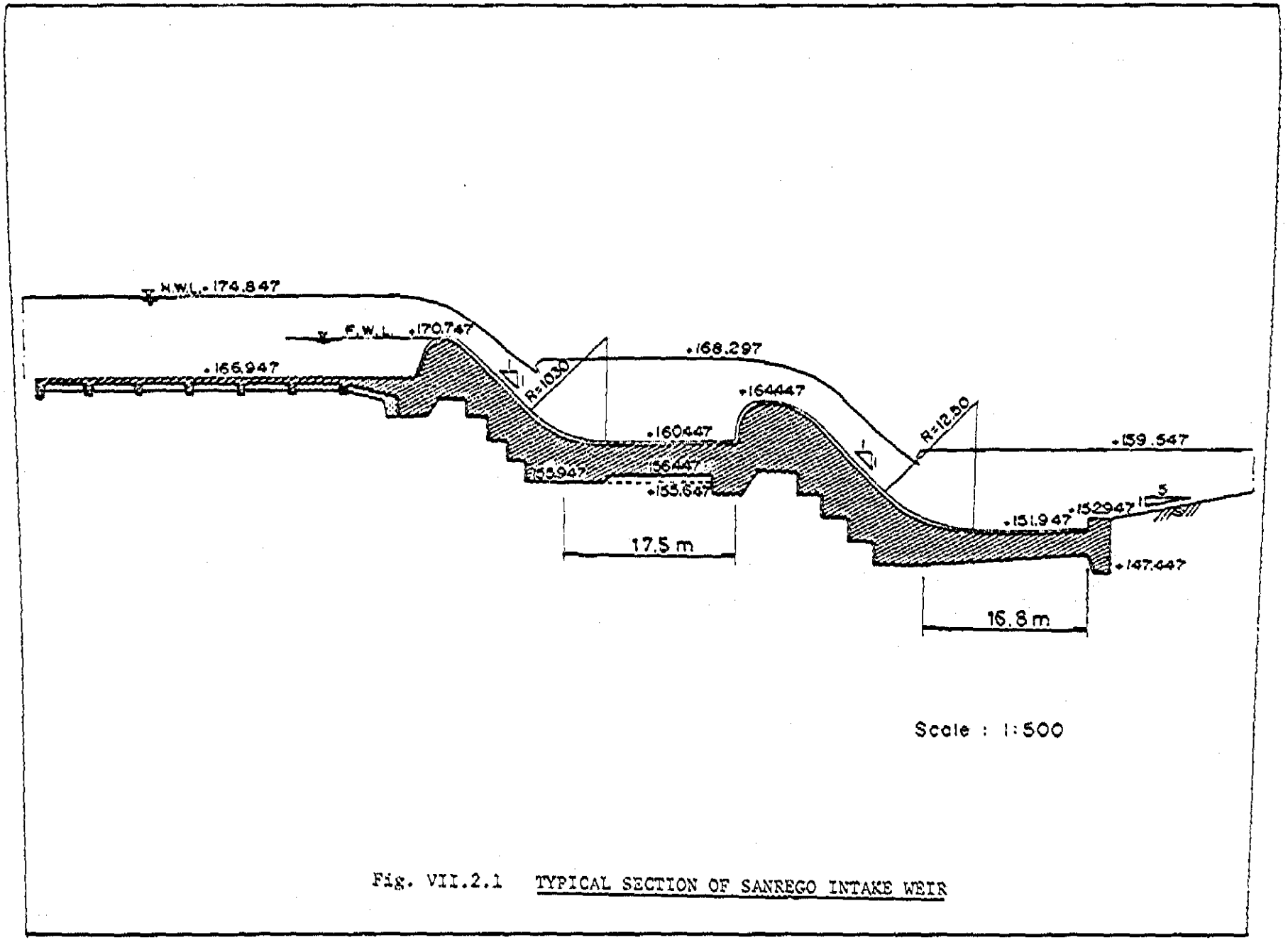

Fig. VII.2.1 TYPICAL SECTION OF SANREGO INTAKE WEIR

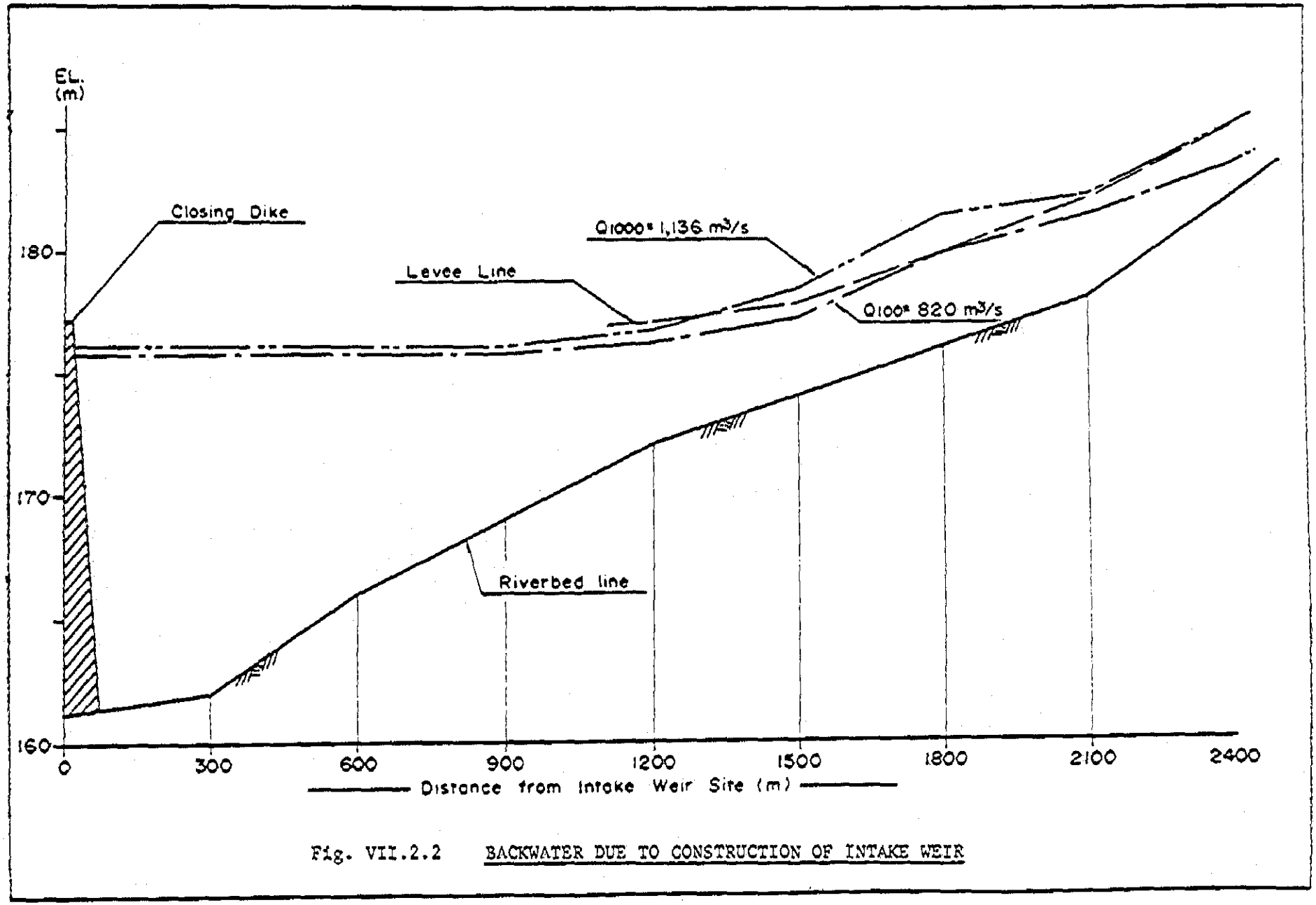

Fig. VII.2.2 BACKWATER DUE TO CONSTRUCTION OF INTAKE WEIR

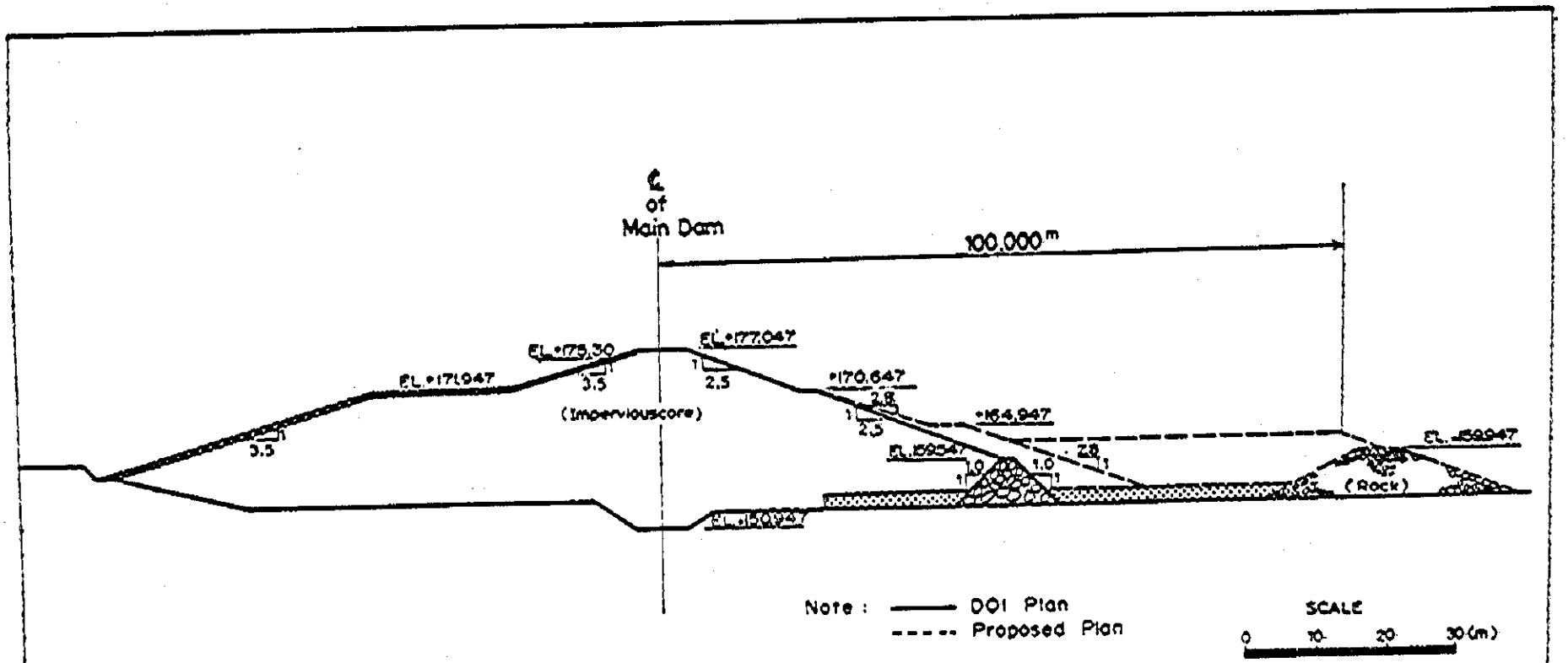

Fig. VII.2 3 TYPICAL CROSS SECTION OF CLOSING DIKE

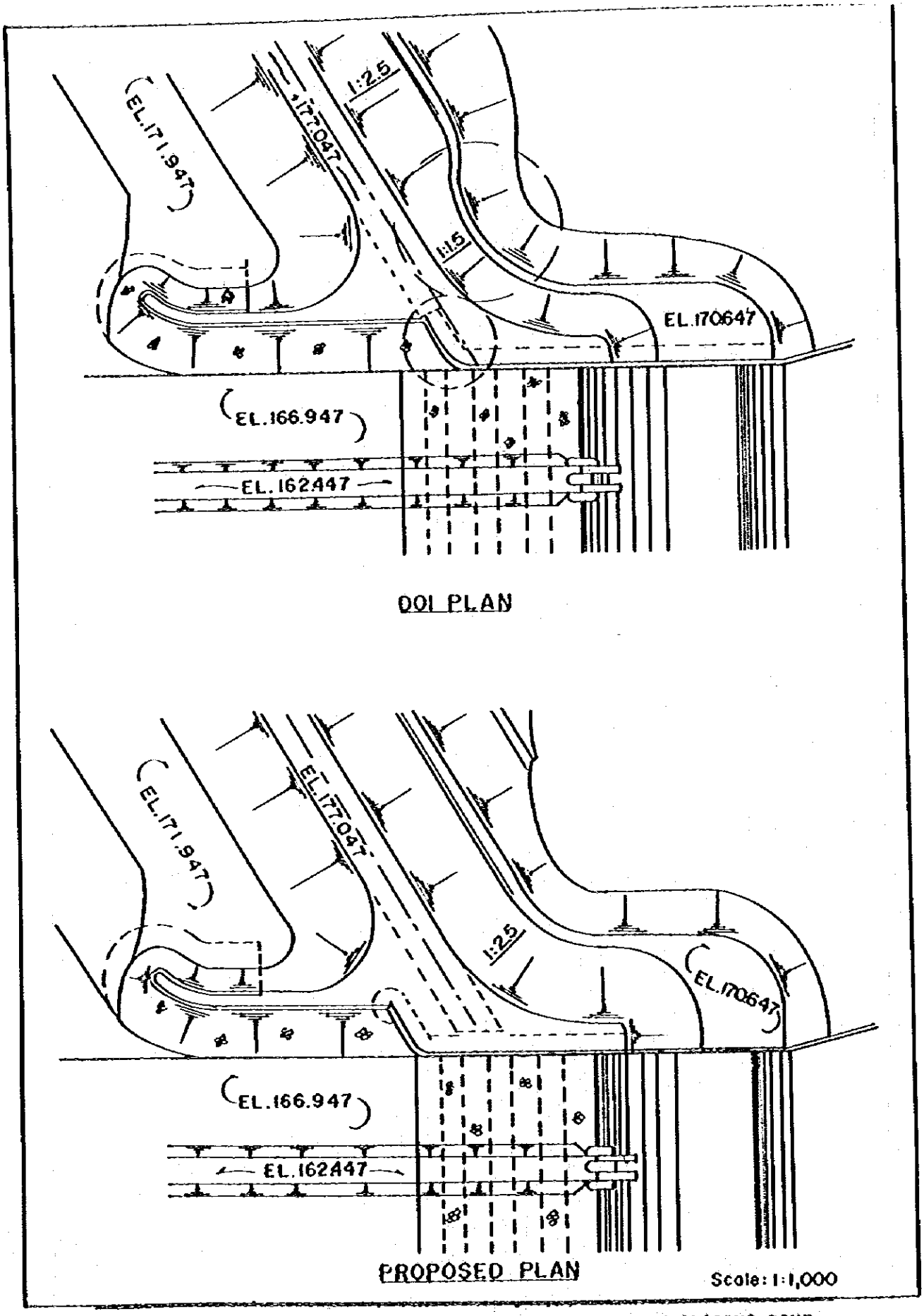

Fig. VII.2.4 PLAN OF CONTACT PLACE BETWEEN CLOSING DIKE AND INTAKE WEIR

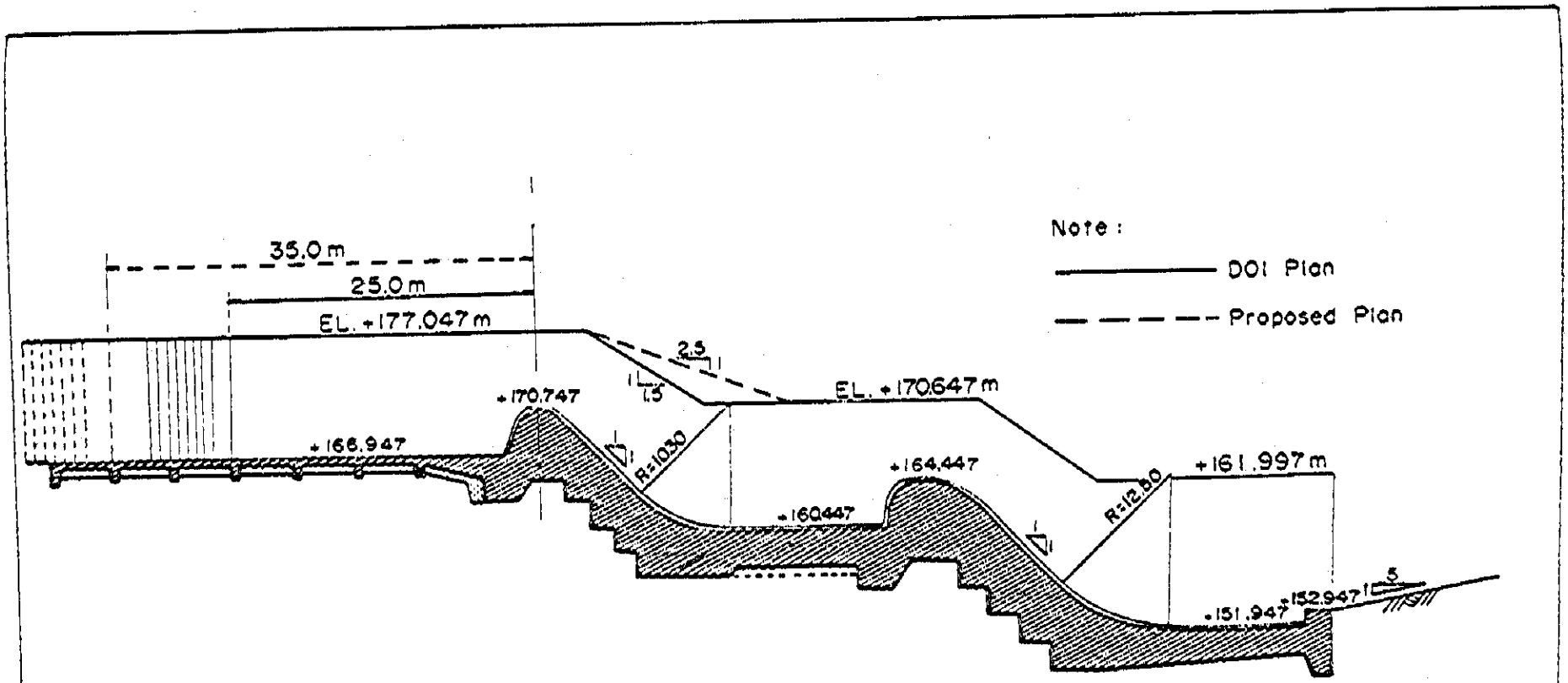

Fig. VII.2.5 PROFILE OF LEFT SIDE WALL OF INTAKE WEIR

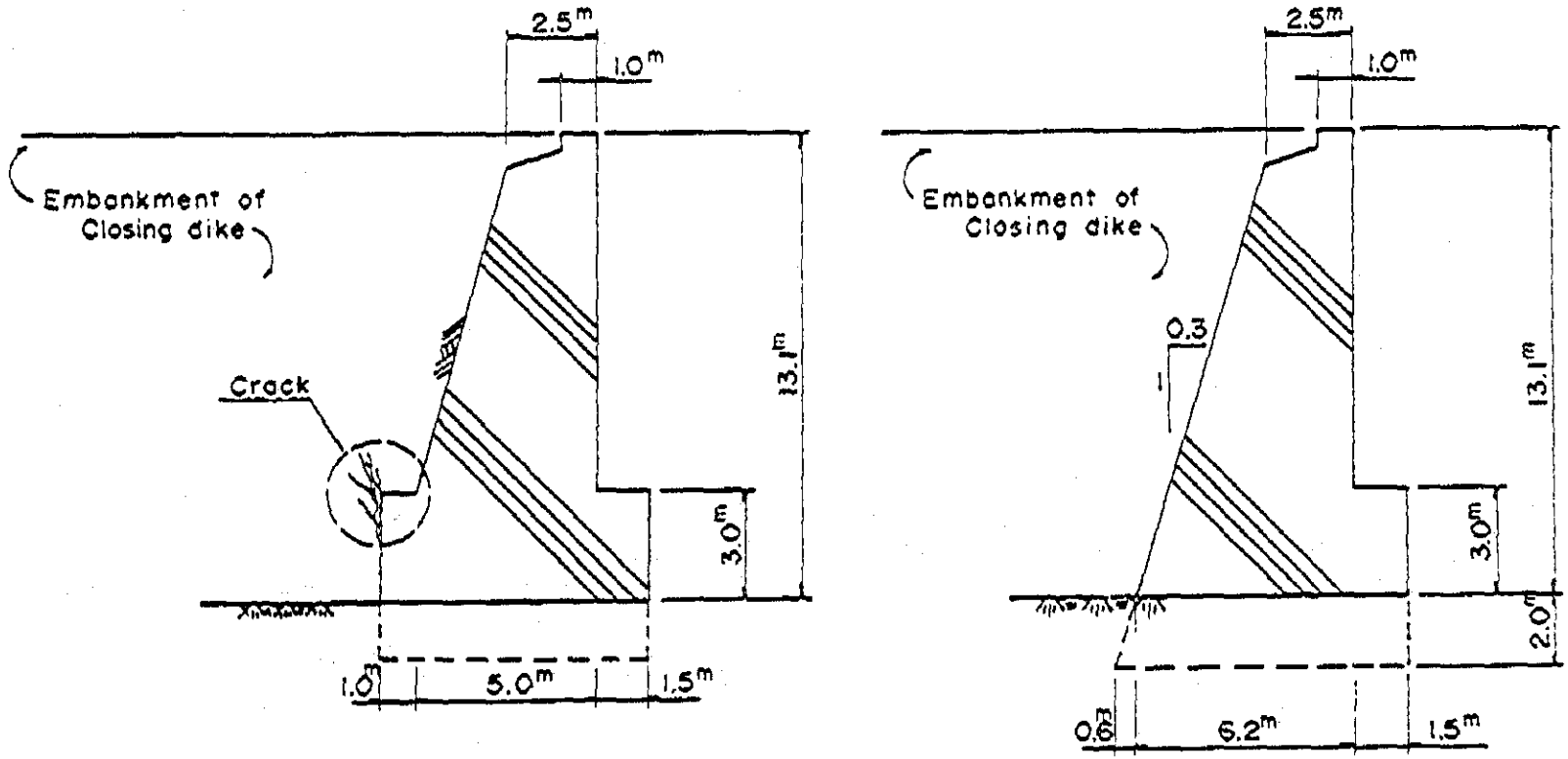

Fig. VII.2.6 CROSS SECTION OF LEFT SIDE WALL OF INTAKE WEIR

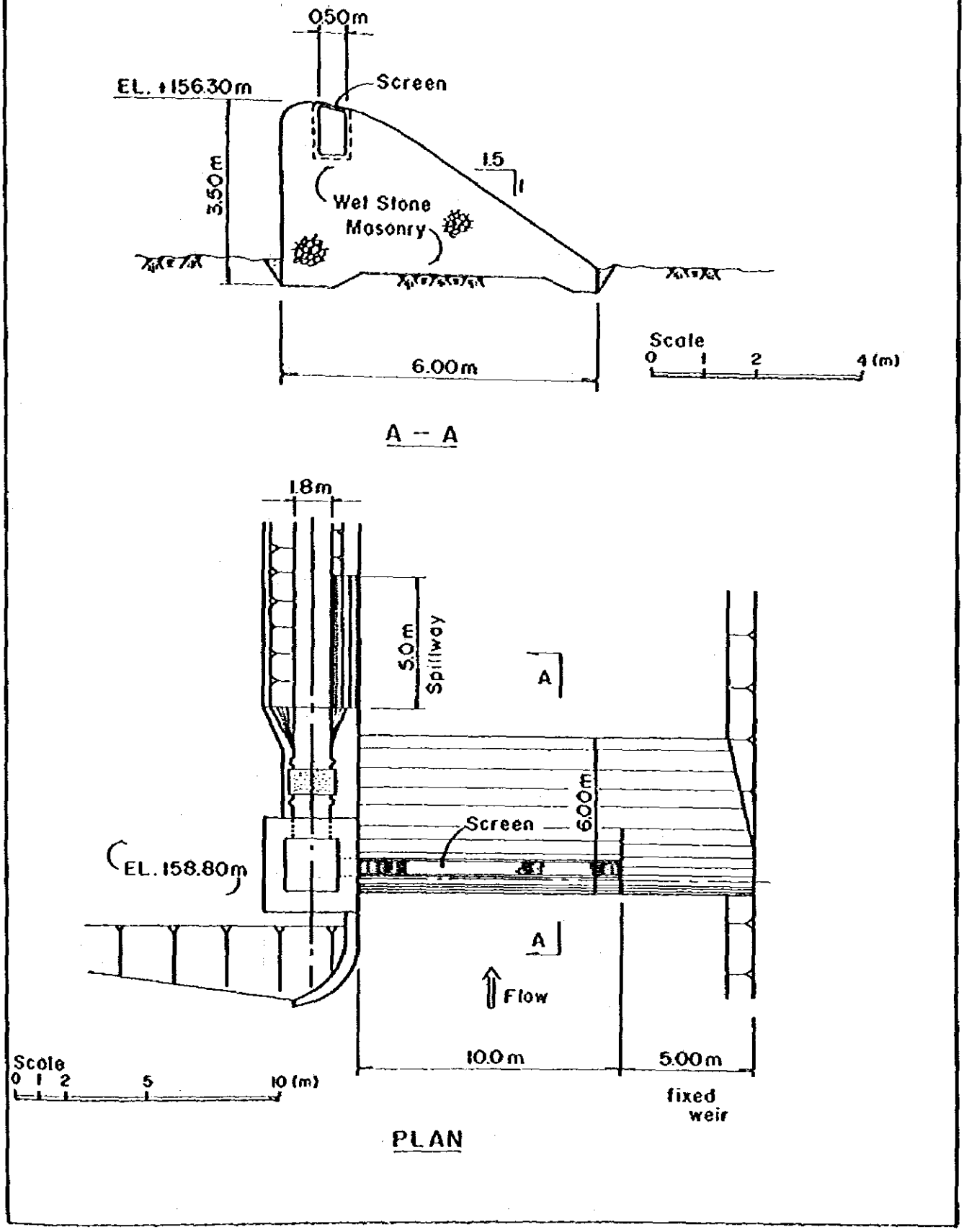

Fig. VII.3.1 TYPICAL SECTION OF PAROTA INTAKE WEIR

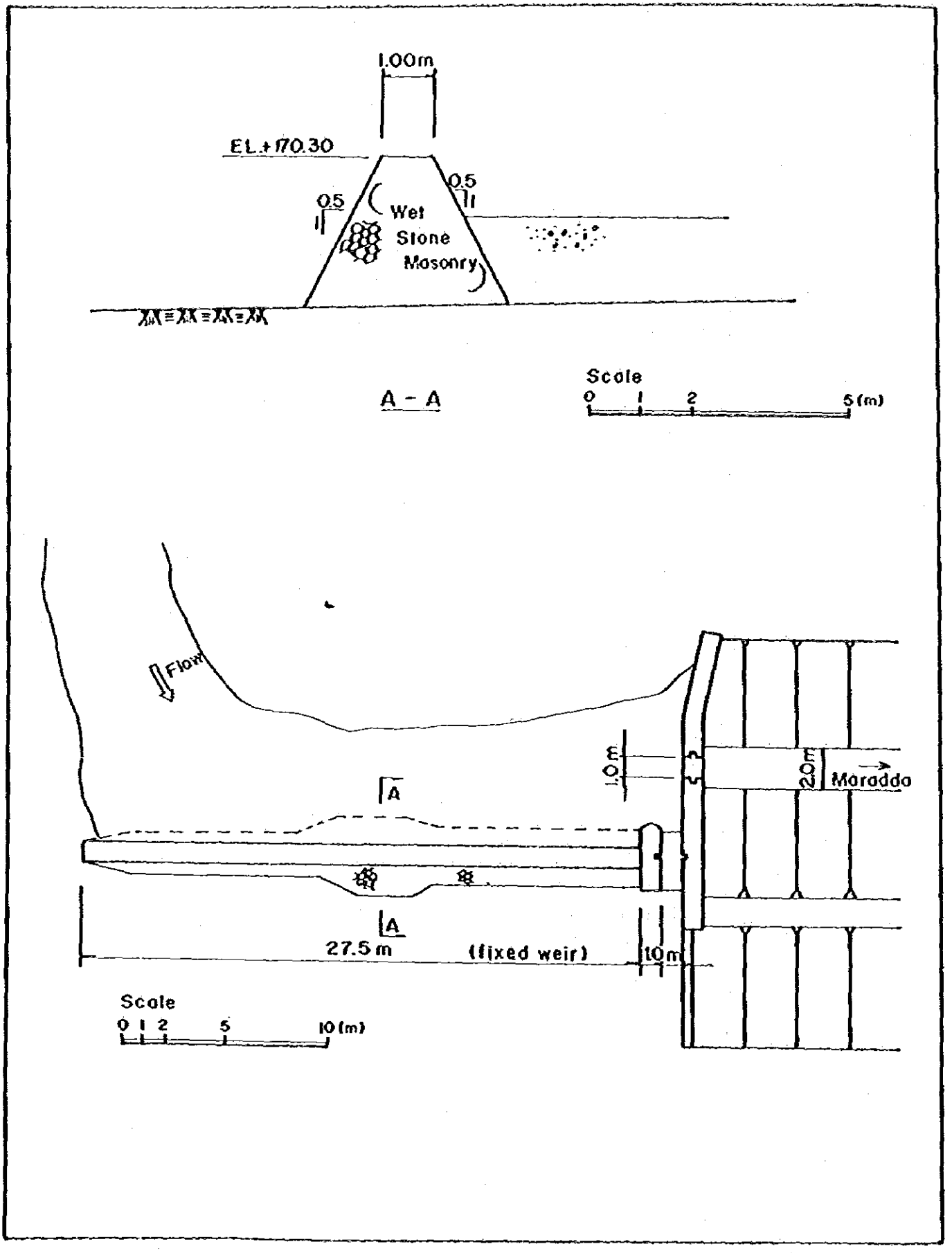

Fig. VII.3.2 TYPICAL SECTION OF BIRU INTAKE WEIR

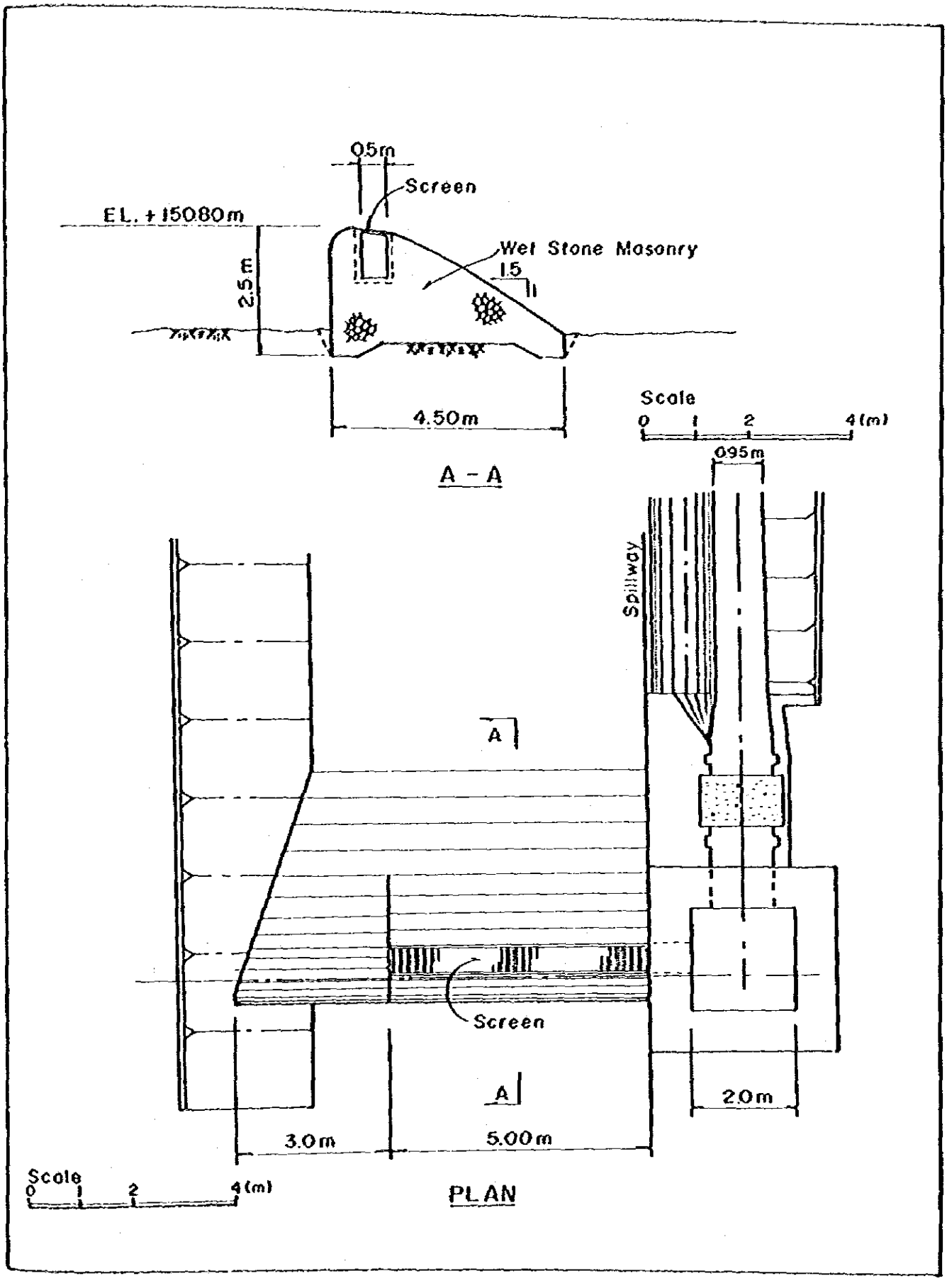

Fig. VII.3.3 TYPICAL SECTION OF MACINAGA INTAKE WEIR

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ANNEX - VIII

CONSTRUCTION PLAN AND COST ESTIMATE

ANNEX - VIII CONSTRUCTION PLAN AND COST ESTIMATE

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ANNEX - VIII CONSTRUCTION PLAN AND COST ESTIMATE

1. CONSTRUCTION PLAN

1.1 General

Construction works of the Project comprise the Sanrego intake weir, main canal system, secondary canal system, small-scaled intake weirs on tributaries, farm road networks, tertiary development and reclamation works. As the above construction works are almost occupied by earth works, due attention must be paid on a characteristic of earth materials which directly affects an earth moving plan, selection of construction equipment, specification of closing dike embankment and so on.

The construction of the Sanrego intake weir including closing dike, and main and secondary canals would be mostly executed by heavy construction equipment. Tertiary canals and other minor works would be implemented mainly by manpower to increase a employment opportunity of the local people in and around the Project area.

1.2 Basic Assumption of Construction Planning

1.2.1 Workable days

Earth work is mostly affected by rainfall. The workable days for embankment of impervious materials must especially be controlled by amount of rainfall. Suspension of these earth works by rainfall would be assumed as following criteria according to daily rainfall intensity.

Daily Rainfall Intensity (mm/day)	Suspension of Work (day)
0 to 10	0
10 to 30	1
30 to 50	2
50 to 100	3
more than 100	4

Annual mean workable days are estimated on the basis of the above criteria and the rainfall records in Maradda for recent 10 years, and the calculation result is shown as follows:

Year	Jan.	Feb.	Mar.	Apr.	May	Jan.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1973	5	13	6	10	8	15	12	8	8	3	2	4
1974	1	6	6	6	6	10	12	2	9	8	2	1
1975	5	1	3	7	19	14	14	9	9	11	5	6
1976	6	2	5	11	14	15	6	0	0	0	7	9
1977	3	1	4	7	4	12	1	0	0	0	0	10
1978	4	2	4	5	9	8	11	6	4	4	1	6
1979	2	3	5	5	4	12	8	0	3	1	3	9
1980	1	7	0	18	12	11	3	1	0	4	2	7
1981	4	1	11	3	13	5	14	3	9	7	9	5
1982	7	6	5	11	13	4	4	3	0	0	-	-
Suspension (Mean)	4	4	5	8	10	11	9	3	4	4	3	6
Workable days	27	24	26	22	21	19	22	28	26	27	27	25

The monthly workable days from the above result are 24.5 days, and taking into account national holidays and sundays, the workable days of the Project is estimated at 20 days for impervious materials and 23 days for general works.

1.2.2 Conversion rate of earth volume

Earth volume is changeable according to the condition as it is. Naturally placed earth materials increases its volume after excavation and decreases after compaction. These changes of volume should be considered for estimation of produced volume by construction equipment, earth moving plan, specification of closing dike embankment and so on. The conversion rate of earth volume is assumed as follows:

Name of Earth	Apparent Unit Weight (t/m^3)	Conversion Rate In Place	In Loose	In Compaction
Sand	1.7	1.00	1.20	0.95
Normal Soil	1.6	1.00	1.25	0.90
Clayey Soil	1.8	1.00	1.35	0.90
Gravel and Weathered Rock	1.9	1.00	1.20	1.00
Excavated Rock	2.5	1.00	1.50	1.20

1.2.3 Basic method of earth works

Earth works consist of excavating, loading, hauling, spreading and compacting. Since there are various methods of these earth works, deep consideration must be needed on the choice of the suitable method. The earth works of big volume have to be depended on the heavy duty equipment.

Following equipments are basically introduced on the earth works of the Project.

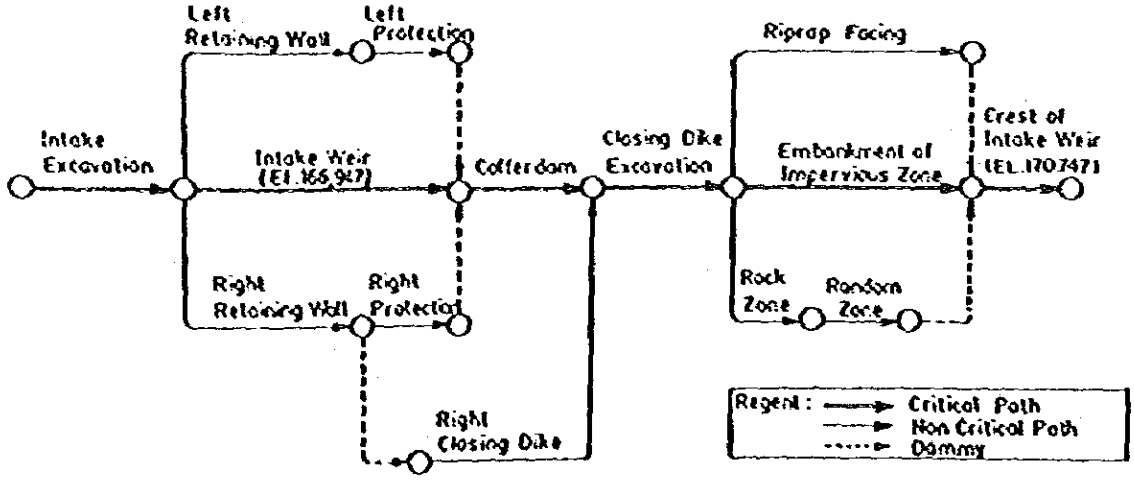
Earth Works	Earth Material	Proposed Equipment
Excavation	Sand, Normal Soil	Bull-Dozer, Back-Hoe Shovel
	Gravel, Weathered Rock	Ripper-Dozer, Back-Hoe Shovel
	Rock	Blasting and Bull-Dozer
Loading	Any kind of materials	Back-Hoe Shovel
Hauling	- do -	Dump-Truck
Spreading	- do -	Bull-Dozer
Compacting	Impervious materials	Tamping-Roller
	Course materials	Vibration-Roller
	Normal Soil	Compactor, Tamper

1.3 Construction of Sanrego Intake Weir

1.3.1 Diversion procedures

The Sanrego intake weir is constructed by coupure method for safety protection from damages caused by flooding during construction period. After completion of foundation excavation, construction on intake weir shall be started, but stone masonry works of the crest have to be limited until EL. 166.947 m because 300 m^3/sec of flood discharge can be passed through the intake weir side during remaining construction of closing dike. Construction of the crest upper than EL. 166.947 m would be progressed on the dry season after completion of closing dike.

The procedures are illustrated as follows:



1.3.2 Excavation

Excavation method of coupure channel and foundation of the intake weir is dependent upon geological condition. Soil materials are mainly excavated by 0.7 m^3 back-hoe shovel. Weathered rock is excavated and gathered by 21 ton ripper-dozer. Solid rock is excavated mainly by blasting with use of bench cut method. Holes for charging dinamite are drilled by crawler drilling machine.

Small volume of rock or rock near the designed excavation line is blasted by skillful manpower with use of jack hummer and pick hummer. After blasted rock is gathered by 21 ton bull-dozer. These excavated materials are loaded by 0.7 m^3 back-hoe shovel into 11 ton dump-truck and hauled to spoil area, after that spreaded by 11 ton bull-dozer

1.3.3 Weir construction

Weir is almost made by stone masonry and reinforced concrete. Construction is mainly by manpower, and concrete is produced by portable concrete mixer. After placed concrete, it must be carefully compacted by vibrator.

As mentioned before, the construction of crest of weir is divided by two stages and the construction joint of old and new must be treated with careful chipping and cleaning.

1.3.4 Construction of closing dike

(1) Excavation

Stripping and soil excavation would be mainly made by 21 ton bull-dozer, and weathered rock would be excavated by ripper-dozer. After excavation, materials would be loaded by 0.7 m^3 back-hoe shovel and hauled by 11 ton dump-truck to the spoil area. At the spoil area, dumped materials would be spreaded by 11 ton bull-dozer.

(2) Embankment

After completion of foundation excavation, contact clay is filled up on the surface of the foundation to make well contact with foundation and embankment materials. Materials for the contact clay would be transported from the borrow area and be well compacted by tamper.

Embankment materials are transported from the following place, respectively.

Impervious Zone	:	Clayey soil at borrow area
Random Zone	:	Excavated materials from coupure channel
Rock Zone	:	Excavated rock from coupure channel
Filter	:	Material at Maradda river

Specified thickness of spreading and number of compaction would be proposed as follows:

Zone	Spreading	Compacting
	(cm)	(no.)
Impervious	20	6
Random	40	4
Rock	50	4

Embankment should be controlled by the D-value, and also water content ratio would be checked throughout the construction period. In case of low water contents ratio, some amount of water would be added to the materials by tank rolley so as to get optimum water contents.

1.4 Canal Construction

1.4.1 Excavation and filling

Stripping and surface excavation of main and secondary canals would be mainly made by 11 ton bull-dozer, and sub-surface and deep excavation, by 0.35 m^3 back-hoe shovel depending on the soil condition at the working site. Weathered rock, which are hard beyond capacity of the back-hoe shovel, would be made by ripper-dozer and pick-hummer. Hard rock would be broken by blasting with dinamite in case of beyond capacity by ripper-dozer. Manpower would mainly be contributed to face smoothing, compacting of canal invert and other minor works.

The excavated materials in excess of filling requirement would be transported to a spoil area. In case of lack of the materials for filling, the materials would be supplemented from borrow area around the site. Spreading of filling materials would be mainly made by bull-dozer and supplementarily, by manpower.

1.4.2 Canal lining

As a result of soil mechanical and geological investigations, some portions of main and secondary canals would be protected with mortar or stone masonry lining. The mortar would be produced by portable concrete mixer. Lining works of mortar and stone masonry be made by manpower.

1.4.3 Related structures

Earth works of related small structures would mainly be done by manpower, and the works of rather big structures such as aqueduct would be done by combination of manpower and back-hoe shovel.

The structures are mainly made of stone masonry or reinforced concrete. The concrete would be produced by a portable concrete mixer.

1.5 Construction of Small-Scaled Intake Weirs on Tributaries

Three intake weirs i.e. Biru, Parota and Macinaga would be constructed as a supplemental intake facilities on three tributaries. Excavation works would be made mainly by back-hoe shovel and supplementarily by manpower. Stone masonry works and other works of intake itself are made by manpower.

Connecting canal constructions are also made by manpower except transportation of filling materials by dump-truck and excavation by back-hoe shovel at borrow area.

1.6 Construction of Farm Road

Farm road of 13.2 km would be newly constructed for the Project. Most of embankment materials are required to be transported from the borrow area. The materials would be excavated and loaded by 0.3 m^3 back-hoe shovel at borrow area, and be transported by 8 ton dump-truck to the site. At site, the materials would be spreaded by 11 ton bulldozer and compacted by 3 ton vibration roller. After completion of the embankment, gravel pavement and sod facing would be made by manpower.

1.7 Construction of Tertiary Canals and Reclamation Works

Tertiary canals and reclamation works would be executed mainly by manpower, but transportation of supplemental earth materials from borrow area would be made by 0.3 m^3 back-hole shovel and 8 ton dump-truck. Related structure would be constructed by manpower.

2. IMPLEMENTATION SCHEDULE

The excavation works of coupure channel for the Sanrego intake weir were almost completed by a local contractor in 1982 and the construction works of the intake weir including closing dike are now prepared for commencement at the beginning of 1983 based on the local tender.

About three (3) years of the construction period will be required for the Sanrego intake weir and closing dike.

The construction of main canal system will be commenced on October, 1984 and be completed on September, 1986. The secondary canal system will be needed about three and half (3.5) years for the construction from April, 1985 to September, 1988.

The construction works of small-scaled intake weirs on the tributaries including connecting canals will be started on April, 1986 and be completed on March, 1987. The farm road networks will be constructed for one (1) year from April, 1988 to March, 1989.

The tertiary development works will take three (3) years for the construction from April, 1986 to March, 1989.

The construction of reclamation works will be done in parallel with the tertiary development works.

The procurement of O&M equipment will be made on 1985/86 of fiscal year for smooth execution of operation and maintenance works for the project facilities.

The total period of the project works including excavation works of coupure channel will be taken about eight (8) years from 1981/82 to 1988/89 as shown in Fig. VIII.2.1.

3. COST ESTIMATE

3.1 General

The project cost comprises direct construction cost, land acquisition cost, procurement cost of O&M equipment, administration cost, engineering services, physical contingency and price contingency.

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

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

US$1.0 = Rp670 = ¥260

(b) The construction works would be executed on the contract basis. 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.

(c) The construction cost comprises foreign currency and local currency portions. Local currency portion is estimated on the basis of the current prices in South Sulawesi in 1982 and 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:

Local currency portion

(i) Labour wage
(ii) Sand, gravel, stone and wooden materials
(iii) 35% of cement
(iv) 20% of steel
(v) 50% of fuel
(vi) 15% of depreciation cost of machinery
(vii) Inland transportation charge
(viii) Transfer payment for local portions, such as general expenses, taxes and levies
(ix) Minor works

Foreign currency portion

(i) 65% of cement
(ii) 80% of steel
(iii) 50% of fuel
(iv) 85% of depreciation cost of machinery
(v) Expenses and fees of engineering services for foreign consultants.

(d) The physical contingency related to the construction quantities is set at 15% of the direct cost. The price contingency is assumed at 7% per annum for foreign currency portion and 13% per annum for local currency portion.

3.2 Estimation of Project Cost

The project cost is estimated at Rp.36,309 million equivalent, comprising Rp.15,895 million of foreign currency and Rp.20,414 million of local currency. The summary of the cost estimate is shown in Table VIII.3.1.

3.3 Annual Disbursement Schedule

The annual disbursement schedule is worked out based on the construction time schedule as shown in Table VIII.3.2 and the summary is as follows:

(Unit: 10^6Rp.)

Financial Years	Total	Foreign Currency	Local Currency
1981/82	943	392	551
1982/83	1,085	469	616
1983/84	1,738	993	745
1984/85	3,133	1,479	1,654
1985/86	6,640	3,520	3,120
1986/87	8,232	3,523	4,709
1987/88	8,006	3,205	4,801
1988/89	6,532	2,314	4,218
Total	36,309	15,895	20,414

3.4 Breakdown of Project Cost

(i) Direct construction cost

Direct construction cost is estimated for the individual items by unit cost basis and the breakdown is shown in Table VIII.3.3.

(ii) Land acquisition

Cost of land acquisition for the project is summarized in Table VIII.3.4.

(iii) O & M equipment

All the construction equipment and materials necessary for the construction of the Project shall be provided by the contractors. While, O & M equipment would be procured by the Government for the smooth operation and maintenance of the project facilities after completion of the construction works. The number of O & M equipment and their purchase costs are estimated as listed in Table VIII.3.5.

(iv) Administration expenses

Administration expenses in the project office comprise staff salary, office expenses, equipment running cost, labour wages and others. These expenses are summarized in Table VIII.3.6 and breakdown of staff salary is shown in Table VIII.3.7.

(v) Engineering services

Engineering services by foreign consultants are required for the detailed design stage and construction supervision. Total required man-month of the engineers is fifty (50) M/M for detailed design stage and two hundred fifty (250) M/M for the construction supervision. The cost for the engineering services is summarized in Table VIII.3.8 and annual assignment schedule is shown in Table VIII.3.9.

3.5 Unit Cost Analysis

Breakdown of construction cost is calculated by use of detailed unit costs.

Each unit cost is composed of the basic unit cost and working rate of labour and/or construction machinery.

Basic cost of labour and materials are basically quotated from "Unit Price" published by the Government of Indonesia, 1982. Basic costs of labour and materials are summarized in Tables VIII.3.10 and VIII.3.11.

Unit cost is calculated in accordance with a criteria of BOW published by the Government of Indonesia and Japanese Standard modified to the condition in Indonesia. Analised unit cost is summarized in Tables VIII.3.12 and VIII.3.13.

3.6 Annual Operation and Maintenance Cost

The annual operation and maintenance cost comprises of the salaries of project administrative and water control staffs, the materials and labour costs for repair and maintenance of project facilities, the costs for operation, repair and maintenance of O & M equipment, and the running costs of project facilities including diesel generators.

The summary of the annual operation and maintenance cost is shown in Table VIII.3.14 and the breakdown of staff salary at O&M stage is shown in Table VIII.3.15.

3.7 Replacement Cost

Some of the project facilities have some shorter useful life than the project life and require replacement at a certain time within the project useful life.

The replacement costs and the useful lives of these facilities are listed in Table VIII.3.16.

Table VIII.3.1 Summary of Project Cost

(Unit: 10^6Rp.)

	Item	Total	Foreign Currency	Local Currency
1.	Preparation Works	844	386	458
2.	Sanrego Intake Weir	4,010	1,949	2,061
3.	Main Canal System	1,700	860	840
4.	Secondary Canal System	6,252	2,951	3,301
5.	Intake Weirs on Tributaries	63	26	37
6.	Farm Road Networks	797	293	504
7.	Tertiary Development	3,945	1,605	2,340
8.	Reclamation Works	384	160	224
	Sub-total	17,995	8,230	9,765
9.	Land Acquisition	416	-	416
10.	O & M Equipment	500	500	-
11.	Administration Expenses	532	-	532
12.	Engineering Services	2,533	2,113	420
13.	Physical Contingency	3,296	1,626	1,670
	Sub-total	7,277	4,239	3,038
	Total	25,272	12,469	12,803
14.	Price Contingency	11,037	3,426	7,611
	Grand Total	36,309	15,895	20,414

Table VIII.3.2 Annual Disbursement of Project Cost

(Unit: 10^6Rp.)

	Item	Total (F)	Total (L)	1981/1982 (F)	1981/1982 (L)	1982/1983 (F)	1982/1983 (L)	1983/1984 (F)	1983/1984 (L)	1984/1985 (F)	1984/1985 (L)	1985/1986 (F)	1985/1986 (L)	1986/1987 (F)	1986/1987 (L)	1987/1988 (F)	1987/1988 (L)	1988/1989 (F)	1988/1989 (L)
1.	Preparatory Works	386	458	48	51	48	51	29	35	116	142	87	107	29	36	29	36	-	-
2.	Sanrego Intake Weir	1,949	2,061	293	354	360	422	409	406	478	473	409	406	-	-	-	-	-	-
3.	Main Canal System	860	840	-	-	-	-	-	-	172	168	430	420	258	252	-	-	-	-
4.	Secondary Canal System	2,951	3,301	-	-	-	-	-	-	-	-	590	660	1,033	1,155	1,033	1,155	295	331
5.	Intake Weirs on Tributaries	26	37	-	-	-	-	-	-	-	-	-	-	26	37	-	-	-	-
6.	Farm Road Networks	293	504	-	-	-	-	-	-	-	-	-	-	-	-	-	-	293	504
7.	Tertiary Development	1,605	2,340	-	-	-	-	-	-	-	-	-	-	481	702	562	819	562	819
8.	Reclamation Works	160	224	-	-	-	-	-	-	-	-	-	-	80	112	80	112	-	-
	Sub-total	8,230	9,765	341	405	408	473	438	441	766	783	1,516	1,593	1,907	2,294	1,704	2,122	1,150	1,654
9.	Land Acquisition	-	416	-	11	-	-	-	-	-	203	-	121	-	61	-	20	-	-
10.	O & M Equipment	500	-	-	-	-	-	-	-	-	-	500	-	-	-	-	-	-	-
11.	Administration Expenses	-	532	-	63	-	63	-	67	-	67	-	68	-	68	-	68	-	68
12.	Engineering Service	2,113	420	-	-	-	-	369	65	358	73	482	98	430	88	283	56	191	40
13.	Physical Contingency	1,626	1,670	51	72	61	80	121	86	168	169	375	282	351	377	298	340	201	264
	Sub-total	4,239	3,038	51	146	61	143	490	218	526	512	1,357	569	781	594	581	484	392	372
	Total	12,469	12,803	392	551	469	616	928	659	1,292	1,295	2,873	2,162	2,688	2,888	2,285	2,606	1,542	2,026
14.	Price Contingency	3,426	7,611	-	-	-	-	65	86	187	359	647	958	835	1,821	920	2,195	772	2,192
	Grand Total	15,895	20,414	392	551	469	616	993	745	1,479	1,654	3,520	3,120	3,523	4,709	3,205	4,801	2,314	4,218

Table VIII.3.3 Breakdown of Direct Construction Cost (1/3)

Item		Unit	Q'ty	Cost (10^3Rp.) Total	FC	LC
1. Preparation Works				844,000	386,000	458,000
2. Sanrego Intake Weir				4,010,000	1,949,000	2,061,000
2-1 Intake Weir						
Coupure Excavation:	Soil	m^3	19,200	24,898	19,714	5,184
	: Weathered Rock	m^3	12,850	23,369	18,569	4,800
	: Rock	m^3	130,000	1,044,070	455,969	588,101
Intake Excavation :	Soil	m^3	7,800	10,115	8,008	2,107
	: Weathered Rock	m^3	5,200	9,496	7,545	1,951
	: Rock	m^3	51,000	409,597	178,881	230,716
Rock-Fill		m^3	4,200	1,935	1,474	461
Concrete Works		m^3	325	15,298	6,531	8,767
Stone Masonry Works		m^3	36,300	931,767	285,340	646,427
Steel Works		ton	1.82	893	660	233
Stop Log		m^3	5.30	2,332	466	1,866
Gate		no.	5	10,175	8,140	2,035
2-2 Closing Dike						
Cofferdam :	Soil	m^3	11,000	14,266	11,296	2,970
Excavation :	Weathered Rock	m^3	1,600	2,922	2,321	601
Embankment		m^3	49,000	97,767	76,794	20,973
Dike Excavation :	Soil	m^3	61,000	79,110	62,637	16,473
	: Weathered Rock	m^3	13,800	25,197	20,022	5,175
	: Rock	m^3	3,800	27,196	13,318	13,878
Embankment :	Impervious Zone	m^3	240,500	485,388	377,995	107,393
	: Random Zone	m^3	60,800	69,087	54,574	14,513
	: Rock Zone	m^3	2,700	6,344	5,069	1,275
	: Filter	m^3	4,200	9,709	7,514	2,195
	: Contact Clay	m^3	8,400	16,714	13,131	3,583
	: Riprap	m^3	8,850	56,409	9,065	47,344
	: Sod Facing	m^2	15,600	10,160	-	10,160
2-3 Overhead & Others		L.S.		625,785	303,957	321,819
3. Main Canal System				1,700,000	860,000	840,000
3-1 Earth Works						
Excavation :	Stripping	m^3	64,800	89,882	69,925	19,957
	: Soil	m^3	76,440	92,407	73,152	19,255
	: Weathered Rock	m^3	32,760	70,915	42,389	28,586
	: Rock	m^3	40,900	236,437	75,843	160,594
Embankment		m^3	336,700	374,135	288,638	85,497
Sod Facing		m^2	97,500	63,492	-	63,492
Mortar Lining		m^2	17,900	20,397	6,162	14,235
Gravel Pavement		m^2	34,800	47,503	382	47,121
3-2 Related Structures						
Turnout		no.	10	40,964	13,618	27,346
Cross Drain/Culvert		no.	21	281,750	96,835	184,915
Bridge		no.	4	8,664	3,089	5,575
Aqueduct		no.	1	74,721	28,940	45,781
Romijn Gate		no.	23	25,300	20,240	5,060
Sluice Gate		no.	6	8,360	6,710	1,650
3-3 Overhead & Others		L.S.		265,013	134,077	130,936

Table VIII.3.3 Breakdown of Direct Construction Cost (2/3)

Item		Unit	Q'ty	Cost (10^3Rp.) Total	FC	LC
4. Secondary Canal System				**6,252,000**	**2,951,000**	**3,301,000**
4-1 Earth Works						
Excavation:	Stripping	m^3	390,400	541,521	421,279	120,242
:	Soil	m^3	381,480	461,168	365,076	96,092
:	Weathered Rock	m^3	156,720	339,550	202,789	136,761
:	Rock	m^3	90,700	652,364	269,456	382,908
Embankment		m^3	857,700	741,940	569,367	172,573
Sod Facing		m^2	644,600	419,762	-	419,762
Mortar Lining		m^2	11,100	12,649	3,821	8,828
Stone Masonry Lining		m^2	19,400	47,416	4,459	42,957
Gravel Pavement		m^2	292,500	399,291	3,218	396,073
4-2 Related Structures						
Turnout		no.	90	368,676	122,562	246,114
Cross Drain/Culvert		no.	58	778,169	267,450	510,719
Drop		no.	64	77,088	22,176	54,912
Bridge		no.	21	45,484	16,216	29,268
Chute		no.	7	61,692	20,420	41,272
Aqueduct		no.	2	149,442	57,880	91,562
Romijn Gate		no.	164	180,400	144,320	36,080
4-3 Overhead & Others		L.S.		975,388	460,511	514,877
5. Intake Weirs on Tributaries				**63,000**	**26,000**	**37,000**
5-1 Biru Intake Weir						
Intake Weir	Excavation	m^3	1,120	1,164	759	405
	Stone Masonry Facing	m^2	22	53	5	48
	Gate & Others	no.	2	2,200	1,760	440
Connecting Canal	Embankment	m^3	3,920	5,589	3,509	2,080
	Sod Facing	m^2	1,200	781	-	781
	Masonry Works & Others	m^2	530	2,454	480	1,974
	Gate (Romijn)	no.	1	1,100	880	220
5-2 Parota Intake Weir						
Intake Weir	Excavation	m^3	165	358	-	358
	Embankment	m^3	330	653	306	347
	Masonry Works & Others	m^3	256	6,742	2,061	4,681
	Steel Works & Others	L.S.		569	164	405
Connecting Canal	Excavation: Soil	m^3	530	265	210	55
	: W/R,R	m^3	2,120	8,834	4,095	4,738
	Embankment	m^3	3,760	2,759	1,359	1,400
	Sod Facing	m^2	1,190	911	-	911
	Masonry Facing & Others	m^2	680	2,483	408	2,075
	Steel Works	L.S.		279	206	73
5-3 Macinaga Intake Weir						
Intake Weir	Excavation: Soil	m^3	180	188	120	68
	Weathered Rock	m^3	20	55	9	46
	Embankment	m^3	40	18	-	18
	Masonry Works & Others	m^3	150	4,350	1,288	3,062
	Steel Works	ton	0.17	85	63	22
Connecting Canal	Excavation : Soil	m^3	4,850	2,734	1,537	1,197
	Embankment	m^3	7,040	4,851	2,296	2,555
	Sod Facing	m^2	3,500	2,279	-	2,279
	Masonry Facing & Others	m^2	364	1,824	376	1,448
5-4 Overhead & Others		L.S.		9,442	4,108	5,334

Table VIII.3.3 Breakdown of Direct Construction Cost (3/3)

Item	Unit	Q'ty	Cost (10^3Rp.) Total	FC	LC
6. Farm Road			**797,000**	**293,000**	**504,000**
6-1 Earth Works					
Excavation: Stripping	m^3	5,940	8,237	6,409	1,828
: Soil	m^3	2,060	1,032	816	216
Embankment	m^3	49,550	84,505	64,976	19,529
Gravel Pavement	m^2	39,600	54,958	436	53,622
Sod Facing	m^2	35,640	23,209	-	23,209
6-2 Related Structures					
Drain Culvert	no.	6	114,037	37,504	76,533
Bridge	no.	3	381,150	135,520	245,630
Crossing Pipe	m	346	6,410	2,002	4,408
6-3 Overhead & Others	L.S.		124,362	45,337	79,025
7. Tertiary Development	ha	**8,000**	**3,945,000**	**1,605,000**	**2,340,000**
7-1 Earth Works					
Excavation: Stripping	m^3	131,500	97,706	-	97,706
: Soil	m^3	211,500	157,147	-	157,147
Embankment	m^3	490,600	720,830	440,835	279,995
Sod Facing	m^2	576,600	311,754	-	311,754
7-2 Related Structures					
Stone Masonry	m^3	52,710	1,229,977	376,683	853,294
Concrete Pipe Works	m	4,680	48,575	18,590	29,985
Steel Gate	no.	2,438	609,520	487,616	121,904
Stop Log	m^3	384	153,599	30,720	122,879
7-3 Overhead & Others	L.S.		615,892	250,556	365,336
8. Reclamation Works			**384,000**	**160,000**	**224,000**
Upland	ha	500	105,484	44,303	61,181
Grassland	ha	600	182,278	75,949	106,329
Orchard	ha	100	36,286	15,189	21,097
Overhead & Others	L.S.		59,952	24,559	35,393

Table VIII.3.4 Summary Table of Land Acquisition

(Unit : 10^3Rp.)

Item	Unit	Q'ty	Local Currency
Sanrego Intake	ha	10.80	10,800
Main Canal	ha	38.17	38,200
Secondary Canal			
Left Bank	ha	49.86	49,900
Right Bank	ha	145.19	145,200
Intake Weirs on Tributaries/1			
Biru Intake	ha	0.63	600
Parota Intake	ha	1.21	1,200
Macinaga Intake	ha	2.14	2,100
Tertiary Development	ha	168.0	168,000
T o t a l			416,000

Note :/1 Including connecting canal

Table VIII.3.5 Purchase Cost of O & M Equipment

(Unit : 10^3Rp.)

No.	Equipment	Unit Cost	Required No.	Amount
1. Vehicle and Equipment				
(1)	Back-hoe shovel 0.35 m^3	31,900	2	63,800
(2)	Bull-dozer, 11 ton	33,200	1	33,200
(3)	Bull-dozer, 5 ton	18,300	2	36,600
(4)	Motor grader, Blade 3 m	31,000	1	31,000
(5)	Water tank rolley, 3.8 kl	12,500	1	12,500
(6)	Soil Compactor, 90 kg	700	3	2,100
(7)	Portable Concrete mixer,0.2m^3	1,300	2	2,600
(8)	Concrete vibrator, ø 32	300	5	1,500
(9)	Submargible pump, ø 150	1,000	3	3,000
(10)	Generator, 10 KVA	2,600	1	2,600
(11)	Trailer truck, 15 ton	29,100	1	29,100
(12)	Dump truck, 8 ton	15,800	1	15,800
(13)	Dump truck, 2 ton	4,800	2	9,600
(14)	Cargo truck w/Crane, 4 ton	12,300	1	12,300
(15)	Truck, pick-up type,2 ton	3,800	1	3,800
(16)	Jeep, four wheel drive	4,800	4	19,200
(17)	Sedan, 6 persons	7,500	1	7,500
(18)	Repair shop tools		L.S	30,000
(19)	Spare parts (20% of the above)		L.S	63,800
	sub-total			380,000
2. Telecommunication System				120,000
	Total			500,000

Table VIII.3.6 Administration Expenses
(Construction Stage)

(Unit : 10^3Rp.)

Year	Staff Salary	Labour Wage	Office Expenses	Equipment Running Cost	Other Related Cost	Total
1981/82	45,200	3,400	3,100	6,300	5,000	63,000
1982/83	45,200	3,400	3,100	6,300	5,000	63,000
1983/84	48,700	3,500	3,100	6,700	5,000	67,000
1984/85	48,700	3,500	3,100	6,700	5,000	67,000
1985/86	48,700	4,000	3,100	6,700	5,500	68,000
1986/87	48,700	4,000	3,100	6,700	5,500	68,000
1987/88	48,700	4,000	3,100	6,700	5,500	68,000
1988/89	48,700	4,000	3,100	6,700	5,500	68,000
T o t a l	382,600	29,800	24,800	52,800	42,000	532,000

Table VIII.3.7 Staff Salary for the Project Office
(Construction Stage)

Year	Grade I		Grade II		Grade III		Grade IV		Grade V		Total Amount
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	
											(10^3Rp)
1981/82	1	2,400	5	8,400	7	9,240	10	9,600	20	15,600	45,200
1982/83	1	2,400	5	8,400	7	9,240	10	9,600	20	15,600	45,200
1983/84	1	2,400	5	8,400	7	9,240	12	11,520	22	17,160	48,700
1984/85	1	2,400	5	8,400	7	9,240	12	11,520	22	17,160	48,700
1985/86	1	2,400	5	8,400	7	9,240	12	11,520	22	17,160	48,700
1986/87	1	2,400	5	8,400	7	9,240	12	11,520	22	17,160	48,700
1987/88	1	2,400	5	8,400	7	9,240	12	11,520	22	17,160	48,700
1988/89	1	2,400	5	8,400	7	9,240	12	11,520	22	17,160	48,700

Remaeks : (1); Number of required staff (person)

(2); Sraff salary (10^3Rp)

Annual Salaries for respective grades are based on the following,

Grade I : 200,000 Rp/month, Project Manager
Grade II : 140,000 Rp/month, Division Chief
Grade III : 110,000 Rp/month, Engineer, Branch Office Chief
Grade IV : 80,000 rp/month, Assistant Engineer, Assistant Officer
Grade V : 65,000 Rp/month, Draftman, Typist, Gate Keeper

Table VIII.3.8 Cost for Engineering Services

Description	Detailed Design	Construction Supervision	Total
I. Yen Currency Portion ($\times 10^3$ Yen)	(50M/M)	(250M/M)	(300M/M)
1) Remuneration	100,000	500,000	600,000
2) Direct Cost	15,000	55,000	70,000
3) Government Inspection and Training	5,000	20,000	25,000
4) Special Equipment	10,000	40,000	50,000
5) Contingency	13,000	62,000	75,000
T o t a l	143,000 (Rp. 369×10^6)	677,000 (Rp. $1,744 \times 10^6$)	820,000 (Rp. $2,113 \times 10^6$)
II. Rupiah Currency Portion ($\times 10^3$ Rp.)			
1) Perdiem Subsistance Allowance	14,000	68,000	82,000
2) Inland Air Fare	12,000	58,000	70,000
3) Inland Communication Cost	1,000	10,000	11,000
4) Office Supply and Consumables	2,000	13,000	15,000
5) Running Cost for Housing	3,000	16,000	19,000
6) Salary for Local Employee	5,000	35,000	40,000
7) Report Printing Cost	10,000	20,000	30,000
8) Vehicles and Gasoline	12,000	103,000	115,000
9) Contingency	6,000	32,000	38,000
T o t a l	65,000 (Rp. 65×10^6)	355,000 (Rp. 355×10^6)	420,000 (Rp. 420×10^6)

Table VIII.3.9 Consultant Assignment Schedule

	Detailed Design (1983/84)	Assigned Period (M/M)
1.	Project Director	1.0
2.	Team Leader	6.0
3.	Irrigation Engineer	4.0
4.	Design Engineer A	6.0
5.	Design Engineer B	6.0
6.	Design Engineer C	6.0
7.	Topo-Survey Engineer A	3.0
8.	Topo-Survey Engineer B	3.0
9.	Construction Planner	3.0
10.	Equipment Engineer	2.0
11.	Technical Spec. Expert	3.0
12.	Specialist as Required	5.0
13.	Liaison Engineer	2.0
	Total	50.0

	Construction Supervision	1983/ 84	1984/ 85	1985/ 86	1986/ 87	1987/ 88	1988/ 89	Assigned Period (M/M)
1.	Project Director	-	0.5	-	0.5	0.5	0.5	2.0
2.	Team Leader	-	12.0	12.0	12.0	12.0	12.0	60.0
3.	Construction Engineer A	-	6.0	12.0	12.0	12.0	12.0	54.0
4.	Construction Engineer B	-	-	12.0	12.0	12.0	-	36.0
5.	Design Engineer A	-	10.0	12.0	12.0	6.0	-	40.0
6.	Design Engineer B	-	-	12.0	12.0	-	-	24.0
7.	Mechanical Engineer	-	-	2.0	-	-	-	2.0
8.	Topo-Survey Engineer	-	6.0	4.0	-	-	-	10.0
9.	O & M Expert	-	-	2.0	-	-	3.0	5.0
10.	Specialist as Required	-	3.0	3.0	2.0	2.0	2.0	12.0
11.	Liaison Engineer	-	1.0	1.0	1.0	1.0	1.0	5.0
	Total	-	38.5	72.0	63.5	45.5	30.5	250.0

Table VIII.3.10 Unit Cost of Labour

No.	Item	Unit	Bone	Sinjai	Result
1.	Labour	md	950	900	950
2.	Foreman	md	1,200	1,200	1,200
3.	Carpenter	md	1,750	1,750	1,750
4.	Head of Carpenter	md	2,000	2,000	2,000
5.	Stone-Worker	md	1,750	1,750	1,750
6.	Head of Stone-Worker	md	2,000	2,000	2,000
7.	Steel-Worker	md	1,750	1,750	1,750
8.	Head of Steel-Worker	md	2,000	2,000	2,000
9.	Painter	md	1,750	1,750	1,750
10.	Head of Painter	md	2,000	2,000	2,000
11.	Asphalt-Mix Worker	md	1,750	1,750	1,750
12.	Driver	md	-	-	2,500
13.	Operator	md	-	-	3,500
14.	Mechanical	md	-	-	3,500
15.	Head of Operator & Mechanical	md	-	-	4,000

Table VIII.3.11 Unit Cost of Material (1/4)

No.	Item	Unit	Bone	Sinjai	Result
1.	Stone				
	a. Compacted River Stone	m^3	3,500	3,500	3,500
	b. Crashed River Stone	m^3	4,000	4,000	4,000
	c. Mountain Stone	m^3	4,000	4,000	4,000
	d. Pasting Stone	m^3	-	-	-
	e. Stone Ø 5 - 7cm	m^3	4,500	5,000	5,000
	f. Split Stone	m^3	6,000	6,000	6,000
2.	Sand				
	a. Dump's Sand	m^3	2,500	2,000	2,500
	b. Morter's Sand	m^3	3,000	2,500	3,000
	c. Concrete's Sand	m^3	3,500	3,500	3,500
3.	Gravel				
	a. Coarse Gravel	m^3	4,500	3,500	4,500
	b. Fine Gravel	m^3	5,000	4,000	5,000
4.	Stirred Lime	m^3	12,500	15,000	15,000
5.	Cement				
	a. "Tonasa"	Zak (40 kg)	2,500	2,700	2,700
	b. "Tiga Roda"	Zak (40 kg)	2,400	2,600	2,600
	C. White Cement	Zak (40 kg)	8,000	8,250	8,250
6.	Brick				
	a. 1st Quality	Piece	28	24	28
	b. 2nd Quality	Piece	26	21	26

to be continued

Table VIII.3.11 Unit Cost of Material (2/4)

No.	Item	Unit	Bone	Sinjai	Result
7.	Dynamite				
	a. Dynamite	kg	-	-	4,500
	b. Detonator	Pc	-	-	1,000
8.	Sod	m^2	-	-	270
9.	Wood				
	a. 1st Class Wood				
	-"Bayam" Beam	m^3	135,000	190,000	190,000
	-"Bayam" Board	m^3	150,000	200,000	200,000
	b. 2nd Class Wood				
	-"Samarinda" Beam	m^3	80,000	90,000	90,000
	-"Samarinda" Board	m^3	90,000	95,000	95,000
	c. 3rd Class Wood				
	-"Lonrong" Beam	m^3	50,000	45,000	50,000
	-"Lonrong" Board	m^3	60,000	50,000	60,000
10.	Nail				
	a. Normal	kg	800	750	800
	b. Screw	kg	2,100	-	2,100
11.	Bamboo				
	a. Large Diameter	Stick	500	700	700
	b. Medium Diameter	Stick	400	500	500
	c. Small Diameter	Stick	300	300	300
12.	Steel for Reinforced Concrete				
	a. Reinforced Iron Bar	kg	400	365	400
	b. Wire for Binding	kg	900	875	900

to be continued

Table VIII.3.11 Unit Cost of Material (3/4)

No.	Item	Unit	Bone	Sinjai	Result
13.	Angle Steel (L)				
	a. L 40,40.3 - 6 m	Stick	5,000	-	5,000
	b. L 30,30.3 - 6 m	Stick	4,000	-	4,000
	c. L 50,50.4 - 6 m	Stick	8,000	-	8,000
	d. L 40,40.4 - 6 m	Stick	7,000	-	7,000
	e. L 50,50.5 - 6 m	Stick	8,500	-	8,500
	f. L 60,60.6 - 6 m	Stick	17,500	-	17,500
	g. L 70,70.7 - 6 m	Stick	-	-	-
14.	Steel Pipe				
	a. Ø ¼ "	Stick	-	3,500	3,500
	b. Ø ½ "	Stick	-	4,000	4,000
	c. Ø ¾ "	Stick	6,000	5,000	6,000
	d. Ø 1 "	Stick	-	-	-
	e. Ø 1¼ "	Stick	-	-	-
	f. Ø 1½ "	Stick	-	-	-
	g. Ø 2 "	Stick	16,500	-	16,500
	h. Ø 2½ "	Stick	-	-	-
	i. Ø 3 "	Stick	-	-	-
15.	PVC Pipe (in Ujung Pandang)				
	a. Ø ½ "	Stick	-	-	(1,500)
	b. Ø ¾ "	Stick	-	-	(1,750)
	c. Ø 1 "	Stick	-	-	(2,500)
	d. Ø 1½ "	Stick	-	-	(3,500)
	e. Ø 2 "	Stick	-	-	(6,000)
	f. Ø 2½ "	Stick	-	-	(9,000)
	g. Ø 3 "	Stick	-	-	(15,000)
	h. Ø 4 "	Stick	-	-	(20,000)

to be continued

Table VIII.3.11 Unit Cost of Material (4/4)

No.	Item	Unit	Bone	Sinjai	Result
16.	Fuel				
	a. Gasoline	Liter	240	240	240
	b. Diesel Oil	Liter	85	85	85
17.	Asphalt	kg	-	-	450
18.	Concrete Pipe (L=1m)				
	a. Ø 300 m/m	m	-	-	6,000
	b. Ø 600 m/m	m	-	-	9,000
	c. Ø 800 m/m	m	-	-	12,000
	d. Ø 1,000 m/m	m	-	-	15,000

Table VIII.3.12 List of Unit Cost by Man Power (1/3)

	Item	Unit	Unit Cost	Currency		Remarks
				Foreign	Local	
			(Rp)	(Rp)	(Rp)	
Mp	1. Excavation by Manpower					
	1-1 Normal	m^3	743	-	743	BOW A1
	1-2 Hard Soil	m^3	990	-	990	A2
	1-3 Soil Incl. Stone	m^3	1,485	-	1,485	A3
	1-4 Mud Soil	m^3	1,485	-	1,485	A4
	1-5 Rocky Soil	m^3	1,979	-	1,979	A5
Mp	2. Hauling by Manpower (Cost = 3.45L + 259.1)					
	2-1 L = 30m	m^3	326	-	326	BOW A6
	2-2 L = 50m	m^3	432	-	432	A7
	2-3 L = 100m	m^3	604	-	604	
	2-4 L = 150m	m^3	777	-	777	
	2-5 L = 200m	m^3	949	-	949	
	2-6 L = 250m	m^3	1,122	-	1,122	
	2-7 L = 300m	m^3	1,294	-	1,294	
Mp	3. Hauling by Trolley (Cost = 0.275L + 99.0)					
	3-1 L = 50m		113	-	113	BOW A8
	3-2 L = 100m		127	-	127	
	3-3 L = 150m		140	-	140	
	3-4 L = 200m		154	-	154	
	3-5 L = 250m		168	-	168	
	3-6 L = 300m		182	-	182	
	3-7 L = 500m		237	-	237	
	3-8 L = 1,000m		374	-	374	
Mp	4. Gathering Aggregate at site					
	4-1 Gravel		1,597	-	1,597	
	4-2 Sand		1,347	-	1,347	
Mp	5. Rock Breaking					
	5-1 Pick Hammer	m^3	3,449	1,573	1,876	
	5-2 Blasting (small)	m^3	5,707	1,714	3,993	
	5-3 Blasting (Big)	m^3	4,664	1,230	3,434	

to be continued

Table VIII.3.12 List of Unit Cost by Man Power (2/3)

	Item	Unit	Unit Cost	Currency Foreign	Currency Local	Remarks
			(Rp)	(Rp)	(Rp)	
Mp 6.	Felling & Pulling out of root by manpower	a	5,974	-	5,974	
Mp 7.	Excluding Sundries, Stones from Soil	a	1,873	-	1,873	
Mp 8.	Smoothing of Face Excavated or Filled up	m^2	449	-	449	
Mp 9.	Fill & Back Fill					
	9-1 By Manpower	m^3	394	-	394	
	9-2 By Compactor	m^3	307	50	257	
Mp 10.	Aggregate Prepared at Site					
	10-1 Gravel	m^3	0,166xL + 3,958	0.125xL + 263	0.041xL + 3.695	
	10-2 Sand	m^3	0.159xL + 3,596	0.122L + 235	0.037L + 3,361	
Mp 11.	Mortar	m^3	22,662	12,530	10,132	
Mp 12.	Concrete Mixed by Manpower					
	12-1 σ28 = 160kg	m^3	34,570	13,098	21,472	BOW G42
	12-2 σ28 = 180kg	m^3	35,703	14,022	21,681	
	12-3 σ28 = 210kg	m^3	37,001	14,918	22,083	BOW G41
Mp 13.	Concrete Mixed by Mixer					
	13-1 σ28 = 160kg	m^3	33,550	14,116	19,434	
	13-2 σ28 = 180kg	m^3	34,738	15,086	19,652	
	13-3 σ28 = 210kg	m^3	36,101	16,027	20,074	
Mp 14.	Form for Concrete					
	14-1 Wooden type I	m^2	3,395	384	3,011	
	14-2 Wooden type II	m^2	2,041	245	1,796	
	14-3 Metal Form	m^2	1,680	1,356	324	

to be continued

Table VIII.3.12 List of Unit Cost by Man Power (3/3)

Item	Unit	Unit Cost (Rp)	Currency Foreign (Rp)	Currency Local (Rp)	Remarks
Mp 15. Reinforced Iron Bar	t	446,300	329,600	116,700	
Mp 16. Wooden Scaffalding	m^3	990	32	958	
Mp 17. Gabion (ø 4m/m)	m^3	14,895	-	14,895	BOW B5f
Mp 18. Stone Masonry					
18-1 For Structure	m^3	23,335	7,146	16,189	G 31 h
18-2 For Lining	m^2	2,222	209	2,013	G 3
Mp 19. Sod Facing	m^3	592	-	592	
Mp 20. Drainage Pump					
20-1 Pump Operation	d	7,906	3,554	4,352	
20-2 Stand table	set	8,328	407	7,921	
Mp 21. Maintenance for Gravel Road	m^2	725	-	725	BOW C7
Mp 22. Asphalt pavement	m^2	1,333	-	1,333	BOW W5
Mp 23. Gravel Pavement	m^2	1,241	10	1,231	
Mp 24. Concrete Pipe					
24-1 ø 300 m/m	m	6,253	2,438	3,815	
24-2 ø 600 m/m	m	9,379	3,658	5,721	
Mp 25. Liprap Facing	m^3	5,050	-	5,050	No include material cost
Mp 26. Mortar Lining	m^2	1,036	313	723	

Table VIII.3.13 List of Unit Cost by Heavy Equipment (1/4)

No.	Item	Unit	Unit Cost	Currency		Remarks
				Foreign	Local	
			(Rp)	(Rp)	(Rp)	
Eq. 1.	Excavation by Bull Dozer (11ton)					
1-1	Sand	m^3	319	252	67	
1-2	Normal Soil	m^3	373	294	79	
1-3	Clayey Soil	m^3	447	353	94	
1-4	Gravel & W/R	m^3	447	353	94	
Eq. 2.	Excavation by Bull Dozer (21ton)					
2-1	Sand	m^3	282	226	56	
2-2	Normal Soil	m^3	328	263	65	
2-3	Clayey Soil	m^3	394	316	78	
2-4	Gravel & W/R	m^3	394	316	78	
2-5	Excavated Rock	m^3	563	451	112	
Eq. 3.	Excavation by Ripper Dozer (21ton)					
3-1	Weathered Rock	m^3	264	213	51	
Eq. 4.	Excavation by Back Hoe ($0.35m^3$)					
4-1	Sand	m^3	460	364	96	
4-2	Normal Soil	m^3	455	360	95	
4-3	Clayey Soil	m^3	585	463	122	
4-4	Gravel & W/R	m^3	644	510	134	
4-5	Excavated Rock	m^3	1,283	1,015	268	
Eq. 5.	Excavation by Back Hoe ($0.7m^3$)					
5-1	Sand	m^3	381	308	73	
5-2	Normal Soil	m^3	410	331	79	
5-3	Clayey Soil	m^3	485	391	94	
5-4	Gravel & W/R	m^3	534	431	103	
5-5	Excavated Rock	m^3	1,070	863	207	
Eq. 6.	Excavation by Back Hoe ($1.2m^3$)					

to be continued

Table VIII.3.13 List of Unit Cost by Heavy Equipment (2/4)

No.	Item	Unit	Unit Cost	Currency		Remarks
				Foreign	Local	
			(Rp)	(Rp)	(Rp)	
6-1	Sand	m^3	412	338	74	
6-2	Normal Soil	m^3	443	364	79	
6-3	Clayey Soil	m^3	524	430	94	
6-4	Gravel & W/R	m^3	576	473	103	
6-5	Excavated Rock	m^3	1,154	947	207	
Eq. 7.	Loading by Tractor Shovel ($1.2m^3$)					
7-1	Sand	m^3	432	342	90	
7-2	Normal Soil	m^3	432	342	90	
7-3	Clayey Soil	m^3	432	342	90	
7-4	Gravel & W/R	m^3	494	391	103	
7-5	Excavated Rock	m^3	494	391	103	
Eq. 8.	Loading by Tractor Shovel ($1.8m^3$)					
8-1	Sand	m^3	405	323	82	
8-2	Normal Soil	m^3	405	323	82	
8-3	Clayey Soil	m^3	405	323	82	
8-4	Gravel & W/R	m^3	463	369	94	
8-5	Excavated Rock	m^3	463	369	94	
Eq. 9.	Loading by Tractor Shovel ($2.2m^3$)					
9-1	Sand	m^3	418	338	80	
9-2	Normal Soil	m^3	418	338	80	
9-3	Clayey Soil	m^3	418	338	80	
9-4	Gravel & W/R	m^3	478	386	92	
9-5	Excavated Rock	m^3	478	386	92	
Eq.10.	Hauling by Dump Track (8ton)					
10-1	Sand	m^3	0.149L + 312	0.112L + 235	0.037L + 77	
10-2	Normal Soil	m^3	0.140L + 293	0.106L + 221	0.034L + 72	

to be continued

Table VIII.3.13 List of Unit Cost by Heavy Equipment (3/4)

No.	Item	Unit	Unit Cost	Currency		Remarks
				Foreign	Local	
			(Rp)	(Rp)	(Rp)	
10-3	Clayey Soil	m^3	0.156L + 330	0.118L + 249	0.038L + 81	
10-4	Gravel & W/R	m^3	0.166L + 349	0.125L + 263	0.041L + 86	
10-5	Excavated Rock	m^3	0.217L + 459	0.164L + 346	0.053L + 113	
Eq.11.	Hauling by Dump Truck (11ton)					
11-1	Sand	m^3	0.127L + 267	0.097L + 204	0.030L + 63	
11-2	Normal Soil	m^3	0.135L + 282	0.103L + 216	0.032 + 66	
11-3	Clayey Soil	m^3	0.143L + 300	0.109L + 229	0.034L + 71	
11-4	Gravel & W/R	m^3	0.151L + 317	0.115L + 242	0.036L + 75	
11-5	Excavated Rock	m^3	0.199L + 417	0.152L + 319	0.047L + 98	
Eq.12.	Spreading by Bull Dozer (11ton)					
12-1	Sand	m^3	166	131	35	
12-2	Normal Soil	m^3	184	145	39	
12-3	Clayey Soil	m^3	186	147	39	
12-4	Gravel & W/R	m^3	152	120	32	
12-5	Excavated Rock	m^3	142	112	30	
Eq.13.	Spreading by Bull Dozer (21ton)					
13-1	Sand	m^3	218	175	43	
13-2	Normal Soil	m^3	243	195	48	
13-3	Clayey Soil	m^3	247	198	49	
14-4	Gravel & W/R	m^3	200	160	40	
13-5	Excavated Rock	m^3	187	150	37	
Eq.14.	Compaction by Vibration Roller (3ton)					
14-1	Filter, Drain	m^3	267	199	68	

to be continued

Table VIII.3.13 List of Unit Cost by Heavy Equipment (4/4)

No.	Item	Unit	Unit Cost	Currency		Remarks
				Foreign	local	
			(Rp)	(Rp)	(Rp)	
Eq.15.	Compaction by Vibration Roller (15ton)					
15-1	Random Materials	m^3	480	392	88	
15-2	Rock Materials	m^3	395	323	72	
Eq.16.	Compaction by Tire Roller (10-20ton)					
16-1	Random Materials	m^3	50	38	12	
Eq.17.	Compacting by Tamping Roller (17t)					
17-1	Impervious Materials	m^3	239	194	45	
Eq.18.	Water Content Control by Tank Rolley (5kl)					
18-1	1 day	day	53,497	36,673	16,824	
Eq.19.	Transportation by Truck (10t) (Up to Site)					
19-1	1 way	way	52,305	38,483	13,822	
19-2	1 ton/way	ton	5,230	3,848	1,382	
Eq.20.	Transportation by Trailer (32t) (Up to Site)					
20-1	1 way	way	113,595	85,028	28,567	
20-2	1 ton	ton	3,549	2,657	892	
Eq.21.	Lifting by Truck Crane (2ton)					
21-1	1 day	day	39,759	27,925	11,834	
Eq.22.	Lifting by Truck Crane (25ton)					
22-1	1 day	day	229,861	184,333	45,528	
Eq.23.	Maintenans of road by Motor Grader					
23-1	1 day	day	100,237	78,413	21,824	
23-2	Grading	m^2	45	35	10	

Table VIII.3.14 Annual Operation & Maintenance Cost

Item	Amount (10^3Rp.)
1. Salaries	
1.1 Staff Salaries	131,000
1.2 Labour Wages 360 M/M @ 30,000	11,000
2. Office Expenses	8,000
3. Operation Cost	
3.1 Gate Operation	10,000
3.2 Vehicles	20,000
4. Maintenance Cost (0.5% of direct cost)	
4.1 Intake Weirs	20,000
4.2 Main and Secondary Canal	38,000
4.3 Farm Road	4,000
5. Miscelleaneous L.S.	24,000
T o t a l	266,000

Table VIII.3.15 Staff Salary at O & M Stage

Item	Required Number	Monthly Unit Rate	Yearly Amount
		(Rp.)	(10^3Rp.)
1. Project Office			
(1) Project Manager	1	200,000	2,400
(2) Secretary/Typist	1	65,000	780
2. Administrative Division			
(1) Administratic Officer (Chief)	1	140,000	1,680
(2) Accountant	1	110,000	1,320
(3) Cashier	1	110,000	1,320
(4) Finance Officer	1	110,000	1,320
(5) Personnel Officer	1	110,000	1,320
(6) Clerks/Typist	2	65,000	1,560
(7) Store Keeper	2	65,000	1,560
3. Technical Division			
(1) Civil Engineer	1	140,000	1,680
(2) Irrigation Engineer	1	110,000	1,320
(3) Design Engineer	1	110,000	1,320
(4) Construction Engineer	1	110,000	1,320
(5) Field Supervisor	2	80,000	1,920
(6) Mechanical Engineer	1	110,000	1,320
(7) Mechanic	1	80,000	960
(8) Electrician	1	80,000	960
(9) Operator	3	80,000	2,880
(10) Driver	4	65,000	3,120
(11) Water Officer	1	110,000	1,320
(12) Assist. Water Officer	2	80,000	1,920
(13) Clerks/Typist	3	65,000	2,340
4. Sub-Office			
(1) Sub-office Chief	3	140,000	5,040
(2) Officer	15	110,000	19,800
(3) Waterman	90	65,000	70,200
T o t a l			130,680 (131,000)

Table VIII.3.16 Replacement Cost and Useful Life

(Unit : 10^6Rp.)

Item	Useful Life (Year)	Replacement Cost (10^6Rp.)
1. O&M Equipment	10	2,000
2. Screen, Back screen pipes of tirol type weir, Stoplog,etc.	10	940
3. Steel Gate	25	280
T o t a l		3,220

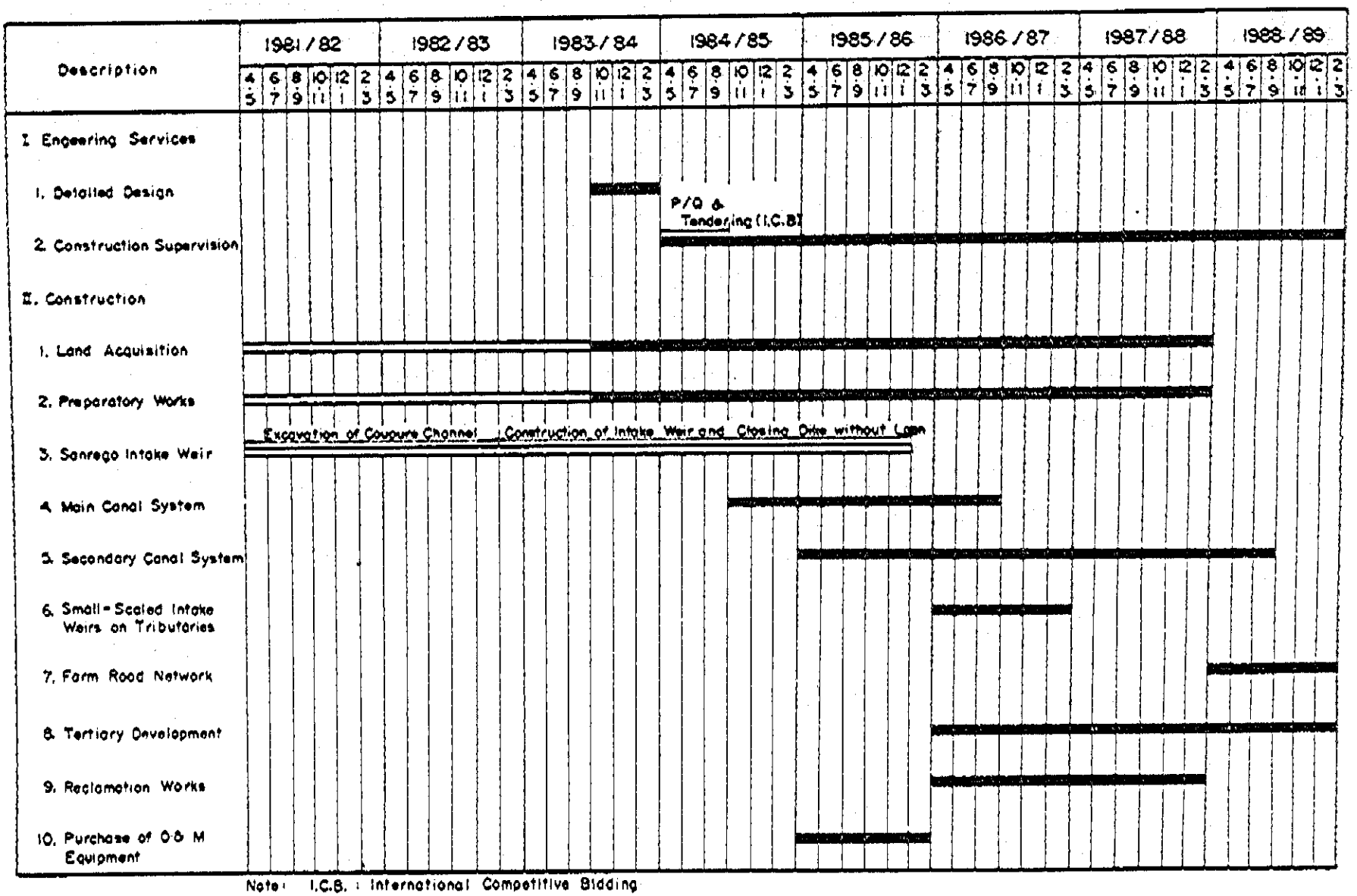


Fig. VIII.2.1 PROJECT IMPLEMENTATION SCHEDULE

ANNEX - IX

PROJECT EVALUATION

ANNEX - IX PROJECT EVALUATION

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ANNEX - IX PROJECT EVALUATION

1. GENERAL

The project evaluation is made in order to ascertain the feasibility of the project in view of economic and financial aspects. The economic feasibility of the project is firstly evaluated by internal rate of return (IRR). Further, sensitivity analysis of IRR is also made with respect to changes in accrued benefits, build-up period and project cost. Secondary, the financial evaluation is carried out by analyzing typical farm budget of average size farmer and by preparing financial statement of the project as a whole. The farm budget analysis is made for assessment of the net reserve of the average size farm. The analysis of financial statement of the project is made to evaluate to repayment capacity on the basis of the estimated fund requirement with assumed financial of the anticipated loan and the expected revenue from the project.

2. ECONOMIC EVALUATION

2.1 Basic Assumptions

For the economic evaluation of the project, the following basic assumptions are made:

(1) The project implementation pariod is eight (8) years from 1981/82 to 1988/89,

(2) Only direct benefit is counted in the evaluation and any indirect or intangible benefits are not taken into account,

(3) The current prices at 1982 level are used in the evaluation,

(4) The exchange rate of Indonesian Rupiah to US Dollar is taken to be Rp 670 equivalent to US$1.00, and

(5) The economic useful life of the project is taken as 50 years from 1981/82 to 2030/31.

2.2 Direct Benefit

The direct benefit of the project primarily accrue from the increased crop production due to stable irrigation water supplies. The benefit is estimated as the difference of the annual net production values under future with and without project conditions.

The crop production gradually increases after commencement of the partial operation of the project. The build-up period for full development of paddy production is assumed to be 5 years for the existing paddy fields and 8 years for the areas to be newly reclaimed, respectively, after completion of the construction works.

The losses of farmland for project facilities total about 300 ha. These losses are counted as the negative benefit in the estimate of the primary incremental production value by deducting these production values from the net production value under future with project condition.

The net direct benefit amounts to Rp 7,155 million or Rp 894,400 per ha at the full development stage as mentioned in ANNEX-V. According to the proposed construction schedule, the benefit will initially accrue in 1988/89 and will gradually increase up to the full benefit in 1997/98.

2.3 Economic Cost

The financial cost for construction works of the roject is estimated at 1982 price level as mentioned in ANNEX-VIII. It includes some amount of transfer payment such as direct/indirect taxes and levies. The transfer payment is assumed to be equivalent to 10% of the direct construction cost. The economic cost of the project is obtained by deducting the transfer payment from the financial cost. Land acquisition cost and price contingency are not included in the economic cost.

The total economic cost of the project is estimated to be Rp 22,668 million, consisting of Rp 11,466 million of foreign currency component and Rp 11,202 million of local currency component as shown in Table IX.2.1. The economic cost is disbursed according to the construction schedule as shown in Table IX.2.2.

2.4 Operation and Maintenance Cost

The operation and maintenance cost of the project will be initially disbursed in 1988/89 when the partial operation will commence. The O&M cost will increase year by year and will reach the full amount of Rp 239 million in 1990/91 when the full operation will start for the whole project area of 8,000 ha.

2.5 Replacement Cost

The steel gates and their attachments will be replaced once during the entire period of the project life, and O&M equipment and some materials mentioned in ANNEX-VIII will be replaced every 10 years.

2.6 Internal Rate of Return (IRR)

Using the costs and benefit estimated in the above, the cost and benefit streams are firstly prepared as shown in Table IX.2.3, then the IRR is calculated. The calculated IRR is around 15.1% and indicates the economic soundness of the project.

2.7 Sensitivity Analysis

In order to evaluate further the soundness of the project to the possible changes of economic conditions in future, the sensitivity analysis is made for the following critical conditions in terms of internal rate of return:

(1) Cost increase due to unforeseen geological and topographical conditions and increase of material costs,

(2) Decrease of forecasted market price of paddy,

(3) Lower production than the expected, and

(4) Over-run of the build-up period.

For the above possible changes of economic conditions, the sensitivity analysis is made and the calculated result of IRR is shown as follows:

Benefit Decreased	IRR (%)					
	Cost Increased			Build-up Period Over-run		
	0%	+10%	+20%	0^{yr}	$+1^{yr}$	$+2^{yr}$
0%	15.1	14.2	13.5	15.1	14.6	14.2
-10%	14.1	13.3	12.5	14.1	13.6	13.3
-20%	13.0	12.2	11.5	13.0	12.6	12.3

From these results, it can be said that the project would be still sound even the worst case, i.e. 20% increase of cost and 20% decrease of benefit.

3. FINANCIAL EVALUATION

3.1 Capacity to Pay

Payment capacity is the ability of farmers to bear the expenses required for development of irrigation facilities. Such capacity is measured by the increase of net income which the project-benefited-farmers can earn annually from the project.

In order to assess the payment capacity of the farmers, the farm budget analysis is made on the average size and peasant farmers under future with and without project conditions.

The result is summarized below (see ANNEX-V):

(Unit: Rp)

Description	Without Project	With Project	Increment
1. Average Size Farmer (2.36 ha)			
Gross Income	705,100	1,354,800	649,700
Gross Out-go	660,100	872,700	212,600
Net Reserve	45,000	482,100	437,100

(Unit: Rp)

Description	Without Project	With Project	Increment
2. Peasant Farmer (1.0 ha)			
Gross Income	504,400	911,000	406,600
Gross Out-go	471,000	708,100	237,100
Net Reserve	33,400	202,900	169,500
3. Peasant Farmer (0.5 ha)			
Gross Income	389,200	666,000	276,800
Gross Out-go	369,000	553,600	184,600
Net Reserve	20,200	112,400	92,200

Annual net reserve or payment capacity will be 10.7 times for the average size farmer, 6.1 times for the peasant farmer holding a land of 1.0 ha and 5.6 times for the peasant farmer holding a land of 0.5 ha, compared with those under without project condition. The increased net reserve would offer incentives for further development to the farmers, and the substantial payment capacity would enable them to pay some charges for irrigation water.

3.2 Water Charge

When the project facilities are completed and water is released to the farmers, but if the water charge is not to be collected, all the costs of the project will have to be born to the Government. It is generally understood that the water charge is imposed to the water users, and the water charges thus collected is spent for the payment of O&M expenditures incurred to the project and for the repayment of the capital cost of the project. In Indonesia, however, the farmers traditionary do not pay any water charge directly, but contribute indirectly by paying the IPEDA tax.

The recent Government's decree and agreements made with the international lending institutions provide the conditions that the Government shall collect the water charges from the water users and recover the entire O&M cost, and that the rate of water charge shall be reviewed and possibly increased to recover a portion of the capital cost of the project.

The annual O&M cost required for the project is estimated at Rp 266 million which is equivalent to about Rp 33,250/ha. This corresponds to about 16% of the capacity to pay of the average size and peasant farmers. This prospective water charge would be the project revenue in the financial evaluation of the project.

3.3 Repayment of Project Cost

The financial evaluation of the project is made by examining the repayment capability for the capital cost of the project. In the examination of repayment capability, it is assumed that the capital required for the project implementation will be arranged under the following conditions:

(1) As mentioned in the project implementation schedule of ANNEX-VIII, the construction of the Sanrego intake weir including the closing dike will be executed by the local contractor based on the local tender from the beginning of 1983. Therefore, the capital for construction works of the Sanrego intake weir will be financed by the budget of the Government. While, the remaining works, such as main and secondary irrigation canal systems, small-scaled intake weirs on three tributaries, etc., will be carried out with the anticipated loan from bilateral or international organizations.

(2) According to the above implementation schedule, the project financial cost is estimated at Rp 36,512 million, comprising Rp 13,326 million for foreign currency and Rp 23,186 million for local currency as shown in Table IX.3.1.

(3) Based on the above result, for the foreign currency portion of Rp 13,326 million plus about 25% of local currency portion, Rp 5,711 million (equivalence to 30% of total loan amount), the capital is financed by bilateral or international organizations with an interest of 3% per annum for a repayment period of 30 years including 10-year grace period.

(4) For the remaining local currency portion of Rp 17,475 million, the capital is financed by the budget allocation of the Government with no repayment.

The repayment schedule for the foreign currency portion is prepared on the basis of the above conditions as shown in Table IX.3.2. This table indicates that the direct revenue from the water charge can not cover the annual repayment of the fund, except O&M cost and replacement cost, and the repayment of the fund has to be made by the subsidy of the Government.

Table IX.2.1 Summary of Economic Cost

(Unit: 10^6Rp)

	Item	Total	Foreign Currency	Local Currency
1.	Preparation Works	759	347	412
2.	Sanrego Intake Weir	3,609	1,754	1,855
3.	Main Canal System	1,530	774	756
4.	Secondary Canal System	5,627	2,656	2,971
5.	Intake Weirs on Tributaries	56	23	33
6.	Farm Road Networks	718	264	454
7.	Tertiary Development	3,551	1,445	2,106
8.	Reclamation Works	346	144	202
	Sub-total	16,196	7,407	8,789
9.	O & M Equipment	450	450	-
10.	Administration Expenses	532	-	532
11.	Engineering Services	2,533	2,113	420
12.	Physical Contingency	2,957	1,496	1,461
	Sub-total	6,472	4,059	2,413
	Total	22,668	11,466	11,202

Table IX.2.2 Annual Disbursement of Economic Cost

(Unit: x10^{6}Rp)

Fiscal Year	Direct Construction Cost	O & M Equipment	Administration Expenses	Engineering Services	Physical Contingency (15%)	Total
1981/82	671	-	63	-	110	844
1982/83	793	-	63	-	129	985
1983/84	791	-	67	434	194	1,486
1984/85	1,394	-	67	431	283	2,175
1985/86	2,798	450	68	580	584	4,480
1986/87	3,781	-	68	518	655	5,022
1987/88	3,444	-	68	339	578	4,429
1988/89	2,524	-	68	231	424	3,247
Total	16,196	450	532	2,533	2,957	22,668

Table IX.2.3 Annual Cost and Benefit Flow

(Unit: $\times 10^6$ Rp)

Year	Year in Order	Cost				Benefit
		Capital	O&M	Replacement	Total	
1981/82	1	844	-	-	844	-
1982/83	2	985	-	-	985	-
1983/84	3	1,486	-	-	1,486	-
1984/85	4	2,175	-	-	2,175	-
1985/86	5	4,480	-	-	4,480	-
1986/87	6	5,022	-	-	5,022	-
1987/88	7	4,429	-	-	4,429	-
1988/89	8	3,247	72	-	3,319	338
1989/90	9	-	155	-	155	1,181
1990/91	10	-	239	-	239	2,532
1991/92	11	-	239	-	239	3,883
1992/93	12	-	239	-	239	5,234
1993/94	13	-	239	-	239	6,281
1994/95	14	-	239	-	239	6,872
1995/96	15	-	239	-	239	7,005
1996/97	16	-	239	-	239	7,105
1997/98	17	-	239	662	901	7,155
1998/99	18	-	239	-	239	7,155
1999/00	19	-	239	-	239	7,155
2000/01	20	-	239	-	239	7,155
2001/02	21	-	239	-	239	7,155
2002/03	22	-	239	-	239	7,155
2003/04	23	-	239	-	239	7,155
2004/05	24	-	239	-	239	7,155
2005/06	25	-	239	-	239	7,155
2006/07	26	-	239	-	239	7,155
2007/08	27	-	239	662	901	7,155
2008/09	28	-	239	-	239	7,155
2009/10	29	-	239	-	239	7,155
2010/11	30	-	239	-	239	7,155
2011/12	31	-	239	-	239	7,155
2012/13	32	-	239	252	491	7,155
2013/14	33	-	239	-	239	7,155
2014/15	34	-	239	-	239	7,155
2015/16	35	-	239	-	239	7,155
2016/17	36	-	239	-	239	7,155
2017/18	37	-	239	662	901	7,155
2018/19	38	-	239	-	239	7,155
2019/20	39	-	239	-	239	7,155
2020/21	40	-	239	-	239	7,155
2021/22	41	-	239	-	239	7,155
2022/23	42	-	239	-	239	7,155
2023/24	43	-	239	-	239	7,155
2024/25	44	-	239	-	239	7,155
2025/26	45	-	239	-	239	7,155
2026/27	46	-	239	-	239	7,155
2027/28	47	-	239	662	901	7,155
2028/29	48	-	239	-	239	7,155
2029/30	49	-	239	-	239	7,155
2030/31	50	-	239	-	239	7,155

Table IX.3.1 Project Financial Cost

(Unit: x10^6 Rp)

Item	Total (F)	Total (L)	1981/1982 (F)	1981/1982 (L)	1982/1983 (F)	1982/1983 (L)	1983/1984 (F)	1983/1984 (L)	1984/1985 (F)	1984/1985 (L)	1985/1986 (F)	1985/1986 (L)	1986/1987 (F)	1986/1987 (L)	1987/1988 (F)	1987/1988 (L)	1988/1989 (F)	1988/1989 (L)
1. Preparatory Works	290	554	-	99	-	99	29	35	116	142	87	107	29	36	29	36	-	-
2. Sanrego Intake Weir	-	4,010	-	647	-	782	-	815	-	951	-	815	-	-	-	-	-	-
3. Main Canal System	860	840	-	-	-	-	-	-	172	168	430	420	258	252	-	-	-	-
4. Secondary Canal System	2,951	3,301	-	-	-	-	-	-	-	-	590	660	1,033	1,155	1,033	1,155	295	331
5. Intake Weirs on Tributaries	26	37	-	-	-	-	-	-	-	-	-	-	26	37	-	-	-	-
6. Farm Road Networks	293	504	-	-	-	-	-	-	-	-	-	-	-	-	-	-	293	504
7. Tertiary Development	1,605	2,340	-	-	-	-	-	-	-	-	-	-	481	702	562	819	562	819
8. Reclamation Works	160	224	-	-	-	-	-	-	-	-	-	-	80	112	80	112	-	-
Sub-total	6,185	11,810	-	746	-	881	29	850	288	1,261	1,107	2,002	1,907	2,294	1,704	2,122	1,150	1,654
9. Land Acquisition	-	416	-	11	-	-	-	-	-	203	-	121	-	61	-	20	-	-
10. O & M Equipment	500	-	-	-	-	-	-	-	-	-	500	-	-	-	-	-	-	-
11. Administration Expenses	-	532	-	63	-	63	-	67	-	67	-	68	-	68	-	68	-	68
12. Engineering Service	2,113	420	-	-	-	-	369	65	358	73	482	98	430	88	283	56	191	40
13. Physical Contingency	1,320	1,976	-	123	-	142	60	147	97	240	313	343	351	377	298	340	201	264
Sub-total	3,933	3,344	-	197	-	205	429	279	455	583	1,295	630	781	594	581	484	392	372
Total	10,118	15,154	-	943	-	1,086	458	1,129	743	1,844	2,402	2,632	2,688	2,888	2,285	2,606	1,542	2,026
14. Price Contingency	3,208	8,032	-	-	-	-	32	147	108	511	541	1,166	835	1,821	920	2,195	772	2,192
Total	13,326	23,186	-	943	-	1,086	490	1,276	851	2,355	2,943	3,798	3,523	4,709	3,205	4,801	2,314	4,218

Remarks: F; Foreign currency
L; Local currency

Table IX.3.2 Cash Flow Statement

(Unit: $x10^6$Rp)

Fiscal Year	Cash Outflow				Cash Inflow					Balance (B) - (A)
	Project Cost	O/M, Replacement Cost	Loan Repayment	Total Outflow (A)	Foreign Loan	Government Budget	Project Revenue	Government Subsidy	Total Inflow (B)	
1981/82	943	-	-	943	-	943	-	-	943	0
1982/83	1,086	-	-	1,086	-	1,086	-	-	1,086	0
1983/84	1,766	-	-	1,766	700	1,066	-	-	1,766	0
1984/85	3,206	-	-	3,206	1,216	1,990	-	-	3,206	0
1985/86	6,741	-	-	6,741	4,204	2,537	-	-	6,741	0
1986/87	8,232	-	-	8,232	5,033	3,199	-	-	8,232	0
1987/88	8,006	-	-	8,006	4,578	3,428	-	-	8,006	0
1988/89	6,532	80	-	6,612	3,306	3,226	80	-	6,612	0
1989/90	-	172	-	172	-	-	172	-	172	0
1990/91	-	266	-	266	-	-	266	-	266	0
1991/92	-	266	-	266	-	-	266	-	266	0
1992/93	-	266	-	266	-	-	266	-	266	0
1993/94	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1994/95	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1995/96	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1996/97	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1997/98	-	1,001	1,524	2,525	-	-	1,001	1,524	2,525	0
1998/99	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1999/00	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2000/01	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2001/02	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2002/03	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2003/04	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2004/05	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2005/06	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2006/07	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2007/08	-	1,001	1,524	2,525	-	-	1,001	1,524	2,525	0
2008/09	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2009/10	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2010/11	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2011/12	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2012/13	-	546	1,504	2,050	-	-	546	1,504	2,050	0

Remarks: Foreign Loan
Interest - 3.0% per annum
Repayment period - 30 years including 10-years grace period.

ANNEX - X

WATERSHED MANAGEMENT

ANNEX - X WATERSHED MANAGEMENT

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ANNEX - X WATERSHED MANAGEMENT

1. GENERAL

The water sources for the Sanrego Irrigation Project would depend on the Sanrego river and some tributaries of the Walanae river namely Parota, Biru and Macinaga rivers. The catchment areas of these rivers are (see Fig. X.1.1):

(Unit: ha)

River	Catchment Area
Sanrego river	17,920
Parota river	3,080
Biru river	2,030
Macinaga river	870
Total	23,900

The major objectives of the present study are (1) to clarify the existing condition of relevant watershed and present land use and (2) to prepare a recommendation on the measures for land conservation in each watershed of the rivers relevant to the Project.

The present status of the said catchment areas has been studied mainly on the basis of aerial photos and topographic maps scaled 1:25,000. Field inspection has also been made to check the preliminary results of photo interpretation and data on afforestation, land conservation, etc. have been collected mainly from the Department of Forestry, South Sulawesi Province.

2. PRESENT CONDITION OF WATERSHED

(1) Sanrego river

The Sanrego river originates in the Mt. Bohonglangi of 1,980 m in altitude and flows down from south to northeast in the study area and joins to the Walanae river at the northern part of the study area. The total length of the river is about 43 km from the originating point to the confluence with the Walanae river. The about 58% of the Sanrego river watershed are covered with forest. The present land use of the Sanrego watershed area is summarized as follows:

Land Use Category	Area	Proportional Extent
	(ha)	(%)
Paddy field	490	3
Upland	60	1
Grassland	6,940	38
Forest		
- Sparse forest	3,850	21
- Dense forest	6,580	37
Total	17,920	100

(2) Three tributaries

In the study area, there exists a number of small tributaries other than the Sanrego river, out of which three (3) tributaries, namely Parota, Biru and Macinaga have comparatively large catchment areas and are considered to be supplemental water sources for the Project.

The Parota river is one of the tributaries of the Sanrego river and its watershed is located on the northeast of the Sanrego river watershed. The catchment area is estimated at 3,080 ha at the junction with the Sanrego river.

The Biru river is a tributary of the Walanae river and flows down from south to north in the study area. The catchment area is measured to be 2,030 ha.

The Macinaga river is the upper reaches of the Baruttung river which is one of the tributaries of the Walane river. The catchment area is measured to be 870 ha.

The present land use of the tributaries watershed area is summarized as follows:

(Unit: ha)

Land Use Category	Tributaries		
	Parota	Biru	Macinaga
Paddy field	120 (4%)	210 (10%)	340 (39%)
Upland	30 (1%)	20 (1%)	10 (1%)
Grassland	1,550 (50%)	800 (40%)	340 (39%)
Forest			
- Sparse forest	150 (5%)	510 (25%)	20 (2%)
- Dense forest	1,230 (40%)	490 (24%)	160 (19%)
Total	3,080 (100%)	2,030 (100%)	870 (100%)

3. WATERSHED MANAGEMENT PLAN

3.1 Basic Concept

In the watershed, forests play an important role in conservation of soil and water resources. The forests generally fix the soils on the sloping land and control the excess percolation and surface run-off. As a result, the forests lower the maximum flood run-off and also stabilize the minimum discharge of the rivers. The forests prevent the watershed from soil erosion, therefore, the run-off water would be kept clean with good water quality. The forest areas in each watershed are:

Watershed	Catchment Area	Forest Area	Proportional Extent
	(ha)	(ha)	(%)
Sanrego	17,920	10,430	58
Parota	3,080	1,380	45
Biru	2,030	1,000	49
Macinaga	870	180	21
Total	23,900	12,990	54

Grassland and forest are dominant in Sanrego watershed covered about 38% and 58% of the area, respectively. The forest resources have been gradually depleted because of shifting cultivation especially in the upper reaches of the Sanrego river. Grassland is dominant in all tributaries watershed. In addition to the lumbering by local people, overgrazing of livestock animals has exerted an aggraviting people, influence on the land and soil conservation in these watershed area. With this in view, the basic concept for watershed management would be as follows:

(1) Soil and water conservation will have to be made through overall watershed management including reforestation and erosion control works.

(2) In due consideration of existing conditions of watershed areas, the first priority must be given to reforestation.

(3) The present unrestricted cutting of trees in the forest areas will have to be controlled by the Department of Forestry. In particular, the trees on the ridges will have to be maintained. Once such trees are cut, natural regeneration is very difficult because of limited availability of soil moisture.

(4) Since over-grazing of livestock animals in the bush and grassland will cause damage to the newly-planted trees, animal grazing should also be controlled by the goverment officials.

(5) The construction of Sabo dams and erosion control works will have to be studied in the future, although they will not be necessary urgently at present.

3.2 Reforestation Plan

On the basis of basic concept mentioned above the following reforestation plan is considered:

(1) Tree species

Tree species for reforestation will have to be those which can improve the hydrological condition, assure high economic value and ecological fitness and be conform with the planning purpose.

Based on climate and topographic conditions of the Sanrego river and three tributaries watershed which have a range of elevation between 100 and 1,000 m, it is considered that the following tree species can be grown in this area:

(a) Eucalyptus sp.

(b) Acasia auriculiformis

(c) Pinus merkusii

(d) Swetenia macrophylla

(e) Anthocephalus cadamba

(f) Albizzia falcata

(g) Callophyllum sp.

But the species of trees for reforestation have to fulfill the following conditions at least.

(a) Seedlings are easily multiplicated and low costed,

(b) Seedlings are multiplicated in short term, and

(c) Seedlings are easily growable under unfavourable natural conditions.

In due consideration of these basic condition, Eucalyptus sp., Acacia auriculiformis, and Pinus merkusii would be selected for the reforestation in the Sanrego river and three tributaries watershed area.

(2) Areas for reforestation

The reforestation work will be necessary in the Sanrego river and three tributaries watershed. The Government is already aware of this matter and has paid attention to the Sanrego watershed management. The Sanrego watershed area belong to P3RPDAS Bila Walanae.

Since PELITA I reforestation area so far covered are about 16,015 ha in the Bila-Walanae watersheds and cost amounted to about Rp 268×10^6 as shown below.

Description	Reforestation Area		Cost	
	Planning (ha)	Actual (ha)	Planning (10^3Rp)	Actual (10^3Rp)
Before Pelita	-	57	-	-
PELITA I	350	270	-	-
PELITA II	9,100	7,900	146,320	106,240
PELITA III	17,226	7,845	537,566	161,954

Remark: -; no data

Source: Department of Forestry, South Sulawesi Province

Although this reforestration has been progressed upto the present condition, the forest area in the Sanrego river and three tributaries watershed is still less than 55% of the entire watersheds. It is proposed that the forest area should be expanded to about 85% of the total watersheds. Therefore the total area to be envisaged for reforestation will be about 20,300 ha as shown below:

(Unit: ha)

Watershed	Total Catchment Area	Existing Forest Area	Proposed Reforestation Area	Total Forest Area	Proportional Extent
Sanrego	17,920	10,340	5,100	15,440	86%
Parota	3,080	1,380	1,250	2,630	85%
Biru	2,030	1,000	750	1,750	86%
Macinaga	870	180	300	480	55%
Total	23,900	12,900	7,400	20,300	85%

For reforestation works, the main problem is the shortage of labour for transplanting. Transplanting time generally takes place on the beginning of wet season and it is the same time for farmers to transplant the paddy seedlings.

(3) Preliminary cost estimate for reforestation

Nursery requirement:

Seedlings will be grown in the nursery for six months generally from April/May and transplanted in the beginning of wet season. The nursery will have to possibly be irrigated though permanent irrigation facilities are not required. Nursery also needs fertilizer and chemical application, weeding and replanting.

One unit nursery; about 1 ha can produce about 400,000 seedlings. Based on planting density 3 m x 2 m and considering the survival rate, the nursery has to be established at the rate of one unit nursery per about 200 ha of reforestation area. Therefore, about 37 nurseries will be needed for 7,400 ha of reforestation area. According to the past experience of the Ministry of Forestry as the executor for implementation of the reforestation work, the total cost per unit nursery amounts to Rp 4,575,000 as mentioned below:

(Unit: Rp)

Nursery Works	Amount
1. Preparation (Seed bed preparation, fertilizer, equipment, chemicals, foreman payment, roof, etc.)	2,214,000
2. Sowing	700,000
3. Maintenance (Irrigation, weeding, replanting, fertilizer application, etc.)	1,659,750
Total	4,573,750

Transplanting works:

Since reforestation area generally has steep slopes, in transplanting works transportation of seedlings is laborious. Transportation and planting of seedlings will need 16.5 man-day/ha and 7.5 man-day/ha, respectively. One labourer can carry and transplant about 100-200 seedlings in a day according to the field condition. The unit cost for transplanting work per ha is given below:

(Unit: 10^3Rp)

Transplanting Works	Amount
1. Field preparation	18,495
2. Controlling (payment for foreman)	7,200
3. Planting	
(1) Seedlings transportation	4,950
(2) Transplanting	4,125
4. Maintenance	5,280
Total	40,050

On the basis of such information, the cost required for the envisaged reforestation covering 7,400 ha is roughly estimated as follows:

(Unit: 10^3Rp)

Item	Amount
Establishment of 37 nurseries	169,000
Transplanting cost	297,000
Total	466,000

(4) Organization for reforestation

All the reforestation plan will have to be carried out by the Project for Planning and Establishment of Reforestation in watershed area (P3RPDAS) which was enforced by Presidential Degree No.8 in 1976. In 1982/1983 this project aims at reforestation of about 1,186,000 ha all over the country in 36 watershed areas as mentioned in Table X.2.1. In South Sulawesi Province, there are 3 branch offices of the P3RPDAS, i.e. Jeneberang - Kelara, Sadang and Bila - Walanae. The total area of reforestation envisaged by these branch offices are about 158,000 ha of which 18,700 ha belong to Bila - Walanae branch office. The watershed areas under present study is managed by the P3RPDAS Bila - Walanae branch office. The office of the Bila - Walanae Watershed Project is located in Soppeng and has an implementation leader in each Kabupaten under the project. Organization Structure of Reforestation Project in South Sulawesi is shown in Fig. X.2.1.

Table X.2.1 Planned Reforestation Work under P3RPDAS for the Year of 1982/1983

(Unit : ha)

No.	Branch Offices of P3RPDAS	Forest Conservation Work in Existing Forest Area	New Reforestation Work	Total
1.	Krueng Aceng	8,500	5,000	13,500
2.	Wampe Sei Ular	16,000	2,209	18,209
3.	Asahan Barumun	59,000	17,646	76,646
4.	Inderagiri	16,000	-	16,000
5.	Agam Kuantan	25,000	4,200	29,200
6.	Batanghari	15,000	-	15,000
7.	Musi	150,000	14,262	164,262
8.	Ketahun	-	-	-
9.	Way Seputih	6,600	3,000	9,600
10.	Way Sekampung	14,000	13,000	27,000
11.	Tulang Bawang	-	2,000	2,000
12.	Ciujung Tl. Lada	15,500	11,500	27,000
13.	Ciliwung, Csd, Cmd	22,000	7,512	29,512
14.	Citarum	-	9,423	9,423
15.	Cimanuk	10,000	7,577	17,577
16.	Citanduy, Csgg.	20,000	2,426	22,426
17.	Serayu Luk Ulo	25,000	-	25,000
18.	Pemali Comal	9,000	-	9,000
19.	Jeratun Seluna	25,000	-	25,000
20.	Solo	48,000	-	48,000
21.	Gunung Kidul	27,000	1,000	28,000
22.	Pakis baru	12,500	-	12,500
23.	Brantas	25,000	-	25,000
24.	Sampean	10,000	-	10,000
25.	Madura	21,000	-	21,000
26.	Riamkanan	-	-	-
27.	Kapuas	-	18,533	18,533
28.	Gorontalo Tondano	30,000	16,000	46,000
29.	Palu Ds	29,000	16,500	45,500
30.	Jeneberang Kelara	51,000	12,936	63,936
31.	Saddang	65,000	10,100	75,100
32.	Bila Walanae	11,000	7,670	18,670
33.	Sulawesi Tenggara	40,000	13,500	53,500
34.	Bali	20,000	748	20,748
35.	Dodokan	77,000	8,300	85,300
36.	Benain Noelmina	65,000	13,325	78,325
	Total	968,100	218,367	1,186,467

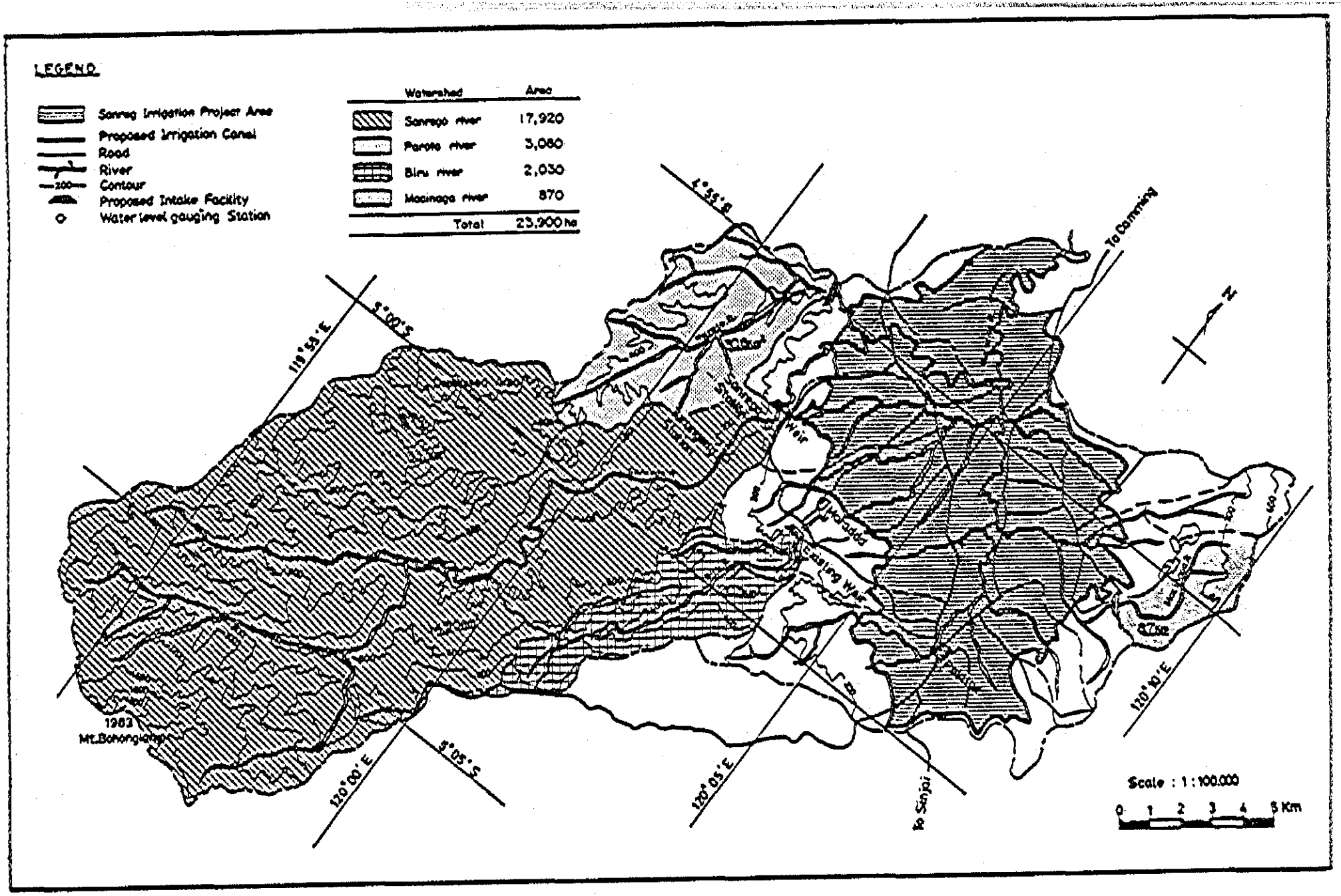

Fig. X.1.1 WATERSHED OF SANREGO RIVER AND THREE TRIBUTARIES

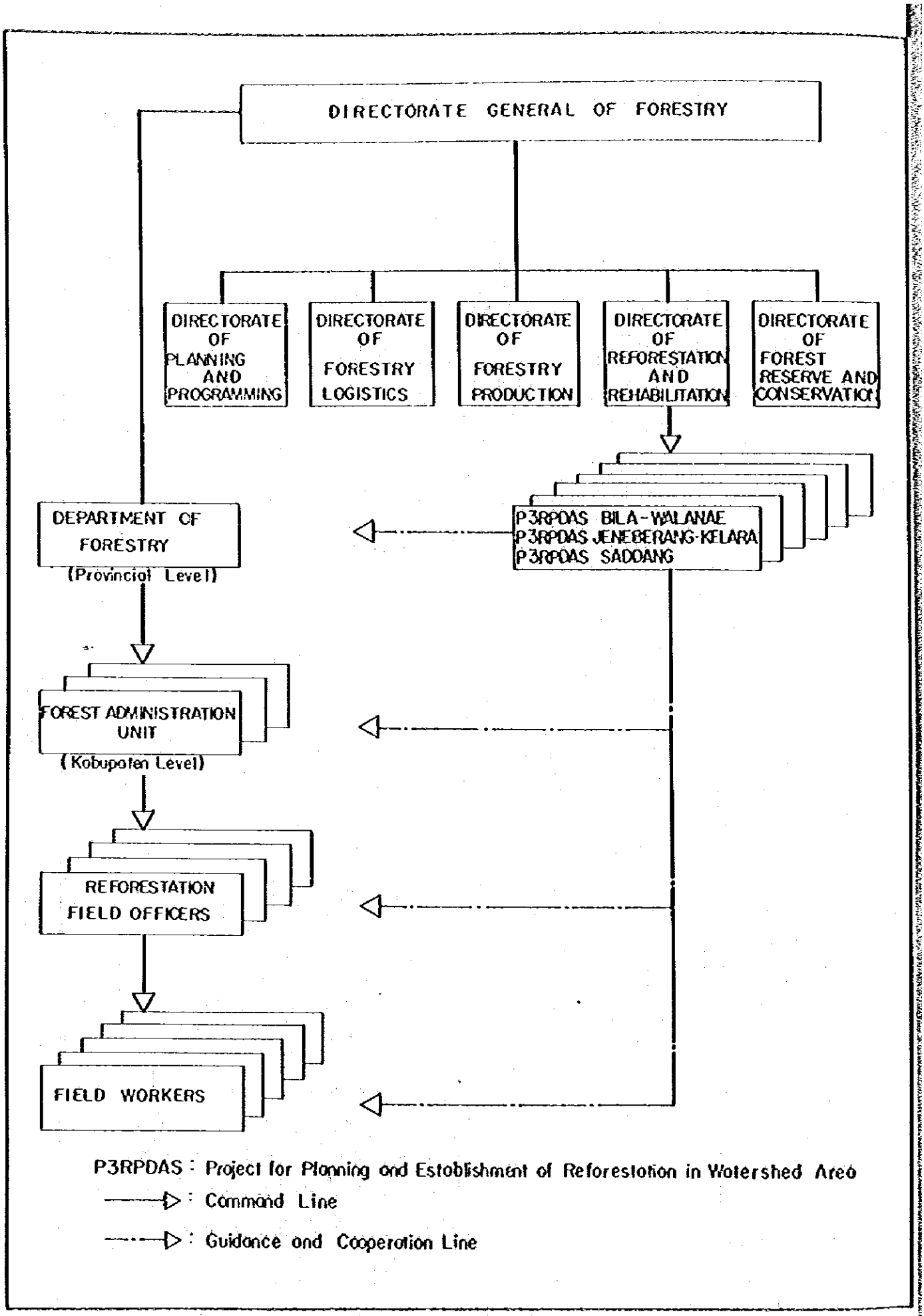

Fig. 2.1 ORGANIZATIONAL STRUCTURE OF REFORESTATION PROJECT IN SOUTH SULAWESI

JICA