Dada Putih		•	•						
28. Vordermann's Flying Squirrel	Petinomys vordermanni	Tupai Terbang Terkecil									
29. Horsfield's Flying Squirrel	Iomys horfieldii	Tupai Terbang Ekor Merah		•	•						
30. Smoky Flying Squirrel	Pteromyscus pulverulentus	Tupai Terbang Kotor									
31. Large Black Flying Squirrel	Aeromys tephromelas	Tupai Terbang Hitam									
32. Red Giant Flying Squirrel	Petaurista petaurista	Tupai Terbang Merah		•	•						
33. Spotted Giant Flying Squirrel	Petaurista elegans	Tupai Terbang Bintang									
34. Malayan Flying Lemur	Cynocephalus variegatns	Kubong									
35. Tigor	Panthera tigris	Harimau Belang		•	•						
36. Hairy-nose Otter	Lutra sumatrana	Memberang Hidung									
37. Smooth Otter	Lutra perspillata	Memberang Licin	•						•	•	•
38. Common Otter	Lutra lutra	Memberang Utara									
39. Leopard Cat	Felis bengalensis	Kucing Batu	•								
40. Crocodile	Crocodylus porosus	Buaya Tembaga		•							
41. Malayan Gharial	Tomistoma schiegeli	Buaya Julung-julung									
42. Malayan Honey-Bear	Helarctos malayanus	Beruang		•	•						
43. Leopard	Panthera parius	Harimau bintang, Harimau kumbang		•	•						

Table N-2 PROTECTED ANIMALS IN SELANGOR

Common Name	Scientific Name	Local Name	Abundant/Rare	Ulu Gombak Forest	Rubber Estate	Oil palm Estate	Primary Forest	Secondary Forest	Bushes	Rice Field	Mangrove Forest
1. Elephant	Elephas maximus	Gajah									
2. Gaur	Bos Gaurus hubbacki	Seladang									
3. Sambur Deer	Cervus unicolor equinus	Rusa									
4. Barking Deer	Munctiacus munt jak	Kijang	A	•							
5. Large Mouse-Deer	Tragulus napu	Napuh	A				•	•			
6. Lesser Mouse-Deer	Tragulus javanicus	Pelanduk	A				•	•			
7. Wild Pig	Sus scrofa	Babi Hutan	A		•		•	•	•		
8. Bearded Pig	Sus barbatus	Babi Bodoh									
9. Small-clawed Otter	Amblonyx clinerea	Memberang Kecil									
10. Common Palm Civet	Paradoxurus hermaphroditus	Musang Pulut	A		•		•	•	•		
11. Malay Civet	Viverra tangalunga	Musang Tengalung					•	•	•		
12. Large Indian Civet	Viverra zibetta	Musang Gibbet					•	•	•		
13. Large Spotted Civet	Viverra megaspila	Musang Titek Besar									
14. Masked Palm Civet	Peguma larvata	Musang Lamri				•	•	•	•		
15. Small-toothed Palm Civet	Arctogalidia trivirgata	Musang akar					•	•			
16. Little Civet	Viverracula malaccensis	Musang bulan									
17. Short-tailed Mongoose	Herpestos brachyurus	Bambun ekor pendek			•		•			•	
18. Small Indian Mongoose	Herpestos auropunctatus	Cerpelai, bambun kecil									
19. Indian Grey Mongoose	Herpestos edwardsii	Bambun kelabu									
20. Javan Mongoose	Herpestos javanicus	Bambun Jawa									
21. Pig-tailed Macaque	Macaca nemestrina	Beruk	A				•	•			
22. Long-tailed/Crab-eating Macague	Macaca fascicularis	Kera	A		•		•	•	•		•
23. Banded Leaf-Monkey	Presbytis melalophos	Lotong Ceneka	A								
24. Dusky Leaf-Monkey	Presbytis obscura	Lotong Cengkong	A		•		•	•			
25. Silvered Leaf-Monkey	Presbytis cristata	Lotong Kelabu	A								•
26. Malayan Porcupine	Hystrix brachyura	Landak Raya	A				•	•			
27. Brush-tailed Porcupine	Atherurus macrcurus	Landak nibung Landak batu	R	•							
28. Prevost's Squirrel	Callasciurus presvostii	Tupai Gading	A	•							
29. Common Giant Squirrel/ Cream Coloured Giant Squirrel	Ratufa affinis	Tupai kerawak putih kuning	A	•							
30. Black Giant Squirrel	Ratufa bicolor	Kerawak hitam	A	•							
31. Malayan Flying Fox	Pteropus vampyrus	Keluang	A	•							•
32. Island Flying Fox	Pteropus hypomeianus	Keluang kecil									
33. Python	Python roticulatus	Ular Sawa	A				•	•			
34. Water Monitor	Varaus salvator	Biawak air									•
35. Clouded Monitor	Varaus nebulosus	Biawak tikus			•						
36. Harlequin Monitor	Varaus rudicollis	Biawak serunai									
37. Dumeril's Monitor	Varaus dumerili	Biawak kudung									

Table N-3 PROTECTED WILD BIRDS IN SELANGOR (1/3)

	Common Name	Scientific Name	Local Name	Abundant/Rare	Rubber Estate	Oil palm Estate	Secondary Forest	Costal Area	River bed	Mash Land	Primary Forest	Gardens	Bushes
1.	Red Jungle Fowl	Gallus gallus	Ayam Hutan	A	•	•	•						•
2.	White-Breasted Waterhen	Amaurornis phoenicurus	Ruak-ruak	A									
3.	Painted Snipe	Rostratula benghalensis	Meragi	A				•					
4.	Red-Wattied Lapwing	Lobiavanellus indicus	Duit-duit										
5.	Grey Plover	Pluvialis squatarole	Kedidi Besar										
6.	Golden Plover	Pluvialis dominica	Burung Keriyut	A				•					
7.	Little Ringed Plover	Charadrius dubius	Kedidi Biji Nangka	A				•					
8.	Kentish Plover	Charadrius alexandrinus	Kedidi Pantai										
9.	Malay Sand plover	Charadrius peroni	Burung Kepala Rapang	A				•	•				
10.	Mongolian Plover	Charadrius mongolus	Burung Kepala Rapang Kecil	A				•					
11.	Large Sand Plover	Charadrius leschenaulti	Burung Kepala Bapang Besar	R				•					
12.	Eastern Dotteral	Charadrius asiaticus	Kedidi Caspian										
13.	Whimbrel	Numenius phaecpus	Burung Pisau Raut	A				•					
14.	Common Curlew	Numenius arquatus	Burung Kendi	A				•					
15.	Australian Curlew	Numenius madagascariensis	Burung Kendi Australia										
16.	Black-tailed Godwit	Limosa limosa	Kedidi Ekor Hitam	A				•					
17.	Bar-tailed Godwit	Limosa lapponica	Kedidi Ekor Berjalur	R				•					
18.	Redshank	Tringa totanus	Burung Kaki Dian Merah	A				•					
19.	Green Shank	Tringa rebularis	Burung Lilin	A				•					
20.	Marsh Sandpiper	Tringa stagnatilis	Kedidi Paya	A				•					
21.	Wood Sanpiper	Tringa glarecla	Kedidi Kayu	A				•					
22.	Nordmann's Greenshank	Tringa guttifer	Burung Kaki Dian Titik										
23.	Terek Sandpiper	Tringa terek	Kedidi Sereng										
24.	Common Sandpiper	Tringa hypoleucas	Kedidi Kelicap	A				•	•	•			
25.	Wandering Tattler	Heteroscelus incanus	Burung Kucau Tongkeng Kelabu										

Note: A Abandant
R Rare

Table N-3

PROTECTED WILD BIRDS IN SELANGOR (2/3)

Common Name	Scientific Name	Local Name	Abundant/Rare	Rubber Estate	Oil palm Estate	Secondary Forest	Costal Area	River bed	Mash Land	Primary Forest	Gardens	Bushes
26. Turnstone	Arenaria interpres	Burung Tiarap Batu Kerikil	A				•					
27. Dowitcher	Limnodromus griseus	Berkek Dada Merah					•					
28. Pintail Snipe	Capella stenura	Berkek					•					
29. Wood Snipe	Capella nemoricola	Berkek Kayu										
30. Swinhoe's Snipe	Capella megala	Burung Tirok										
31. Common Snipe	Capella gallinago	Berkek Ekor Kipas	A				•	•				
32. Woodcock	Scolopax rusticola	Berkek Besar	R						•			
33. Knot	Calidris canutus	Kedidi Dian Kecil	R				•					
34. Great Knot	Calidris tenuirostris	Kedidi Dian Besar										
35. Sanderling	Crocethia alba	Kedidi Kepak Jalur Putih										
36. Little Stint	Calidris ruficollis	Kedidi Leher Putih										
37. Temminek's Stint	Calidris temmincki	Kedidi Temminck										
38. Long-toed Stint	Calidris minutillus	Kedidi Jari Panjang										
39. Curlew Sandpiper	Calidris ferriginues	Kedidi Kendi										
40. Broad-billed Sandpiper	Limicola falcinellus	Kedidi Paroh Lobar										
41. Ruff	Philomachus pugnax	Burung Ropol										
42. Crab Plover	Dromas ardecla	Kedidi Ketam										
43. Collared Pratincole	Glareola practincola	Kedidi Padang										
44. Seimund's Pintail Pigeon	Sphenurus seimundi	Punai Gunung										
45. Wedge-tailed Green Pigeon	Sphenurus sphenurus	Punai Bukit										
46. Large Thick-Billed Green Pigeon	Treron capellei	Lenggauk	A			•				•		
47. Lesser Thick-Billed Green Pigeon	Treron curvirestra	Punai Daun	A			•				•	•	
48. Cinnamon-headed Green Pigeon	Treron fulvicollis	Punai Bakau										
49. Little Green Pigeon	Treron olax	Punai Siul	A									
50. Pink-necked Green Pigeon	Treron vernans											

Table N-3 PROTECTED WILD BIRDS IN SELANGOR (3/3)

Common Name	Scientific Name	Local Name	Abundant/Rare	Secondary Forest	Primary Forest	Forest	Tin mine area	Swamp	Mining Pool	Rice Fields	Gaden	Mash Land
51. Orange-breasted Green Pigeon	Treron bicinta	Punai Siam										
52. Jambu Fruit Pigeon	Ptilinopus jambu	Punai Gading		•	•						•	
53. Barred Cuckoo Dove	Macropygia unchall	Tekukor Api Gunung										
54. Little Cuckoo Dove	Macropygia ruficops	Tekukor Api										
55. Indian Whistling Duck	Dendrocygna javanica	Belibis	A					•	•			
56. White-winged Wood Duck	Cairina scutulata	Serati Hutan										
57. Gargany Teal	Anas guerguedula	Itik Gargany										
58. Common Teal	Anas crecca	Itik Eropah										
59. Shoveller	Anas clypeata	Itik Sudu										
60. Cotton Teal	Nettapus coromandelianus	Itik Air										
61. Tufted Duck	Aythya fuligula											
62. Slaty-breasted Rail	Rullus striatus	Sintar	A						•	•		•
63. Malay Banded Crake	Rallina facestiata	Sintar Api	A						•	•		•
64. Philippine Banded Crake	Rallina curizonoides	Sintar Merah	R							•		•
65. Baillon's Crake	Porzana pusilla	Sintar Konek	R							•		•
66. Ruddy Crake	Porzana fusca	Sintar Kecil	R							•		•
67. Chinese Banded Crake	Porzana paykulli	Sintar Berjalur	A							•		
68. White-browed Rail	Poliolimna	Sintar Perut Kelabu	A							•		
69. Watercock	Gallicrex cinerea	Ayam-ayam	A							•		
70. Moorhen	Gallinula chlorophus	Tiong	A					•	•			
71. Painted Quail	Coturnix	Puyuh	A			•	•					
72. Barred Bustard Quail	Turnix suscitator	Puyuh					•					
73. Emerald Dove	Chalcophaps indica	Punai Tanah	A	•	•							
74. Red-whiskered Bulbul	Pcynonotus jocosus	Merbah Telinga Merbah	A			•						
75. Yellow-crowned Bulbul	Pcynonotus zeylanicus	Barau-barau	A			•						
76. Hill Myna	Gracula religiosa	Tiong Mas	A			•						
77. Common Shama	Gopsychus malabaricus	Murai Batu	A	•	•							
78. Oriental White-eyed	Zosterops palpebrosa	Kelicap Kunyit	A			•					•	

Table N-4 SQUATTERS IN FEDERAL TERRITORY (within 30m zone from the river edge)

Name of River	No. of Squatter Location			Total Length of Squatter Area (m)			No. of Family			Population		
	Right Bank	Left Bank	Both Banks Total	Right Bank	Left Bank	Both Banks Total	Right Bank	Left Bank	Both Banks Total	Right Bank	Left Bank	Both Banks Total
Klang	11	8	19	3,090	1,820	4,910	35	254	289	146	1,242	1,388
Gombak	4	3	7	460	520	980	98	160	258	518	902	1,420
Batu	3	6	9	560	860	1,420	117	198	315	683	1,070	1,753
Kerayong	20	21	41	3,120	3,800	6,920	269	172	441	1,314	870	2,184
Total	38	38	76	7,230	7,000	14,230	519	784	1,303	2,661	4,084	6,745

Table N-5 PROPOSED INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETERS	(units)	CLASSES					
		I	II A	II B	III	IV	V
Ammoniacal Nitrogen	mg/L	0.1	0.3	0.3	0.9	2.7	> 2.7
BOD	mg/L	1	3	3	6	12	> 12
COD	mg/L	10	25	25	50	100	>100
DO	mg/L	7	5 - 7	5 - 7	3 - 5	< 3	< 1
pH	mg/L	6.5 - 8.5	6 - 9	6 - 9	5 - 9	5 - 9	-
Color	TCU	15	150	150	-	-	-
Elect. Cond.*	µmhos/cm	1000	1000	-	-	6000	-
Floatables		N	N	N	-	-	-
Odour		N	N	N	-	-	-
Salinity*	0/00	0.5	1	-	-	2	-
Taste		N	N	N	-	-	-
Total Diss. Solid*	mg/L	500	1000	-	-	4000	-
Total Susp. Solids	mg/L	25	50	50	150	300	> 300
Temperature	°C	-	Normal ±2	-	Normal ±2	-	-
Turbidity	NTU	5	50	50	-	-	-
F. Colif.**	counts/ 100 mL	10	100	400	5000 (20000)a	5000 (20000)a	
Tot. Colif.	counts/ 100 mL	100	5000	5000	50000	50000	> 50000

For Klang River

N = No visible floatable materials/debris,
or No objectionable odour,
or No objectionable taste.

* = Related parameters, only one recommended for use

** = Geometric mean

a = Maximum not to be exceeded

CLASS	USES
I	Conservation of natural environment Water supply I - practically no treatment necessary (except by disinfection or boiling only) Fishery I - very sensitive aquatic species
IIA	Water supply II - conventional treatment required Fishery II - sensitive aquatic species
IIB	Recreational use with body contact
III	Water supply III - extensive treatment required Fishery III - common, of economic value, and tolerant species Livestock drinking
IV	Irrigation
V	None of the above

This data is adapted from the Water Quality Criteria and standards for Malaysia, Final report JUL.1986, DOE.

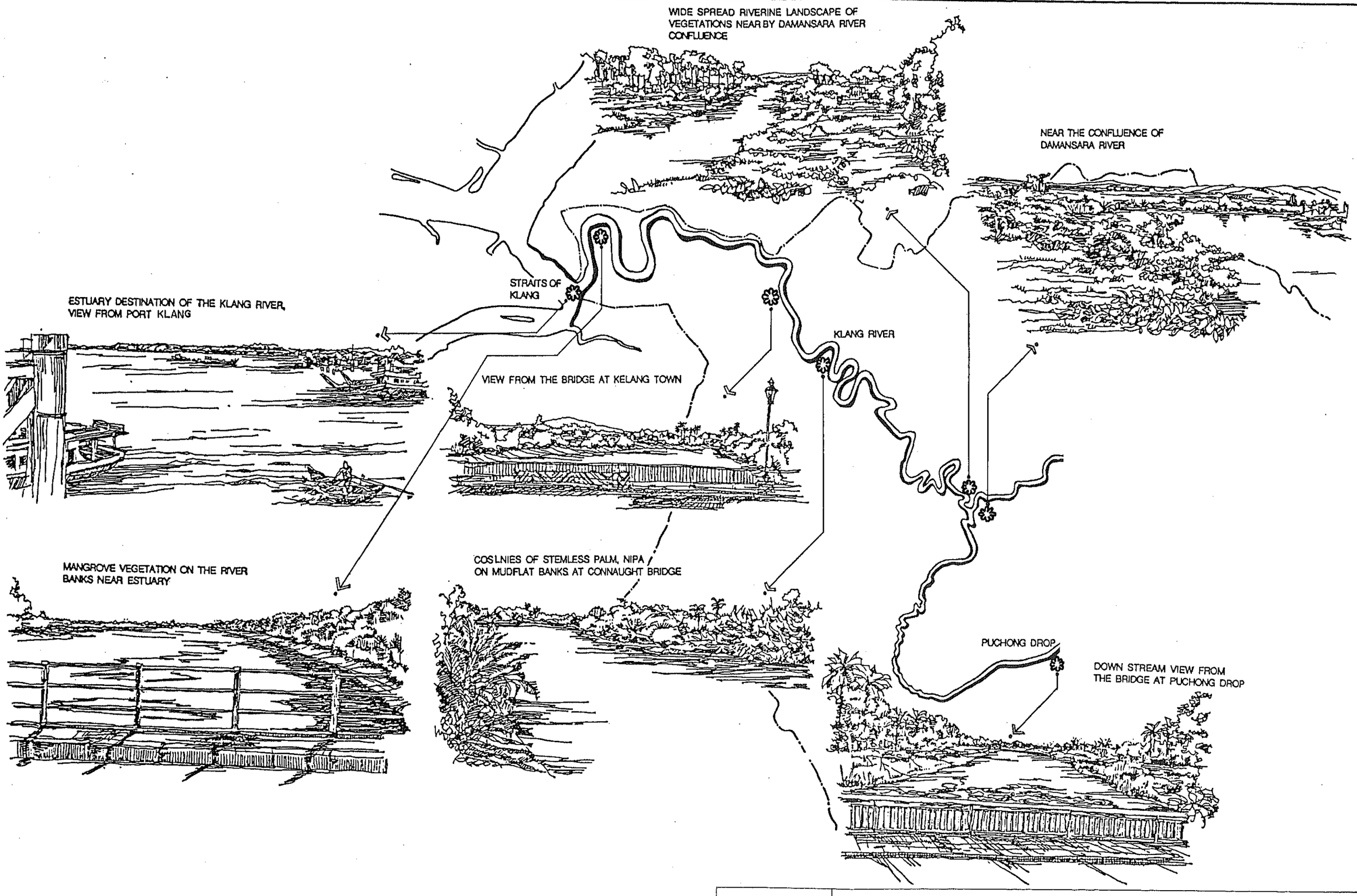
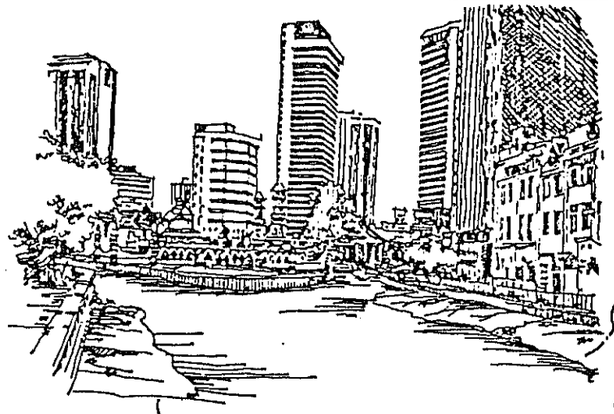


FIG. N-1	EXISTING RIVERSIDE LANDSCAPE (1/2)

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA

THE CONFLUENCE OF KLANG RIVER AND BATU RIVER AT MARKET STREET

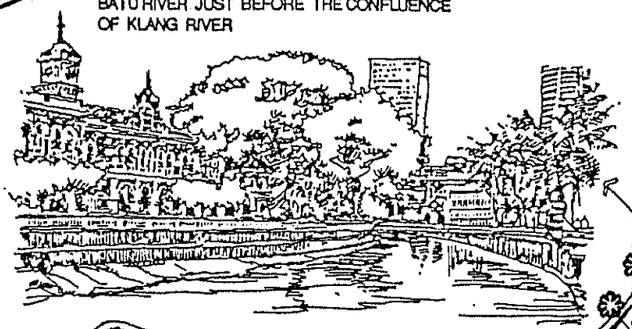


UPPER STREAM NEAR BY KLANG GATES DAM

BATU RIVER

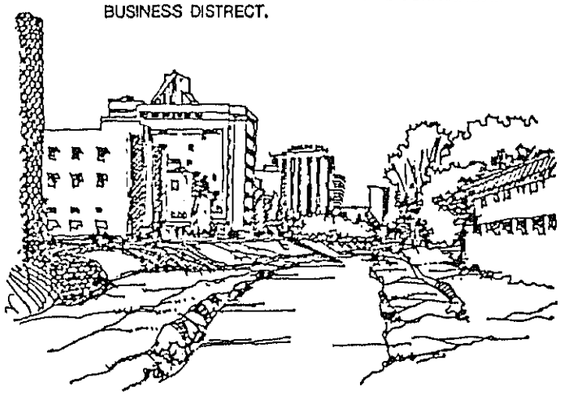
DAMANSARA RIVER

BATU RIVER JUST BEFORE THE CONFLUENCE OF KLANG RIVER



GOMBAK RIVER

UPSTREAM, ENTERING THE CENTRAL COMMERCIAL BUSINESS DISTRECT.

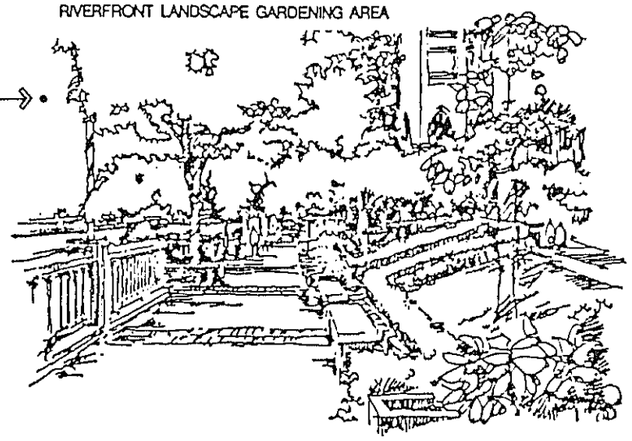


KLANG RIVER

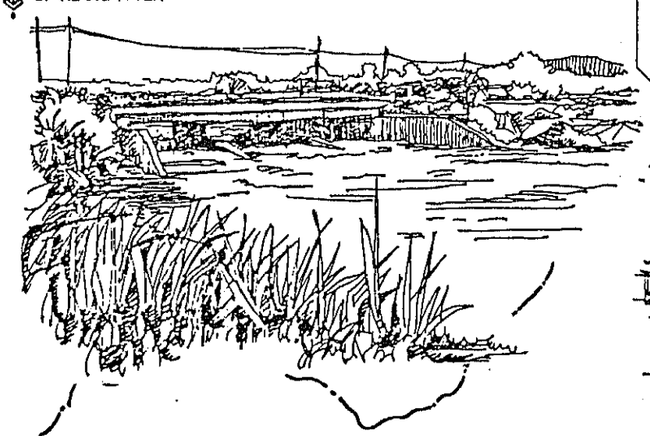
KLANG RIVER

AMPANG RIVER

PEDESTRIAN WALKWAY AND RIVERFRONT LANDSCAPE GARDENING AREA



PUCHONG DROP, VIEW FROM THE UPSTREAM OF KLANG RIVER



KERAYONG RIVER

MID-STREAM NEAR BY BRIDGE AT BRICKFIELDS STREET

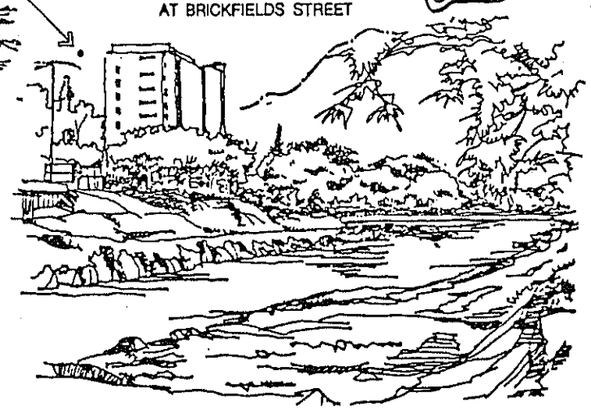
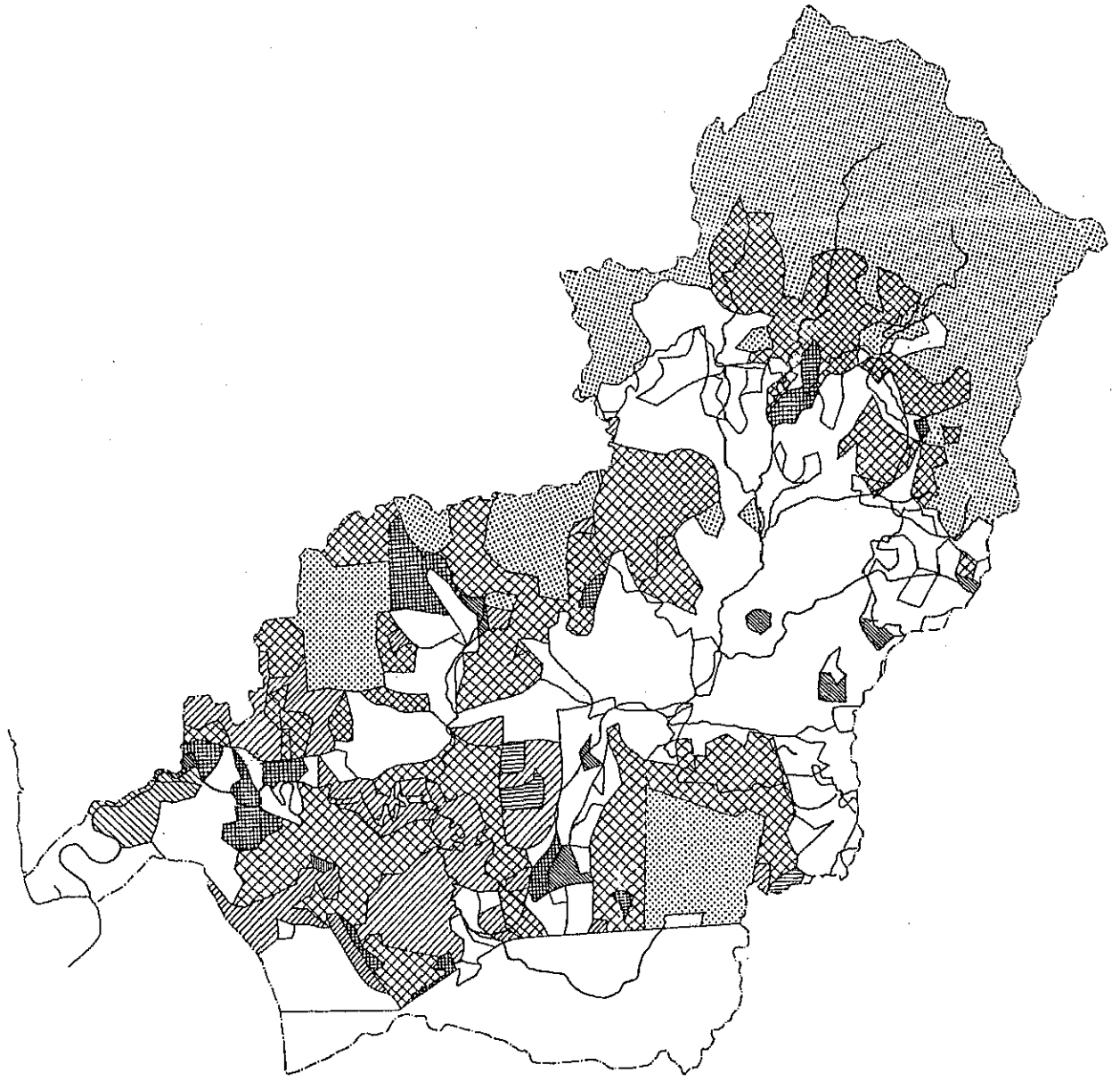


FIG. N-1 EXISTING RIVERSIDE LANDSCAPE (2/2)

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN



Source : KVEIP report vol. 1, 1987

LEGEND

AGRICULTURE

- COFFEE
- SCRUB GRASS LAND
- OIL PALM
- COCONUT
- COCOA
- RUBBER / SCRUBLAND
- MIXED HORTICULTURE
- FOREST

N

0 2 4 6 8 10Km

FIG. N-2 FOREST RESOURCE MAP IN THE STUDY AREA

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA

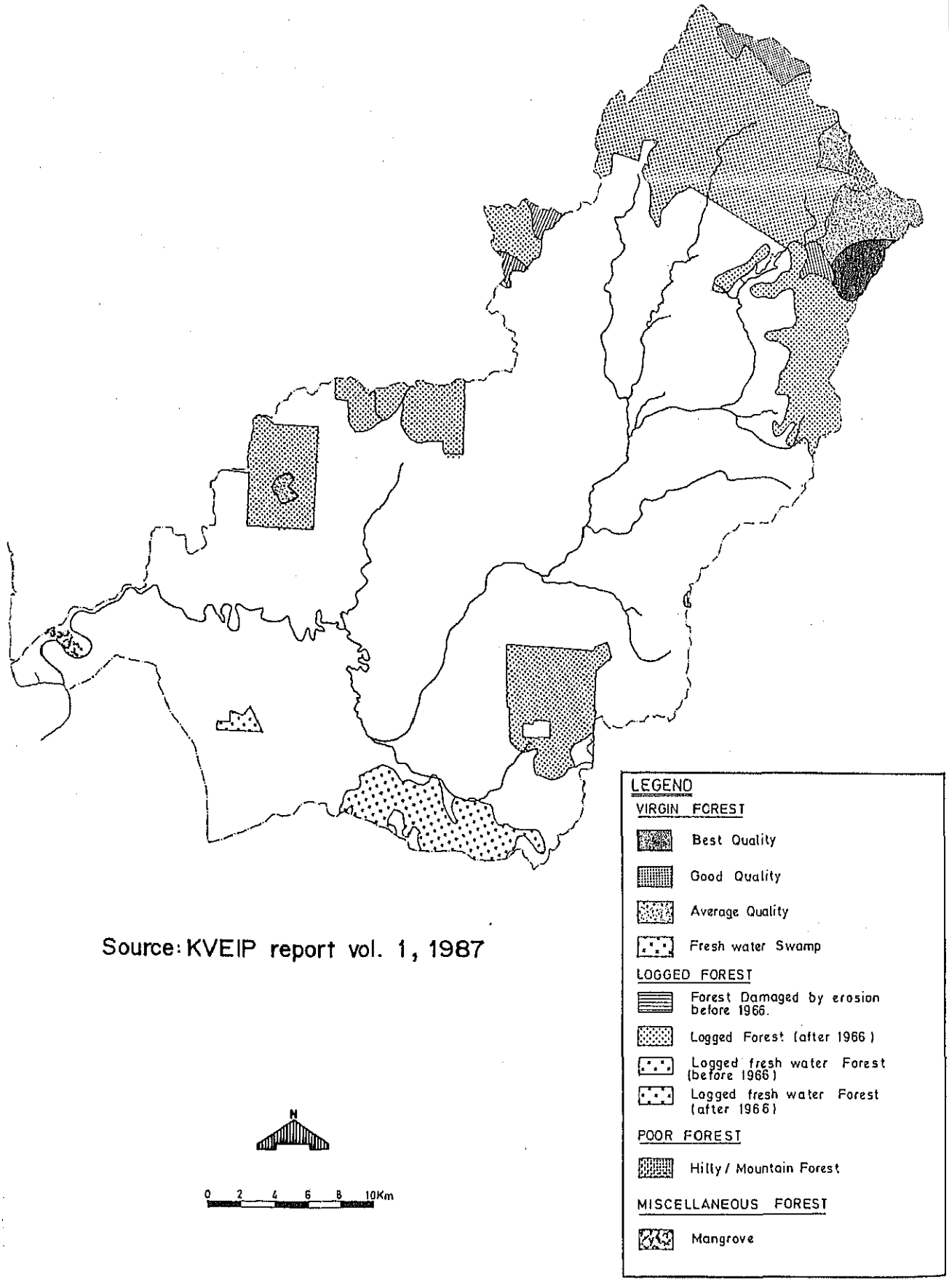


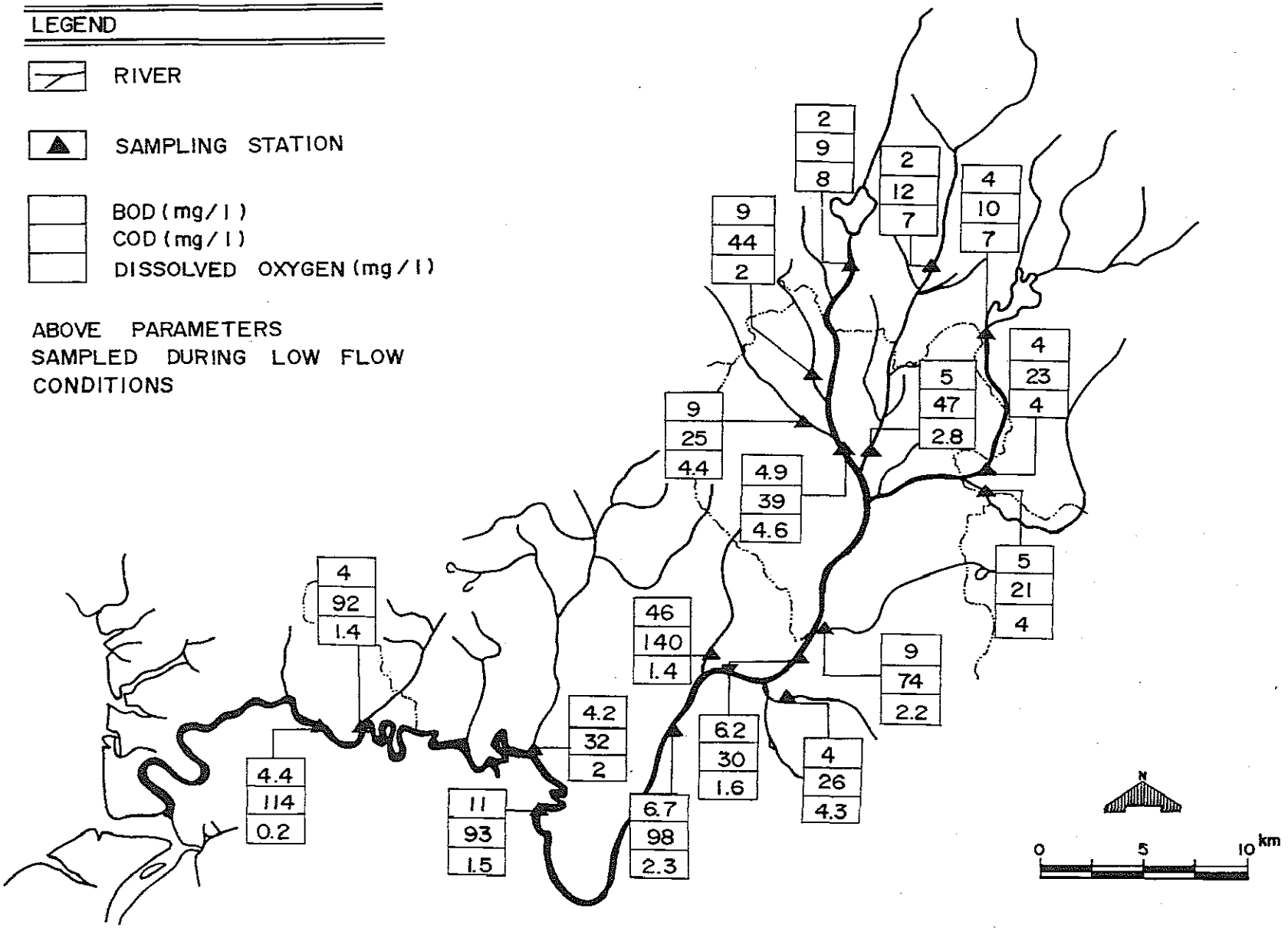
FIG. N-3 **AGRICULTURAL VEGETATION MAP IN THE STUDY AREA**

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA

FIG. N-4

WATER QUALITY IN THE KLANG RIVER, BOD, COD AND DO AT SAMPLING STATIONS



Source: KVEIP report vol. 1, 1987

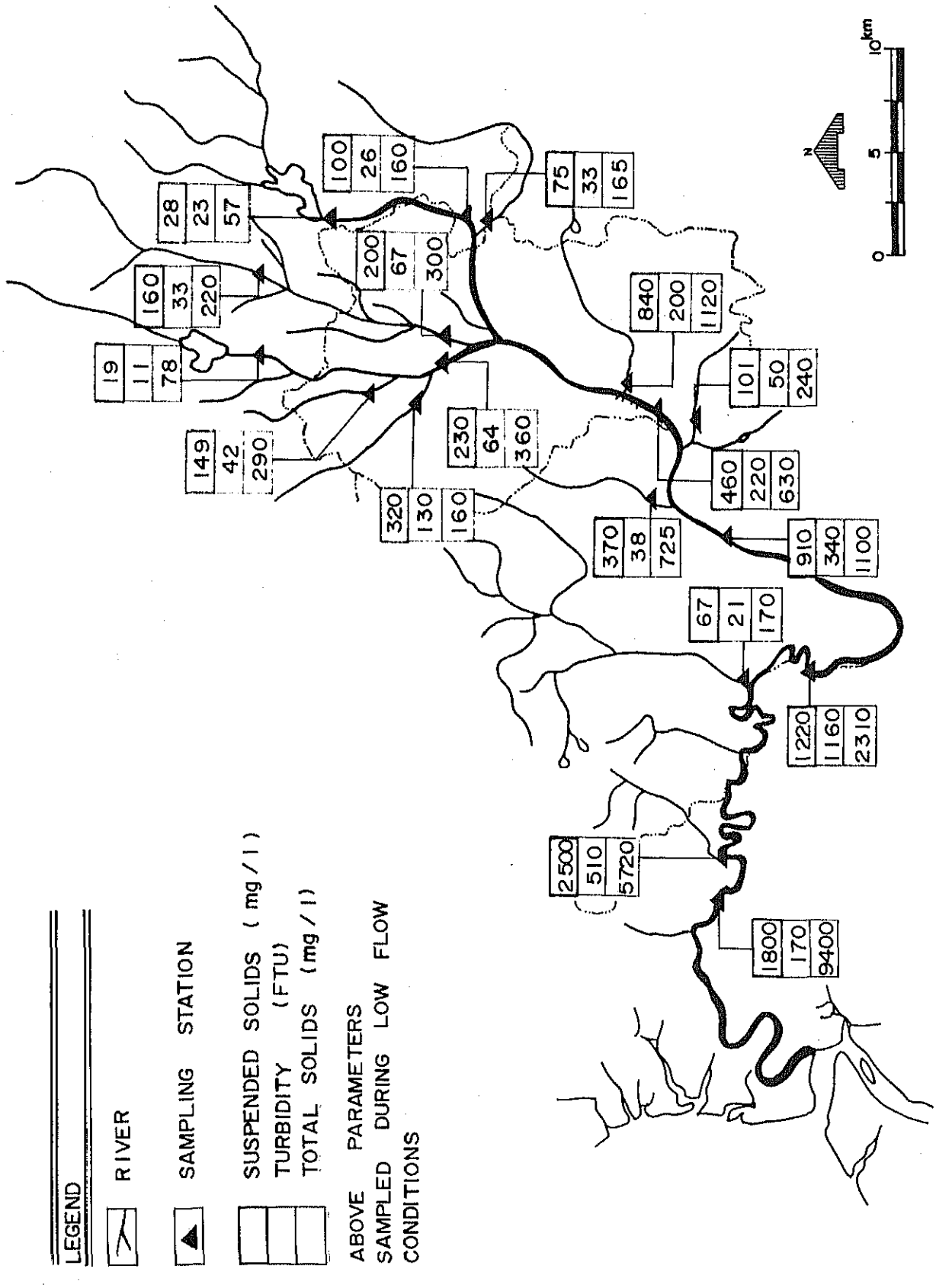
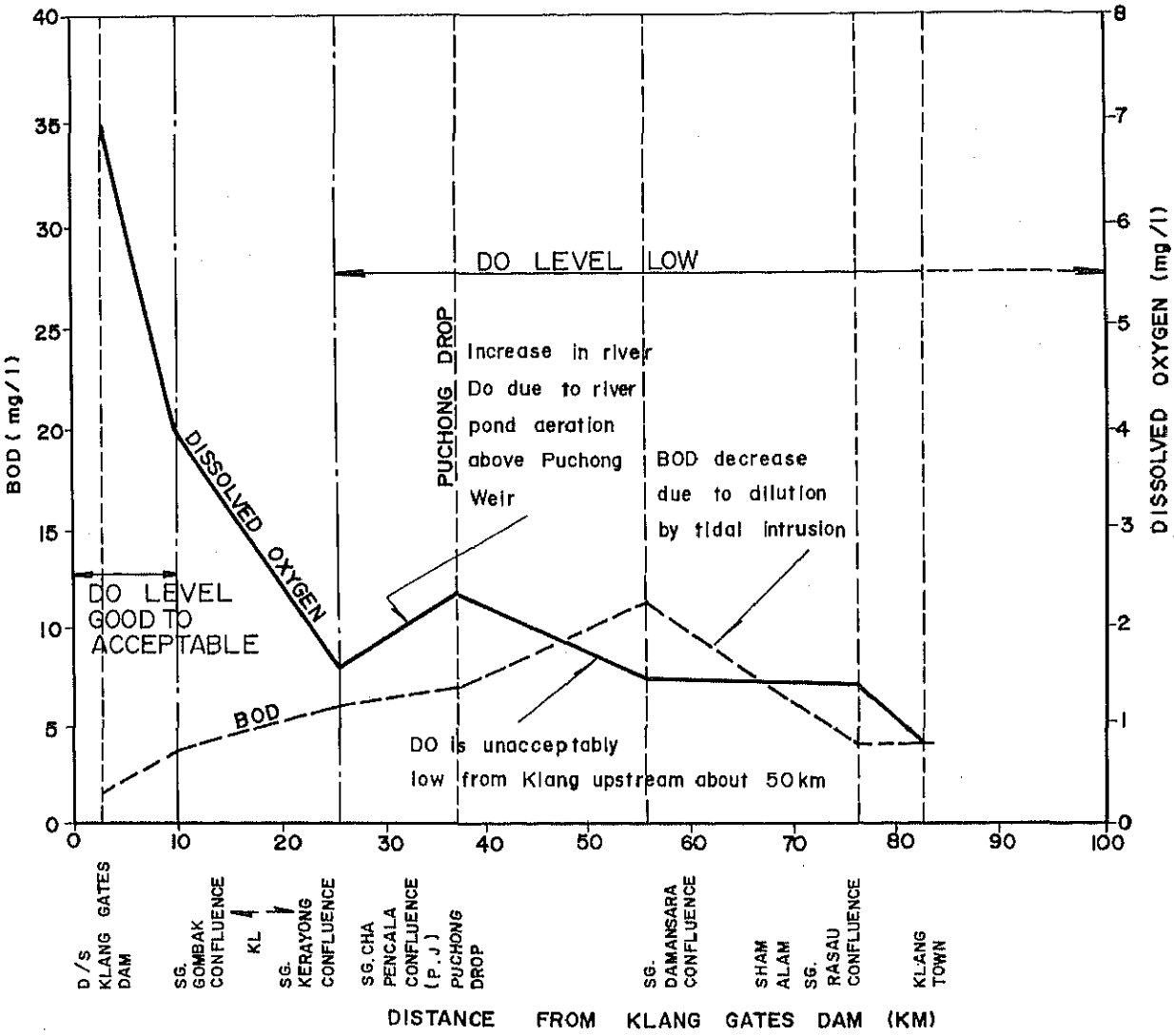


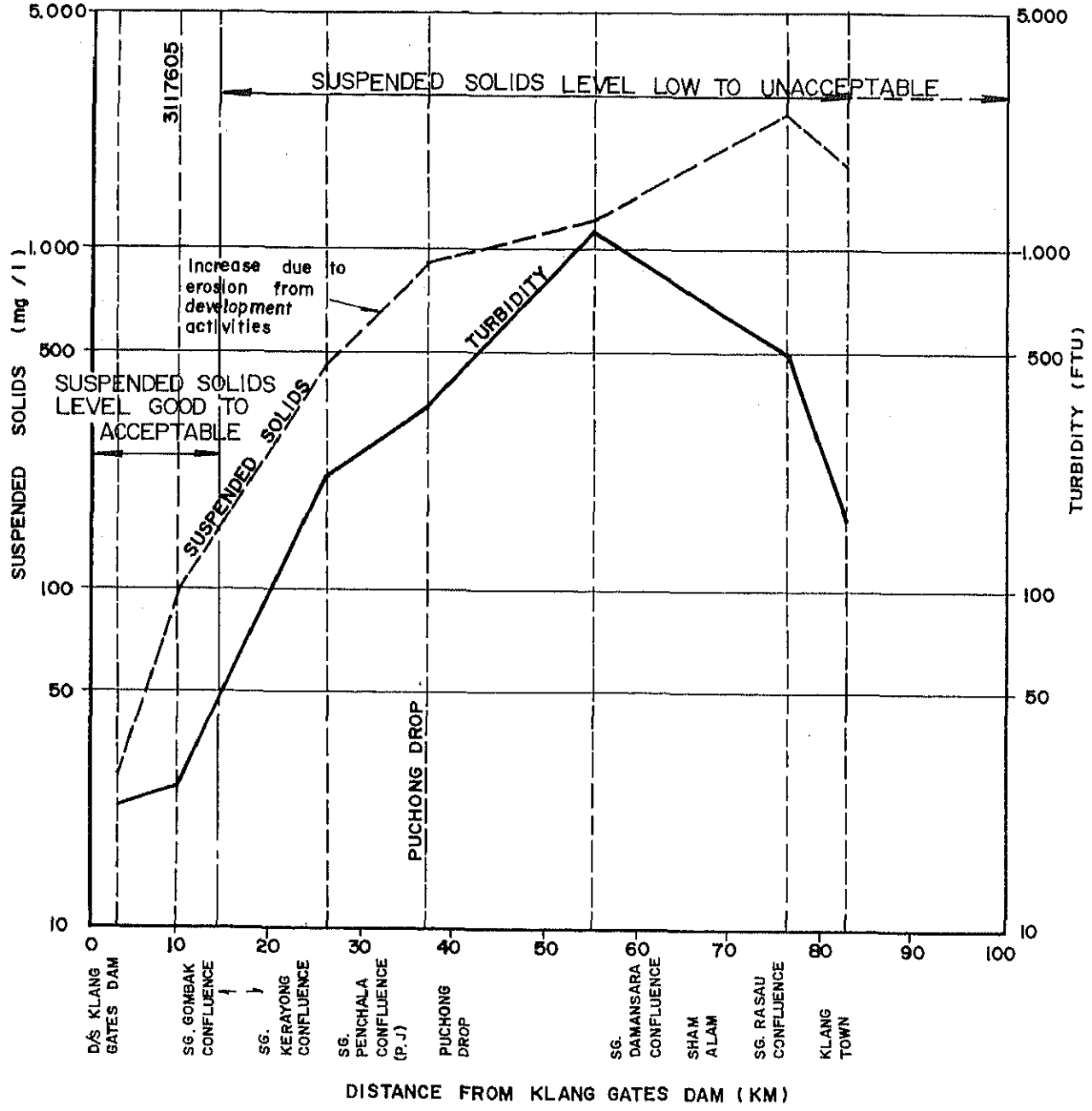
FIG. N-5 WATER QUALITY IN THE KLANG RIVER, SUSPENDED SOLIDS TURBIDITY AND TOTAL SOLIDS AT SAMPLE STATIONS

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN



Source KVEIP report vol. 1 1987

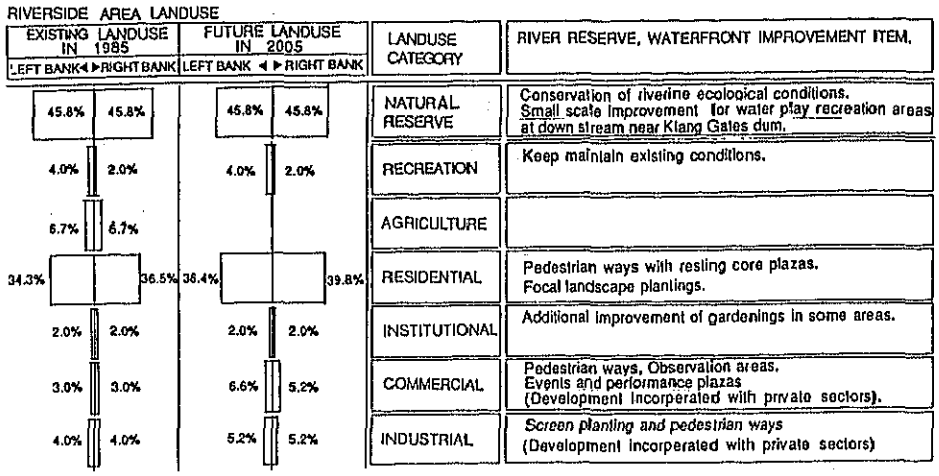
FIG. N-6 BASE LINE CONDITION OF WATER QUALITY AT BOD AND VARIATION IN THE KLANG RIVER



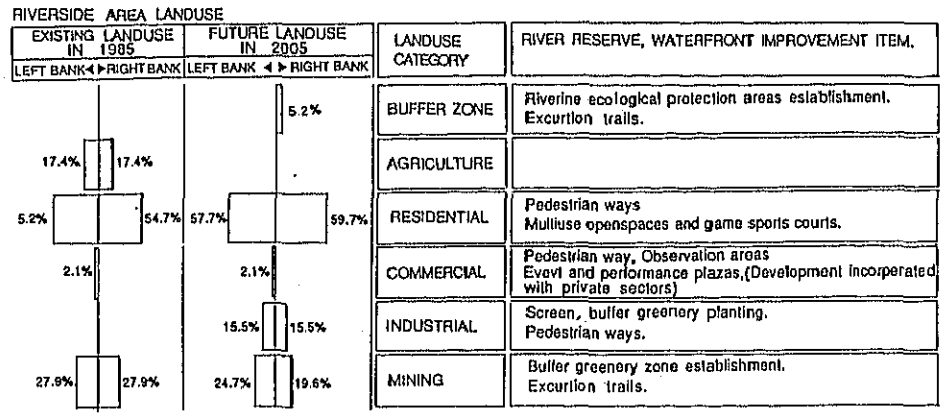
Source KVEIP report vol. 1 1987

FIG. N-7	BASE LINE CONDITION OF WATER QUALITY AT SUSPENDED SOLIDS, TURBIDITY VARIATION IN THE KLANG RIVER

UPPER STREAM (KLANG RIVER)



MIDDLE STREAM



DOWN STREAM

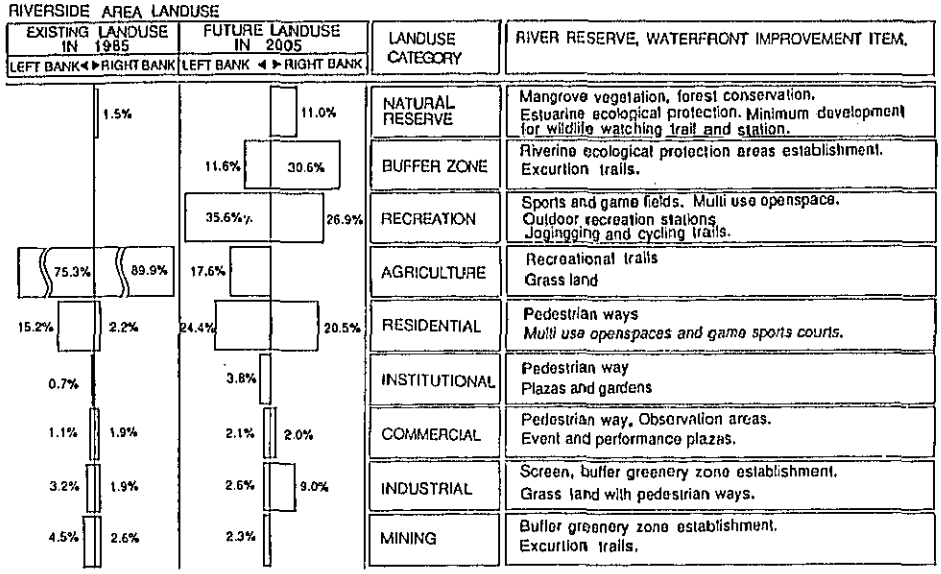
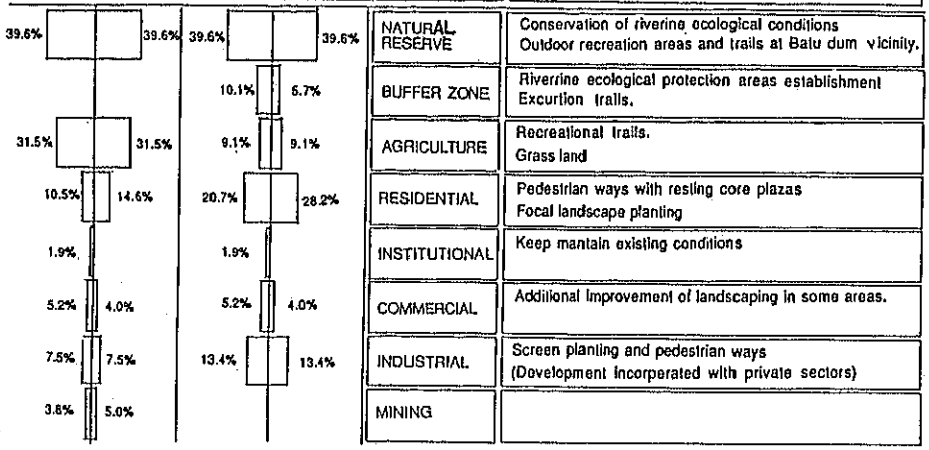


FIG. N-8

RIVERSIDE LAND USE AND RIVERSIDE IMPROVEMENT RECOMMENDATION SCHEM FOR THE KLANG RIVER

UPPER STREAM (BATU RIVER)

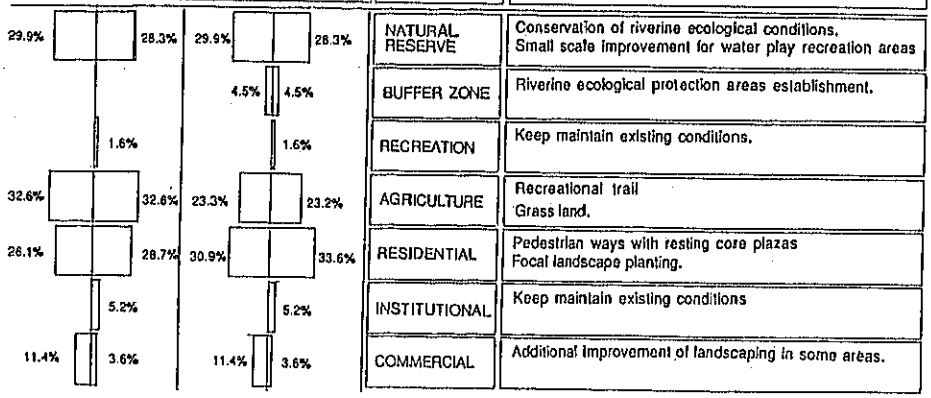
RIVERSIDE AREA LANDUSE



LANDUSE CATEGORY	RIVER RESERVE, WATERFRONT IMPROVEMENT ITEM.
NATURAL RESERVE	Conservation of riverine ecological conditions Outdoor recreation areas and trails at Batu dum vicinity.
BUFFER ZONE	Riverrine ecological protection areas establishment Excurtion trails.
AGRICULTURE	Recreational trails. Grass land
RESIDENTIAL	Pedestrian ways with resting core plazas Focal landscape planting
INSTITUTIONAL	Keep mantain existing conditions
COMMERCIAL	Additional improvement of landscaping in some areas.
INDUSTRIAL	Screen planting and pedestrian ways (Dovelopment incorperated with private sectors)
MINING	

UPPER STREAM (GOMBAK RIVER)

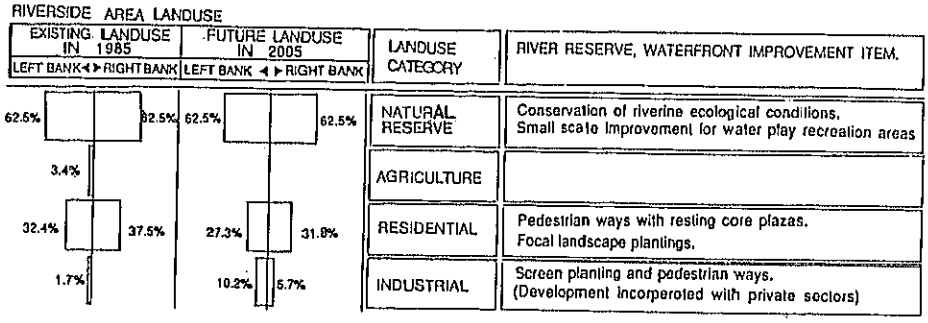
RIVERSIDE AREA LANDUSE



LANDUSE CATEGORY	RIVER RESERVE, WATERFRONT IMPROVEMENT ITEM.
NATURAL RESERVE	Conservation of riverine ecological conditions. Small scale improvement for water play recreation areas
BUFFER ZONE	Riverine ecological protection areas establishment.
RECREATION	Keep maintain existing conditions.
AGRICULTURE	Recreational trail Grass land.
RESIDENTIAL	Pedestrian ways with resting core plazas Focal landscape planting.
INSTITUTIONAL	Keep maintain existing conditions
COMMERCIAL	Additional improvement of landscaping in some areas.

UPPER STREAM (AMPANG RIVER)

RIVERSIDE AREA LANDUSE



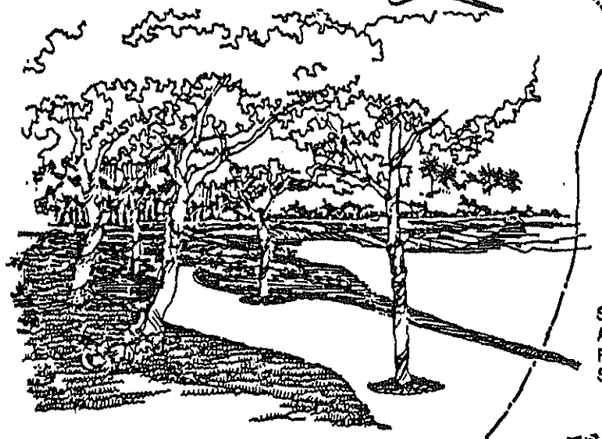
LANDUSE CATEGORY	RIVER RESERVE, WATERFRONT IMPROVEMENT ITEM.
NATURAL RESERVE	Conservation of riverine ecological conditions. Small scale improvement for water play recreation areas
AGRICULTURE	
RESIDENTIAL	Pedestrian ways with resting core plazas. Focal landscape plantings.
INDUSTRIAL	Screen planting and pedestrian ways. (Development incorperoted with private sectors)

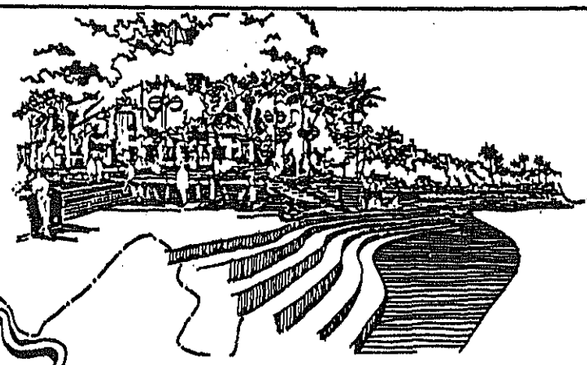
FIG. N-9

RIVERSIDE LAND USE AND RIVERSIDE IMPROVEMENT RECOMMENDATION SCHEM FOR TRIBUTARIES

STRAITS OF KLANG

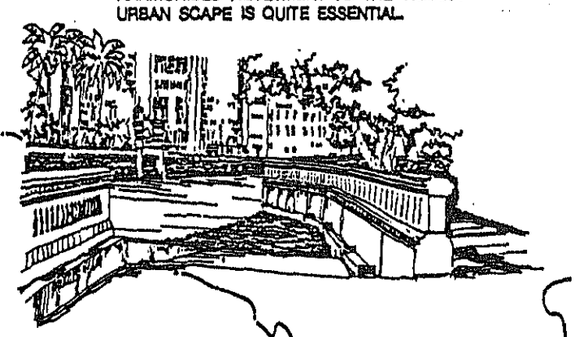
MAXIMUM CONTRIBUTION TO CONSERVE MANGROVE COLONIES AND FOREST AND SMALL IMPROVEMENT FOR MAINTENANCE AND RESEARCH TRAILS MAY BE PROJECTED.





A WIDE ACCESS TO THE RIVER, WATERFRONT PLAZAS WITH SOME PUBLIC USE FACILITY COULD BE AN URBAN NODAL AT DOWNSTREAM URBAN CENTRE.

RIVER ACCESS FOR THE PEDESTRIANS, HARMONIZED REVETMENT TO THE VICINITY URBAN SCAPE IS QUITE ESSENTIAL.

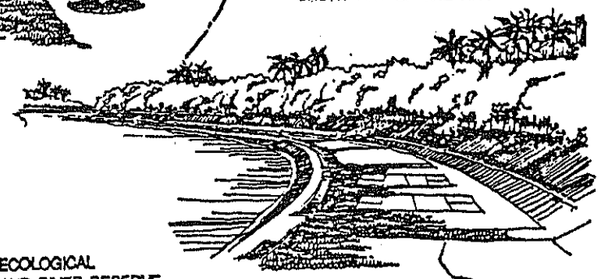


KLANG RIVER

DAMANSARA RIVER

GENTLE BANK SLOPE WITH ROWS OF TREES CREATE A OPEN AND CLEAN RIVERINE SCAPE AT MID-STREAM.

SPORTS AND GAMECOURTS COULD BE ARRANGED AT HIGH WATER RIVER BED WHEN EXTRA RIVER RESERVES ARE PRODUCED BY THE SHORT CUT OF THE RIVER FLOWS.

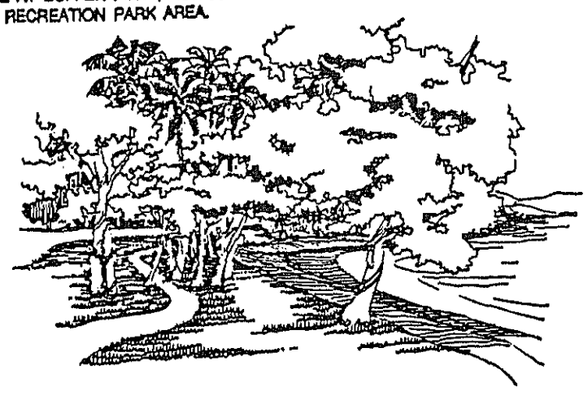


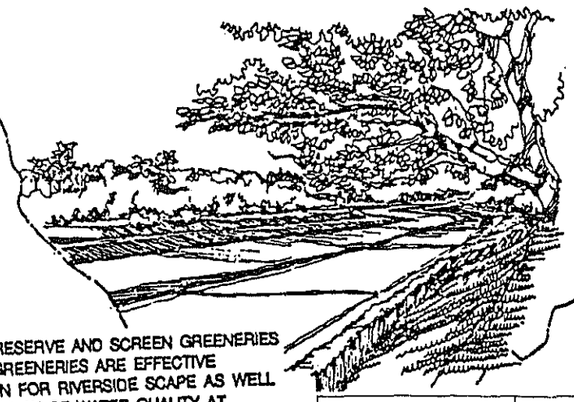
SULAIMAN

PUCHONG DROP

KERAYONG RIVER

SOME SIGNIFICANT RIVERINE ECOLOGICAL RESOUCES ARE PROTECTED AND RIVER RESERVE AREA IMPROVEMENT SHOULD BE CAREFULLY DONE AT BUFFER ZONE, AGRICULTURAL AREA AND RECREATION PARK AREA.





WIDE RIVER RESERVE AND SCREEN GREENERIES OR BUFFER GREENERIES ARE EFFECTIVE CONTRIBUTION FOR RIVERSIDE SCAPE AS WELL AS CONSERVATION OF WATER QUALITY AT MINING AND INDUSTRIAL AREA.

SOME WIDELY ORGANIZED RIVERSIDE PLAZA WITH URBAN AMENITY MAY NECESSITATE IN FOCAL LOCATIONS.

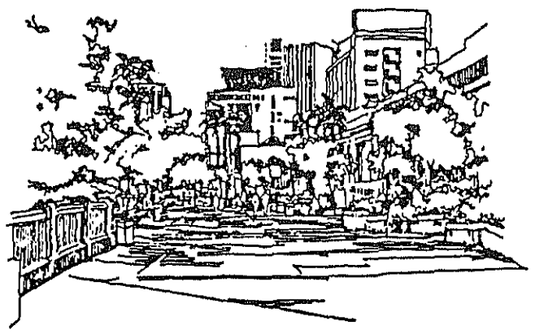
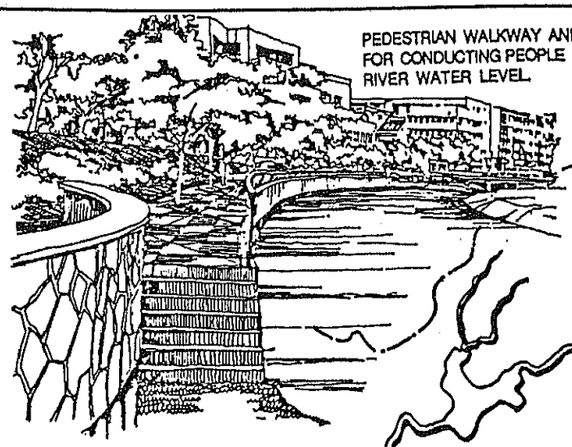


FIG. N-10 RECOMMENDATION GUIDELINE FOR RIVERSIDE LANDSCAPE IMPROVEMENT (1/2)

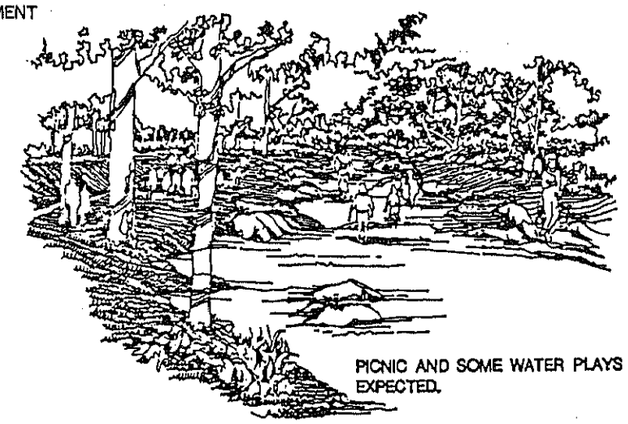
THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA



PEDESTRIAN WALKWAY AND ACCESS STAIRS FOR CONDUCTING PEOPLE DOWN TO THE RIVER WATER LEVEL.

NATURAL STYLE STREAMSIDE IMPROVEMENT INCORPERATED WITH SURROUNDING ENVIRONMENT.

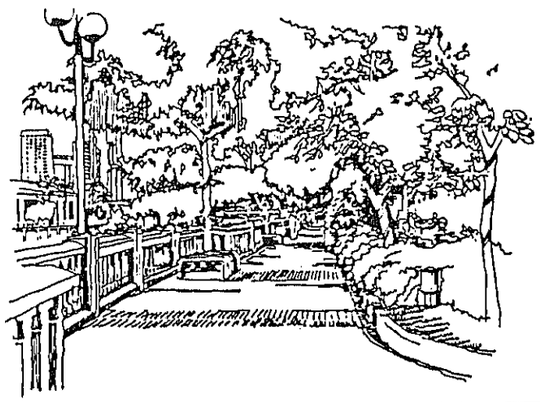


PICNIC AND SOME WATER PLAYS ARE EXPECTED.

SMALL SCALE RIVERINE IMPROVEMENT FOR WATER RELATED RECREATION ACTIVITIES AT UPPER STREAM.

RIVERSIDE WALKWAY WITH SHADOWY TREE PLANTINGS AND FLOWERING SHRUBS.

THROUGH CENTRAL DISTRICT OF THE URBAN AREA.



RIVERSIDE-PEDESTRIAN WAY WITH URBAN CORE PLAZA'S IMPLEMENTATION INCORPORATED WITH PRIVATE PARTICIATION.

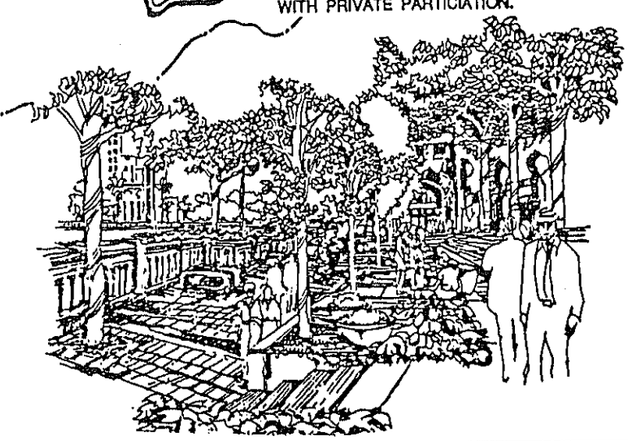


FIG. N-10 RECOMMENDATION GUIDELINE FOR RIVERSIDE LANDSCAPE IMPROVEMENT (2/2)

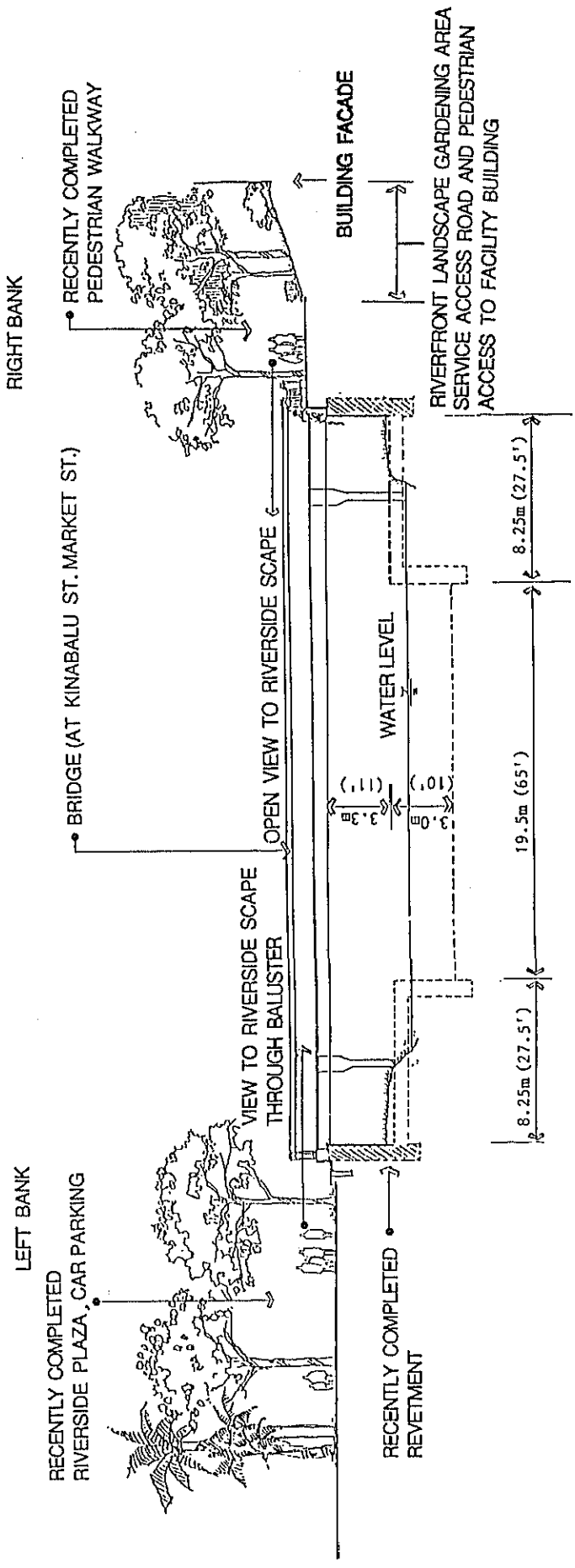


FIG. N-11 **TYPICAL SECTION OF THE KLANG RIVER AT CENTRAL DISTRICT, KUALA LUMPUR**

THE STUDY ON THE FLOOD MITIGATION OF THE KLANG RIVER BASIN

JICA

FIG. N-12

EXISTING RIVERSIDE LAND USE AND IMPROVED RIVERSIDE AREA

EXISTING LANDUSE CONDITION IN 1988 (AREA LENGTH ALONG RIVER)