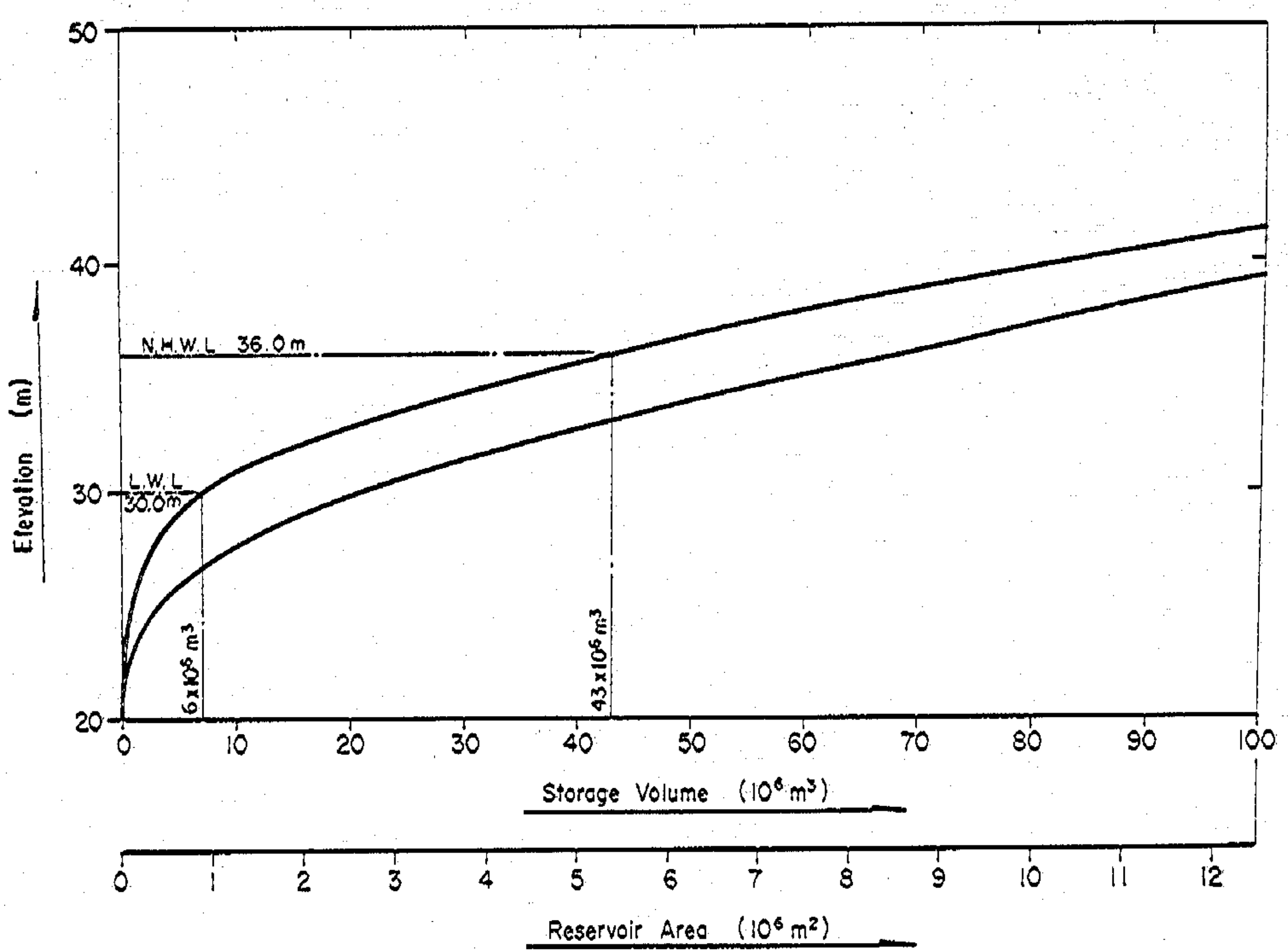


Fig. 5.5 STORAGE CAPACITY AND RESERVOIR AREA CURVE OF KALOLA RESERVOIR

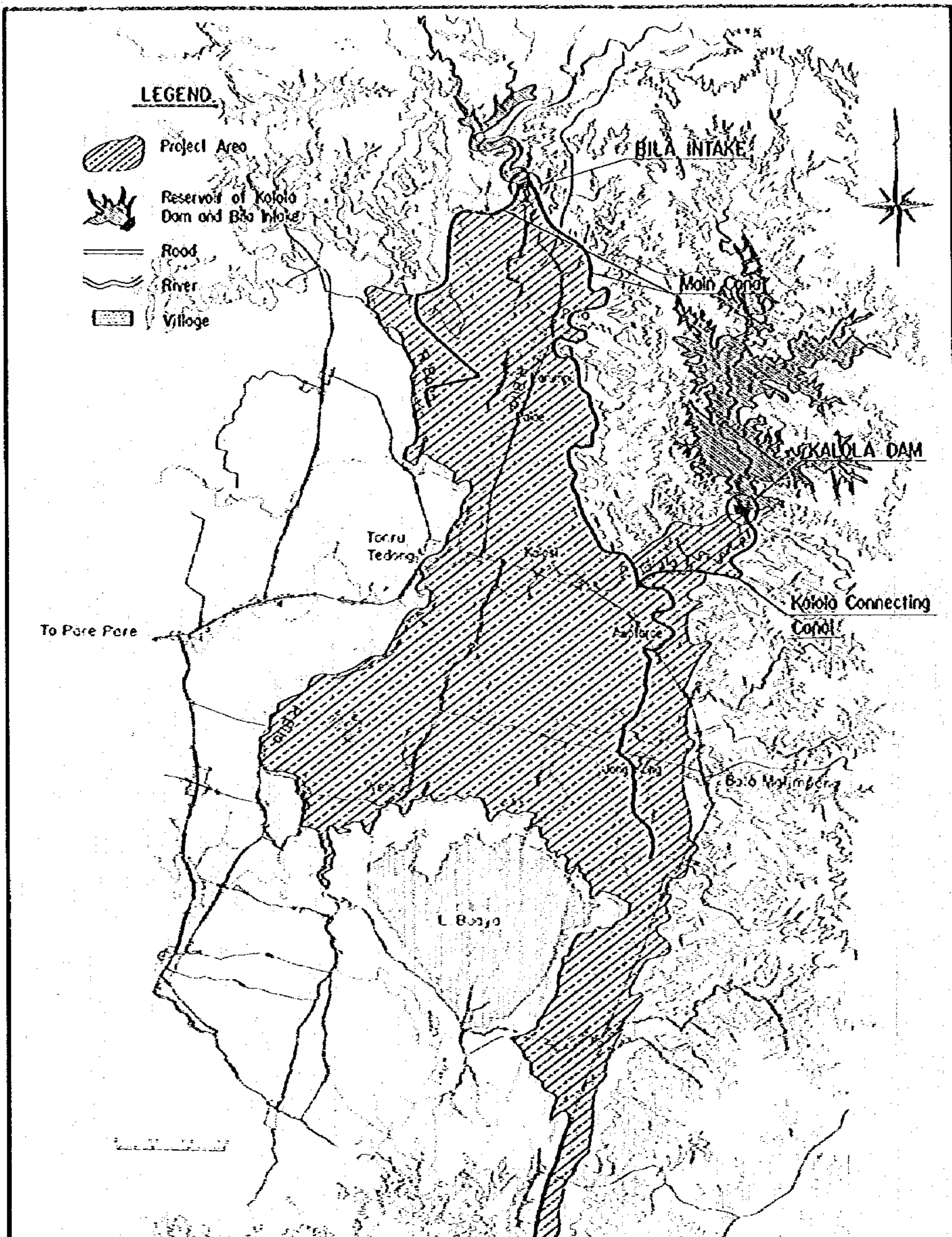


Fig. 6.1 GENERAL LAYOUT OF PROPOSED PLAN

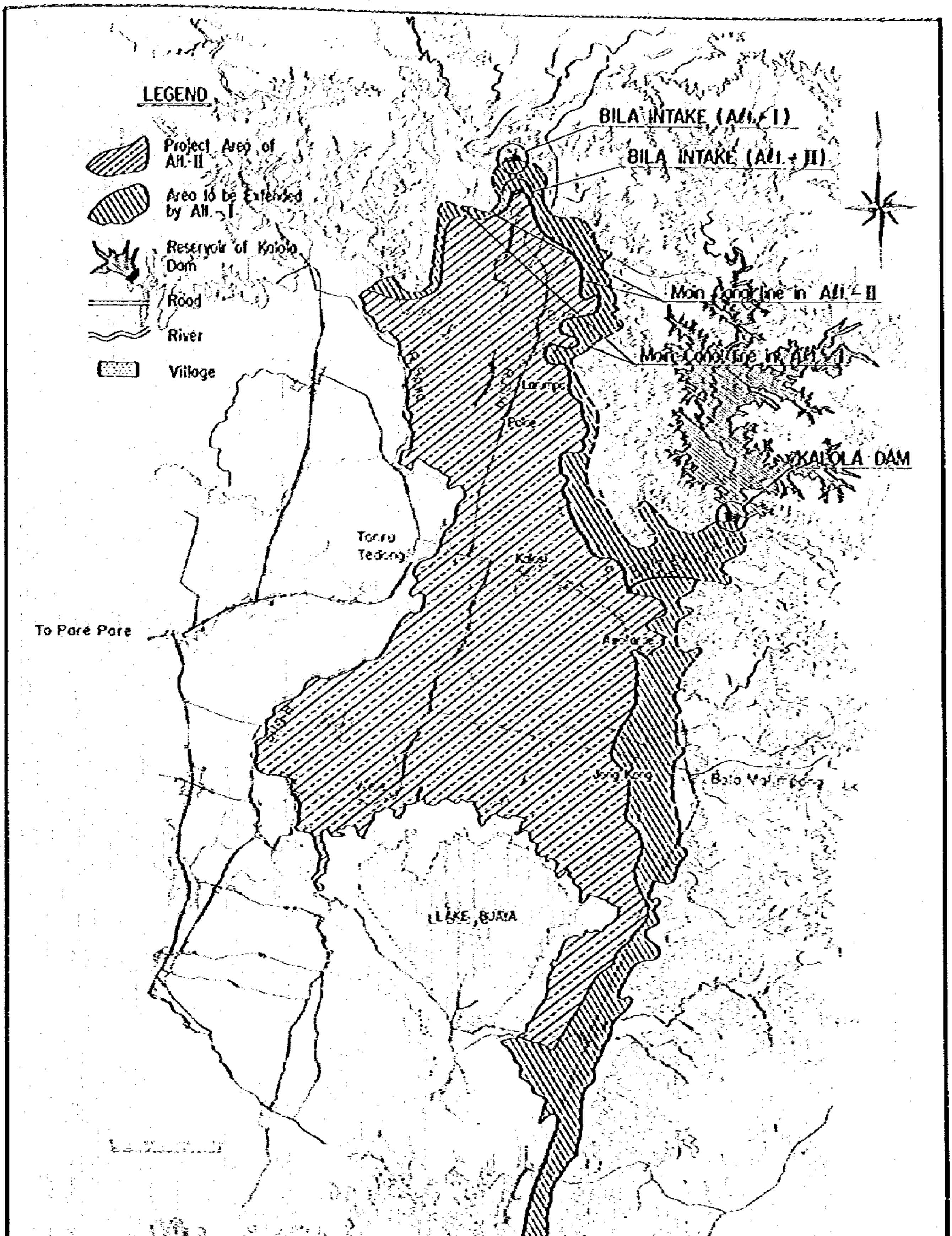


Fig. 6.2 GENERAL LAYOUT OF ALTERNATIVE PLANS

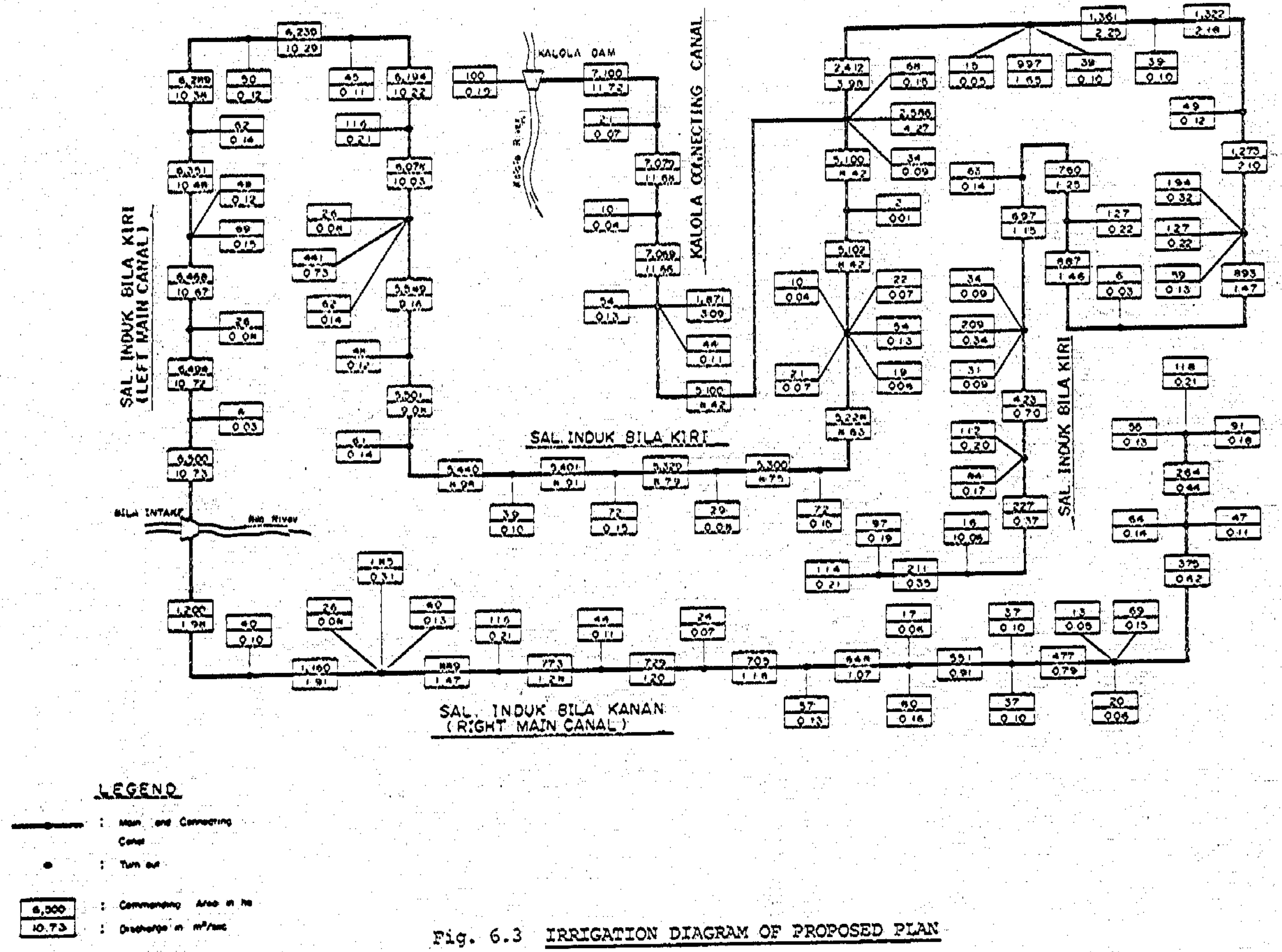


Fig. 6.3 IRRIGATION DIAGRAM OF PROPOSED PLAN

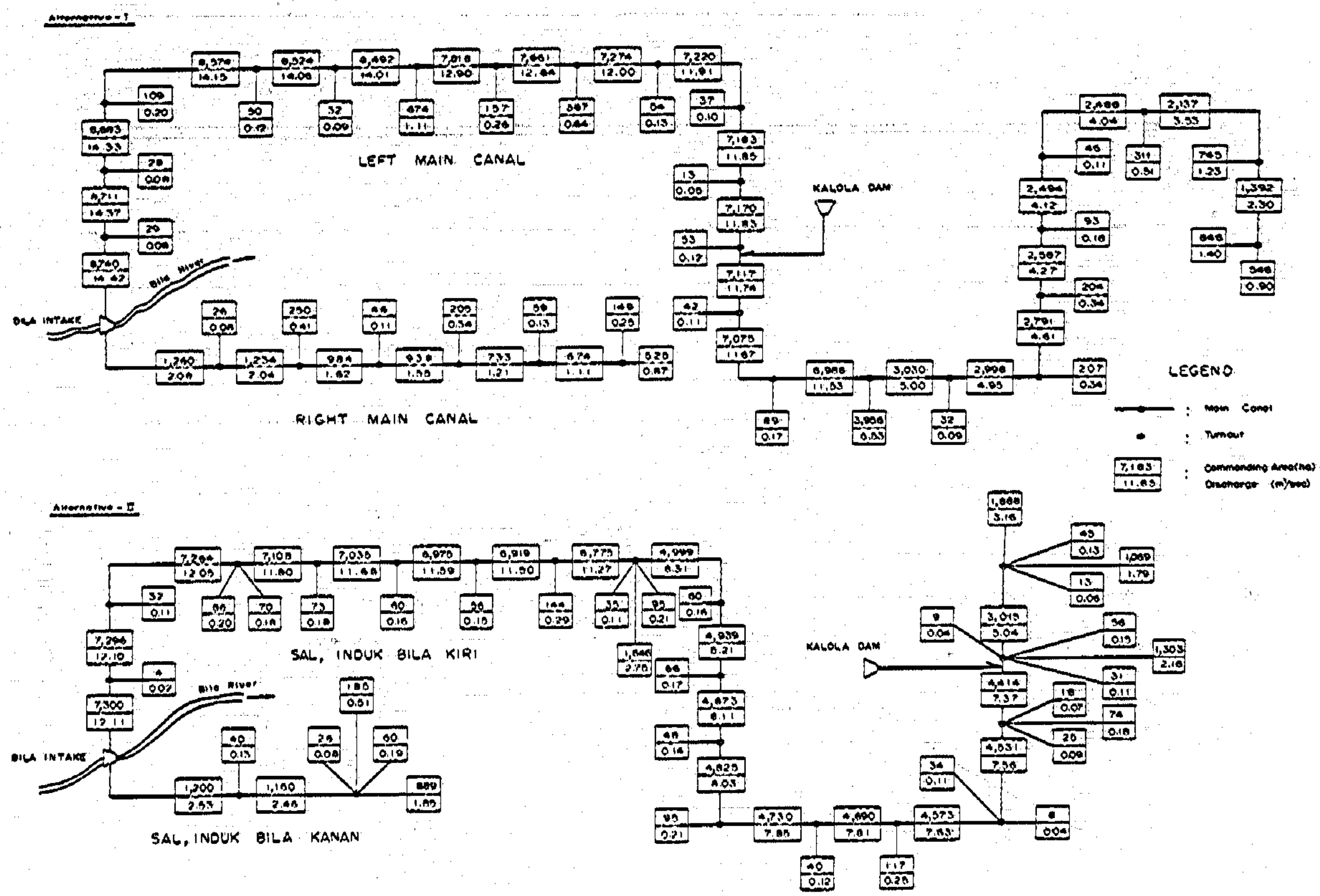


Fig. 6.4 IRRIGATION DIAGRAM OF ALTERNATIVE PLANS

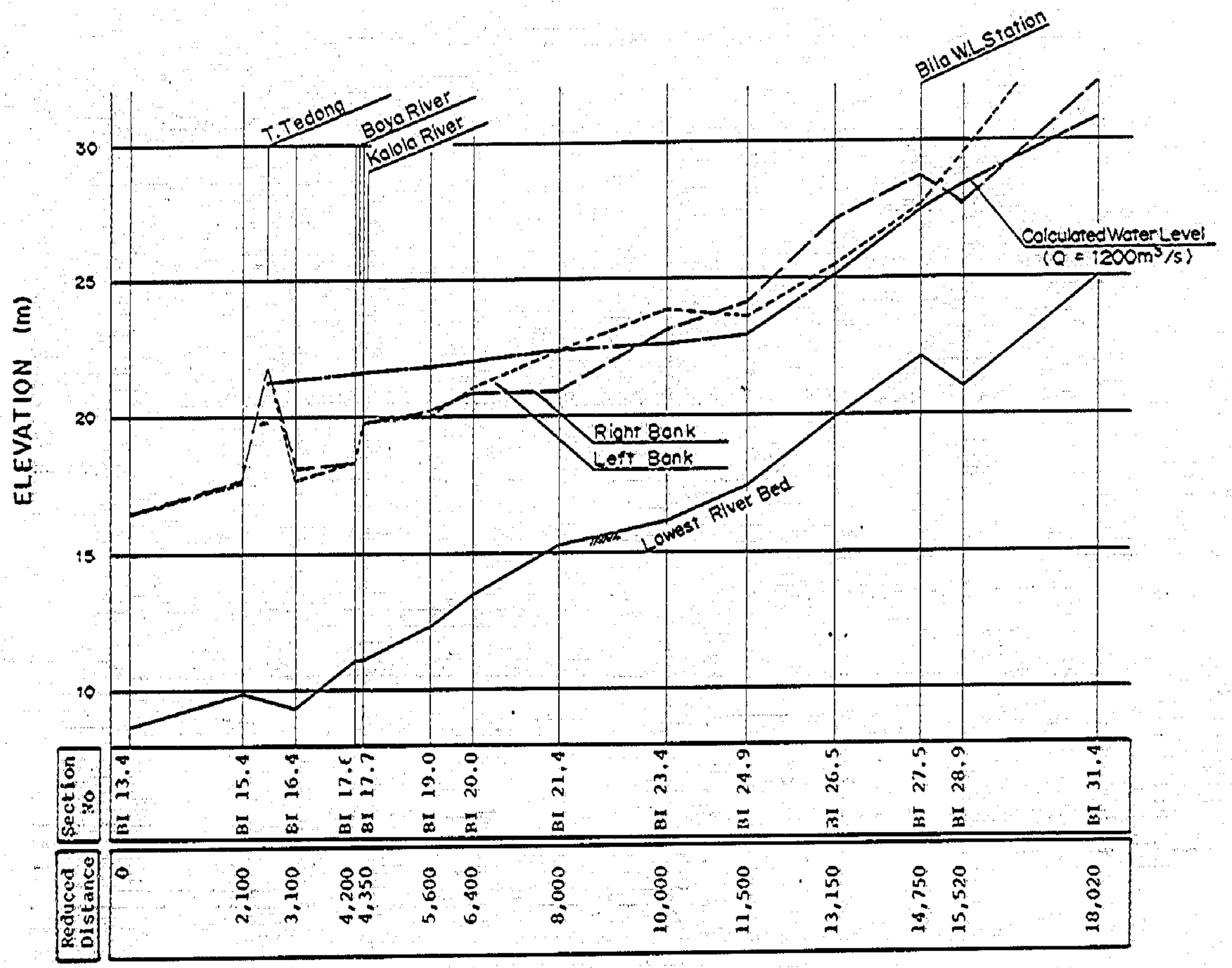


Fig. 7.1 FLOOD WATER PROFILE OF THE BILA RIVER

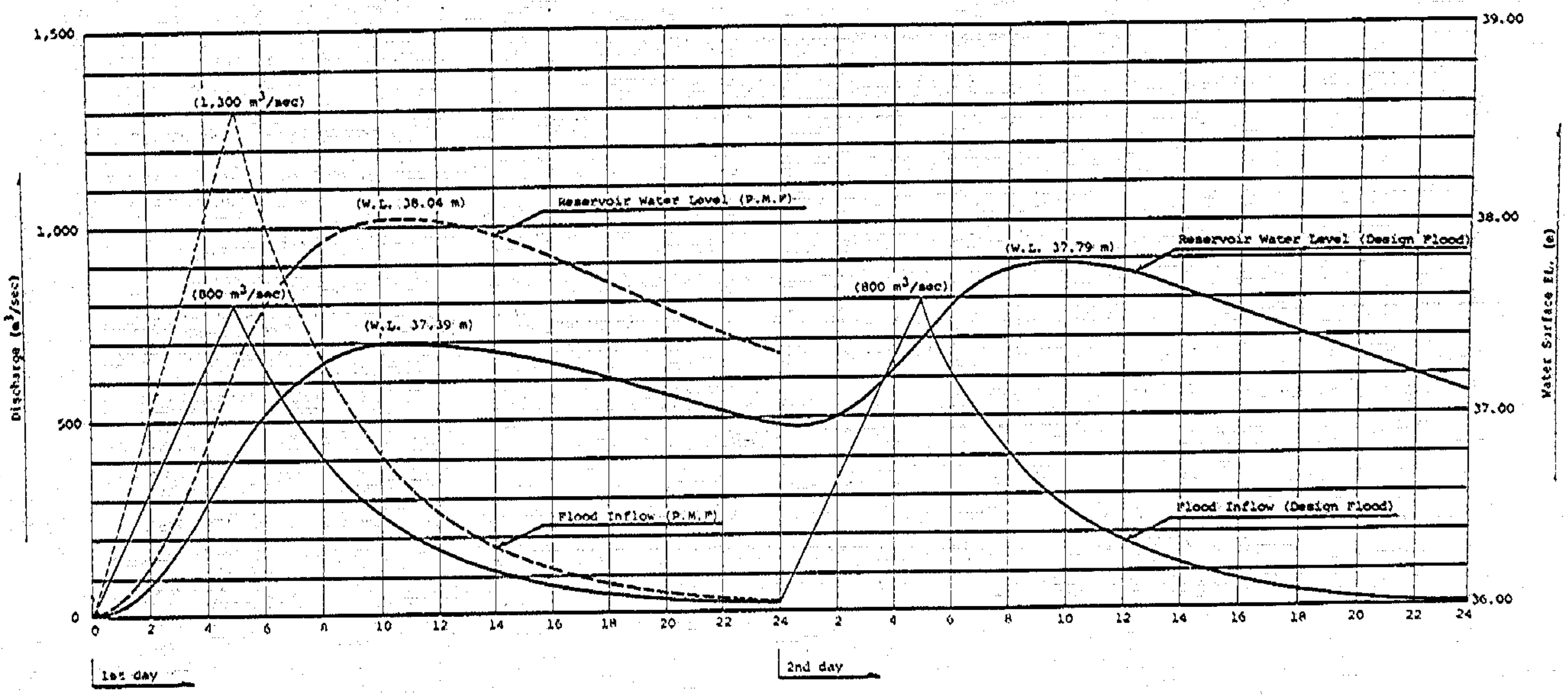


Fig. 7.2 HYDROGRAPH OF FLOOD INFLOW AND OUTFLOW AT KALOLA DAM SITE

(1) Possible maximum rainfall X(pm)

X(pm)=X(n)+Km·S(n) ------------I

where: X(n) : Mean maximum daily rainfall
Km : Statistic variable
S(n) : Standard deviation

(2) Mean maximum daily rainfall at Tanrutedong

Year	Date	Maximum daily rainfall
1972	May 5	84
1973	Apr. 6	110
1974	Sep. 9	128
1975	Aug. 11	126
1976	Sep. 2	105
1977	Aug. 13	120
1978	May 8	90
1979	Sep. 11	170
1980	Mar. 28	150
1981	Jul. 21	157
Maximum		170
Mean X(n)		124
Mean X(n-max)		119
Standard deviation S(n)		26.9
Standard deviation S(n-max)		23.3

(3) Ajustment factor for X(n) and S(n)

	X(n)	S(n)
a. Ajustment by abnormal data (fig A&B)	1.04	1.06
b. Ajustment by observation period (fig C)	1.05	1.30
Combined factor	1.09	1.38
Revised X(n) & S(n)	135	37.1
Km (fig D)	13.8	
X(pm)---- I	647	

(4) Ajustment factor for X(pm)

a. Conversion to areal rainfall (fig E)	0.95
Revised X(pm)	615

(5) Calculation of possible maximum flood Q(pmf)

Q(pmf)= 0.2778·A·r·f (m³/sec.)

r=(R24/24)·(24/T)^{2/3}

where : A : catchment area (km²) 122
r : rainfall intensity(mm/hr)
f : runoff coefficient. 0.6
R24: daily rainfall (mm/day) =615
T : time of concentration .6

Q(pmf)=1313 m³/sec.

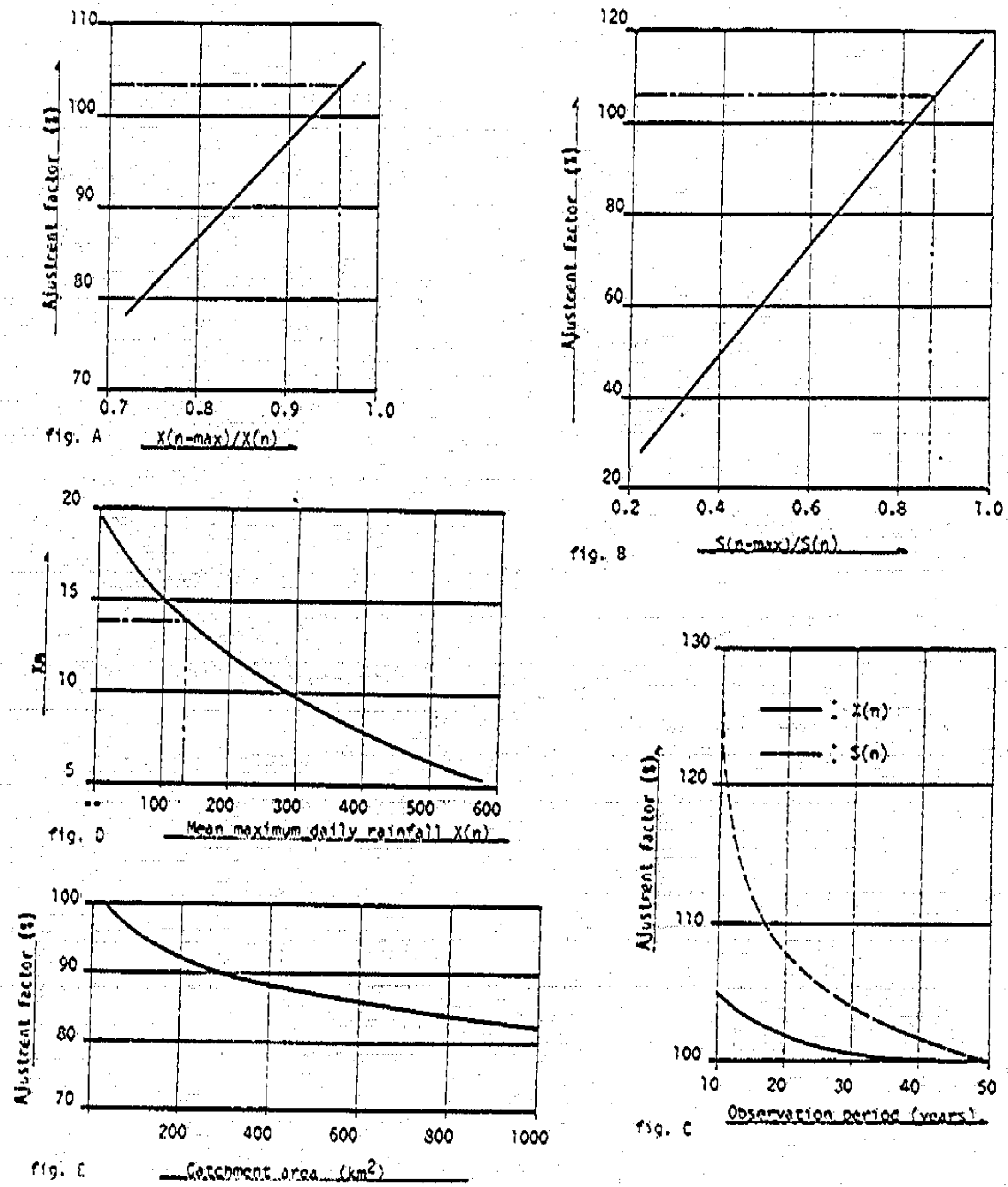


Fig. 7.3 ESTIMATE OF PROBABLE MAXIMUM FLOOD

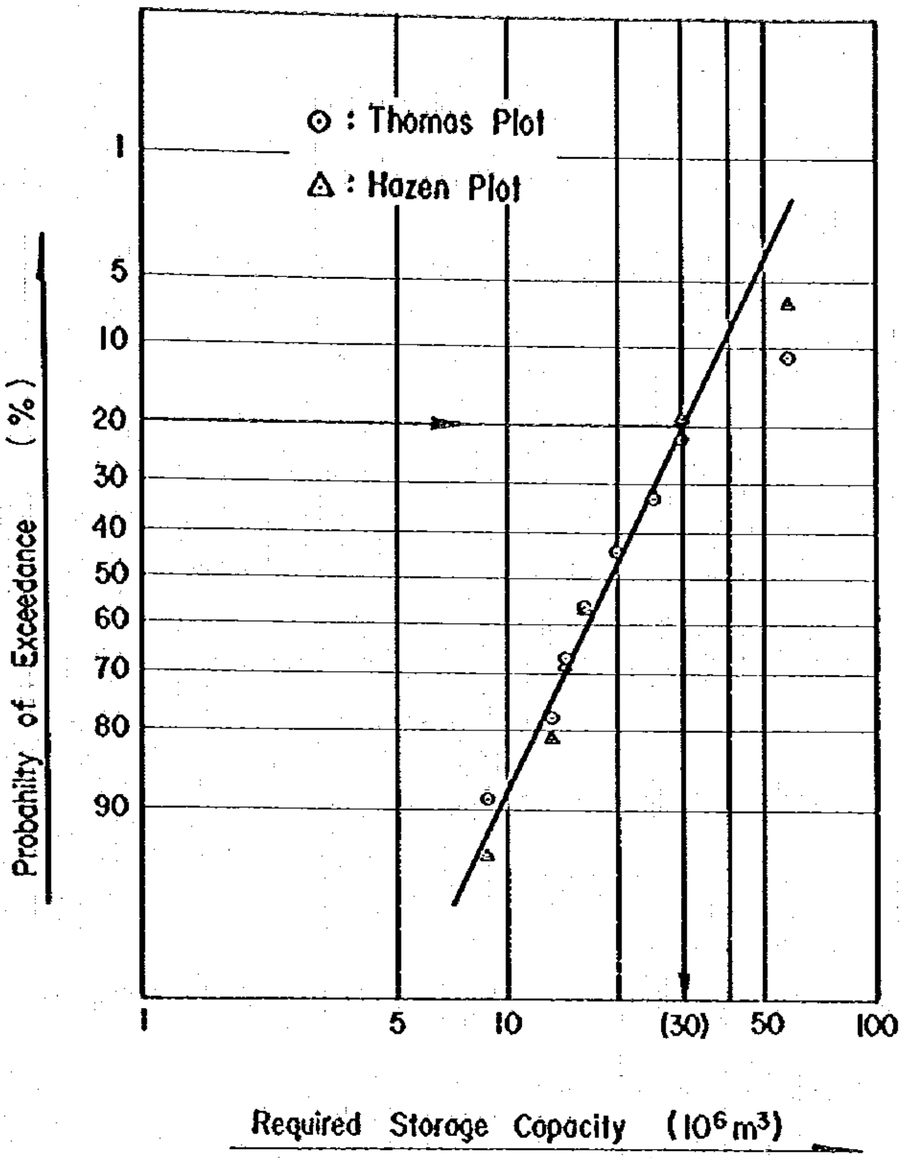


Fig. 7.4 DESIGN STORAGE CAPACITY OF KALOLA DAM SITE

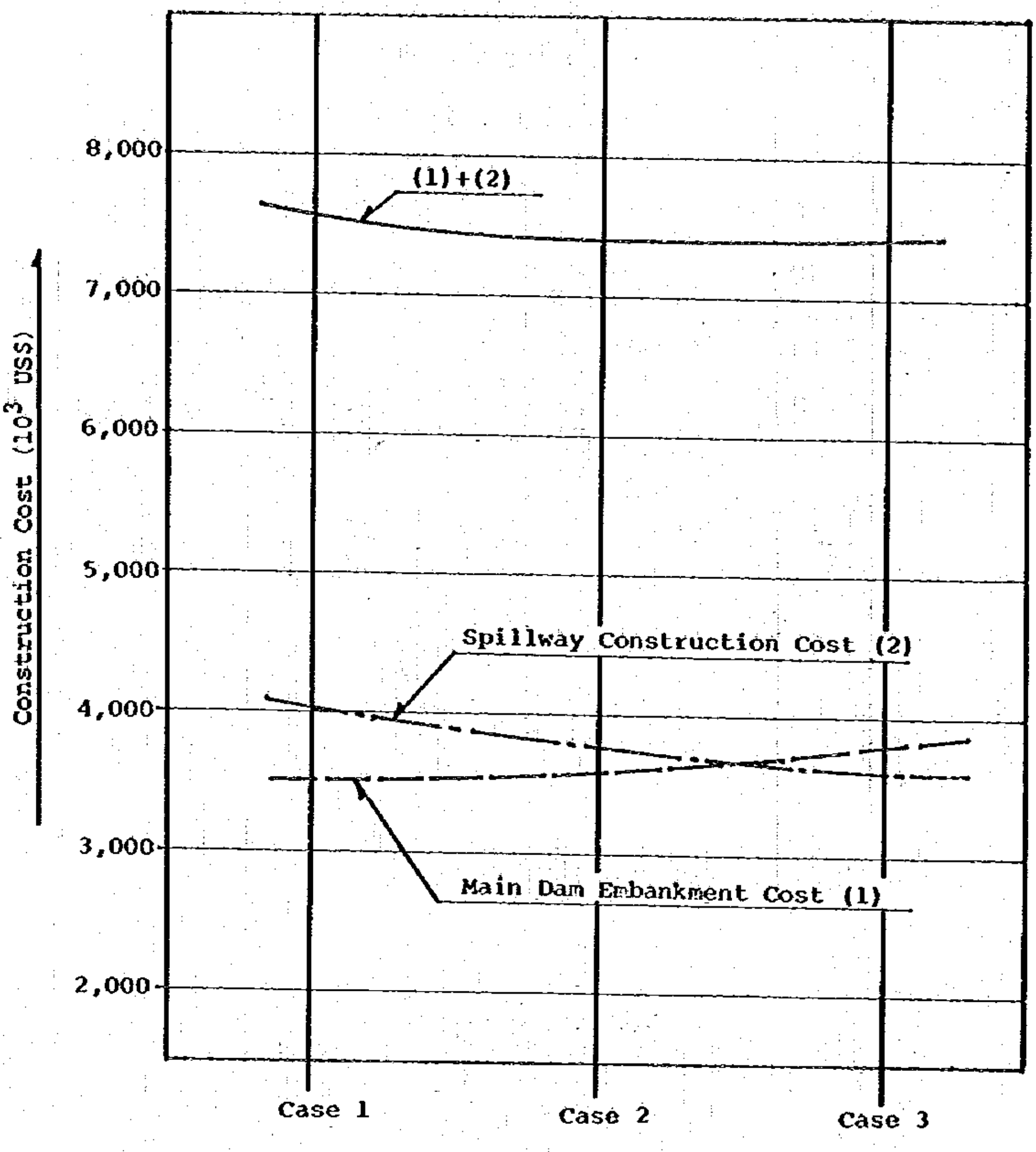
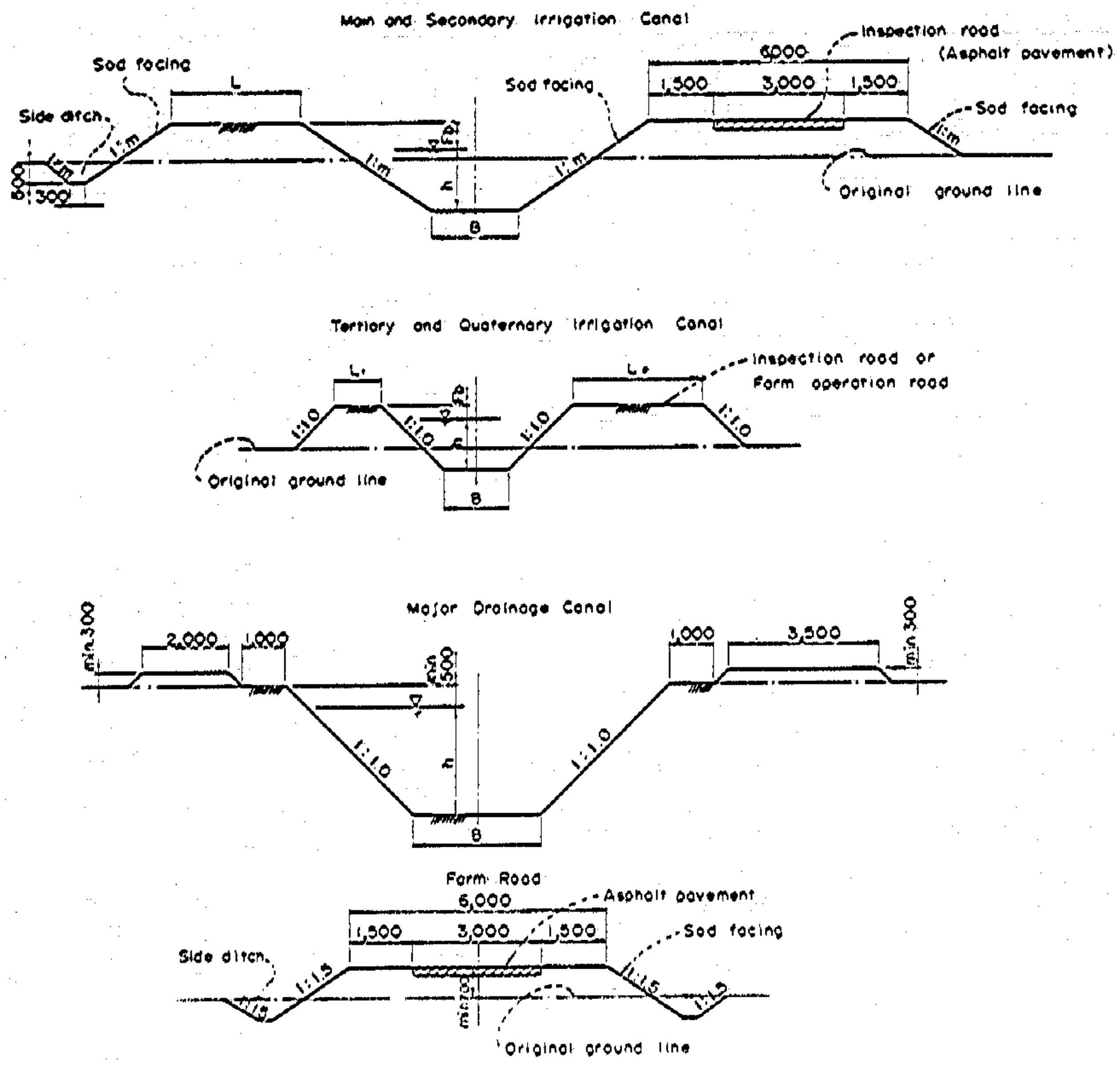


Fig. 7.5 CHOICE OF SPILLWAY DIMENSIONS



Typical Width of Bank and Berm (mm)

— For main and secondary canal (L)

Main Canal	3,000～2,500
Secondary canal	
1.50m³/sec ≤ Q	2,000
Q < 1.50m³/sec	1,500

— For tertiary and quaternary canal (L_1, L_2)

	L_1	L_2
Tertiary Canal	1,000	3,000
Quaternary Canal	500	1,000

Minimum Freeboard (Fb)

Discharge (m³/sec)	Fb (mm)
$Q \leq 0.30$	300
$0.30 < Q \leq 0.50$	400
$0.50 < Q \leq 1.00$	500
$1.00 < Q \leq 7.50$	600
$7.50 < Q \leq 15.00$	750

Side Slope (m)

	m
$3.00 < Q \leq 15.00$ m³/sec	1.5
$Q \leq 3.00$ m³/sec	1.0

Fig. 7.6 TYPICAL CROSS SECTION OF CANAL AND ROAD

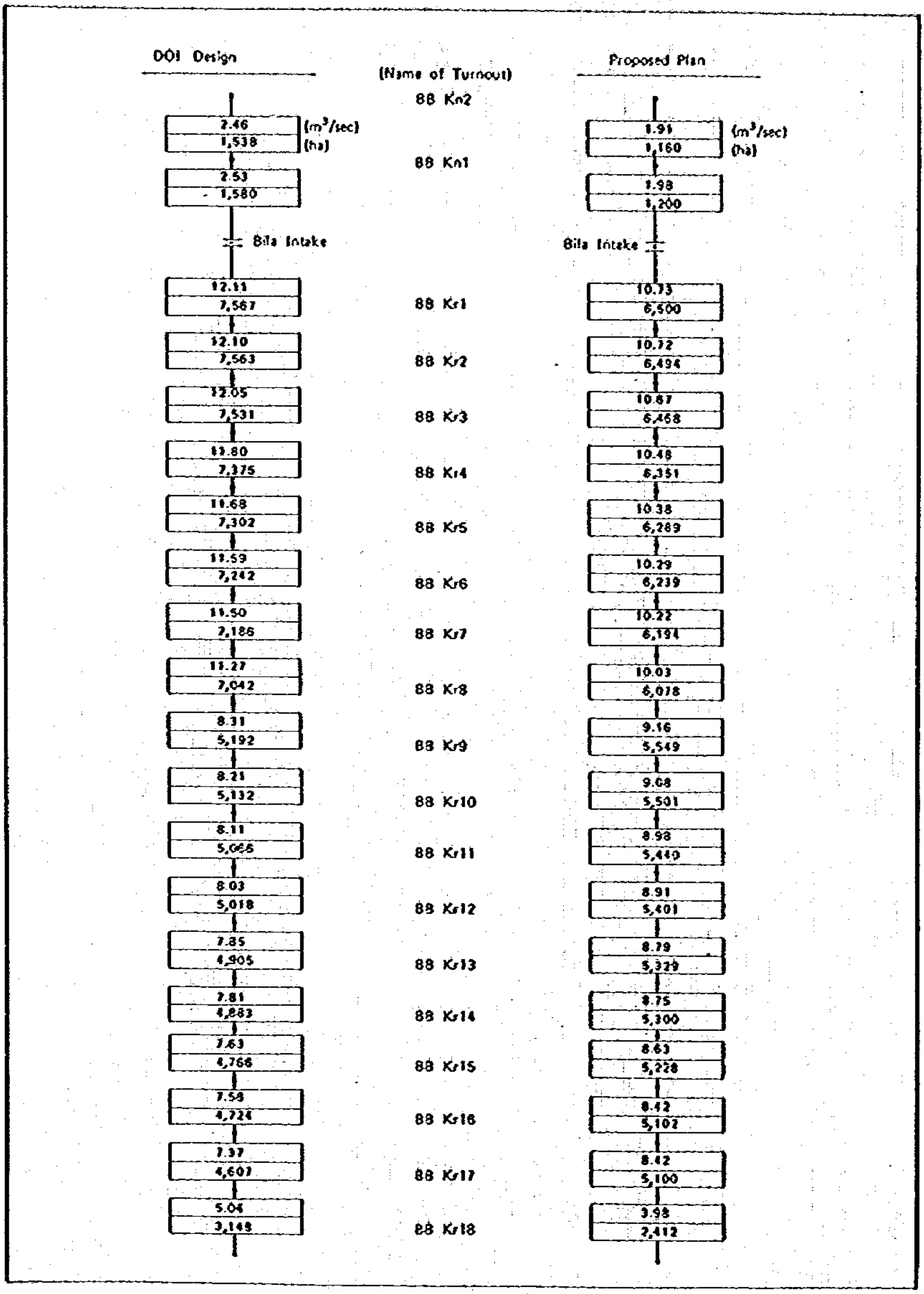


Fig. 7.7 COMPARISON OF COMMAND AREA AND DESIGN DISCHARGE BETWEEN ORIGINAL AND REVISED CONDITIONS

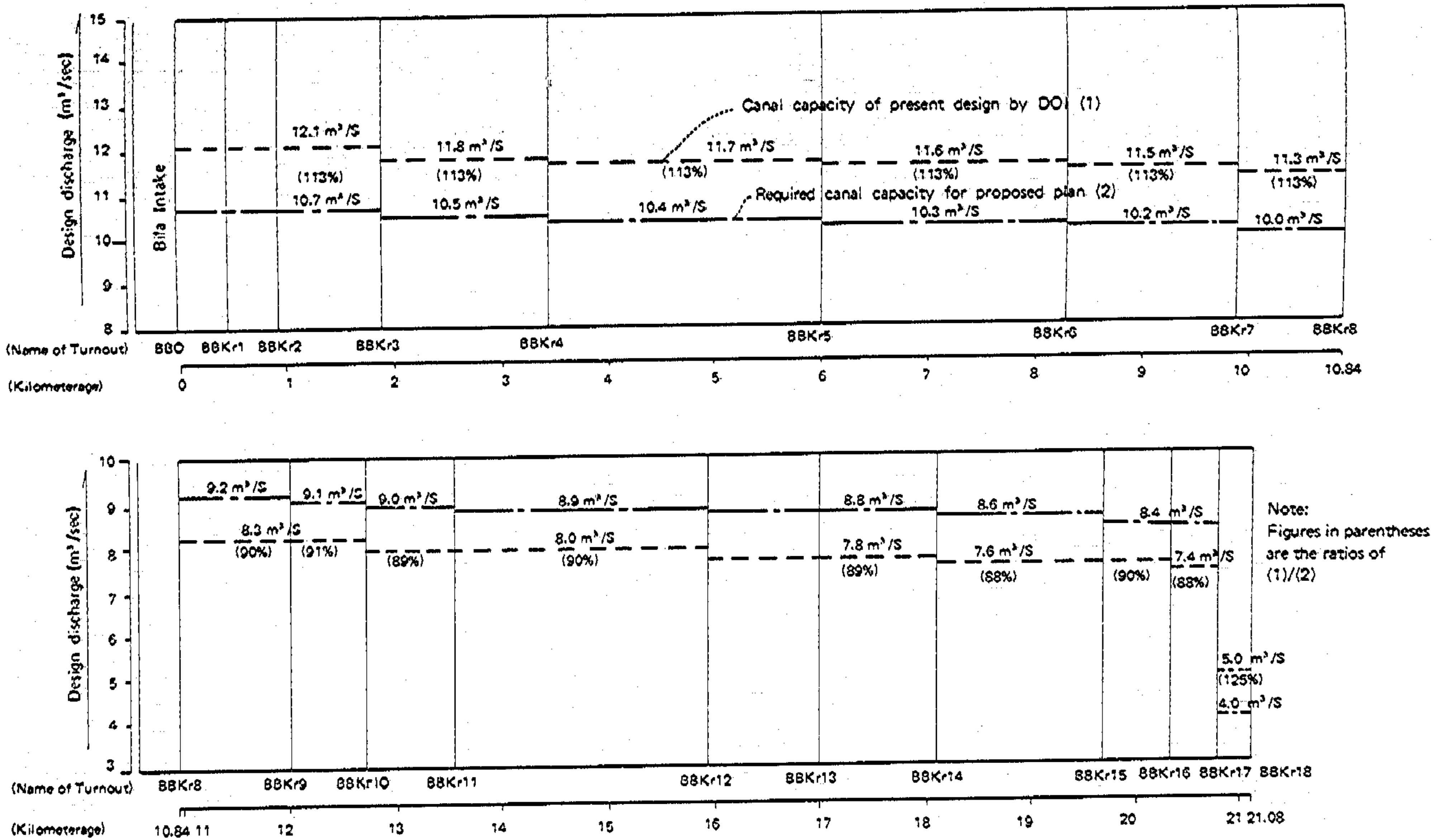


Fig. 7.8 COMPARISON OF CANAL CAPACITY BETWEEN ORIGINAL AND REVISED CONDITIONS

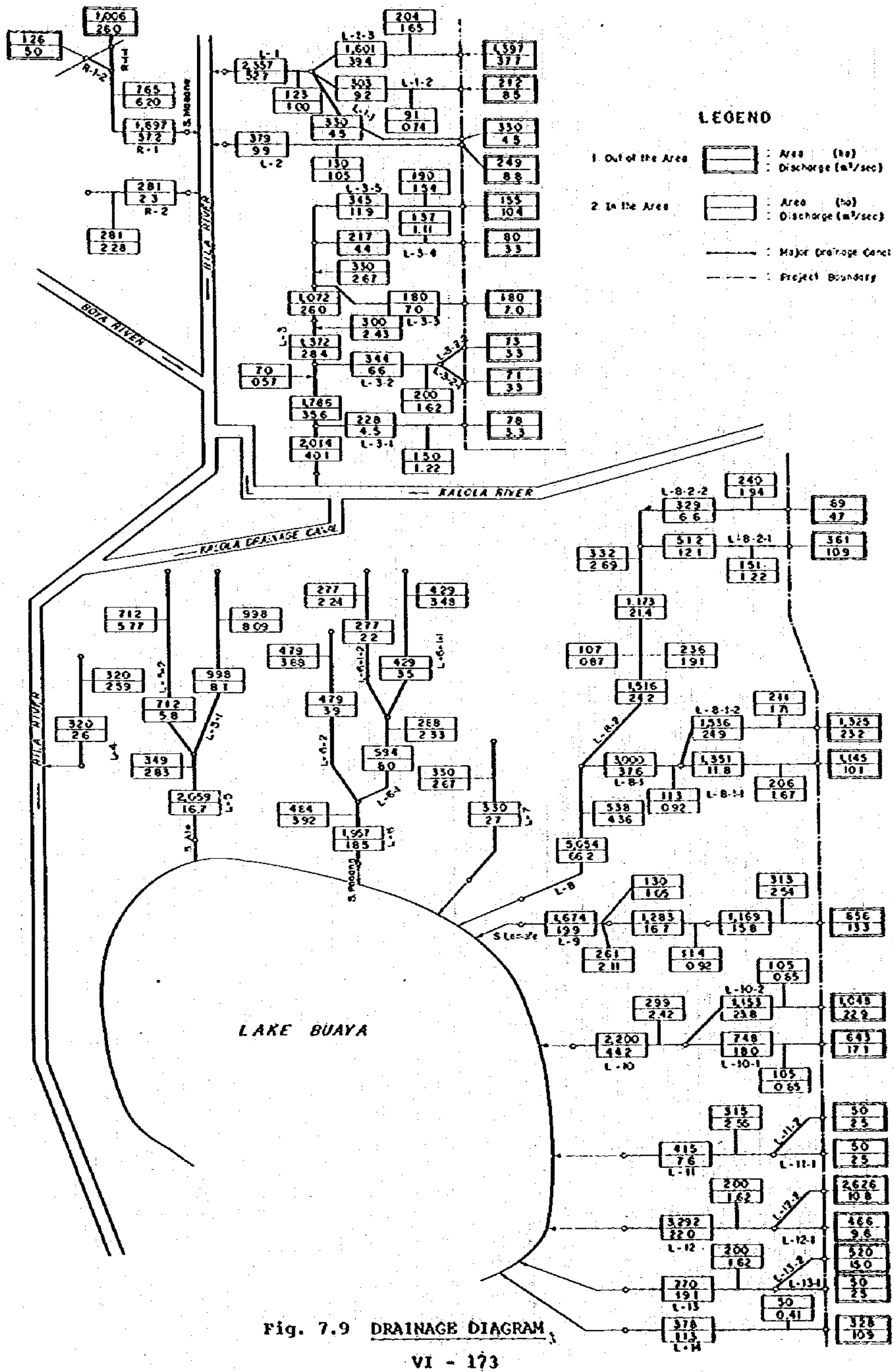


Fig. 7.9 DRAINAGE DIAGRAM

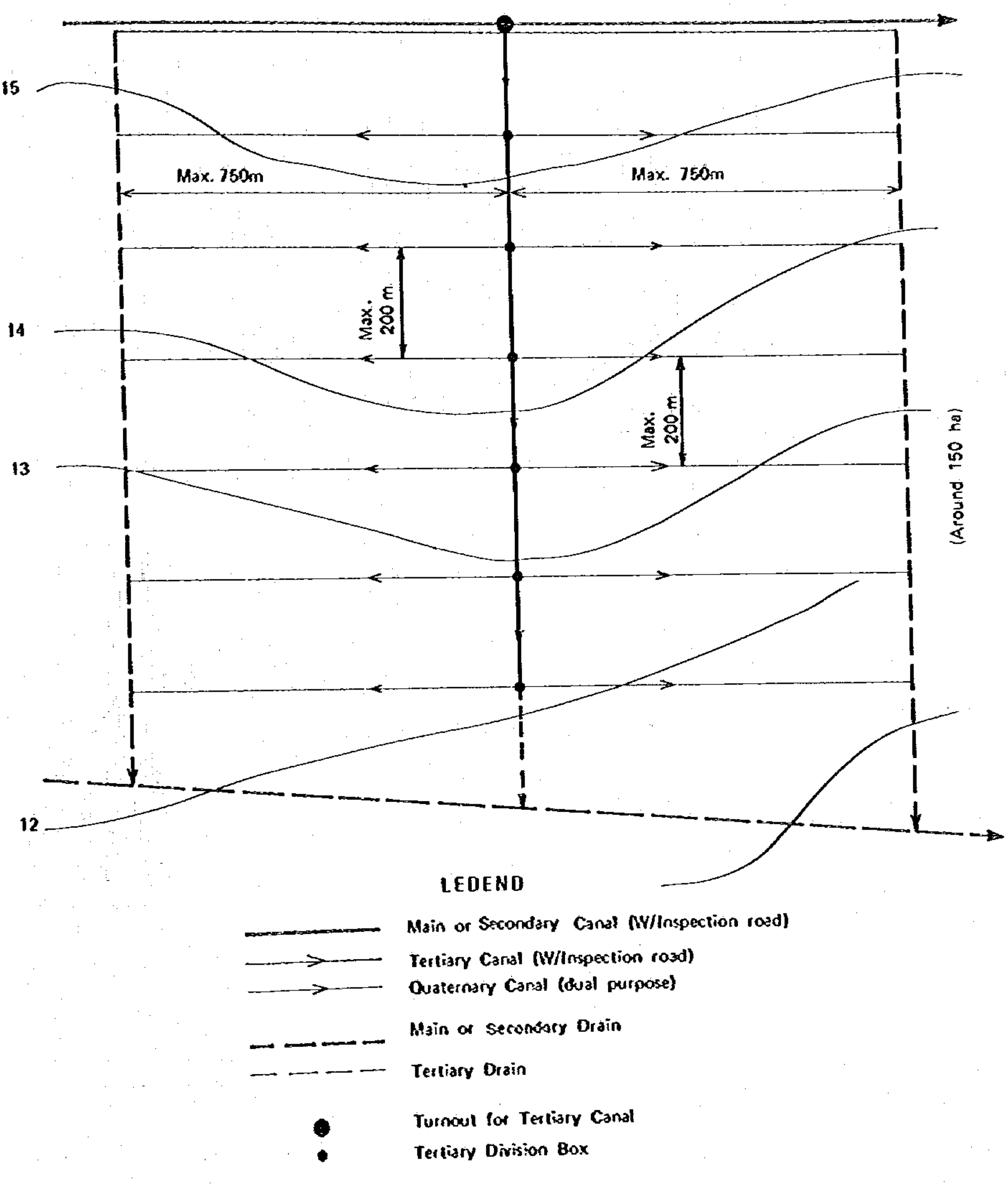


Fig. 7.10 TYPICAL LAYOUT OF TERTIARY SYSTEM

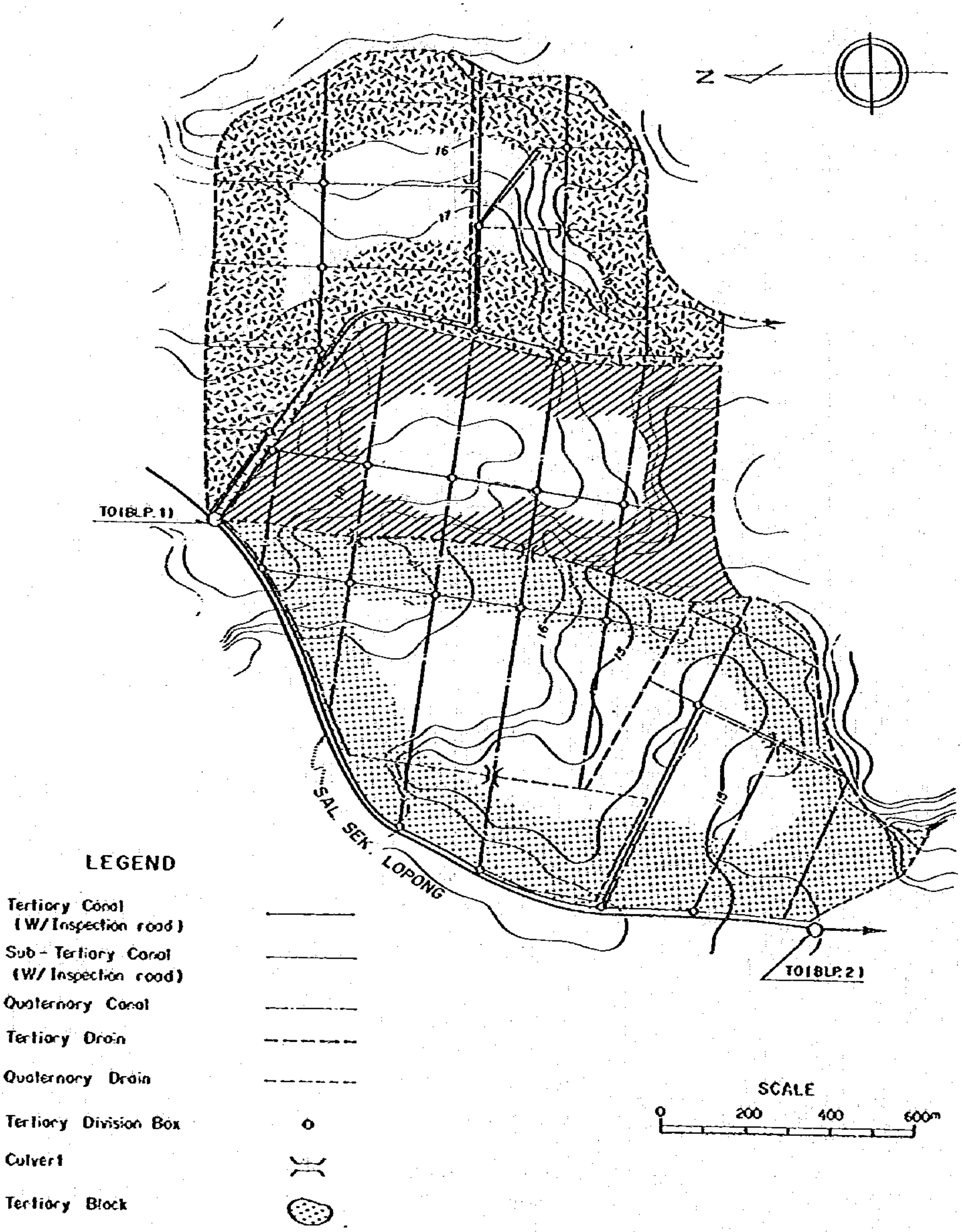


Fig. 7.11 LAYOUT OF TERTIARY SYSTEM REPRESENTATIVE AREA-1

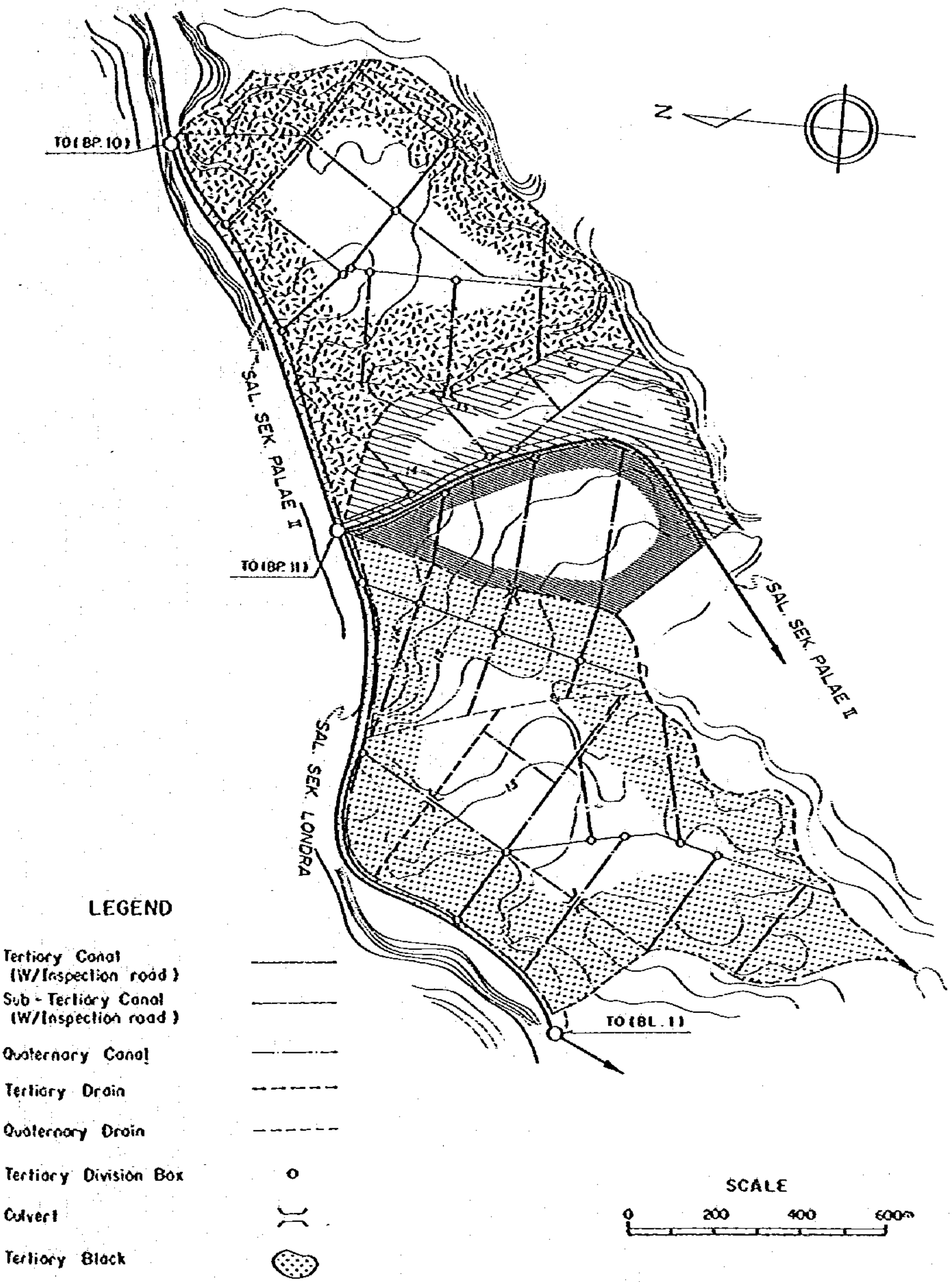


Fig. 7.12 LAYOUT OF TERTIARY SYSTEM REPRESENTATIVE AREA-2

ANNEX - VII

PROJECT IMPLEMENTATION SCHEDULE

ANNEX-VII PROJECT IMPLEMENTATION SCHEDULE

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ANNEX-VII PROJECT IMPLEMENTATION SCHEDULE

1. BASIC CONSIDERATIONS

The Project implementation schedule is formulated on the following considerations:

The civil works to be executed by the Project are broadly classified into the main civil works and the tertiary development works. The civil works consist of the main project facilities such as Bila intake structure, Kalola dam, main and secondary canals, major drainage canals, construction roads. The tertiary development works include all the facilities below the tertiary outlets such as tertiary irrigation canals, tertiary drain, farm roads, farm ditches and their related structures.

The main civil works would be undertaken by a qualified civil work contractor/contractors with assistance of foreign technical services, which should be selected through competitive bidding, and the tertiary canals drains and roads, by the local contractors. The quaternary canal networks in the tertiary system would be constructed by farmers themselves under the quidasnce of the local government.

As the civil works of the Project include a large volume of earth works, the mechanized construction will principally be introduced in the main civil works. In order to increase the employment opportunity in and around the Project area, however, the manpower construction will be adopted as much as possible. The large scale civil work such as Bila intake, Kalola dam, main and secondary canals, major drainage canals and construction roads will be carried out mainly by heavy construction machinery. The tertiary development works will be carried out by manpower with minor construction equipment.

Taking into accout the large scale of the civil works, the Project would be implemented in three stages; (1) review of the existing design and detailed design of the main project facilities (2) construction of the main project facilities and (3) the detailed design and construction of tertiary development works. The tertiary development works would be initiated simultaneously with the main works, so that upon completion of the main works, immediate benefits can be envisaged.

2. IMPLEMENTATION SCHEDULE

The Project implementation schedule is as shown in Fig. 2.1. It includes the Project preparatory works and the construction works. The Project preparatory works will last 22 months including the time necessary for survey and mapping works, review of the existing design and the detailed design works, mobilization, and construction of offices and quarters. The construction works will last 68 months for the main civil works and tertiary development works.

The Project mobilization which includes financing, legalization, establishment of the Project organization would have to be completed by the middle of 1983. In order to facilitate the early commencement of the construction works, the tendering should be promoted in the end of 1983.

3. CONSTRUCTION PLAN

3.1 General

In order to establish the construction time schedule, the workable days for each month are estimated based on the following assumptions:

(1) The following time lengths to suspend the work are set for respective ranges of daily rainfall.

Daily rainfall depth (mm)	Time to be suspended (day)
0 - 10	0
10 - 30	0.5
30 - 50	1.0
More than 50	2.0

(2) Holidays including national holidays are excluded from the work day.

(3) Main civil works consisting earth works and concrete works are suspended during the rainy season from April to June.

The work days are estimated to be 210 days per annum.

3.2 Construction Plan

3.2.1 Preparatory works

The preparatory works such as aerial photo mapping, detailed design, construction of office and quarters, and land acquisition will be started on March of 1983.

Aerial photo maps on a scale of 1:5,000 with a contour interval of 0.5 m would have to be prepared for the Project area of 20,000 ha. This map will be used for the design and construction of the tertiary development.

The review and improvement of the existing design of the canals and Bila intake structure will be started on March 1983. The design of the Bila intake structure will be completed by the end of October 1983, and the design of the canals, by the end of February 1984. The design of Kalola dam will be made by use of accumulated hydrological data on the Kalola river and be completed by the end of August 1984.

The Project office and quarters will be completed prior to the major construction works. This will be started from the beginning of 1984 and completed by the end of 1984. The land acquisition for the Project facilities will be completed at least one year prior to the construction works.

3.2.2 Bila intake

The Bila intake structure consists of various components such as an intake weir, intake, bridge coupure channel, closure embankment, etc. The intake weir will be constructed by means of coupure channel. The time required for construction of the intake will be 57 months from the start of the preparatory works.

The construction of the weir will be carried out in the excavated site on the coupure channel in the dry condition. Since the weir consisting of mainly wet stone masonry will be constructed by labour force, the time required for completing the masonry works will be 3 years. The masonry works will be started on the beginning of March 1985 and completed by the end of February 1988.

After completing the intake weir, the excavation of coupure channel will be started and completed by the end of December 1989. Earthfilling of the closure embankment will be carried out by use of excavated material from the coupure channel, so that the embankment will be conducted in parallel with the construction of the coupure channel. Since these works involve a large volume of earthworks, the machinery works will mainly be employed.

3.2.3 Kalola dam

Time required for completing the Kalola dam will be about 56 month from the start of the preparatory works. The preparatory works consisting a coffer dam and pressure diversion tunnel will be started on the beginning of May 1985 and completed by the end of October 1986. Following to the completion of the diversion works, the main dam construction will be started on the November 1986, and it will be completed by the end of December 1989.

The concrete work of the spillway will be executed in parallel with the embankment work of the main dam, starting on the May 1987 and completing by the end of May 1989. The construction of intake and installation of gates will be executed in 7 months completing by the end of June 1989.

3.2.4 Canals, drains and construction roads

The construction of main irrigation canal including main inspection road will be carried out for 40 months from January 1985 through April 1988. In parallel with construction of the main irrigation canal, the secondary irrigation canals will be constructed in 25 motnhs, starting from June 1987. The construction of the irrigation canal will be executed from the upper reaches to the lower reaches. In the rainy season, the earthworks will be suspended and a main effort will be paid to the construction of related structures. The excavated materials from the canals will be used for embankment of canals and inspection roads.

The construction road for access of constructing the Project facilities will be started on Janaury 1985, parallel with the main canal construction. The inspection roads will also be use of access during the construction. The lack of embankment material of canals and inspection roads will be obtained from excavation in drainage canals. The major drainage canals will be executed for the period from January 1987 to the end or February 1990.

The pavement of the inspection roads and construction roads will be made at the final stages of respective construction periods. The construction roads will be transferred as the village link roads.

3.2.5 Tertiary development

The detailed design of the tertiary development will be started from September 1984 based on the aerial photo maps and field survey. The construction will be executed in stagewise. The construction will be started on October 1986 from the upper part of the Project area, and be completed by the end of February 1990.

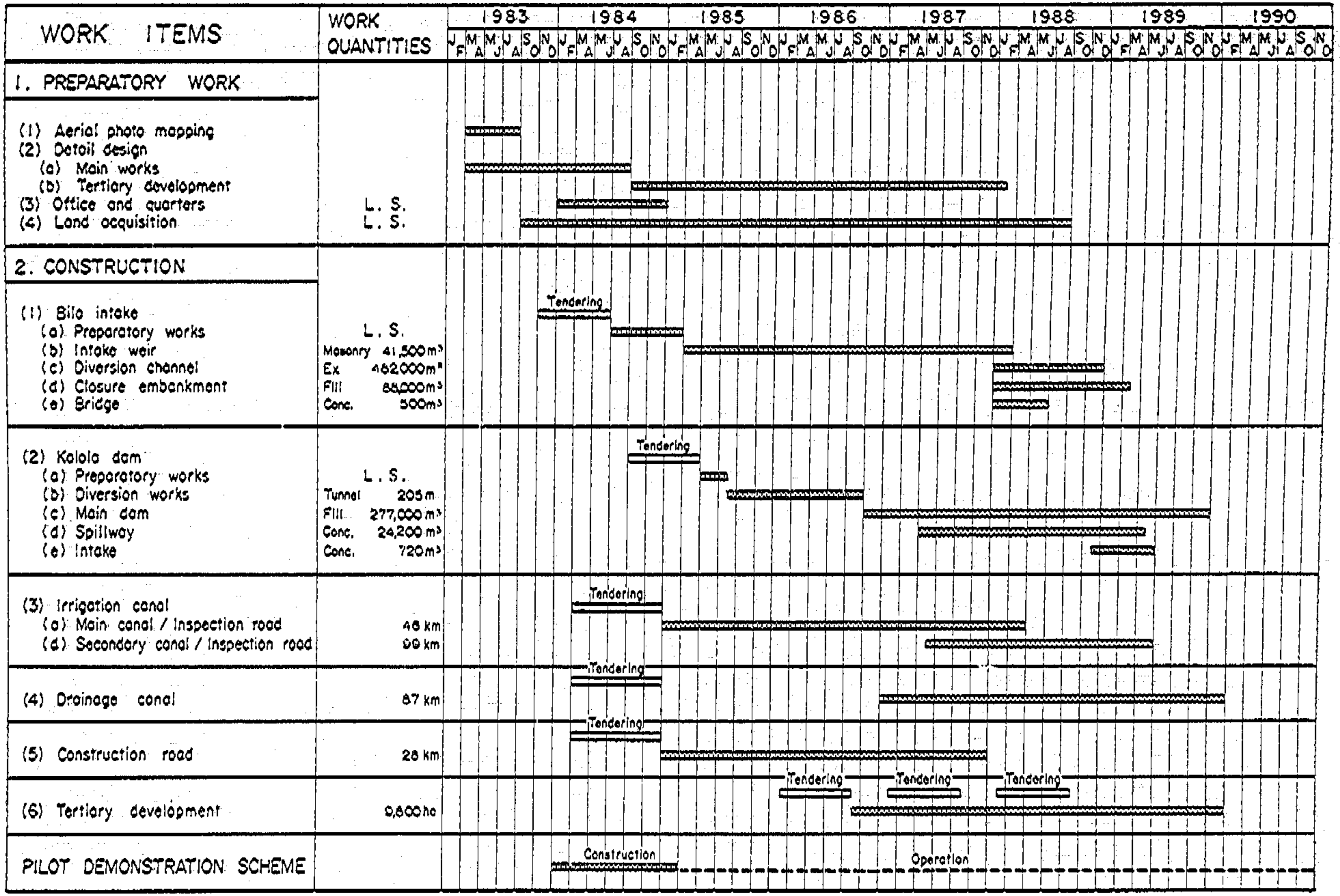

Fig. 2.1 PROJECT IMPLEMENTATION SCHEDULE

ANNEX - VIII

COST ESTIMATE

ANNEX-VIII COST ESTIMATE

CONTENTS

ANNEX-VIII COST ESTIMATE

1. CONSTRUCTION COST

1.1 General

The following considerations are taken for the cost estimate of the Project:

(1) The exchange rate used in the estimate is:

US$1.0 = Rp.625 = ¥220

(2) The construction works would be executed on the contract basis; main civil works, such as Bila intake, Kalola dam, main and secondary canals, etc. would be constructed by contractors selected through competitive bidding and the tertiary development work, by local contractors. The construction machinery and equipment required for the construction works would be provided by the contractors themselves. Therefore depreciation cost of the machinery and equipment is considered in the estimate of the construction cost, instead of the procurement cost of machinery and equipment.

(3) The construction cost comprises foreign currency and local currency portions. Local currency portion is estimated on the basis of the current price in South Sulawesi in 1981 and of the data obtained from the on-going and completed irrigation projects around the Project area. Foreign currency portion is estimated based on the CIF prices at Ujung Pandang. The currency is classified into local and foreign portions according to the following criteria;

(a) Local currency portion

(i) labour wage

(ii) sand, gravel, stone and wooden materials

(iii) fuel, oil, etc.

(iv) expenses and fees of engineering services for local consultants

(v) inland transportation charge

(vi) transfer payment for local portions, such as general expenses, taxes and levies

(vii) minor works

(b) Foreign currency portion

(i) reinforcing steel bars and other structural steel

(ii) cement

(iii) major metal works

(iv) depreciation cost of construction machinery and equipment

(v) expenses and fees of engineering services by foreign consultants

(4) In the estimate of the construction cost of the quaternary system, only the costs of materials necessary for the construction of the related structures are included, since such works would be executed by farmers themselves under the guidance of the Government.

(5) The physical contingency related to the construction quantities is set at 15% of the direct cost in view of the preliminary nature of the estimate. The price contingency of 7% per annum for the foreign currency portion and 10% for the local currency portion is included in the estimate.

(6) The associated costs to be financed by the Government, such as the cost for strengthening the extension services, facilities of the water users' association, and improvement of the social infrastructures are not included in the estimate.

1.2 Estimate of Construction Cost

The construction cost of the Project is estimated at Rp.67,823 million equivalent, comprising Rp.32,926 million of local currency and Rp.34,897 million equivalent of foreign currency. The summary and breakdown of the cost estimate are as shown in Table 1.1 and Table 1.3 through Table 1.10.

The basic prices of local materials and labour wages used in the estimate and the unit rates for major work items are as shown Table 1.12, Table 1.13 and Table 1.14, respectively.

1.3 Annual Disbursement Schedule

The annual disbursement schedule is worked out based on the construction time schedule as shown in Table 1.2. The summary is as shown below:

(Unit: $Rp.10^6$)

Year	Foreign Currency	Local Currency	Total
1983	1,520	960	2,480
1984	1,286	3,928	5,214
1985	3,004	3,343	6,347
1986	3,771	2,836	6,607
1987	5,940	6,176	12,116
1988	10,723	7,380	18,103
1989	6,978	6,186	13,164
1990	1,675	2,117	3,792
Total	34,897	32,926	67,823

2. ANNUAL OEPRATION AND MAINTENANCE COSTS

Annual operation and maintenance costs at the full development stage is estimated at Rp.344,840 x 10^3, comprising the costs for; (1) operation and maintenance cost of the project offices including personnel cost, (2) operation and maintenance cost of the project facilities. These costs are shown in Table 2.1

3. REPLACEMENT COST

Some of the Project facilities, especially equipment and mechanical works have some shorter useful life than the civil works, and require replacement at a certain time within the Project useful life.

The replacement costs and the useful life of those facilities are listed in Table 3.1.

Table 1.1 Summary of Construction Cost

(Unit: 10^6 Rp.)

Item	Total	Foreign Currency	Local Currency
1. Preparatory Works	1,718	698	1,020
2. Bila Intake	2,665	1,774	891
3. Kaloia Dam	7,656	5,456	2,200
4. Irrigation Canals and Roads			
- Irrigation canals and inspection roads	8,208	4,574	3,634
- Drainage canals	1,343	1,063	280
- Construction road	780	491	289
5. Tertiary Development	4,485	444	4,041
6. Office and Quarters	640	-	640
Sub-total	27,495	14,500	12,995
7. Land Acquisition	2,370	-	2,370
8. O & M Equipment	992	942	50
9. Administration Expenses	612	-	612
10. Engineering Services	4,889	4,529	360
11. Physical Contingency	5,454	2,996	2,458
Sub-total	14,317	8,467	5,850
Total	41,812	22,967	18,845
12. Price Contingency	26,011	11,930	14,081
GRAND TOTAL	67,823	34,897	32,926

Table 1.2 Annual Disbursement Schedule of Construction Cost

(Unit: 10^6Rp.)

Description	Total		1983		1984		1985		1986		1987		1988		1989		1990	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
1. Preparatory Work	698	1,020	-	-	349	510	349	510	-	-	-	-	-	-	-	-	-	-
2. Bila Intake	1,774	891	-	-	-	-	155	216	183	254	183	254	1,245	162	8	5	-	-
3. Kalola Dam	5,456	2,200	-	-	-	-	208	76	878	303	728	222	1,540	519	1,412	565	690	515
4. Canals & Roads																		
(1) Canals & inspection roads	4,574	3,634	-	-	-	-	597	453	595	453	1,320	1,048	1,442	1,170	622	510	-	-
(2) Drainage canals	1,063	280	-	-	-	-	-	-	-	-	340	90	340	90	340	89	43	11
(3) Construction roads	491	289	-	-	-	-	167	98	162	96	162	95	-	-	-	-	-	-
5. Tertiary System	444	4,041	-	-	-	-	-	-	31	283	129	1,172	129	1,172	129	1,172	26	242
6. Office and Quarters	-	640	-	-	-	640	-	-	-	-	-	-	-	-	-	-	-	-
<u>Sub-total</u>	14,500	12,995	-	-	349	1,150	1,474	1,353	1,849	1,389	2,862	2,881	4,696	3,113	2,511	2,341	759	768
7. Land Acquisition	-	2,370	-	570	-	1,300	-	500	-	-	-	-	-	-	-	-	-	-
8. O & M Equipment	942	50	-	-	-	-	-	-	-	-	-	-	471	25	471	25	-	-
9. Administration Expenses	-	612	-	46	-	68	-	88	-	101	-	101	-	101	-	97	-	10
10. Engineering Service	4,529	360	1,155	74	564	48	519	44	489	41	580	49	640	54	549	47	33	3
11. Physical Contingency	2,996	2,458	173	103	137	385	299	298	351	230	516	455	871	494	530	376	119	117
<u>Sub-total</u>	8,467	5,850	1,328	793	701	1,801	818	930	840	372	1,096	605	1,982	674	1,550	545	152	130
<u>Total</u>	22,967	18,845	1,328	793	1,050	2,951	2,292	2,283	2,689	1,761	3,958	3,486	6,678	3,787	4,061	2,886	911	898
12. Price Contingency	11,930	14,081	192	167	236	977	712	1,060	1,082	1,075	1,982	2,690	4,045	3,593	2,917	3,300	764	1,219
GRAND TOTAL	34,897	32,926	1,520	960	1,286	3,928	3,004	3,343	3,771	2,836	5,940	6,176	10,723	7,380	6,978	6,186	1,675	2,117

Remarks: /1; Engineering service of item 10 includes the expenses required for the detailed design.

/2; Price contingency of item 12 is calculated from the standpoint 1981 based on the annual increase rates of 7% and 10% for the foreign currency and local currency portions respectively.

Table 1.3 Breakdown of Direct Construction Cost (1/4)
(Bila Intake)

Item	Unit	Q'ty	Cost (10^3Rp.) FC	LC	Total
1. Intake Weir					
Backfill spreading	m^3	8,600	2,730	173	2,903
compaction	m^3	8,600	509	1,986	2,495
Concrete works					
Reinforced concrete	m^3	100	2,664	1,664	4,328
Reinforced bar	ton	10	4,270	348	4,618
Form work	m^2	300	-	1,116	1,116
Masonry work	m^3	36,200	453,948	534,312	988,260
Wooden gate	m^2	32	-	22,742	22,742
Gabion	m^3	5,900	-	96,274	96,274
Gravel metaling	m^3	630	-	504	504
Total (1)			464,121	659,119	1,123,240
2. Intake Structure					
Wet stone masonry	m^3	5,300	66,452	78,238	144,690
Excavation; T/S	m^3	600	315	16	331
; C/S	m^3	4,200	2,204	114	2,318
; W/R	m^3	1,200	513	28	541
; W/R	m^3	1,200	817	43	860
Spreading ; C/S	m^3	2,400	762	48	810
Compaction; C/S	m^3	2,400	142	554	696
Hauling to spoil area ; T/S	m^3	600	751	65	816
; C/S	m^3	1,534	1,921	165	2,086
; W/R	m^3	1,200	1,784	152	1,936
Spreading in spoil area; T/S	m^3	600	190	12	202
; C/S	m^3	1,534	487	31	518
; W/R	m^3	1,200	391	24	495
Wooden gate	m^2	35	-	24,875	24,875
Reinforced concrete	m^3	250	6,660	4,159	10,819
Reinforced bar	ton	18	7,686	626	8,312
Form	m^2	650	-	2,418	2,418
Total (2)			91,075	111,558	202,633
3. Diversion Channel					
Excavation; C/S	m^3	96,000	40,823	2,388	43,211
; W/R	m^2	380,000	162,490	9,002	171,492
Loading ; C/S	m^3	96,000	48,669	2,843	51,512
; W/R	m^3	380,000	220,104	12,603	232,707
Hauling ; C/S	m^3	96,000	120,194	10,348	130,542
; W/R	m^3	283,400	421,288	35,919	457,207
Spreading ; C/S	m^3	96,000	30,475	1,933	32,408
; W/R	m^3	283,400	89,964	5,707	95,671
Total (3)			1,134,007	80,743	1,214,750
4. Closure Embankment					
Excavation; C/S	m^3	11,000	5,772	300	6,072
Embankment			-	-	-
Spreading	m^3	88,000	27,935	1,772	29,707
Compaction	m^3	88,000	5,212	20,326	25,538
Total (4)			38,919	22,398	61,317
5. Bridge					
Bearing shoe	Nos.	20	14,214	-	14,214
Reinforced concrete	m^3	400	10,655	6,655	17,310
Form	m^2	1,200	-	4,463	4,463
Reinforced bar	ton	50	21,351	1,740	23,091
Scafolding	m^3	3,500	-	3,967	3,967
Total (5)			46,220	16,825	63,045
GRAND TOTAL			1,774,342	890,643	2,664,985

Table 1.3 Breakdown of Direct Construction Cost (2/4)

(Kalola Dam)

Item	Unit	Q'ty	Cost (10^3Pp.) FC	LC	Total
1. Coffering Work					
Excavation ; T/S	m^3	7,000	3,675	189	3,864
; C/S	m^3	20,000	10,500	540	11,040
Loading ; T/S	m^3	7,000	3,549	210	3,759
; C/S	m^3	20,000	10,140	600	10,740
Hauling ; T/S	m^3	7,000	5,334	455	5,789
; C/S	m^3	20,000	15,240	1,300	16,540
Spreading in spoil area	m^3	27,000	8,559	540	9,099
Borrow pit					
Excavation; T/S	m^3	1,000	425	25	450
; C/S	m^3	22,000	9,350	550	9,900
Loading	m^3	22,000	11,154	660	11,814
Hauling	m^3	22,000	27,544	2,376	29,920
Quarry site I					
Excavation; T/S	m^3	7,000	2,975	175	3,150
; R	m^3	9,000	12,312	639	12,951
Loading ; T/S	m^3	7,000	3,549	210	3,759
; R	m^3	9,000	13,869	828	14,697
Hauling ; T/S	m^3	7,000	8,764	756	9,520
; R	m^3	9,000	8,280	711	8,991
Spreading in spoil area	m^3	7,000	2,219	140	2,359
Spreading ; Core	m^3	20,000	6,800	400	7,200
; Filter	m^3	3,400	1,156	68	1,224
; R. rock	m^3	22,000	7,480	440	7,920
; Rock	m^3	45,000	15,300	900	16,200
Compacting ; Core	m^3	20,000	5,600	280	5,880
; Filter	m^3	3,400	201	785	986
; R. Rock	m^3	22,000	2,244	396	2,640
; Rock	m^3	45,000	13,545	1,125	14,670
Purchase cost; Filter	m^3	3,400	-	14,096	14,096
Total 1			209,764	29,334	239,158
2. River Diversion Work					
(1) Channel					
Excavation; T/S	m^3	5,000	2,125	125	2,250
; C/S	m^3	95,000	40,375	2,375	42,750
; W/R	m^3	5,000	2,140	120	2,260
Loading ; T/S	m^3	5,000	2,735	150	2,885
; C/S	m^3	95,000	51,965	2,650	54,615
; W/R	m^3	5,000	3,125	170	3,295
Hauling ; T/S	m^3	5,000	6,560	670	7,230
; C/S	m^3	95,000	124,640	12,730	137,370
; W/R	m^3	5,000	7,800	810	8,610
Spreading in spoil area	m^3	91,000	28,847	1,820	30,667
Reinforced concrete	m^3	5,800	154,512	96,512	251,024
Reinforced iron bar	ton	92	39,255	3,201	42,456
Form	m^2	8,000	-	29,752	29,752
Gabion	m^3	2,700	-	44,059	44,059
Sub-total			454,109	195,344	659,453
(2) Tunnel work					
Excavation	m^3	9,100	132,842	23,323	156,165
Loading	m^3	9,100	5,588	349	5,937
Hauling	m^3	9,100	14,196	1,474	15,670
Spreading in spoil area	m^3	9,100	2,885	182	3,067
Concrete lining	m^3	3,050	81,252	50,752	132,004
Form	set	2	3,601	3,660	7,261
Plug concrete	m^3	570	15,185	9,485	24,670
Grouting	m	550	718	3,029	3,747
Reinforced iron bar	ton	73	33,734	2,749	36,483
Sub-total			290,101	94,963	385,064
Total 2			744,210	290,307	1,044,517
3. Dam Embankment					
Excavation ; T/S	m^3	36,000	15,308	895	16,203
; C/S	m^3	5,000	2,126	124	2,250
; W/R	m^3	15,000	6,414	355	6,769
Loading ; T/S	m^3	36,000	18,251	1,066	19,317
; C/S	m^3	5,000	2,535	148	2,683
; W/R	m^3	15,000	8,688	497	9,185
Hauling ; T/S	m^3	36,000	45,073	3,880	48,953
; C/S	m^3	5,000	6,260	533	6,793
; W/R	m^3	15,000	22,298	1,901	24,199
Spreading in spoil area	m^3	56,000	17,777	1,128	18,905
Borrow pit					
Excavation; T/S	m^3	2,000	850	50	900
C/S	m^3	69,000	29,341	1,716	31,057
Loading	m^3	69,000	34,983	2,070	37,053
Hauling	m^3	69,000	86,388	7,452	93,840
Quarry site I					
Excavation; T/S	m^3	29,000	12,332	721	13,053
; W/R	m^3	55,000	23,518	1,303	24,821
; R	m^3	28,000	38,304	1,988	40,292
Loading ; T/S	m^3	29,000	14,703	870	15,573
; W/R	m^3	55,000	34,375	1,870	36,245
; R	m^3	37,000	57,017	3,404	60,421

(to be continued)

Table 1.3 Breakdown of Direct Construction Cost (3/4)
(Kalola Dam)

Item	Unit	Q'ty	Cost (10^3Rp.) FC	LC	Total
Hauling ; T/S	m^3	29,000	36,308	3,132	39,440
; W/R	m^3	27,000	18,873	1,593	20,466
; W/R	m^3	28,000	41,636	3,556	45,192
; R	m^3	10,000	9,200	790	9,990
; R	m^3	19,000	37,183	3,211	40,394
Spreading in spoil area	m^3	83,000	26,311	1,660	27,971
Quarry site II					
Excavation; T/S	m^3	13,000	5,528	323	5,851
; W/R	m^3	17,000	7,269	403	7,672
; R	m^3	111,000	245,998	370,641	616,639
Loading ; W/R	m^3	17,000	26,198	1,571	27,769
; R	m^3	111,000	171,055	10,255	181,310
Hauling ; W/R	m^3	17,000	45,086	3,846	48,932
; R	m^3	111,000	387,602	33,527	421,129
Spreading					
Impervious core	m^3	42,000	14,278	846	15,124
Filter	m^3	20,000	6,799	403	7,202
Random rock	m^3	67,000	22,777	1,349	24,126
Rock	m^3	134,000	45,554	2,698	48,252
Riprap	m^3	9,000	3,060	181	3,241
Drain	m^3	5,000	1,700	101	1,801
Purchase cost					
Filter	m^3	20,000	-	82,915	82,915
Drain	m^3	5,000	-	29,613	29,613
Compacting					
Impervious core	m^3	42,000	11,741	597	12,338
Filter	m^3	20,000	1,185	4,620	5,805
Random rock	m^3	67,000	6,825	1,190	8,015
Rock	m^3	134,000	40,316	3,333	43,649
Total 3			1,689,023	594,331	2,283,354
4. Foundation Treatment					
Blanket grout					
Grout hole drilling	m	1,900	45,344	4,632	49,976
Grouting	m	1,900	2,480	10,465	12,945
Curtain grout					
Grout hole drilling	m	11,300	269,678	27,546	297,224
Grouting	m	11,300	14,750	62,240	76,990
Test hole drilling	m	1,300	43,077	6,506	49,583
Total 4			375,329	111,369	486,718
5. Spillway					
Excavation ; T/S	m^3	30,000	15,742	817	16,559
; C/S	m^3	120,000	62,968	3,269	66,237
; W/R	m^3	90,000	61,298	3,198	64,496
; R	m^3	60,000	82,086	4,264	86,350
Hauling ; T/S	m^3	30,000	37,560	3,234	40,794
; C/S	m^3	36,000	21,236	1,791	23,027
; C/S	m^3	84,000	105,169	9,054	114,223
; W/R	m^3	45,000	31,449	2,665	34,113
; W/R	m^3	45,000	66,895	5,703	72,598
; R	m^3	30,000	27,611	2,381	29,992
; R	m^3	30,000	58,704	5,082	63,786
Spreading in spoil area	m^3	187,000	59,997	3,806	63,803
Embankment					
Spreading	m^3	32,000	10,159	644	10,802
Compacting	m^3	32,000	1,895	7,391	9,286
Reinforced concrete	m^3	24,200	644,688	402,688	1,047,376
Form	m^2	12,200	–	45,376	45,376
Reinforced iron bar	ton	360	126,265	13,222	175,437
Blanket grout					
Grout hole drilling	m	300	7,160	731	7,891
Grouting	m	300	392	1,652	2,044
Curtain grout					
Grout hole drilling	m	720	17,183	1,755	18,938
Grouting	m	720	940	3,966	4,906
Test hole drilling	m	100	3,309	550	3,809
Gabion	m^3	3,000	-	49,953	48,953
Rock bolt	Pcs.	2,200	292,160	27,041	319,201
Total 5			1,770,864	599,183	2,370,047
6. Intake Facility					
Reinforced concrete	m^3	720	19,181	11,981	31,162
Form	m^2	2,200	-	94,193	94,193
Reinforced iron bar	ton	43	18,362	1,496	19,858
Total 6			37,543	107,670	145,213
7. Haul Road					
Excavation; T/S	m^3	10.000	4,620	300	4,920
; C/S	m^3	68.000	43,112	2,312	45,424
Embankment; C/S	m^3	8.000	[illegible]	[illegible]	5,048
Asphalt pavement	m^2	3.000	1,404	5,901	7,305
Gravel metalling	m^2	15.000	7,020	8,835	15,855
Total 7			60,932	17,620	78,552
8. Metal Works	L.S.		558,000	450,000	1,008,000
GRAND TOTAL			5,455,655	2,199,834	7,655,559

Table 1.3 Breakdown of Direct Construction Cost (4/4)
(Canals and Road)

Item	Unit	Q'ty	Cost (10³Rp.) FC	LC	Total
1. Main Canal System					
(1) Earth Works					
Excavation, common	m^3	698,000	442,532	23,732	446,264
Excavation, weathered rock	m^3	127,000	104,521	5,588	110,109
Earthfill with excavated material	m^3	496,000	296,112	16,864	312,976
Earthfill with borrowed material	m^3	103,000	261,929	20,909	282,838
Sod facing	m^2	529,000	-	634,800	634,800
Stripping of top soil	m^3	134,000	136,144	11,792	147,936
Disposal of soil	m^3	127,000	211,201	16,510	227,711
Asphalt pavement	m^2	138,500	64,818	272,430	337,248
Sub-total			1,517,257	1,002,625	2,519,882
(2) Related Structures					
Reinforced concrete	m^3	1,900	50,616	31,616	82,232
Wet stone masonry	m^3	26,800	336,072	395,568	731,640
Form	m^2	6,400	-	23,808	23,808
Reinforcement bar	ton	93	39,711	3,237	42,948
Base concrete	m^3	40	938	695	1,633
Backfill	m^3	76,000	4,560	45,600	50,160
Gate	ton	6	32,400	8,100	40,500
Sub-total			466,297	508,625	972,922
Total 1			1,981,554	1,511,250	3,492,804
2. Secondary Canal System					
(1) Earth Works					
Excavation, common	m^3	350,000	211,900	11,900	233,800
Earthfill with excavated material	m^3	315,000	188,055	10,710	198,765
Earthfill with borrowed material	m^3	610,000	1,551,230	123,830	1,675,060
Sod facing	m^2	1,025,000	-	1,230,000	1,230,000
Stripping of top soil	m^3	204,000	207,264	17,952	225,216
Asphalt pavement	m^2	210,700	98,608	414,447	513,055
Sub-total			2,267,057	1,808,839	4,075,896
(2) Related Structures					
Reinforced concrete	m^3	1,300	34,623	21,623	56,264
Wet stone masonry	m^3	15,800	198,132	233,208	431,340
Form	m^2	4,400	-	16,368	16,368
Reinforcement bar	ton	55	23,485	1,914	25,399
Base concrete	m^3	80	1,876	1,390	3,266
Backfill	m^3	39,400	2,364	23,640	26,004
Gate	ton	12	64,800	16,200	81,000
Sub-total			325,283	314,353	639,642
Total 2			2,592,346	2,123,192	4,715,538
3. Drainage System					
(1) Earth Works					
Excavation, common	m^3	1,026,000	864,918	49,248	914,166
Earthfill with excavated material	m^3	217,000	129,549	7,378	136,927
Stripping of top soil	m^3	58,000	58,928	5,104	64,032
Sub-total			1,053,395	61,730	1,115,125
(2) Related Structures					
Reinforced concrete	m^3	40	1,066	666	1,732
Wet stone masonry	m^3	580	7,273	8,561	15,834
Form	m^2	140	-	521	521
Reinforcement bar	ton	2	854	70	924
Gabion	m^3	12,600	-	208,870	208,870
Sub-total			9,193	218,688	227,881
Total 3			1,062,588	280,418	1,343,006
4. Road System					
(1) Earth Works					
Excavation, common	m^3	30,000	19,020	1,020	20,040
Earthfill with borrowed material	m^3	158,000	401,794	32,074	433,868
Sod facing	m^2	71,000	-	85,200	85,200
Stripping of top soil	m^3	29,000	29,464	2,552	32,016
Asphalt pavement	m^2	84,000	39,312	165,228	204,540
Sub-total			489,590	286,074	775,664
(2) Related Structures					
Wet stone masonry	m^3	130	1,630	1,919	3,549
Concrete pipe ø300	m	450	-	651	651
Sub-total			1,630	2,570	4,200
Total 4			491,220	288,644	779,864
GRAND TOTAL			6,127,708	4,203,504	10,331,212

Table 1.4 Breakdown of Direct Construction Cost of Tertiary System

Item	Unit	Q'ty	Cost (10^3Rp.)		
			FC	LC	Total
1. Earth Works					
Excavation, common	m^3	1,585,000	-	2,355,310	2,355,310
Earthfill	m^3	2,538,000	-	1,060,884	1,060,884
Total (1)			-	3,416,194	3,416,194
2. Related Structures					
Wet stone masonry	m^3	35,400	443,916	522,504	966,420
Wooden plate	m^3	600	-	92,391	92,391
Concrete pipe	m	760	-	8,244	8,244
Backfill	m^3	4,700	-	1,739	1,739
Total (2)			443,916	624,878	1,068,794
GRAND TOTAL			443,916	4,041,072	4,484,988

Table 1.5 Breakdown of Direct Construction Cost of Offices and Quarters

Unit: 10^3Rp.

Description	Unit	Q'ty	Amount (Local Currency)
1. Main Office	m^2	800	120,000
2. Branch Office	m^2	400	40,000
3. Repair Shop	m^2	400	28,000
4. Store House	m^2	500	35,000
5. Quarters	m^2	2,400	288,000
6. Motor Poor	m^2	10,000	70,000
7. Land Preparation for Office Yard Including Fencing, etc.	L.S.		59,000
TOTAL			640,000

Table 1.6 Breakdown of Land Acquisition Cost

Description	Unit	Q'ty	Amount (Local Currency) (10^3Rp.)
1. Bila Intake	ha	25	50,000
2. Kalola Dam	ha	400	800,000
3. Canals and Road			
(1) Main irrigation canal	ha	110	330,000
(2) Secondary irrigation canal	ha	250	750,000
(3) Major drain	ha	60	180,000
(4) Construction road	ha	30	90,000
(5) Miscellaneous	ha	50	150,000
4. Office and Quarters	ha	4	20,000
TOTAL			2,370,000

Table 1.7 Procurement Cost of Major Equipment for Operation and Maintenance

Item No.	Equipment	Unit Price (10^3Rp)	Required No.	Amount (10^3Rp)
1.	VEHICLE AND EQUIPMENT			
(1)	Dragline, 0.8 m^3	88,940	1	88,940
(2)	Backhoe, 0.6 m^3	64,870	2	129,740
(3)	Backhoe, 0.3 m^3	30,090	1	30,090
(4)	Bulldozer, 11 ton	48,150	2	96,300
(5)	Dozer shovel, 1.4 m^3	22,070	1	22,070
(6)	Wheel loader, 1.0 m^3	27,420	1	27,420
(7)	Motor grader, 11 ton	53,500	1	53,500
(8)	Water tanker, 5 m^3	29,420	1	29,420
(9)	Tire roller, 8 - 10 ton	23,400	1	23,400
(10)	Tamper, 80 kg	870	3	2,610
(11)	Soil compactor, 90 kg	800	3	2,400
(12)	Portable concrete mixer, 0.2 m^2	870	1	870
(13)	Concrete vibrator, ø 45	330	2	660
(14)	Submersible pump, ø150	1,070	2	2,140
(15)	Generator, 10 kw	330	1	330
(16)	Trailer truck, 30 ton	44,100	1	44,100
(17)	Dump truck, 11 ton	28,760	2	57,540
(18)	Dump truck, 2 ton	6,550	2	13,100
(19)	Cargo truck w/crane, 8 ton	28,800	1	28,800
(20)	Cargo truck w/crane, 2 ton	8,690	2	17,380
(21)	Truck, 1ton pick-up type	4,350	2	8,700
(22)	Jeep, four wheel drive	8,000	5	40,000
(23)	Sedan, 6 persons	8,700	1	8,700
(24)	Repair shop tools		L.S.	30,000
(25)	Spare parts (20% of the above)		L.S.	151,700
2.	TELECOMMUNICATION SYSTEM		1 set	233,600
	TOTAL			991,790

Table 1.8 Administration Expenses

(Unit: 10^3Rp.)

Year	Staff Salary	Labour Wage	Office Expenses	Equipment Running Cost	Other Related Cost	Total
1983	32,000	1,000	2,200	7,000	3,800	46,000
1984	44,000	3,400	3,300	11,000	6,300	68,000
1985	59,000	4,600	5,500	11,000	7,900	88,000
1986	69,000	6,500	5,500	11,000	9,000	101,000
1987	69,000	6,500	5,500	11,000	9,000	101,000
1988	69,000	6,500	5,500	11,000	9,000	101,000
1989	78,000	2,400	5,500	11,000	10,100	107,000
Total	420,000	30,900	33,000	73,000	55,100	612,000

Table 1.9 Cost Estimate of Engineering Service
(1981 Price Level)

Item	Q'ty	Amount (10^6Rp.) FC	LC	Total
1. Aerial Photo Mapping	350 km^2	278	0	278
2. Detailed Design				
(1) Remuneration	194 M/M /1	958	0	958
(2) Direct Cost	L.S.	94	50	144
(3) Equipment Cost	L.S.	45	0	45
(4) Other Related Cost	L.S.	124	59	183
Sub-total		1,221	109	1,330
3. Construction Stage				
(1) Remuneration	514 M/M /2	2,418	0	2,418
(2) Direct Cost	L.S.	220	116	336
(3) Equipment Cost	L.S.	104	0	104
(4) Other Related Cost	L.S.	288	135	423
Sub-total		3,030	251	3,281
Total		4,529	360	4,889

Remarks:

/1; Including 34 M/M of local consultants

/2; Including 114 M/M of local consultants

Table 1.10 Staff Numbers and Staff Salary of the Project Office

Year	Grade I		Grade II		Grade III		Grade IV		Grade V		Total
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(Rp.)
1983	1	2,160	2	2,880	4	4,560	10	8,400	20	13,200	31,200 (32,000)
1984	1	2,160	3	4,320	6	6,840	20	16,800	20	13,200	43,320 (44,000)
1985	1	2,160	4	5,760	8	9,120	26	21,840	30	19,800	58,680 (59,000)
1986	1	2,160	5	7,200	12	13,680	26	21,840	36	23,760	68,640 (69,000)
1987	1	2,160	5	7,200	12	13,680	26	21,840	36	23,760	68,640 (69,000)
1988	1	2,160	5	7,200	12	13,680	26	21,840	36	23,760	68,640 (69,000)
1989	1	2,160	5	7,200	10	11,400	28	23,520	51	33,660	77,940 (78,000)
1990	1	2,160	5	7,200	8	9,120	30	25,200	66	43,560	87,240 (88,000)

Remarks: (1): Number of required staff (person)

(2): Staff salary (10^3Rp.)

Annual salary for respective grades is based on the following,

Grade I ;	180,000	Rp./month,	Project Manager
Grade II ;	120,000	"	Division Chief
Grade III;	95,000	"	Engineer, Branch Office Chief
Grade IV ;	70,000	"	Assistant Engineer Assistant Officer
Grade V ;	55,000	"	Draftman, Typist Gate Keeper

Table 1.11 Assignment Schedule of Foreign Consultants

Design stage

Speciality	Man-Month			
	General	Irrigation Facilities	Kalola Dam	Bila Intake
Project Director	2			
Team Leader	18			
Sr. Irrigation Engineer		18		
Irrigation Design Engineer (1)		10		
" (2)		10		
Drainage Design Engineer		10		
Hydraulic Design Engineer		6		
Dam Engineer			13	4
Dam Structural Engineer			10	2
Hydrologist			4	2
Geologist			6	1
Soil Mechanical Engineer		3	3	
Construction Planner		3	2	1
Topographic Surveyor (1)		6		2
" (2)		6		
" (3)		4	2	
Specialist as required	6			
Liaison Engineer	6			
Total	32	76	40	12

Remark: Addition to the above, local consultants 34 M/M will be needed.

Construction stage

Speciality	Man-Month			
	General	Irrigation Facilities	Kalola Dam	Bila Intake
Project Director	3			
Team Leader (Sr. Construction Engineer)	76			
Irrigation Construction Engineer		68		
Irrigation Design Engineer		56		
Dam Construction Engineer			65	
Dam Design Engineer			45	6
Geologist		2	20	2
Soil Mechanical Engineer		4	24	
O & M Expert	4			
Specialist as required	12			
Home Support	12			
Total	107	130	155	8

Remark: Addition to the above, local consultants 114 M/M will be needed.

Table 1.12 Price of Local Materials and Labour Wages

(Unit: Rp.)

Item		Unit	Unit Price
1.	Materials		
(1)	Masonry stone (for structure)	m^3	6,000
(2)	Masonry stone (for lining)	m^3	5,000
(3)	Stone for gabion	m^3	5,000
(4)	Gravel	m^3	7,000
(5)	Sand for concrete	m^3	3,000
(6)	Sand for dump	m^3	2,500
(7)	Timber, board, 1st class	m^3	185,000
	2nd class	m^3	90,000
	3rd class	m^3	55,000
	beam, 1st class	m^3	170,000
	2nd class	m^3	85,000
	3rd class	m^3	50,000
(8)	Nail	kg	750
(9)	Asphalt	kg	400
2.	Fuel and Lubricant		
(1)	Gasoline	ℓ	150
(2)	Diesel oil	ℓ	52.5
3.	Labour Wages		
(1)	Labour	Man-day	750
(2)	Foreman	Man-day	1,000
(3)	Carpenter	Man-day	1,500
(4)	Head of Carpenter	Man-day	1,750
(5)	Stone-Worker	Man-day	1,500
(6)	Head of Stone-Worker	Man-day	1,750
(7)	Steel-Worker	Man-day	1,500
(8)	Head of Steel-Worker	Man-day	1,750
(9)	Painter	Man-day	1,500
(10)	Head of Painter	Man-day	1,750
(11)	Asphalt-Mix Worker	Man-day	1,500
(12)	Driver	Man-day	1,500
(13)	Operator	Man-day	2,000
(14)	Mechanical	Man-day	2,250
(15)	Head of Operator & Mechanical	Man-day	2,750

Table 1.13 List of Unit Rates of Works for Kalola Dam and Bila Intake Weir (1/3)

(Unit: Rp.)

Works	Unit	Foreign Currency	Local Currency	Total
1. Earthworks by Manpower				
(1) Excavation by Manpower				
(a) Normal	m^3	-	696	696
(b) Hard soil	m^3	-	927	927
(c) Soil incl. stone	m^3	-	1,392	1,392
(d) Mud soil	m^3	-	1,392	1,392
(e) Rocky soil	m^3	-	1,655	1,655
(2) Hauling by Manpower				
(a) Distance 30 m	m^3	-	304	304
(b) Distance 50 m	m^3	-	404	404
100 m	m^3	-	566	566
150 m	m^3	-	727	727
200 m	m^3	-	890	890
250 m	m^3	-	1,051	1,051
300 m	m^3	-	1,213	1,213
(3) Hauling by Trolly				
Distance L = 50 m	m^3	-	105	105
L = 100 m	m^3	-	118	118
L = 150 m	m^3	-	131	131
L = 200 m	m^3	-	145	145
L = 250 m	m^3	-	158	158
L = 300 m	m^3	-	171	171
L = 500 m	m^3	-	223	223
L = 1,000 m	m^3	-	353	353
(4) Gathering Aggregates at Site				
(a) Gravel	m^3	-	1,675	1,675
(b) Sand	m^3	-	1,256	1,256
(5) Rock Breaking				
(a) Pick-Hammer	m^3	3,888	1,354	5,242
(b) Blasting	m^3	2,216	3,339	5,555
(6) Filling & Pulling out of Root by Manpower	are	-	5,593	5,593
(7) Excluding Sundries, Stone from Soil	are	-	1,755	1,755
(8) Smoothing of Face excavated or filled up	m^2	-	420	420
(9) Filling up or Back Filling				
(a) Compacting by Manpower	1 m^3	-	370	370
(b) Compacting by Compactor	1 m^3	59	231	290
2. Earthworks by Machine				
(1) Excavation by 11 ton Bulldozer				
(a) Sand	m^3	407	25	432
(b) Normal	m^3	462	30	492
(c) Clay	m^3	553	36	589
(d) Gravel	m^3	553	36	589
(e) Blasted rock	m^3	791	51	842
(2) Excavation by 21 ton Bull-dozer				
(a) Sand	m^3	366	21	387
(b) Normal soil	m^3	425	25	450
(c) Clay	m^3	512	31	543
(d) Gravel	m^3	512	31	543
(e) Blasted rock	m^3	730	43	773

(to be continued)

Table 1.13 List of Unit Rates of Works for Kalola Dam and Bila Intake Weir (2/3)

Works		Unit	Foreign Currency	Local Currency	Total
(3)	Ripping by 21 ton Ripper-dozer				
	(a) Weathered rock	m^3	428	24	452
(4)	Excavation by 0.6 m^3 Back-hoe shovel				
	(a) Sand	m^3	487	26	513
	(b) Normal soil	m^3	525	27	552
	(c) Clay	m^3	651	32	683
	(d) Gravel	m^3	681	36	717
	(e) Blasted-rock	m^3	1,368	71	1,439
(5)	Excavation by 1.2 m^3 Back-hoe shovel				
	(a) Sand	m^3	539	18	557
	(b) Normal soil	m^3	582	19	601
	(c) Clay	m^3	687	23	710
	(d) Gravel	m^3	756	25	781
	(e) Blasted-rock	m^3	1,511	50	1,561
(6)	Excavation by 0.6 m^3 Power-shovel				
	(a) Blasted-rock	m^3	1,541	92	1,633
(7)	Excavation by 1.2 m^3 Power-shovel				
	(a) Blasted-rock	m^3	1,708	45	1,753
(8)	Loading by 1.2 m^3 Tractor-shovel				
	(a) Sand	m^3	547	30	577
	(b) Normal soil	m^3	547	30	577
	(c) Clay	m^3	547	30	577
	(d) Gravel	m^3	625	34	660
	(e) Blasted rock	m^3	625	34	660
(9)	Loading by 1.8 m^3 Tractor-shovel				
	(a) Sand	m^3	507	30	537
	(b) Normal soil	m^3	507	30	537
	(c) Clay	m^3	507	30	537
	(d) Gravel	m^3	579	33	612
	(e) Blasted rock	m^3	579	33	612
(10)	Hauling by 6 ton Dump-truck				
	(a) Sandy loam	m^3	0.267 x L + 562	0.027 x L + 58	0.294 x L + 620
	(b) Sand	m^3	0.284 x L + 598	0.030 x L + 62	0.314 x L + 660
	(c) Clay	m^3	0.301 x L + 632	0.031 x L + 66	0.332 x L + 698
	(d) Gravel	m^3	0.317 x L + 668	0.033 x L + 69	0.35 x L + 737
	(e) Blasted rock	m^3	0.418 x L + 879	0.043 x L + 91	0.461 x L + 970
(11)	Hauling by 11 ton Dump-truck				
	(a) Sandy loam	m^3	0.255 x L + 536	0.022 x L + 46	0.277 x L + 582
	(b) Sand	m^3	0.271 x L + 570	0.023 x L + 49	0.294 x L + 619
	(c) Clay	m^3	0.287 x L + 603	0.025 x L + 52	0.312 x L + 655
	(d) Gravel	m^3	0.303 x L + 636	0.026 x L + 54	0.329 x L + 690
	(e) Blasted rock	m^3	0.399 x L + 837	0.034 x L + 73	0.433 x L + 910
(12)	Spreading by Bull-dozer				
	(a) Using 11 ton Bull-dozer	m^3	318	20	338
	(b) Using 21 ton Bull-dozer	m^3	340	20	360
(13)	Compacting by 3t Double tamping				
	(a) Impervious zone	m^3	280	14	294

(to be continued)

Table 1.13 List of Unit Rates of Works for Kalola Dam and Bila Intake Weir (3/3)

Works	Unit	Foreign Currency	Local Currency	Total
(14) Compacting by 8-20t Tire-roller				
(a) Random zone	m^3	102	18	120
(15) Compacting by 6-7t Vibration roller				
(a) Rock zone	m^3	301	25	326
(16) Excavation 0.35 m^3 Back-hoe shovel				
(a) Sand	m^3	588	32	620
(b) Normal soil	m^3	634	34	668
(c) Clay	m^3	747	40	787
(d) Gravel	m^3	823	44	867
(e) Blasted-rock	m^3	1,638	88	1,726
(17) Excavation of tunnel	m^3	14,598	2,563	17,161
3. Concrete Works				
(1) Concrete mixed by hand				
(a) Reinforced	m^3	26,177	16,790	42,967
(b) Plain	m^3	24,607	16,956	41,563
(c) Base plain (1:2:4)	m^3	22,924	17,547	40,521
(2) Concrete mixed by mixer				
(a) Reinforced	m^3	26,638	16,637	43,275
(b) Plain	m^3	25,068	16,803	41,871
(c) Base plain	m^3	23,445	17,384	40,829
(3) Concrete for weir	m^3	35,239	12,213	47,452
(4) Mortar (1:4)	m^3	21,989	3,779	25,768
(5) Reinforcing bars	ton	427,012	34,795	461,807
(6) Form for concrete				
(a) for common structure	m^2	-	2,234	2,234
(b) for small structure	m^2	-	3,719	3,719
(c) for weir	m^2	4,835	2,803	7,638
(7) Wooden scaffolding	m^3	-	1,134	1,134
(8) Tunnel				
(a) Concrete lining	m^3	31,678	18,884	50,562
(b) Steel form	m^2	43,353	42,654	86,007
(9) Wet stone masonry				
(a) for lining	m^2	366	2,394	2,760
(b) for weir and structure	m^3	12,539	14,754	27,293
4. Grouting				
(1) Grout hole drilling ⌀ 45 mm/m	m	23,865	2,438	26,303
(2) Test hole drilling ⌀ 66 mm/m	m	33,089	5,005	38,094
(3) Grout hole drilling ⌀ 100 mm/m	m	23,394	7,798	31,191
(4) Grouting of cement	m	6,260	553	6,813
(5) Grouting of cement ⌀ 100 mm/m	m	12,062	637	12,699
5. Others				
(1) Gabion		-	16,318	16,318
(2) Sod facing		-	1,201	1,201

Table 1.14 List of Unit Prices of Major Work of Canal and Road

(Unit: Rp.)

Work Item	Unit	Foreign Currency	Local Currency	Total
1. Earth works				
Stripping of top soil	m^3	1,016	88	1,104
Excavation in canal, common	m^3	634	34	668
Excavation in drain, common	m^3	843	48	891
Excavation, weathered rock	m^3	823	44	867
Earthfill with excavated material	m^3	597	34	631
Earthfill with borrowed material	m^3	2,543	203	2,746
Disposal of soil	m^3	1,663	130	1,793
Sod facing	m^2	-	1,200	1,200
Asphalt pavement	m^2	468	1,967	2,435
2. Concrete works				
Reinforced concrete	m^3	26,640	16,640	43,280
Reinforcement bar	ton	427,000	34,800	461,800
Form for concrete	m^2	-	3,720	3,720
Plain concrete	m^3	23,450	17,380	40,830
Wet stone masonry	m^3	12,540	14,760	27,300
Sluice gate	ton	5,400,000	1,350,000	6,750,000
Concrete pipe Ø1000	m	-	10,848	10,848
Ø 300	m	-	1,447	1,447
Gabion	m^3	-	16,318	16,318
Backfill for structure	m^3	60	600	660

Table 2.1 Annual Operation and Maintenance Cost

Item	Amount	
	Total (10³Rp.)	Unit Cost (Rp./ha)
1. Salaries and Wages		
(1) Staff salaries	88,000	8,980
(2) Labour wages	2,400	244
2. Office Expenses	5,500	561
3. Operation Cost	11,000	1,122
4. Maintenance Cost (1.0% of direct cost)		
(1) Bila intake	26,640	2,718
(2) Kalola dam	76,550	7,811
(3) Canals and road	103,400	10,551
5. Miscellaneous L.S. (10% of the above)	31,350	3,199
Total	344,840 (= US$551,750)	35,186 (= US$/ha 56)

Table 3.1 Replacement Cost

Item	Useful Life (year)	Replacement Cost (10³Rp.)
1. O & M Equipment	10	991,790
2. Project Facilities		
(1) Bila intake, gate	25	47,620
(2) Kalola dam, gate	25	1,008,000
(3) Irrigation canals, gate	25	121,500

ANNEX - IX

FLOOD CONTROL PLAN

ANNEX-IX FLOOD CONTROL PLAN

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ANNEX-IX FLOOD CONTROL PLAN

1. GENERAL

This report entitled ANNEX-IX "FLOOD CONTROL PLAN" presents the results of the pre-feasibility study on the flood control plan of the Bila, Boya, Kalola and Lancirang rivers.

The study was mainly carried out from the following aspects:

(1) distribution of the design flood discharges of the main stream and other flood control facilities including the study of a floodway

(2) establishment of the general features of a prospective flood control plan

2. PRESENT CONDITIONS OF RIVERS

2.1 River System

The Bila river originates in Mt. Tallu (El. 3018 m) and runs southward passing through the extensive fertile cultivated land via Tenru Tedong. It finally pours into Lake Tempe, gathering water from such tributaries as the Boya, Kalola and Lancirang rivers. The river system is shown in Fig. 1.1 of ANNEX I and Fig. 2.1.

The river length and catchment area of the Bila river and its tributaries are shown below:

Name of River	Catchment Area (km2)	River Length (km)
Bila River	485	80
Kalola River	167	50
Boya River	536	90
Lancirang River	180	50
Total	1,368	-

2.2 Topography

The downstream area of the Bila river is an alluvial zone formed by sediment from the Bila and other rivers. The elevation of the Bila river basin ranges from 8 m near Lake Tempe to 30 m near the Bila gaging station which is located at the upper end of the alluvial plain. The alluvial plain area has a flat topography sloping from north to south with gradients ranging from 1/1,000 at the upper basin to 1/3,500 near Lake Tempe and Lake Buaya.

2.3 Carrying Capacity of the Existing River Channels

In order to estimate the carrying capacity of the river channel, cross sections were surveyed by the Team in the stretches shown in Fig. 2.2 during the period from August to October, 1981.

For calculation of the carrying capacity, coefficients of roughness were adopted at the following values:

Name of River	Stretch	Manning's n
Bila River	Downstream of conf. of Boya	0.025
	Conf. of Boya to Bila AWLR	0.030
Boya River		0.030
Kalola River		0.030
Lancirang River		0.030

Applying uniform flow calculation method, bankful carrying capacity of river channels was estimated as shown in Table 2.1 and Fig. 2.2.

2.4 Floods in the Past

According to the results of hydrological data described in ANNEX I "METEOROLOGY AND HYDROLOGY", the discharges of more than 500 m3/sec at Tanru Tedong were estimated as shown in Table 2.2.

3. DESIGN CRITERIA

3.1 Design Discharge

3.1.1 Scale of design discharge

(1) Bila and Boya rivers

The flood control plan is executed with two scales of the design discharges. One is adopted at the design discharge of 20-year return period for a future stage plan and another is adopted at the discharge of 5-year return period for a first stage plan.

The design discharge of 20-year return period was proposed in the Master Plan Study for the following reasons.

(a) The optimum B/C ratio was found to be that for a 20-year return period under the conditions of the proposed irrigation projects in the Bila and Boya areas;

Discount Rate	Return Period of Discharge		
	10-year	20-year	50-year
8 %	1.31	1.32	1.21
10 %	1.06	1.07	0.98
12 %	0.89	0.89	0.82

(b) A scale of 20 to 50-year return period is actually applied to the flood control project in Indonesia as shown in Table 3.1.

On the other hand, the design discharge of 5-year return period was proposed for the following reasons.

(a) In respect to implementation of flood control project, the Indonesian Government recently adopted at a two phase system in some rivers in Java Island such as the Solo, Madiun and Brantas rivers. For the first-phase the design discharge of 10-year return period was adopted.

(b) The economic importance in the objective area of the Study seems to be behind that of river basins in Java Island.

(2) Kalola and Lancirang rivers

With regard to the tributaries, a scale of 5-year return period was adopted for the following reasons.

(a) The inundation area caused by the tributaries is locally limited.

(b) No tributaries flow through the towns such as Tanru Tedong.

3.1.2 Probable flood discharge

The probable flood discharges are estimated by the hydrological study described in ANNEX-I "METEOROLOGY AND HYDROLOGY". The outline is described as follows.

The equation is given by the correlation between specific discharge and catchment area.

$$q = K A^c$$

where, q : Specific discharge in m3/sec/km2
A : Catchment area in km2
K, c : Constant

In the Bila river basin, there is data available for estimating discharge recorded at the Bila water level station. Annual maximum discharge at the station is obtained as follows:

Year	Month	Date	Water Level (m)	Discharge (m3/sec)	Data Collection
1974	Sep.	12	3.98	680	Master Plan
1975	Jul.	28	4.07	705	- do -
1976	Mar.	13	2.95	430	- do -
1977	Jun.	18	3.14	505	- do -
1978	May	14	4.10	750	- do -
1979	Sep.	11	3.48	590	the study
1980	May	4	2.81	430	- do -
1981	May	15	3.38	565	- do -

Using these data, the discharges corresponding to the return period of 2-year, 5-year and 10-year were estimated as follows:

Return Period	Peak Discharge (m3/sec)		Specific Discharge (m3/sec/km2)	
	M/S	F/S	M/S	F/S
2-year	580	570	1.53	1.50
5-year	700	710	1.85	1.87
10-year	790	800	2.08	2.11

These values estimated in the study are almost the same as the values in the Master Plan Study. Accordingly, the same values of K and c are applied to the study. The discharge formulae for each return period are as follows:

Return Period	Discharge Formula
2-year	$q = 21.744\ A^{-0.451}$
5-year	$q = 26.214\ A^{-0.444}$
10-year	$q = 33.176\ A^{-0.462}$
20-year	$q = 41.308\ A^{-0.474}$
50-year	$q = 53.634\ A^{-0.495}$

Remark: q : Specific discharge in m3/sec/km2
A : Catchment area in km2

The probable flood discharges are calculated as shown in Table 3.2.

3.2 Design Criteria for River Channel

3.2.1 Survey results for design

In planning the improvement of the river channel the following data are used:

- The topographical maps on a scale of 1/25,000 provided by the JICA are used for planning the alignment of levees.
- In designing cross sections of river channel, 66 cross sections which have been surveyed by the Team are used.
- The results of soil survey are used for the design of river channel and the construction plan.

3.2.2 Manning's coefficient of roughness

Manning's coefficient of roughness for the Bila river and its tributaries are adopted at following values:

Name of River	Stretch	Coefficient of roughness Low-water channel	Coefficient of roughness High-water channel
Bila River	Downstream from the confluence of Boya river	0.025	0.040
Bila River	Upstream from the confluence of Boya river	0.030	0.045
Boya River	Whole stretch	0.030	0.045
Kalola River	Whole stretch	0.030	-
Lancirang River	Whole stretch	0.030	-
Floodway		0.030	-

3.2.3 Alignment of river channel

In planning the alignment of levees, the following items will be considered.

(1) On the route of the improved river channel, the alignment of levees is planned along the existing river channel, taking maintenance after the improvement works into consideration.

(2) On the plan for floodway, the alignment of levees is planned taking the irrigation and drainage system into consideration.

3.2.4 Longitudinal profile

The longitudinal profile of river channel is planned in consideration of the following items.

(1) The slope of the river bed is planned to make a gradual change from steep one to gentle one in the descending course so as to balance with the tractive force to protect the river channel from the occurrences of scour and deposition.

(2) The design bed height is planned in relation to the design bed slope and design cross-sectional form, taking into account the usage for ship transportation and fishing.

(3) In the backwater section affected by the lake, the height of levee is planned taking the following water levels into consideration.

(a)	Maximum water level of Lake Tempe	: EL 9.6 m
(b)	Mean water level of Lake Tempe	: EL 5.6 m
(c)	Lowest water level of Lake Tempe	: EL 3.2 m

(4) The design high water level is planned in relation to the design discharge and the cross sectional form and longitudinal sectional form of the river channel. The water level is estimated by means of uniform flow and/or non-uniform flow calculation.

3.2.5 Cross sectional form

The cross sectional form is planned in consideration of the following items.

(1) The design cross sectional form of the Bila and Boya rivers is planned to be a compound cross-section.

(2) The river width of the Bila and Boya rivers is planned to provide the necessary width in a scale of the discharge of 20-year return period.

(3) A scale of the low water channel for a 20-year return period is planned to have the carrying capacity to three times of flooding per year.

(4) The slope gradient of low water channel is adopted at 1 : 2.

3.2.6 Levee

The crown width and the freeboard of levees are adopted at the following values:

Design Discharge (m3/sec)	Freeboard (m)	Crown Width (m)
200 to less than 500	0.8	4
500 to less than 2,000	1.0	4

The slope gradient of levee is adopted at 1 : 2. The critical height of levees is 5 meters in accordance with the soil mechanical study.

3.2.7 Stability of embankment

On the proposed routes of embankment of levees along the existing river channel and the proposed floodway, the critical height of embankment is studied applying Taylor's method in case of frictionless material.

The factor of safety of the slope of embankment is estimated by the following equation.

$$FS = No. \frac{C}{rt.H}$$

where,
- FS : Factor of Safety
- No. : Stability Factor
- C : Cohesion in t/m2
- rt : Wet density of soil in t/m3, and
- H : Height of embankment in m.

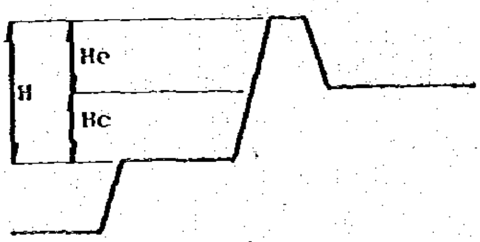
The values for the calculation are estimated on the basis of results of the soil investigation on typical samples of foundation soil and borrow pits. The values of C and rt are estimated at 2.5 t/m2 and 1.85 t/m3, respectively and it is assumed that firm soil is located at a depth of 15 m below the original ground surface.

The slope of embankment is adopted at 1 : 2 and also a cut is to be excavated in soft clay to depths of 1, 2, 3 and 4 m.

Assuming the factor of safety at 1.5, the critical height of embankment is estimated as follows:

(Unit: m)

Critical height		
He	Hc	H
1	4	5
2	3	5
3	2	5
4	1	5



4. FLOOD CONTROL PLAN

4.1 General

The southern part of the Bila area as well as the Boya area, which extends over both sides of the Bila river are presently affected by flooding in the rainy season.

In the Master Plan, two (2) comparative plans are studied for the improvement of mainstream of the Bila river. One is the improvement of the existing river channel and the other is the plan of the floodway passing through the center of the Bila area to minimize the improvement of the existing river channel. The master plan recommended the floodway plan because the construction cost of the floodway was slightly behind that of the improvement of the existing channel.

In this study, the flood control plan is carefully reviewed using newly obtained data.

4.2 Study on Route Selection of River Channel

4.2.1 Route of river channel

In planning the improvement route, the following four routes are selected.

(1) Plan 1 : Improvement of the existing river channel

(2) Plan 2 : Improvement of the existing river channel with shift of the Kalola river toward downstream of Tanru Tedong

(3) Plan 3 : Construction of floodway along the route proposed in the Master Plan Study

(4) Plan 4 : Construction of floodway along the Ate drainage canal

These routes are shown in Fig. 4.1 to 4.4. The design discharges for each plan are adopted at two scales of discharge for 20-year and 5-year return periods. The design discharge distributions for each plan are shown in Fig. 4.5.

4.2.2 Extent of river channel for improvement

The extent of channel improvement for each plan is as follows:

(Unit: km)

Plan	Name of River	Section	Length
Plan 1	Bila river	Near bifurcation to near confluence of Boya	17.9
	Kalola river	Confluence of Bila to spillway	4.5
Plan 2	Bila river	Near bifurcation to near confluence of Boya	17.9
	Kalola river	Confluence of Bila to spillway	4.1
Plan 3	Bila river	Near bifurcation to near confluence of Boya	17.9
	Kalola river	Floodway to spillway	4.4
	Floodway	Lake Buaya to bifurcation of Bila	8.0
Plan 4	Bila river	Near bifurcation to near confluence of Boya	17.9
	Kalola river	Confluence of Bila to spillway	4.1
	Floodway	Lake Buaya to bifurcation of Bila	10.0

4.2.3 Comparison of plans

The design longitudinal profiles and the dimensions of cross-sections for each plan are shown in Fig. 4.6, 4.7 and 4.8 and Table 4.1, respectively.

The construction costs of river improvement works for each plan are estimated for selecting the best improvement route. The components of construction costs are composed of those for the land acquisition and civil works. The construction costs for each plan are estimated as shown in Table 4.2 and 4.3.

Comparing the construction costs for each plan, Plan 2 (Improvement of the existing river channel with shifting the Kalola river toward downstream of Tanru Tedong) is recommendable from the following points of view.

(1) Comparing the construction costs of Plan 1 with Plan 2, Plan 2 is economically profitable.

(2) Although the construction cost of Plan 2 is almost the same as other plans, Plan 3 and Plan 4 will increase the construction costs to establish agricultural facilities across the floodway in case that the Bila Irrigation Project will be ahead of the Flood Control Project.

4.3 Proposed Flood Control Plan

4.3.1 General principles in planning

In this study, planning for improvement is made in the whole stretches including the Bila, Boya, Kalola and Lancirang rivers. The channel improvement route is adopted at Plan 2.

General principles to be taken in planning of river channel improvement are as follows.

(1) The design discharge for the improving route of Plan 2 was adopted at two (2) kinds of discharge with scales of 5-year return period and 20-year return period.

(2) The river width for 5-year return period will be set at the same as that for a 20-year return period.

(3) Necessary carrying capacity will be secured by excavation and/or dredging works together with building new levees.

(4) In the improvement plan for a 20-year return period, carrying capacity of the low water channel is adopted at 600 m3/sec in the stretch of the Bila river from the bifurcation to the confluence of the Boya. This discharge of 600 m3/sec is evaluated at three times as big as flooding per year.

4.3.2 Design longitudinal profile and cross-section

The extent of river channel improvement is shown below:

(Unit: km)

Name of River	Section	Length
Bila river	Near bifurcation to about 2 km upstream from confluence of Boya river	20
Boya river	Confluence of Bila to hilly districts	7
Kalola river	Confluence of Bila to hilly districts	10
Lancirang river	Confluence of Bila to Desa Ajubissue	8
Total		45

The design high water level and the dimensions of design cross section are adopted as shown in Table 4.4 and Table 4.5 respectively. The design longitudinal profiles for each river are shown in Fig. 4.9 and 4.10 and some typical cross-sections are shown in Fig. 4.11 and 4.12.

4.3.3 Work quantity

(1) Work quantity for whole stretches

The main works for the whole stretches are summarized below:

Item	Unit	Q'ty	
		20-year	5-year
1. Land Acquition and Compensation			
(1) Paddy field	ha	49	49
(2) Cultivable	ha	18	18
(3) Un-cultivable	ha	765	765
(4) Residential	ha	44	44
(5) House	Nos.	599	599
2. Dredging	10^3 m^3	20	20
3. Excavation	10^3 m^3	12,340	8,510
4. Embankment	10^3 m^3	1,910	1,910
5. Surplus soil	10^3 m^3	10,430	6,600
6. Revetment	m	6,000	6,000
7. Outlet	Nos.	3	3
8. Bridge	Nos.	6	6

(2) Work quantity for Kalola river

The Kalola river is only a river which flows entirely through the Project area among the Bila and its tributaries. In case that the Kalola river is planned to be improved, the downstream area in the Project will be prevented from floods. The discharge of the Bila downstream from the confluence of the Kalola, however, will increase as compared with that in the present condition. Since the water level will be caused to rise by the increased discharge, the excavation works for the Bila river will be needed to keep the water level as it is.

The work quantities of the Kalola river including the excavation work of the Bila area are summarized as follows:

Item	Unit	Q'ty
1. Land Acquisition and Compensation		
(1) Paddy field	ha	17
(2) Cultivable	ha	2
(3) Un-cultivable	ha	58

to be continued

Item	Unit	Q'ty
(4) Residential	ha	1
(5) House	Nos.	31
2. Excavation	10^3 m^3	1,720
3. Embankment	10^3 m^3	300
4. Surplus soil	10^3 m^3	1,420
5. Outlet	Nos.	1
6. Bridge	Nos.	3

4.3.4 Construction plan

(1) Period of construction works and execution system

The period of construction is adopted at 5-year plan including the period of detailed design.

The execution system is applied to full-contracting system.

(2) Preparatory works

Preparatory works comprise construction and maintenance of temporary access roads, offices, stores, workshops, quarters and labour camps, and topographic survey.

(3) Construction work

Dredging works will be executed using amphibious dredgers. Dredging materials will be used for filling up the low place near the working site.

Excavation will be executed by use of swamp bulldozers and backhoes. Excavated soil will be transported to embankment sites or spoil bank by use of swamp bulldozers or backhoes and dump trucks.

Embankment of levees will be made by use of the materials hauled from excavation sites nearby. Compacting and forming of embankment will be made by use of bulldozers, tamping rollers and manpowers.

Surplus soil after supplying to embankment will be heaped up near the embankment sites by use of bulldozers.

4.3.5 Cost estimate

(1) Unit price

The estimated unit costs used here are mentioned in ANNEX-VIII COST ESTIMATE. The unit prices for each work item are summarized as follows:

(Unit: Rp)

No.	Work Item	Unit	L.C.	F.C.	Total
1.	Dredging	m3	900	1,850	2,750
2.	Excavation	m3	75	1,025	1,100
3.	Embankment	m3	996	504	1,500
4.	Surplus soil	m3	17	268	285
5.	Revetment	m	25,000	-	25,000
6.	Outlet	Nos.	38,000,000	11,300,000	50,000,000
7.	Bridge A /1	m	800,000	1,200,000	2,000,000
	Bridge B /2	m	300,000	200,000	500,000

Remark:
/1: Bridge A: for provincial road
/2: Bridge B: for village road

(2) Cost estimate

(a) Cost estimate for the whole stretches

The cost for the whole stretches is estimated as shown in Table 4.6 and 4.7 and summarized as follows:

(Unit: 10^6 Rp)

Item	20-year			5-year		
	L.C.	F.C.	Total	L.C.	F.C.	Total
1. Land Acquisition and Compensation	2,290	-	2,290	2,290	-	2,290
2. Civil Works	3,843	18,017	21,860	3,471	12,759	16,230
(1) Preparatory	129	601	730	120	440	560
(2) Dredging	18	37	55	18	37	55
(3) Excavation	926	12,648	13,574	638	8,723	9,361
(4) Embankment	1,902	963	2,865	1,902	963	2,865
(5) Surplus soil	178	2,795	2,973	113	1,768	1,881
(6) Revetment	150	-	150	150	-	150
(7) Outlet	116	34	150	116	34	150
(8) Bridge	317	439	756	317	439	756
(9) Miscellaneous	107	500	607	97	355	452
3. Overhead & Others	950	2,220	3,170	700	1,640	2,340
4. Contingency	1,067	3,013	4,080	989	2,151	3,140
5. Engineering and Administration	1,050	2,450	3,500	1,050	2,450	3,500
Total	9,200	25,700	34,900	8,500	19,000	27,500

(b) Cost estimate for the Kalola river

The cost for the Kalola river is estimated as shown in Table 4.8 and summarized as follows:

(Unit: 10^6 Rp)

Item	5-year		
	L.C.	F.C.	Total
1. Land Acquisition	200	-	200
2. Civil Works	630	2,570	3,200
(1) Preparatory	22	88	110
(2) Dredging	-	-	-
(3) Excavation	129	1,763	1,892
(4) Embankment	299	151	450
(5) Surplus soil	25	380	405
(6) Revetment	-	-	-
(7) Outlet	39	11	50
(8) Bridge	101	115	216
(9) Miscellaneous	15	62	77
3. Overhead & Others	140	320	460
4. Contingency	140	430	570
5. Engineering and Administration	150	340	490
Total	1,260	3,660	4,920

4.3.6 Economic evaluation

(1) Flood damage

(a) Flood damage survey

In order to estimate flood control benefits, the field investigation by means of interview was carried out over the inundation area caused by the Bila river and its tributaries.

Surveyed items for this field investigation are as follows:

(i) Occurrence date of past floods.

(ii) Water depth, duration and direction of flow in the past floods.

(iii) Annual frequency and duration of inundation.

(iv) Ground height from the paddy field.

Sites of the field investigation are as follows:

Province (Propinsi)	District (Kabupaten)	Sub-district (Kecamatan)	Village (Desa)	Surveyed Number
Sulawesi Selatan	Sidrap	Dua Pitue	Tanru Tedong	20
			Bila	10
			Lancirang	10
			Otting	1
	Wajo	Belawa	Belawa	8
			Wele	14
		Tanasitolo	Lowa	2
		Maniang Pajo	Anabanua	2
			Kalola	2
Total				69

Considering the topography, inundation depth and inundation period in affected areas by flood in each river, and the inundation area is divided into twenty-two (22) blocks in the whole area caused by the Bila and its tributaries. The delineation of inundation area is shown in Fig. 5.8 of ANNEX I.

(b) Flood damage to paddy and others

Flood damages consist of those to agricultural crops, houses, house-hold effects, public utility facilities, etc.

According to the flood damage report at Kantor Kepala Desa Tanru Tedong-Kecamatan Dua Pitue and Kantor Kepala Desa Wele-Kecamatan Belawa, the proportions of the paddy to others in the total flood damages are estimated as shown in Table 4.9 and 4.10, and these results are summarized as follows:

(Unit: %)

Item	Year	Percentage of damage	
		Paddy	Others
Tanru Tedong	1978	71	29
Wele	1980	68	32

In the inundation area, almost all the areas are of paddy field and the houses are built with the high floor type. The other flood damages except paddy, therefore, account only about 30% in the total damages.

Amount of total flood damages will be estimated on the assumption that the proportion of paddy to others is 70% to 30%.

(c) Estimation of damage to paddy

In estimating flood damage to paddy, the unit price of paddy is adopted at Rp. 200 per kg, and the following yield of paddy are applied:

(i) 2.97 ton/ha under present condition

(ii) 5.0 ton/ha under proposed condition

The flood damage to paddy are estimated by use of the following data as described in ANNEX-I METEOROLOGY AND HYDROLOGY.

(i) Probable flood inundation depth and duration.

(ii) Estimated flood inundation depth and duration for each flood during a period from 1974 to 1981.

(iii) Rate of damage to paddy due to submergence prepared by the Ministry of Agriculture and Forestry, Japan.

Stage	Days after Transplanting (day)	Plant Height (cm)	Remarks
Tillering	0 to 40	0 to 59	May & Nov.
Booting	41 to 60	60 to 76	Jun. & Dec.
Heading	61 to 75	77 to 79	Jul. & Jan.
Ripening	75 to 90	80 to 100	Aug. & Feb.

The rate of damage for each stage is shown in Fig. 4.13.

Using data mentioned above, the flood damage for each year are estimated in percentage and amount as shown in Table 4.11 to 4.16 respectively.

(d) Average annual decrease in flood damages

The probable flood damages are estimated as shown in Fig. 4.14, 4.15 and Table 4.17 and 4.18. The average annual decrease in flood damages are estimated as shown in Table 4.19 to 4.22. These results are summarized as follows:

(Unit: 10^6 Rp.)

Flood discharge level	Amount of average annual decrease in damages			
	Whole area		Kalola area	
	Present condition	Irrigated condition	Present condition	Irrigated condition
1/2	640	1,590	120	230
1/5	1,280	3,380	240	490
1/10	1,540	4,160	290	610
1/20	1,680	4,610	320	680
1/50	1,770	4,910	340	730

4.3.7 Cost-benefit Analysis

(1) Benefit

Benefit that will arise from the flood control is represented as effect of decrease in damages to be caused by floods. This benefit will be estimated as the average annual decrease of damages. This benefit will accrue every year throughout the project life of 50 years after the completion of construction. The partial benefits arised during the construction period are estimated assuming that they may be given in a ratio of the invested construction cost to the total construction cost.

(2) Economic cost

The economic cost is given by deducting transfer costs such as sales tax, income tax, duty, subsidy, etc. from the construction costs in local portion (Labour: 7%, Material: 5%), and the annual operation and maintenance costs. The OM costs of flood control are estimated at 0.5% of civil works throughout the project life after the completion of construction.

(3) Comparison of cost and benefit

The cost-benefit analysis is made for each of a 5-year and a 20-year river channel improvement works in the whole stretches, and Kalola river improvement works. These results are summarized as follows:

(a) Under present condition

(Unit: 10^6 Rp.)

River improvement plan	2 %		4 %		6 %	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
20-year river channel	34,580	47,030	31,400	30,590	28,870	21,230
5-year river channel	27,010	35,830	24,570	23,310	22,620	16,170
Kalola river	4,990	7,000	4,500	4,550	4,120	3,160

(b) Under irrigated condition

(Unit: 10^6 Rp.)

River improvement plan	10 %		12 %		14 %	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
20-year river channel	24,920	32,230	23,290	25,410	21,840	20,550
5-year river channel	19,550	23,550	18,280	18,570	17,140	15,020
Kalola river	3,530	3,450	3,300	2,720	3,090	2,200

(4) Benefit-Cost Analyses

(a) Under present condition

(Unit: 10^6 Rp.)

River improvement plan	IRR	B/C			B-C		
	(%)	2 %	4 %	6 %	2 %	4 %	6 %
20-year river channel	3.8	1.36	0.97	0.74	12,450	-810	-7,640
5-year river channel	3.7	1.33	0.95	0.72	8,820	1,260	-6,450
Kalola river	4.2	1.40	1.01	0.77	2,010	50	-960

(b) Under irrigated condition

(Unit: 10^6 Rp.)

River improvement plan	IRR	B/C			B-C		
	(%)	10 %	12 %	14 %	10 %	12 %	14 %
20-year river channel	13.1	1.29	1.09	0.94	7,310	2,120	-1,290
5-year river channel	12.2	1.21	1.02	0.88	4,000	290	-2,120
Kalola river	9.9	0.98	0.82	0.71	-80	-580	-890

5. CONCLUSION

The comparative study on the alternative flood control measures has been made on the basis of preliminary designs and cost estimates of the alternatives, and it is concluded that the following river improvement plans are most applicable to the Bila - Boya area:

(Unit: km)

Name of river	Section	Length
Bila river	Near bifurcation to about 2 km upstream from confluence of Boya river	20
Boya river	Confluence of Bila to hilly districts	7
Kalola river	Confluence of Bila to hilly districts	10
Lancirang river	Confluence of Bila to Desa Ajubissue	8
Total	(Whole stretches)	45

The construction costs of plans for 20-year and 5-year return periods were estimated as follows:

(Unit: 10^6 Rp.)

Scale of River channel	Bila river	Boya river	Kalola river	Lancirang river	Total
20 - year	24,940	3,960	3,630	2,370	34,900
5 - year	19,040	2,460	3,630	2,370	29,500

These river improvement plans are not economically feasible under present situation of low agricultual production in the area. The selected plans are, therefore, not incorporated in the Bila irrigation project. After completion of irrigation projects in the Bila-Boya area, however, the agricultural production would increase and the economic values to be protected by the flood control measures would become large. Under such a future situation, these river improvement plans would become economically justifiable as the Master Plan Team concluded.

Table 2.1 Carrying Capacity of Existing River Channel

Section No.		Distance: Between two sections (m)	Distance: Accumulative (m)	Lowest river bed (EL.m)	El. of Bank: Left (EL.m)	El. of Bank: Right (EL.m)	Carrying capacity: Left (m³/sec)	Carrying capacity: Right (m³/sec)
BL -	6.0	500	-5,900	5.61	8.6	8.9	141	168
BL -	5.7	1,400	-5,400	4.86	8.9	9.1	171	188
BL -	4.0	2,000	-4,000	5.06	9.4	9.4	158	158
BL -	2.0	1,800	-2,000	6.07	10.7	10.6	218	208
BL -	0.2	200	- 200	6.27	11.6	11.7	193	203
BR -	5.4	2,000	-5,400	4.48	9.3	9.4	123	129
BR -	3.4	3,100	-3,400	5.35	10.1	10.3	161	174
BR -	0.3	300	- 300	6.34	11.6	11.9	334	378
BI	0.0	0	0	3.98	11.9	11.9	498	498
BI	1.2	1,200	1,200	5.40	12.4	12.4	486	486
BI	2.3	1,100	2,300	7.25	11.8	11.9	450	467
BI	3.6	1,250	3,550	7.20	13.3	13.3	604	604
BI	4.8	1,250	4,800	6.74	13.9	13.5	693	616
BI	5.8	1,000	5,800	7.26	14.0	14.1	681	702
BI	6.8	1,000	6,800	7.54	13.8	15.2	606	910
BI	9.4	2,550	9,350	8.60	14.9	14.8	592	575
BI	10.1	750	10,100	8.71	15.3	15.2	741	720
BI	11.7	1,750	11,850	9.06	15.7	16.2	668	778
BI	13.4	1,500	13,350	8.66	16.5	16.5	1,096	1,096
BI	15.4	2,100	15,450	9.98	17.6	17.7	653	674
BI	16.4	1,000	16,450	9.35	17.7	18.1	1,080	1,210
BI	17.6	1,100	17,550	11.07	18.4	18.4	1,151	1,151
BI	17.7	150	17,700	11.02	19.8	19.8	1,611	1,611
BI	19.0	1,250	18,950	12.37	20.0	20.2	1,129	1,196
BI	20.0	800	19,750	13.53	21.0	20.9	1,143	1,120
BI	21.4	1,600	21,350	15.29	22.4	20.3	5,380	2,178
BI	23.4	2,000	23,350	16.05	23.9	20.2	3,300	622
BI	24.9	1,500	24,850	17.41	23.6	22.0	2,833	1,191
BI	26.5	1,650	26,500	19.93	25.5	27.2	1,052	3,390
Boya								
BO	0.0	0	0	11.77	17.6	18.8	571	830
BO	1.1	1,100	1,100	12.02	18.4	19.1	654	829
BO	2.1	1,000	2,100	12.02	19.6	19.6	844	844
BO	3.9	1,800	3,900	13.43	20.0	19.8	726	685
BO	6.0	2,100	6,000	14.49	21.2	21.2	814	814
BO	7.0	1,000	7,000	14.44	22.9	23.2	898	1,012
Kalola								
(Northern course)								
KA	0.0	0	0	11.19	18.9	18.9	244	244
KA	1.7	1,700	1,700	11.46	17.8	17.6	204	192
KA	2.9	1,200	2,900	11.84	17.9	18.0	66	69
KA	4.40	1,500	4,400	15.86	20.0	20.0	62	62
KA	4.41	2	4,402	18.37	20.4	20.7	18	23
KA	4.5	98	4,500	14.37	20.2	21.0	189	259
KA	6.1	1,600	6,100	15.14	21.0	20.2	237	165
KA	7.0	900	7,000	17.07	21.7	21.7	182	182
KA	8.3	1,300	8,300	16.04	22.4	21.9	196	146
KA	9.0	700	9,000	16.86	23.0	23.2	227	248
KA	9.9	900	9,900	17.41	23.6	23.4	220	201
(Southern course)								
KA	1.7	1,700	1,700	11.46	17.8	17.6	204	192
KAL	3.10	1,400	3,100	14.50	18.2	18.2	87	87
KAL	3.11	2	3,102	15.53	17.5	17.5	18	18
KAL	4.50	1,398	4,500	15.40	18.8	19.1	25	19
KAL	4.51	10	4,510	14.68	19.4	19.3	147	140
KAL	5.3	795	5,300	14.98	20.8	20.6	165	152
KA	4.5	150	5,450	14.37	20.2	21.0	189	259
Lancirang								
LA	0.0	0	0	7.90	13.8	13.4	164	145
LA	3.5	3,500	3,500	11.1	15.0	15.0	57	57

Table 2.2 List of Past Floods

Year	Month	Date	Tanru Tedong W.L (m)	Tanru Tedong Qmax (m^3/sec)	Bila W.L (m)	Bila Qmax (m^3/sec)
1974	Jul.	15		629		
	Sep.	12-17	7.06	924*	3.98	680*
	Oct.	16-17		710		
	Nov.	10		541		
	Dec.	25		659		
1975	Jun.	19		678		
	Jul.	28-30		831*	4.07	705*
	Aug.	12-14		804		
	Aug.	31		732		
	Oct.	8		531		
1976	Mar.	4- 5		767		
	Mar.	13		-	2.95	430*
	May	4- 6	6.88	878*		
	May	27		508		
	Jun.	12		576		
1977	Apr.	2		627		
	Apr.	17		647		
	Jun.	14-15		657		
	Jun.	18-20	6.00	672*	3.14	505*
	Aug.	13		524		
	Dec.	14-15		577		
1978	Mar.	30		503		
	Apr.	28-30	6.82	863*	3.76	660
	May	1- 2		814	3.04	485
	May	14		-	4.10	750*
	Jun.	26		772	2.44	345
	Jul.	17		612	2.96	465
	Jul.	23-24		810	2.94	460
	Aug.	8		553	2.50	360
1979	Jun.	9-10	6.86	873	3.36	555
	Jun.	19-20	5.79	627	2.50	360
	Sep.	11	6.93	891*	3.48	590*
1980	May	4- 5	-	-	2.81	430*
	May	27	-	-	2.55	370
1981	Mar.	27-29	6.15	705	2.17	285
	Apr.	1- 2	5.26	520	2.10	270
	May	5	5.26	520	1.74	195
	May	11-12	5.66	600	1.87	220
	May	14-18	6.96	898*	3.38	565*
	Jul.	15-17	5.50	567	2.05	260
	Jul.	19	5.56	579	1.56	160
	Jul.	22-26	6.34	748	2.74	410

Remark : * ; Annual maximum
- ; No data
Peak discharge more than 500 m^3/sec at Tanru Tedong were selected.

Table 3.1 Design Flood Discharge of the Rivers in Indonesia

No.	Name of River	Province	Catchment Area (km^2)	Design Flood (m^3/s)	Return Period (yr)	Remarks
1.	Sungai Cimanuk	West Jawa	3,006	1,440	25	
2.	Kali Serang	Central Jawa	937	900	25	
3.	Sungai Citanduy	West Jawa	3,680	1,900	25	
4.	Sungai Ular	North Sumatera	1,080	800	25	
5.	Kali Pemali	Central Jawa	1,228	1,300	25	
6.	Sungai Cipanas	West Jawa	220	385	25	
7.	Bengawan Solo	Central/East	3,400	1,500	10	1st stage
		Jawa		2,000	40	2nd stage
8.	Kali Madium	East Jawa	2,400	1,100	10	1st stage
				2,300	40	2nd stage
9.	Sungai Wampu	North Sumatera	3,840	1,320	20	
10.	Sungai Arakundo	Aceh	5,495	1,800	20	
11.	Sungai Kring Aceh	Aceh	1,775	1,300	20	
12.	Kali Brantas	East Jawa	10,000	1,350	10	1st stage
				1,500	50	2nd stage
13.	Sungai Bah Bolon	North Sumatera	2,776	1,220	20	

Table 3.2 Probable Flood Discharges of the Bila River and its Tributaries

(Unit: m^3/sec)

Point for discharge calculation	Catchment area (km^2)	Probable flood discharge 2-year	5-year	10-year	20-year	50-year
1. Main stream						
Bila AWLR station	379	566	711	809	938	1,076
confluence of Kalola R. (upstream)	420	599	753	855	999	1,133
confluence of Boya R. (upstream)	587	720	908	1,024	1,181	1,342
Tanru Tedong	1,123	1,028	1,302	1,452	1,662	1,862
confluence of Lancirang R. (upstream)	1,188	1,060	1,343	1,496	1,716	1,915
confluence of Lake Tempe	1,368	1,146	1,453	1,615	1,843	2,057
2. Tributaries						
Kalola river (proposed dam site)	122	304	379	440	517	607
Kalola river (confluence of the Bila)	167	361	451	521	610	711
Boya river (confluence of the Bila)	536	685	863	975	1,126	1,281
Lancirang river (confluence of the Bila)	180	376	470	542	634	739

Table 4.1 Dimension of Design River Channel for Study on Selection of Improving Route

Section	Plan	Q (m^3/sec)	H1 (m)	H2 (m)	B1 (m)	B2 (m)	Bh (m)	B3 (m)	V1 (m/sec)	V2 (m/sec)
Bila BI 0.0 km to 7.13 km	1 and 2	1,900	3 to 3.4	1.7 to 2.1	148	160	40	240	2.29	0.76
	1 and 2	1,500	3 to 3.4	1.7 to 2.1	118	130	55	240	2.28	0.77
	3-1, 4-1	1,400	3 to 3.4	1.7 to 2.1	108	120	30	180	2.27	0.76
	3-1, 4-1	1,000	3 to 3.4	1.7 to 2.1	78	90	45	180	2.25	0.77
	3-2, 4-2	700	3 to 3.4	1.7 to 2.1	55	67	10	87	2.22	0.76
	3-3, 4-3	500	Existing River Channel							
Bila BI 7.13 km to 11.85 km	1 and 2	1,800	3.4 to 3.7	2.1 to 2.3	115.2	130	40	210	2.50	0.79
	1 and 2	1,400	3.4 to 3.7	2.1 to 2.3	95.2	110	50	210	2.48	0.79
	3-1, 4-1	1,300	3.4 to 3.7	2.1 to 2.3	75.2	90	30	150	2.46	0.78
	3-1, 4-1	900	3.4 to 3.7	2.1 to 2.3	55.2	70	40	150	2.42	0.79
	3-2, 4-2	600	Existing River Channel							
	3-3, 4-4	400	Existing River Channel							
Bila BI 11.85 km to 13.5 km	1 and 2	1,800	3.7 to 3.8	2.3 to 2.4	104.4	120	30	180	2.57	0.79
	1 and 2	1,400	3.7 to 3.8	2.3 to 2.4	74.4	90	45	180	2.54	0.81
	3-1	1,300	3.7 to 3.8	2.3 to 2.4	74.4	90	30	150	2.54	0.80
	3-1	900	3.7 to 3.8	2.3 to 2.4	44.4	60	45	150	2.47	0.81
	3-2	600	Existing River Channel							
	3-3	400	Existing River Channel							
	4-1 to 3	1,700	3.7 to 3.8	2.3 to 2.4	94.4	110	30	170	2.56	0.80
	4-1 to 3	1,400	3.7 to 3.8	2.3 to 2.4	74.4	90	40	170	2.54	0.81
Bila BI 13.5 km to 17.6 km	1	1,800	3.8 to 4.0	2.1 to 2.6	84	100	35	170	2.66	0.87
	1	1,400	3.8 to 4.0	2.1 to 2.6	64	80	45	170	2.63	0.88
	2, 3 and 4	1,600	3.8 to 4.0	2.1 to 2.6	74	90	30	150	2.65	0.87
	2, 3 and 4	1,200	3.8 to 4.0	2.1 to 2.6	54	70	40	150	2.61	0.88
Bila BI 17.6 km to 17.85 km	1	1,200	4.0	2.1	59	100	30	160	2.57	0.82
	1	1,000	4.0	2.1	44	80	40	160	2.52	0.83
	2, 3 and 4	1,000	4.0	2.1	54	90	30	150	2.55	0.82
	2, 3 and 4	800	4.0	2.1	34	50	50	150	2.48	0.83
Kaiola	1	460	3.0	2.5	34	46	15	76	1.55	-
	2 and 4	460	3.0	2.5	20	32	15	62	1.90	-
	3	460	3.0	1.8	33	45	15	75	1.81	-
Floodway	3 - 1	500	2.0	1.8	32	40	30	100	1.46	-
	3 - 1	300	2.0	1.8	12	20	30	80	1.36	-
	3 - 2	1,200	2.0	1.8	112	120	30	180	1.65	-
	3 - 2	800	2.0	1.8	62	70	30	130	1.56	-
	3 - 2	1,000	2.0	1.8	92	100	30	160	1.62	-
	3 - 2	600	2.0	1.8	42	50	30	110	1.50	-
	3 - 3	1,400	2.0	1.8	132	140	30	200	1.67	-
	3 - 3	1,000	2.0	1.8	92	100	30	160	1.62	-
	3 - 3	1,200	2.0	1.8	112	120	30	180	1.65	-
	3 - 3	800	2.0	1.8	62	70	30	130	1.56	-
	4 - 1	500	2.0	1.8	32	40	30	100	1.46	-
	4 - 2	1,200	2.0	1.8	112	120	30	180	1.65	-
	4 - 2	800	2.0	1.8	62	70	30	130	1.56	-
	4 - 3	1,400	2.0	1.8	132	140	30	200	1.67	-
	4 - 3	1,000	2.0	1.8	92	100	30	160	1.62	-

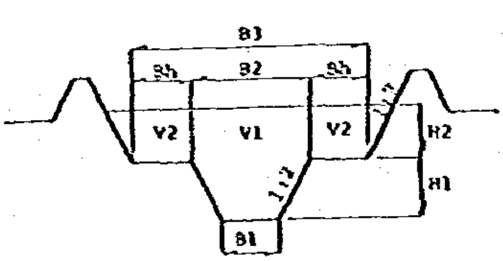


Table 4.2 Comparison of Construction Cost (T=1/20)

(Unit : 10^6 Rp.)

Description	Plan -1	Plan -2	Plan 3-1	Plan 3-2	Plan 3-3	Plan 4-1	Plan 4-2	Plan 4-3
1. Land acquisition and compensation	1,390	1,300	1,740	1,740	1,870	1,760	1,850	1,920
2. Civil Works	19,650	18,690	17,500	21,970	23,970	17,580	22,470	23,820
a. Preparatory	1,790	1,700	1,590	2,000	2,180	1,600	2,040	2,170
b. Dredging	55	55	550	2,750	3,300	550	2,750	3,300
c. Excavation	11,077	10,636	7,493	8,559	9,229	7,033	8,166	8,647
d. Embankment	1,724	1,614	2,043	2,019	1,805	2,669	2,658	2,444
e. Surplus soil	2,543	2,292	1,553	1,834	2,049	1,315	1,611	1,776
f. Revetment	150	150	150	150	150	150	150	150
g. Outlet	150	150	150	150	150	150	150	150
h. Bridge	544	556	629	699	779	666	746	766
i. Ground sill	-	-	1,900	2,000	2,350	2,000	2,350	2,450
j. Miscellaneous	1,617	1,537	1,442	1,809	1,978	1,447	1,849	1,967
Total	21,040 (4)	19,990 (3)	19,240 (1)	23,710 (5)	25,840 (8)	19,340 (2)	24,320 (6)	25,740 (7)

Table 4.3 Comparison of Construction Cost (T=1/5)

(Unit : 10^6 Rp.)

Description	Plan -1	Plan -2	Plan 3-1	Plan 3-2	Plan 3-3	Plan 4-1	Plan 4-2	Plan 4-3
1. Land acquisition and compensation	1,390	1,300	1,740	1,740	1,870	1,760	1,850	1,920
2. Civil Works	14,150	13,900	14,220	15,470	18,550	14,300	16,090	18,820
a. Preparatory	1,290	1,260	1,290	1,410	1,690	1,300	1,460	1,710
b. Dredging	55	55	550	1,375	2,200	550	1,375	2,200
c. Excavation	7,462	7,369	5,341	5,382	6,541	4,882	5,066	6,244
d. Embankment	1,724	1,614	2,043	2,019	1,805	2,669	2,658	2,445
e. Surplus soil	1,606	1,603	995	1,011	1,352	758	808	1,154
f. Revetment	150	150	150	150	150	150	150	150
g. Outlet	150	150	150	150	150	150	150	150
h. Bridge	544	556	629	699	779	666	746	766
i. Ground sill	-	-	1,900	2,000	2,350	2,000	2,350	2,450
j. Miscellaneous	1,169	1,143	1,172	1,274	1,533	1,175	1,327	1,551
Total	15,540 (4)	15,200 (1)	15,960 (2)	17,210 (5)	20,420 (7)	16,060 (3)	17,940 (6)	20,740 (8)

Table 4.4 Dimension of Design Longitudinal Profile

(Unit : m)

Section No.		River Bed	High water Channel	H.W.L.	Levee Crown
Bila R.					
BI	0.0	7.30	10.30	12.00	13.00
BI	1.2	7.64	10.72	12.48	13.48
BI	2.3	7.96	11.10	12.92	13.92
BI	3.6	8.31	11.53	13.42	14.42
BI	4.8	8.67	11.96	13.92	14.92
BI	5.8	8.96	12.31	14.32	15.32
BI	6.8	9.24	12.66	14.72	15.72
Lancirang		9.34	12.77	14.85	15.85
BI	9.4	9.97	13.54	15.74	16.74
BI	10.1	10.19	13.80	16.04	17.04
BI	11.7	10.69	14.41	16.74	17.74
BI	13.4	11.11	14.93	17.34	18.34
Kalola		11.16	14.98	17.40	18.40
BI	15.4	11.71	15.65	18.18	19.18
BI	16.4	12.00	16.00	18.58	19.58
BI	17.6	12.92	16.92	19.02	20.02
Boya		12.96	16.96	19.04	20.04
BI	17.7	13.04	17.04	19.08	20.08
BI	19.0	14.08	18.08	19.58	20.58
BI	20.0	14.75	18.75	19.90	20.90
BI	21.4	-	-	20.54	-
Boya					
BO	0.0	13.00	17.00	19.00	20.00
BO	1.1	13.44	17.44	19.44	20.44
BO	2.1	13.84	17.84	19.84	20.84
BO	3.9	14.56	18.56	20.56	21.56
BO	6.0	15.40	19.40	21.40	22.40
Kalola					
KA	0.0	12.10	-	17.60	18.40
KA	1.8	13.30	-	18.80	19.60
KA	4.50	14.20	-	19.70	20.50
KA	4.51	14.21	-	19.71	20.51
KA	4.52	14.21	-	19.71	20.51
KA	5.3	14.73	-	20.23	21.03
KA	4.5	14.83	-	20.33	21.13
KA	6.1	15.90	-	21.40	22.20
KA	7.0	16.50	-	22.00	22.80
KA	8.3	17.37	-	22.87	23.67
KA	9.0	17.83	-	23.33	24.13
KA	9.9	18.43	-	23.93	24.73
Lancirang					
LA	0.0	9.40	-	14.90	15.90
LA	3.5	12.58	-	16.78	17.58
LA	7.0	15.76	-	19.96	20.76

Table 4.5 Dimension of Design Cross Section

(Unit : m)

Name of River	Section	Q (m^3/sec)	H_1	H_2	B_1	B_2	B_h	B_3
Bila	BI 0.00 km to BI 7.13 km	1,900	3.0 to 3.4	1.7 to 2.1	-	160	40	240
		1,500	- do -	- do -	-	130	55	- do -
	BI 7.13 km to BI 11.85 km	1,800	3.4 to 3.7	2.1 to 2.3	-	130	40	210
		1,400	- do -	- do -	-	110	50	- do -
	BI 11.85 km to BI 13.50 km	1,800	3.7 to 3.8	2.3 to 2.4	-	120	30	180
		1,400	- do -	- do -	-	90	45	- do -
	BI 13.50 km to BI 17.60 km	1,600	3.8 to 4.0	2.1 to 2.6	-	90	30	150
		1,200	- do -	- do -	-	70	40	- do -
	BI 17.60 km to BI 17.85 km	1,000	4.0	2.1	54	90	30	150
		800	- do -	- do -	34	50	50	- do -
	BI 17.85 km to BI 20.00 km	1,000	4.0	2.1 to 1.2	54	90	30	150
		800	- do -	- do -	34	70	40	- do -
Boya	BO 0.00 km to BO 6.00 km	1,200	4.0	2.0	84	100	30	160
		900	- do -	- do -	54	70	45	- do -
Kalola	KA 0.00 km to KA 9.90 km	460	3.0	2.5	20	32	15	62
Lancirang	LA 0.00 km to LA 8.00 km	470	2.5	1.7	30	40	30	100

Table 4.6 Construction Cost of Whole Stretches (T = 1/20)

(Unit : 10^6 Rp.)

Item	Unit	Unit Price	Bila river Q'ty	Bila river Amount	Boya river Q'ty	Boya river Amount	Kalola river Q'ty	Kalola river Amount	Lancirang river Q'ty	Lancirang river Amount	Total Q'ty	Total Amount
1. Land Acquisition and Compensation	L.S.	-	-	1,520	-	290	-	200	-	280	-	2,290
2. Civil Works				11,710	-	2,450		2,320		1,380		21,860
(1) Preparatory	L.S.	-	-	520	-	80	-	80	-	50	-	730
(2) Dredging	10^3m^3	2,750	20	55	-	-	-	-	-	-	20	55
(3) Excavation	10^3m^3	1,100	9,410	10,351	1,410	1,551	1,120	1,232	400	440	12,340	13,574
(4) Embankment	10^3m^3	1,500	960	1,440	250	375	300	450	400	600	1,910	2,865
(5) Surplus soil	10^3m^3	285	8,450	2,408	1,160	331	820	234	-	-	10,430	2,973
(6) Revetment	L.S.	-	-	150	-	-	-	-	-	-	-	150
(7) Outlet	Nos.	-	-	-	1	50	1	50	1	50	3	150
(8) Bridge	L.S.	-	-	340	-	-	-	216	-	200	-	756
(9) Miscellaneous	L.S.	-	-	446	-	63	-	58	-	40	-	607
3. Overhead & Others	-	-	-	2,280	-	360	-	330	-	200	-	3,170
4. Contingency	L.S.	-	-	2,930	-	460	-	420	-	270	-	4,080
5. Engineering and Administration	L.S.	-	-	2,500	-	400	-	360	-	240	-	3,500
TOTAL	-	-	-	24,940	-	3,960	-	3,630	-	2,370	-	34,900

Table 4.7 Construction Cost of Whole Stretches (T = 1/5)

(Unit : 10^6 Rp.)

Item	Unit	Unit Price	Bila river		Boya river		Kalola river		Lancirang river		Total	
			Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
1. Land Acquisition and Compensation	L.S.	-	-	1,520	-	290	-	200	-	280	-	2,290
2. Civil Works			-	11,220	-	1,310	-	2,320	-	1,380	-	16,230
(1) Preparatory	L.S.	-	-	380	-	50	-	80	-	50	-	560
(2) Dredging	10^3m^3	2,750	20	55	-	-	-	-	-	-	20	55
(3) Excavation	10^3m^3	1,100	6,360	6,996	630	693	1,120	1,232	400	440	8,510	9,361
(4) Embankment	10^3m^3	1,500	960	1,440	250	375	300	450	400	600	1,910	2,865
(5) Surplus soil	10^3m^3	285	5,400	1,539	380	108	820	234	-	-	6,600	1,881
(6) Revetment	L.S.	-	-	150	-	-	-	-	-	-	-	150
(7) Outlet	Nos.	-	-	-	1	50	1	50	1	50	3	150
(8) Bridge	L.S.	-	-	340	-	-	-	216	-	200	-	756
(9) Miscellaneous	L.S.	-	-	320	-	34	-	58	-	40	-	452
3. Overhead & Others		-	-	1,620	-	190	-	330	-	200	-	2,340
4. Contingency	L.S.	-	-	2,180	-	270	-	420	-	270	-	3,140
5. Engineering and Administration	L.S.	-	-	2,500	-	400	-	360	-	240	-	3,500
Total				19,040		2,460		3,630		2,370		27,500

Table 4.8 Construction Cost of Kalola River

(Unit : 10^6 Rp.)

Item	Unit	Unit Price	Bila river		Boya river		Kalola river		Lancirang river		Total	
			Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
1. Land Acquisition and Compensation	L.S.	-	-	-	-	-	-	200	-	-	-	200
2. Civil Works		-	-	880	-	-	-	2,320	-	-	-	3,200
(1) Preparatory	L.S.	-	-	30	-	-	-	80	-	-	-	110
(2) Dredging	10^3m^3	-	-	-	-	-	-	-	-	-	-	-
(3) Excavation	10^3m^3	1,100	600	660	-	-	1,120	1,232	-	-	1,720	1,892
(4) Embankment	10^3m^3	1,500	-	-	-	-	300	450	-	-	300	450
(5) Surplus soil	10^3m^3	285	600	171	-	-	820	234	-	-	1,420	405
(6) Revetment	L.S.	-	-	-	-	-	-	-	-	-	-	-
(7) Outlet	Nos.	-	-	-	-	-	1	50	-	-	-	50
(8) Bridge	L.S.	-	-	-	-	-	-	216	-	-	-	216
(9) Miscellaneous	L.S.	-	-	19	-	-	-	58	-	-	-	77
3. Overhead & Others		-	-	130	-	-	-	330	-	-	-	460
4. Contingency (20%)	L.S.	-	-	150	-	-	-	420	-	-	-	570
5. Engineering and Administration (10%)	L.S.	-	-	130	-	-	-	360	-	-	-	490
Total				1,290				3,630				4,920

Remark : Bila River Excavation 45 m2 x 13,500 ÷ 600,000 m^3.

Table 4.9 Flood Damages in Past Flood (Tanru-Tedong, 1978)

(Unit : 10^3 Rp.)

Item	Unit	Quantity	Unit Price	Amount	Rate of Damage	Estimated Flood Damage	Remarks
1. Paddy 3.1 ton/ha, 180 Rp./kg	ha	1,500	558	837,000	0.20	167,400	71%
2. Houses						32,740	14%
(1) Farmer	Nos.	1,982	2,000	3,964,000	0.003	11,890	
(2) Mosque	Nos.	3	10,000	30,000	0.03	900	
(3) School	Nos.	20	17,000	340,000	0.03	10,200	
(4) Others	Nos.	25	13,000	325,000	0.03	9,750	
3. Livestock						21,940	9%
(1) Bufallo	Nos.	400	150	60,000	0.01	600	
(2) Cow	Nos.	3,351	200	670,200	0.03	20,110	
(3) Horse	Nos.	230	150	34,500	-	-	
(4) Goat	Nos.	165	35	5,775	0.03	170	
(5) Chicken	Nos.	17,591	2	35,182	0.03	1,060	
4. Public						13,700	6%
(1) Kabupaten Road	km	5	11,600	58,000	0.05	2,900	
(2) Desa Road	km	9	2,400	21,600	0.50	10,800	
Total						235,780	

Table 4.10 Flood Damages in Past Flood (Kelle, 1980)

(Unit : 10^3 Rp.)

Item	Unit	Quantity	Unit Price	Amount	Rate of Damage	Estimated Flood Damage	Remarks
1. Paddy 3.1 ton/ha, 180 Rp./kg	ha	1,919	558	1,070,802	0.10	107,080	68%
2. Houses						20,650	13%
(1) Farmer	Nos.	1,494	3,000	4,482,000	0.001	4,480	
(2) Mosque	Nos.	4	11,000	44,000	0.03	1,320	
(3) School	Nos.	9	20,000	180,000	0.03	5,400	
(4) Others	Nos.	21	15,000	315,000	0.03	9,450	
3. Livestock						10,760	7%
(1) Bufallo	Nos.	51	150	7,650	0.01	80	
(2) Cow	Nos.	1,798	200	359,600	0.02	7,190	
(3) Horse	Nos.	77	150	11,550	-	-	
(4) Goat	Nos.	135	35	4,725	-	-	
(5) Chicken	Nos.	17,458	2	34,916	0.1	3,490	
4. Public						18,720	12%
(1) Kabupaten Road	km	-	-		-	-	
(2) Desa Road	km	25	2,400	60,000	0.3	18,000	
(3) Bridge	Nos.	9	800	7,200	0.1	720	
Total						157,210	

Table 4.11 Estimated Percentage of Flood Damages to Paddy for Each Area
(Under Present Condition)

1. Bila Area

(Unit: %)

Year	BI - 1 220 ha	BI - 2 420 ha	BI - 3 630 ha	KA - 1 100 ha	KA - 2 10 ha	KA - 3 780 ha	KA - 4 290 ha	BK - 1 360 ha	BK - 2 250 ha	BK - 3 280 ha	BO - 1 90 ha	Ave. 3,430 ha
1974	8	8	26	11	8	26	23	11	8	26	3	18
1975	31	27	32	30	23	31	31	31	31	31	23	30
1976	23	23	23	23	23	23	35	35	23	23	10	25
1977	35	0	35	0	0	35	35	34	34	35	0	28
1978	37	37	26	37	0	37	37	37	37	37	0	34
1979	26	26	28	45	15	28	40	40	28	28	15	30
1980	10	0	10	0	0	10	10	10	10	10	0	8
1981	27	27	27	27	0	27	27	27	27	27	0	26
Ave.	25	19	26	22	9	27	30	28	25	27	6	25

2. Boya Area

Year	BO - 2 280 ha	BO - 3 520 ha	BO - 4 200 ha	BB - 1 770 ha	BB - 2 190 ha	LA - 1 730 ha	LA - 2 680 ha	LA - 3 140 ha	LA - 4 450 ha	LA - 5 280 ha	BL - 1 860 ha	Ave. 5,100 ha
1974	3	26	24	11	24	23	8	29	29	21	29	20
1975	23	31	34	31	34	31	29	46	46	45	60	38
1976	10	10	55	23	55	35	10	35	45	35	52	31
1977	0	35	36	34	36	35	0	36	36	37	36	29
1978	0	37	37	37	37	37	37	46	46	46	61	41
1979	15	24	53	26	53	40	25	46	41	40	51	36
1980	0	10	23	10	23	10	10	10	10	23	10	11
1981	0	27	27	27	27	27	27	27	27	27	27	26
Ave.	6	25	36	25	36	30	18	34	35	34	41	29

Table 4.12 Estimated Percentage of Flood Damages to Paddy for Each Area
(Under Irrigated Condition)

1. Bila Area

(Unit: %)

Year	BI - 1 220 ha	BI - 2 420 ha	BI - 3 630 ha	KA - 1 100 ha	KA - 2 10 ha	KA - 3 780 ha	KA - 4 290 ha	BK - 1 360 ha	BK - 2 250 ha	BK - 3 280 ha	BO - 1 90 ha	Ave. 3,430 ha
1974	10	8	28	11	8	28	24	11	8	28	3	20
1975	31	27	32	30	23	31	31	31	31	31	23	30
1976	23	23	23	23	23	23	35	35	23	23	10	25
1977	35	0	35	0	0	35	35	34	34	35	0	28
1978	60	60	69	60	0	60	60	60	60	60	0	60
1979	26	26	28	45	15	28	40	40	28	28	15	30
1980	10	0	10	0	0	10	10	10	10	10	0	8
1981	35	50	50	35	8	50	50	50	50	50	8	47
Ave.	29	24	34	26	10	33	36	34	31	33	7	31

2. Boya Area

Year	BO - 2 280 ha	BO - 3 520 ha	BO - 4 350 ha	BB - 1 770 ha	BB - 2 500 ha	LA - 1 940 ha	LA - 2 680 ha	LA - 3 400 ha	LA - 4 450 ha	LA - 5 500 ha	BL - 1 1,290 ha	Ave. 6,680 ha
1974	3	28	26	11	26	25	8	43	43	45	43	28
1975	23	3	34	31	34	31	29	46	46	45	60	37
1976	10	10	55	23	55	35	10	35	45	35	52	35
1977	0	35	36	34	36	35	0	36	36	37	36	30
1978	0	47	60	60	60	60	47	69	56	69	106	65
1979	15	24	53	26	53	40	25	46	41	40	51	39
1980	0	10	23	10	23	10	10	10	10	23	10	12
1981	8	35	82	35	82	79	50	82	82	82	82	66
Ave.	7	24	46	29	46	39	22	46	45	47	55	39

Table 4.13 Estimated Annual Flood Damages to Paddy for Each Area
(Under Present Condition)

1. Bila Area

(Unit: 10^6Rp.)

Year	BI - 1 220 ha	BI - 2 420 ha	BI - 3 630 ha	KA - 1 100 ha	KA - 2 10 ha	KA - 3 780 ha	KA - 4 290 ha	BK - 1 360 ha	BK - 2 250 ha	BK - 3 280 ha	BO - 1 90 ha	Total 3,430 ha
1974	10	20	97	7	0	120	40	24	12	43	2	375
1975	41	67	120	18	1	144	53	66	46	52	12	620
1976	30	57	86	14	1	107	60	75	34	38	5	507
1977	46	0	131	0	0	162	60	73	50	58	0	580
1978	48	92	97	22	0	171	64	80	55	62	0	691
1979	34	65	105	27	1	130	69	86	42	47	8	614
1980	13	0	37	0	0	46	17	21	15	17	0	166
1981	35	67	101	16	0	125	47	58	40	45	0	534
Total	257	368	774	104	3	1,005	410	483	294	362	27	4,087

2. Boya Area

Year	BO - 2 280 ha	BO - 3 520 ha	BO - 4 200 ha	BB - 1 770 ha	BB - 2 190 ha	LA - 1 730 ha	LA - 2 680 ha	LA - 3 140 ha	LA - 4 450 ha	LA - 5 280 ha	BL - 1 860 ha	Total 5,100 ha
1974	5	80	28	50	27	100	32	24	78	35	148	607
1975	38	96	40	142	38	134	117	38	123	75	307	1,148
1976	17	31	65	105	62	152	40	29	120	58	266	945
1977	0	108	43	155	41	152	0	30	96	62	184	871
1978	0	114	44	169	42	160	149	38	123	77	312	1,228
1979	25	74	63	119	60	173	101	38	110	67	260	1,090
1980	0	31	27	46	26	43	40	8	26	38	51	336
1981	0	83	32	123	30	117	109	22	72	45	138	771
Total	85	617	342	909	326	1,031	588	227	748	457	1,666	6,996

Table 4.14 Estimated Annual Flood Damages to Paddy for Each Area
(Under Irrigated Condition)

(Unit: 10^6Rp.)

1. Bila Area

Year	BI - 1 220 ha	BI - 2 420 ha	BI - 3 630 ha	KA - 1 100 ha	KA - 2 10 ha	KA - 3 780 ha	KA - 4 290 ha	BK - 1 360 ha	BK - 2 250 ha	BK - 3 280 ha	BO - 1 90 ha	Total 3,430 ha
1974	22	34	176	11	1	218	70	40	20	78	3	673
1975	68	113	202	30	2	242	90	112	78	87	21	1,045
1976	51	97	145	23	2	179	102	126	58	64	9	856
1977	77	0	221	0	0	273	102	122	85	98	0	978
1978	132	252	435	60	0	468	174	216	150	168	0	2,055
1979	57	109	176	45	2	218	116	144	70	78	14	1,029
1980	22	0	63	0	0	78	29	36	25	28	0	281
1981	77	210	315	35	1	390	145	180	125	140	7	1,625
Total	506	815	1,733	204	8	2,066	828	976	611	741	54	8,542

2. Boya Area

Year	BO - 2 280 ha	BO - 3 520 ha	BO - 4 350 ha	BB - 1 770 ha	BB - 2 500 ha	LA - 1 940 ha	LA - 2 680 ha	LA - 3 400 ha	LA - 4 450 ha	LA - 5 500 ha	BL - 1 1,290 ha	Total 6,680 ha
1974	8	146	91	85	130	235	54	172	194	225	555	1,895
1975	64	16	119	239	170	291	197	184	207	225	774	2,486
1976	28	52	193	177	275	329	68	140	203	175	671	2,311
1977	0	182	126	262	180	329	0	144	162	185	464	2,034
1978	0	244	210	462	300	564	320	276	252	345	1,367	4,340
1979	42	125	186	220	265	376	170	184	185	200	658	2,591
1980	0	52	81	77	115	94	68	40	45	115	129	816
1981	22	182	287	270	410	743	340	328	369	410	1,058	4,419
Total	164	999	1,293	1,772	1,845	2,961	1,217	1,468	1,617	1,880	5,676	20,892

Table 4.15 Estimated Annual Flood Damages to Paddy, Whole Area

(Unit: 10^6Rp.)

Year	Under Present Conditions			Under Proposed Conditions		
	Bila Area	Boya Area	Whole Area	Bila Area	Boya Area	Whole Area
1974	375	607	982	673	1,895	2,568
1975	620	1,148	1,768	1,045	2,486	3,531
1976	507	945	1,452	856	2,311	3,167
1977	580	871	1,451	978	2,034	3,012
1978	691	1,228	1,919	2,055	4,340	6,395
1979	614	1,090	1,704	1,029	2,591	3,620
1980	166	336	502	281	816	1,097
1981	534	771	1,305	1,625	4,419	6,044
Total	4,087	6,996	11,083	8,542	20,892	29,434

Table 4.16 Estimated Annual Flood Damages to Paddy, Bila Area

Year	Under Present Condition			Under Proposed Conditions		
	Kalola Area	Other Area	Bila Area	Kalola Area	Other Area	Bila Area
1974	193	182	375	346	327	673
1975	271	349	620	456	589	1,045
1976	231	276	507	389	467	856
1977	282	298	580	477	501	978
1978	323	368	691	880	1,175	2,055
1979	285	329	614	478	551	1,029
1980	81	85	166	137	144	281
1981	236	298	534	719	906	1,625
Total	1,902	2,185	4,087	3,882	4,660	8,542

Table 4.17 Probable Flood Damages in Whole Area

(Unit: 10^6Rp.)

Return Period	Under Present Conditions			Under Proposed Conditions		
	Paddy	Others	Total	Paddy	Others	Total
1 - year	500	210	710	1,100	470	1,570
2 - year	1,300	560	1,860	3,350	1,440	4,790
5 - year	1,700	730	2,430	5,000	2,140	7,140
10 - year	1,900	810	2,710	5,900	2,530	8,430
20 - year	2,050	880	2,930	6,600	2,830	9,430
50 - year	2,250	960	3,210	7,450	3,190	10,640

Table 4.18 Probable Flood Damages in Kalola Area

Return Period	Under Present Conditions			Under Proposed Conditions		
	Paddy	Others	Total	Paddy	Others	Total
1 - year	80	30	110	140	60	200
2 - year	250	110	360	480	210	690
5 - year	310	130	440	740	320	1,060
10 - year	340	150	490	870	370	1,240
20 - year	370	160	530	990	420	1,410
50 - year	400	170	570	1,110	480	1,590

Table 4.19 Estimated Average Annual Flood Damages, Under Present Condition in Whole Area

(Unit: 10^6 Rp.)

Flood discharge level	Average annual probability of exceedance for discharge level	Average annual probability	Amount of assumed damages at applicable discharge level	Average amount of assumed damages	Average annual amount of damages	Amount of average annual decrease of damages
1/1	1.0	-	710	-	-	-
1/2	0.5	0.50	1,860	1,285	640	640
1/5	0.2	0.30	2,430	2,145	640	1,280
1/10	0.1	0.10	2,710	2,570	260	1,540
1/20	0.05	0.05	2,930	2,820	140	1,680
1/50	0.02	0.03	3,210	3,070	90	1,770

Table 4.20 Estimated Average Annual Flood Damages, Under Irrigated Condition in Whole Area

Flood discharge level	Average annual probability of exceedance for discharge level	Average annual probability	Amount of assumed damages at applicable discharge level	Average amount of assumed damages	Average annual amount of damages	Amount of average annual decrease of damages
1/1	1.0	-	1,570	-	-	-
1/2	0.5	0.50	4,790	3,180	1,590	1,590
1/5	0.2	0.30	7,140	5,965	1,790	3,380
1/10	0.1	0.10	8,430	7,785	780	4,160
1/20	0.05	0.05	9,430	8,930	450	4,610
1/50	0.02	0.03	10,640	10,035	300	4,910

Table 4.21 Estimated Average Annual Flood Damages, Under Present Condition in Kalola Area

(Unit: 10^6Rp.)

Flood discharge level	Average annual probability of exceedance for discharge level	Average annual probability	Amount of assumed damages at applicable discharge level	Average amount of assumed damages	Average annual amount of damages	Amount of average annual decrease of damages
1/1	1.0	-	110	-	-	-
1/2	0.5	0.50	360	235	120	120
1/5	0.2	0.30	440	400	120	240
1/10	0.1	0.10	490	465	50	290
1/20	0.05	0.05	530	510	30	320
1/50	0.02	0.03	570	550	20	340

Table 4.22 Estimated Average Annual Flood Damages, Under Irrigated Condition in Kalola Area

Flood discharge level	Average annual probability of exceedance for discharge level	Average annual probability	Amount of assumed damages at applicable discharge level	Average amount of assumed damages	Average annual amount of damages	Amount of average annual decrease of damages
1/1	1.0	-	200	-	-	-
1/2	0.5	0.50	690	450	230	230
1/5	0.2	0.30	1,060	880	260	490
1/10	0.1	0.10	1,240	1,150	120	610
1/20	0.05	0.05	1,410	1,330	70	680
1/50	0.02	0.03	1,590	1,500	50	730