TABLE L-3 PRODUCTION RATE OF MAJOR EQUIPMENT

No.	Equipment	Capacity	Production Rate
1.	Backhoe	0.6 m3	40 m^3/h.
2.	Backhoe	0.4 m3	30 m^3/h.
3.	Swamp bulldozer	20 t	70 m^3/h.
4.	Swamp bulldozer	16 t	60 m^3/h.
5.	bulldozer	11 t	50 m^3/h.
6.	Crawler loader	2 m3	70 m^3/h.
7.	Crawler loader	1.5 m3	60 m^3/h.
8.	Dump truck	10 t	20 m^3/h. (L = 1 km)
9.	Dump truck	6 t	12 m^3/h. (L = 1 km)
10.	Dragline	0.6 m3	35 m^3/h.
11.	Amphibious excavator	0.6 m3	25 m^3/h.
12.	Vibration roller	5 t	100 m^3/h.
13.	Diesel pile hammer	2.5 t	1 no./hr. (lit.=20 m)
14.	Vibration hammer	22 kw	6 nos./hr. (lit.=2 m)
15.	Motor grader	3.1 m	180 m^3/h.

TABLE L-4 SUMMARY OF FINANCIAL COST FOR THE URGENT PROJECT

(10^3 M$)

Cost Items	Costs		
	F.C.	L.C.	Amount
1. Direct Construction Cost	42,200	19,320	61,520
2. Land acquisition & house evacuation cost	-	98,490	98,490
3. Administration expenses<1	-	3,100	3,100
4. Engineering services cost<2	4,220	1,930	6,150
Sub total (1 - 4)	46,420	122,840	169,260
5. Contingency			
(1) Physical contingency<3	6,960	18,430	25,390
(2) Price contingency<4	6,380	12,620	19,000
Sub total	13,340	31,050	44,390
Total (1 - 5)	59,760	153,890	213,650

Notes :

* F.C. : Foreign currency component
* L.C. : Local currency component

<1 : 5% of 1 approximately

<2 : 10% of 1 approximately for detailed design and of direct cost and construction supervision

<3 : 15% approximately of base cost(1 - 4)

<4 : 3% for F.C. and 3.2% for L.C. per annum (1991 - 1995)

TABLE L-5-1 SUMMARY OF FINANCIAL COST FOR THE URGENT PROJECT RIVER IMPROVEMENT WORKS

(10^3 M$)

Cost Items	Costs		
	F.C.	L.C.	Amount
1. Direct Construction Cost	25,110	11,330	36,440
2. Land acquisition & house evacuation cost	-	97,860	97,860
3. Administration expenses<1	-	1,830	1,830
4. Engineering services cost<2	2,510	1,130	3,640
Sub total (1 - 4)	27,620	112,150	139,770
5. Contingency			
(1) Physical contingency<3	4,140	16,830	20,970
(2) Price contingency<4	3,790	11,180	14,970
Sub total	7,930	28,010	35,940
Total (1 - 5)	35,550	140,160	175,710

Notes :

* F.C. : Foreign currency component
* L.C. : Local currency component

<1 : 5% of 1 approximately

<2 : 10% of 1 approximately for detailed design and of direct cost and construction supervision including hydraulic model test

<3 : 15% approximately of base cost(1 - 4)

<4 : 3% for F.C. and 3.2% for L.C. per annum (1991 - 1995)

TABLE L-5-2 SUMMARY OF FINANCIAL COST FOR THE URGENT PROJECT URBAN DRAINAGE WORKS

(10^3 M$)

Cost Items	Costs		
	F.C.	L.C.	Amount
1. Direct Construction Cost	17,090	7,990	25,080
2. Land acquisition & house evacuation cost	-	630	630
3. Administration expenses<1	-	1,260	1,260
4. Engineering services cost<2	1,710	800	2,510
Sub total (1 - 4)	18,800	10,680	29,480
5. Contingency			
(1) Physical contingency<3	2,820	1,600	4,420
(2) Price contingency<4	2,600	1,440	4,040
Sub total	5,420	3,040	8,460
Total (1 - 5)	24,220	13,720	37,940

Notes :

* F.C. : Foreign currency component
* L.C. : Local currency component

<1 : 5% of 1 approximately

<2 : 10% of 1 approximately for detailed design and of direct cost and construction supervision

<3 : 15% approximately of base cost(1 - 4)

<4 : 3% for F.C. and 3.2% for L.C. per annum (1991 - 1995)

TABLE L-5-3 SUMMARY OF FINANCIAL COST FOR THE URGENT PROJECT
SG.Pinang System

(10^3 M$)

Cost Items	Costs		
	F.C.	L.C.	Amount
1. Direct Construction Cost	19,040	8,630	27,670
2. Land acquisition & house evacuation cost	-	75,950	75,950
3. Administration expenses<1	-	1,380	1,380
4. Engineering services cost<2	1,900	860	2,760
Sub total (1 - 4)	20,940	86,820	107,760
5. Contingency			
(1) Physical contingency<3	3,140	13,020	16,160
(2) Price contingency<4	2,880	8,650	11,530
Sub total	6,020	21,670	27,690
Total (1 - 5)	26,960	108,490	135,450

Notes :

* F.C. : Foreign currency component
* L.C. : Local currency component

<1 : 5% of 1 approximately

<2 : 10% of 1 approximately for detailed design and of direct cost and construction supervision including hydraulic model test

<3 : 15% approximately of base cost(1 - 4)

<4 : 3% for F.C. and 3.2% for L.C. per annum (1991 - 1995)

<5 : Sg.Pinang System contains Sg.Pinang, Sg.Air Itam Sg. Dondang,Sg.Jelutong,Terjun Diversion

* Direct construction cost is the sum of the cost for each construction works (Table L-7: 2/16 ~ 16/16) and cost for general items (Table L-7: 1/16)

TABLE L-5-4 : SUMMARY OF FINANCIAL COST FOR THE URGENT PROJECT
SG.Keluang System

(10^3 M$)

Cost Items	Costs		
	F.C.	L.C.	Amount
1. Direct Construction Cost	6,070	2,700	8,770
2. Land acquisition & house evacuation cost	-	21,910	21,910
3. Administration expenses<1	-	440	440
4. Engineering services cost<2	610	270	880
Sub total (1 - 4)	6,680	25,320	32,000
5. Contingency			
(1) Physical contingency<3	1,000	3,800	4,800
(2) Price contingency<4	910	2,520	3,430
Sub total	1,910	6,320	8,230
Total (1 - 5)	8,590	31,640	40,230

Notes :

* F.C. : Foreign currency component
* L.C. : Local currency component

<1 : 5% of 1 approximately

<2 : 10% of 1 approximately for detailed design and of direct cost and construction supervision

<3 : 15% approximately of base cost(1 - 4)

<4 : 3% for F.C. and 3.2% for L.C. per annum (1991 - 1995)

<5 : Sg.Keluang System contains Sg.Keluang, Sg.Ara Sg.Gelugor, Sg. Dua Besar

TABLE L-6-1 ANNUAL DISBURSEMENT SCHEDULE FOR THE FINANCIAL COST
THE URGENT PROJECTS

Cost Items		Amount	1991		1992		1993		1994		1995	
			F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Direct construction costs	F.C	42,200	0	0	0	0	16,880	0	12,660	0	12,660	0
	L.C	19,320	0	0	0	0	0	7,728	0	5,796	0	5,796
	Total	61,520	0	0	0	0	16,880	7,728	12,660	5,796	12,660	5,796
2. Land acquisition & house evacuation costs	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	98,490	0	0	0	49,245	0	49,245	0	0	0	0
	Total	98,490	0	0	0	49,245	0	49,245	0	0	0	0
3. Administration costs<1	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	3,100	0	620	0	620	0	620	0	620	0	620
	Total	3,100	0	620	0	620	0	620	0	620	0	620
4. Engineering services cost<2	F.C	4,220	1,055	0	1,055	0	703	0	703	0	703	0
	L.C	1,930	0	482.5	0	483	0	322	0	322	0	322
	Total	6,150	1,055	483	1,055	483	703	322	703	322	703	322
Total 1 to 4		169,260	1,055	1,103	1,055	50,348	17,583	57,915	13,363	6,738	13,363	6,738
5. Physical contingency<3	F.C	6,960	158	0	158	0	2,638	0	2,005	0	2,005	0
	L.C	18,430	0	165	0	7,552	0	8,687	0	1,011	0	1,011
	Total	25,390	158	165	158	7,552	2,638	8,687	2,005	1,011	2,005	1,011
Total 1to 5		194,650	1,213	1,268	1,213	57,900	20,221	66,602	15,368	7,748	15,368	7,748
6. Price contingency	F.C (3.0% p.a.)	6,380	40	0	80	0	1,880	0	1,930	0	2,448	0
	L.C (3.2% p.a.)	12,620	0	40	0	3,760	0	6,610	0	972	0	1,234
	Total	19,000	40	40	80	3,760	1,880	6,610	1,930	972	2,448	1,234
Ground Total 1 to 6		213,650	1,253	1,308	1,293	61,660	22,101	73,212	17,298	8,721	17,816	8,982

Notes <1 : 5% approximately of direct cost
<2 : 10% approximately of direct cost and 80% for F.C. 20% for L.C.
<3 : 15% approximately of base cost (1 - 4)

TABLE L-6-2 ANNUAL DISBURSEMENT SCHEDULE FOR THE FINANCIAL COST
THE RIVER SYSTEM

Cost Items		Amount	1991		1992		1993		1994		1995	
			F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Direct construction costs	F.C	25,110	0	0	0	0	10,044	0	7,533	0	7,533	0
	L.C	11,330	0	0	0	0	0	4,532	0	3,399	0	3,399
	Total	36,440	0	0	0	0	10,044	4,532	7,533	3,399	7,533	3,399
2. Land acquisition & house evacuation costs	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	97,860	0	0	0	48,930	0	48,930	0	0	0	0
	Total	97,860	0	0	0	48,930	0	48,930	0	0	0	0
3. Administration costs<1	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	1,830	0	366	0	366	0	366	0	366	0	366
	Total	1,830	0	366	0	366	0	366	0	366	0	366
4. Engineering services cost<2	F.C	2,510	628	0	628	0	418	0	418	0	418	0
	L.C	1,130	0	283	0	283	0	188	0	188	0	188
	Total	3,640	628	283	628	283	418	188	418	188	418	188
Total 1 to 4		139,770	628	649	628	49,579	10,462	54,016	7,951	3,953	7,951	3,953
5. Physical contingency<3	F.C	4,140	94	0	94	0	1,569	0	1,193	0	1,193	0
	L.C	16,830	0	98	0	7,437	0	8,103	0	594	0	594
	Total	20,970	94	98	94	7,437	1,569	8,103	1,193	594	1,193	594
Total 1to 5		160,740	722	747	722	57,016	12,032	62,119	9,144	4,547	9,144	4,547
6. Price contingency	F.C (3.0% p.a.)	3,790	22	0	44	0	1,116	0	1,148	0	1,456	0
	L.C (3.2% p.a.)	11,180	0	24	0	3,707	0	6,156	0	571	0	724
	Total	14,970	22	24	44	3,707	1,116	6,156	1,148	571	1,456	724
Ground Total 1to 6		175,710	743	770	766	60,723	13,147	68,276	10,292	5,118	10,600	5,272

Notes <1 : 5% approximately of direct cost
<2 : 10% approximately of direct cost and 80% for F.C. 20% for L.C.
<3 : 15% approximately of base cost (1 - 4)

TABLE L-6-3 ANNUAL DISBURSEMENT SCHEDULE FOR THE FINANCIAL COST
THE URBAN DRAINAGE

Cost Items		Amount	1991		1992		1993		1994		1995	
			F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Direct construction costs	F.C	17,090	0	0	0	0	6,836	0	5,127	0	5,127	0
	L.C	7,990	0	0	0	0	0	3,196	0	2,397	0	2,397
	Total	25,080	0	0	0	0	6,836	3,196	5,127	2,397	5,127	2,397
2. Land acquisition & house evacuation costs	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	630	0	0	0	315	0	315	0	0	0	0
	Total	630	0	0	0	315	0	315	0	0	0	0
3. Administration costs<1	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	1,260	0	252	0	252	0	252	0	252	0	252
	Total	1,260	0	252	0	252	0	252	0	252	0	252
4. Engineering services cost<2	F.C	1,710	428	0	428	0	285	0	285	0	285	0
	L.C	800	0	200	0	200	0	133	0	133	0	133
	Total	2,510	428	200	428	200	285	133	285	133	285	133
Total 1 to 4		29,480	428	452	428	767	7,121	3,896	5,412	2,782	5,412	2,782
5. Physical contingency<3	F.C	2,820	64	0	64	0	1,282	0	974	0	812	0
	L.C	1,600	0	68	0	115	0	584	0	417	0	417
	Total	4,420	64	68	64	115	1,282	584	974	417	812	417
Total 1to 5		33,900	492	520	492	882	8,403	4,481	6,386	3,200	6,224	3,200
6. Price contingency	F.C (3.0% p.a.)	2,600	10	0	20	0	770	0	800	0	1,000	0
	L.C (3.2% p.a.)	1,440	0	17	0	57	0	450	0	402	0	510
	Total	4,040	10	17	20	57	770	450	800	402	1,000	510
Ground Total 1to 6		37,940	502	536	512	939	9,173	4,931	7,186	3,601	7,224	3,709

Notes<1 : 5% approximately of direct cost
<2 : 10% approximately of direct cost and 80% for F.C. 20% for L.C.
<3 : 15% approximately of base cost (1 - 4)

TABLE L-6-4 ANNUAL DISBURSEMENT SCHEDULE FOR THE FINANCIAL COST
Sg. Pinang System

Cost Items		Amount	1991		1992		1993		1994		1995	
			F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Direct construction costs	F.C	19,040	0	0	0	0	7,616	0	5,712	0	5,712	0
	L.C	8,630	0	0	0	0	0	3,452	0	2,589	0	2,589
	Total	27,670	0	0	0	0	7,616	3,452	5,712	2,589	5,712	2,589
2. Land acquisition & house	F.C	0	0	0	0	0	0	0	0	0	0	0
evacuation costs	L.C	75,950	0	0	0	37,975	0	37,975	0	0	0	0
	Total	75,950	0	0	0	37,975	0	37,975	0	0	0	0
3. Administration costs<1	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	1,380	0	276	0	276	0	276	0	276	0	276
	Total	1,380	0	276	0	276	0	276	0	276	0	276
4. Engineering services cost<2	F.C	1,900	475	0	475	0	317	0	317	0	317	0
	L.C	860	0	215	0	215	0	143	0	143	0	143
	Total	2,760	475	215	475	215	317	143	317	143	317	143
Total 1 to 4		107,760	475	491	475	38,466	7,933	41,846	6,029	3,008	6,029	3,008
5. Physical contingency<3	F.C	3,140	71	0	71	0	1,190	0	904	0	904	0
	L.C	13,020	0	80	0	5,770	0	6,277	0	451	0	451
	Total	16,160	71	80	71	5,770	1,190	6,277	904	451	904	451
Total 1to 5		123,920	546	571	546	44,236	9,123	48,123	6,933	3,460	6,933	3,460
6. Price contingency	F.C (3.0% p.a.)	2,880	21	0	38	0	846	0	871	0	1,104	0
	L.C (3.2% p.a.)	8,650	0	10	0	2,880	0	4,770	0	434	0	551
	Total	11,530	21	10	38	2,880	846	4,770	871	434	1,104	551
Ground Total 1 to 6		135,450	567	581	584	47,116	9,969	52,893	7,804	3,894	8,037	4,011

Notes <1 : 5% approximately of direct cost
<2 : 10% approximately of direct cost and 80% for F.C. 20% for L.C.
<3 : 15% approximately of base cost (1 - 4)
<4 : Sg.Pinang System contains Sg.Pinang, Sg.Air Itam, Sg. Dondang,Sg.Jelutong,Terjun Diversion

TABLE L-6-5 ANNUAL DISBURSEMENT SCHEDULE FOR THE FINANCIAL
Sg. Keluang System

Cost Items		Amount	1991		1992		1993		1994		1995	
			F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Direct construction costs	F.C	6,070	0	0	0	0	2,428	0	1,821	0	1,821	0
	L.C	2,700	0	0	0	0	0	1,080	0	810	0	810
	Total	8,770	0	0	0	0	2,428	1,080	1,821	810	1,821	810
2. Land acquisition & house evacuation costs	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	21,910	0	0	0	10,955	0	10,955	0	0	0	0
	Total	21,910	0	0	0	10,955	0	10,955	0	0	0	0
3. Administration costs<1	F.C	0	0	0	0	0	0	0	0	0	0	0
	L.C	440	0	88	0	88	0	88	0	88	0	88
	Total	440	0	88	0	88	0	88	0	88	0	88
4. Engineering services cost<2	F.C	610	153	0	153	0	102	0	102	0	102	0
	L.C	270	0	68	0	68	0	45	0	45	0	45
	Total	880	153	68	153	68	102	45	102	45	102	45
Total 1 to 4		32,000	153	156	153	11,111	2,530	12,168	1,923	943	1,923	943
5. Physical contingency<3	F.C	1,000	22	0	22	0	379	0	288	0	288	0
	L.C	3,800	0	23	0	1,667	0	1,825	0	141	0	141
	Total	4,800	22	23	22	1,667	379	1,825	288	141	288	141
Total 1to 5		36,800	175	179	175	12,778	2,909	13,993	2,211	1,084	2,211	1,084
6. Price contingency	F.C (3.0% p.a.)	910	5	0	11	0	270	0	277	0	352	0
	L.C (3.2% p.a.)	2,520	0	0	0	830	0	1,380	0	136	0	173
	Total	3,430	5	0	11	830	270	1,380	277	136	352	173
Ground Total 1 to 6		40,230	180	179	185	13,608	3,178	15,373	2,488	1,221	2,563	1,257

Notes <1 : 5% approximately of direct cost
<2 : 10% approximately of direct cost and 80% for F.C. 20% for L.C.
<3 : 15% approximately of base cost (1 - 4)

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (1/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
1	General Items							
1.1	Access and construction roads	km	5	70,000	350,000	30,000	150,000	500,000
1.2	Temporary buildings	L.S	-	-	49,000	-	21,000	70,000
1.3	Communication system	L.S	-	-	7,000	-	3,000	10,000
1.4	Power supply system	L.S	-	-	35,000	-	15,000	50,000
1.5	Boreholes and exploratory excavation	L.S	-	-	49,000	-	21,000	70,000
1.6	Care of water	L.S	-	-	55,000	-	25,000	80,000
1.7	Cost for traffic control	L.S	-	-	105,000	-	45,000	150,000
1.8	Demolishing cost for existing structures	L.S	-	-	190,000	-	80,000	270,000
1.9	Renewal cost of water supply pipes	P.S	-	-	280,000	-	120,000	400,000
1.10	Renewal cost of power supply lines	P.S	-	-	140,000	-	60,000	200,000
1.11	Maintenance and protection cost for existing water supply pipes	L.S	-	-	35,000	-	15,000	50,000
1.12	Maintenance and protection cost for existing power supply lines	L.S	-	-	35,000	-	15,000	50,000
	Total of 1				1,330,000		570,000	1,900,000

THE COSTS OF THE GENERAL ITEMS FOR EACH PROJECT

Unit : 1000 M$

GENERAL ITEMS	F.C	L.C	AMOUNT
Sg.Pinang system	630.0	270.0	900.0
Sg.Keluang system	170.0	70.0	240.0
Urban Drainage system	530.0	230.0	760.0
TOTAL	1,330.0	570.0	1,900.0

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (2/16) 1,900,000

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
2	River Improvement works							
2.1	Sg. Pinang system							
	(1) Sg. Pinang (3.15 km)							
	(Channel)							
2.1.1	Channel excavation with hauling	cu.m	275,000	3.5	962,500	1.5	412,500	1,375,000
2.1.2	Levee embankment	cu.m	15,200	5.6	85,120	2.4	36,480	121,600
2.1.3	Jetty embankment, l=710 m	cu.m	5,000	8.4	42,000	3.6	18,000	60,000
2.1.4	Sodding	sq.m	10,000	0.7	7,000	0.3	3,000	10,000
2.1.5	Revetment, wet masonry	sq.m	38,000	35	1,330,000	15	570,000	1,900,000
2.1.6	Landscaping	L.S	-	-	5,000	-	45,000	50,000
	(Related strucures)							
2.1.7	Renewal of Jelutong bridge RC-T girder, 3-span	sq.m	470	1,120	526,400	480	225,600	752,000
	L=47.0m, W=10.0m, A=470.0m2							
2.1.8	Renewal of Sungai bridge' RC-T girder, 2-span	sq.m	258	1,120	288,960	480	123,840	412,800
	L=43.0m, W=6.0m, A=258.0m2							
2.1.9	Renewal of Patani bridge RC-T girder, 2-span	sq.m	430	1,050	451,500	450	193,500	645,000
	L=43.0m, W=10.0m, A=430.0m2							
2.1.10	Renewal of Perak bridge RC-T girder, 2-span	sq.m	495	1,050	519,750	450	222,750	742,500
	L=33.0m, W=15.0m, A=495.0m2							
2.1.11	Renewal of wooden bridge to RC-T girder type, 2-span	set	2	52,500	105,000	22,500	45,000	150,000
2.1.12	L=33.0m, W=3.0m, A=99.0m2							
2.1.13	Renewal of Ayer Itam bridge RC-T girder, 2-span	sq.m	528	1,050	554,400	450	237,600	792,000
	L-33.0m, W=16.0m, A-528.0m2 (Others)							
2.1.13	Inspection road, t=10cm	lin.m	7,600	14	106,400	6	45,600	152,000
2.1.14	Miscellaneous works	L.S	-	-	150,000	-	150,000	300,000
	Amount of (1)				5,135,000		2,329,000	7,463,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (3/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(2) Sg. Jelutong (2.14km) (Channel)							
2.1.15	Channel excavation w/hauling	cu.m	19,700	3.5	68,950	1.5	29,550	98,500
2.1.16	Levee embankment	cu.m	10,000	5.6	56,000	2.4	24,000	80,000
2.1.17	Sodding	sq.m	2,000	0.7	1,400	0.3	600	2,000
2.1.18	Concrete	cu.m	5,200	140	728,000	60	312,000	1,040,000
2.1.19	Landscaping works (Related structures)	L.S	-	-	2,000	-	18,000	20,000
2.1.20	Drop structures	cu.m	100	140	14,000	60	6,000	20,000
2.1.21	Renewal of small bridge to RC-Slab, L=5-8m, W=1-4m (Others)	set	17	10,500	178,500	4,500	76,500	255,000
2.1.22	Inspection road, t=10cm	lin.m	4,210	14	58,940	6	25,260	84,200
2.1.23	Miscellaneous works	L.S	-	-	30,000	-	30,000	60,000
	Amount of (2)				1,138,000		522,000	1,660,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (4/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(3) Sg. Dondang (4.32 km) (channel)							
2.1.24	Channel excavation w/hauling	cu.m	110,000	3.5	385,000	1.5	165,000	550,000
2.1.25	Levee embankment	cu.m	14,900	5.6	83,440	2.4	35,760	119,200
2.1.26	Sodding	sq.m	15,000	0.7	10,500	0.3	4,500	15,000
2.1.27	Revetment, wet masonry	sq.m	53,300	35	1,865,500	15	799,500	2,665,000
2.1.28	Landscaping works (Related structures)	L.S	-	-	3,000	-	17,000	20,000
2.1.29	Drop strucrures	cu.m	270	140	37,800	60	16,200	54,000
2.1.30	Rnewal of T. Thean bridge (1)RC-T girder, 1-span L=16.0m, W=4.0m, A=64.0m2	sq.m	64	1,050	67,200	450	28,800	96,000
2.1.31	Renewal of T. Thean bridge (2)RC-T girder, 1-span L=16.0m, W=5.0m, A=80.0m2	sq.m	80	1,050	84,000	450	36,000	120,000
2.1.32	Renewal of T. T. Dua bridge RC-T girder, 1-span L=16.0m, W=11.0m, A=176.0m2	sq.m	176	1,050	184,800	450	79,200	264,000
2.1.33	Renewal of T. TEIK bridge RC slab, 1-span L=11.0m, W=5.0m, A=55.0m2	sq.m	55	840	46,200	360	19,800	66,000
2.1.34	Renewal of wooden bridge to RC-T girder type with 1-span L-16.0m, W=3.0m, A=48.0m2	sq.m	48	1,050	50,400	450	21,600	72,000
2.1.35	Renewal of wooden bridge to RC slab type, 1-span, 3-set L=11.0m, W=3.0m, A=33.0m2 (Others)	sq.m	99	840	83,160	360	35,640	118,800
2.1.36	Inspection road, t=10cm	lin.m	7,584	14	106,176	6	45,504	151,680
2.1.37	Miscellaneous works	L.S	-	-	100,000	-	100,000	200,000
	Amount of (3)				3,108,000		1,405,000	4,512,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (5/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(4) Air Terjun flood diversion channel (1.74km)							
2.1.38	Excavation w/haul. including temporary walls by steel sheetpiles 51kg/m, 902cm3 of secton modulas and 15 times use, full depreciation 800m2/time (100m*8m)	cu.m	56,220	7	393,540	3	168,660	562,200
2.1.39	Concrete rectangular culvert W5.5m, H3.22m, w/re-bar, form	cu.m	20,200	140	2,828,000	60	1,212,000	4,040,000
2.1.40	Open concrete channel W6.3m, H2.76m, w/re-bar, form	cu.m	1,600	140	224,000	60	96,000	320,000
2.1.41	Backfill	cu.m	2,000	2.1	4,200	0.9	1,800	6,000
2.1.42	Revetment, wet masonry	sq.m	900	35	31,500	15	13,500	45,000
2.1.43	Landscaping works	L.S	-	-	2,000	-	18,000	20,000
2.1.44	Improvement, Air Terjun river Confluence, L=100m approx.	L.S	-	-	21,000	-	9,000	30,000
2.1.45	Outlet channel works	L.S	-	-	14,000	-	6,000	20,000
2.1.46	Restoration works of roads	L.S	-	-	350,000	-	150,000	500,000
2.1.47	Miscellaneous works	L.S	-	-	75,000	-	75,000	150,000
	Amount of (4)				3,944,000		1,750,000	5,694,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (6/16) 5,694,000

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(5) Sg. Air Itam (3.0km)							
	(Channel)							
2.1.48	Channel excavation w/hauling	cu.m	235,000	3.5	822,500	1.5	352,500	1,175,000
2.1.49	Levee embankment	cu.m	8,550	5.6	47,880	2.4	20,520	68,400
2.1.50	Revetment, wet masonry	sq.m	30,000	35	1,050,000	15	450,000	1,500,000
2.1.51	Landscaping works	L.S	-	-	2,000	-	18,000	20,000
	(Related sttructures)							
2.1.52	Drop structure	cu.m	40	140	5,600	60	2,400	8,000
2.1.53	Renewal of Scotland bridge RC-T girder, 2-span L=28.0m, W=33.0m, A=924m2	sq.m	924	1050	970,200	450	415,800	1,386,000
2.1.54	Renewal of Air Itam bridge RC-T girder, 1-span L=16.0m, W=25.0m, A=400m2	sq.m	400	1050	420,000	450	180,000	600,000
2.1.55	Renewal, L.B. Lancang bridge RC-T girder, 1-span L=16.0m, W=8.0m, A=128m2	sq.m	128	1050	134,400	450	57,600	192,000
	(Others)							
2.1.56	Inspection road	lin.m	5,800	14	81,200	6	34,800	116,000
2.1.57	Miscellaneous works	L.S	-	-	100,000	-	100,000	200,000
	Amount of (5)				3,634,000		1,632,000	5,266,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (7/16)

5,266,000

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Totai (M$)
	(6) Dondang retention ponds (3 places, 8.4 ha)							
2.1.58	Excavation, pond A, B and C with hauling	cu.m	360,000	3.5 0	1,260,000 0	1.5 0	540,000 0	1,800,000 0
2.1.59	Sodding	sq.m	3,000	0.7	2,100	0.3	900	3,000
2.1.60	Revetment, wet masonry	sq.m	1,000	35	35,000	15	15,000	50,000
2.1.61	Weir structure by stones W=40-80m, H=4-5m, 3 places	L.S	-	-	20,000	-	30,000	50,000
2.1.62	Outlet structure	L.S	-	-	15,000	-	15,000	30,000
2.1.63	Sluice gate, 2m * 2m, 1m * 1m	set	3	14,000	42,000	6,000	18,000	60,000
2.1.64	Flap gate, 0.5m * 0.5m	set	3	7,000	21,000	3,000	9,000	30,000
2.1.65	Lanscaping works	L.S	-	-	5,000	-	45,000	50,000
2.1.66	Miscellaneous works	L.S	-	-	50,000	-	50,000	100,000
	Amount of (6)				1,451,000		723,000	2,174,000
	Total of 2.1				18,410,000		8,361,000	26,769,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (8/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
2.2	Sg. Keluang system							
	(1) Sg. Keluang (3.38km)							
	(Channel)							
2.2.1	Channel excavation w/hauling	cu.m	29,000	3.5	101,500	1.5	43,500	145,000
2.2.2	Levee embankment	cu.m	58,000	5.6	324,800	2.4	139,200	464,000
2.2.3	Sodding	sq.m	8,000	0.7	5,600	0.3	2,400	8,000
2.2.4	Revetment, low water channel including partial coffering	sq.m	14,000	35	490,000	15	210,000	700,000
2.2.5	Revetment, high water channels	sq.m	9,400	35	329,000	15	141,000	470,000
2.2.6	Landscaping works	L.S	-	-	2,000	-	18,000	20,000
	(Others)							
2.2.7	Inspection road	lin.m	3,100	14	43,400	6	18,600	62,000
2.2.8	Miscellaneous works	L.S	-	-	40,000	-	40,000	80,000
	Amount of (1)				1,336,300		612,700	1,949,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (9/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(2) Ara river (1.87km)							
	(Channel)							
2.2.9	Channel excavation w/hauling	cu.m	73,000	3.5	255,500	1.5	109,500	365,000
2.2.10	Levee embankment	cu.m	23,000	5.6	128,800	2.4	55,200	184,000
2.2.11	Sodding	sq.m	6,000	0.7	4,200	0.3	1,800	6,000
2.2.12	Revetment, low water channel including partial coffering	sq.m	11,000	35	385,000	15	165,000	550,000
2.2.13	Revetment, high water channel	sq.m	10,000	35	350,000	15	150,000	500,000
2.2.14	Landscaping works	L.S	-	-	1,000		9,000	10,000
	(Related structures)							
2.2.15	Renewal of bridge, RC-T l=53m, W=3m	sq.m	159	1050	166,950	450	71,550	238,500
2.2.16	Renewal of bridge, RC-T l=27m, W=3m	sq.m	81	1050	85,050	450	36,450	121,500
	(Others)							
2.2.17	Inspection road	lin.m	3,740	14	52,360	6	22,440	74,800
2.2.18	Miscellaneous works	L.S	-	-	50,000	-	50,000	100,000
	Amount of (2)				1,478,860		670,940	2,149,800
	(3) Relau diversion channel (1.55km)							
2.2.19	Excavation w/hauling	cu.m	75,900	3.5	265,650	1.5	113,850	379,500
2.2.20	Backfill	cu.m	19,700	2.1	41,370	0.9	17,730	59,100
2.2.21	Concrete, t=40cm, U channel	cu.m	10,500	140	1,470,000	60	630,000	2,100,000
2.2.22	Bridge construction, newly	sq.m	352	1050	369,600	450	158,400	528,000
2.2.23	Landscaping works	L.S	-	-	1,000	-	9,000	10,000
2.2.24	Miscellaneous works	L.S	-	-	25,000	-	25,000	50,000
	Amount of (3)				2,172,620		953,980	3,126,600
	Total of 2.2				4,987,780		2,237,620	7,225,400

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (10/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
2.3	Sg. Gelugor (0.5 km)	L.S	-	-	350,000	-	150,000	500,000
2.4	Sg. Dua Besar (2.1 km)	L.S	-	-	560,000	-	240,000	800,000
	Total of 2 (2.1 to 2.4)				24,307,780		10,988,620	35,294,400
3	Drainage Works							
3.1	N-12 Drainage system (157 ha)							
3.1.1	Exca. w/hauling & temporary sheetpile (Trunk drain : 2.7 km)	cu.m	21,500	5.6	120,400	2.4	51,600	172,000
3.1.2	Concrete w/re-bar & form	cu.m	3,600	140	504,000	60	216,000	720,000
3.1.3	Backfill	cu.m	7,900	2.1	16,590	0.9	7,110	23,700
3.1.4	Restoration of roads	sq.m	9,800	70	686,000	30	294,000	980,000
3.1.5	Wooden pile, 100mm dia. 1=4m	nos.	38,550	3.5	134,925	1.5	57,825	192,750
3.1.5	Miscellaneous works	L.S	-	-	50,000	-	50,000	100,000
	Total of 3.1				1,512,000		677,000	2,189,000
3.2	S-10 Drainage system (120 ha)							
	(1) Trunk drain (1.66 km)							
3.2.1	Exca. w/hauling & temporary sheetpile	cu.m	32,000	5.6	179,200	2.4	76,800	256,000
3.2.2	Concrete w/re-bar & form	cu.m	10,000	140	1,400,000	60	600,000	2,000,000
3.2.3	Backfill	cu.m	21,000	2.1	44,100	0.9	18,900	63,000
3.2.4	Restoration of roads	sq.m	11,700	70	819,000	30	351,000	1,170,000
3.2.5	Wooden pile, 100mm dia. 1=4m	nos.	34,500	3.5	120,750	1.5	51,750	172,500
3.2.6	Miscellaneous works	L.S	-	-	50,000	-	50,000	100,000
	Amount of (1)				2,613,050		1,148,450	3,761,500

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (11/16)

1.0 US$=MS 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(2) Retention pond (1.9ha)							
3.2.7	Embankment	cu.m	64,000	5.6	358,400	2.4	153,600	512,000
3.2.8	Steel sheetpilling, permanent	nos.	1,000	700	700,000	300	300,000	1,000,000
3.2.9	Revetment by dry masonry	sq.m	4,000	28	112,000	12	48,000	160,000
3.2.10	Revetment by wet masonry	sq.m	5,300	35	185,500	15	79,500	265,000
3.2.11	Asphalt pavement, levee top	sq.m	8,000	14	112,000	6	48,000	160,000
3.2.12	Landscaping works	L.S	-	-	3,000	-	27,000	30,000
3.2.13	Miscellaneous works	L.S	-	-	50,000	-	50,000	100,000
	Amount of (2)				1,520,900	335.4	706,100	2,227,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (12/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(3) Pumping house (Civil & building works)							
3.2.14	Excavation w/hauling	cu.m	10,000	2.8	28,000	1.2	12,000	40,000
3.2.15	Fooundation pilling, R.C type Dia.400mm, l=30m	nos.	164	700	114,800	300	49,200	164,000
3.2.16	Steel sheetpiles, type 2, permanent l=10m, W=0.4m, 48kg/m	nos.	423	700	296,100	300	126,900	423,000
3.2.17	Backfill	cu.m	4,800	2.1	10,080	0.9	4,320	14,400
3.2.18	Building, R.C type (Concrete, 4750m3), 280 m2	L.S	-	-	500,000		500,000	1,000,000
3.2.19	Landscaping works (Mechanical/Electrical works)	L.S	-	-	3,000	-	27,000	30,000
3.2.20	Drainage pumps, horizontal shaft axial flow, w/motor Q=2.0m3/s, H=1.5m	set	3	160,000	480,000	40,000	120,000	600,000
3.2.21	Auxiliary facilities (O.H. Crane : 3.5 tons, D. Generator : 200 kva and ancillaries)	L.S	-	-	160,000	-	40,000	200,000
3.2.22	Gate and trashrack (Gate 3.5 ton * 4 stes. and trashrack, 6 tons for 2-set)	ton	20	16,000	320,000	4,000	80,000	400,000
3.2.23	Garbage equipment	set	3	80,000	240,000	20,000	60,000	300,000
3.2.24	Erection cost, pump & others	L.S	-	-	150,000	-	150,000	300,000
3.2.25	Miscellaneous works	L.S	-	-	100,000	-	100,000	200,000
	Amount of (3)				2,401,980		1,269,420	3,671,400

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (13/16)

1.0 US$=MS 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(4) Outlet channel (L = 20 m)							
3.2.26	Excavation w/hauling	cu.m	150	2.8	420	1.2	180	600
3.2.27	Embankment	cu.m	1,800	5.6	10,080	2.4	4,320	14,400
3.2.28	Revetment by dry masonry	sq.m	250	28	7,000	12	3,000	10,000
3.2.29	Miscellaneous works	L.S	-	-	750	-	750	1,500
	Amount of (4)				18,250		8,250	26,500
	Total of 3.2				6,555,000		3,133,000	9,687,000
3.3	S-18 Drainage system (104 ha)							
	(1) Trunk drain (1.7 km)							
3.3.1	Exca. w/hauling & temporary sheetpile	cu.m	41,000	5.6	229,600	2.4	98,400	328,000
3.3.2	Concrete w/re-bar & form	cu.m	20,000	140	2,800,000	60	1,200,000	4,000,000
3.3.3	Backfill	cu.m	13,000	2.1	27,300	0.9	11,700	39,000
3.3.4	Restoration of roads	sq.m	18,800	70	1,316,000	30	564,000	1,880,000
3.3.5	Wooden pile, 100mm dia. l=4m	nos.	75,000	3.5	262,500	1.5	112,500	375,000
3.3.6	Miscellaneous works	L.S	-	-	75,000	-	75,000	150,000
	Amount of (1)				4,710,400		2,061,600	6,772,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (14/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(2) Retention pond (2.4 ha)							
3.3.7	Embankment	cu.m	76,000	5.6	425,600	2.4	182,400	608,000
3.3.8	Revetment by dry masonry	sq.m	4,300	28	120,400	12	51,600	172,000
3.3.9	Revetment by wet masonry	sq.m	7,500	35	262,500	15	112,500	375,000
3.3.10	Asphalt pavement, levee top	sq.m	8,600	14	120,400	6	51,600	172,000
3.3.11	Steel sheetpiling, type-2, permanent, lit.=20m	nos.	700	800	560,000	300	210,000	770,000
3.3.12	Landscaping works	L.S	-	-	1,000	-	9,000	10,000
	Miscellaneous works	L.S	-	-	50,000	-	50,000	100,000
	Amount of (2)				1,539,900		667,100	2,207,000

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (15/16)

1.0 US$=MS 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(3) Pumping house (Civil & building works)							
3.3.14	Excavation w/hauling	cu.m	12,000	2.8	33,600	1.2	14,400	48,000
3.3.15	Foundation piling, R.C type 400mm, l=30m	nos.	164	700	114,800	300	49,200	164,000
3.3.16	Steel sheetpiles, type 2, permanent (l=10m, W=0.4m, 48kg/m)	nos.	325	1,400	455,000	600	195,000	650,000
3.3.17	Backfill	cu.m	4,500	2.1	9,450	0.9	4,050	13,500
3.3.18	Building, R.C type (Concrete, 6000 m3), 280 m2	L.S	-	-	500,000	-	500,000	1,000,000
3.3.19	Landscaping works	L.S	-	-	2,000	-	18,000	20,000
	(Mechanical/Electrical works)							
3.3.20	Drainage pumps, horizontal shaft axial flow w/motor Q1.0m3/s, H=1.5m	set	2	100,000	200,000	30,000	60,000	260,000
3.3.21	Auxiliary facilities (O.H. Crane, 3.5 tons, Diesel Generator of 100 kva and others)	L.S	-	-	160,000	-	40,000	200,000
3.3.22	Gate and trashrack	ton	20	16,000	320,000	4,000	80,000	400,000
3.3.23	Garbage equipment	set	3	80,000	240,000	20,000	60,000	300,000
3.3.24	Erection cost, pump & others	L.S	-	-	100,000	-	100,000	200,000
3.3.25	Miscellaneous works	L.S	-	-	90,000	-	90,000	180,000
	Amount of (3)				2,224,850		1,210,650	3,435,500

TABLE L-7 PRICED BILL OF QUANTITIES FOR THE URGENT PROJECTS (16/16)

1.0 US$=M$ 2.7=¥140.0

Item No.	Works Items	Unit	Q'ty	Unit Cost F.C (M$) Unit	F.C (M$) Amount	L.C (M$) Unit	L.C (M$) Amount	Total (M$)
	(4) Outlet channel (L = 20 m)							
3.3.26	Excavation w/hauling	cu.m	150	3.5	525	1.5	225	750
3.3.27	Embankment	cu.m	1,800	5.6	10,080	2.4	4,320	14,400
3.3.28	Revetment by dry masonry	sq.m	250	28	7,000	12	3,000	10,000
3.3.29	Miscellaneous works	L.S	-	-	550	-	550	1,100
	Amount of (4)				18,155		8,095	26,250
	Total of 3.3 (3.1 to 3.3)				8,493,000		3,947,000	12,441,000
	Total of 3				16,560,000		7,757,000	24,318,000
	GRAND TOTAL, 1 + 2 + 3				42,198,000		19,300,000	61,498,000

TABLE L-8 LAND ACQUISITION AND HOUSE EVACUATION COSTS (SUMMARY)

River / Drainage		LAND ACQUISITION			HOUSE EVACUATION			
		Area /1 (sq.m)	Unit cost /2 (M$)	Amount (M$)	Number (nos.)	Unit cost /3 (M$)	Amount (M$)	Total (M$)
A. Rivers								
1. Sg. Pinang System								
(1) Sg. Pinang	(3,150 m)	78,286	431	33,741,266	100	-	6,077,260	39,818,526
(2) Sg. Jelutong	(2,150 m)	13,806	431	5,950,386	17	-	840,170	6,790,556
(3) Sg. Air Itam (I1)	(1,100 m)	20,575	485	9,978,875	4	-	100,620	10,079,495
(I2)	(1,016 m)	19,290	323	6,230,670	2	-	97,000	6,327,670
(I3)	(884 m)	11,405	162	1,847,610	10	-	647,360	2,494,970
(Amount)	(3,000 m)	51,270	-	18,057,155	16	-	844,980	18,902,135
(4) Sg. Dondang	(4,320 m)	63,398	140	8,875,720	26	-	1,046,980	9,922,700
(5) A. Terjun diversion	(1,740 m)	983	377	370,591	1	-	145,500	516,091
Sub Total		207,743	-	66,995,118	160	-	8,954,890	75,950,008
2. Sg. Keluang System								
(1) Sg. Keluang	(2,540 m)	40,470	120	4,856,400	0	-	0	4,856,400
(2) Sg. Ara	(2,360 m)	59,655	146	8,709,630	16	-	706,590	9,416,220
(3) Relau diversion	(1,530 m)	32,085	97	3,112,245	0	-	0	3,112,245
Sub Total		132,210	-	16,678,275	16	-	706,590	17,384,865
3. Sg. Gelugor	(500 m)	4,500	215	967,500	0	-	0	967,500
4. Sg. Dua Besar	(2,092 m)	21,953	162	3,556,386	0	-	0	3,556,386
Total (Rivers), 1+2+3+4		366,406	-	88,197,279	176	-	9,661,480	97,858,759
B. Drainage								
1. S-18 Drainage route	(200 m)	1,200	431	517,200	2	-	112,050	629,250
Grand Total, A + B		367,606	-	88,714,479	178	-	9,773,530	98,488,009

Notes /1 : See table, breakdown of land acquisition & house evacuation costs (1/2)
/2 : Source, Valuation Department
/3 : See table, breakdown of land acquisition & house evacuation costs (2/2)

TABLE L-9 BREAKDOWN OF LAND ACQUISITION & HOUSE EVACUATION COSTS (LAND ACQUISITION AREA) (1/2)

River / Drainage	Division	Area (sq.m) Left Bank	Right Bank	Total
A. Rivers				
1. Sg. Pinang System				
(1) Sg. Pinang	1	2,320	990	3,310
	2	12,155	4,158	16,313
	3	2,130	1,250	3,380
	4	0	5,580	5,580
	5	1,738	100	1,838
	6	550	810	1,360
	7	416	0	416
	8	8,400	2,850	11,250
	9	2,805	3,757	6,562
	10	2,600	2,040	4,640
	11	1,221	3,975	5,196
	12	2,533	660	3,193
	13	4,890	1,950	6,840
	14	2,112	832	2,944
	15	416	675	1,091
	16	906	0	906
	17	1,935	0	1,935
	18	972	0	972
	19	560	0	560
	Amount	48,659	29,627	78,286
(2) Sg. Jelutong	1	0	1,200	1,200
	2	200	900	1,100
	3	560	1,200	1,760
	4	3,000	700	3,700
	5	329	570	899
	6	192	1,680	1,872
	7	160	385	545
	8	120	780	900
	9	100	56	156
	10	0	1,620	1,620
	11	0	54	54
	Amount	4,661	9,145	13,806
(3) Sg. Air Itam (I1)	1	1,105	105	1,210
	2	2,220	140	2,360
	3	5,440	1,600	7,040
	4	2,295	720	3,015
	5	840	700	1,540
	6	600	630	1,230
	7	850	3,120	3,970
	8	0	210	210
	Amount	13,350	7,225	20,575
(I2)	1	630	360	990
	2	2,720	300	3,020
	3	560	1,560	2,120
	4	2,380	1,050	3,430
	5	1,260	540	1,800
	6	900	1,020	1,920
	7	990	4,320	5,310
	8	700	0	700
	Amount	10,140	9,150	19,290
(I3)	1	960	1,800	2,760
	2	540	1,360	1,900
	3	1,530	135	1,665
	4	1,800	490	2,290
	5	1,800	510	2,310
	6	0	480	480
	Amount	6,630	4,775	11,405
(Amount)		30,120	21,150	51,270
(4) Sg. Dondang	1	222	360	582
	2	594	384	978
	3	483	270	753
	4	414	644	1,058
	5	561	240	801
	6	492	1,020	1,512
	7	252	468	720
	8	650	494	1,144
	9	440	992	1,432
	10	66	510	576
	11	330	300	630
	12	1,224	282	1,506
	13	1,420	300	1,720
	14	792	260	1,052
	15	1,170	1,260	2,430
	16	803	960	1,763
	17	720	780	1,500
	18	720	468	1,188
	19	867	2,210	3,077
	20	1,309	847	2,156
	21	175	360	535
	22	141	480	621
	23	1,826	324	2,150
	24	1,296	435	1,731
	25	72	1,120	1,192
	26	180	1,650	1,830
	27	435	3,078	3,513
	28	140	639	779
	29	380	1,430	1,810
	30	341	384	725
	31	150	703	853
	32	270	190	460
	33	552	559	1,111
	34	222	1,080	1,302
	35	30	552	582
	36	72	572	644
	37	135	168	303
	38	920	66	986
	39	495	51	546
	40	650	210	860
	41	744	1,500	2,244
	42	220	675	895
	43	300	540	840
	44	1,176	390	1,566
	45	408	1,155	1,563
	46	112	1,100	1,212
	47	700	600	1,300
	48	570	84	654
	49	297	660	957
	50	376	444	820
	51	0	1,860	1,860
	52	0	376	376
	Amount	26,914	36,484	63,398
(5) A. Terjun diversion		-	-	983
Sub Total				207,743
2. Sg. Keluang System				
(1) Sg. Keluang	1	6,500	3,800	10,300
	2	1,800	3,060	4,860
	3	3,150	6,800	9,950
	4	2,420	7,740	10,160
	5	2,600	2,600	5,200
	Amount	16,470	24,000	40,470
(2) Sg. Ara	1	1,560	3,900	5,460
	2	5,460	8,520	13,980
	3	7,560	595	8,155
	4	6,125	3,120	9,245
	5	1,785	900	2,685
	6	1,075	5,088	6,163
	7	2,200	3,990	6,190
	8	1,300	1,552	2,852
	9	900	1,296	2,196
	10	880	225	1,105
	11	1,624	0	1,624
	Amount	30,469	29,186	59,655
(3) Relau diversion		-	-	32,085
Sub Total				132,210
3. Sg. Gelugor		-		4,500
4. Sg. Dua Besar		-		21,953
Total (Rivers), 1+2+3+4				366,406
B. Drainage				
1. S-18 Drainage route		-	-	1,200
Grand Total, A + B				367,606

TABLE L-9 BREAKDOWN OF LAND ACQUISITION & HOUSE EVACUATION COSTS
(NOS. OF HOUSE EVACUATION AND UNIT PRICE) (2/2)

River / Drainage		House Evacuation											
		Squater	Wooden House			Concrete House			Shop Factory	Pubic Building	Mosque Temple	Others	Total
			Large	Small	Total	Large	Small	Total					
A. Rivers													
1. Sg. Pinang System													
(1) Sg. Pinang		35	1	39	40	7	1	8	9	1	3	4	100
(2) Sg. Jelutong		1	7	0	7	1	1	2	2	2	2	1	17
(3) Sg. Air Itam	(I1)	0	2	0	2	0	0	0	0	1	1	0	4
	(I2)	0	0	0	0	0	0	0	1	1	0	0	2
	(I3)	0	1	1	2	2	0	2	3	3	0	0	10
(Amount)		0	3	1	4	2	0	2	4	5	1	0	16
(4) Sg. Dondang		1	3	11	14	1	0	1	5	0	0	5	26
(5) A. Terjun diversion		0	0	0	0	1	0	1	0	0	0	0	1
Sub Total		37	14	51	65	12	2	14	20	8	6	10	160
2. Sg. Keluang System													
(1) Sg. Keluang		0	0	0	0	0	0	0	0	0	0	0	0
(2) Sg. Ara		4	4	7	11	0	0	0	0	0	0	1	16
(3) Relau diversion		0	0	0	0	0	0	0	0	0	0	0	0
Sub Total		4	4	7	11	0	0	0	0	0	0	1	16
Total (Rivers), 1+2		41	18	58	76	12	2	14	20	8	6	11	176
B. Drainage													
1. S-18 Drainage route		0	0	1	1	0	0	0	1	0	0	0	2
Grand Total, A + B		41	18	59	77	12	2	14	21	8	6	11	178
Unit price	(M$)	100,000	50,310	15,050	-	145,500	48,500	-	97,000	-	-	-	-

TABLE L-10 BASIC WAGE RATES
(Base : 8 hours/day)

No.	Descriptions	Wage rates (M$)
1.	Foreman	50.0
2.	Operator, heavy equipment	60.0
3.	Operator, light equipment	50.0
4.	Assistant operator	40.0
5.	Truck diver	40.0
6.	Mechanic	60.0
7.	Assistant mechanic	40.0
8.	Welder	45.0
9.	Rigger	40.0
10.	Electrician	50.0
11.	Concrete worker	30.0
12.	Carpenter	35.0
13.	Mason	40.0
14.	Steel worker	40.0
15.	Painter	35.0
16.	Plumber	35.0
17.	Fitter	35.0
18.	Common labour (general labour)	25.0

Note: Inclusive of site allowances

TABLE L-11 UNIT PRICES OF MAJOR CONSTRUCTION MATERIALS
(Site delivery basis)

No.	Matereial Items	Unit	Unit price (M$)
1.	Portland cement (50 kg/bag) *	bag	9.5
2.	Reinforcing bar, round, *	ton	1,200.0
3.	Re-bar, deformed, *	ton	1,300.0
4.	Diesel oil (light oil) *	lit.	0.6
5.	Petrol (gasoline) *	lit.	1.1
6.	Lubricants *	lit.	2.5
7.	Aggregate, fine	cu.m	20.0
8.	Aggregate, coarse, granite	cu.m	35.0
9.	Masonry stone	cu.m	30.0
10.	Wooden materials	cu.m	1,300.0
11.	Bitumen, 80/100 penetration grade*	ton	400.0
12.	Cutback bitumen, *	ton	300.0
13.	Steel sheetpile, 51.0 kg/m with two coats of coal tar epoxy paint 1=8m, 5m, and 1.2m long	sq.m	180.0
14.	- do -, 60.4 kg/m, 1 = 9.5m	sq.m	210.0
15.	- do -, 68.3 kg/m	sq.m	250.0
16.	Shaped steel	ton	2,200.0
17.	Steel pipe pile, 600mm dia.	ton	2,500.0
18.	Wooden pile (Bakau pile), 100mm dia., 1=5.5 m approx.	no.	5.1
19.	- do -, 130m dia., 1=5.5m	no.	7.2
20.	Ready mixed concrete, G-20	cu.m	135.0
21.	- do -, G-30	cu.m	150.0

Note: * Government controlled price items

TABLE L-12 HOURLY COST OF EQUIPMENT

US$1.0 = M$2.7 = ¥140.0

No.	Equipment	CIF site delivery cost (1000 M$) (1)	Life <1 Year (2)	Life <1 Hr/Year (3)	Depreciation cost <2 F.C (M$/hr.) (4)	Management cost <3 L.C (M$) (5)	Maintenance & repair cost <4 Ratio (6)	Maintenance & repair cost <4 Total (M$/hr.) (7)	Maintenance & repair cost <4 F.C (M$) (8)	Maintenance & repair cost <4 L.C (M$) (9)	Houly cost, total F.C (M$) (10)	Houly cost, total L.C (M$) (11)	Total equivalent (M$) (12)
1.	Backhoe, 0.6 m3	270.0	5.0	1,800.0	27.0	10.5	0.9	27.0	21.6	5.4	48.6	15.9	64.5
2.	Backhoe, 0.4 m3	162.0	5.0	1,800.0	16.2	6.3	0.9	16.2	13.0	3.2	29.2	9.5	38.7
3.	Swamp bulldozer, 16 t	308.0	6.0	1,500.0	30.8	14.4	0.9	30.8	24.6	6.2	55.4	20.5	76.0
4.	Swamp bulldozer, 13 t	260.0	6.0	1,500.0	26.0	12.1	0.9	26.0	20.8	5.2	46.8	17.3	64.1
5.	Bulldozer, 11 t	230.0	6.0	1,500.0	23.0	10.7	0.9	23.0	18.4	4.6	41.4	15.3	56.7
6.	Crawler loader, 2 m3	310.0	6.0	1,500.0	31.0	14.5	0.9	31.0	24.8	6.2	55.8	20.7	76.5
7.	Crawler loader, 1.5 m3	250.0	6.0	1,500.0	25.0	11.7	0.9	25.0	20.0	5.0	45.0	16.7	61.7
8.	Dump truck, 10 t	150.0	5.0	1,500.0	18.0	7.0	0.7	14.0	11.2	2.8	29.2	9.8	39.0
9.	Dump truck, 6 t	110.0	5.0	1,500.0	13.2	5.1	0.7	10.3	8.2	2.1	21.4	7.2	28.6
10.	Dragline, 0.6 m3	480.0	8.0	1,300.0	41.5	25.8	0.7	32.3	25.8	6.5	67.4	32.3	99.7
11.	Amphibious excavator, 0.6 m3	560.0	5.0	1,200.0	84.0	32.7	0.9	84.0	67.2	16.8	151.2	49.5	200.7
12.	Vibration roller, 5 t	100.0	6.0	800.0	18.8	8.8	0.9	18.8	15.0	3.8	33.8	12.5	46.3
13.	Diesel pile hammer, 2.5 t	150.0	5.0	800.0	33.8	13.1	0.9	33.8	27.0	6.8	60.8	19.9	80.6
14.	Vibration hammer, 30 kw	120.0	5.0	800.0	27.0	10.5	0.8	24.0	19.2	4.8	46.2	15.3	61.5
15.	D. generator, 100 kva	70.0	7.0	1,000.0	9.0	4.9	0.7	7.0	5.6	1.4	14.6	6.3	20.9
16.	Concrete pump car, 40 m3/h	220.0	5.0	1,200.0	33.0	12.8	0.7	25.7	20.5	5.1	53.5	18.0	71.5
17.	Motor grader, 3.1 m	190.0	7.0	1,000.0	24.4	13.3	0.9	24.4	19.5	4.9	44.0	18.2	62.2
18.	Road roller, 8 t	110.0	8.0	800.0	15.5	9.6	0.7	12.0	9.6	2.4	25.1	12.0	37.1
19.	Water tanker, 6 kl	110.0	6.0	1,000.0	16.5	7.7	0.9	16.5	13.2	3.3	29.7	11.0	40.7
20.	Workshop car, 6 t	200.0	6.0	1,200.0	25.0	11.7	0.9	25.0	20.0	5.0	45.0	16.7	61.7
21.	Truck crane, 10 t	280.0	8.0	1,000.0	31.5	19.6	0.7	24.5	19.6	4.9	51.1	24.5	75.6
22.	Crawler crane, 30 t	580.0	7.0	1,000.0	74.6	40.6	0.7	58.0	46.4	11.6	121.0	52.2	173.2

Note: <1 : The life time was estimated based on the results of site survey and equipment date by Ministry of construction in Japan.
<2 : Salvage value of 10% was applied.
<3 : Yearly management cost of 7% was applied and local component. The management cost comprises the insurance, tax, interest and other expenses for the equipment management.
<4 : F.C portion of 80% and L.C portion of 20% were applied on the basis of the other project's data in Malaysia.

TABLE L-13 ANNUAL OPERATION AND MAINTENANCE COSTS

No.	Descriptions	Unit	Quantity	Unit cost (M$)	Amount (M$)
A.	Flood mitigation facilities				
	River channel/retention ponds				
	(Staff)				
	(1) Supervising staff	m/month	3	2,000	6,000
	(2) Administration staff	"	3	1,500	4,500
	(Labour)				
	(3) Operator for equipment	"	6	1,500	9,000
	(4) Driver for vehicle	"	12	1,200	14,400
	(5) Common labour	"	36	700	25,200
	(Equipment)				
	(6) Dragline, 0.6 m3	month	6	3,000	18,000
	(7) Dump truck, 6 tons	"	6	900	5,400
	(8) Pick up truck, 1 ton	"	6	500	3,000
	(Material)				
	(9) Fuel and other materials	L.S	-	-	14,500
	Amount				100,000
	Drainage facilities				
B.	Pumping stations/retention ponds				
	(Staff)				
	(1) Supervising staff	m/month	6	2,000	12,000
	(2) Administration staff	"	6	1,500	9,000
	(Labour)				
	(3) Operator for pumps	"	24	1,500	36,000
	(4) Operator for equipment	"	6	1,500	9,000
	(5) Driver for vehicle	"	18	1,200	21,600
	(6) Common labour	"	48	700	33,600
	(Equipment)				
	(7) Garbage truck, 6 tons	month	6	900	5,400
	(8) Dragline w/pontoon, 0.6 m3	"	3	4,000	12,000
	(9) Pick up truck, 1 ton	"	12	500	6,000
	(Material)				
	(10) Fuel and other materials	L.S	-	-	55,400
	Amount				200,000
	Total				300,000

TABLE L-14 REPLACEMENT COST

No.	Cost Items	Life (Year)	Cost (M$)
A.	Flood mitigation facilities		
	Rivers/retention ponds		
	1. Gates (sluice and flap)	20	90,000
B.	Drainage facilities		
	Pump station		
	1. Drainage pumps	15	1,200,000
	2. Auxiliary equipment	15	400,000
	3. Gate and trashrack	15	800,000
	4. Garbage equipment	15	600,000
	Total		3,090,000

Figures

Fig. L-1 IMPLEMENTATION SCHEDULE FOR THE MASTER PLAN FOR FLOOD MITIGATION AND DRAINAGE WORKS IN PENANG ISLAND

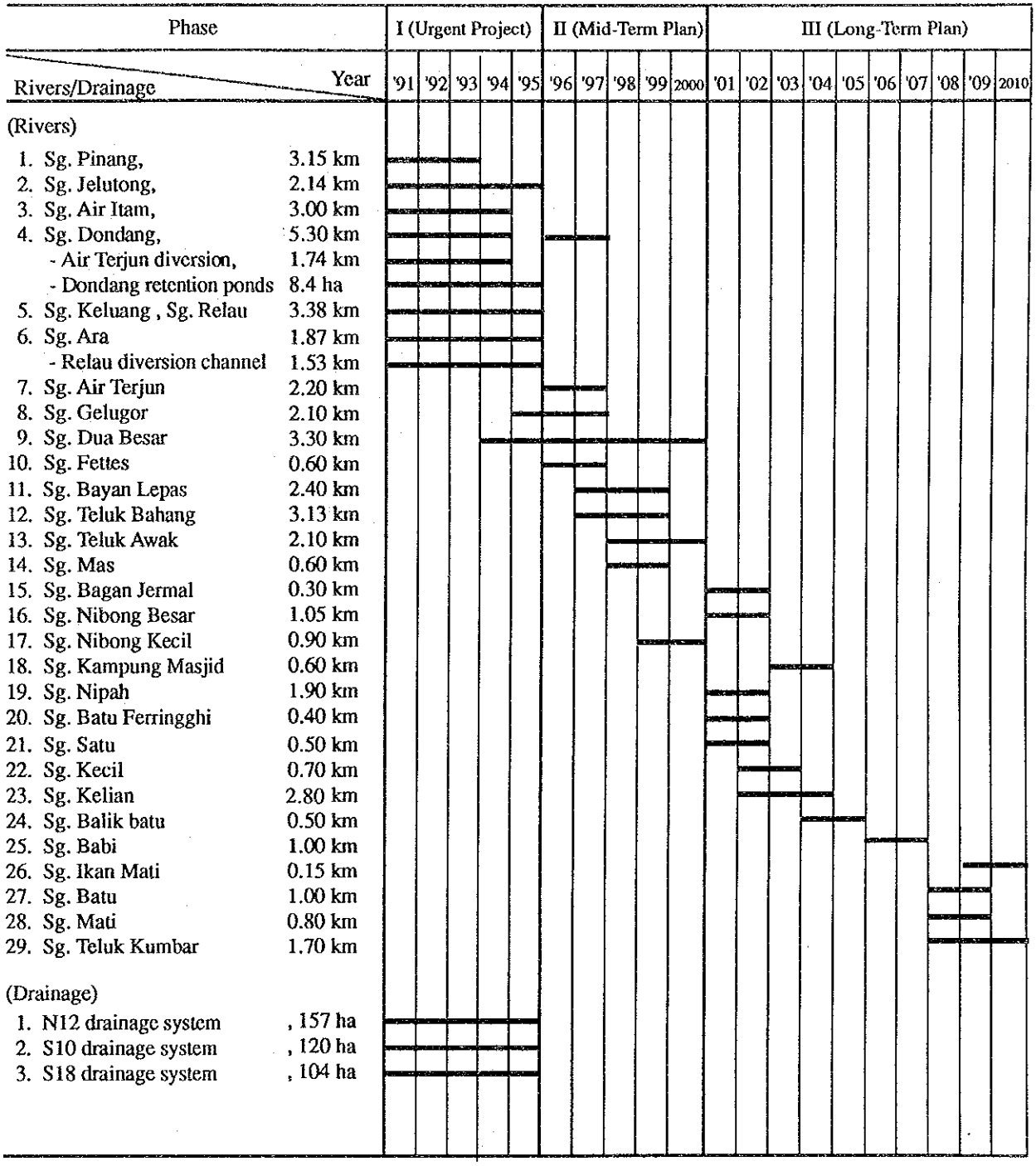
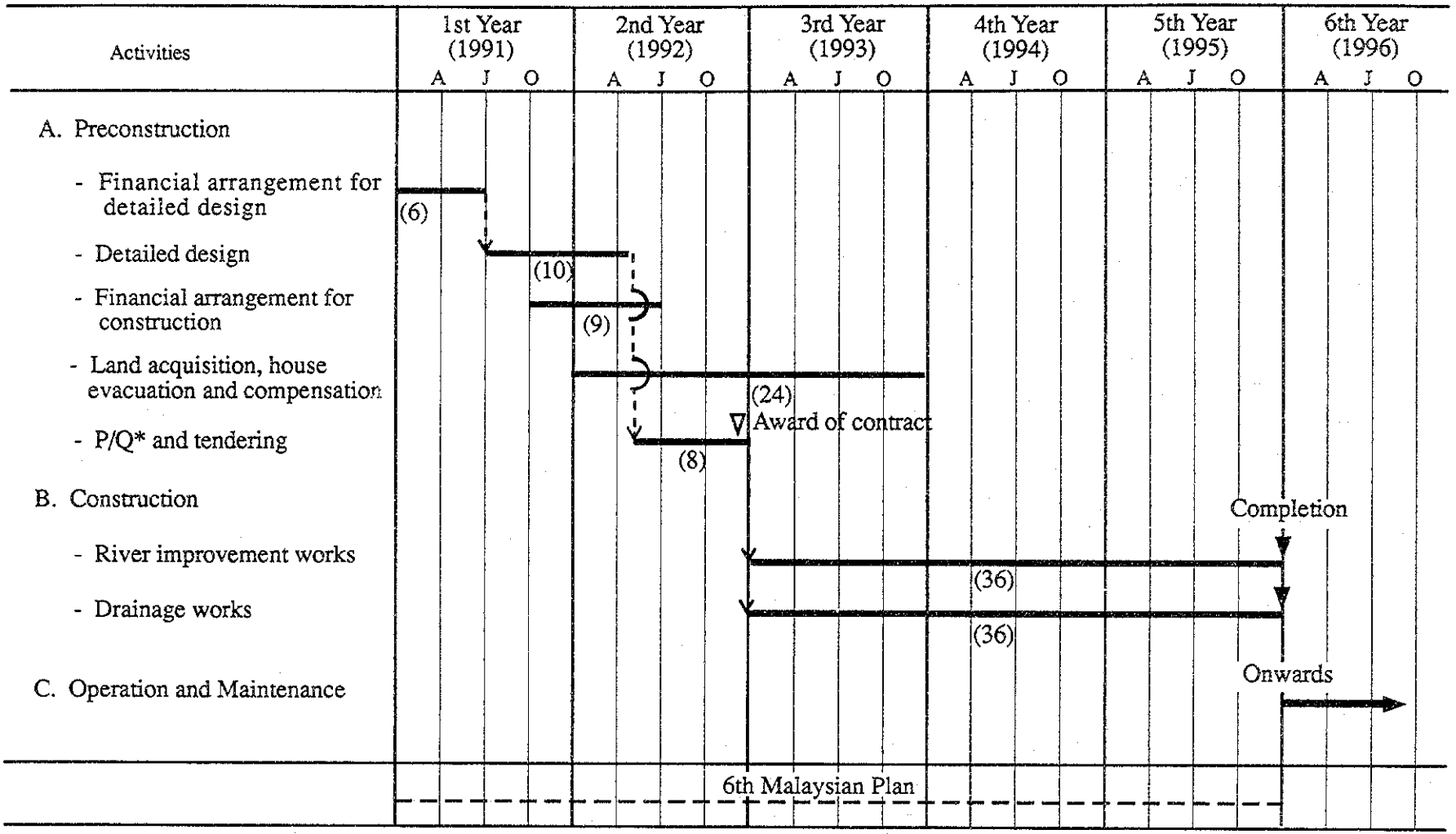


FIG. L-2 IMPLEMENTATION SCHEDULE FOR THE URGENT PROJECTS



* Prequalification of tender

Fig. L-3 CONSTRUCTION TIME SCHEDULE FOR THE URGENT PROJECTS

Work Items	Unit	Q'ty	1st Year (1993) 4 7 10	2nd Year (1994) 4 7 10	3rd Year (1995) 4 7 10
A. River improvement works					
1. Sg. Pinang system					
(1) Pinang river, channel works	km	3.15			
, related structures	-	L.S			
(2) Jelutong river, channel works	km	2.14			
, related structures	-	L.S			
(3) Air Itam river, channel works	km	3.00			
, related structures	-	L.S			
(4) Dondang river, channel works	km	4.32			
, retention ponds	places	3			
, related structures	-	L.S			
(5) A. Terjun diversion channel, culvert	km	1.74			
2. Sg. Keluang system					
(1) Keluang river, channel works	km	3.38			
, related structures	-	L.S			
(2) Ara river, channel works	km	1.87			
, related structures	-	L.S			
(3) Relau diversion channel works	km	1.53			
3. Sg. Gelugor	km	0.50			
4. Sg. Dua Besar	km	2.10			
B. Drainage improvement works					
1. N-12 drainage system					
(1) Trunk drains	-	L.S			
2. S-10 drainage system					
(1) Trunk drains	-	L.S			
(2) Retention pond	Place	1	Civil & building	Install & test	
(3) Pumping station	Place	1			
(4) Outlet channel	Lin.m				
3. S-18 drainage system					
(1) Trunk drains	-	L.S			
(2) Retention pond	Place	1			
(3) Pumping station	Place	1		Civil & building	Install & test
(4) Outlet channel	lin.m				
			4 7 10 1st Year (1993)	4 7 10 2nd Year (1994)	4 7 10 3rd Year (1995)

Fig. L-4 ORGANIZATION CHART FOR CONSTRUCTION OF THE URGENT PROJECTS BY DID

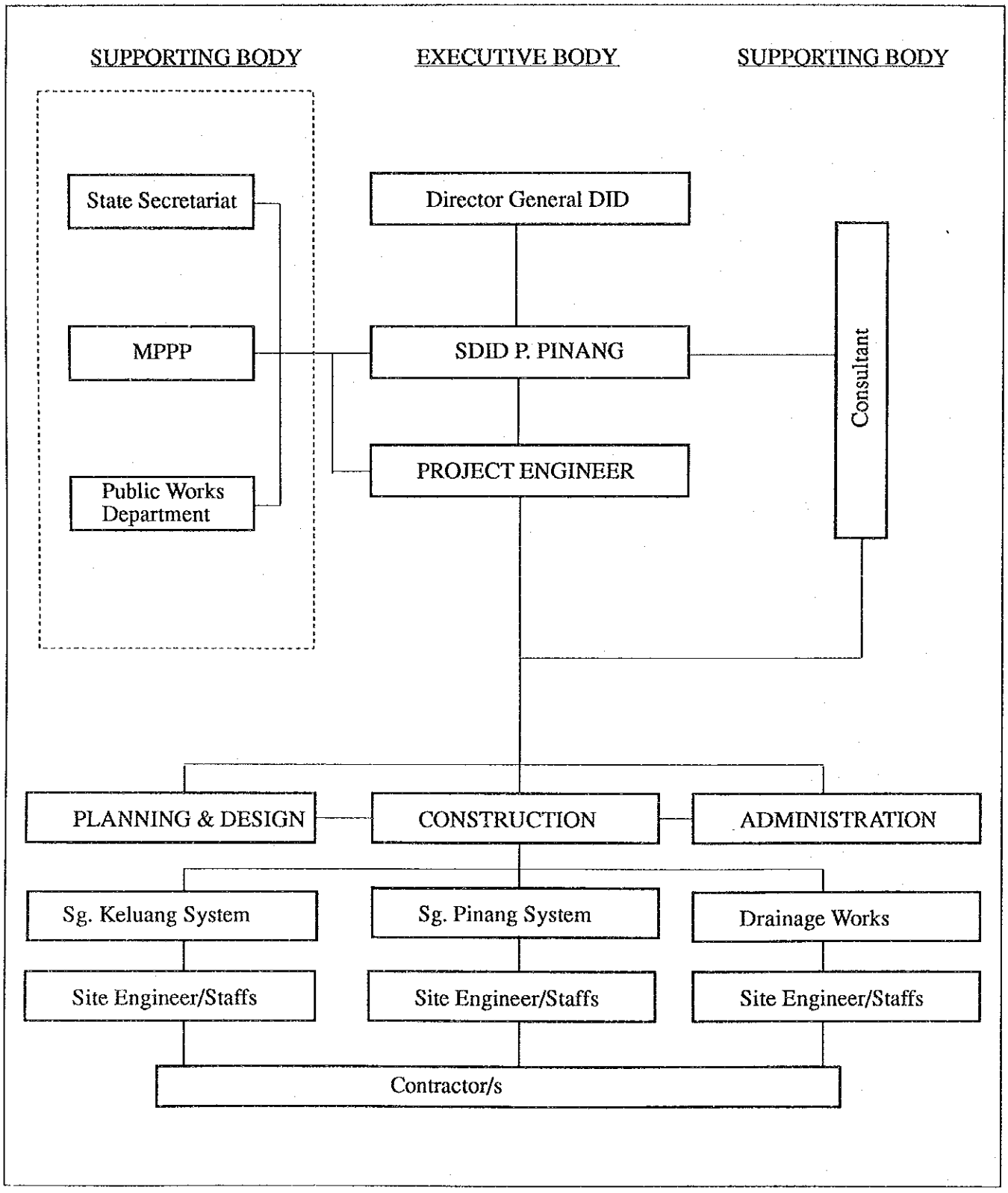
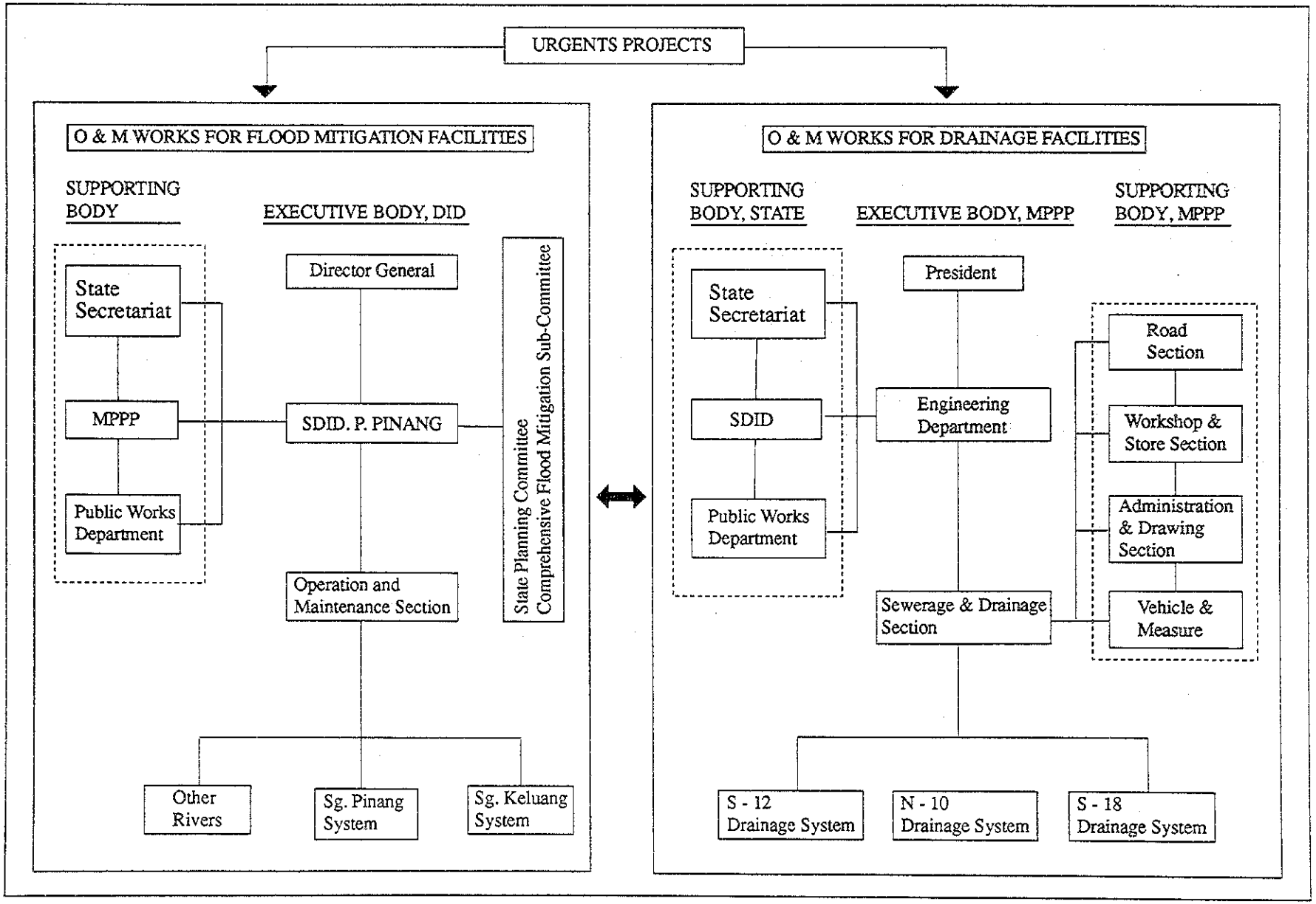
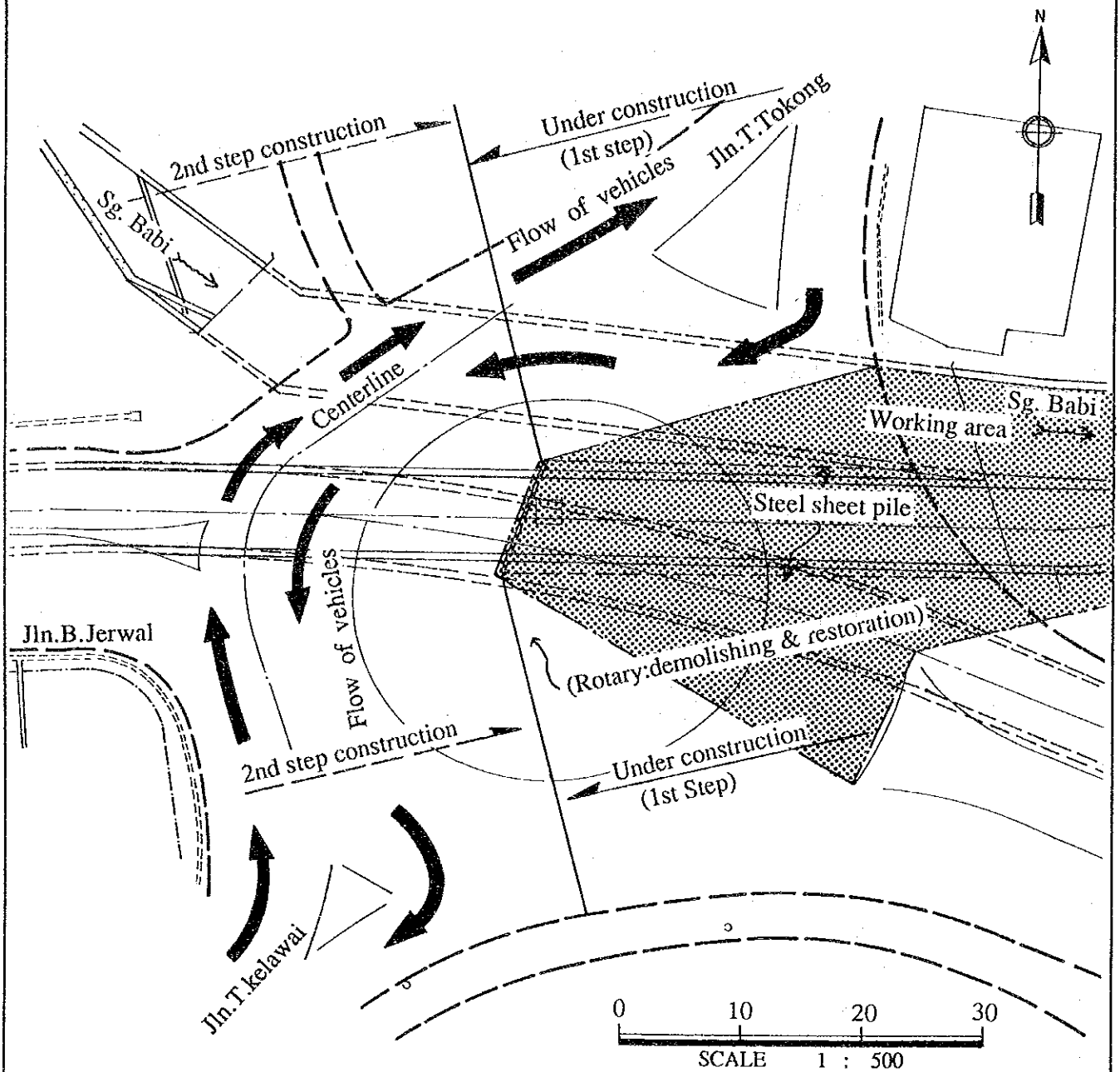
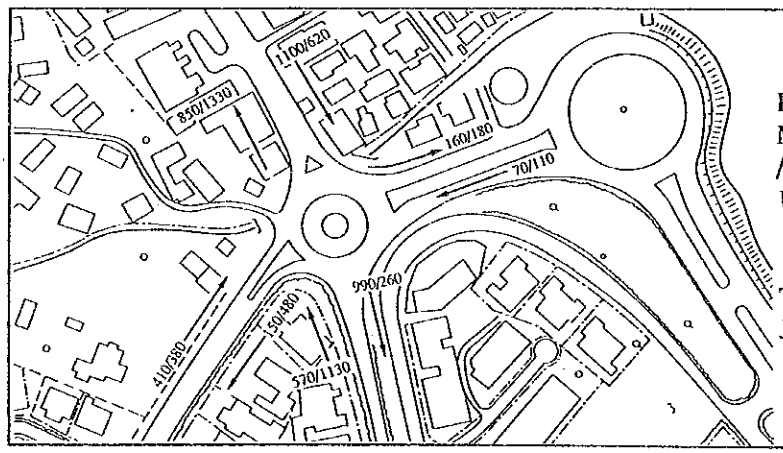


Fig. L-5 ORGANIZATION CHART FOR OPERATION & MAITENANCE WORKS BY DID & MPPP





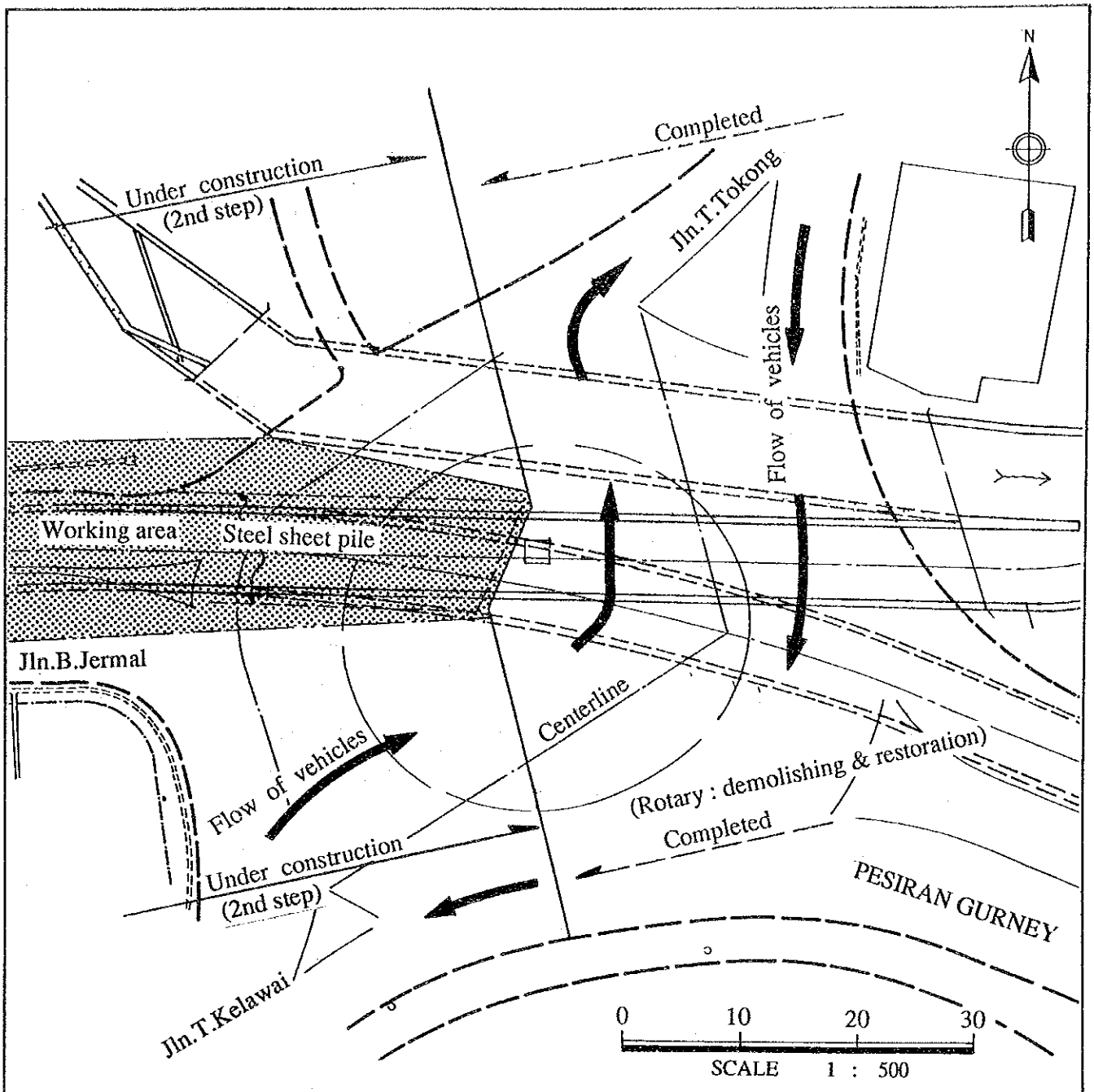


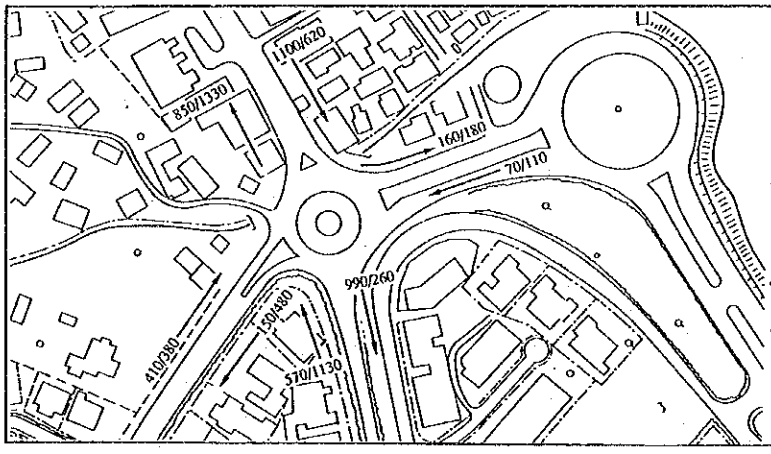
Peak hour traffic flow
Morning(8:00-9:00)
/ Evening(17:00-18:00)
Unit : PCU

・Source ;
Traffic count at intersection
JICA, 1987.

FIG. L-6	PROPOSED TRAFFIC SYSTEM DURING CONSTRUCTION OF AIR TERJUN DIVERSION CHANNEL (1/4)

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND

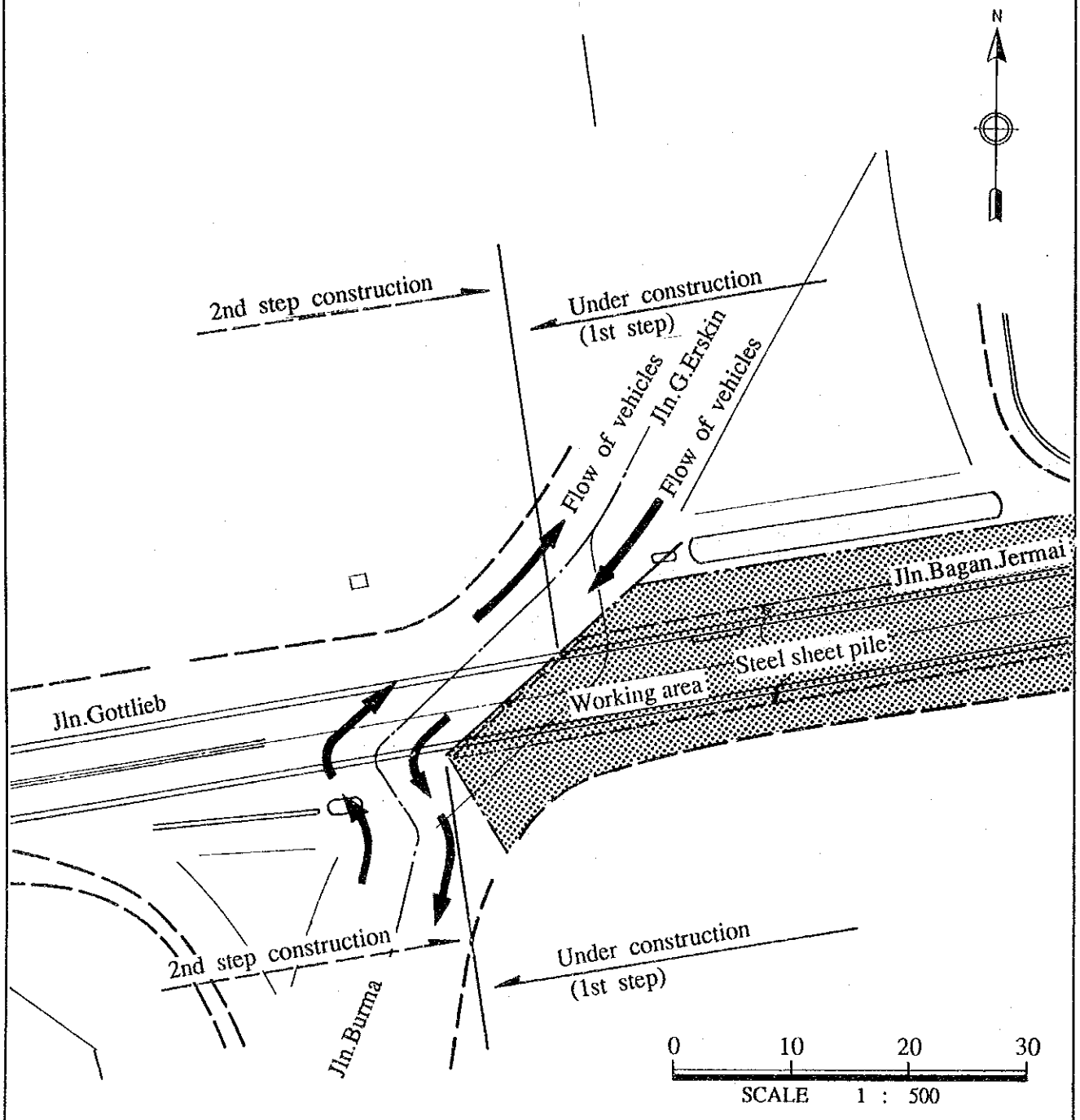


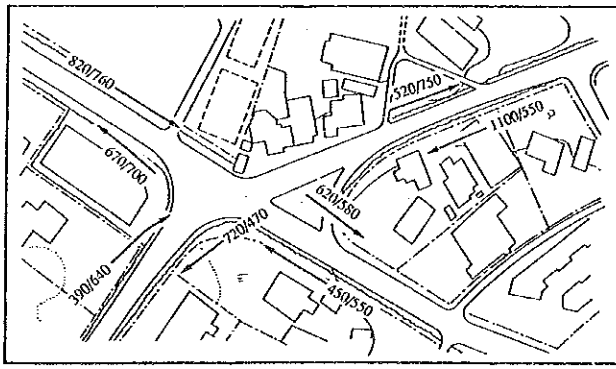


Peak hour traffic flow
Morning(8:00-9:00)
/ Evening(17:00-18:00)
Unit : PCU

· Source ;
Traffic count at intersection
JICA, 1987.

FIG. L-7	PROPOSED TRAFFIC SYSTEM DURING CONSTRUCTION OF AIR TERJUN DIVERSION CHANNEL (2/4)



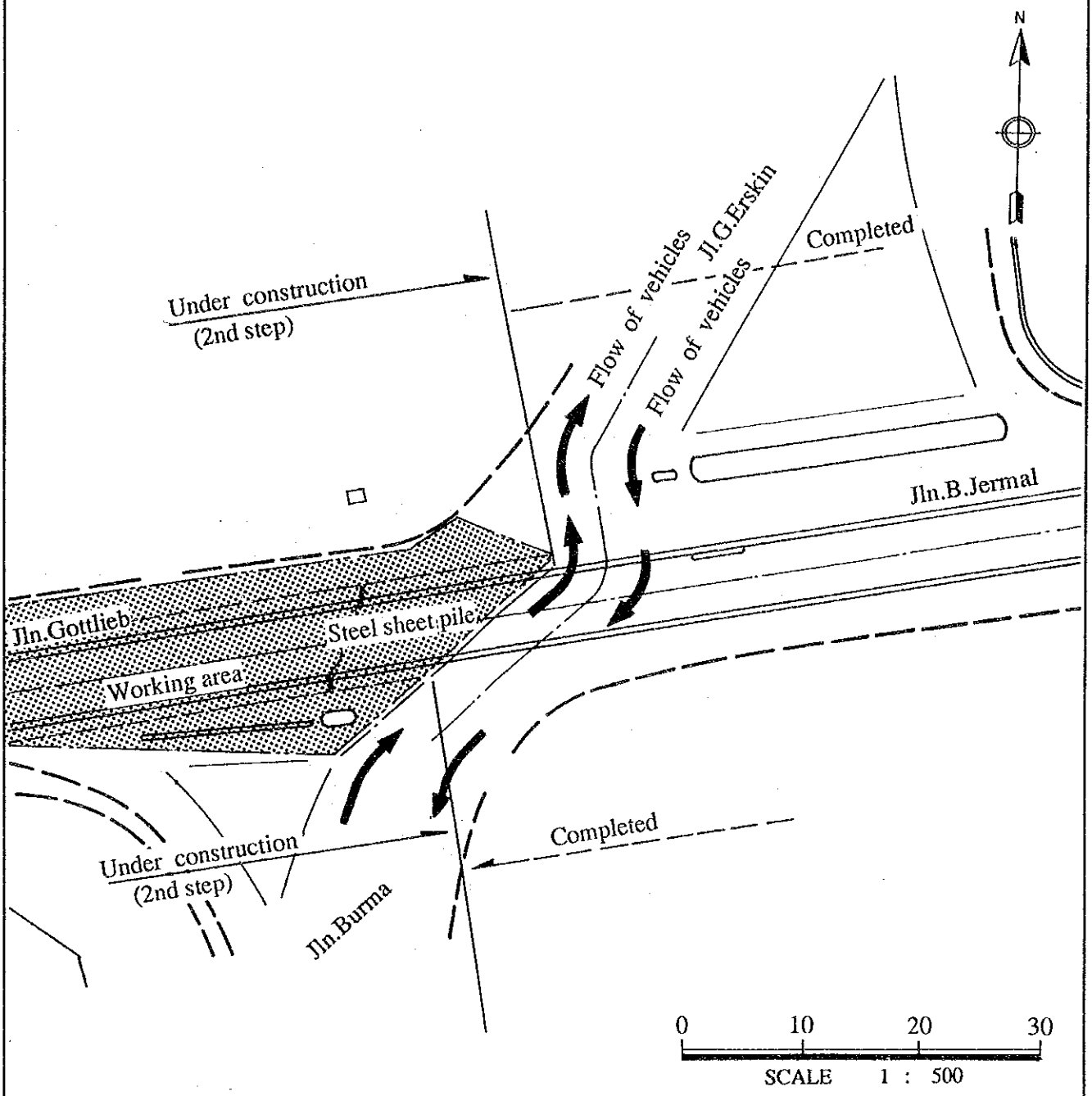


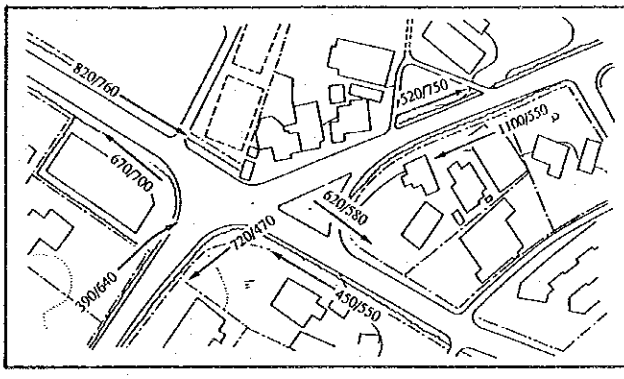
Peak hour traffic flow
Morning(8:00-9:00) / Evening(17:00-18:00)
Unit : PCU

· Source ;
Traffic count at intersection
JICA, 1987.

FIG. L-8	PROPOSED TRAFFIC SYSTEM DURING CONSTRUCTION OF AIR TERJUN DIVERSION CHANNEL (3/4)

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND





Peak hour traffic flow
Morning(8:00-9:00) / Evening(17:00-18:00)
Unit : PCU

· Source ;
Traffic count at intersection
JICA, 1987.

FIG. L-9	PROPOSED TRAFFIC SYSTEM DURING CONSTRUCTION OF AIR TERJUN DIVERSION CHANNEL (4/4)

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND

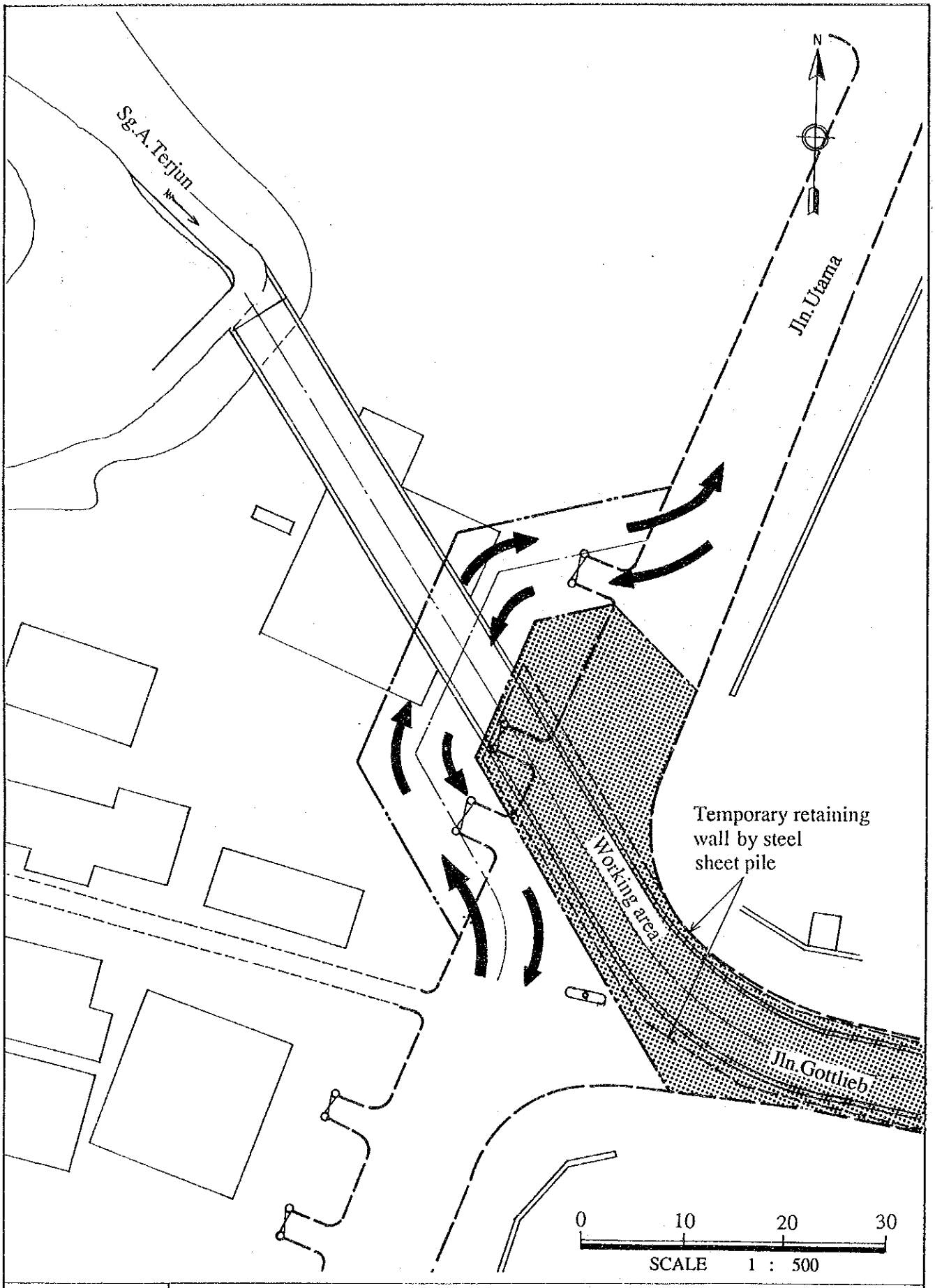
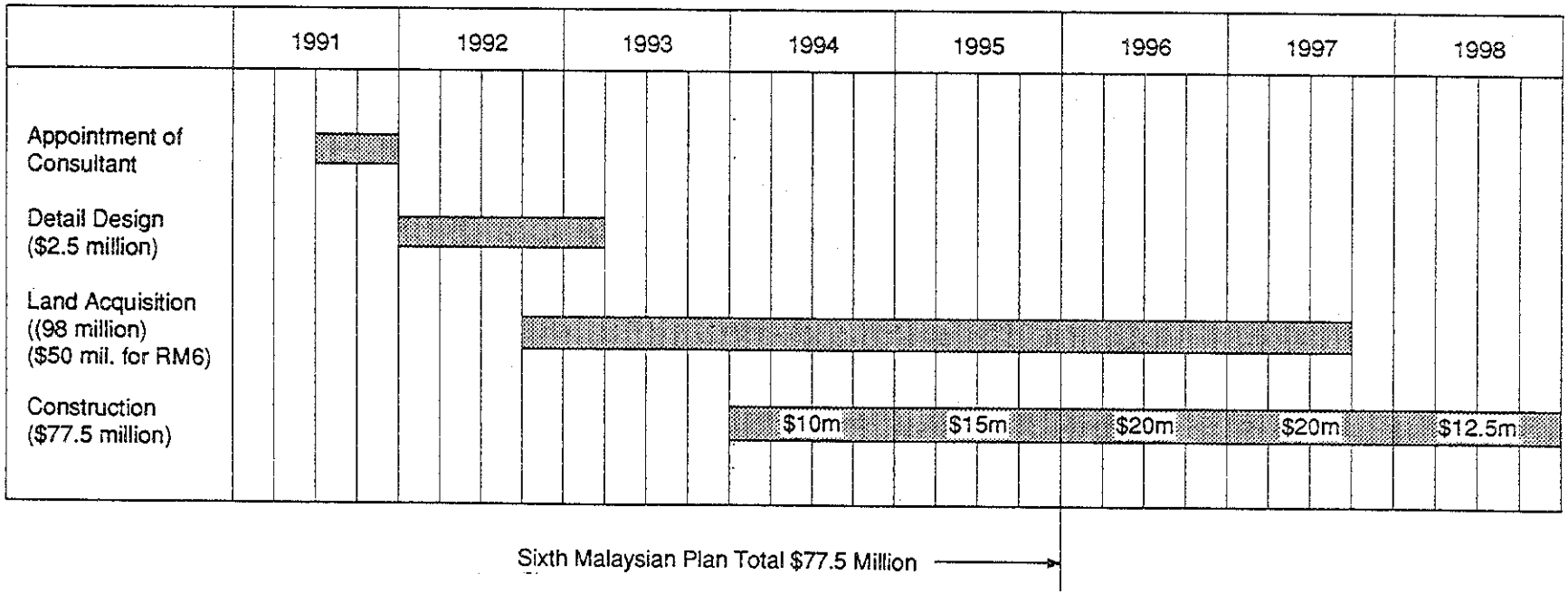


FIG. L-10 PROPOSED DETOUR ROUTE DURING CONSTRUCTION OF A. TERJUN DIVERSION CHANNEL (Under Jln.UTAMA)

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND

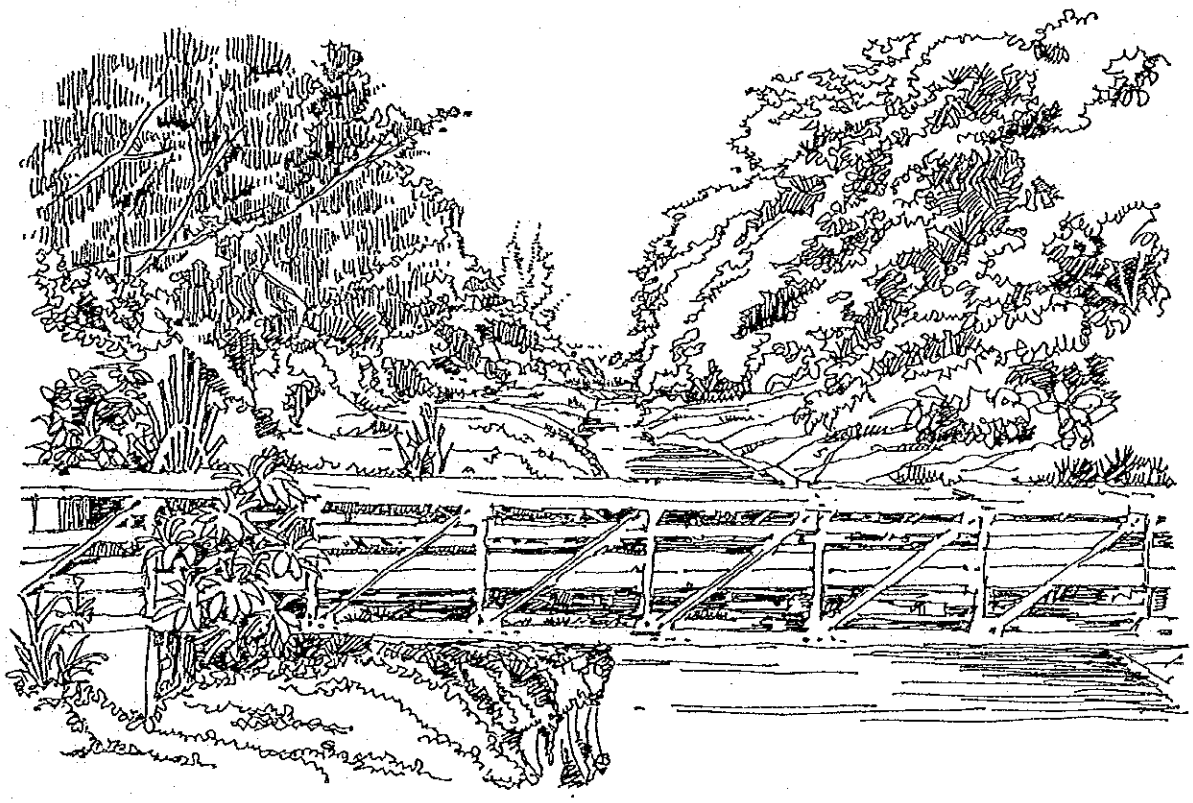
JICA

Fig. L-11 IMPLEMENTATION SCHEDULE FOR FLOOD MITIGATION PROJECT IN PENANG ISLAND BY DID



APPENDIX M

EVALUATION OF URGENT FLOOD MITIGATION AND DRAINAGE PROJECTS



APPENDIX M EVALUATION OF URGENT FLOOD MITIGATION AND DRAINAGE PROJECTS

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APPENDIX M EVALUATION OF URGENT FLOOD MITIGATION AND DRAINAGE PROJECTS

1 ECONOMIC EVALUATION

This economic evaluation aims at assessing the investment efficiency of three urgent projects identified in the master plan.

Three urgent projects are as follows;

- Sg. Pinang Flood Mitigation Project
- Sg. Keluang Flood Mitigation Project
- Georgetown Drainage Project (Zone N-12, S-10, and S-18)

Among these three projects, Sg. Pinang project area includes Georgetown Drainage project area.

In this common flood prone area, the flooding problems can not be solved by the sole project and the effect of flood mitigation or drainage project would be achieved only after implementing together these two projects.

Hence, for the economic evaluation, these two projects were also evaluated as one project.

Framework of evaluation method itself is kept same as that for the master plan study. However, there are two major differences; first is the enlargement of benefit item coverage, and second is accuracy in cost estimation.

1.1 Economic Construction Cost

1.1.1 Conversion Factor

Project costs at 1990 market prices for each urgent project are shown in Tables L.6-3, L.6-4 and L.6-5 in APPENDIX L.

For economic analysis, the nominal project cost is converted into economic cost which excludes the portion of transfer items (tax, duties and subsidy). The economic costs were calculated by using conversion factors selected by each cost item as shown below.

Conversion factors of every cost item are selected from "National Parameters for Project Appraisal in Malaysia, 1988" and presented as follows:

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

1.1.2 Economic Construction Cost

The project cost was divided into domestic and foreign portion in accordance with the availability of the materials in Malaysian boundary.

Domestic portion of the cost at the market was converted into economic cost by means of the above mentioned conversion factors. Foreign portion was used as economic cost without any modification. Exchange rate at August 1990 was used.

Economic costs of the three urgent projects are shown in Table M-1 and summarized as follows:

(unit; Million M$)

Project	Economic Cost
Sg. Pinang Flood Mitigation	112,072
Sg. Keluang Flood Mitigation	33,343
Georgetown Drainage	32,544

1.1.3 Operation, Maintenance and Replacement Costs

The annual operation and maintenance cost was estimated to be 1% of economic construction cost and summarized as follows:

(unit: 1000 M$)

	O/M Cost	Replacement Cost (0.91) *1
Sg. Pinang	1121	90 (88)*2 every 20 year
Sg. Keluang	333	-
Georgetown Drainage	325	3,000 (2,946) every 15 year

( )*1 : Conversion factor ( )*2 : Economic Cost

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, and trash racks are assumed to be replaced by new ones at the same prices as the present level every 15 or 20 years after completion of construction. The replacement cost for each urgent project is also shown above.

1.2 Economic Benefit

Benefits of these urgent flood mitigation and drainage projects are defined as difference between the flood damage potential cases, "with the project" and "without the project". This is equivalent to the magnitude of reduction in flood damage.

The following benefits were estimated in monetary terms:

i) Reduction of general property damage

ii) Reduction of public property damage

iii) Reduction of indirect damage

These flood damage potentials by damage item and flood frequency for each project are shown in Table M-2-1 through M-2-3 and summarized in Table M-3.

Average annual flood damage reduction is calculated by the following equations:

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

Where,
- D : Average annual damage
- Nm : Excess probability for discharge level m
- Lm : Amount of probable flood damage at applicable discharge level m
- m : Ordinal number for discharge level corresponding to return period

Average annual flood damage for each urgent projects is as follows:

(unit; Million M$ in 1990 prices)

Project	1990	2010
Sg. Pinang	27.6	30.1
Sg. Keluang	0.4	11.4
Georgetown Drainage	3.4	3.9

1.3 Comparison of Cost and Benefit

The economic evaluation of the project was made in terms of the economic internal rate of return (EIRR), net present value (NPV) and benefit-cost ratio (B/C) based on the following assumptions:

- The total economic construction costs were distributed to each year of the construction period according to implementation program (see Table M-4-1 ~ M-4-4).
- The project benefits are assumed to be realized 5 years after the beginning of the project implementation, in 1996.
- Enrollment of the annual operation and maintenance costs is expected to start from the first year (1996) after the completion of construction works.
- The benefit increases exponentially between 1990 to 2010 and remains constant after 2010.
- Opportunity cost of capital is 8%.

The opportunity cost of capital was set up based on the following reasons.

The opportunity cost of capital (OCC) is one of the most important of the national parameters used for project appraisal. Hoverer, there exist no single method of estimating the OCC. Direct calculation of the OCC is generally impossible.

A further problem with the OCC is its lack of stability. Of all the parameters for project appraisal, it is the most likely to be subject to changes in a short term. Therefor, the OCC will require to be reviewed most regularly.

According to the "National Parameters for Project Appraisal in Malaysia, January 1986", it refers that a value of 13% should be taken as the best single estimate of the OCC in 1984, while 8% was adopted in 1977.

In principal, a value of the OCC was based on the "Base Lending Rate (BLR)". Actually, the BLRs in 1984 and 1977 were 12.25% and 7.50% receptively.

Accordingly, a value of the OCC in 1990 was determined with reference to the BLR of commercial banks and financial companies , of which data have been issued by the Bank Negara Malaysia as shown in Table M-6.

In 1990, a moderate base lending rate ranged between 7.0% and 9.0%. therefore, a value of 8.0% was adopted for the project appraisal as a single best value for the OCC in 1990.

Cash flows of economic costs and benefits are shown in Table M-4-1 through M-4-4.

The results of evaluation are as follows:

Project	EIRR (%)	NPV (1000 M$)	B/C
Sg. Pinang	17.5	132,212	2.34
Sg. Keluang	14.6	33,829	2.15
Georgetown Drainage	8.6	1,713	1.06
Sg. Pinang & G/T Drainage	16.0	133,925	2.06

As shown in the above table, all urgent projects are judged feasible because;

- Economic internal rate of return of each project shown higher level than the opportunity cost of capital (=8%).
- Other two evaluation indicators approve the implementation of the projects, too.

1.4 Sensitivity Analysis

Results of the cost benefit comparison were assessed on different assumptions of benefit and cost in order to measure the impacts of unexpected changes in benefit and cost on the investment efficiency.

In this study, benefit is assumed to fall down up to 80% of the original level, while cost increases up to 120%. Changes in economic internal rate of return are shown in Table M-5 and summarized as follows:

Project Title	Cost 20% up	Benefit 20% down	Cost 20% up and Benefit 20% down
Sg. Pinang Project	15.1	14.6	12.4
Sg. Keluang Project	12.8	12.5	10.9
Georgetown Drainage Project	6.8	6.4	4.8
Sg. Pinang & G/T Drainage Project	13.7	13.2	11.1

Results show that two flood mitigation projects are feasible even in the possible worst case with cost 20% higher than the original and benefit 20% less than original. While, in the case of evaluation for sole drainage project, the investment efficiency goes down lower than the opportunity cost of capital.

However, as described before, this drainage project should be evaluated together with Sg. Pinang Flood Mitigation project.

Furthermore, besides this damage reduction benefit, although not estimate in monetary terms in this report, Georgetown Drainage project generates the benefits as follows:

i) In the study area, there exist lowlying areas which are affected by high tides. During the high tides (about 2 weeks per month), extremely polluted water stagnates in the drains including domestic waste, catering industry waste and garbage disposal. These aggravated conditions are expected to be greatly improved by implementation of drainage works.

ii) Drainage project areas are included in the city centre and very valuable zone as a commercial, business and tourist area. In such area, improvement of sanitary condition generates enormous intangible merits.

Finaly, it is concluded that three flood mitigation and drainage projects are all feasible and their implementation are recommended.

2 SOCIAL IMPACTS

First, these projects can contribute to remove the development constraint in the future. Flood generally causes an interruption of traffic and therefore makes it difficult to deliver inputs/outputs of manufacturing sector on time. In some cases, their production schedule might be changed because of flood. It is also anticipated that, without project, future investment might be depressed in the future. This development constraint can be removed by the project.

Secondly, these projects can contribute to an improvement of people's public health and amenity. It is obvious that floodings especially in the town area cause epidemic disease and aggravate living amenity. In addition, it also gives unfavorable impression on town, especially to the foreign tourists. These defects of the flood should be removed and the prerequisite of the living circumstance should be guaranteed by the projects.

Thirdly, implementation of the flood mitigation and drainage projects most effectively contribute to meet the inhabitants' preference to the government investment policy. Interview survey clarifies that the drainage system improvement project ranks at the top of project list anticipated by the people in Penang Island. Priority preference is given to these projects below;

Top preference; drainage system improvement

2nd preference;	sewage system improvement
3rd preference;	housing development
4th preference;	river/sea water purification
5th preference;	road network and traffic improvement
6th preference;	public transport system improvement

3 CONCLUSIONS

It is concluded that three urgent projects are all feasible and their implementation are recommended.

Its reason lies in the fact that evaluation indicators of three projects are higher than the opportunity cost of capital and the proposed flood mitigation and drainage projects ensure to conduce an improvement of social welfare and to validate opportunity of further economic development.

Tables

TABLE M-1 ANNUAL DISBURSEMENT SCHEDULE OF ECONOMIC COST

(Sg. Pinang)

(Unit: 1000 M$)

Cost Items		Amount	1991	1992	1993	1994	1995
1. Direct Cost	F.C	19,040	0	0	7,616	5,712	5,712
	L.C	7,853	0	0	3,141	2,356	2,356
	Total	26,893	0	0	10,757	8,068	8,068
2. Land Acquisition & House Evacuation Costs	F.C	0	0	0	0	0	0
	L.C	66,836	0	33,418	33,418	0	0
	Total	66,836	0	33,418	33,418	0	0
3. Administration Cost	F.C	0	0	0	0	0	0
	L.C	1,132	226	226	226	226	226
	Total	1,132	226	226	226	226	226
4. Engineering Services Cost	F.C	1,901	475	475	317	317	317
	L.C	704	176	176	117	117	117
	Total	2,605	651	651	434	434	434
5. Physical Contingency	F.C	3,140	71	71	1,190	904	904
	L.C	11,466	70	5,078	5,524	397	397
	Total	14,606	141	5,149	6,714	1,301	1,301
Grand Total	F.C	24,081	546	546	9,123	6,933	6,933
	L.C	87,991	473	38,898	42,427	3,096	3,096
	Total	112,072	1,019	39,444	51,550	10,029	10,029

(Sg. Keluang)

(Unit: 1000 M$)

Cost Items		Amount	1991	1992	1993	1994	1995
1. Direct Cost	F.C	6,070	0	0	2,428	1,821	1,821
	L.C	2,457	0	0	983	737	737
	Total	8,527	0	0	3,411	2,558	2,558
2. Land Acquisition & House Evacuation Costs	F.C	0	0	0	0	0	0
	L.C	19,281	0	9,640	9,640	0	0
	Total	19,281	0	9,640	9,640	0	0
3. Administration Cost	F.C	0	0	0	0	0	0
	L.C	361	72	72	72	72	72
	Total	361	72	72	72	72	72
4. Engineering Services Cost	F.C	612	153	153	102	102	102
	L.C	222	56	56	37	37	37
	Total	834	209	209	139	139	139
5. Physical Contingency	F.C	999	22	22	379	288	288
	L.C	3,341	20	1,467	1,606	124	124
	Total	4,340	42	1,489	1,985	412	412
Grand Total	F.C	7,681	175	175	2,909	2,211	2,211
	L.C	25,662	148	11,235	12,338	970	970
	Total	33,343	323	11,410	15,247	3,181	3,181

(Georgetown Drainage)

(Unit: 1000 M$)

Cost Items		Amount	1991	1992	1993	1994	1995
1. Direct Cost	F.C	17,090	0	0	6,836	5,127	5,127
	L.C	7,271	0	0	2,908	2,181	2,181
	Total	24,361	0	0	9,744	7,308	7,308
2. Land Acquisition & House Evacuation Costs	F.C	0	0	0	0	0	0
	L.C	554	0	277	277	0	0
	Total	554	0	277	277	0	0
3. Administration Cost	F.C	0	0	0	0	0	0
	L.C	1,033	207	207	207	207	207
	Total	1,033	207	207	207	207	207
4. Engineering Services Cost	F.C	1,711	428	428	285	285	285
	L.C	655	164	164	109	109	109
	Total	2,366	592	592	394	394	394
5. Physical Contingency	F.C	2,820	64	64	1,068	812	812
	L.C	1,409	60	101	514	367	367
	Total	4,229	124	165	1,582	1,179	1,179
Grand Total	F.C	21,621	492	492	8,189	6,224	6,224
	L.C	10,323	430	749	4,015	2,864	2,864
	Total	32,544	922	1,241	12,204	9,088	9,088

TABLE M-2-1 FLOOD DAMAGE POTENTIAL BY DAMAGE ITEM AND FLOOD FREQUENCY (SG. PINANG)

(unit: million M$ in 1990 Prices)

Damage Item	1990						2010					
	1/1.1	1/5	1/10	1/30	1/50	1/100	1/1.1	1/5	1/10	1/30	1/50	1/100
A. General Property												
(1) Houses	0.4	1.2	11.6	33.0	47.9	63.9	0.4	1.3	11.9	38.2	55.2	73.9
(2) Household Articles	0.6	1.8	8.9	27.3	45.7	69.2	0.6	1.9	9.3	31.4	51.9	78.7
(3) Commercial Assets	0.4	1.3	7.2	15.3	19.2	22.7	0.4	1.3	13.2	18.0	22.6	26.6
(4) Commercial Stocks	0.6	2.0	10.6	22.4	28.2	33.2	0.7	2.1	11.1	26.3	33.1	39.0
Sub-total	2.1	6.2	38.2	98.0	141.1	189.1	2.2	6.6	45.5	113.8	163.0	218.3
B. Public Property												
(1) Road	3.8	11.6	50.6	89.7	105.3	113.2	3.8	11.6	50.6	89.7	105.3	113.2
(2) Bridge	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3) Electricity Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4) Telecomm. Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5) School,Hospital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(6) Gov. Building Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	3.8	11.6	50.6	89.7	105.3	113.2	3.8	11.6	50.6	89.7	105.3	113.2
C. Agricultural Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D. Income/Sale Loss												
(1) Shop Revenue	0.0	0.1	0.5	0.9	1.1	1.2	0.1	0.2	0.8	1.4	1.7	1.8
(2) Factory Production	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3) Bus Services	0.1	0.2	0.7	1.3	1.5	1.7	0.1	0.2	1.1	2.0	2.4	2.6
(4) Taxi Services	0.1	0.2	0.7	1.3	1.5	1.7	0.1	0.2	1.1	2.0	2.3	2.5
(5) Trishaw Services	0.1	0.2	1.0	1.9	2.2	2.4	0.1	0.3	1.5	2.8	3.3	3.5
Sub-total	0.2	0.7	3.1	5.5	6.5	6.9	0.3	1.0	4.6	8.2	9.6	10.3
E. Vehicle's Running Cost												
(1) Operating Cost	0.0	0.1	0.3	0.6	0.7	0.7	0.0	0.1	0.5	0.9	1.0	1.1
(2) Time Cost	0.2	0.6	2.7	4.9	5.7	6.1	0.3	0.9	4.1	7.3	8.7	9.3
Sub-total	0.2	0.7	3.1	5.5	6.4	6.9	0.3	1.0	4.6	8.3	9.7	10.4
Grand Total	6.4	19.1	94.9	198.7	259.1	316.1	6.7	20.2	105.4	219.9	287.4	352.2

Remarks; Flood damage potentials of 'General Property' for 1.1-year return flood are estimated based on flood prone area in proportion with that for 5-year return flood.

TABLE M-2-2 FLOOD DAMAGE POTENTIAL BY DAMAGE ITEM AND FLOOD FREQUENCY (SG. KELUANG)

(unit; million M$ in 1990 Prices)

Damage Item	1990						2010					
	1/1.1	1/5	1/10	1/30	1/50	1/100	1/1.1	1/5	1/10	1/30	1/50	1/100
A. General Property												
(1) Houses	0.0	0.0	0.1	0.3	1.4	2.2	1.0	3.1	5.1	7.0	11.8	13.1
(2) Household Articles	0.1	0.2	0.5	0.8	2.2	3.3	2.6	7.7	12.7	17.6	29.4	32.1
(3) Commercial Assets	0.0	0.1	0.2	0.4	1.0	1.3	0.4	1.1	3.8	2.6	4.7	5.4
(4) Commercial Stocks	0.0	0.1	0.2	0.3	0.8	1.0	0.3	0.9	1.4	2.2	3.9	4.3
Sub-total	0.1	0.4	0.9	1.9	5.6	7.8	4.3	12.9	23.0	29.4	49.8	55.0
B. Public Property												
(1) Road	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	4.4	7.7	9.1	9.8
(2) Bridge	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3) Electricity Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4) Telecomm. Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5) School,Hospital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(6) Gov. Building Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	4.4	7.7	9.1	9.8
C. Agricultural Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D. Income/Sale Loss												
(1) Shop Revenue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2) Factory Production	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3) Bus Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4) Taxi Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5) Trishaw Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E. Vehicle's Running Cost												
(1) Operating Cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2) Time Cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grand Total	0.1	0.4	0.9	1.9	5.6	7.8	4.7	13.9	27.4	37.2	58.9	64.8

Remarks: Flood damage potentials of 'General Property' for 1.1-year return flood are estimated based on flood prone area in proportion with that for 5-year return flood.

TABLE M-2-3 FLOOD DAMAGE POTENTIAL BY DAMAGE ITEM AND FLOOD FREQUENCY
(GEORGETOWN DRAINAGE)

(unit: million M$ in 1990 Prices)

Damage Item	1990			2010		
	1/1.1	1/5	1/10	1/1.1	1/5	1/10
A. General Property						
(1) Houses	0.1	0.4	2.4	0.1	0.4	2.5
(2) Household Articles	0.2	0.6	2.7	0.2	0.6	2.8
(3) Commercial Assets	0.1	0.4	1.3	0.2	0.5	1.0
(4) Commercial Stocks	0.2	0.6	1.9	0.2	0.7	2.1
Sub-total	0.7	2.2	8.3	0.7	2.3	8.4
B. Public Property						
(1) Road	0.4	1.1	5.1	0.4	1.1	5.1
(2) Bridge	0.0	0.0	0.0	0.0	0.0	0.0
(3) Electricity Facility	0.0	0.0	0.0	0.0	0.0	0.0
(4) Telecomm. Facility	0.0	0.0	0.0	0.0	0.0	0.0
(5) School,Hospital	0.0	0.0	0.0	0.0	0.0	0.0
(6) Gov. Building Facility	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	0.4	1.1	5.1	0.4	1.1	5.1
C. Agricultural Products	0.0	0.0	0.0	0.0	0.0	0.0
D. Income/Sale Loss						
(1) Shop Revenue	0.0	0.0	0.2	0.0	0.1	0.3
(2) Factory Production	0.0	0.0	0.0	0.0	0.0	0.0
(3) Bus Services	0.1	0.2	0.7	0.1	0.2	1.1
(4) Taxi Services	0.1	0.2	0.7	0.1	0.2	1.1
(5) Trishaw Services	0.1	0.2	1.0	0.1	0.3	1.5
Sub-total	0.2	0.6	2.8	0.3	0.9	4.1
E. Vehicle's Running Cost						
(1) Operating Cost	0.0	0.1	0.3	0.0	0.1	0.5
(2) Time Cost	0.2	0.6	2.7	0.3	0.9	4.1
Sub-total	0.2	0.7	3.1	0.3	1.0	4.6
Grand Total	1.5	4.6	19.1	1.8	5.4	22.2

Remarks; Flood damage potentials of 'General Property' for 1.1-year return flood are estimated based on flood prone area in proportion with that for 5-year return flood.

TABLE M-3 FLOOD DAMAGE POTENTIAL BY FLOOD FREQUENCY

(Sg. Pinang)
(unit: million M$ in 1990 Prices)

Year	1.1-year Return Flood	5-year Return Flood	10-year Return Flood	30-year Return Flood	50-year Return Flood	Annual Average Flood Damage Potential
1990	6.4	19.1	94.9	198.7	259.1	27.6
2010	6.7	20.2	105.4	219.9	287.4	30.1

((Sg. Keluang)
(unit; million M$ in 1990 Prices)

Year	1.1-year Return Flood	5-year Return Flood	10-year Return Flood	30-year Return Flood	50-year Return Flood	Annual Average Flood Damage Potential
1990	0.1	0.4	0.9	1.9	5.6	0.4
2010	4.7	13.9	27.4	37.2	58.9	11.4

(Georgetown Drainage)
(unit: million M$ in 1990 Prices)

Year	1.1-year Return Flood	5-year Return Flood	10-year Return Flood	Annual Average Flood Damage Potential
1990	1.5	4.6	19.1	3.4
2010	1.8	5.4	22.2	3.9

TABLE M-4-1 FLOWS OF ECONOMIC COST AND BENEFIT (SG. PINANG)

0.08 (Unit: 1000 M$ in 1990 Prices)

Year	Costs								Economic Benefits	Balance
	Economic Construction Cost						Maintenance Cost	Replacement Cost	Total Costs		
	Direct Cost	Land Acqu. & House Evacuation	Admini. Cost	Engineering Services Cost	Physical Contingency	Sub-total	1%			27578	
1990	0	0	0	0	0	0	0		0	0	0
1991	0	0	226	651	141	1,019	0		1,019	0	-1,019
1992	0	33,418	226	651	5,149	39,444	0		39,444	0	-39,444
1993	10,757	33,418	226	434	6,714	51,550	0		51,550	0	-51,550
1994	8,068	0	226	434	1,301	10,029	0		10,029	0	-10,029
1995	8,068	0	226	434	1,301	10,029	0		10,029	0	-10,029
1996							1,121		1,121	28,321	27,200
1997							1,121		1,121	28,445	27,324
1998							1,121		1,121	28,569	27,448
1999							1,121		1,121	28,692	27,572
2000							1,121		1,121	28,816	27,696
2001							1,121		1,121	28,940	27,819
2002							1,121		1,121	29,064	27,943
2003							1,121		1,121	29,188	28,067
2004							1,121		1,121	29,312	28,191
2005							1,121		1,121	29,435	28,315
2006							1,121		1,121	29,559	28,439
2007							1,121		1,121	29,683	28,562
2008							1,121		1,121	29,807	28,686
2009							1,121		1,121	29,931	28,810
2010							1,121		1,121	30,055	28,934
2011							1,121		1,121	30,055	28,934
2012							1,121		1,121	30,055	28,934
2013							1,121		1,121	30,055	28,934
2014							1,121		1,121	30,055	28,934
2015							1,121	88	1,208	30,055	28,846
2016							1,121		1,121	30,055	28,934
2017							1,121		1,121	30,055	28,934
2018							1,121		1,121	30,055	28,934
2019							1,121		1,121	30,055	28,934
2020							1,121		1,121	30,055	28,934
2021							1,121		1,121	30,055	28,934
2022							1,121		1,121	30,055	28,934
2023							1,121		1,121	30,055	28,934
2024							1,121		1,121	30,055	28,934
2025							1,121		1,121	30,055	28,934
2026							1,121		1,121	30,055	28,934
2027							1,121		1,121	30,055	28,934
2028							1,121		1,121	30,055	28,934
2029							1,121		1,121	30,055	28,934
Total	26,893	66,836	1,132	2,605	14,606	112,072	38,104	88	150,264	1,008,854	858,590
PV=	19,961	55,179	904	2,121	11,716	89,880	8,838	13	98,731	230,943	132,212
										EIRR=	17.5%
										B/C =	2.34

TABLE M-4-2 FLOWS OF ECONOMIC COST AND BENEFIT (SG. KELUANG)

0.08 (Unit: 1000 M$ in 1990 Prices)

Year	Costs								Economic Benefits	Balance
	Economic Construction Cost						Maintenance Cost	Replacement Cost	Total Costs		
	Direct Cost	Land Acqu. & House Evacuation	Admini. Cost	Engineering Services Cost	Physical Contingency	Sub-total	1%			392	
1990	0	0	0	0	0	0	0		0	0	0
1991	0	0	72	209	42	323	0		323	0	-323
1992	0	9,640	72	209	1,489	11,410	0		11,410	0	-11,410
1993	3,411	9,640	72	139	1,985	15,247	0		15,247	0	-15,247
1994	2,558	0	72	139	412	3,181	0		3,181	0	-3,181
1995	2,558	0	72	139	412	3,181	0		3,181	0	-3,181
1996							333		333	3,706	3,372
1997							333		333	4,258	3,924
1998							333		333	4,810	4,477
1999							333		333	5,362	5,029
2000							333		333	5,914	5,581
2001							333		333	6,467	6,133
2002							333		333	7,019	6,685
2003							333		333	7,571	7,238
2004							333		333	8,123	7,790
2005							333		333	8,675	8,342
2006							333		333	9,228	8,894
2007							333		333	9,780	9,446
2008							333		333	10,332	9,999
2009							333		333	10,884	10,551
2010							333		333	11,436	11,103
2011							333		333	11,436	11,103
2012							333		333	11,436	11,103
2013							333		333	11,436	11,103
2014							333		333	11,436	11,103
2015							333		333	11,436	11,103
2016							333		333	11,436	11,103
2017							333		333	11,436	11,103
2018							333		333	11,436	11,103
2019							333		333	11,436	11,103
2020							333		333	11,436	11,103
2021							333		333	11,436	11,103
2022							333		333	11,436	11,103
2023							333		333	11,436	11,103
2024							333		333	11,436	11,103
2025							333		333	11,436	11,103
2026							333		333	11,436	11,103
2027							333		333	11,436	11,103
2028							333		333	11,436	11,103
2029							333		333	11,436	11,103
Total	8,527	19,281	361	834	4,340	33,343	11,337	0	44,680	330,859	286,179
PV=	6,329	15,918	288	679	3,475	26,689	2,629	0	29,318	63,147	33,829
										EIRR=	14.6%
										B/C =	2.15

TABLE M-4-3 FLOWS OF ECONOMIC COST AND BENEFIT (GEORGETOWN DRAINAGE)

0.08 (Unit: 1000 M$ in 1990 Prices)

Year	Costs: Economic Construction Cost: Direct Cost	Land Acqu. & House Evacuation	Admini. Cost	Engineering Services Cost	Physical Contingency	Sub-total	Maintenance Cost 1%	Replacement Cost	Total Costs	Economic Benefits 3354	Balance
1990	0	0	0	0	0	0	0		0	0	0
1991	0	0	207	592	124	922	0		922	0	-922
1992	0	277	207	592	165	1,241	0		1,241	0	-1,241
1993	9,744	277	207	394	1,582	12,204	0		12,204	0	-12,204
1994	7,308	0	207	394	1,179	9,088	0		9,088	0	-9,088
1995	7,308	0	207	394	1,179	9,088	0		9,088	0	-9,088
1996							325		325	3,527	3,201
1997							325		325	3,556	3,230
1998							325		325	3,584	3,259
1999							325		325	3,613	3,288
2000							325		325	3,642	3,317
2001							325		325	3,671	3,345
2002							325		325	3,700	3,374
2003							325		325	3,728	3,403
2004							325		325	3,757	3,432
2005							325		325	3,786	3,461
2006							325		325	3,815	3,489
2007							325		325	3,844	3,518
2008							325		325	3,872	3,547
2009							325		325	3,901	3,576
2010							325	2,946	3,271	3,930	659
2011							325		325	3,930	3,605
2012							325		325	3,930	3,605
2013							325		325	3,930	3,605
2014							325		325	3,930	3,605
2015							325		325	3,930	3,605
2016							325		325	3,930	3,605
2017							325		325	3,930	3,605
2018							325		325	3,930	3,605
2019							325		325	3,930	3,605
2020							325		325	3,930	3,605
2021							325		325	3,930	3,605
2022							325		325	3,930	3,605
2023							325		325	3,930	3,605
2024							325		325	3,930	3,605
2025							325	2,946	3,271	3,930	659
2026							325		325	3,930	3,605
2027							325		325	3,930	3,605
2028							325		325	3,930	3,605
2029							325		325	3,930	3,605
Total	24,361	554	1,033	2,366	4,229	32,544	11,065	5,892	49,500	130,597	81,097
PV=	18,081	458	825	1,926	3,181	24,471	2,566	831	27,869	29,581	1,713
										EIRR=	8.6%
										B/C =	1.06

TABLE M-4-4 FLOWS OF ECONOMIC COST AND BENEFIT (SG. PINANG , GEORGETOWN DRAINAGE)

0.08

(Unit: 1000 M$ in 1990 Prices)

Year	Costs									Economic Benefits	Balance
	Economic Construction Cost						Maintenance Cost	Replacement Cost	Total Costs		
	Direct Cost	Land Acqu. & House Evacuation	Admini. Cost	Engineering Services Cost	Physical Contingency	Sub-total				30,932	
1990	0	0	0	0	0	0	0		0	0	0
1991	0	0	433	1,243	265	1,942	0		1,942	0	-1,942
1992	0	33,695	433	1,243	5,314	40,685	0		40,685	0	-40,685
1993	20,502	33,695	433	828	8,296	63,754	0		63,754	0	-63,754
1994	15,376	0	433	828	2,480	19,117	0		19,117	0	-19,117
1995	15,376	0	433	828	2,480	19,117	0		19,117	0	-19,117
1996							1,446		1,446	31,848	30,402
1997							1,446		1,446	32,000	30,554
1998							1,446		1,446	32,153	30,707
1999							1,446		1,446	32,306	30,860
2000							1,446		1,446	32,458	31,012
2001							1,446		1,446	32,611	31,165
2002							1,446		1,446	32,764	31,317
2003							1,446		1,446	32,916	31,470
2004							1,446		1,446	33,069	31,623
2005							1,446		1,446	33,221	31,775
2006							1,446		1,446	33,374	31,928
2007							1,446		1,446	33,527	32,081
2008							1,446		1,446	33,679	32,233
2009							1,446		1,446	33,832	32,386
2010							1,446	2,946	4,392	33,985	29,592
2011							1,446		1,446	33,985	32,538
2012							1,446		1,446	33,985	32,538
2013							1,446		1,446	33,985	32,538
2014							1,446		1,446	33,985	32,538
2015							1,446	88	1,534	33,985	32,451
2016							1,446		1,446	33,985	32,538
2017							1,446		1,446	33,985	32,538
2018							1,446		1,446	33,985	32,538
2019							1,446		1,446	33,985	32,538
2020							1,446		1,446	33,985	32,538
2021							1,446		1,446	33,985	32,538
2022							1,446		1,446	33,985	32,538
2023							1,446		1,446	33,985	32,538
2024							1,446		1,446	33,985	32,538
2025							1,446	2,946	4,392	33,985	29,592
2026							1,446		1,446	33,985	32,538
2027							1,446		1,446	33,985	32,538
2028							1,446		1,446	33,985	32,538
2029							1,446		1,446	33,985	32,538
Total	51,254	67,390	2,165	4,972	18,834	144,615	49,169	5,980	199,764	1,139,451	939,686
PV=	38,042	55,637	1,729	4,047	14,897	114,351	11,404	844	126,600	260,525	133,925
										EIRR=	16.0%
										B/C =	2.06

TABLE M-5 SUMMARY OF SENSITIVITY TESTS

Project Title		Economic Internal Rate of Return									
		Cost				Benefit				Cost 15% up Benefit 15% down	Cost 20% up Benefit 20% down
		5% up	10% up	15% up	20% up	5% down	10% down	15% down	20% down		
Sg. Pinang Flood Mitigation Project	EIRR	16.8	16.2	15.6	15.1	16.8	16.0	15.3	14.6	13.6	12.4
	B/C	2.23	2.13	2.03	1.95	2.22	2.11	1.99	1.87	1.73	1.56
Sg. Keluang Flood Mitigation Project	EIRR	14.1	13.6	13.2	12.8	14.1	13.5	13.0	12.5	11.8	10.9
	B/C	2.05	1.96	1.87	1.79	2.05	1.94	1.83	1.72	1.59	1.44
Georgetown Drainage Project	EIRR	8.1	7.6	7.2	6.8	8.1	7.5	7.0	6.4	5.7	4.8
	B/C	1.01	0.96	0.92	0.88	1.01	0.96	0.90	0.85	0.78	0.71
Sg. Pinang Flood Mitigation & Georgetown Drainage Project	EIRR	15.3	14.7	14.2	13.7	15.3	14.6	13.9	13.2	12.3	11.1
	B/C	1.96	1.87	1.79	1.71	1.95	1.85	1.75	1.65	1.52	1.37

TABLE M-6 BASE LENDING RATE OF COMMERCIAL BANKS AND FINANCIAL COMPANIES

Akhir tempoh			1 Kadar pinjaman asas *Base lending rate*	2 Kadar pinjaman asas *Base lending rate*
Sebelum perlaksanaan rejim kadar faedah baru pada 23hb. Oktober, 1978[3]				
1985	Dis.	Terendah	9.75	11.00
		Tertinggi	11.25	12.80
		Mod	10.75	12.00
1986	Dis.	Terendah	9.25	10.50
		Tertinggi	10.00	12.75
		Mod	10.00	11.50
1987	Dis.	Terendah	7.00	9.00
		Tertinggi	7.50	9.75
		Mod	7.50	9.25
1988	Dis.	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	9.00
1989	Dis.	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	8.50
1990	Apr.	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	8.50
	Mei	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	8.50
	Jun	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	8.50
	Jul.	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	8.50
	Ogos	Terendah	6.75	8.50
		Tertinggi	7.00	9.00
		Mod	7.00	8.50
	Sep.	Terendah	7.25	8.75
		Tertinggi	7.50	9.50
		Mod	7.50	9.00
	Okt.	Terendah	7.25	9.00
		Tertinggi	7.50	9.50
		Mod	7.50	9.00

1: *Interest Rates of Commercial Banks*

2: *Interest Rates of Finance Companies*

APPENDIX N

OPERATION AND MAINTENANCE PLAN FOR URGENT PROJECTS

APPENDIX N OPERATION AND MAINTENANCE PLAN FOR URGENT PROJECTS

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APPENDIX N OPERATION AND MAINTENANCE PLAN FOR URGENT PROJECTS

1. PRESENT STATUS OF OPERATION AND MAINTENANCE OF THE EXISTING FLOOD MITIGATION AND DRAINAGE FACILITIES

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

Flood Mitigation

a) Periodical dredging in Sg. Pinang and other rivers.

b) Periodical removal of floating debris by screening.

c) Clearing of river banks and leveling of maintenance road surface.

d) O/M of flood forecasting and warning system.

Drainage

a) Periodical removal of sedimentation and floating debris by screening.

b) Maintenance of flap gate.

c) Removal of floating debris in Prangin Pump Station

d) O/M of Prangin Pump Station. (S-10 Drain)

These activities are conducted mainly by State DID and MPPP. However due to budget constraints and ambiguousness of demarcation of river stretches among the agencies concerned, these flood control and drainage activities are still at rather an unsatisfactory level. Among these facilities, especially, Prangin Pumping Station has a problem of O/M. Present status of this pump station is summarized in Table N-1.

2 REQUIRED OPERATION AND MAINTENANCE WORKS

In the urgent projects, the several new facilities for flood mitigation are to be constructed. They are the Dondang Retention Ponds, the Diversion Channels, water gates, tidal gates and pumping station. Hence in order to ensure the expected beneficial effects of both the existing and proposed flood mitigation and drainage facilities, the following O/M works are strongly recommended to be undertaken by the relevant agencies.

River Channel

a) Periodical dredging

b) Removal of floating debris

c) Clearing of river banks and leveling of maintenance road surface.

Retention Ponds

d) O/M of outlet gates in the Dondang Retention Ponds

e) Periodical desilting in the Retention Ponds if necessary

f) Clearing and removal of garbage after flooding

Pumping Stations and Retention Ponds

g) O/M of pumps in S-10 and S-18 pump station

h) O/M of tidal gates in S-10 and S-18 Retention Ponds

i) Removal of floating debris by screening

j) Periodical dredging of the retention ponds if necessary

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

a) Trucks for garbage transportation : 2 nos

b) Supervision vehicles : 2 nos

3. OPERATION AND MAINTENANCE OF GATES AND PUMPING STATION

3.1 Pumping Stations in S-10 and S-18 Areas

The tidal gates at the S-10 and S-18 Retention Ponds will be constructed to protect the inland against high tides.

These gates are kept open under normal circumstances. When the tidal level is expected to rise beyond an elevation of 1.2 m, the operation of the tidal gates is necessary.

These gates shall be closed when the sea water level is about -0.8 m and remain closed until the tidal level peaks beyond 1.2 m and shall be opened when the level recedes below 1.2 m. In general, under the condition of no rainfall, the pumps will not be operated as the retention pond has sufficient space capacity to maintain its water level not to exceed that of the lowest most elevation, even when normal dry weather flow enters the pond.

However, under the condition of rainfall once the runoff entering the pond exceeded a certain amount, the pumps will be operated.

The general guideline for operation of tidal gate and drainage pump is as follows:

i) Basic conditions

- Design High Water Level of the Pond;		+ 1.20m
- Design Low Water Level;		- 0.80m
- Effective Depth of the Pond;		2.00m
- Lowest ground level in the catchment;		+ 1.40m
- Design discharge of trunk drain;	S-10	$1.85m^3/s$
	S-18	$15.0m^3/s$
- Pump Capacity;	S-10	$6m^3/s$
	S-18	$2m^3/s$
- Storage Capacity of Retention Pond;	S-10	$22,000m^3$
	S-18	$56,000m^3$

ii) Operation of tidal gate

- Timing of closing;	when the tidal level lowers below an elevation of - 0.80m (D.L.W.L. of the pond).
- Duration of closing;	6 - 7 hours.
- Timing of opening;	when the tide level falls below an elevation of + 1.20m.

iii) Operation of Pump

The pump will be operated only when the floods in coincidence with high tide occurs.

- Timing of operation;	when the rising speed of water level goes beyond 30 cm/h, or when the inflow to the pond increases beyond the design pump capacity.
- Duration of continuous operation;	Maximum 6 -7 h.

These conditions should be examined in more details in the further stage.

3.2 Retention Ponds in Dondang Area

At the outlet of each retention pond, two kinds of gate i.e. flap gate and sluice gate will be installed.

The flap gate will be used to release the inner water in the retention pond, and the sluice gate to discharge water stored in the pond for flood mitigation of Sg. Dondang respectively.

Under normal flooding conditions, discharge only from the retention pond area will be released automatically through flap gate.

When the scale of floods of Sg. Dondang exceeds 30-year return period, discharge of Sg. Dondang enter into the retention pond overflowing through the weir.

The release of water stored in the retention pond has to be regulated so that the river discharge will not exceed the allowable design discharge at each point near the outlet of each pond.

4. REQUIRED ORGANIZATION FOR CONSTRUCTION, OPERATION AND MAINTENANCE

The required organization for construction of the proposed urgent flood mitigation and drainage works in shown in Fig. N-1.

Fig. N-2 shows the required organization to operation and Maintenance.

Such an organization is recommended to be created by reorganizing the existing organizational structure of SDID and MPPP.

In addition as the retention ponds in Dondang area are planned for multipurpose usage, this execution works are to be coordinated between SDID and MPPP.

Tables

Table N-1 Present Status of O/M of S-10 Pump Facilities

1. General feature of the existing pumping facilities

. Pump capacity and number : 50,000 gal/min, 2 units
. Time installation : 1963
. Structure of pump facilities : refer plan
. Pitch of screen : Primary screen - 3 ins
Secondary screen - 2.75 ins
. Feature of flap gates : refer plan

2. Operation and Maintenance

- Tidal gate

. Frequency of closure of tidal gate : about 30 times per month
. Water level for gate operation : 5 feet from canal bed level
. Period of closure of tidal gate : no record but depends on the tide and rain
. Major problem : garbage get stuck in the gate and unable to close fully

- Pump

. Frequency and time of operation : average 6 hrs per month
. Water level for operation :
High water level - 5 feet from canal bed level
Low water level - 2 feet from canal bed level
. Major problem in operation :
Garbage pass through the screen and choke the pump eg rubber and wire

- Screen

. Frequency of maintenance or re-installation average life span : about 3 years

- Collection of garbage

. Frequency of removal of garbage : once per day
. How to remove the garbage : mainly manpower, sometime use machine to remove sand
. Average amount of garbage to be removed : roughly 0.5 -1 ton per day
. Transportation to dump site : by lorry to Lebuh Bakau dumping site
. Major problem of removal and transportation of garbage : Removal and transportation of garbage is carried out by the Health Department. Sometimes removal is not done daily

- Number of staff for O & M of pumping station

. Pump and gate operation :
Working time : 12:00.mn to 4:00 am
& during high tide ie above 2.3 m
& during heavy rain
No of staff : one
. Removal of garbage :
No of laborer : one or two from the Health Dept.

- Cost of O & M

. O & M : Operation - $ 105.00 per month
Maintenance - $ 550.00 per month
. Removal of garbage : Not available, to be obtained from the Health Dept.

- Interval of periodical checking of pump facilities

. Daily checking is carried out by the operator Servicing and detail maintenance checking - one a month

Figures

Fig. N-1 ORGANIZATION CHART FOR CONSTRUCTION OF THE URGENT PROJECTS BY DID

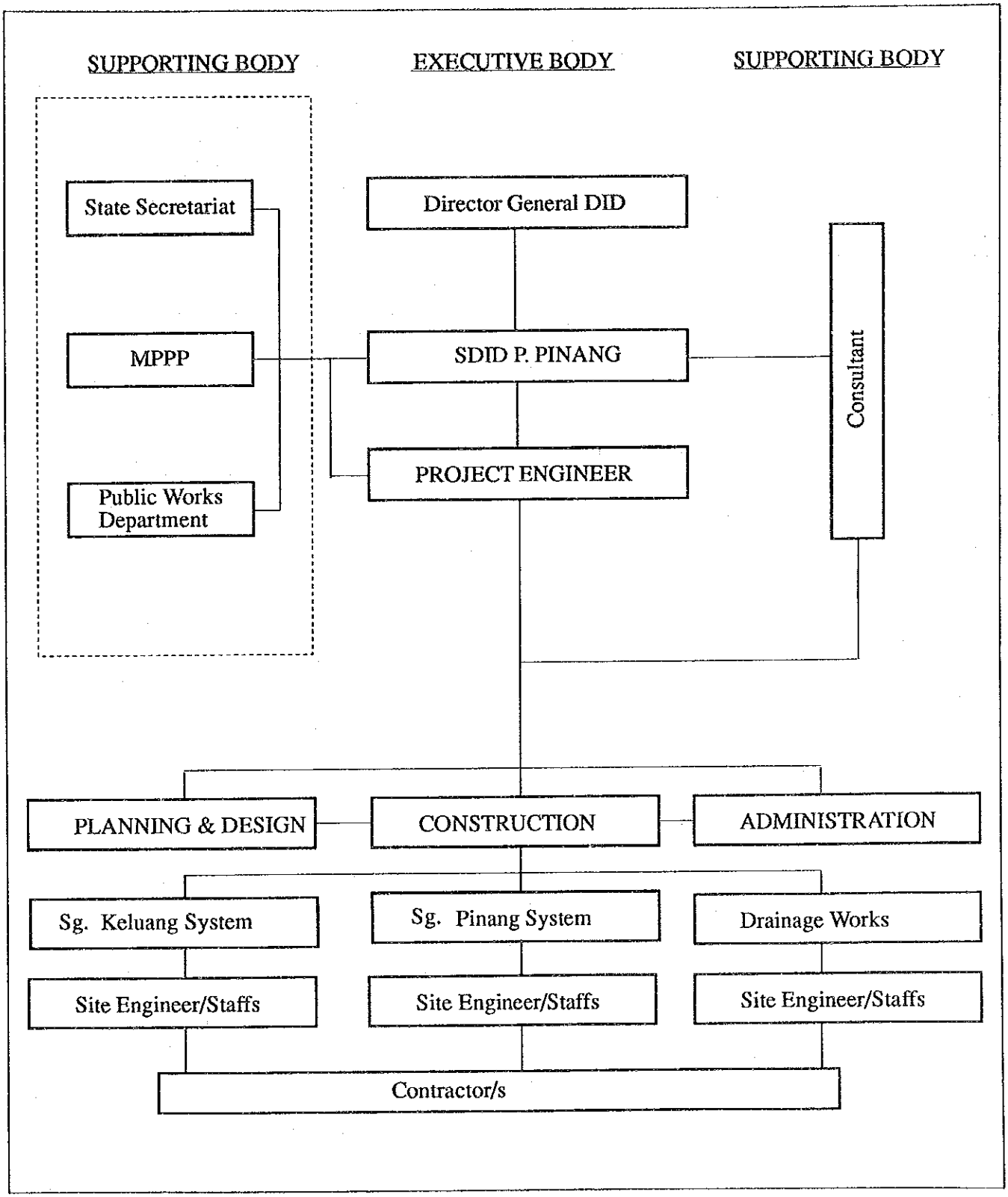
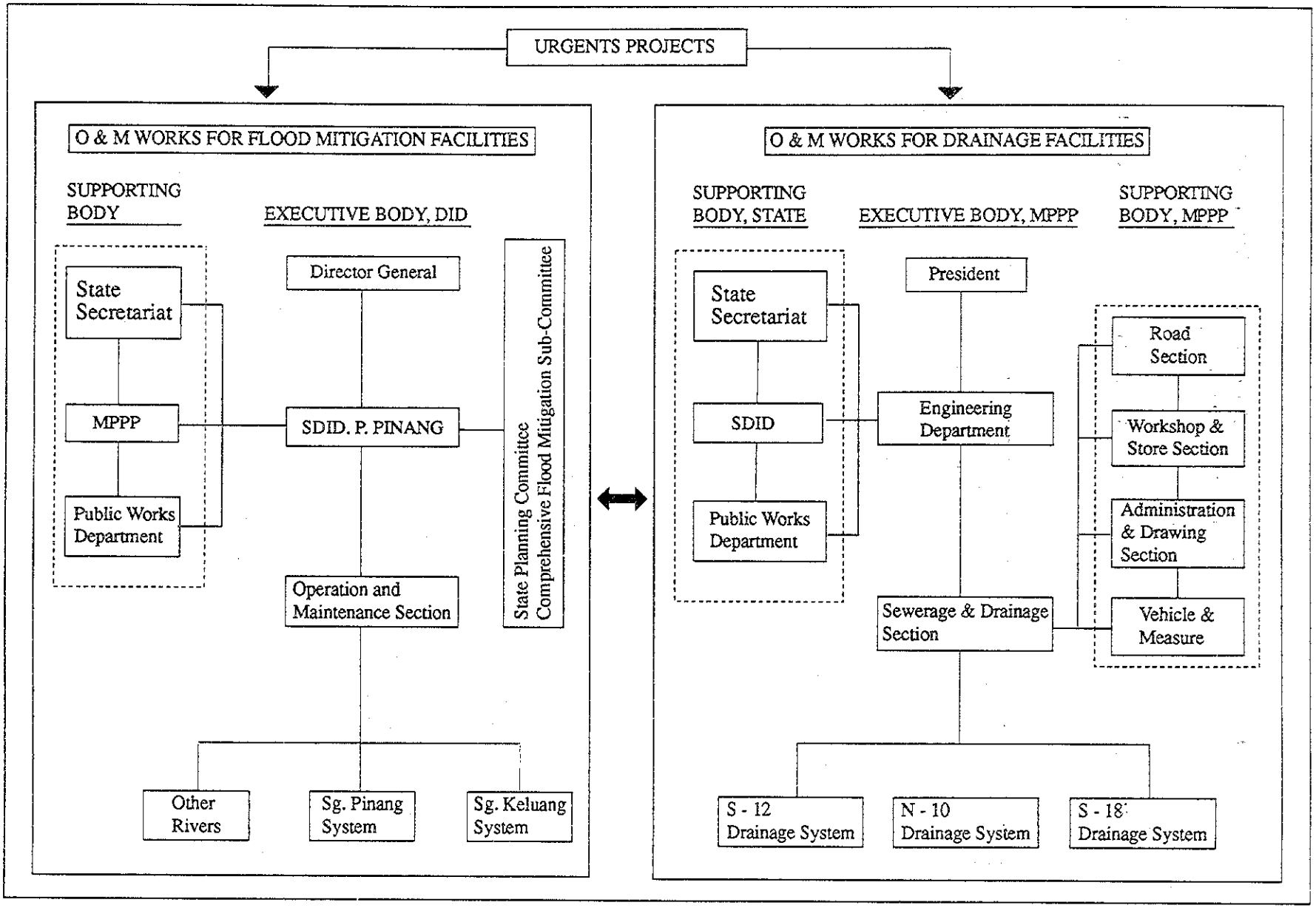
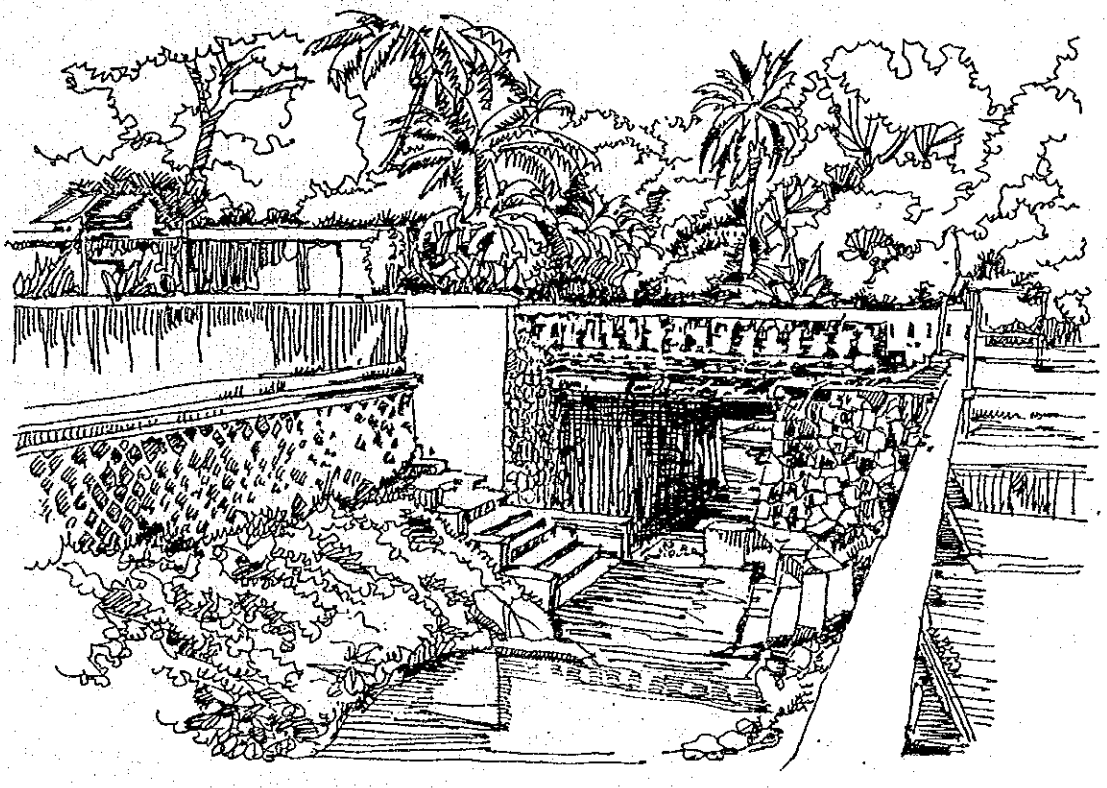


Fig. N-2 ORGANIZATION CHART FOR OPERATION & MAITENANCE WORKS BY DID & MPPP



APPENDIX O

LANDSCAPING OF RIVER CORRIDOR



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APPENDIX O. LANDSCAPING OF RIVER CORRIDOR

1. INTRODUCTION

The objectives of the landscaping of river corridor study are:

i) Review of existing river landscape condition schemes and aesthetic aspects of the river system in Penang Island incorporating the flood mitigation and drainage, master plan and feasibility study.

ii) General study for conceptual landscape improvement is made in concerning with the river channels and retention ponds, and relevant measures to enhance aesthetic value of these surrounding areas.

2. LANDSCAPE FEATURES OF RIVER SYSTEM IN PENANG ISLAND

This section outlines the existing landscape conditions of major river systems in the study area.

River systems in Penang Island are comprised of many small rivers of short range, with some tributaries originated from the hill range and it's foothill. One of a major river system is Sg. Pinang which has several tributaries within the city of Georgetown.

On the other hand, in comparison to Sg. Pinang system, many small to medium size rivers are distributed equally along the coastal range of the Island.

In concerning with landscape condition of the riverside area, generally riparian condition of the most rivers that are in urbanized area is lacking the aesthetic aspects due to water pollution, clogged solid wastes, and conditions of grown sedge and vegetation on the banks.

River reserve areas are often shown inadequate outlooks with grown plants and disordered huts and its devices of surrounding areas.

The potential resource of landscape is still recognized being in rich conditions at some riparian area.

In conjunction with the consideration of future riverside open space use, Fig.O-1 and O-2 show a characteristic existing features of riverside landscape at Georgetown and other riverside in Penang Island

3. THE STRUCTURE PLAN AND SG. PINANG IMPROVEMENT PLAN

The Structure plan of Municipal Council of Peneng Island has issued the policy for the Sg. Pinang and its corridor, and the policy described that the amenity potential for the Sg. Pinang and its corridor will be realized.

Regarding the policy, three objectives should be necessary to implement the Sg. Pinang Improvement plan and these are as follows.

i) To improve the environment quality of the river and its corridor.

ii) To improve access to and circulation to the river and its corridor.

iii) To realize the potential of the river and the corridor for recreation and amenity.

And also mentioning that the landscape planning process should involve an analysis of the problems, assets and opportunities for change within the corridor.

4. LANDSCAPE COMPONENTS OF RIVER IN GENERAL

There are diversified landscape components through river corridor if we carefully observe.

Consideration of Landscaping of river corridor is basically understood of these diversified scenic elements woven along the riverine condition and town scape of vicinity areas.

When the landscape of river corridor in urban area is considered, following basic classification and components can be identified for study of planning and design to he landscaping the objective area along the river.

4.1 Landscape Components of Riverine Area

The river has many aspects of landscape components in relation with human activities and the nature. The natural characteristic of the river is usually having quite diversified form and dynamics within the riverine spaces. The landscape components of the river are generally divided into two categories which are attributed the space within the river and surrounding space of the river.

4.1.1 Landscape of River

(1) River channel: Planar form of channel, Longitudinal form and form of high water river bed, etc.

(2) Micro topographic condition of river channel: Sand bank and bar, river bed material, etc.

(3) Water Surface: River flow condition, water quality, reflected scenery in the water surface, etc.

(4) River structures and facilities: River banks, revetments and water gates, etc.

(5) Installed facilities within river space: Play grounds and recreational facilities, information and sign boards, sitting and resting facilities such as benches and stools.

(6) Riverine vegetation: Row of trees, preservation trees and shrubs, groves and grass land and etc.

4.1.2 River surroundings

(1) Traffic route: Bicycle routes and networks, pedestrian paths and networks, service roads, etc.,

(2) Road devices: Signage boards, poles and road side plantings , etc.,

(3) Building facilities: Buildings, huts, drainage facilities and structures, water access stairs, etc.,

(4) Open spaces: Parks, plazas, game courts, etc.,

(5) River crossing facilities: Variety of bridges, water supply pipes, electric transmission cables, etc.,

(6) Long distance scenery: Natural elements such as mountain ranges, hills and slopes, groves and thickets, Artificial elements ....Sky line of urban buildings, high rise buildings, transmission towers,etc.,

(7) Human activities: Figure of peoples, automobiles, bicycles and boats,etc.,

(8) Wild life: Territorial fauna such as riverine animals, birds, insects, Aquatic fauna such as fishes and turtle, etc.,

(9) Natural phenomenal components: Seasonal changes, weather changes, daily duration and time changes,

The Fig.O-3 shows characteristics of landscape component of the river.

5. FUNCTION OF RIVER LANDSCAPE

5.1 Outline of River Function

Generally river has being considered that there are three functions for flood mitigation, water utilization and environmental aspects.

The function of flood mitigation is for safe guarding and preventing flood disasters to objective areas and inhabitants. And this is more fundamental function of the river to be held.

The function of water utilization is for a effective utilization of river water, and this is not only the utilization of water resources as water supply and irrigation purposes but also involving a category of water transportation and fishery.

The function of environment is more wide range of aspects such as an acquiring spaces for recreational, sports activities and walkways, amelioration of microclimate condition, inhabitation of aquatic fauna and flora.

Rivers in Penang island has characters affected by topographic and climatic condition, historically the flood has been often occurred while town and settlements has obliged to

settle within flood prone areas. Under these circumstance, flood mitigation has been always considered as a social necessity.

Function of river always has been considered interrelation between river and social condition. In recent year a function of amenity is arising within the river's function of environment, however this is somewhat a social necessity for strong demand to the environmental quality.

5.2 Role of Landscaping of River

Landscaping of river is somewhat results of human motivation with background of social value and consensus to the river, and this idea becomes to be a reality of landscaping.

The functions of river could be more conceptual thing and it could be more flexible in form for design. So that the landscaping of the river should be more cooperated with surrounding environmental elements, urban conditions and character of social demand and activities to be performed.

6. CHARACTERISTIC LANDSCAPING REALIZATION

6.1 General Scheme of Landscaping

6.1.1 Integration of riverine objectives

Landscaping of river can be involved the surrounding riverine elements in various meanings and relations, and landscape design should be incorporated and integrated with river engineering.

6.1.2 Realization of objectives to more usual scenery

Most of river structures are to be designed for preparing unusual case of flood phenomena, however the form of river structure which responses to the objective function is not always shown a comfortable scenery as daily and usual landscape to the people.

Landscape design would give interpretation of the scenery of unusual structural form to the design of more amicable, usual forms and condition.

6.1.3 Perspective approach of landscaping

Since landscaping of river is provisional design of sequential continuity and expansion of riverine space, perspective approach of landscaping would be more suitable to enhance the scenic potentials and specific character of the river.

6.2 Landscaping Design Involved Scenic Attributes and Diversified Activities

6.2.1 Findings of scenic attributes

Future planning, design and management decisions for river corridor landscaping will have the great potential impact on the river corridor views. These may be enhanced to create high

quality views by changing landuse character, removing certain distracting features, or managing vegetation growth in certain ways.

1) Findings of positive attributes

1. Views, presence of water
2. Vegetation
3. Natural landscape
4. Urban image
5. Water features
6. Views to opposite edge
7. Unique landscapes
8. Edge variety
9. Superior view
10. Nearness of water

2) Findings of negative attributes

1. Unordered allocation of utilities and facilities
2. Excessive screening development
3. Poor signage
4. Excessive vegetation
5. Unordered topography
6. General clutter
7. Poor field maintenance
8. Fences and cluttered enclosure

Development of a recreational, an educational and interpretive programme stressing the importance of scenic resources and the need for Municipal Council and State Government to develop appropriate policy and legal tools to control adverse private development.

Development of overlay zoning and site review mechanism to restrict encroachment from private development on high quality view areas. Design guidelines could be developed for problematic landuse and development activities.

6.2.2 Activities within the river space

River front in urban area is the somehow quite important place with specific value incorporated life style and dynamic activities.

A close to home recreation resource that can be provide for a wide variety recreation activities is a desired commodity today due to increasing public demand. Even communities are located within the midst of unlimited recreational resources, and demanding more close recreation.

7. ENHANCEMENT OF RIVER CORRIDOR LANDSCAPE

7.1 Enhancement of River Corridor Landscape

Together with the future riverside park areas, spaces of the river reserve itself are become valuable open space as utilized recreational cores with pedestrian walks.

These series of space along the river can be made well harmonized environment to represent effective facade of the urban area.

Functional services of these space are pedestrian walks, rest places and plazas with landscaping, and these new environmental function of the riverside spaces are quite effective.

The existing landscape condition will be changed to be more attractive environmental situation through these improvement of the riverside development works.

In general, within the urbanized area, each river side zones are tended to acquire proper spaces as for river reserves and make them to be adequate aspects of facade of the city as well as the region.

Spaces of river reserve itself are to be valuable open space as utilized vicinity recreational activities, and function for pedestrian path networks, further more these existences may contribute to the landscape beautification for the vicinity townscape.

These series of space along the river reserve can be made well harmonized environment to be represented the face of the each district and to be a major structural spine of the city town scape as well as the regional framework.

Functional services of these space are to be pedestrian ways, resting area and plaza with focal gathering place and some landscaped gardening area, and these new environmental function of the river side spaces are quite effective in addition to rehabilitate the existing riverside zone conditions.

In some of the area where commercial zone or institutional facility area are adjacent, more amicable and attractive designed river front improvement will be sufficient for the peoples who gather and enjoy the daily activities.

In these case, well formulated shape of plazas, resting place, kiosk, event and performance area together with full furnished landscaped space layout would be encourage the quality of the space.

Thus the existing landscape condition will be changed to be more attractive environmental situation through these improvement of the riverside development works.

Penang Island itself, there are great potential of tourism resources and historical background which shows the variety of townscape and social dynamism. Together with these potential, the riverside environment should express adequate riverine outlooks toward future development scheme.

Fig. O-4, O-5, O-6, O-7 and Fig. O-8 show the river corridor landscape improvement schemes and variations, and Fig.O-8 shows a riverside improvement referential scheme.

While in the rural area and hillside zone where rivers flow under more natural condition, river reserve area shall be utilized in consideration with providing some recreational trails, activity spaces such as sports and game play courts.

Also some potential riverine ecology conservation areas shall be specially organized. On the other hand, estuary mangrove and related vegetation colonies shall be conserved to the maximum as a nature reserve.

7.2 General Guideline of Improvement of the river Corridor Landscape

As for considering the riverside improvement schemes of river systems in Penang Island, following improvement guidelines may be suggested for the river corridor landscaping.

7.2.1 Qualitative improvement of river revetments as means of improving the riverside landscape.

For ongoing and planned implementation of revetments, consideration of expected activities on the objective riverside area and aesthetic space solutions shall be undertaken.

7.2.2 Keeping a clean condition of the river reserve.

Most of the river reserves are left without maintenance, for further prevention of environmental degradation, intensive cares and maintenance of the river reserve shall be carried out.

7.2.3 Improving the river reserve and establishing recreational open space usage of the river reserve.

Smoothing the bank areas, grading and grassing of the ground surfaces are generally required. Some trees and shrubs should be allowed to remain for environmental conservation and aesthetical reason. Improved spaces along revetments shall be also utilized for vicinity recreational activities.

7.2.4 Providing some attractive observation places and plazas, resting core areas at strategic riverside points.

In order to expose and emphasize the view of the riverine landscape at focal points, observation plazas and resting core areas shall be introduced.

7.2.5 Providing the sequential walkways system along riverside and establishing aesthetic space for each bridge brinks.

Consideration should be taken for easy access and sequential walkway system from nearby road and public core space. These area shall be served as aesthetical focal points for the riverine zone through the river.

Bridges have always served as nodal points for viewing the riverine landscape, and sufficient space for walkways should be allocated for pedestrians to take some good strolling.

7.2.6 Efficient Projection of riverside walkway improvement in conjunction with nearby development of some strategic commercial and business district areas.

The pedestrian walkways, plazas and malls network shall be better to link up with adjacent development of riverside commercial and business facilities.

In commercial landuse area and some park landuse area, the riverine facade where river side reserves are mostly limited are expected to appear the view for the citizens and visitors.

Further development shall be considered for taking the contribution to acquire the space for river side walkways, and adding more plazas and landscapings to strengthen this area as the focal core for urban amenity.

7.2.7 Conservation of valuable natural vegetation along environmentally sensitive areas.

Well balanced natural vegetations are observed at the upstream banks in the hillside forest areas and some areas of estuary mangrove colonies. In these area, very few improvement works could be provided to allow pedestrian trails to access the water margin together with small spaces for observation.

7.3 Consideration Incorporated with Private Sectors

Due to enhance the riverine environmental quality condition and park areas involving retention ponds, some incorporation with private sectors may be important beside proceeding the project works D.I.D's contribution.

Private sectors of aptitude scale of housing development and commercial complex development, sometime touristic development adjacent river front area may be welcome to incorporate sharing the cost of water front development as such implementation of pedestrian walks, plazas, afforestation and gardening beside basic works of revetments and river works.

These well landscaped spaces will be given more commercial value and attractiveness to the visitors as well as vicinity residents, the more opportunities will be held by investors side. In some case, specific spaces or facilities can be rent to the private sectors by contract with pubic superintendency side for sharing certain amount of counterpart investment or payment.

7.4 Possible Participation of the Private Sectors

Regarding to the parks with retention ponds, since these parks surrounding area is in residential use character and less opportunity for the commercial demand for utilising the space of the parks. The space of the retention ponds portion is quite large enough to be able to install such private based sports and game spaces as tennis courts, roller skate and skate board courts and other game spaces. The well organized sports club and or fitness club which are operated private sector will be corresponded the rising demand for people of new township as well as vicinity region.

In this aspects, public side such MPPP as superintendency of the parks may arise an objective public relation significance and strategic campaign in association with Sate D.I.D. to whatever private sectors to participate the proper projects for investment or maintenance and operation. Health management and recreation business will be a new trends for awaiting the middle to upper-middle income class people's life style, and the park space is quite suitable for these facilities to project if vicinity marketability is in good sounds.

Regarding the river side area, since the river reserve space should be maintained by the public side and the responsibility of an improvement of these spaces should be belonged to the State DID side. However it is possible to project the privatisation activities that there are enough spaces for some beneficial facilities such as kiosk, eating and drinking spaces for refreshments and foods at higher level portion within the river reserve adjacent to commercial area. And also these installed facilities should not given any functional disturbance to the river flow at the time of flood occurrence.

In this aspect, it is possible that the superintendency side will contract with the proper private sectors and gives permission of proper space use, installation of beneficial facilities with landscaping of its surrounding space and asks permission fee, cleaning and maintenance obligation to them. The superintendency side shall prepare proper requirements and design guide line for the space, facilities and landscaping to the private sectors or participants.

Regarding the adjacent river side areas where there are mostly future park landuse spaces beside the river reserve, to realise aptitude quality of river corridor landscaping, proper scale of development shall be necessary to meet with variety of sites through the river. Some site portions may need a simple furnishings of landscaping and some may need more variety of landscaping with amenity elements and these schemes are depended on the character of each objective site with its vicinity environmental condition. For further reference to consider the implementation of river corridor landscaping, Fig. 15-9 shows the scheme of standard cost for river corridor landscaping.

7.5 Necessity of Water Quality Improvement

The aspect of grading-up of the river corridor landscaping is that very important to improve the existing riverine condition to enforce the quality of river environment for the public.

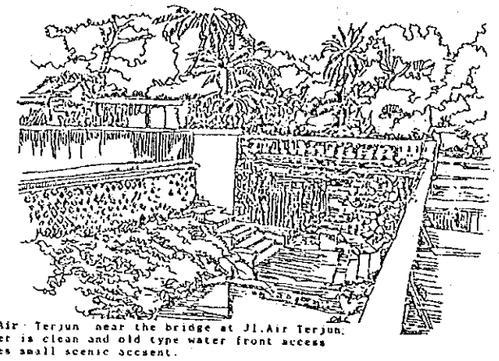
Perceptional point of view at the initial stage for grading-up of river environment, well landscaped river side area gives an impression of high recognition of environmental value around the river side area to the peoples.

However the improvement of the river environment is not only means on landscaping of river corridor but also considering of improvement of river water quality. A contribution to both of the improvement of river side area and

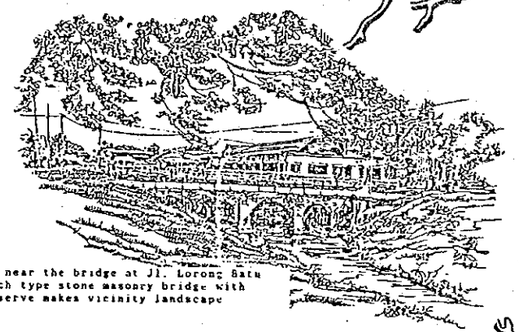
water quality shall meet together and it will become to be more idealistic and comprehensive resolution of the river improvement scheme.

So that the improvement of river water quality is vitally important and necessary to realise the grading-up of total environmental quality of the river. The State Government and Municipal Council get together to proceed the administrative programme and campaign on this subject of river water improvement, and take an administrative initiative to the public awareness on the cleaning and improvement of the river water

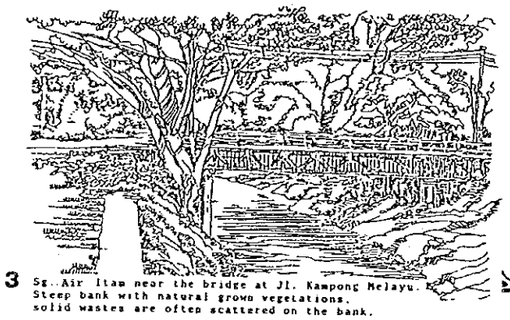
Figures



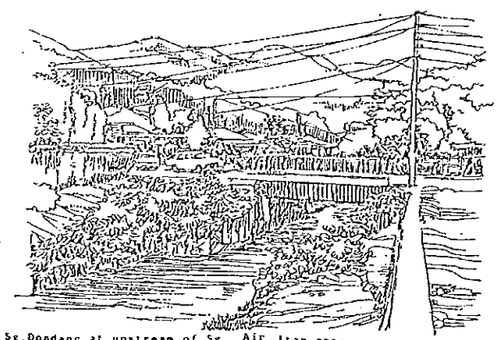
1 Sg.Air Terjun near the bridge at Jl.Air Terjun. Water is clean and old type water front access makes small scenic accsent.



2 Sg. Air Itam near the bridge at Jl. Lorong Batu Lancheng. Arch type stone masonry bridge with wide river reserve makes vicinity landscape focus.

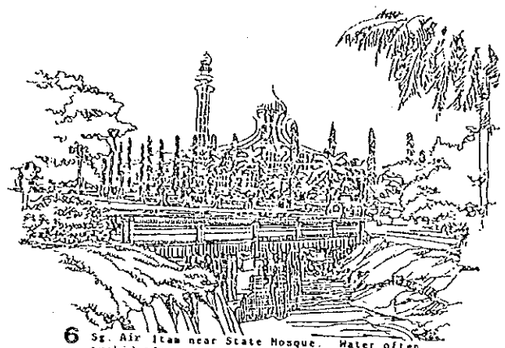


3 Sg. Air Itam near the bridge at Jl. Kampong Melayu. Steep bank with natural grown vegetations, solid wastes are often scattered on the bank.



4 Sg.Dondang at upstream of Sg. Air Itam confluence. River banks are in full with sedge plants and wild shrubs.

5 Sg. Air Terujun on the bridge at Jl.Pesiaran Kuari. Deep old masonry channel with clean water represents good river side landscape.



6 Sg. Air Itam near State Mosque. Water often turbid after rain, some portion of the bank is under improvement works.

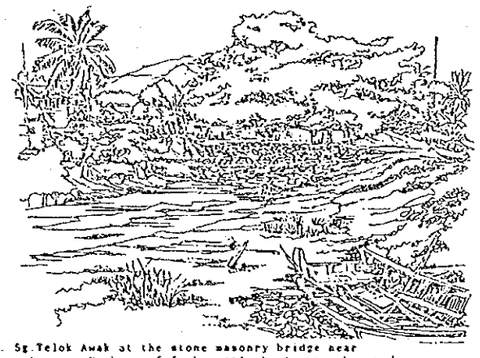
7 Sg. Air Itam on the bridge at Jl. Scotland. Dark grey turbid water flows into a clean water channel at the confluence.

8 Sg. Air Itam near the bridge at Jl.Lengkok Ariff. The river course is wound through public facility area.

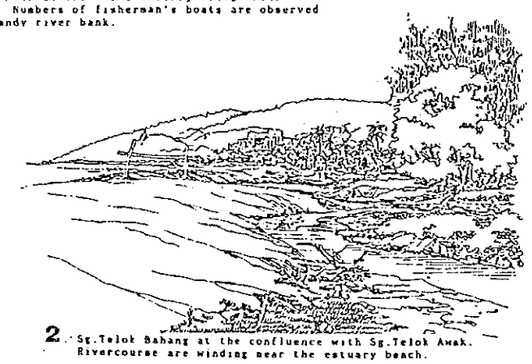
9 Sg. Pinang . at estuary area. Muddy water with some floating debris are destruied the scenic potentials. Komtar building can be seen as a huge landmark.

FIG. O-1 RIVERSIDE LANDSCAPE IN GEORGETOWN

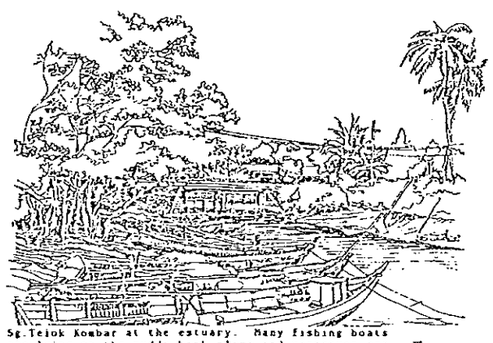
THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND



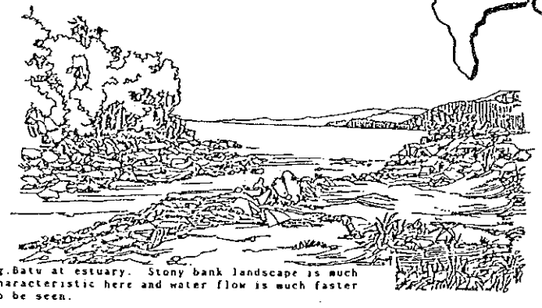
1 Sg.Telok Awak at the stone masonry bridge near estuary. Numbers of fisherman's boats are observed at the sandy river bank.



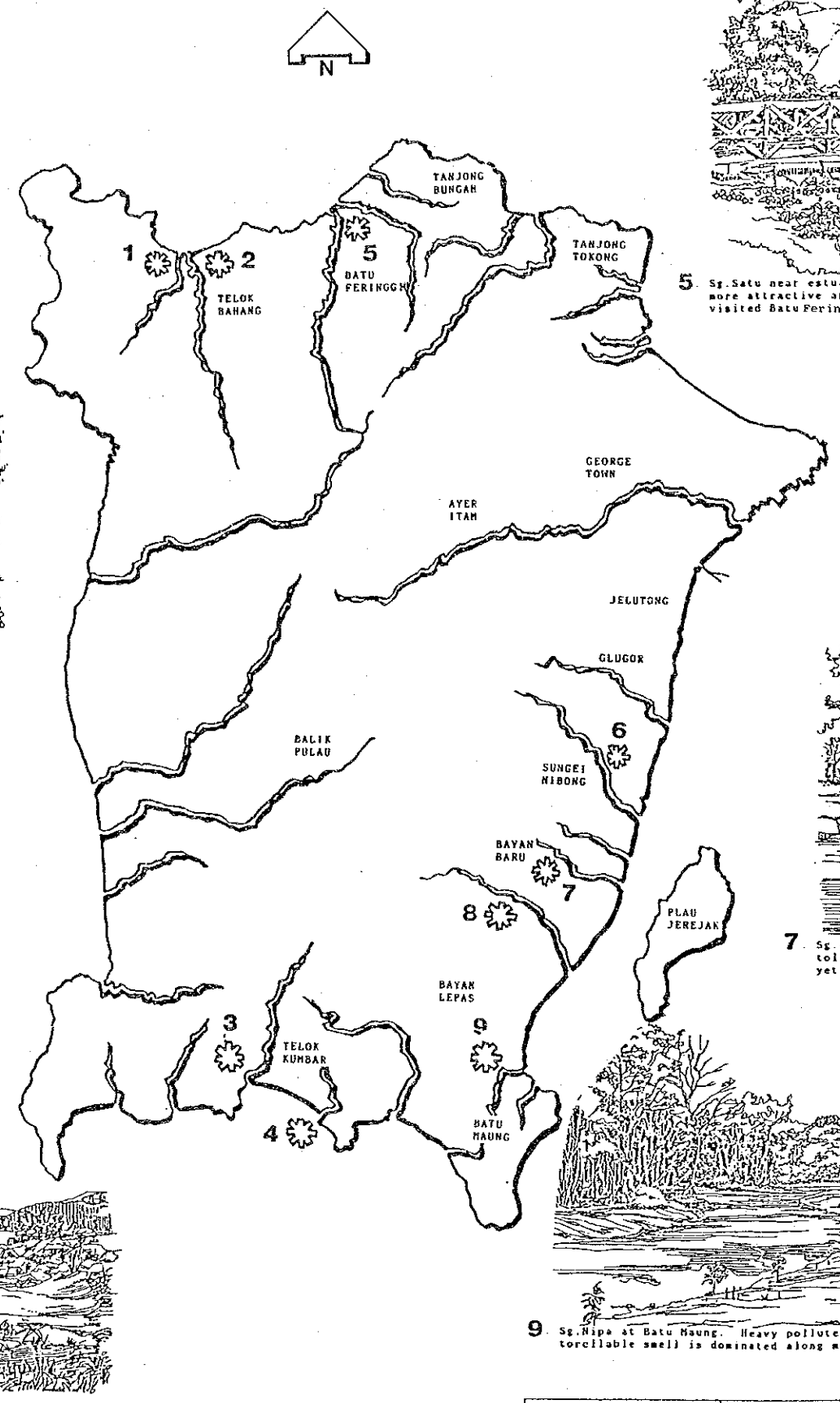
2 Sg.Telok Bahang at the confluence with Sg.Telok Awak. Rivercourse are winding near the estuary beach.

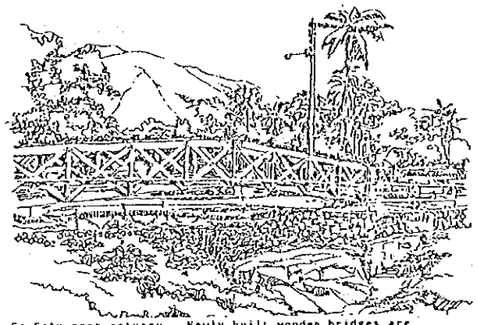


3 Sg.Telok Kumbar at the estuary. Many fishing boats are lying on the muddy bank slope and mangroves are dencely inhabited near here.

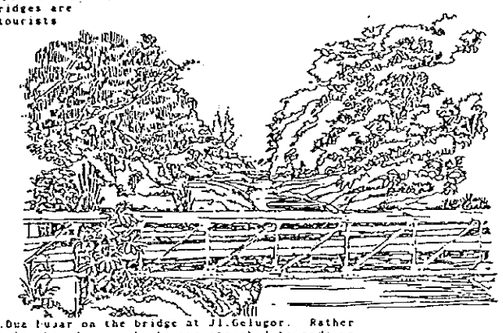


4 Sg.Batu at estuary. Stony bank landscape is much characteristic here and water flow is much faster to be seen.





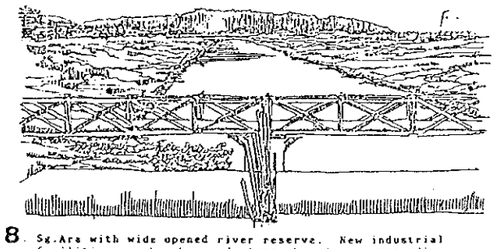
5 Sg.Satu near estuary. Newly built wooden bridges are more attractive and safe strolling for the tourists visited Batu Feringghi resort area.



6 Sg.Duz Luar on the bridge at Jl.Gelugor. Rather gentle shaped river banks are streched towards upstream.

7 Sg.Nibong Kechil. Exstra dark turbid flow with intollerable smells are allways in such a condition. yet some mangroves are still survived.

9 Sg.Nipa at Batu Maung. Heavy polluted water with intorellable smell is dominated along mangrove forest.



8 Sg.Ara with wide opened river reserve. New industrial facilities can be observed along the river surroundings.

FIG. O-2 RIVERSIDE LANDSCAPE IN PENANG ISLAND

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND

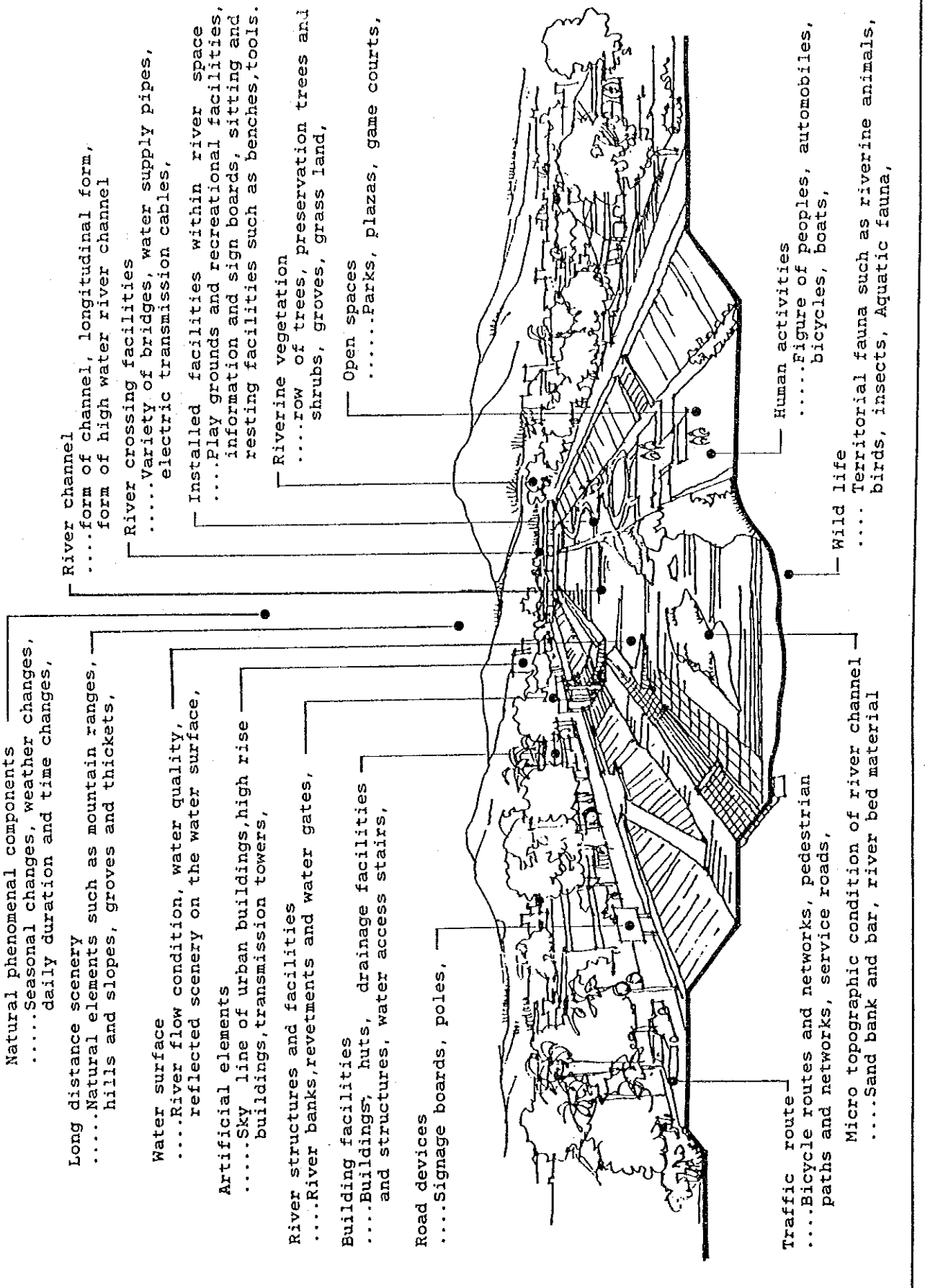


FIG. O-3 CHARACTERISTICS OF LANDSCAPE COMPONENTS OF RIVER

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND

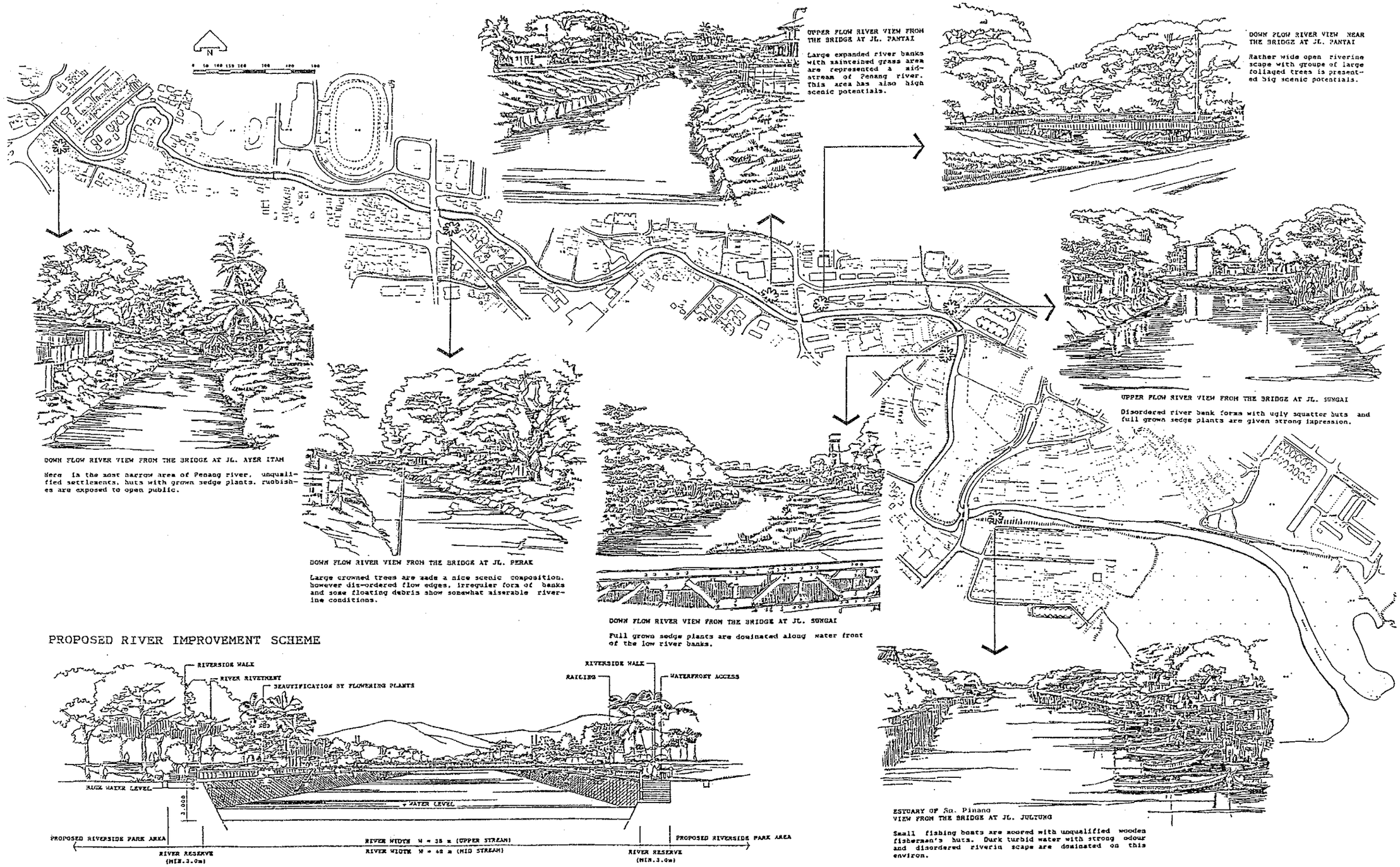


FIG. O-4	RIVERSIDE LANDSCAPE AND FUTURE IMPROVEMENT SCHEME: SG. PINANG

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND

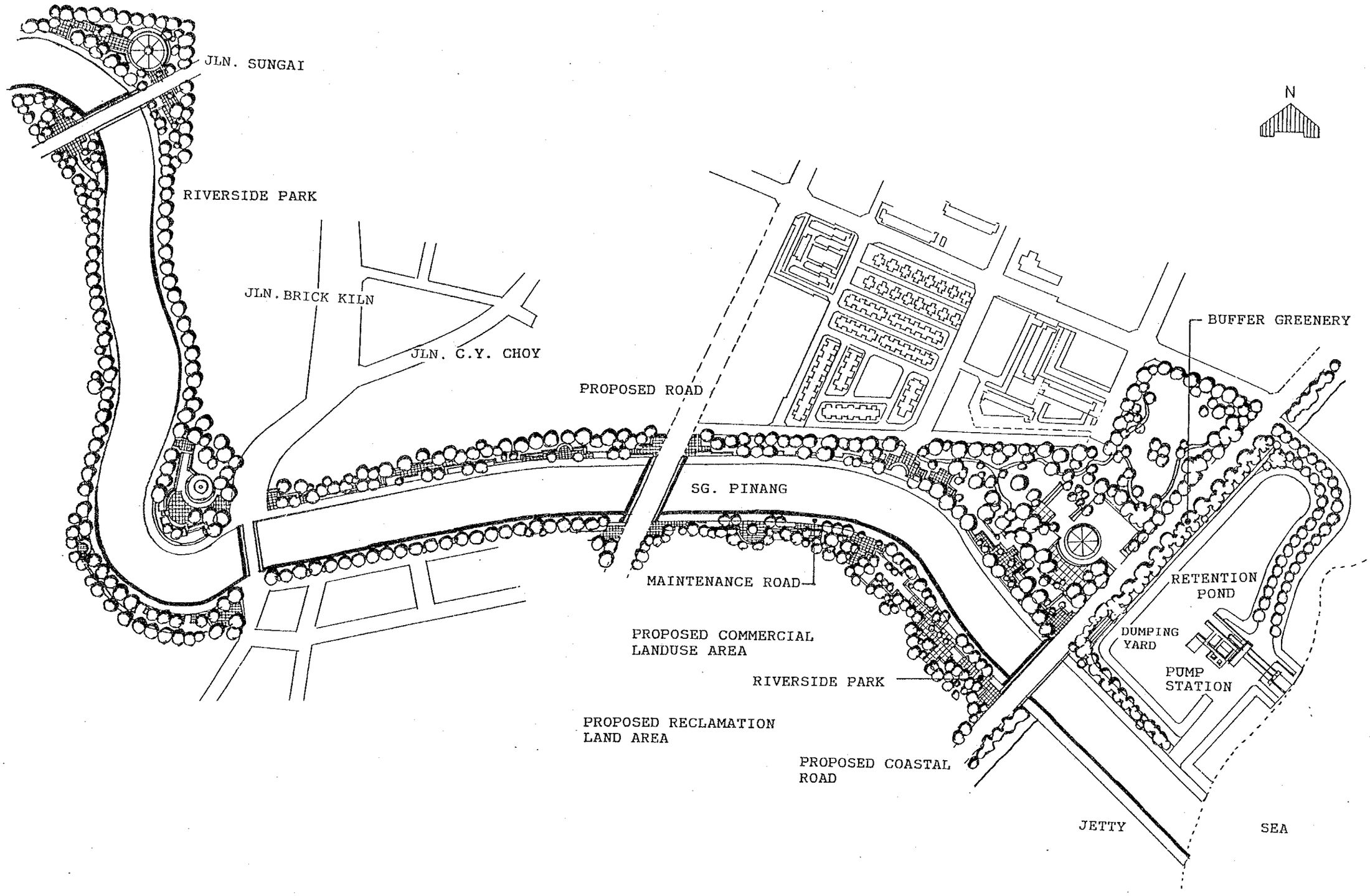


FIG. O-5	RIVERSIDE LANDSCAPE AND FUTURE IMPROVEMENT SCHEME: SG. PINANG AT ESTUARY

THE STUDY ON FLOOD MITIGATION AND DRAINAGE IN PENANG ISLAND