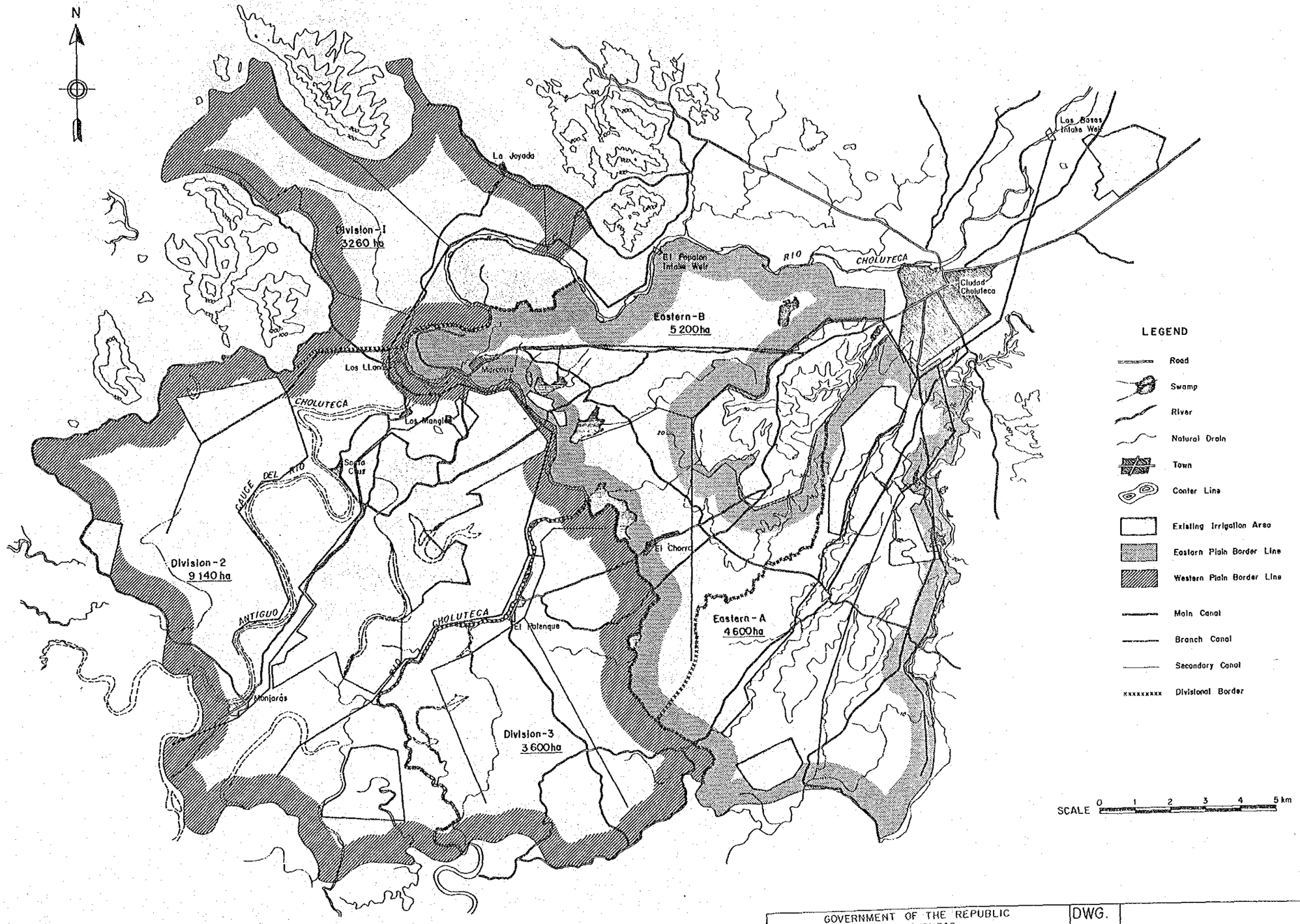

GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. H-11	DIVISION OF PROJECT AREA

ANNEX I

DAM AND POWER PLAN

ANNEX - I

DAM AND POWER PLAN

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I. DAM AND POWER PLAN

I.1 DAM AND RESERVOIR

I.1.1 San Fernando Reservoir

Through the study of alternative plans in Annex G, it was proposed to design a concrete gravity dam at San Fernando (catchment area of 1,665 km^2 with an average annual inflow of around 400 MCM). The effective storage capacity at the San Fernando damsite was determined to be 380 MCM for irrigation of 23,960 ha and power generation of 53.6 GWh. (Refer to Annex G.6)

The minimum operating level of the San Fernando reservoir was determined on the basis of estimated sediment yield. To allow sediment deposit of 67 MCM in 50 years, the minimum operation level was set at EL. 797.0 m. The full supply level was determined to be at EL. 826.5 m.

To determine the maximum reservoir water level, a flood routing study was made by applying the probable maximum flood and probable maximum discharge for a return period of 200 years. In the flood routing analysis, the width of spillway was pre-determined at 30 m at maximum, because of a narrow topographic shape of the damsite. The flood routing study indicated that the probable maximum flood with a peak discharge of 5,300 m^3/s would be lowered to 3,380 m^3/s, and the maximum reservoir water level would reach up to EL. 832.83 m, as shown on Table I-01 and Figure I-01. As a consequence, the maximum reservoir water level was designed to be at EL. 833.0 m.

I.1.2 Spillway and Freeboard

The spillway was designed to safely discharge flood for a return period of 200 years, regardless of natural flood control effect by the reservoir. The estimated flood peak discharge of 2,920 m^3/s at San Fernando could be discharged at EL. 828.0 m without natural flood control

effect. With a flood control effect of the reservoir, the outflow discharge of the PMF from the spillway would be 3,380 m^3/s. The spillway crest elevation was set at EL. 819.0 m. The width of overflow section was topographically limited to 30 m. The spillway would be equipped with 3 sets of spillway gates with 10.0 m in width and 8.0 m in height.

A freeboard from the maximum reservoir water level up to the dam crest was determined on the basis of wave height of reservoir water and creep height on dam slope by S.M.B. method, as well as some possible risk of delay of the spillway gate operation. The wave height and creep height were estimated to be 1.0 m, and a freeboard of 1.0 m would be additionally provided for spillway gate operation. Consequently, the dam crest elevation was designed to be at EL. 835.0 m

I.1.3 Preliminary Design of Dam

The river bed at the damsite is approximately at EL. 740.0 m. Through the geological survey explained in Annex D.2.1, the weathered rock outcrops at the damsite are to be excavated up to the maximum excavation surface at EL. 735.0 m. Consequently, the San Fernando dam was designed to have a height of 100.0 m. The crest length at EL. 835.0 m would be approximately 320 m. The dam crest is designed to be 8.0 m in width.

Stability analysis for design of the San Fernando dam was made on the basis of design conditions summarized hereunder.

Max. water level	EL. 833.0 m
Full supply level	EL. 826.5 m
Min. operation level	EL. 797.0 m
Spillway crest elevation	EL. 819.0 m
Dam crest elevation	EL. 835.0 m
Foundation elevation	EL. 735.0 m
River bed elevation	EL. 740.0 m

Unit weight of concrete	2.35 t/m^3
Unit weight of sediment load	1.0 t/m^3
Shearing strength	10 kg/cm^2
Earthquake acceleration	0.16 g
Internal friction angle	45°

The stability against sliding, bearing capacity and overturning were calculated in the following manner:

a) Stability against Sliding:

$$N = \frac{f \cdot \Sigma V + To \cdot B}{\Sigma H}$$

where, N: Safety factor against shearing sliding ($\geqq 4$)
f: Coefficient of internal friction angle ($f = \tan 45°$)
To: Shearing strength of foundation rock ($10 kg/cm^2$)
B: Width of dam foundation (m)
ΣV: Total vertical forces (ton)

b) Stability against Bearing Capacity:

$$q = \frac{\Sigma V}{B}\left(1 \pm \frac{6e}{B}\right)$$

where, q: Bearing capacity (t/m)
ΣV: Total vertical forces (ton)
B: Width of dam foundation (m)
e: Eccentric distance (m)

c) Stability against Overturning:

$$Xo = \frac{\Sigma M}{\Sigma V}$$

where, Xo: Horizontal distance of resultant forces (m)
ΣM: Total moment (t · m)
ΣV: Total vertical forces (ton)

The result of stability analysis is shown in detail on Table I-02.

For foundation treatment, joints and seams are to be adequately treated by consolidation grouting and, if required, by dental work. Double grout curtain is to be provided at the heel of the dam, and drainage holes are drilled in the bottom inspection gallery at the downstream side of the curtain grouting, to release uplift pressures.

An embedded pipe cooling system would be required in concreting the dam. A network of galleries would be incorporated in the dam for inspection and other purposes.

In accordance with such design criteria, a preliminary design of the San Fernando dam was prepared as shown on DWG-I-02 and DWG-I-03.

I.1.4 Diversion During Construction

Diversion works would consist of an upstream and downstream cofferdams and a circular shape diversion tunnel. In view of the height of mat concrete designed for dam safety at the bottom of dam, the upstream cofferdam was designed to be a concrete dam of 20 m in height above foundation rock or 15 m above the river bed (crest elevation of the cofferdam at EL. 755.0 m). The discharge capacity of river diversion tunnel was determined by applying the design flood for a return period of 1.5 years which was estimated at 260 m^3/s. The river diversion flood routing was calculated as shown on Table I-03. As a consequence, the diversion tunnel was designed to be 6.0 m in diameter. The tunnel would be lined with concrete of 50 cm in average thickness. The diversion tunnel would be approximately 340 m in length, as shown on DWG-I-04.

I.2 POWER FACILITIES

1.2.1 Generating Equipment

The installed capacity of the generating plants to be installed at the San Fernando power station located at the toe of the dam was determined in accordance with the formula presented in Annex G.3.2 and the proposed reservoir water level. The rated reservoir water level was designed at EL. 815.0 m, and the maximum plant discharge was estimated at 32.2 m^3/s.

The plant discharge in the dry season would vary in the range of 8 m^3/s to 32 m^3/s, in accordance with the requirement of water release for irrigation. A combined efficiency of turbine and generator of 18.2 MW with 8 m^3/s discharge was estimated at 59%, and the efficiency of 9.1 MW was estimated at 74%. In view of a combined efficiency of turbine and generator, as well as mechanical phenomena under low load operation, it was designed to install two units of generators.

The maximum output of turbine was calculated on the basis of the following conditions:

Maximum plant discharge (Q)	16.1 m^3/s
High water level	EL. 826.5 m
Rated water level	EL. 815.0 m
Low water level	EL. 797.0 m
Tailwater level at max. plant discharge	EL. 745.0 m
Rated effective head (h)	67.5 m
Expected efficiency of turbine at max. output and rated head (η)	88.3 %

Thus, the maximum output of the turbine was calculated at 9.4 MW as shown below:

$$Pt = 9.8 \cdot Q \cdot h \cdot \eta$$
$$= 9.8 \times 16.1 \times 67.5 \times 0.883$$
$$\fallingdotseq 9{,}400 \text{ kW}$$

The selected rated speed of turbine is 450 r.p.m, and its specific speed was calculated at 225.5 kW-m.

The rated capacity of turbine and generator was determined at 9,100 kW and 10,000 kVA, respectively, on the basis that the efficiency at maximum output would be 96.8% and power factor would be 91%.

In addition to two sets of turbines and generators as outlined above, a mini-hydropower would be installed to make use of water to be released for supplemental irrigation in the rainy season in the San Juan de Flores area, which is located immediately downstream of the San Fernando dam. The water release for irrigation in the rainy season would be in the range of 0.1 m^3/s to 0.9 m^3/s. The installed capacity of the mini-hydropower plant would be 500 kW. The rated speed of turbine would be 1,200 r.p.m, and the rated capacity of generator would be 625 kVA.

I.2.2 Power Station and Related Facilities

The power house was designed to be sited at the top of the San Fernando dam to equip turbines and generators as proposed above. It would be a reinforced concrete structure of 44.8 m in length, 30.0 m in width and 19.0 m in height. The power house would have adequate spaces for office, control room, cubicle room, assembly bay, and other electrical and mechanical auxiliaries. A layout of the power house and generating equipment, as well as outdoor switchyard is shown on DWG-I-05.

The power intake would be provided on the upstream face of the dam, with a bellmouth shaped opening. The conduit center line was designed to be at EL. 791.0 m, to allow intake at the low water level at EL. 797.0 m. The intake structure would include intake gates, trashracks and guides. The intake gates would be operated by stationary hoist from the operation deck. The penstock would be about 96.0 m in length, with a diameter from 3.5 m to 1.6 m.

Power generated at the San Fernando power station would be sent to the load center in Tegucigalpa. A 25 km long transmission line would be constructed to connect the power station with the receiving substation in Tegucigalpa. The voltage of this transmission line was

determined to be 69 kV, which is the standard voltage of the existing transmission line network. A single circuit line with 120 m^2 or 266.8 MCM ACSR conductors would be installed.

TABLES

Table I-01 RESULT OF FLOOD ROUTING WITH PMF

B = 30 m Hd = 13.9 Gate = 7.5 Spillway Crest = EL. 819.0 m

T (hr)	Q In (m^3)	Q Out (m^3/s)	H (m)	Area (km^2)	C
0.5	60.0	60.0	826.5	20.6	1.98
1.5	60.0	60.0	826.5	20.6	1.98
2.5	65.0	65.0	826.5	20.6	1.98
3.5	75.0	75.0	826.5	20.6	1.98
4.5	85.0	85.0	826.5	20.6	1.98
5.5	95.0	95.0	826.5	20.6	1.98
6.5	125.0	125.0	826.5	20.6	1.98
7.5	175.0	175.0	826.5	20.6	1.98
8.5	207.5	207.5	826.5	20.6	1.98
9.5	222.5	222.5	826.5	20.6	1.98
10.5	277.5	277.5	826.5	20.6	1.98
11.5	372.5	372.5	826.5	20.6	1.98
12.5	442.5	442.5	826.5	20.6	1.98
13.5	487.5	487.5	826.5	20.6	1.98
14.5	540.0	540.0	826.5	20.6	1.98
15.5	600.0	600.0	826.5	20.6	1.98
16.5	680.0	680.0	826.5	20.6	1.98
17.5	780.0	780.0	826.5	20.6	1.98
18.5	930.0	930.0	826.5	20.6	1.98
19.5	1,130.0	1,130.0	826.5	20.6	1.98
20.5	1,335.0	1,225.1	826.5	20.6	1.98
21.5	1,545.0	1,235.0	826.5	20.6	1.99
22.5	1,720.0	1,253.3	826.6	20.7	1.99
23.5	1,860.0	1,278.1	826.7	20.7	1.99
24.5	1,942.5	1,307.2	826.8	20.8	2.00
25.5	1,967.5	1,337.5	826.9	20.9	2.00
26.5	1,970.0	1,367.3	827.0	20.9	2.00
27.5	1,950.0	1,395.4	827.1	21.0	2.01
28.5	1,942.5	1,421.7	827.2	21.0	2.01
29.5	1,947.5	1,446.8	827.3	21.1	2.01
30.5	1,980.0	1,471.7	827.3	21.1	2.02
31.5	2,040.0	1,497.7	827.4	21.2	2.02
32.5	2,140.0	1,526.5	827.5	21.2	2.02
33.5	2,280.0	1,559.9	827.6	21.3	2.03
34.5	2,465.0	1,599.9	827.8	21.4	2.03
35.5	2,695.0	1,648.5	827.9	21.5	2.04
36.5	3,000.0	1,708.5	828.1	21.6	2.05
37.5	3,380.0	1,783.4	828.4	21.7	2.05
38.5	3,827.5	1,876.6	828.7	21.9	2.06
39.5	4,347.5	1,991.5	829.0	22.1	2.08

(to be continued)

Table I-01

B = 30 m Hd = 13.9 Gate = 7.5 Spillway Crest = EL. 819.0 m

T (hr)	Q In (m^3)	Q Out (m^3/s)	H (m)	Area (km^2)	C
40.5	4,737.5	2,126.2	829.4	22.3	2.09
41.5	4,992.5	2,273.2	829.9	22.6	2.10
42.5	5,160.0	2,426.1	830.3	22.8	2.12
43.5	5,250.0	2,579.9	830.7	23.1	2.13
44.5	5,237.5	2,729.3	831.1	23.3	2.14
45.5	5,122.5	2,868.3	831.5	23.5	2.15
46.5	4,980.0	2,993.3	831.8	23.7	2.16
47.5	4,800.0	3,102.8	832.1	23.9	2.17
48.5	4,597.5	3,195.5	832.3	24.0	2.18
49.5	4,372.5	3,270.8	832.5	24.1	2.18
50.5	4,097.5	3,327.2	832.7	24.2	2.19
51.5	3,772.5	3,362.9	832.7	24.3	2.19
52.5	3,457.5	3,377.7	832.8	24.3	2.19
53.5	3,152.5	3,373.5	832.8	24.3	2.19
54.5	2,865.0	3,352.1	832.7	24.3	2.19
55.5	2,595.0	3,315.6	832.6	24.2	2.18
56.5	2,315.0	3,265.4	832.5	24.1	2.18
57.5	2,025.0	3,201.8	832.3	24.0	2.18
58.5	1,767.5	3,126.3	832.2	23.9	2.17
59.5	1,542.5	3,041.7	831.9	23.8	2.17
60.5	1,360.0	2,950.8	831.7	23.7	2.16
61.5	1,220.0	2,856.6	831.5	23.5	2.15
62.5	1,095.0	2,760.9	831.2	23.4	2.14
63.5	985.0	2,664.7	831.0	23.2	2.14
64.5	887.5	2,568.9	830.7	23.1	2.13
65.5	802.5	2,474.2	830.4	22.9	2.12
66.5	730.0	2,381.1	830.2	22.8	2.11
67.5	670.0	2,290.3	829.9	22.6	2.11
68.5	615.0	2,202.2	829.7	22.5	2.10
69.5	565.0	2,116.8	829.4	22.3	2.09
70.5	515.0	2,034.0	829.2	22.2	2.08
71.5	465.0	1,953.8	828.9	22.0	2.07
72.5	425.0	1,876.2	828.7	21.9	2.06
73.5	395.0	1,801.5	828.4	21.8	2.06
74.5	365.0	1,729.9	828.2	21.6	2.05
75.5	335.0	1,661.0	828.0	21.5	2.04
76.5	310.0	1,594.9	827.8	21.4	2.03

Table I-02 RESULT OF STABILITY CALCULATIONS

	Force		Arm Length		Moment	
	H (ton)	V (ton)	X (m)	Y (m)	HY (t.m)	VX (t.m)
Case 1: H.W.L + Earthquake (K = 0.16)						
Weight of the dam	-	13,170.60	75.17	-	-	989,971.00
Horizontal component of hydrostatic force	4,283.65	-	-	31.63	135,471.00	-
Vertical component of hydrostatic force	-	2,071.35	18.11	-	-	37,512.60
Inertia force caused by the earthquake on the dam itself	2,107.29	-	-	25.31	53,340.70	-
Hydrodynamic pressure	772.89	-	-	36.40	28,133.30	-
Soil pressure	522.78	1,192.15	22.22	14.73	7,702.28	26,493.50
Total	7,686.62	16,434.10	-	-	224,647.00	1,053,980.00
Case 2: Reservoir Empty and Earthquake (K = 0.08)						
Weight of the dam	-	13,170.60	75.17	-	-	989,971.00
Inertia force caused by the earthquake on the dam itself	-1,053.65	-	-	25.31	-26,670.30	-
Total	-1,053.65	13,170.60	-	-	-26,670.30	989,971.00

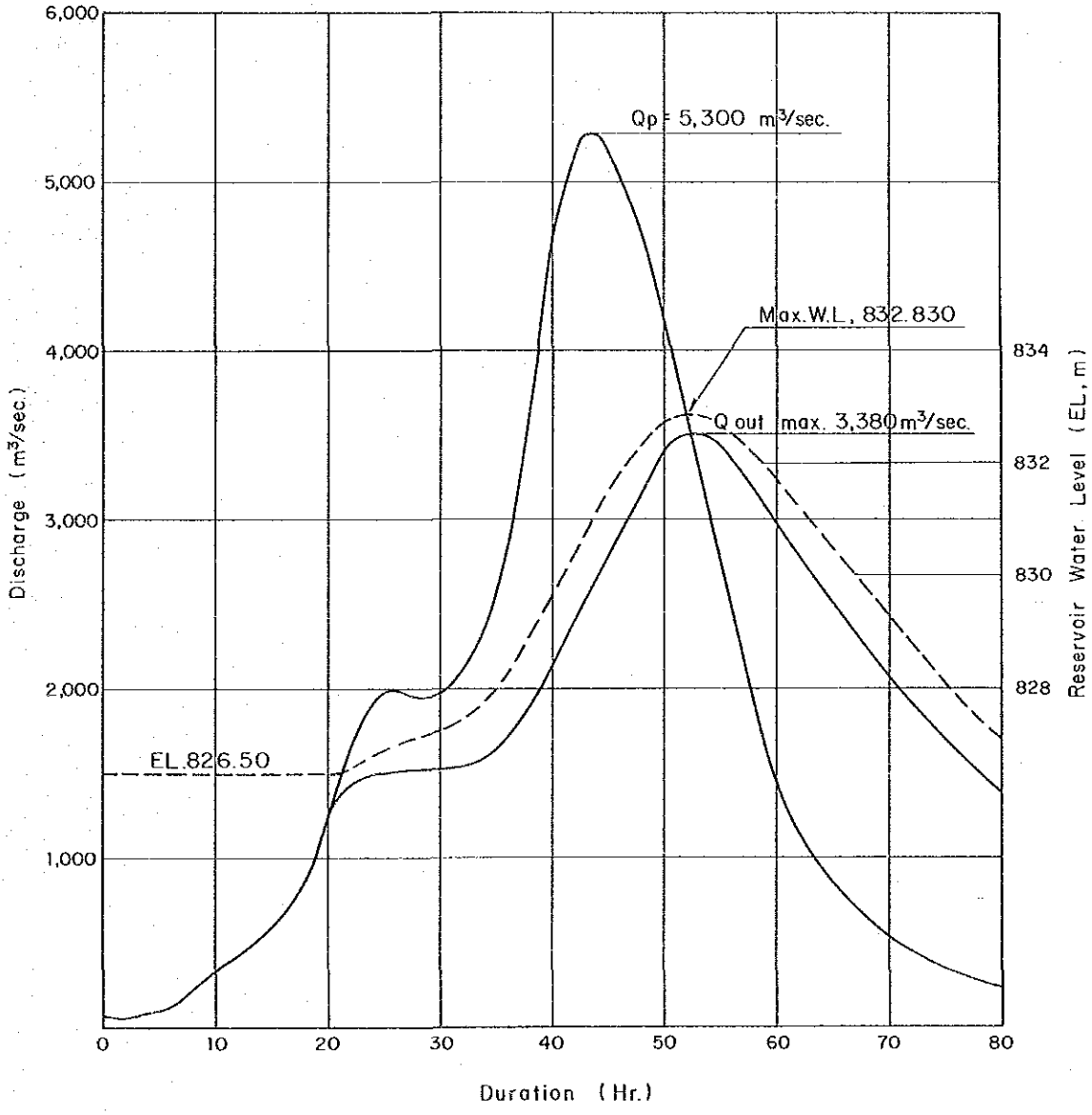
	Sliding Safety Factor	Bearing Capacity (ton/m)		Overturning (B/6)
Case 1	4.076	95.625	124.967	3.303 (24.833)
Case 2	-26.641	93.233	83.554	-1.360 (24.833)

Table I-03 RIVER DIVERSION FLOOD ROUTING

Time	Inflow	Average Inflow	Pusai	Phai	Storage	R.W.L	Outflow
0	64	-	-	-	-	747.2	63.8
1	68	238,168	0.01	0.25	0.13	747.3	67.2
2	73	254,902	0.00	0.27	0.13	747.5	72.5
3	84	283,348	-0.01	0.29	0.14	747.9	81.6
4	95	323,508	-0.02	0.32	0.15	748.3	93.8
5	119	385,420	-0.04	0.36	0.16	748.9	113.7
6	142	469,086	-0.07	0.42	0.18	750.0	135.9
7	174	569,485	-0.07	0.50	0.22	750.5	160.2
8	207	686,617	-0.05	0.61	0.28	751.3	185.4
9	224	775,303	-0.03	0.72	0.35	752.2	207.8
10	240	835,542	0.01	0.81	0.41	753.0	223.0
11	248	879,048	0.04	0.88	0.46	753.7	235.6
12	255	905,821	0.06	0.94	0.50	754.2	245.0
13	252	912,514	0.07	0.97	0.52	754.5	249.7
14	248	899,128	0.07	0.97	0.52	754.5	249.7*
15	241	880,721	0.07	0.95	0.51	754.3	246.9
16	235	857,295	0.05	0.92	0.49	754.0	241.8
17	221	820,482	0.03	0.87	0.45	753.5	233.6
18	207	770,283	0.00	0.80	0.40	752.9	221.8
19	187	710,043	-0.03	0.71	0.34	752.1	206.1
20	168	639,764	-0.05	0.61	0.28	751.3	184.8
21	154	579,525	-0.07	0.53	0.23	750.6	165.0
22	140	529,325	-0.07	0.46	0.19	750.1	148.4
23	131	487,492	-0.06	0.41	0.18	749.8	132.0
24	121	454,026	-0.06	0.39	0.17	749.4	124.5
25	117	428,926	-0.05	0.37	0.16	749.0	116.8
26	112	412,193	-0.04	0.36	0.16	748.9	113.2
27	110	400,480	-0.04	0.36	0.16	748.8	110.2
28	112	400,480	-0.04	0.36	0.16	748.9	111.7
29	119	415,540	-0.05	0.37	0.16	749.1	117.2
30	125	438,966	-0.06	0.39	0.17	749.3	123.9
31	134	465,739	-0.06	0.41	0.17	749.7	130.7
32	142	495,859	-0.07	0.43	0.18	750.0	139.5
33	147	519,285	-0.07	0.45	0.19	750.1	145.4
34	151	536,019	-0.08	0.46	0.19	750.2	149.7
35	149	541,039	-0.08	0.47	0.19	750.2	150.4
36	147	534,345	-0.07	0.46	0.19	750.1	147.9

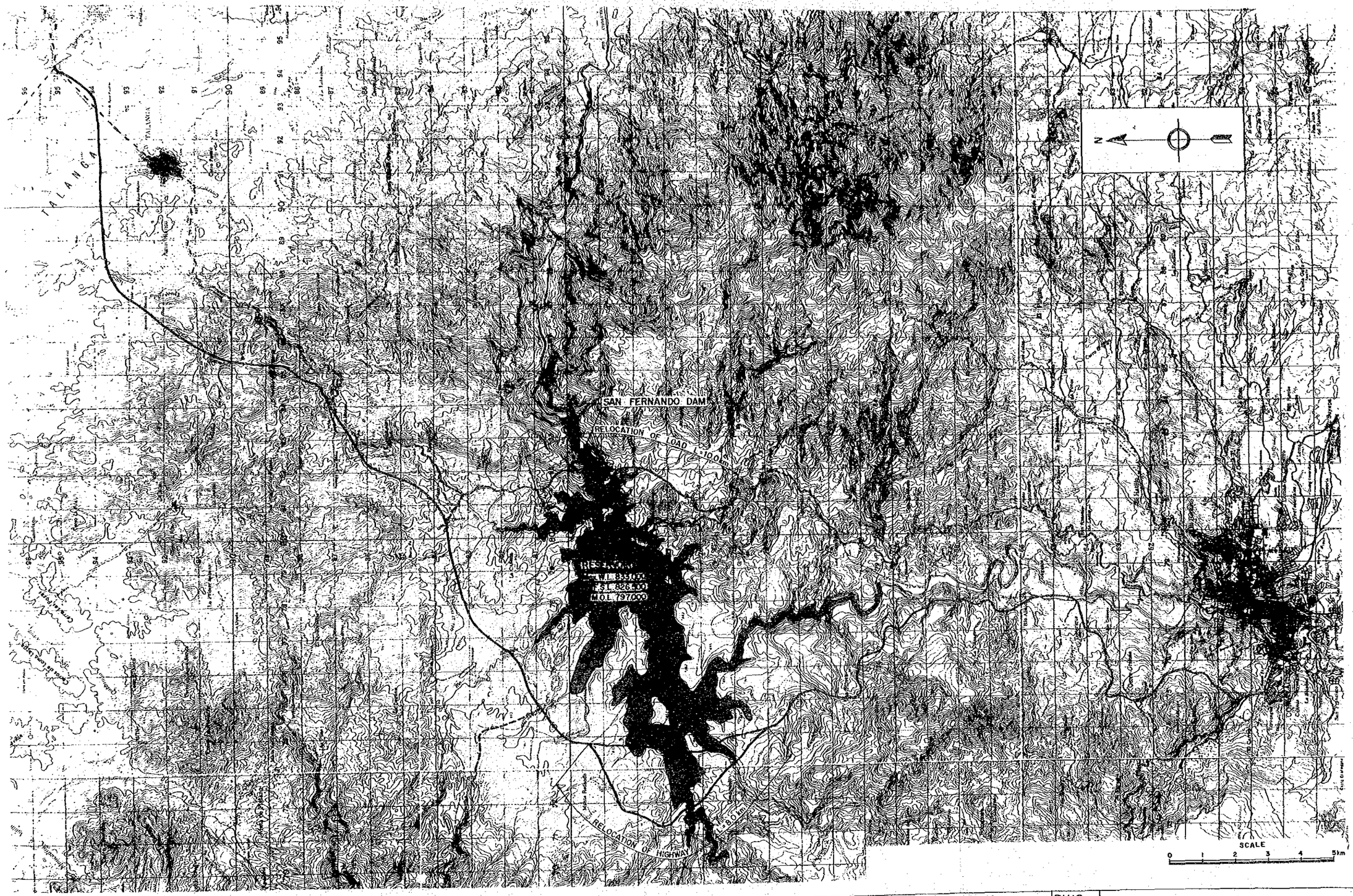
* R,W,L, 754.5 m > Crest of U/S cofferdam, EL. 755.0 m

FIGURES

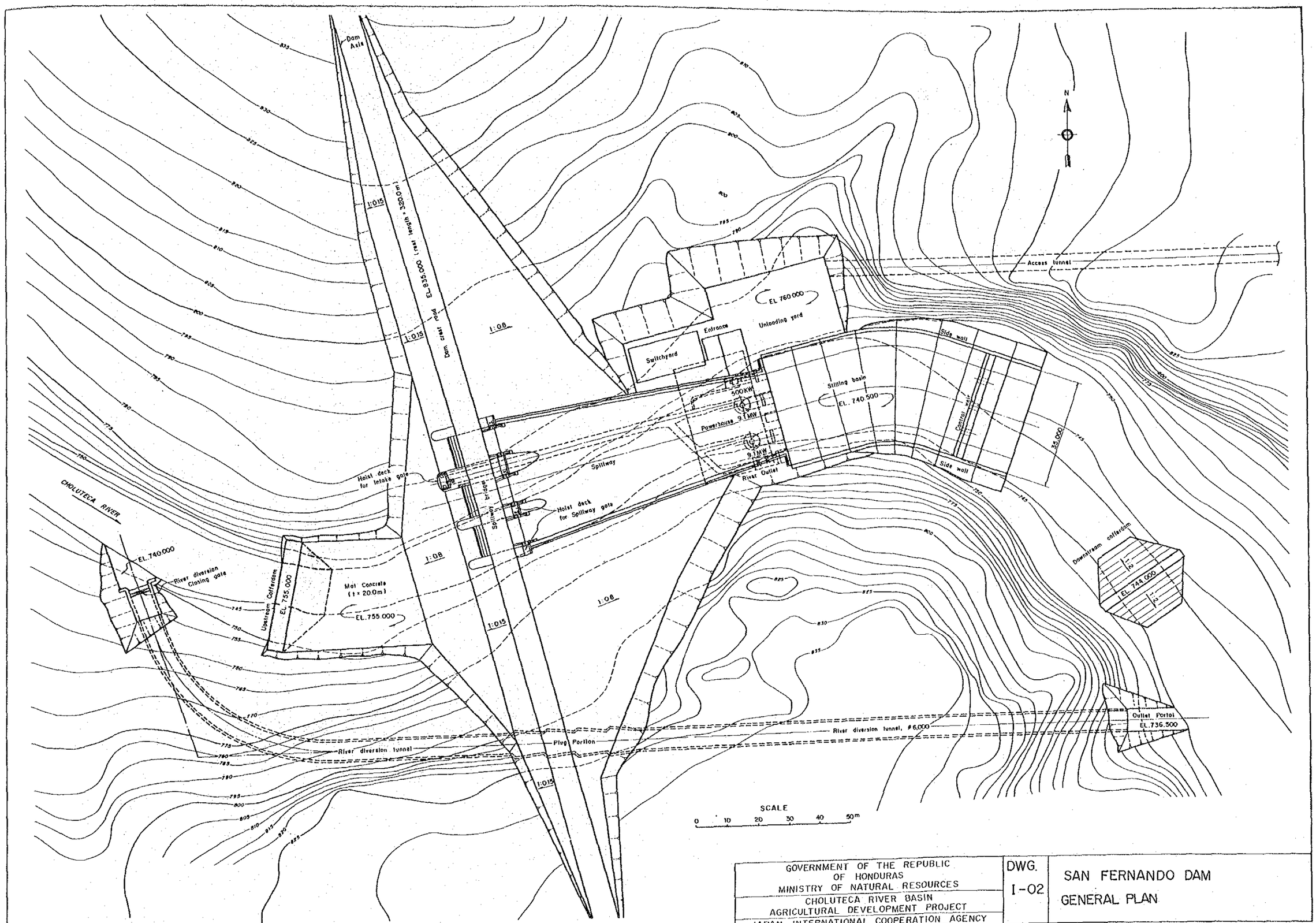


GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. I-01	FLOOD ROUTING WITH PMF

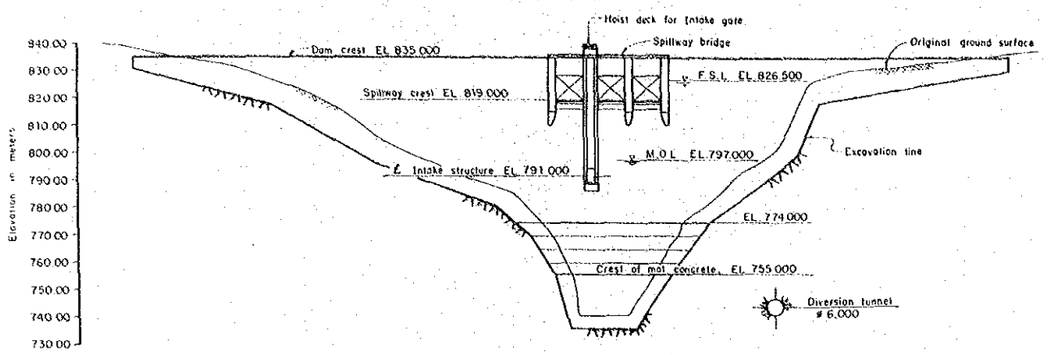
DRAWINGS



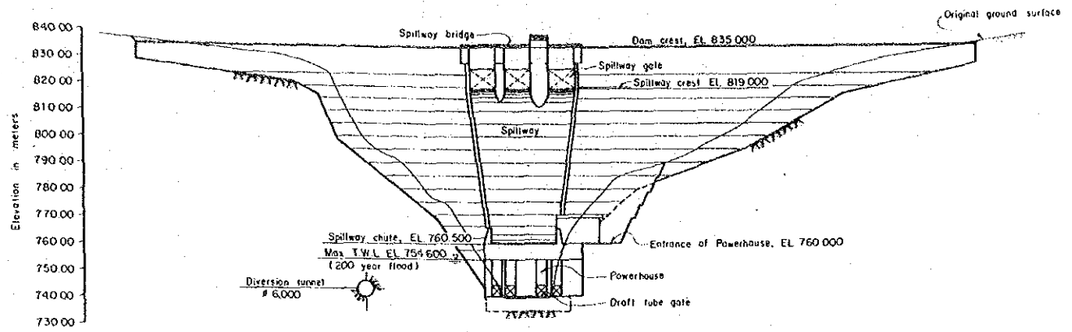
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. I-01	SAN FERNANDO DAM VICINITY MAP



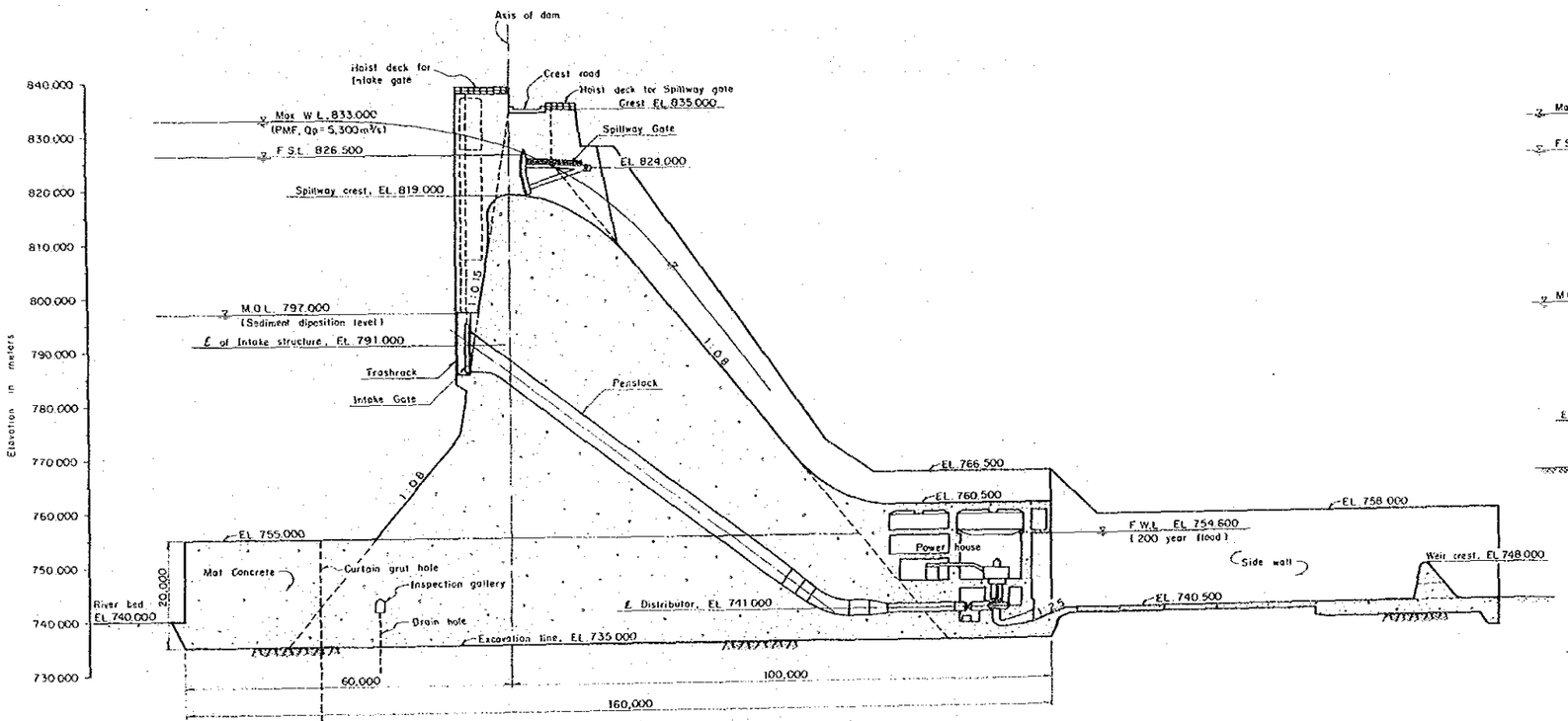
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. I-02	SAN FERNANDO DAM GENERAL PLAN



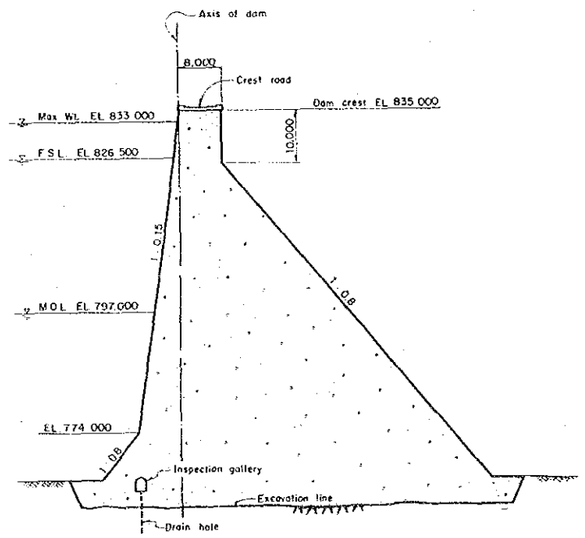
UPSTREAM ELEVATION SCALE A



DOWNSTREAM ELEVATION SCALE A



TYPICAL SECTION OF OVERFLOW PORTION
SCALE B

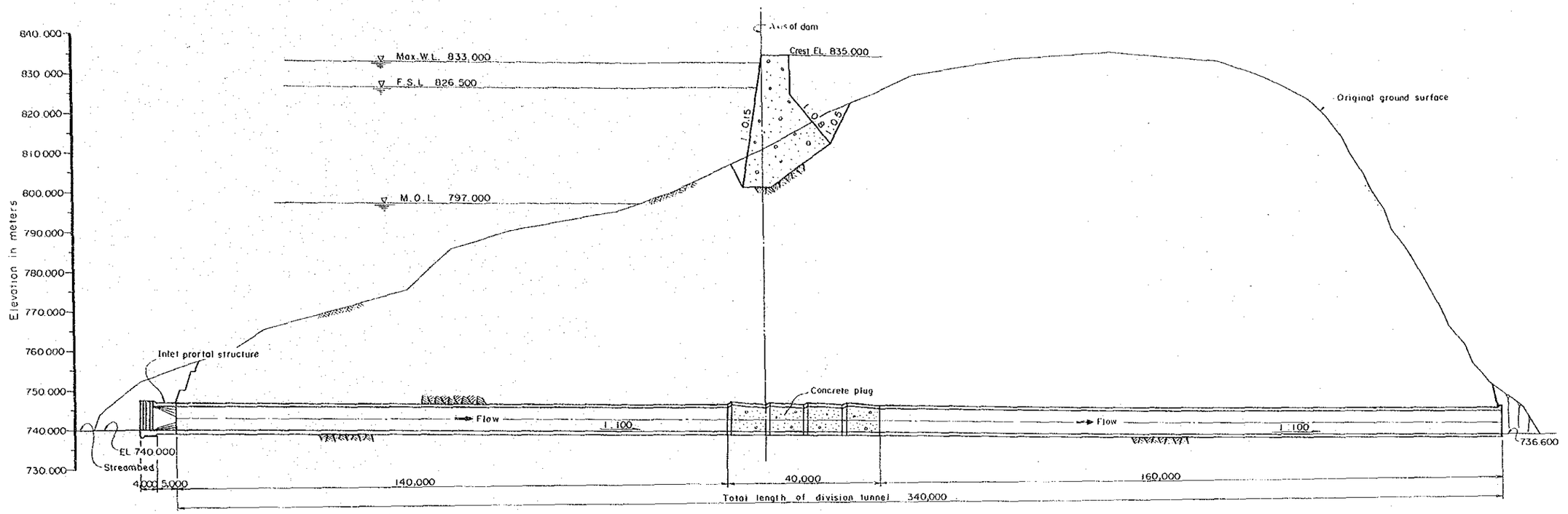


TYPICAL SECTION OF NONOVERFLOW PORTION
SCALE B

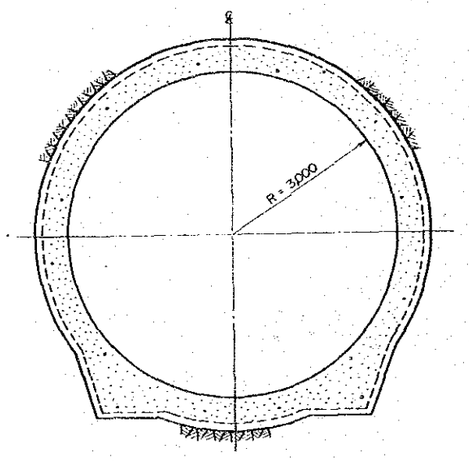
SCALE A 0 50 100m

SCALE B 0 10 20 30 40 50 m

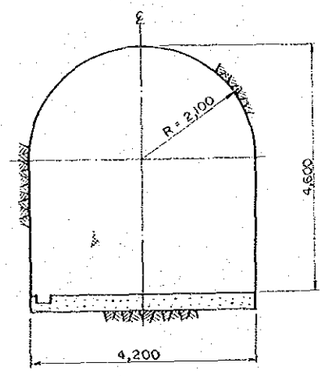
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. 1-03	SAN FERNANDO DAM ELEVATIONS AND SECTIONS



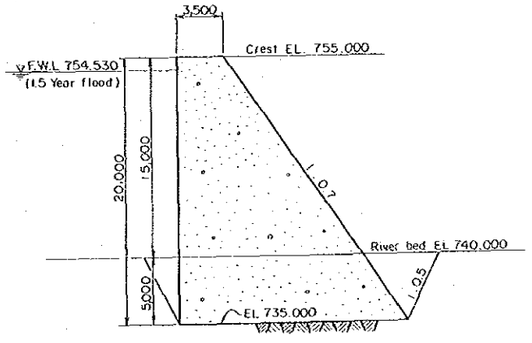
PROFILE ALONG ℄ DIVERSION TUNNEL SCALE A



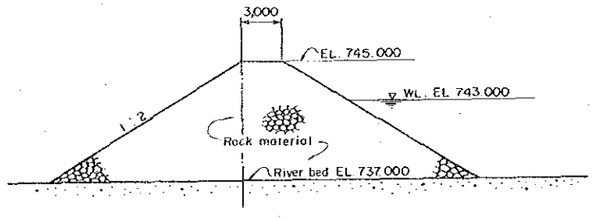
TYPICAL SECTION OF
DIVERSION TUNNEL
SCALE B



TYPICAL SECTION OF
ACCESS ROAD TO POWER HOUSE
SCALE B

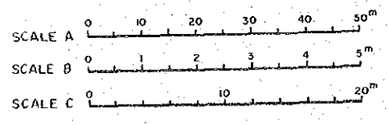


UPSTREAM COFFERDAM

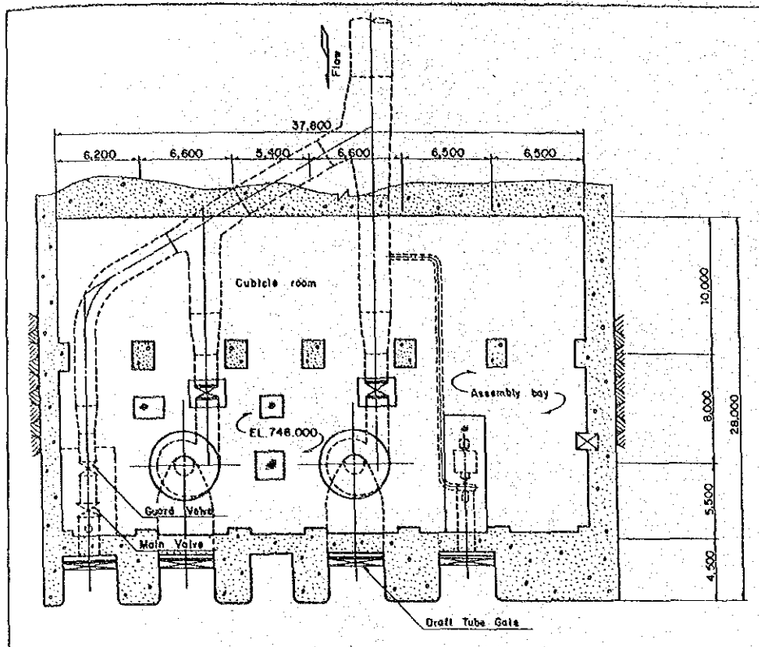


DOWNSTREAM COFFERDAM

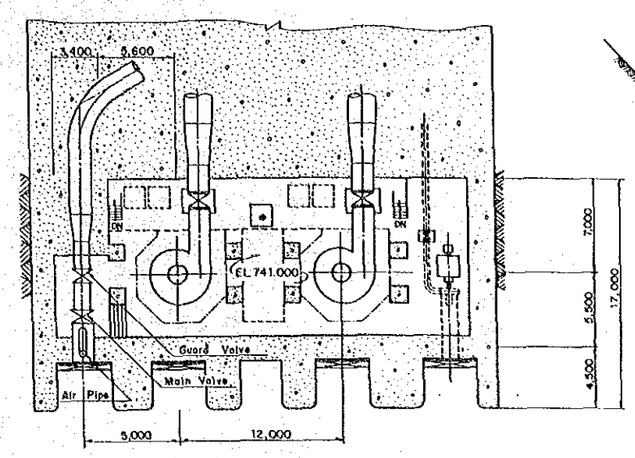
TYPICAL SECTION OF COFFERDAMS SCALE C



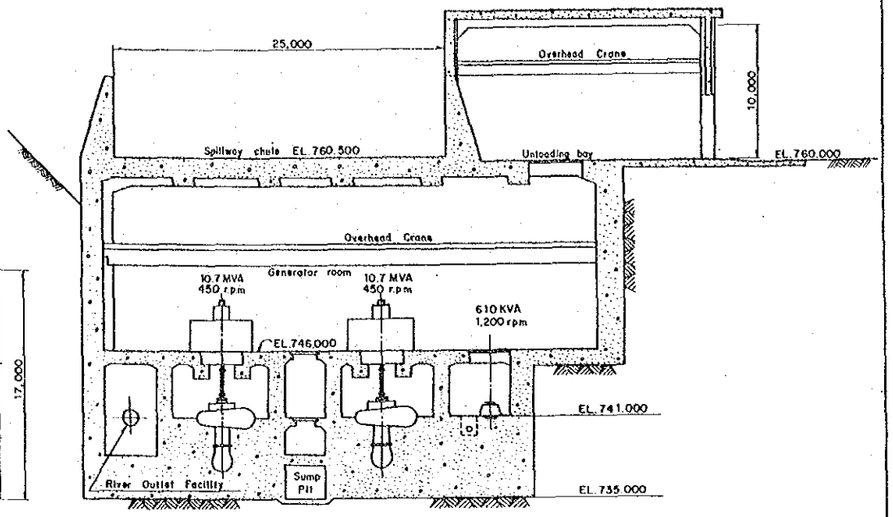
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. I-04	SAN FERNANDO DAM PROFILE AND SECTIONS



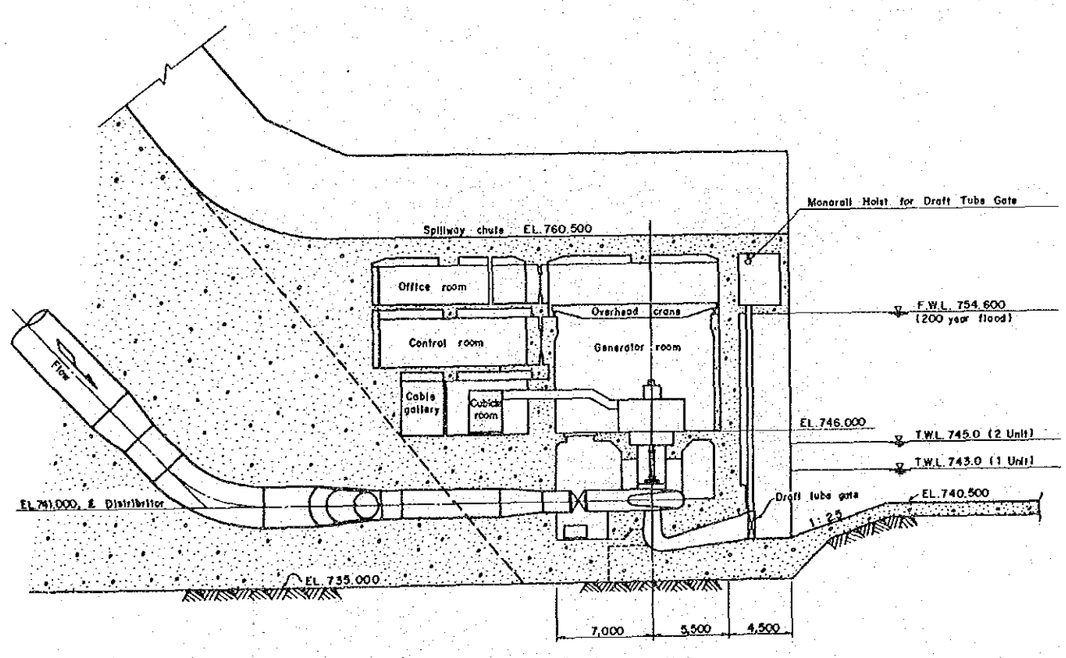
GENERATOR FLOOR PLAN (EL.746.000) SCALE A



TURBINE FLOOR PLAN (EL.741.000) SCALE A

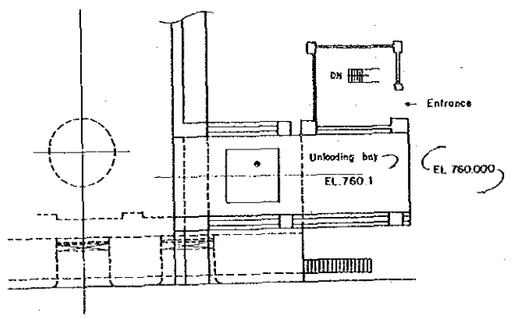


LONGITUDINAL SECTION SCALE A

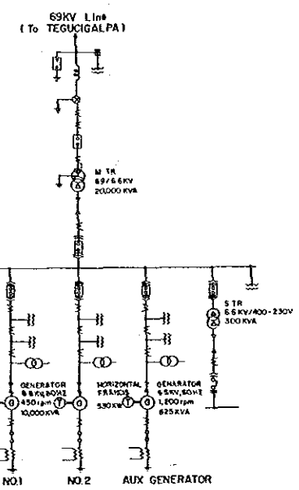


TRANSVERSE SECTION SCALE A

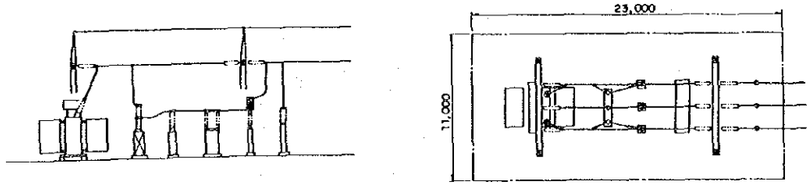
SCALE A 0 10 20



PLAN OF ENTRANCE & UNLOADING BAY SCALE A



SINGLE LINE DIAGRAM NO SCALE



SWITCHYARD SCALE A

GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG I-05	SAN FERNANDO POWERHOUSE AND SINGLE LINE DIAGRAM

ANNEX J

PROJECT EVALUATION

ANNEX - J

PROJECT EVALUATION

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J. PROJECT EVALUATION

J.1 CONSTRUCTION COST ESTIMATE

J.1.1 Basis of Estimate

The construction cost was estimated on the basis of work quantities measured through the preliminary design and the unit prices estimated for each item of work. All the costs were estimated at mid-1984 prices. The basis of estimate is briefly explained hereunder.

1) Civil Works:

Construction contracts will be awarded to contractors to be selected through international competitive tenders. The unit prices of civil works include direct costs such as labor, materials and equipment, as well as indirect costs such as contractors' overhead and profit. They were estimated in the following manner:

a) Labor Cost:

The workable days for civil works were estimated on the basis of meteorological records, as shown in Table J-01. For instance, around 208 days are workable for common civil works and 252 days for concrete works. The labor cost was estimated on the basis of daily wage rates of labors as listed up on Table J-02. The actual working hours were presumed to be 7.0 hours a day.

b) Material Cost:

The cost of construction materials includes cement, fuel and lubricants, steel and bars, wooden materials, explosives, electric power, etc. The unit prices of major materials are shown on Table J-03. The locally available materials will be procured in Honduras, and other materials will be imported from abroad. As an exceptional case, the cost of locally manufactured cement was presumed to be disbursable for 70% in foreign currency and 30% in local currency.

c) Equipment Cost:

The equipment cost includes the depreciation, maintenance and repair, as well as administration costs. The equipment to be required for each work item was selected according to the construction time schedules and work quantity. The unit prices of imported equipment were estimated on the basis of CIF Honduras and inland transportation cost.

d) Miscellaneous Cost:

About 5% of the labor, materials and equipment costs were added as miscellaneous cost to cover non-itemized construction costs.

e) Indirect Costs:

Contractors' overhead costs and profit were estimated as indirect costs. It was presumed that the indirect costs would be around 25 - 30% of the direct costs.

2) Electrical and Metalworks:

The cost of metalworks, such as gates, stoplogs, trashracks, penstocks, valves, etc., as well as such electrical works as generating equipment and substation, was estimated on the basis of current international unit prices per ton of similar works.

3) Land Compensation:

The cost of land compensation in the submergible area by the San Fernando dam (2,450 ha) was estimated in according with the land use interpreted by aerial photographs. (In economic evaluation, production forgone of the land is counted as negative benefits of the projects.) In addition, compensation of land for construction of irrigation and drainage canals on the Choluteca plain was estimated. Further, the cost of land expropriation, entitling and training for the possible resettlement area was incorporated in the estimate of land compensation.

4) Engineering Services and Administration:

The cost of engineering services was estimated to cover the fee of consultants to be retained for detailed design, assistance in pre-construction engineering and supervision of the construction works. The cost will also cover detailed topographic, geologic and soil-mechanic investigations required for the design and construction.

5) Physical and Price Contingencies:

The cost estimate was made on the basis of data and information available from the feasibility level investigation. Therefore, some allowances should be provided for such unknown factors as i) changes in items and quantities in the detailed design, ii) changes in the assumed geological conditions to be encountered during construction, iii) degree of accuracy of available topographic maps in some places, etc. The physical contingency was estimated at 10% of the direct construction cost. On the other hand, the price contingency was estimated to cover the price escalation. The escalation rate of the costs to be incurred in local currency was presumed at 6%, based on the price indices as noted in Annex A.2.6. The escalation rate of the costs to be incurred in foreign currency was assumed at 5% in the light of recent international price escalation in similar works.

J.1.2 Construction Cost

The direct construction cost of dam and power facilities was estimated at around Lp. 105.5 million, of which about Lp. 15.5 million would be for power facilities. Details of the estimated cost are shown on Table J-04 and J-05. On the other hand, the direct construction cost of irrigation and drainage facilities was estimated for each case of implementation program, i.e. irrigation of 23,960 ha (total irrigable area), 20,600 ha (Western plain + Eastern plain - A), 16,000 ha (Western plain) and 12,400 ha (1st phase in Western plain). The estimated cost is shown in detail on Table J-04 to J-06.

The total estimated construction cost, including land compensation, engineering and administration, physical and price contingencies, for each case of implementation program is shown on Table J-04, and summarized as follows:

(Unit: Lp.10^3)

	Foreign Currency	Local Currency	Total
Dam, Power & Irrigation			
23,960 ha	269.5	107.3	376.8
20,600 ha	263.5	106.1	369.6
16,000 ha	218.2	84.6	302.8
12,400 ha	197.2	75.6	272.8

J.1.3 Disbursement Schedule

The estimated construction cost will be disbursed in accordance with the progress of construction works. By referring to the construction time schedule presented in the Main Report, Chapter 7.1, a disbursement schedule was prepared for each case of implementation program as shown on Table J-07. Details of disbursement of dam and power facilities, as well as irrigation facilities, are shown on Tables J-09 and J-10. Annual disbursement in each case is summarized as follows:

(Unit: Lp.10^6)

	1985	1986	1987	1988	1989	1990	1991	1992-4	Total
Dam, Power & Irrigation:									
20,600 ha	7.6	5.7	30.9	80.6	99.6	75.8	10.3	59.1	369.6
16,000 ha	7.6	5.7	30.9	80.6	97.5	71.8	8.7	-	302.8
12,400 ha	7.6	5.7	30.4	78.7	96.2	54.2	-	-	272.8
Middle reach	-	-	-	1.6	2.8	2.8	-	-	7.2

Further, in the cases of dam, power and irrigation of 20,600 ha and 16,000 ha, the cost of dam and irrigation was segregated from power facility cost, to facilitate financial evaluation of each component of the facilities, as shown on Table J-08.

J.2 ECONOMIC EVALUATION

J.2.1 Economic Cost

Economic evaluation was made on the basis of economic cost estimated for the implementation of the project. The economic cost is the cost to be required by the project from the view point of national economy. There are some costs which are not to be counted as economic costs in terms of national economy, even if those costs are financially required for implementation.

1) Economic Construction Cost:

The economic cost was estimated in terms of local currency. In the economic cost, such transfer payments as taxes and subsidies are excluded. Shadow rates were assumed in evaluating the economic value of labor, foreign exchange, etc. from the viewpoint of national economy.

a) Taxes:

Taxes to be imposed in Honduras are considered as a transfer payment which is only transferred within the national economy and are excluded from the economic cost. As for local materials, their market prices include some taxes which are not exempted or reimbursable. The amount of such taxes was deducted in estimating the purchase cost of local materials.

b) Shadow Wage Rate:

The wages of skilled labors appear to reflect the market mechanism and are taken into account as the economic cost. The unskilled labors are in excess of actual demand, and unemployment and under employment rate is substantially high as reviewed in Annex A.1.2. In such a case, the opportunity cost of unskilled labor, which is defined as the production value of unskilled labor to be sacrified in other fields by employment in the project, is considered to be economic cost of unskilled labor. As noted in Annex A.1.2 the opportunity cost of unskilled labor is evaluated at 0.5 of the wage to be actually paid to labor, and this shadow wage rate was applied in the project evaluation.

c) Shadow Exchange Rate:

The equipment, plants and materials, as well as agricultural products, to be imported from or exported to foreign countries will be estimated at a higher rate if they are valued in local currency. As noted in Annex A.2.4, the shadow exchange rate of foreign currency is evaluated at Lp. 2.5 per U.S. Dollar. Consequently, this shadow exchange rate was applied in estimating the economic cost of imported equipment, materials and services, as well as of exported or import-substituted agricultural products.

In the estimate of costs to be incurred in local currency, the taxes to be imposed on local purchase and the shadow wage rate of unskilled labor were calculated as approximately 5% of the principal costs estimated on the basis of market prices. On the other hand, the costs to be incurred in foreign currency were valued at 1.25times of the estimated financial costs.

The economic construction cost of the San Fernando dam, power and irrigation facilities was estimated for each case of implementation program, as summarized on Table J-11. The disbursement of such an economic cost was also estimated as indicated in Table J-11.

2) Operation, Maintenance and Replacement Cost:

In addition to the construction cost, the economic cost of the project comprises the operation and maintenance cost (O&M cost) and necessary replacement cost. They were estimated as follows:

a) O&M Cost:

The O&M cost covers the wages of operation and maintenance staff, regular maintenance and minor repair costs. The annual O&M cost was estimated at 0.1% of the San Fernando dam construction cost, 0.5% of the power facility costs, and 2.0% of irrigation facility costs. The annual O&M cost was estimated at Lp. 3.1 million for the San Fernando dam and irrigation of 23,960 ha, and of Lp. 2.35 million for the dam and irrigation of 19,360 ha.

b) Replacement Cost:

The economic life of civil works is 50 years, and the project life was assumed to be the same period for economic evaluation. On the other hand, the economic life of electrical works and metalworks was assumed to be 25 years, and a replacement cost after this useful life period was taken into account. A salvage value of about 10% was assumed in estimating the replacement cost.

J.2.2 Economic Benefit

Economic benefit accrues directly from increased agricultural production and electric power generation. The benefit was estimated in such a manner as explained hereunder.

1) Agricultural Benefit:

Agricultural benefit was estimated by incremental benefit, comparing "with" and "without" project conditions. For economic evaluation, economic prices of farm inputs and outputs were estimated in accordance with the following procedures:

a) The economic price of agricultural products was basically estimated by referring to the IBRD price forecasts. The projected 1995 world market prices were valued at 1984 constant prices. The farm-gate price was calculated by estimating transportation, processing and other charges, as shown on Table J-12. The farm-gate prices of some products not included in the IBRD forecasts were estimated by applying a ratio between economic prices and local market prices of similar products, as summarized on Table J-13.

b) The economic price on farm inputs was estimated by applying a ratio between economic prices and market prices calculated for some representative inputs, as shown on Table J-14. For the estimate of machinery cost, the shadow exchange rate was applied to the imported components (75%). Labor cost was estimated by applying the shadow wage rate of 0.5.

On the basis of economic prices of inputs and outputs, the economic net return of each crop was calculated respectively for "with" and "without" project conditions. A summary of net return of each crop is shown on Table J-15 and J-16, and their breakdown is presented in Table J-17 and J-18. Further, the net incremental benefit of agricultural development in the Western plain and Eastern plain - A was estimated in accordance with the cropping areas studied in Annex E and Annex F, as summarized on Table J-19 and J-20. Through the development of Western plain (16,000 ha), it is expected that the net incremental benefit would amount to Lp. 39.89 million. Likewise, the development of Eastern plain - A (4,600 ha) would bring about a net return of Lp. 14.65 million.

Benefit from the development in the middle reach valleys (2,680 ha in San Juan de Flores and 680 ha in other existing areas), for which water would be stored and secured by the San Fernando dam, was also estimated as an associated benefit of the project. The net return of each crop was estimated respectively for "with" and "without" project conditions in Table J-21 and J-22. The net incremental benefit would amount to Lp. 5.65 million in the middle reach valleys, as shown on Table J-25.

Consequently, the agricultural benefit annually accruable from the project was estimated to amount to approximately Lp. 45.5 million for the first stage development of 19,360 ha, and to Lp. 60.2 million in total by the second stage development of 23,960 ha.

The said benefit would be achieved in a build-up period of 5 years. In preparing a benefit flow, therefore, the benefit during the build-up period was calculated to gradually increase from 40% of the target in the first year, 55% in the second year, 70% in the third year and 85% in the fourth year, as shown in Table J-26.

2) Power Benefit:

As noted in Annex G.3, power plants would be installed to make use of water released for irrigation and to cover the base load of the demand in the dry season. Power would also be generated in the rainy season by mini-hydropower. In a rainy year, power would also be generated by surplus water to be released from the reservoir. For evaluation of power benefit, the capacity value and energy value of alternative power source was estimated as explained hereunder.

a) Capacity Value:

Although the installed capacity was determined at 18.2 MW (average capacity in April), power generation in the dry season would be rather fluctuated in accordance with water release for irrigation. An average capacity during the period from December to April would be 11.1 MW, and this was taken in evaluating the capacity value of the alternative power source which would be an oil-fired thermal plant. Although some peak power would be generated by surplus water in the rainy year, such a peak power generation would be unstable and additional capacity value was not counted in evaluation.

The capacity value was calculated on the basis of 50 MW class oil-fired thermal plant which would cost $920/kW. As shown on Table J-27, capacity value was estimated at Lp. 2,630/kW or Lp. 29.2 million for 11.1 MW. The first operation and maintenance value was estimated at Lp. 52.6/kW or Lp. 584,000 per annum.

b) Energy Value:

The energy value of oil-fired thermal plant was estimated on the basis of prevailing fuel cost ($27.18/bbl). As shown on Table J-28, the energy value was estimated at Lp. 0.1311/kWh. For an annual energy output of 53.6 GWh, the energy value was estimated at Lp. 7.02 million per annum. The annual variable operation and maintenance value was estimated at Lp. 536,000.

c) Replacement Cost:

The replacement cost to be required after the service life of 25 years was estimated to be about 90% of the initial investment cost.

On the basis of the above estimate, the annual economic power benefit was estimated as summarized on Table J-29. The annual benefit during the period of alternative power operation would amount to around Lp. 8.1 million.

3) Negative Benefit:

The San Fernando reservoir will flood an area of 2,450 ha. The present production in the area cannot continue after the completion of dam. Though it is small, the production forgone in the reservoir area was estimated at Lp. 0.38 million as shown in Table J-30. This was taken into account as a negative effect of the project.

J.2.3 Economic Internal Rate of Return

The economic cost estimated in Chapter J.2.1 and economic benefit estimated in J.2.2 were computed into an economic cost and benefit flow of each case of implementation, as shown on Table J-31. Further, the economic internal rate of return (EIRR) was calculated as summarized hereunder.

	EIRR (%)
Dam, Power & Irrigation	
20,600 ha (+ middle reach)	14.2
16,000 ha (+ middle reach)	13.7
12,400 ha (+ middle reach)	12.9

Judging from EIRR calculated above, the full scale development with irrigation of 20,600 ha in the Choluteca plain was found to be economically feasible, and it is recommended that the implementation program be set with a target to irrigate the Western plain (16,000 ha) and Eastern plain - A (4,600 ha). Even in case that the implementation is programed for the first stage development on the Western plain, EIRR would be well over the opportunity cost of capital in Honduras (at least 12%) and its implementation is thus economically justifiable.

J.2.4 Sensitivity Analysis

A sensitivity analysis of EIRR was made by assuming some changes in variables in benefit and cost. The result of sensitivity analysis is summarized as follows:

Dam, Power and Irrigation (20,600 ha)

Cost Increase	Benefit Decrease			
	0%	5%	10%	15%
0%	14.2	13.7	13.1	12.4
5%	13.7	13.1	12.5	11.9
10%	13.2	12.6	12.0	11.4
15%	12.7	12.1	11.6	11.0

Dam, Power and Irrigation (16,000 ha)

Cost Increase	Benefit Decrease			
	0%	5%	10%	15%
0%	13.7	13.1	12.5	11.8
5%	13.1	12.6	12.0	11.4
10%	12.6	12.1	11.5	10.9
15%	13.1	11.6	11.1	10.5

Dam, Power and Irrigation (12,400 ha)

Cost Increase	Benefit Decrease			
	0%	5%	10%	15%
0%	12.9	12.3	11.7	11.1
5%	12.4	11.9	11.3	10.7
10%	11.9	11.4	10.8	10.2
15%	11.4	10.9	10.4	9.8

It was observed that an increase in costs is less sensitive, though slightly as it is, than the decrease in benefit. (Refer to Figure J-01) Even in case that the cost is increased by 10%, or the benefit is decreased by 10%, EIRR would still fall within a range which economically justifies the implementation of the project.

J.3 FINANCIAL EVALUATION

J.3.1 Capacity-to-Pay

The financial evaluation was made, in the first place, from the viewpoint of farmers' economy by examining their capacity-to-pay. The capacity-to-pay was esamined in the case of i) a typical farm budget of farmers holding 10 ha, and ii) a typical budget of cooperatives with 20 members in 100 ha.

A typical farm budget of farmers holding 10 ha was estimated in Annex F.3.4 (Table F-14), and the net return was calculated for three types of cropping patterns as cited hereunder.

	Net Return (Lp.10^2)
Sugar cane, as major crop	15.2
Cotton, as major crop	20.5
Paddy as major crop	18.8

The net return is a repayment capacity at a farm level. Since water charge is actually ineffective, the operation and maintenance cost of irrigation facilities is provisionally considered as a charge which farmers have to pay for. From the financial cost of irrigation facilities estimated in Chapter J.1.2 (facilities for 16,000 ha), the operation and maintenance cost was estimated at around Lp. 105/ha. The charge of Lp. 1,050 per 10 ha would account for about 5 - 7% of the net return or capacity-to-pay of such a typical small farmer.

The capacity-to-pay of a typical cooperative with 20 members in 100 ha was evaluated on the basis of typical farm budget estimated in Annex F.3.4 (Table F-15). From the net return of cooperative, living expenses of member farmers were deducted at the rate of Lp. 4,550/member as in the case of typical small farmers. Consequently, the capacity-to-pay of cooperative would amount to Lp. 88,000 - Lp. 107,000. The charge for operation and maintenance (Lp. 10,500 per 100 ha) would represent about 10 - 12% of the capacity-to-pay.

From the above review, it was clear that the farmers' income will be greatly improved under "with" project condition, and even a small farmer will have enough capacity-to-pay water charge or operation and maintenance cost of irrigation facilities.

J.3.2 Financial Internal Rate of Return

The financial internal rate of return (FIRR) was additionally calculated to evaluate repayment capacity of capital investment. The project evaluation by FIRR was made respectively for irrigation plan and power generation plan.

1) FIRR of Irrigation Plan:

FIRR of irrigation plan was calculated on the following conditions:

a) Benefit is estimated on the basis of revenue from marketable products in financial terms.

b) Capital investment required for construction of dam (exclusive of power facilities) and irrigation facilities are considered as financial cost.

c) Price escalation is applied to both capital investment (5% in foreign currency and 6% in local currency) and benefit (5%) during the construction period.

d) Annual operation and maintenance cost of dam is presumed to be 0.1% of construction cost. Annual operation and maintenance cost of irrigation facilities is estimated at 2% of construction cost.

On the basis of above conditions, a flow of benefit and cost for irrigation plan was prepared as shown on Table J-32(1) for the full scale development of 20,600 ha on the Choluteca plain, and Table J-32(2) for the first stage development (16,000 ha on the Western plain).

FIRR was calculated at 13.1% for the full scale development and at 11.7% for the first stage development. This leads to the implication that repayment of investment in dam and irrigation facilities by farmers would be relatively hard, and it may be desirable that the irrigation project be subsidized by the government.

2) FIRR of Power Generation Plan:

FIRR of power generation plan was calculated on the following conditions:

a) Benefit is estimated on the basis of revenue from power sales. Power revenue was Lp. 0.16 per kWh in 1983, and would increase at the annual rate of 5%.

b) Power loss is estimated at 4.8% of generated energy.

c) Since water release for irrigation is utilized for power generation and dam height is decided regardless of power generation, cost of dam is not allocated to power generation in this financial study.

d) Capital cost is estimated for power station and related facilities. Price escalation is presumed to be 5% in foreign currency and 6% in local currency during the construction period.

e) Operation and maintenance cost of power facilities is estimated at around 0.5% of construction cost. O&M cost of distribution systems (Lp. 0.0067/kWh) will be additionally counted.

On the basis of above conditions, a flow of cost and revenue for power generation plan was prepared as shown on Table J-33. FIRR of power generation plan was thus calculated at 34.0%. This fact indicates that the installation of a power plant at the San Fernando dam is financially viable and highly profitable.

A combined flow of benefit and cost for power generation and irrigation of 16,000 ha is presented on Table J-34. FIRR of the combined plan was calculated at 13.5%.

TABLES

Table J-01 ESTIMATE OF WORKABLE DAYS

Month	-3mm	3-10mm	10-30mm	30mm Over	Sunday & Holiday	Embankment Workable Day Common	Filter	Rock	Concrete
Jan.	8.4	1.2	0.2	0	6	24	24	25	24
Feb.	3.5	1.0	0.3	0	4	22	23	24	23
Mar.	2.2	0.4	0.3	0.1	7	23	23	23	23
Apr.	3.3	1.3	0.5	0.4	6	21	22	23	22
May	4.1	3.0	2.4	1.3	5	15	19	22	21
Jun.	7.3	5.4	4.7	1.4	4	8	14	20	17
Jul.	12.1	5.4	2.2	0.3	5	16	21	23	21
Aug.	12.4	4.0	2.4	0.3	4	17	21	24	22
Sep.	9.0	4.8	3.3	0.9	5	13	16	21	18
Oct.	6.7	5.5	3.9	0.7	7	9	14	18	16
Nov.	9.2	2.1	1.7	0.5	4	19	21	22	22
Dec.	10.8	1.5	1.2	0	6	21	22	24	23
						208	240	269	252

The calculation formula of workable days:

1. Core: Monthly day - (3-10mm) x 1/2 - (10-30mm over) x 2 - Holidays
2. Filter: Monthly day - (10-30mm over) x 2 - Holidays
3. Rock: Monthly day - (10-30mm over) x 1 - Holidays
4. Concrete: Monthly day - (3-10mm) x 1/2 - (10-30mm over) x 1 - Holidays

Table J-02 LABOUR COST

Description	Unit	Unit Price (LPS)
Foreman	Man-day	60
Operator (A)	"	32
Operator (B)	"	25
Mechanic	"	32
Electrician	"	40
Driver	"	18
Welder	"	37
Blasting Worker	"	30
Reinforcement Steel Worker	"	30
Concrete Worker	"	18
Carpenter	"	18
Plasterer	"	18
Mason	"	18
Common Labour	"	6

Table J-03 MATERIAL COST

Description	Unit	Unit Price (LP.)
Dynamite	kg	12.8
Detonator	NOS	1.5
A.E. Agent	kg	3.0
Release Agent	l	2.8
Reinforcement Bar	ton	800
H-Shaped Steel	ton	900
Square Pipe 60x60x2.3	kg	1.0
Plywood	m^2	9.8
Water Stop W330x9	m	20
Joint Filler	m^2	30
Metal Form	m^2	28.2
Light Steel Channel	kg	0.96
Steel Angle	kg	0.9
Anchor Bolt (Set)	(set)	132
Timber, Plant	m^3	220
Cross Bit Dia 65mm	NOS	220
Rod L-3m	"	120
Rod Sleeve	"	96
Rod Shank	"	200
Cross Bit Dia 44mm	"	66
Diamond Bit Dia 44mm	Carat	1,160
Diamond Reamer 66mm	Carat	1,180
Boring Rod (2m)	NOS	106
AN-FO	kg	3.7
Gasoline	l	0.95
Diesel Oil	l	0.61
Lubricant	l	3.06
Grease	kg	3.9
Cement	kg	0.186
Electric Power	kWh	0.174

Table J-04(1) SUMMARY OF COST ESTIMATE

(Dam, Power and Irrigation 23,960 ha)

(Unit: Lp.10³)

Description	Foreign Currency Component	Local Currency Component	Total
1. SAN FERNANDO DAM AND POWER STATION			
1.1 Access road and preparatory works	5,368	3,191	8,559
1.2 River diversion works	3,720	1,170	4,890
1.3 Dam and spillway	50,369	18,241	68,610
1.4 Intake, penstock and outlet	700	58	758
1.5 Powerhouse and tail race	2,372	1,133	3,505
1.6 Generating equipment	9,272	736	10,008
1.7 Transmission line and sub-station	1,130	850	1,980
1.8 Highway relocation	5,120	2,080	7,200
Sub-total	78,051	27,459	105,510
2. CHOLUTECA PLAIN IRRIGATION SYSTEM			
2.1 Preparatory works	1,937	1,467	3,404
2.2 Intake weir	13,974	3,716	17,690
2.3 Main canal	15,486	3,925	19,411
2.4 Branch canal	27,565	7,560	35,125
2.5 Secondary canal	2,714	1,052	3,766
2.6 Drainage canal	5,154	1,371	6,525
2.7 Farm road	7,570	2,206	9,776
2.8 On-farm construction	4,297	1,605	5,902
2.9 Clearing and reclamation	10,175	3,416	13,591
Sub-total	88,872	26,318	115,190
3. IRRIGATION IN MIDDLE REACH	4,900	1,062	5,962
4. LAND COMPENSATION	-	8,750	8,750
5. ENGINEERING AND ADMINISTRATION	17,640	8,857	26,497
6. CONTINGENCIES			
6.1 Physical contingency	18,948	7,246	26,194
6.2 Price contingency	61,077	27,657	88,734
Sub-total	80,025	34,903	114,928
Total	269,488	107,349	376,837

Table J-04(2) SUMMARY OF COST ESTIMATE

(Dam, Power and Irrigation 20,600 ha)

(Unit: Lp.10^3)

Description	Foreign Currency Component	Local Currency Component	Total
1. SAN FERNANDO DAM AND POWER STATION			
1.1 Access road and preparatory works	5,368	3,191	8,559
1.2 River diversion works	3,720	1,170	4,890
1.3 Dam and spillway	50,369	18,241	68,610
1.4 Intake, penstock and outlet	700	58	758
1.5 Powerhouse and tail race	2,372	1,133	3,505
1.6 Generating equipment	9,272	736	10,008
1.7 Transmission line and sub-station	1,130	850	1,980
1.8 Highway relocation	5,120	2,080	7,200
Sub-total	78,051	27,459	105,510
2. CHOLUTECA PLAIN IRRIGATION SYSTEM			
2.1 Preparatory works	1,937	1,467	3,404
2.2 Intake weir	13,974	3,716	17,690
2.3 Main canal	15,486	3,925	19,411
2.4 Branch canal	27,565	7,560	35,125
2.5 Secondary canal	2,714	1,052	3,766
2.6 Drainage canal	5,154	1,371	6,525
2.7 Farm road	7,570	2,206	9,776
2.8 On-farm construction	4,297	1,605	5,902
2.9 Clearing and reclamation	10,175	3,416	13,591
Sub-total	88,872	26,318	115,190
3. LAND COMPENSATION	-	8,750	8,750
4. ENGINEERING AND ADMINISTRATION	17,150	8,750	25,900
5. CONTINGENCIES			
5.1 Physical contingency	18,409	7,128	25,537
5.2 Price contingency	61,077	27,657	88,734
Sub-total	79,486	34,785	114,271
Total	263,559	106,062	369,621

Table J-04(3) SUMMARY OF COST ESTIMATE

(Dam, Power and Irrigation 16,000 ha)

(Unit: Lp.10³)

Description	Foreign Currency Component	Local Currency Component	Total
1. SAN FERNANDO DAM AND POWER STATION			
1.1 Access road and preparatory works	5,368	3,191	8,559
1.2 River diversion works	3,720	1,170	4,890
1.3 Dam and spillway	50,369	18,241	68,610
1.4 Intake, penstock and outlet	700	58	758
1.5 Powerhouse and tail race	2,372	1,133	3,505
1.6 Generating equipment	9,272	736	10,008
1.7 Transmission line and sub-station	1,130	850	1,980
1.8 Highway relocation	5,120	2,080	7,200
Sub-total	78,051	27,459	105,510
2. CHOLUTECA PLAIN IRRIGATION SYSTEM			
2.1 Preparatory works	1,495	1,248	2,743
2.2 Intake weir	6,987	1,858	8,845
2.3 Main canal	12,941	3,261	16,202
2.4 Branch canal	18,348	5,009	23,357
2.5 Secondary canal	2,714	1,052	3,766
2.6 Drainage canal	4,559	1,185	5,744
2.7 Farm road	5,328	1,563	6,891
2.8 On-farm construction	3,350	1,248	4,598
2.9 Clearing and reclamation	8,259	2,873	11,132
Sub-total	63,981	19,297	83,278
3. LAND COMPENSATION	-	4,690	4,690
4. ENGINEERING AND ADMINISTRATION	15,600	7,600	23,200
5. CONTINGENCIES			
5.1 Physical contingency	15,764	5,907	21,671
5.2 Price contingency	44,774	19,680	64,458
Sub-total	60,538	25,587	86,129
Total	218,170	84,633	302,803

Table J-04(4) SUMMARY OF COST ESTIMATE

(Dam, Power and Irrigation 12,400 ha)

(Unit: Lp.10^3)

Description	Foreign Currency Component	Local Currency Component	Total
1. SAN FERNANDO DAM AND POWER STATION			
1.1 Access road and preparatory works	5,368	3,191	8,559
1.2 River diversion works	3,720	1,170	4,890
1.3 Dam and spillway	50,369	18,241	68,610
1.4 Intake, penstock and outlet	700	58	758
1.5 Powerhouse and tail race	2,372	1,133	3,505
1.6 Generating equipment	9,272	736	10,008
1.7 Transmission line and sub-station	1,130	850	1,980
1.8 Highway relocation	5,120	2,080	7,200
Sub-total	78,051	27,459	105,510
2. CHOLUTECA PLAIN IRRIGATION SYSTEM			
2.1 Preparatory works	1,495	1,248	2,743
2.2 Intake weir	6,988	1,857	8,845
2.3 Main canal	12,943	3,262	16,205
2.4 Branch canal	15,968	4,373	20,341
2.5 Secondary canal	1,841	674	2,515
2.6 Drainage canal	3,432	893	4,325
2.7 Farm road	3,495	1,017	4,512
2.8 On-farm construction	2,345	874	3,219
2.9 Clearing and reclamation	2,888	1,004	3,892
Sub-total	51,395	15,202	66,597
3. LAND COMPENSATION	-	4,000	4,000
4. ENGINEERING AND ADMINISTRATION	14,140	6,550	20,690
5. CONTINGENCIES			
5.1 Physical contingency	14,360	5,322	19,682
5.2 Price contingency	39,254	17,076	56,330
Sub-total	53,614	22,398	76,012
Total	197,200	75,609	272,809

Table J-05 CONSTRUCTION COST ESTIMATE
SAN FERNANDO DAM AND POWER STATION

Items	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost (Lp.)	Amount (Lp.10³)	Unit Cost (Lp.)	Amount (Lp.10³)	Unit Cost (Lp.)	Amount (Lp.10³)
1. Access Road & Preparatory Works								
New access road	km	18.0	140,000	2,520	100,000	1,800	240,000	4,320
Preparatory works	L.S.			2,848		1,391		4,239
Sub-total				5,368		3,191		8,559
2. River Diversion Works								
Excavation in open	m³	1,000	28	28	10	10	38	38
Excavation in tunnel	m³	15,000	104	1,560	86	540	140	2,100
Cofferdam, impervious fill	m³	1,450	12.2	18	3.8	5	16	23
Cofferdam, rockfill	m³	3,380	16.4	55	4.6	16	21	71
Concrete, potal str.	m³	300	96	29	38	11	134	40
Concrete, tunnel linning	m³	4,600	252	1,159	58	267	310	1,426
Concrete, tunnel plug	m³	1,300	116	151	58	75	174	226
Reinforcement steel	ton	430	1,140	490	260	112	1,400	602
Tunnel steel support	ton	75	1,580	119	-	-	1,580	119
Drilling and grouting	L.S.			69		56		125
Care of river	L.S.			42		78		120
Sub-total				3,720		1,170		4,890
3. Dam and Spillway								
Excavation, weatherd rock	m³	36,000	14.2	511	2.8	101	17	612
Excavation, rock	m³	157,960	20.4	3,215	6.6	1,040	27	4,255
Concrete, dam	m³	472,000	84	39,648	30	14,160	114	53,808
Concrete, pier	m³	2,180	100	218	38	83	138	301
Concrete, retaining wall	m³	1,980	96	190	36	71	132	261
Concrete, stilling basin	m³	15,540	96	1,492	36	559	132	2,051
Reinforcement steel	ton	636	1,140	725	260	165	1,400	890
Spillway bridges	L.S.			140		55		195
Spillway gate	ton	144	12,500	1,800	700	101	13,200	1,901
Anchor bar	ton	30	2,000	60	400	12	2,400	72
Foundation treatment	L.S.			2,370		1,894		4,264
Sub-total				50,369		18,241		68,610

(to be continued)

Table J-05

	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost (Lp.)	Amount (Lp.10^3)	Unit Cost (Lp.)	Amount (Lp.10^3)	Unit Cost (Lp.)	Amount (Lp.10^3)
4. Intake, Penstock & Outlet								
Intake structure	m^3	50	100	5	38	2	138	7
Reinforcement steel	ton	5	1,140	6	260	1	1,400	7
Intake gate, trash rack	ton	40	5,600	224	400	16	6,000	240
Penstock	ton	90	3,300	297	300	27	3,600	324
Outlet valve	L.S.			168		12		180
Sub-total				700		58		758
5. Powerhouse & Tailrace								
Concrete, substructure	m^3	3,200	100	320	38	121	138	441
Concrete, superstructure	m^3	5,300	114	604	60	318	174	922
Anchor block	m^3	150	100	15	38	6	138	21
Reinforcement steel	ton	415	1,140	473	260	108	1,400	581
Architectural works	L.S.			960		580		1,540
Sub-total				2,372		1,133		3,505
6. Generating Equipment								
Turbine and governor	L.S.			3,794		258		2,026
Generator	L.S.			2,802		122		1,462
Overhead crane	L.S.			1,304		76		690
Transformer	L.S.			1,372		280		826
Sub-total				9,272		736		10,008
7. Transmission Line and Sub-station								
69 kV line and line post	km	25.0	45,200	1,130	34,000	850	79,200	1,980
Sub-total				1,130		850		1,980
8. Highway Relocation								
New highway	km	8.0	640,000	5,120	260,000	2,080	900,000	7,200
Sub-total				5,120		2,080		7,200
Total				78,051		27,459		105,510

Table J-06(1) CONSTRUCTION COST ESTIMATE
IRRIGATION SYSTEM FOR
WESTERN PLAIN: 16,000 HA

(Unit: Lp.10³)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
1. Communication System and Quarters								
Office & quarters	L.S.		-	152	-	593	-	745
Workshop & others	L.S.		-	121	-	145	-	266
Laboratory	L.S.		-	82	-	235	-	317
Temporary transmission	L.S.		-	261	-	94	-	355
Water supply	L.S.		-	344	-	74	-	418
Telecommunications	L.S.		-	212	-	35	-	247
Health Services	L.S.		-	323	-	72	-	395
Sub-total				1,495		1,248		2,743
2. Headwork (El Papalon Intake Weir)								
Earthworks								
Excavation, river bed	m³	29,500	7	207	1.4	41	8.4	248
Backfill	m³	6,600	8.4	55	2.6	17	11	72
Concrete works								
Mas concrete (Type-B)	m3	10,200	100	1,020	34	347	134	1,367
Structural (Type-A)	m3	2,400	102	245	40	96	142	341
Foundation (Type-D)	m³	2,700	102	275	38	103	140	378
Reinforcement bar	ton	240	1,130	271	270	65	1,400	336
Concrete form	m2	17,300	9	156	11.2	194	20.2	350
Rock riprap	m3	300	68	20	20	6	88	26
Vertical concrete block	m³	1,100	170	187	70	77	240	264
Operation deck	m	10	406	4	174	2	580	6
Sluice gate	ton	32	7,800	250	400	13	8,200	263
Trash rack	ton	41	5,200	213	400	16	5,600	229
Steel sheet piles	ton	300	1,714	514	6	2	1,720	516
Stop log	m3	30	0	0	120	4	120	4
Dike embankment	m³	344,000	8	2,752	2.4	826	10.4	3,578
Temporary works								
Coffer dam	m3	9,700	10	97	2.8	27	12.8	124
Sheet pile	ton	380	1,714	651	6	2	1,720	653
Access road	m	1,000	70	70	20	20	90	90
Sub-total				6,987		1,858		8,845

(to be continued)

Table J-06(1)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
3. Main Canal								
Canal								
Earthworks								
Excavation	m^3	279,400	3	838	0.6	168	3.6	1,006
Embankment	m^3	569,200	5.4	3,074	1.6	911	7	3,985
Stripping	m^3	113,200	0.4	45	0.2	23	0.6	68
Sod facing	m^2	169,200	0.2	34	0.4	68	0.6	102
Concrete lining	m^3	32,400	222	7,193	48	1,555	270	8,748
Related structures								
Earthworks								
Excavation	m^3	8,700	7	61	1.6	14	8.6	75
Backfill	m^3	2,300	9.2	21	2.8	6	12	27
Concrete works								
Structural (Type-D)	m^3	2,700	100	270	40	108	140	378
Foundation (Type-A)	m^3	600	100	60	36	22	136	82
Reinforcement bar	ton	195	1,140	222	600	117	1,740	339
Concrete form	m^2	9,700	9	87	11.2	109	20.2	196
Stop log	m^3	20	0	0	120	2	120	2
Precast concrete pipe	m	300	60	18	20	6	80	24
Gates	ton	97	7,700	747	380	37	8,080	784
Rock riprap	m^3	40	66	3	20	1	86	4
Bifurcation structure								
Earthworks								
Excavation	m^3	3,000	7	21	1.4	4	8.4	25
Stripping	m^3	350	0.6	0	0.2	0	0.8	0
Embankment	m^3	1,700	8.4	14	2.6	4	11	18
Backfill	m^3	760	9.4	7	2.8	2	12.2	9
Concrete works								
Structural (Type-A)	m^3	720	102	73	38	27	140	100
Foundation (Type-D)	m^3	150	102	15	38	6	140	21
Reinforcement bar	ton	60	1,140	68	600	36	1,740	104
Concrete form	m^2	2,900	9	26	11.2	32	20.2	58
Trashrack	ton	8.5	5,200	44	400	3	5,600	47
Stop log	m^3	2	0	0	130	0	130	0
Sub-total				12,941		3,261		16,202

(to be continued)

Table J-06(1)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
4. Branch Canal								
Canal								
Earthworks								
Excavation	m^3	21,900	3	66	0.6	13	3.6	79
Embankment	m^3	1,124,100	7.8	8,767	2.4	2,698	10.2	11,466
Stripping	m^3	167,900	0.6	101	0.2	34	0.8	135
Sod facing	m^2	307,800	0.2	62	0.4	123	0.6	185
Concrete lining	m^3	35,400	232	8,213	48	1,699	280	9,912
Related structures								
Earthworks								
Excavation	m^3	4,150	7	29	1.6	7	8.6	36
Backfill	m^3	2,300	8.2	19	2.6	6	10.8	25
Concrete works								
Structural (Type-A)	m^3	1,875	110	206	40	75	150	281
Foundation (Type-D)	m^3	525	100	53	40	21	140	74
Reinforcement bar	ton	100	1,140	114	600	60	1,740	174
Concrete form	m^2	4,600	8.6	40	24	110	32.6	150
P.C. pipe	L.S.		-	4	-	50	-	54
Concrete block	m^3	10	170	2	70	1	240	3
Stop log	m^3	8	0	0	130	1	130	1
Rock riprap	m^3	35	60	2	20	1	80	3
Gate & metalworks	L.S.		-	351	-	35	-	386
Siphon								
Earthworks								
Excavation	m^3	3,300	8.4	28	1.6	5	10	33
Backfill	m^3	2,600	9	23	2.8	7	11.8	30
Embankment	m^3	700	8.4	6	2.6	2	11	8
Concrete works								
Structural (Type-A)	m^3	300	100	30	40	12	140	42
Foundation (Type-D)	m^3	50	100	5	36	2	136	7
Reinforcement bar	ton	30	1,130	34	270	8	1,400	42
Concrete form	m^2	2,100	9	19	11.2	24	20.2	43
Metalworks	L.S.		-	8	-	2	-	10
Temporary works								
Coffering	m^3	1,000	11.2	11	3.2	3	14.1	14
Sheet pile	ton	70	1,694	119	6	0	1,700	119
Access road	m	500	70	35	20	10	90	45
Sub-total				18,348		5,009		23,357

(to be continued)

Table J-06(1)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
5. Secondary Canal								
Canals								
Earthworks								
Excavation	m^3		4.4	0	1.8	0	6.2	0
Embankment	m^3	212,600	7.8	1,658	2.4	510	10.2	2,168
Stripping	m^3	61,900	0.6	37	0.2	12	0.8	49
Sod facing	m^2	167,500	0.2	34	0.4	67	0.6	101
Related structures								
Earthworks								
Excavation	m^3	6,060	7	52	1.6	10	8.6	52
Backfill	m^3	3,900	8.2	32	2.6	10	10.8	42
Concrete works								
Structural (Type-A)	m^3	2,115	108	228	42	89	150	317
Foundation (Type-D)	m^3	870	98	85	42	37	140	122
Reinforcement bar	ton	130	1,140	148	600	78	1,740	226
Concrete form	m^2	5,810	8.6	50	24	139	32.6	189
P.C. pipe	L.S.		-	5	-	52	-	57
Concrete block lining	m^3	66	170	11	72	5	242	16
Stop log	m^3	8	0	0	120	1	120	1
Gate & metalworks	L.S.		-	384	-	42	-	426
Sub-total				2,714		1,052		3,766
6. Drainage Canal								
Earthworks								
Excavation	m^3	1,295,000	3	3,885	0.6	777	3.6	4,662
Related structures								
Earthworks								
Excavation	m^3	5,400	7.6	41	2	11	9.6	52
Backfill	m^3	2,000	8.4	17	2.6	5	11	22
Concrete works								
Structural (Type-A)	m^3	2,700	110	297	40	108	150	405
Foundation (Type-D)	m^3	120	98	12	42	5	140	17
Reinforcement bar	ton	200	1,140	228	600	120	1,740	0
Concrete form	m^2	6,100	8.6	52	24	146	32.6	198
P.C. pipe (Total length 40m)	L.S.		-	1	-	5	-	6
Rock riprap	m^3	400	66	26	20	8	86	34
Sub-total				4,559		1,185		5,744

(to be continued)

Table J-06(1)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
7. Farm Road								
Main farm roads								
Stripping	m^3	36,800	0.6	22	0.2	7	0.8	29
Embankment	m^3	123,050	8	984	2.4	295	10.4	1,279
Gravel metalling	m^3	20,700	38	787	9	186	47	973
Secondary farm roads								
Stripping	m^3	74,430	0.6	45	0.2	15	0.8	60
Embankment	m^3	186,000	8	1,488	2.4	446	10.4	1,934
Tertiary road								
Stripping	m^3	103,360	0.6	62	0.2	21	0.8	83
Embankment	m^3	200,640	8	1,605	2.4	482	10.4	2,087
El Palenque causeway								
Earthworks								
Excavation	m^3	1,100	7.6	8	1.8	2	9.4	10
Backfill	m^3	600	8.4	5	2.6	2	11	7
Concrete works								
Structural (Type-A)	m^3	650	108	70	42	27	150	97
Foundation (Type-D)	m^3	200	98	20	42	8	140	28
Reinforcement bar	ton	30	1,180	35	280	8	1,460	43
Concrete form	m^2	500	9	5	11.2	6	20.2	11
Temporary works								
Coffering	m^3	24,000	8	192	2.4	58	10.4	250
Sub-total				5,328		1,563		6,891

(to be continued)

Table J-06(1)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
8. On-Farm Development								
Canals								
Tertiary canal								
Excavation	m^3		4.4	0	1.8	0	6.2	0
Embankment	m^3	277,900	7.8	2,168	2.4	667	10.2	2,835
Collector drain								
Excavation	m^3	182,400	4.4	803	1.8	328	6.2	1,131
Related structures								
Earthworks								
Excavation	m^3	1,226	7.6	9	2	2	9.6	11
Backfill	m^3	477	8.4	4	2.6	1	11	5
Concrete works								
Structural (Type-A)	m^3	1,518	108	164	42	64	150	228
Foundation (Type-D)	m^3	243	98	24	42	10	140	34
Reinforcement bar	ton	45	1,140	51	260	12	1,400	63
Concrete form	m^2	14,134	9	127	11.2	158	20.2	285
Stop log	m^3	46	0	0	120	6	120	6
Sub-total				3,350		1,248		4,598
9. Clearing and Reclamation								
Land reclamation	ha	11,970	690	8,259	240	2,873	930 /1	11,132
Sub-total				8,259		2,873		11,132
Total				63,981		19,297		87,278

Note: /1: (Pasture land (6,960 ha) x Lp. 900/ha + Existing farm land (4,030 ha) x Lp. 650/ha + Paddy field (4,050 ha) x Lp. 400/ha) ÷ 11,970 ha

Table J-06(2) CONSTRUCTION COST ESTIMATE
IRRIGATION SYSTEM FOR
EASTERN PLAIN - A

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
1. Communication System and Quarters								
Office & others	L.S.		-	121	-	34	-	155
Workshop & others	L.S.		-	35	-	42	-	77
Laboratory	L.S.		-	24	-	68	-	92
Temporary transmission	L.S.		-	76	-	27	-	103
Water supply	L.S.		-	100	-	22	-	122
Telecommunications	L.S.		-	35	-	10	-	45
Health services	L.S.		-	51	-	16	-	67
Sub-total				442		219		661
2. Headwork (Las Bases Intake Weir)								
Earthworks								
Excavation, river bed	m^3	29,500	7	207	1.4	41	8.4	248
Backfill	m^3	6,600	8.4	55	2.6	17	11	72
Concrete works								
Mas concrete (Type-B)	m^3	10,200	100	1,020	34	347	134	1,367
Structural (Type-A)	m^3	2,400	102	245	40	96	142	341
Foundation (Type-D)	m^3	2,700	102	275	38	103	140	378
Reinforcement bar	ton	240	1,130	271	270	65	1,400	336
Concrete form	m^2	17,300	9	156	11.2	194	20.2	350
Rock riprap	m^3	300	68	20	20	6	88	26
Vertical concrete block	m^3	1,100	170	187	70	77	240	264
Operation deck	m	10	406	4	174	2	580	6
Sluice gate	ton	32	7,800	250	400	13	8,200	263
Trash rack	ton	41	5,200	213	400	16	5,600	229
Steel sheet piles	ton	300	1,714	514	6	2	1,720	516
Stop log	m^3	30	0	0	120	4	120	4
Dike embankment	m^3	344,000	8	2,752	2.4	826	10.4	3,578
Temporary works								
Coffer dam	m^3	9,700	10	97	2.8	27	12.8	124
Sheet pile	ton	380	1,714	651	6	2	1,720	653
Access road	m	1,000	70	70	20	20	90	90
Sub-total				6,987		1,858		8,845

(to be continued)

Table J-06(2)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
3. Main Canal								
Canal								
Earthworks								
Excavation	m^3	20,700	3	62	0.6	12	3.6	74
Embankment	m^3	125,450	5.4	677	1.6	201	7	878
Stripping	m^3	26,050	0.4	10	0.2	5	0.6	15
Sod facing	m^2	61,200	0.2	12	0.4	24	0.6	36
Concrete lining	m^3	6,450	222	1,432	48	310	270	1,742
Related structures								
Earthworks								
Excavation	m^3	2,306	7	16	1.6	4	8.6	20
Backfill	m^3	610	9.2	6	2.8	2	12	8
Concrete works								
Structural (Type-D)	m^3	716	100	72	40	29	140	101
Foundation (Type-A)	m^3	159	100	16	36	6	136	22
Reinforcement bar	ton	52	1,140	59	600	31	1,740	90
Concrete form	m^2	2,570	9	23	11.2	29	20.2	52
Stop log	m^3	6	0	0	120	1	120	1
Precast concrete pipe	m	80	60	5	20	2	80	7
Gates	ton	20	7,700	154	380	8	8,080	162
Rock riprap	m^3	10	66	1	20	0	86	1
Sub-total				2,545		664		3,209

(to be continued)

Table J-06(2) (Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
4. Branch Canal								
Canal								
Earthworks								
Excavation	m^3	0	3	0	0.6	0	3.6	0
Embankment	m^3	506,700	7.8	3,952	2.4	1,216	10.2	5,168
Stripping	m^3	103,400	0.6	62	0.2	21	0.8	83
Sod facing	m^2	242,200	0.2	48	0.4	97	0.6	145
Concrete lining	m^3	19,500	232	4,524	48	936	280	5,460
Related structures								
Earthworks								
Excavation	m^3	3,154	7	22	1.6	5	8.6	27
Backfill	m^3	1,750	8.2	14	2.6	5	10.8	19
Concrete works								
Structural (Type-A)	m^3	1,425	110	157	40	57	150	214
Foundation (Type-D)	m^3	399	100	40	40	16	140	56
Reinforcement bar	ton	74	1,140	84	600	44	1,740	128
Concrete form	m^2	3,500	8.6	30	24	84	32.6	114
P.C. pipe	L.S.		-	3	-	39	-	42
Concrete block	m	8	170	1	70	1	240	2
Stop log	m^3	6	0	0	130	1	130	1
Rock riprap	m^3	27	60	2	20	1	80	3
Gate & metalworks	L.S.		-	278	-	28	-	306
Sub-total				9,217		2,551		11,768

(to be continued)

Table J-06(2)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
5. Drainage Canal								
Earthworks								
Excavation	m^3	150,750	3	452	0.6	90	3.6	542
Related structures								
Earthworks								
Excavation	m^3	1,570	7.6	12	2	3	9.6	15
Backfill	m^3	580	8.4	5	2.6	2	11	7
Concrete works								
Structural (Type-A)	m^3	522	110	57	40	21	150	78
Foundation (Type-D)	m^3	23	98	2	42	1	140	3
Reinforcement bar	ton	39	1,140	44	600	23	1,740	67
Concrete form	m^2	1,770	8.6	15	24	42	32.6	57
P.C. pipe (Total length 40m)	L.S.		-	0	-	2	-	2
Rock riprap	m^3	120	66	8	20	2	86	10
Sub-total				595		186		781
6. Farm Road								
Main farm roads								
Stripping	m^3	22,720	0.6	14	0.2	5	0.8	19
Embankment	m^3	75,970	8	608	2.4	182	10.4	790
Gravel metalling	m^3	12,780	38	486	9	115	47	601
Secondary farm roads								
Stripping	m^3	27,876	0.6	17	0.2	6	0.8	23
Embankment	m^3	69,690	8	558	2.4	167	10.4	725
Tertiary roads								
Stripping	m^3	34,612	0.6	21	0.2	7	0.8	28
Embankment	m^3	67,188	8	538	2.4	161	10.4	699
Sub-total				2,242		643		2,885

(to be continued)

Table J-06(2)

(Unit: Lp.10^3)

Item	Unit	Q'ty	Foreign Currency		Local Currency		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
7. On-Farm Development								
Canals								
Tertiary canal								
Excavation	m^3	0	4.4	0	1.8	0	6.2	0
Embankment	m^3	86,600	7.8	675	2.4	208	10.2	883
Collector drain								
Excavation	m^3	30,540	4.4	134	1.8	55	6.2	189
Related structures								
Earthworks								
Excavation	m^3	627	7.6	5	2	1	9.6	6
Backfill	m^3	268	8.4	2	2.6	1	11	3
Concrete works								
Structural (Type-A)	m^3	532	108	57	42	22	150	79
Foundation (Type-D)	m^3	84	98	8	42	4	140	12
Reinforcement bar	ton	16	1,140	18	260	4	1,400	22
Concrete form	m2	5,359	9	48	11.2	60	20.2	108
Stop log	m^3	15	0	0	120	2	120	2
Sub-total				947		357		1,304
8. Clearing and Reclamation								
Land reclamation	ha	3,795	505	1,916	143	543	-	2,459
Sub-total				1,916		543		2,459
Total				24,891		7,021		31,912

Table J-07(1) DISBURSEMENT SCHEDULE (FINANCIAL)

Dam, Power and Irrigation 20,600 ha

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		8th (1992)	
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
1. Dam Works	-	-	630	450	6,199	2,873	11,557	3,786	25,888	10,363	21,029	7,217	-	-	-	-
2. Power Station	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	-	-
3. Irrigation Systems	-	-	-	-	6,602	2,324	22,302	8,462	14,813	4,213	10,925	3,286	3,555	1,125	3,715	1,038
Sub-total	-	-	630	450	14,881	5,517	40,659	12,838	48,209	16,006	34,314	10,933	3,555	1,125	3,715	1,038
4. Land Acquisition	-	-	-	-	-	1,970	-	1,920	-	2,240	-	2,620	-	-	-	-
5. Engineering and Administ.	4,840	1,740	2,440	1,160	860	800	2,700	1,540	2,500	1,080	1,700	680	860	1,000	500	300
6. Physical Contingency	484	174	307	161	1,574	829	4,336	1,630	5,071	1,933	3,602	1,423	442	212	422	134
7. Price Contingency	266	115	348	220	2,736	1,741	10,303	4,697	15,396	7,186	13,985	6,559	1,896	1,177	2,212	874
Grand Total	5,590	2,029	3,725	1,991	20,051	10,857	57,998	22,625	71,176	28,445	53,601	22,215	6,753	3,514	6,849	2,346

(Unit: Lp.10³)

Items	9th (1993)		10th (1994)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	-	-	65,303	24,689	89,992
2. Power Station	-	-	-	-	12,748	2,770	15,518
3. Irrigation Systems	12,227	3,399	8,733	2,471	88,872	26,318	115,190
Sub-total	12,227	3,399	8,733	2,471	166,923	53,777	220,700
4. Land Acquisition	-	-	-	-	-	8,750	8,750
5. Engineering and Administ.	440	260	310	190	17,150	8,750	25,900
6. Physical Contingency	1,267	366	904	266	18,409	7,128	25,537
7. Price Contingency	7,678	2,773	6,257	2,315	61,077	27,657	88,734
Grand Total	21,612	6,798	16,204	5,242	263,559	106,062	369,621

Middle Reach 3,360 ha

(Unit: Lp.10³)

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Power Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Irrigation Systems	-	-	-	-	-	-	1,060	308	1,920	377	1,920	377	-	-	4,900	1,062	5,962
Sub-total	-	-	-	-	-	-	1,060	308	1,920	377	1,920	377	-	-	4,900	1,062	5,962
4. Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Engineering and Administ.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Physical Contingency	-	-	-	-	-	-	106	31	192	38	192	38	-	-	490	107	597
7. Price Contingency	-	-	-	-	-	-	117	34	211	42	211	42	-	-	539	118	657
Grand Total	-	-	-	-	-	-	1,283	373	2,323	457	2,323	457	-	-	5,929	1,287	7,216

Table J-07(2) DISBURSEMENT SCHEDULE (FINANCIAL)

Dam, Power and Irrigation 16,000 ha

(Unit: Lp.10^3)

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	630	450	6,199	2,873	11,557	3,786	25,888	10,363	21,029	7,217	-	-	65,303	24,689	89,992
2. Power Station	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	12,748	2,770	15,518
3. Irrigation Systems	-	-	-	-	6,602	2,324	28,303	8,462	14,815	4,213	10,926	3,283	3,335	1,015	63,981	19,297	83,278
Sub-total	-	-	630	450	14,881	5,517	40,660	12,838	48,211	16,006	34,315	10,930	3,335	1,015	142,032	46,756	188,788
4. Land Acquisition	-	-	-	-	-	1,970	-	1,920	-	800	-	-	-	-	-	4,690	4,690
5. Engineering and Administ.	4,840	1,740	2,440	1,160	860	800	2,700	1,540	2,500	1,080	1,700	680	560	600	15,600	7,600	23,200
6. Physical Contingency	484	174	307	161	1,574	829	4,336	1,630	5,071	1,789	3,602	1,161	390	162	15,764	5,906	21,670
7. Price Contingency	266	115	348	220	2,736	1,741	10,303	4,697	15,396	6,650	13,985	5,351	1,744	895	44,778	19,669	64,447
Grand Total	5,590	2,029	3,725	1,991	20,051	10,857	57,999	22,625	71,178	26,325	53,602	18,122	6,029	2,672	218,174	84,621	302,795

Table J-07(3) DISBURSEMENT SCHEDULE (FINANCIAL)

Dam, Power and Irrigation 12,400 ha

(Unit: Lp.10³)

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	630	450	6,199	2,873	11,557	3,786	25,888	10,363	21,029	7,217	-	-	65,303	24,689	89,992
2. Power Station	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	12,748	2,770	15,518
3. Irrigation Systems	-	-	-	-	6,526	2,272	27,912	8,192	14,619	4,078	2,338	660	-	-	51,395	15,202	66,597
Sub-total	-	-	630	450	14,805	5,465	40,269	12,568	48,015	15,871	25,727	8,307	-	-	129,446	42,661	172,107
4. Land Acquisition	-	-	-	-	-	1,700	-	1,650	-	650	-	-	-	-	-	4,000	4,000
5. Engineering and Administ.	4,840	1,740	2,440	1,160	860	800	2,400	1,340	2,200	930	1,400	580	-	-	14,140	6,550	20,690
6. Physical Contingency	484	174	307	161	1,567	797	4,267	1,556	5,022	1,745	2,713	889	-	-	14,360	5,322	19,682
7. Price Contingency	266	115	348	220	2,723	1,674	10,138	4,484	15,245	6,488	10,534	4,095	-	-	39,254	17,076	56,330
Grand Total	5,590	2,029	3,725	1,991	19,955	10,436	57,074	21,598	70,482	25,684	40,374	13,871	-	-	197,200	75,609	272,809

Table J-08(1) DISBURSEMENT SCHEDULE (FINANCIAL)

Dam and Irrigation 20,600 ha

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		8th (1992)	
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
1. Dam Works	-	-	630	450	6,199	2,873	11,557	3,786	25,888	10,363	21,029	7,217	-	-	-	-
2. Power Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Irrigation Systems	-	-	-	-	6,602	2,324	28,304	8,462	14,815	4,213	10,927	3,283	3,557	1,124	3,715	1,038
Sub-total	-	-	630	450	12,801	5,197	39,861	12,248	40,703	14,576	31,956	10,500	3,557	1,124	3,715	1,038
4. Land Acquisition	-	-	-	-	-	1,970	-	1,920	-	2,240	-	2,620	-	-	-	-
5. Engineering and Administ.	4,840	1,740	2,440	1,160	740	750	2,640	1,470	2,100	980	1,580	650	860	1,000	500	300
6. Physical Contingency	484	174	307	161	1,354	792	4,250	1,564	4,280	1,780	3,354	1,377	442	212	422	134
7. Price Contingency	266	115	348	220	2,352	1,663	10,979	4,507	12,995	6,617	13,022	6,347	1,896	1,177	2,212	874
Grand Total	5,590	2,029	3,725	1,991	17,248	10,372	56,850	21,709	60,078	26,193	49,912	21,494	6,755	3,513	6,849	2,346

(Unit: Lp.10^3)

Items	9th (1993)		10th (1994)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	-	-	65,303	24,689	89,992
2. Power Station	-	-	-	-	-	-	-
3. Irrigation Systems	12,227	3,399	8,733	2,471	88,880	26,314	115,194
Sub-total	12,227	3,399	8,733	2,471	154,183	51,003	205,186
4. Land Acquisition	-	-	-	-	-	8,750	8,750
5. Engineering and Administ.	440	260	310	190	16,450	8,500	24,950
6. Physical Contingency	1,267	366	904	266	17,064	6,826	23,890
7. Price Contingency	7,678	2,773	6,257	2,315	57,126	26,608	83,734
Grand Total	21,612	6,798	16,204	5,242	244,823	101,687	346,510

Power Generating Works

(Unit: Lp.10^3)

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Power Station	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	12,748	2,770	15,518
3. Irrigation Systems	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	12,748	2,770	15,518
4. Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Engineering and Administ.	-	-	-	-	120	50	60	70	400	100	120	30	-	-	700	250	950
6. Physical Contingency	-	-	-	-	220	37	86	66	791	153	248	46	-	-	1,345	302	1,647
7. Price Contingency	-	-	-	-	382	78	204	190	2,401	569	963	212	-	-	3,950	1,049	4,999
Grand Total	-	-	-	-	2,802	485	1,150	916	11,100	2,252	3,691	718	-	-	18,743	4,371	23,114

Table J-08(2) DISBURSEMENT SCHEDULE (FINANCIAL)

Dam and Irrigation 16,000 ha

(Unit: Lp.10^3)

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	630	450	6,199	2,873	11,557	3,786	25,888	10,363	21,029	7,217	-	-	65,303	24,689	89,992
2. Power Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Irrigation Systems	-	-	-	-	6,602	2,324	28,304	8,462	14,815	4,213	10,927	3,283	3,336	1,034	63,984	19,316	83,300
Sub-total	-	-	630	450	12,801	5,197	39,861	12,248	40,703	14,576	31,956	10,500	3,336	1,034	129,287	44,005	173,292
4. Land Acquisition	-	-	-	-	-	1,970	-	1,920	-	800	-	-	-	-	-	4,690	4,690
5. Engineering and Administ.	4,840	1,740	2,440	1,160	740	750	2,640	1,470	2,100	980	1,580	650	560	600	14,900	7,350	22,250
6. Physical Contingency	484	174	307	161	1,354	792	4,250	1,564	4,280	1,636	3,354	1,115	390	163	14,419	5,605	20,024
7. Price Contingency	266	115	348	220	2,354	1,663	10,099	4,507	12,995	6,081	13,022	5,139	1,744	906	40,828	18,631	59,459
Grand Total	5,590	2,029	3,725	1,991	17,249	10,372	56,850	21,709	60,078	24,073	49,912	17,404	6,030	2,703	199,434	80,281	279,715

Power Generating Works

(Unit: Lp.10^3)

Items	1st (1985)		2nd (1986)		3rd (1987)		4th (1988)		5th (1989)		6th (1990)		7th (1991)		Total		Total
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	
1. Dam Works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Power Station	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	12,748	2,770	15,518
3. Irrigation Systems	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	-	-	-	-	2,080	320	800	590	7,508	1,430	2,360	430	-	-	12,748	2,770	15,518
4. Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Engineering and Administ.	-	-	-	-	120	50	60	70	400	100	120	30	-	-	700	250	950
6. Physical Contingency	-	-	-	-	220	37	86	66	791	153	248	46	-	-	1,345	302	1,647
7. Price Contingency	-	-	-	-	382	78	204	190	2,401	569	963	212	-	-	3,950	1,049	4,999
Grand Total	-	-	-	-	2,802	485	1,150	916	11,100	2,252	3,691	718	-	-	18,743	4,371	23,114