DATA BOOK

V DAM DATA

V. DAM DATA

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DAM DATA

1. SUMMARY OF DAM

WRR I **River System:** Laoag **Province:** Ilocos Norte

Cura-Tina-Gasgas Multipurpose Project

The project consists of three (3) dams on the Tina, Gasgas, and Cura rivers, all small tributaries of the Laoag River. Water stored in the Cura and Gasgas reservoirs will be diverted into the Tina reservoir through connecting tunnels. A power plant will be provided at the Tina dam.

Client: DPWH **Consultants:** Asiatic

Purpose: Irrigation, Power, Flood Control **Status:** F/S in 1982

Hydrological Information	Cura	Tina	Gasgas	Total/Mean
Catchment Area (km^2)	63.1	98.4	71.4	232.9
Mean Annual Run-off (m^3/s)	9.91	15.32	11.12	36.35
Specific run-off ($m^3/s/100km^2$)	15.7	15.6	15.6	15.6
Denudation Rate (mm/yr)	0.014	0.014	0.014	0.014
Dam				
Geological Condition	UV	NI	NI	
Dam Type	Rockfill	ditto	ditto	
Crest EL (EL. m)	202	192	203	
Dam Height (m)	62	85	55	
Crest length (m)	170	254	196	
Dam Volume (10^6m^3)	0.41	1.50	0.41	
Reservoir				
Surcharge WL (WL.m)	199	188.4	200	
Full Supply WL (WL.m)	188	177.5	191	
Minimum Ope. WL (WL.m)	145	140	155	
Draw down (m)	43	37.5	36	
Storage Volume (10^6m^3)				
Gross	13.2	34.2	1.64	
Active	12.5	33.1	1.21	
Dead	0.7	1.1	0.43	

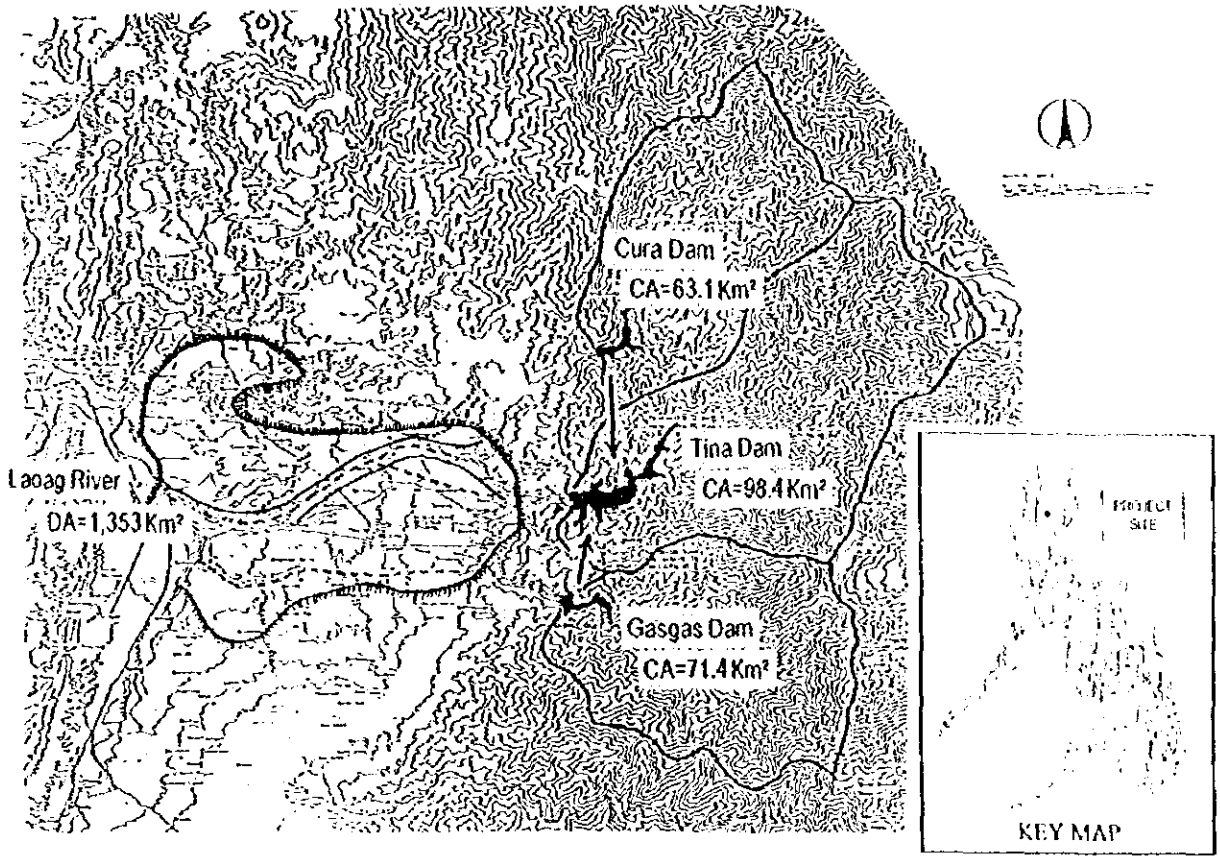
Connecting Tunnel	Cura	Tina	Gasgas
		→	←
Dia (m)		2.0	2.0
L (Km)		5.0	3.4
Q (m^3/s)		4	4

Hydropower			
Install. Capa (MW)	-	5.6	-
Plant Discharge (m^3/s)	-	14.7	-
Rated Net Head (m)	-	44.7	-
Annual Energy (GWh)	-	24.4	-
Firm		12.4	
Secondary		12.0	

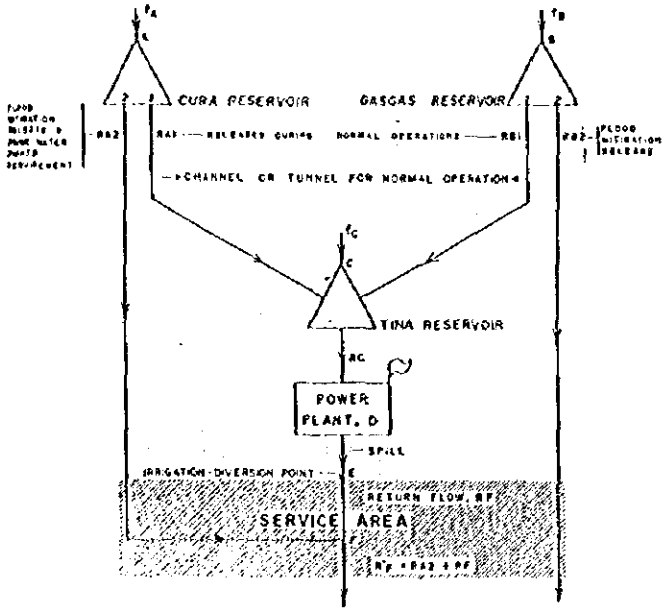
Irrigation 8,600 ha

Construction Cost US$ 140 x 10^6

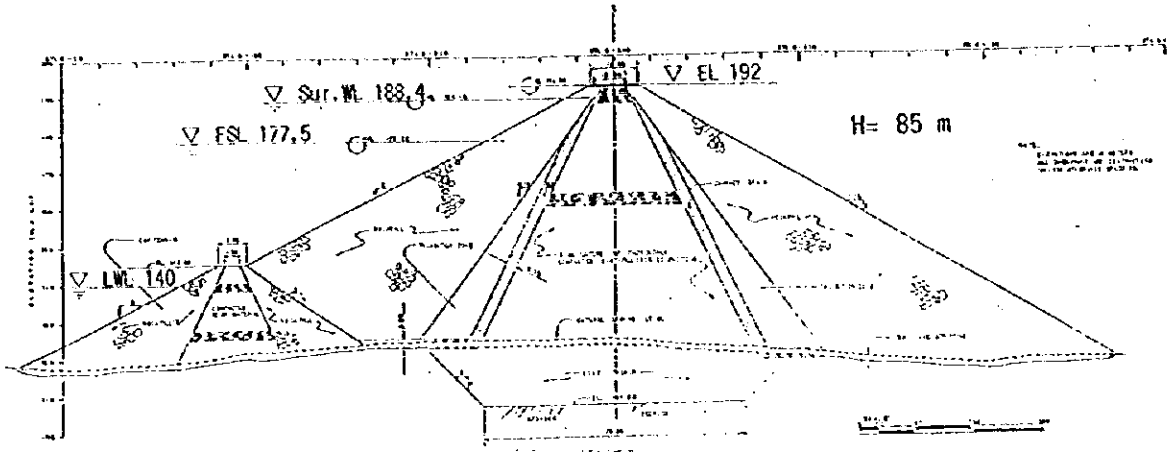
Source: Draft Final Report for F/S, Main Report; Asiatic Consultants, Inc., 1982



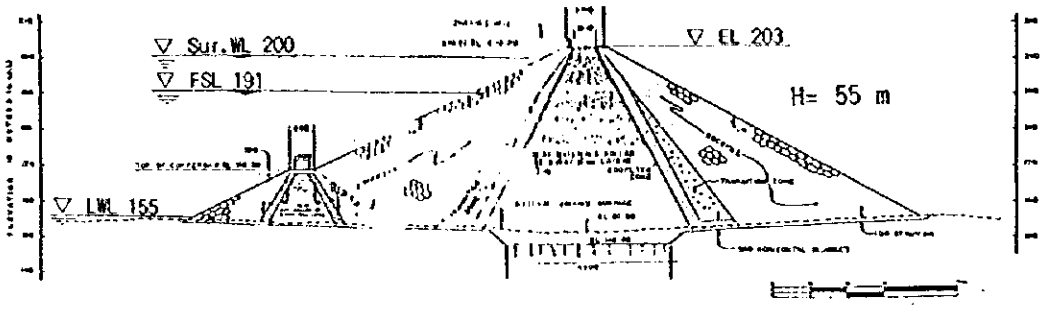
PROJECT LOCATION MAP



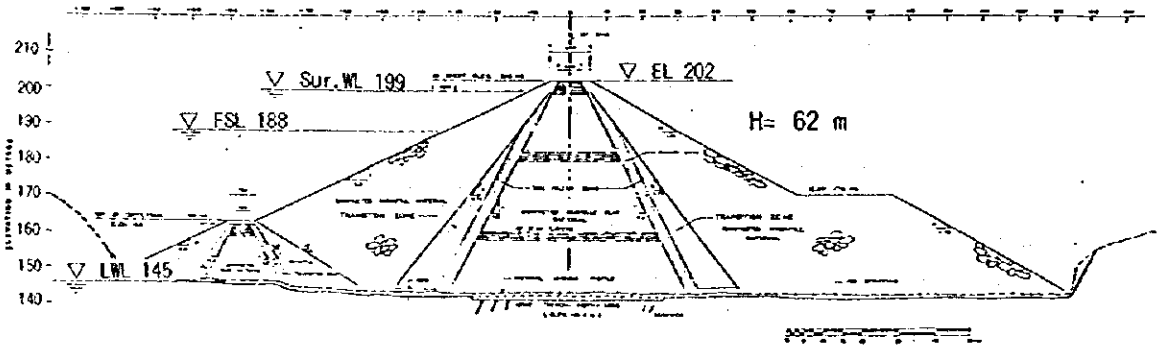
SCHEMATIC OUTLINE OF THE TINA-GASGAS-CURA SYSTEM



TYPICAL CROSS-SECTION OF TINA DAM



TYPICAL CROSS-SECTION OF GASGAS DAM



TYPICAL CROSS-SECTION CURA DAM

WRR I **River System:** Abra/Laoag **Province:** Ilocos Norte/Abra

Palsiguan/Nueva Dams

This project aims at irrigation water supply for 12,400 ha of paddy field in the Laoag River basin. Since the catchment area of the Laoag basin is rather small, 1,353 km^2 and there are no appropriate large damsites in the basin, the river run-off in the adjacent Abra basin would be diverted through a waterway tunnel of 9.1 km long. A rockfill dam with a height of 143m would be developed on the Palsiguan River, which is one of the tributaries of the Abra River. The original NIA's project features were revised by the JICA team.

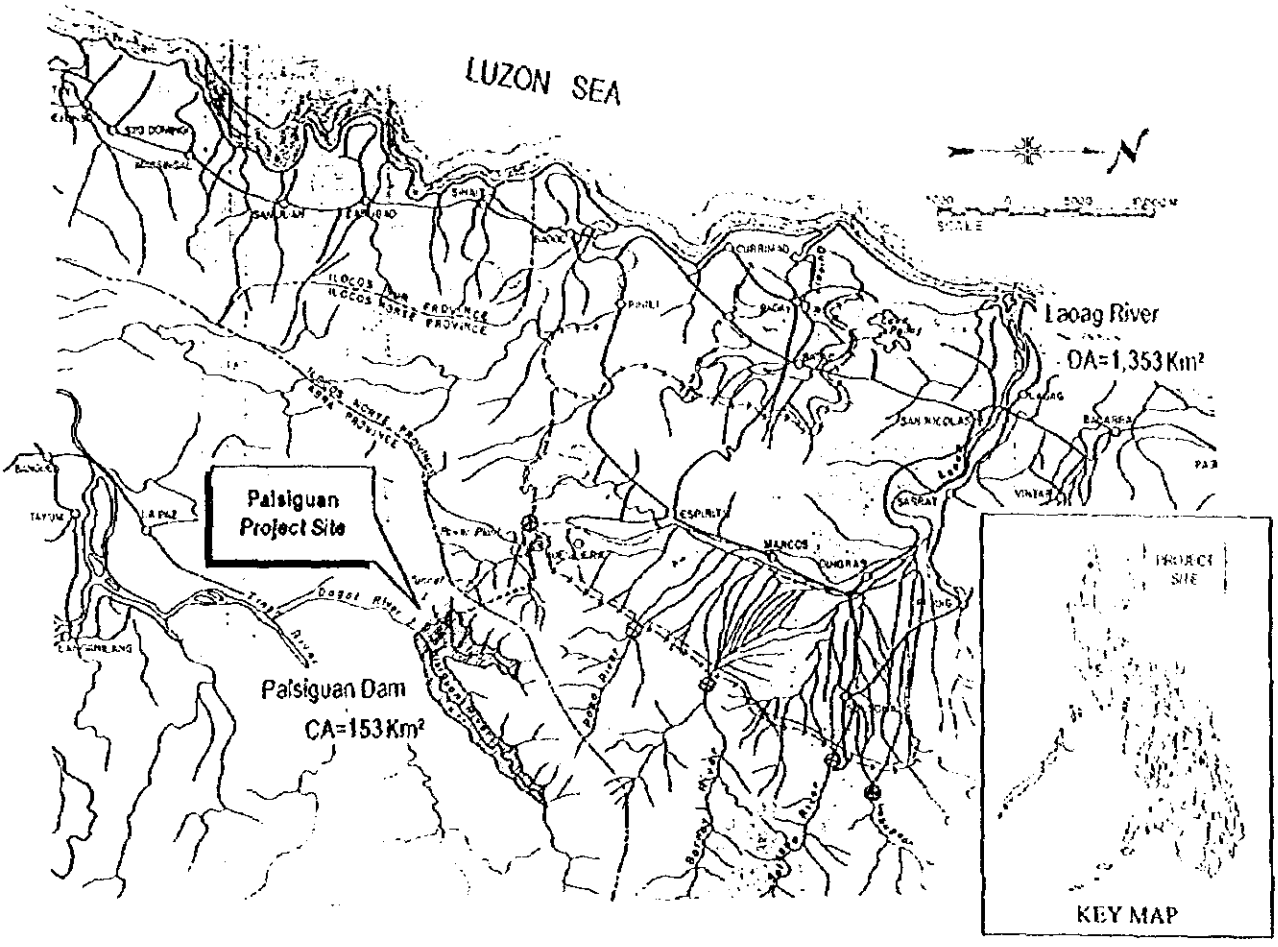
Client: NIA **Consultant:** /JICA

Purpose: Irrigation, Power **Status :** F/S

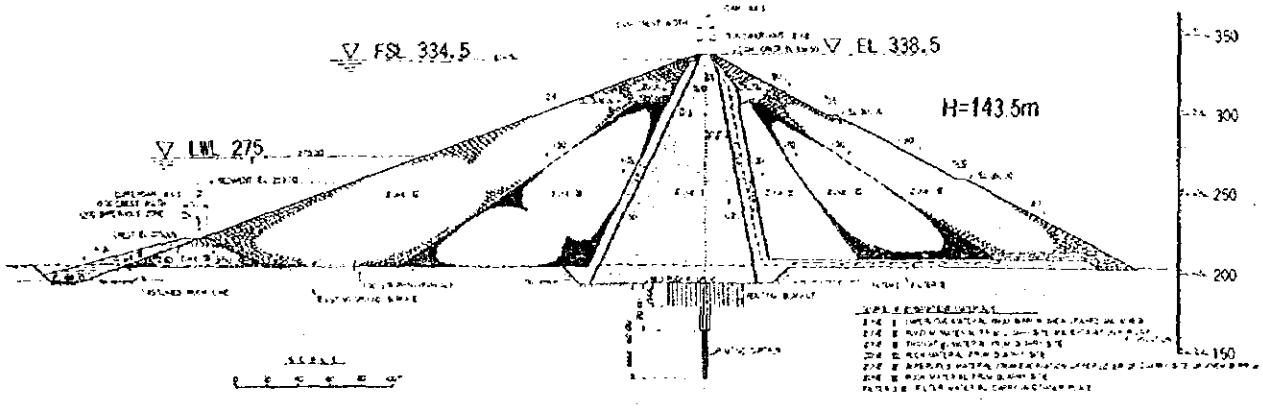
	Palsiguan	Nueva
Hydrological Information		
Catchment Area (km^2)	153	52.4
Annual Rainfall (mm)	2,700	2,500
Mean Annual Run-off (m^3/s)	11.6	
Specific run-off ($m^3/s/100\ km^2$)	7.62	
Denudation rate	1.5	
Dam		
Geological Condition	NI	NI
Type	Rockfill	Conc. Gravity
Crest EL (EL.m)	338.5	152
Height (m)	143.5	45.5
Crest length (m)	480	220
Volume ($10^6 m^3$)	9.1	0.14
Design Flood (m^3/s)	3,070	970
Reservoir		
Full Supply WL (WL. m)	334.5	150
Min. Ope. WL (WL. m)	275	148.5
Draw down (m)	59.5	1.5
Storage Volume ($10^6 m^3$)		
Gross	232	4.99
Active	189	0.50
Dead	43	4.45
Surface Area at FSWL (km^2)	5.1	0.27

Hydropower	Palsiguan	Nueva
Type	Underground	Conventional
Installed Capa. (MW)	36	6.8
Plant Max. Q (m^3/s)	28.2	29.3
Rated Net Head (m)	149	28
Tail WL (WL.m)	150	120.5
Annual Energy (Gwh)	160	40
Irrigation (ha)		12,400 ha
Construction Cost	Total: US$716 x 10^6	

Source: F/S Report on Ilocos Norte Irrigation Project, JICA 1980.



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR I River System: Abra/Tineg/Binongan Province: Abra

Binongan Dam with Tineg Weir

Client: NPC **Consultant:** Shawinigan/ADB

Purpose: Power, Flood Control **Status:** F/S in 1985

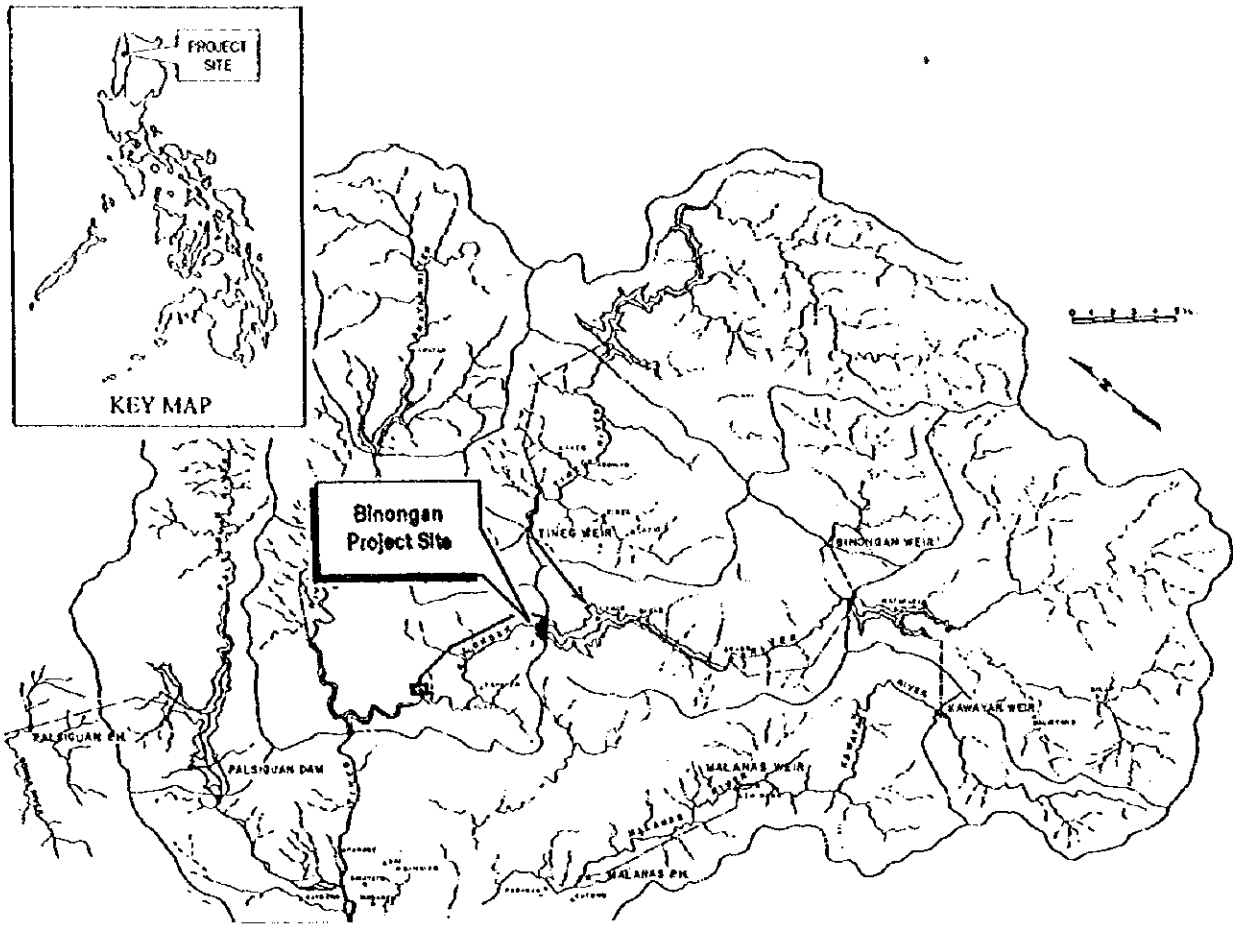
	Binongan	Tineg
Hydrological Information		
Catchment Area (km^2)	377	306
Annual Basin Rainfall (mm)	2,700	2,700
Mean Annual Run-off (m^3/s)	24.5	24.2
Specific Run-off ($m^3/s/100\ km^2$)	6.50	7.91
Denudation rate (mm/yr)	3.5	
Dam/Weir		
Geological condition	UV	UV
Type	Rockfill	Conc. Weir
Crerst EL (EL.m)	387	392.9
Height (m)	112	13
Crest length (m)	375	90
Volume (10^6m^3)	3.35	
Design Flood (m^3/s)	5,200	
Reservoir		
Surcharge WL (WL. m)	383	
Full Supply WL (WL. m)	380	
Min. Ope. WL (WL.m)	350	
Draw down (m)	30	
Storage Volume (10^6m^3)		
F/C Space	9	
Gross	121	
Active	79	
Dead	42	
Surface Area at FSWL (km^2)	3.54	
Transbasin Waterway from Tineg to Binongan		
Sill EL at intake	EL. 388.7m	
Sill EL at outlet	EL. 380.0m	
Dia of tunnel	3.8m	
Length of tunnel	4,770 m	

Hydro power

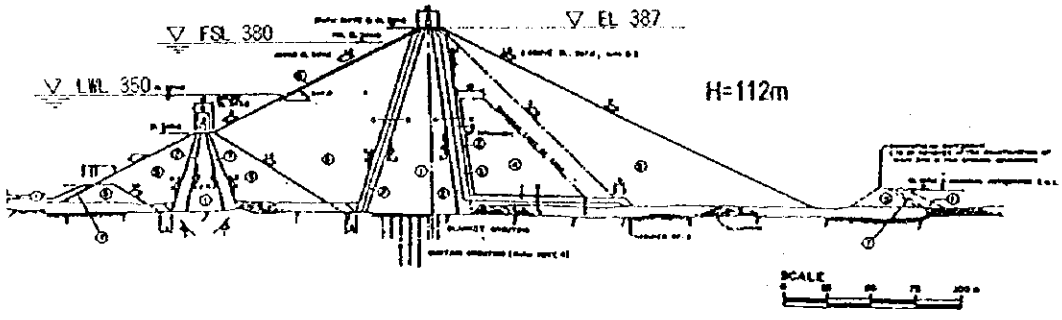
Type	Conventional
Waterway tunnel	dia= 5.75m
	L = 12 km
Installed Capacity	175 MW
Plant Max Q	90 m^3/s
Rated Net Head	218 m
Tail WL	WL 140m
Annual Energy	718 Gwh

Construction Cost: US$ 468 x 10^6

Source: F/S Report on Binongan Hydroelectric Project
Main Report by Shawinigan/ADB in 1985



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR I **River System:** Abra **Province:** Abra

SUPO

Client: NPC **Consultant:** Nippon Koei/JICA

Purpose: Power, Irrigation, Flood Control **Status:** Master Plan in 1987

Hydrological Information

Catchment Area:	1,293 km^2	Annual Basin Rainfall:	2,750 mm
Mean Annual run-off:	45 m^3/s	Specific Run-off:	3.49 $m^3/s/100km^2$
Denudation rate:	6.0 mm/yr		

Dam

Geological Condition: NI/UV (Basalts)

Type:	Rockfill	Crest EL	: EL 327 m
Height :	138 m	Crest length	: 440 m
Design Flood:	7,700 m^3/s	Volume	: 6.0 x $10^6 m^3$

Reservoir

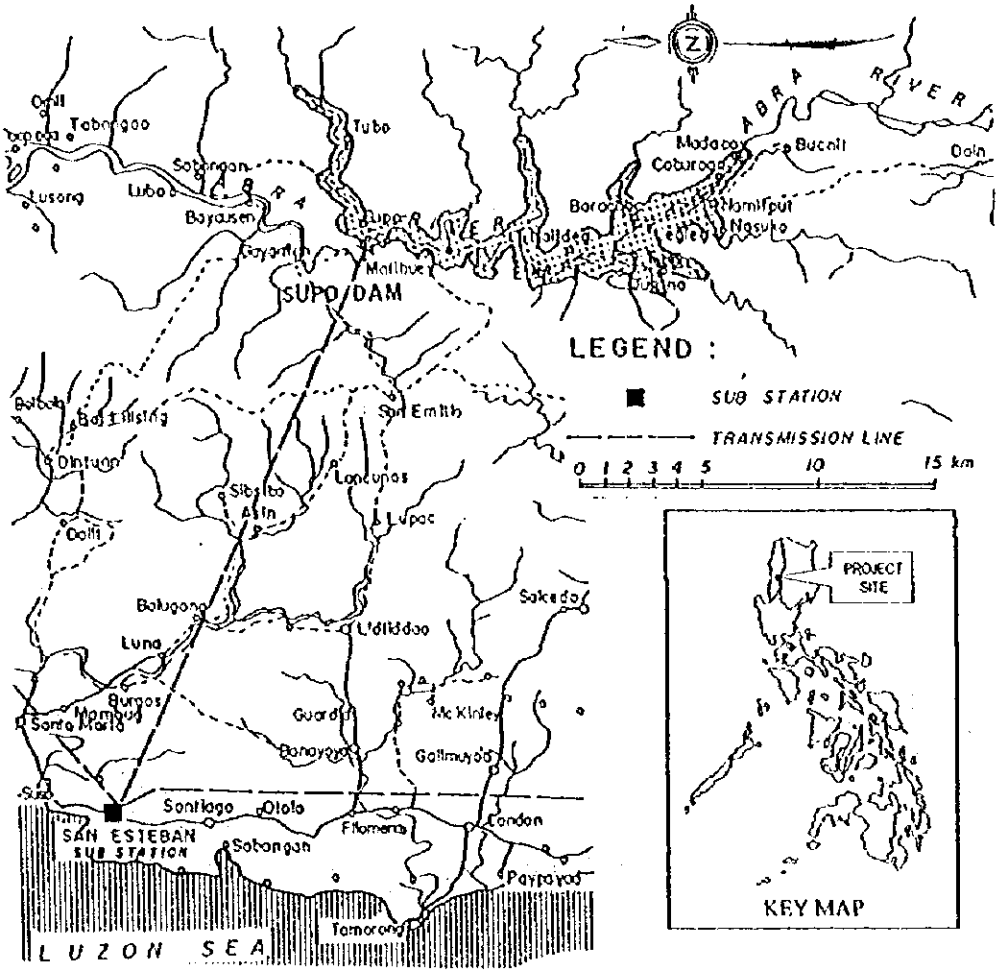
		Storage Volume ($10^6 m^3$)	
Surcharge WL:	WL 325 m	F/C Space:	300
Full Supply WL:	WL 320 m	Gross:	1,132
Min. Ope. WL:	WL 280 m	Active:	832
Draw down:	40 m	Dead:	300
Surface Area at FSWL:	32 km^2		

Hydro Power

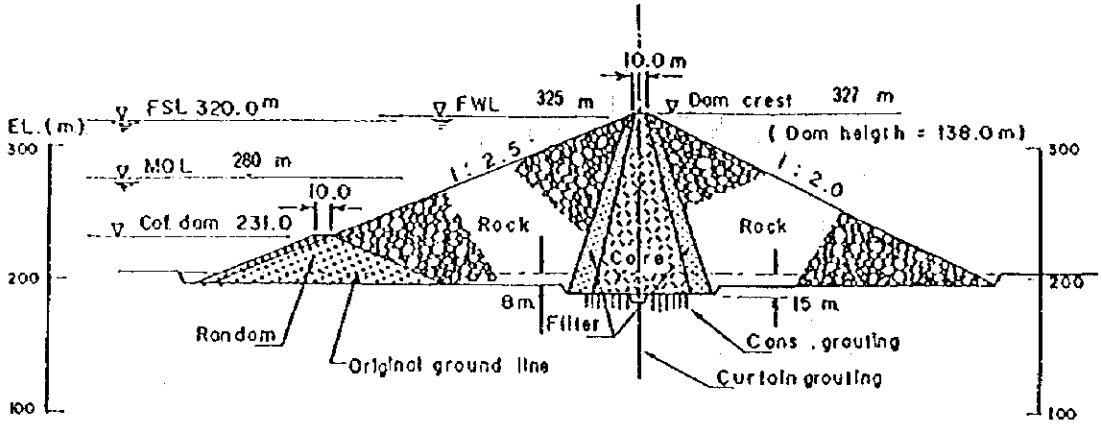
		Energy (GWh)	
Type :	Conventional	Annual:	340
Installed Capa. :	120 MW	Firm:	256
Plant Max. Q :	144 m^3/s	2-nd	84
Rated Net Head:	100 m		
Tail WL :	WL 204 m		

Construction Cost: US$ 368 x 10^6

Source: Report for HPPS App. B & C by Nippon Koei/JICA 1987 with some revisions.



PROJECT LOCATION MAP

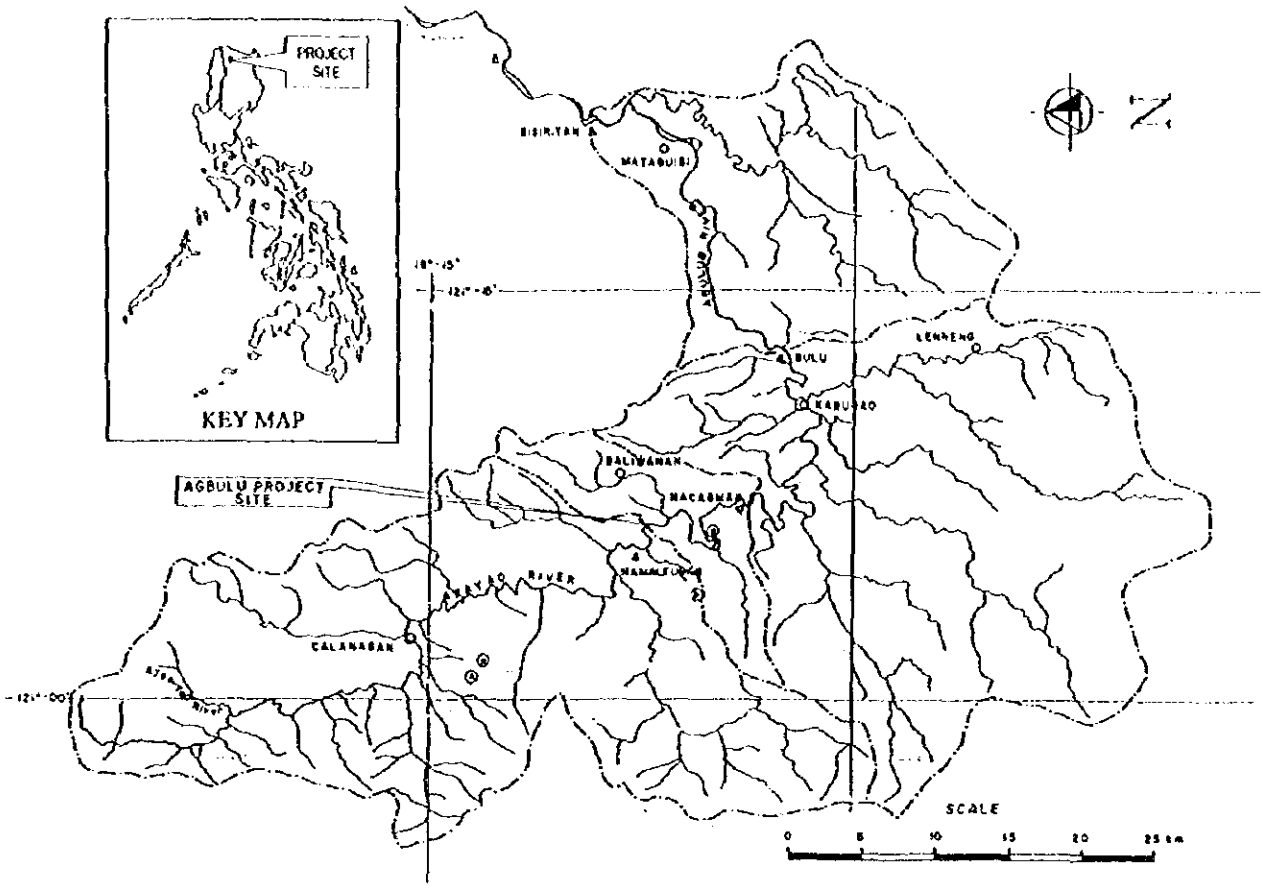


TYPICAL CROSS-SECTION

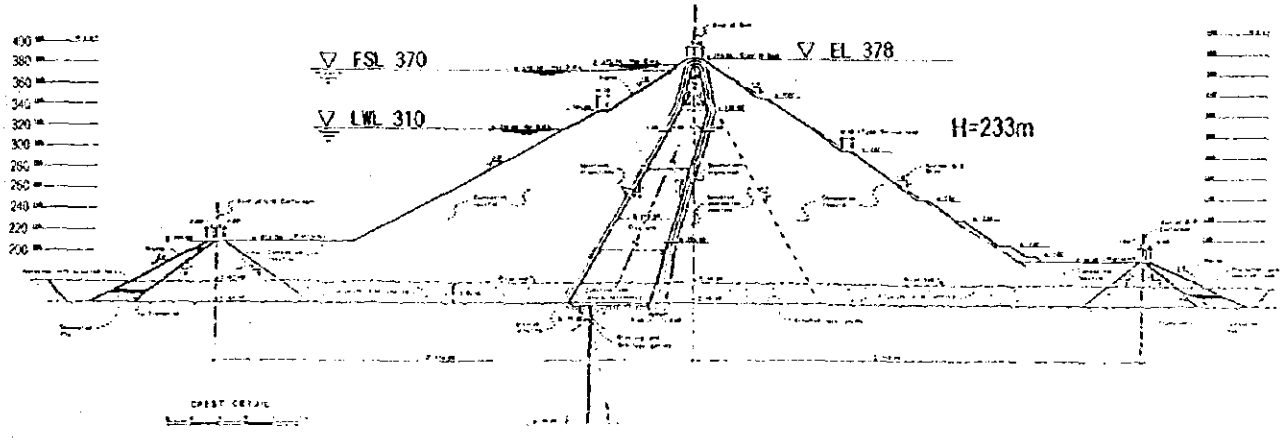
AGBULE and GENED

	Agbule	Gened
Client:	NPC	NPC
Consultant:	COLENCO/ELC	New JEC
River:	Abulug/Apayao	Abulug/Apayao
Purpose:	Power	Power
Status:	F/S in 1992	D/D in 1979
Hydrological Information		
Catchment Area (km^2)	773	1,661
Annual Basin Rainfall (mm)	4,510	4,200
Mean Annual Run-off (m^3/s)	101	185
Specific Run-off ($m^3/s/100\ km^2$)	13.1	11.1
Denudation rate (mm/yr)	1.7	0.2
Dam		
Geological Condition	UV	Andesitic/Basaltic Pyroclastics
Type	Rockfill	Concrete Arch
Crest EL (EL.m)	378	185
Height (m)	233	175
Crest length (m)	610	472
Volume ($10^6 m^3$)	22.1	2
Design Flood (m^3/s)	5,250	15,000
Reservoir		
Surcharge WL (WL.m)	372.7	
Full supply WL (WL.m)	370	180
Min. Ope. WL (WL.m)	310	160
Draw down (m)	60	20
Storage Volume ($10^6 m^3$)		
Gross	3,424	2,800
Active	2,164	1,200
Dead	1,260	1,600
Surface Area at FSWL (km^2)	48.6	63

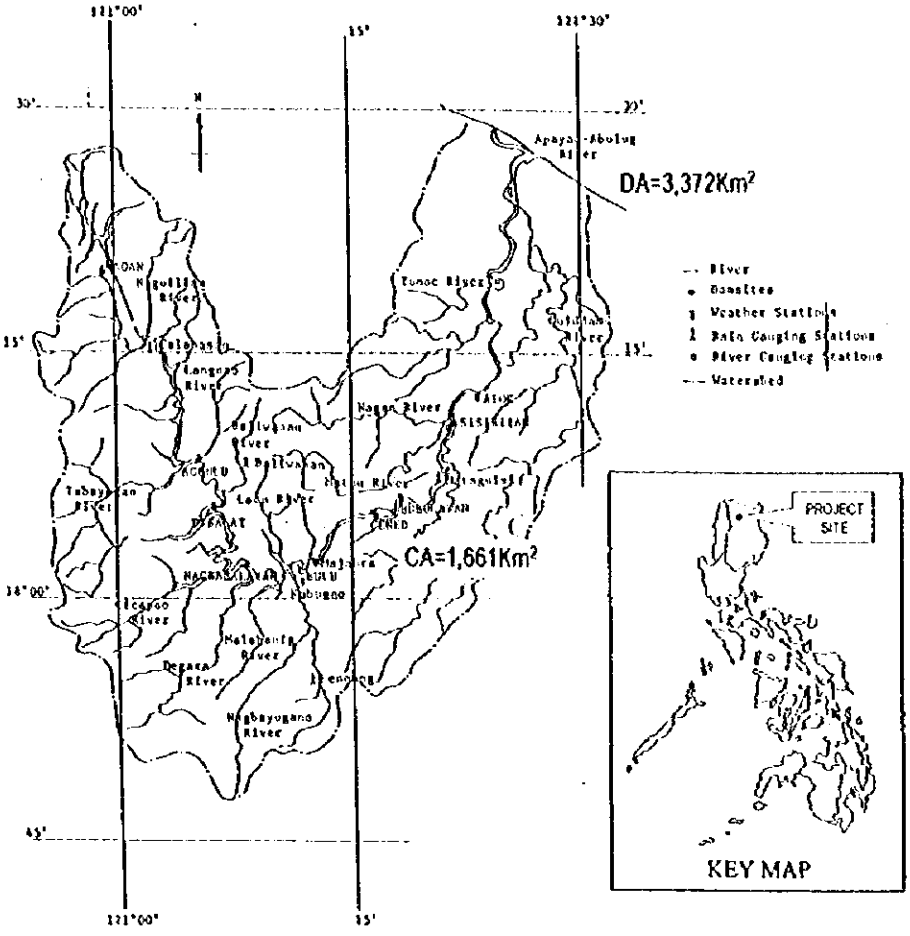
	Agbulc	Gened
Hydropower		
Type	Conventional	Conventional
Installed Capacity (MW)	360	600
Plant Max. Q (m^3/s)	205	562
Rated Net Head (m)		116
Waterway (dia (m) x length (km))	7.30 x 6.14	8.1 x 1.34 x 2 Nos
Tail WL (WL.m)	135.5	50.7
Energy (GWh)		
Annual	1,479	1,632
Firm	1,288	490
2-nd	191	1,142
Construction Cost: (US$ 10^6)	994	892
Source:	F/S Main Report 1992	Basic Design Report 1979



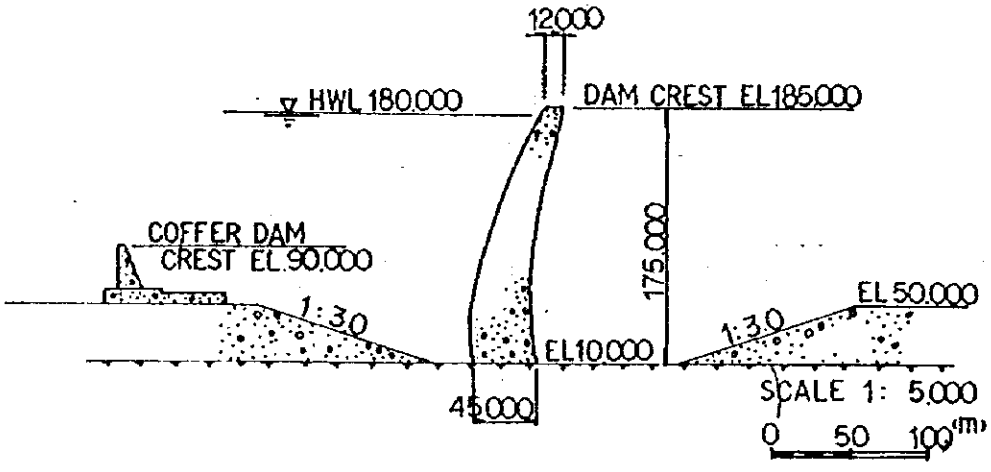
PROJECT LOCATION MAP



TYPICAL CROSS-SECTION



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR II River System: Cagayan Province: Cagayan

BANTAY

Client: NPC **Consultant:** NipponKoei/JICA

Purpose: Power **Status:** Master Plan in 1987

Hydrological Information

Catchment Area	742 km^2	Annual Basin Rainfall	2,880 mm
Mean Annual Run-off	34 m^3/s	Specific Run-off	4.57 $m^3/s/100km^2$
Denudation rate	4.0 mm/yr		

Dam

Geological Condition:	$N_2 + Q_1$ (sandstone)		
Type	Earthfill	Crest EL:	EL 69 m
Height	64 m	Crest Length:	320 m
Design Flood	2,100 m^3/s	Volume:	2.6 x $10^6 m^3$

Reservoir

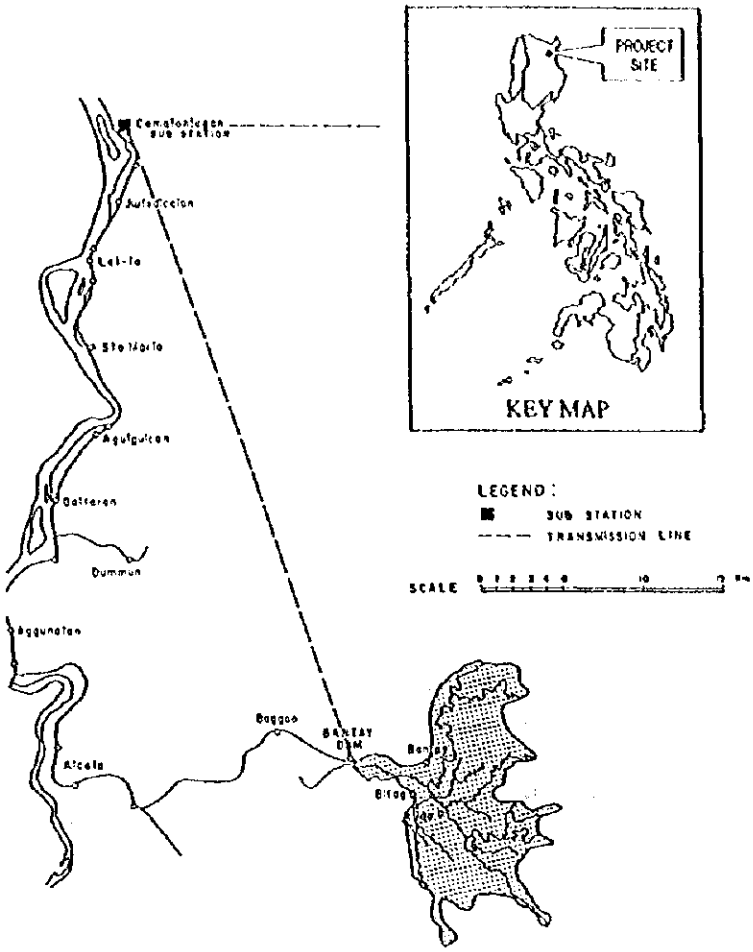
		Storage Volume ($10^6 m^3$)	
Surcharge WL :	WL 66.9m	F/C space	354
Full Supply WL:	WL 62.0m	Gross:	1,646
Min. Ope. WL:	WL 44.5m	Active:	1,278
Draw down :	17.5m	Dead :	368
Surface Area at FSWL:	105 km^2		

Hydro power

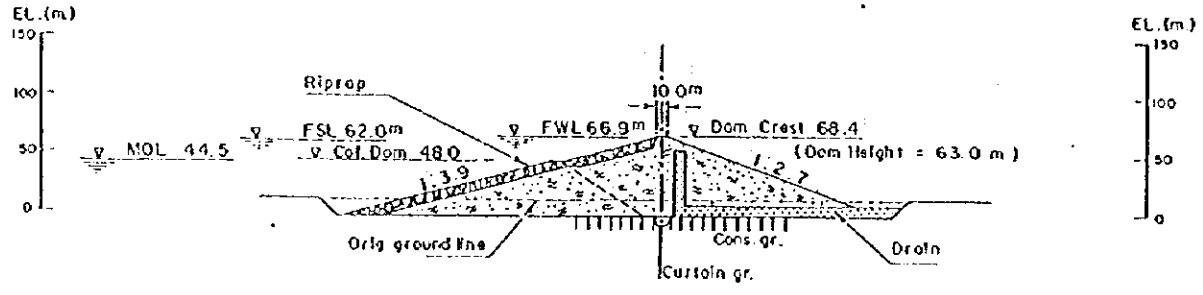
		Energy (GWh)	
Type:	Conventional	Annual:	68
Installed Capa:	40 MW	Firm :	68
Plant max Q :	140 m^3/s		
Rated Net Head:	35 m		
Tail WL:	WL 20 m		

Construction Cost: US$ 188 x 10^6

Source: Report for HPPS App. B & C by Nippon Koei/JICA 1987 with some revisions.



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR II **River System: Cagayan** **Province:** Kalinga Apayao

CHICO IV

Client: NPC **Consultant:** Lahmeyer

Purpose: Power **Status:** D/D in 1982

Hydrological Information

Catchment Area: 1,410 km^2

Mean Annual run-off : 86.3 m^3/s Specific Run-off: 6.12 $m^3/s/100km^2$

Dam

Geological Condition:

Type: Rockfill

Height: 160 m

Design Flood: 7,500 m^3/s

Crest EL : EL 455 m

Crest length : 890 m

Volume : 17.8 x $10^6 m^3$

Reservoir

Full Supply WL: WL 451 m

Min. Ope. WL: WL 411 m

Draw down: 40 m

Surface Area at FSWL: 14 km^2

Storage Volume ($10^6 m^3$)

Gross: 740

Active: 430

Dead: 310

Hydropower

Installed capa. : 360 MW

Plant Max. Q : 355 m^3/s

Rated Net Head: 132.5 m

Tail WL : WL 300 m

Energy (GWh)

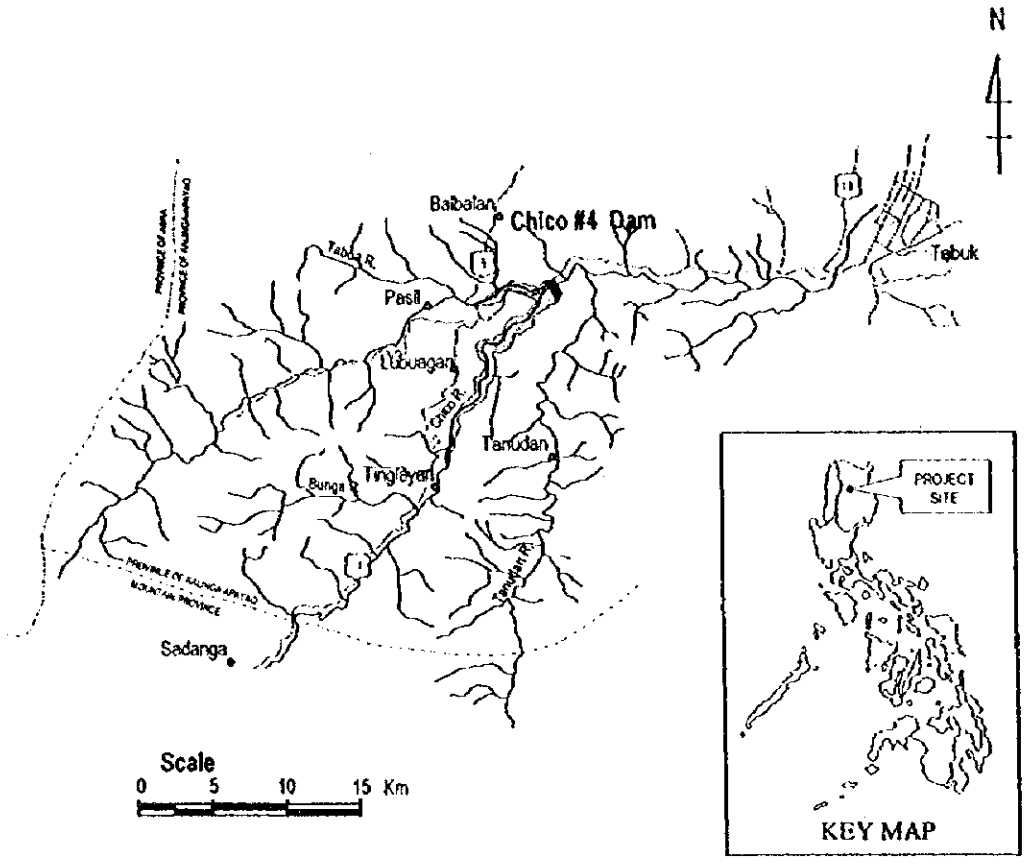
Annual: 955

Firm: 216

2-nd: 739

Construction Cost: US$ 758 x 10^6

Source: Proposed Hydroelectric Projects NPC 1988



PROJECT LOCATION MAP

WRR II **River System:** Cagayan/Ilagan **Province:** Isabela

ABUAN HYDRO-POWER PROJECT

Client: NPC **Consultant:** Lahmeyer/NipponKoei

Purpose: Power **Status:** F/S in 1996

Hydrological Information

Catchment Area	487 km^2	
Mean Annual Run-off	30.2 m^3/s	Specific Run-off 6.20 $m^3/s/100km^2$
Denudation rate	2.6 mm/yr	

Dam

Geological Condition:	$Volcanic N_1$ (Basalt)		
Type	Rockfill	Crest EL:	EL 13 m
Height	100 m		
Design Flood	6,600 m^3/s	Volume:	2.64 x $10^6 m^3$

Reservoir

		Storage Volume ($10^6 m^3$)	
Surcharge WL :	WL 135.5m		
Full Supply WL:	WL 131m	Gross:	250
Min. Ope. WL:	WL 110m	Active:	124
Draw down :	21m	Dead :	126

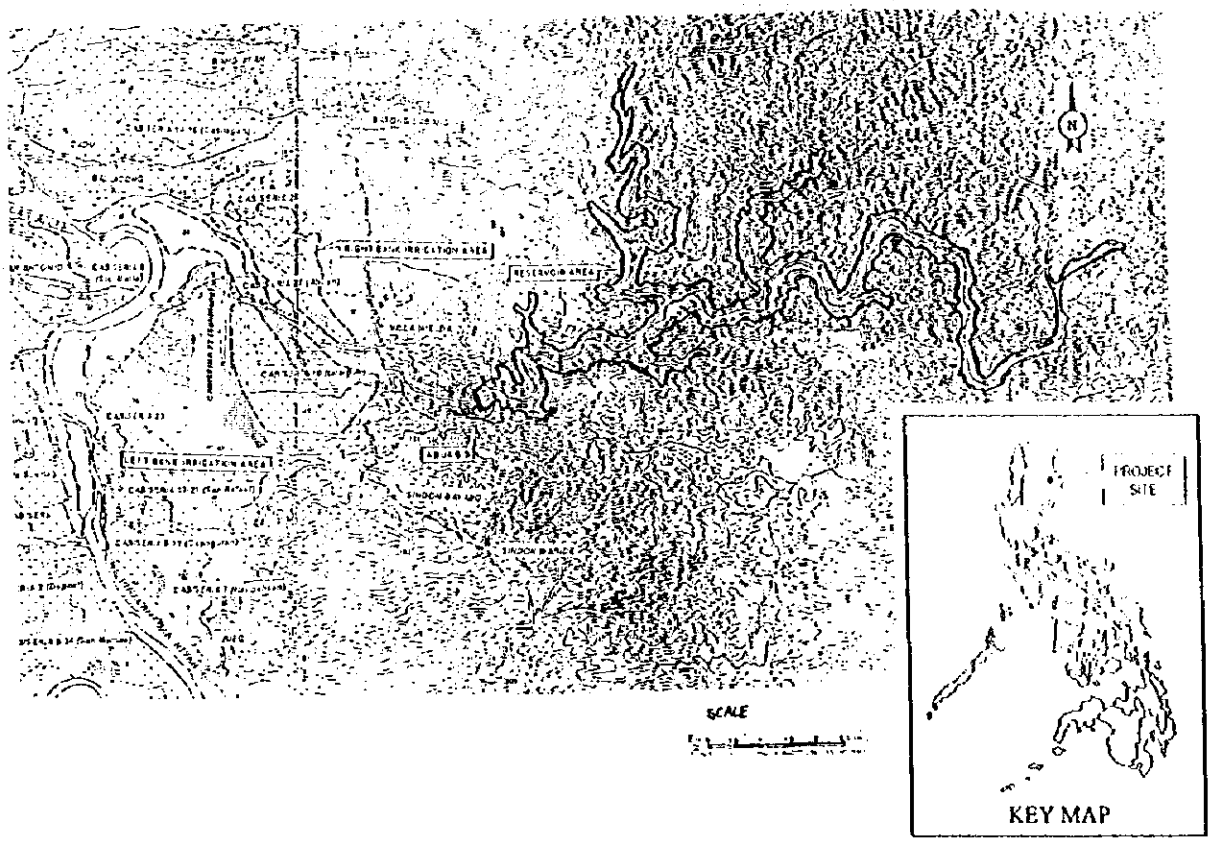
Hydropower

		Energy (GWh)	
Type:	Conventional	Annual:	172
Installed Capa:	60 MW	Firm :	128
Plant max Q :	95 m^3/s	2-nd :	44
Rated Net Head:	70 m		
Tail WL:	WL 48.6m		

Irrigation: 610 ha

Construction Cost: US$ 159 x 10^6

Source: Draft Final Report by Lahmeyer/Nippon Koei in 1996



PROJECT LOCATION MAP

WRR II River System: Cagayan Province: Kalinga-Apayao Mountain

MALLIG No. 2 and SIFFU No. 1

Consultant: NK/JICA

	Mallig No.2	Siffu No. 1
Purpose	Irrigation and Flood Control	Flood Control, Hydropower Supple-Mental Water Supply Of Magat Dam
Status	Master Plan	Master Plan
Hydrological Information		
Catchment Area (km^2)	362 + 1,951 (Chico intake)	656
Mean Annual Run-off (m^3/s)	16.9 + 30.0	34.9
Specific run-off ($m^3/s/100\ km^2$)	4.67	5.32
Dam		
Type	Rockfill	Earthfill
Crest EL (EL.m)	188	118
Height (m)	84	58
Crest length (m)	300	240
Volume ($10^6 m^3$)	2.36	1.66
Design Flood (m^3/s)	1,680	3,000
Reservoir		
Full Supply WL (WL. m)	185.5	115.5
Surcharge WL (WL. m)	183	113
Full Supply WL (WL. m)	180	106
Min. Ope. WL (WL. m)	160	97
Draw down (m)	20	9
	Mallig No.2	**Siffu No.1**
Storage Volume ($10^6 m^3$)		
F/C Space	112	115
Gross	1,037	314
Active	545	94
Surface Area at FSWL (km^2)	41	19

Channel/Tunnel from Chico		
Design Discharge (m^3/s)	30	
Tunnel Dia (m) x L (km)	4.0 x 4.0	
Channel L (km)	1.6	
Hydropower		
Installed Capacity (MW)		5.4
Plant Max. Q (m^3/s)		19.9
Rated Net Head (m)		32.0
Annual Energy (GWh)		41.1
Construction Cost (US $ x 10^6)	99	67

Source: Final Report for Master Plan, Cagayan Basin, NK/JICA, 1987

WRR II **River System:** Cagayan/Magat **Province:** Isabela

MAGAT

Client: NIA **Consultant:** Bureau of Reclamation US

Purpose: Multi- **Status:** Existing (1983)

Hydrological Information

Catchment Area : 4,143 km^2 Annual Basin Rainfall: 2,000 mm
Mean Annual run-off : 192 m^3/s Specific Run-off: 4.65 $m^3/s/100km^2$
Denudation rate: 1.6 mm/yr

Dam

Type: Rockfill/Gravity Crest EL : EL 200 m
Height: 114 m Crest length : 2,925 m
Design Flood: 30,400 m^3/s

Reservoir

		Storage Volume (10^6m^3)	
Surcharge WL:	WL 197.45 m	F/C Space:	210
Full Supply WL:	WL 193 m	Gross:	1,254
Min. Ope. WL:	WL 157.8 m	Active:	969
Draw down:	35.2 m	Dead:	285
Surface Area at FSWL:	17 km^2		

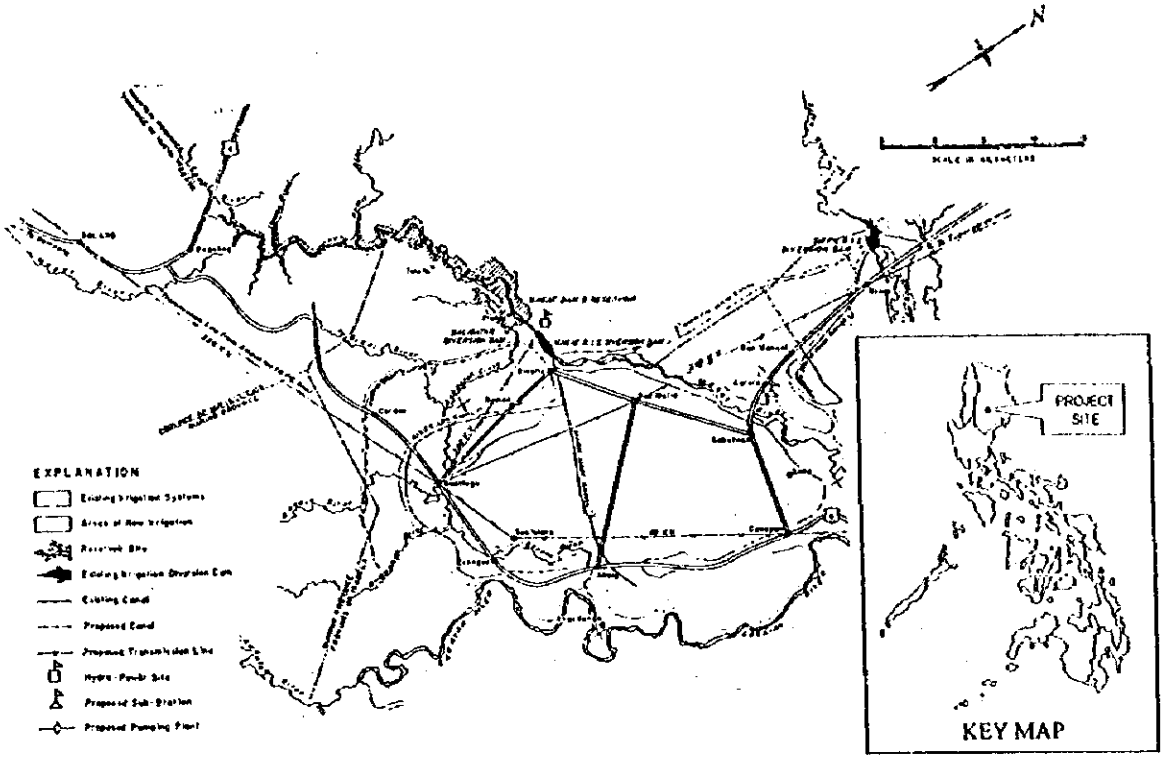
Hydropower

Installed capa. : 300 MW

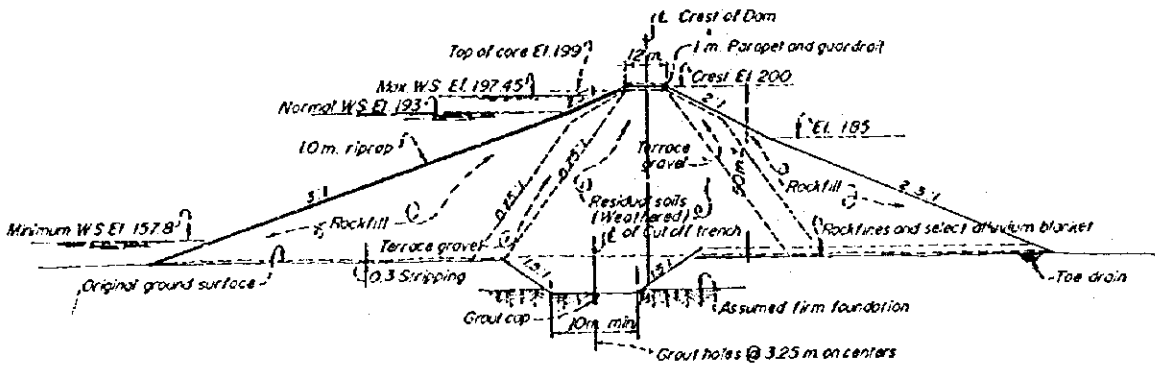
Energy (GWh)
Annual : 991
Firm : 314
2-nd : 677

Irrigation: 104,600 ha

Source: F/S Report by Bureau of Reclamation US 1973



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR II **River System:** Cagayan/Magat **Province:** Nueva Viscaya

MATUNO

Client: NIA **Consultant:** Nippon Koei/JICA

Purpose: Irrigation/Power **Status:** F/S in1984

Hydrological Information

Catchment Area:	593 km^2	Annual Basin Rainfall:	2,520 mm
Mean Annual run-off :	37.4 m^3/s	Specific Run-off:	6.30 $m^3/s/100km^2$
Denudation rate:	0.6 mm/yr		

Dam

Geological Condition:	N_1 (Conglo)		
Type:	Rockfill	Crest EL :	EL 529m
Height :	147 m	Crest length :	580 m
Design Flood:	10,000 m^3/s	Volume :	10.0 x 10^6m^3

Reservoir

		Storage Volume (10^6m^3)	
Surcharge WL:	WL 524.7m		
Full Supply WL:	WL 520 m	Gross:	137
Min. Ope. WL:	WL 480m	Active:	97
Draw down:	40m	Dead:	40

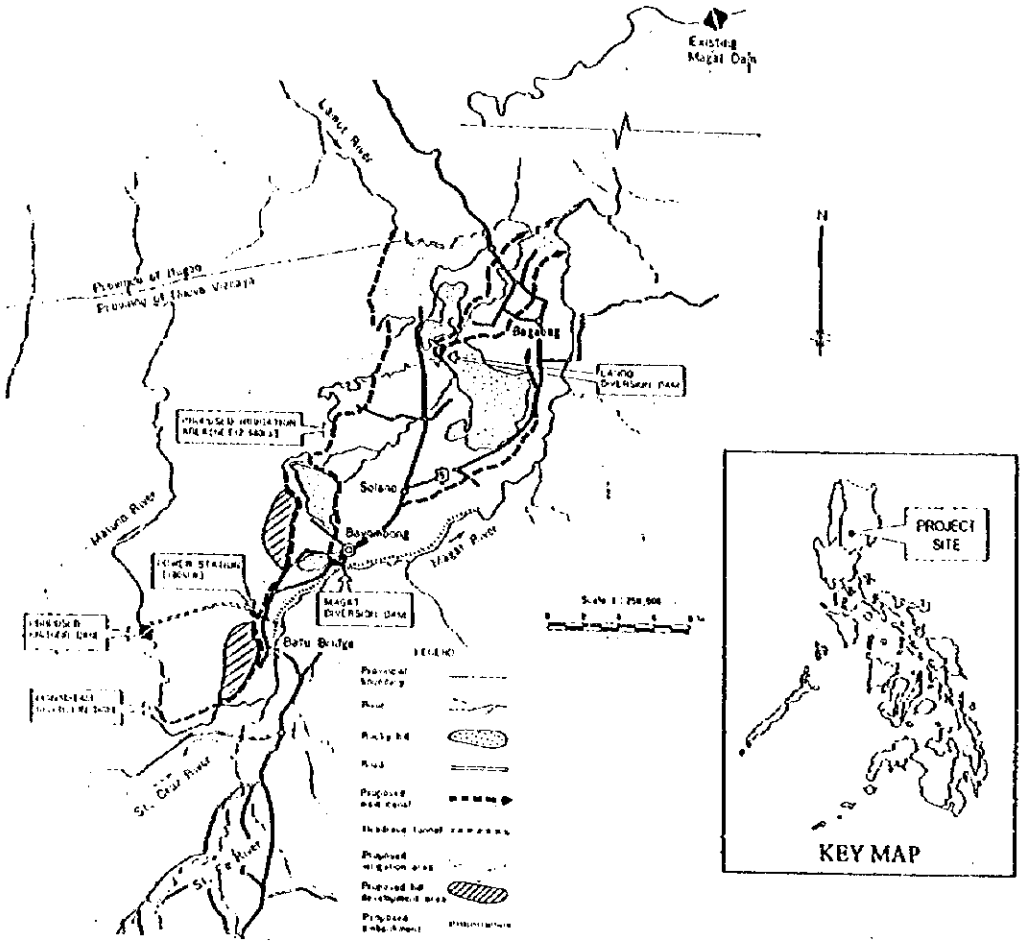
Hydropower

			Energy (GWh)	
Type	:	Conventional	Annual:	528
Installed capa.	:	180 MW	Firm:	353
Plant Max. Q	:	75 m^3/s	2-nd:	175
Tail WL	:	WL 300m		

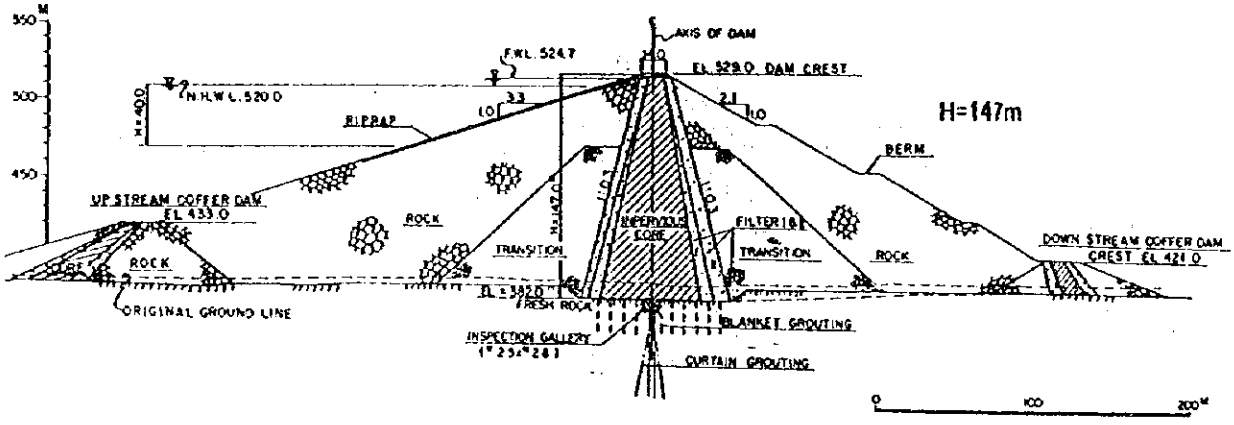
Irrigation: 13,600 ha

Construction Cost: US$ 668 x 10^6

Source: F/S on Matuno by Nippon Koei/JICA, 1984



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

ADDALAM A and ILAGUEN B

Client: NPC
Purpose: Power

Consultant:
Status : F/S

	ADDALAM A	ILAGUEN B
Hydrological Information		
River System	Cagayan/Addalam	Cagayan/Ilaguen
Province	Quirini	Isabela
Dam		
Reservoir		
Storage Volume ($10^6 m^3$)		
Active	32	31
Hydropower		
Installed Capa. (MW)	45	46
Energy (GWh)		
Annual	102	102

Source : NPC's Information

WRR II **River System:**Cagayan **Province:**Quirino

DIDUYON

Client: NPC **Consultant:** New JEC

Purpose: Power **Status:** F/S in 1980

Hydrological Information

Catchment Area: 477 km^2

Mean Annual run-off : 30.8 m^3/s Specific Run-off: 6.45 $m^3/s/100km^2$

Dam

Type: Conc. Gravity

Height: 111 m

Crest EL : EL 653 m

Crest length : 375 m

Volume : 1.2 x $10^6 m^3$

Reservoir

Full Supply WL: WL 648 m

Min. Ope. WL: WL 620 m

Draw down: 28 m

Storage Volume ($10^6 m^3$)

Gross: 579

Active: 454

Dead: 125

Hydropower

Type : Conventional

Installed capa. : 352 MW

Plant Max. Q : 85 m^3/s

Rated Net Head: 451 m

Tail WL : WL 162 m

Energy (GWh)

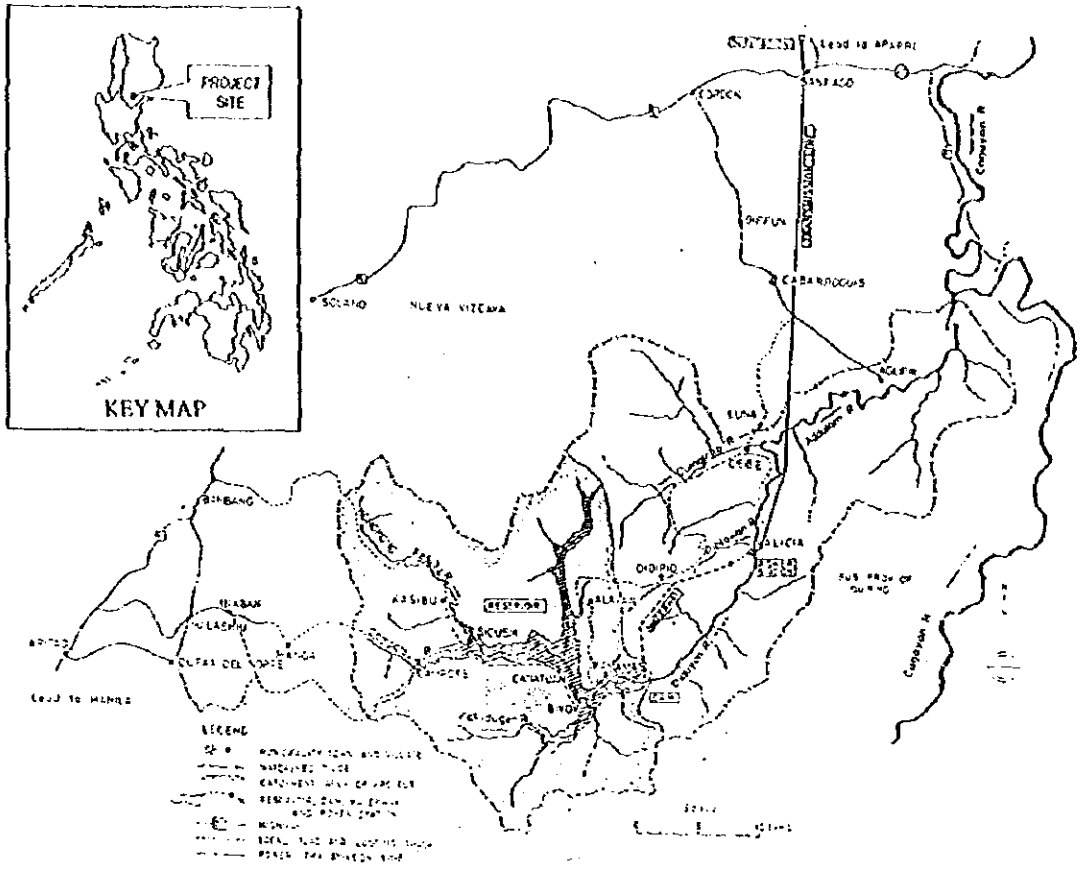
Annual: 957

Firm: 709

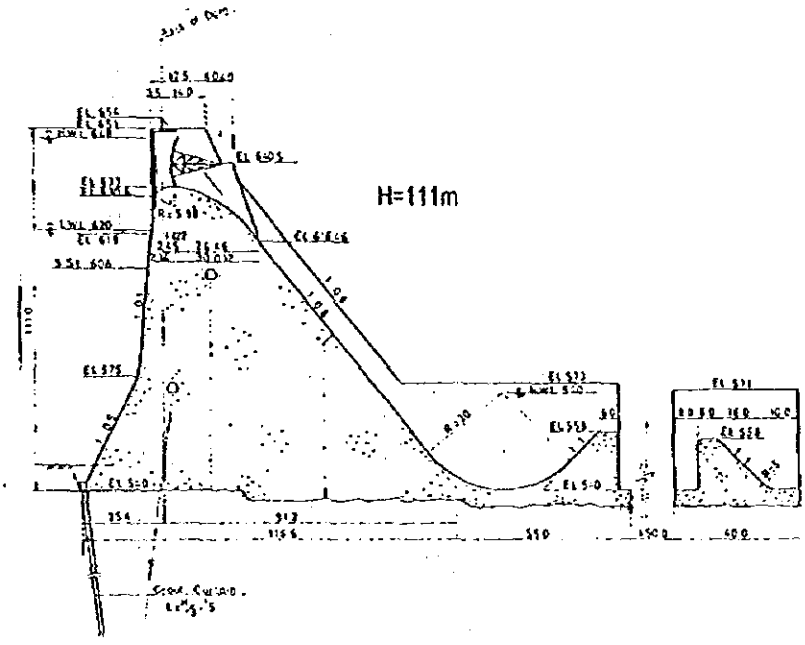
2-nd: 248

Construction Cost: US$ 664 x 10^6

Source: Proposed Hydroelectric Project NPC 1988.



PROJECT LOCATION MAP



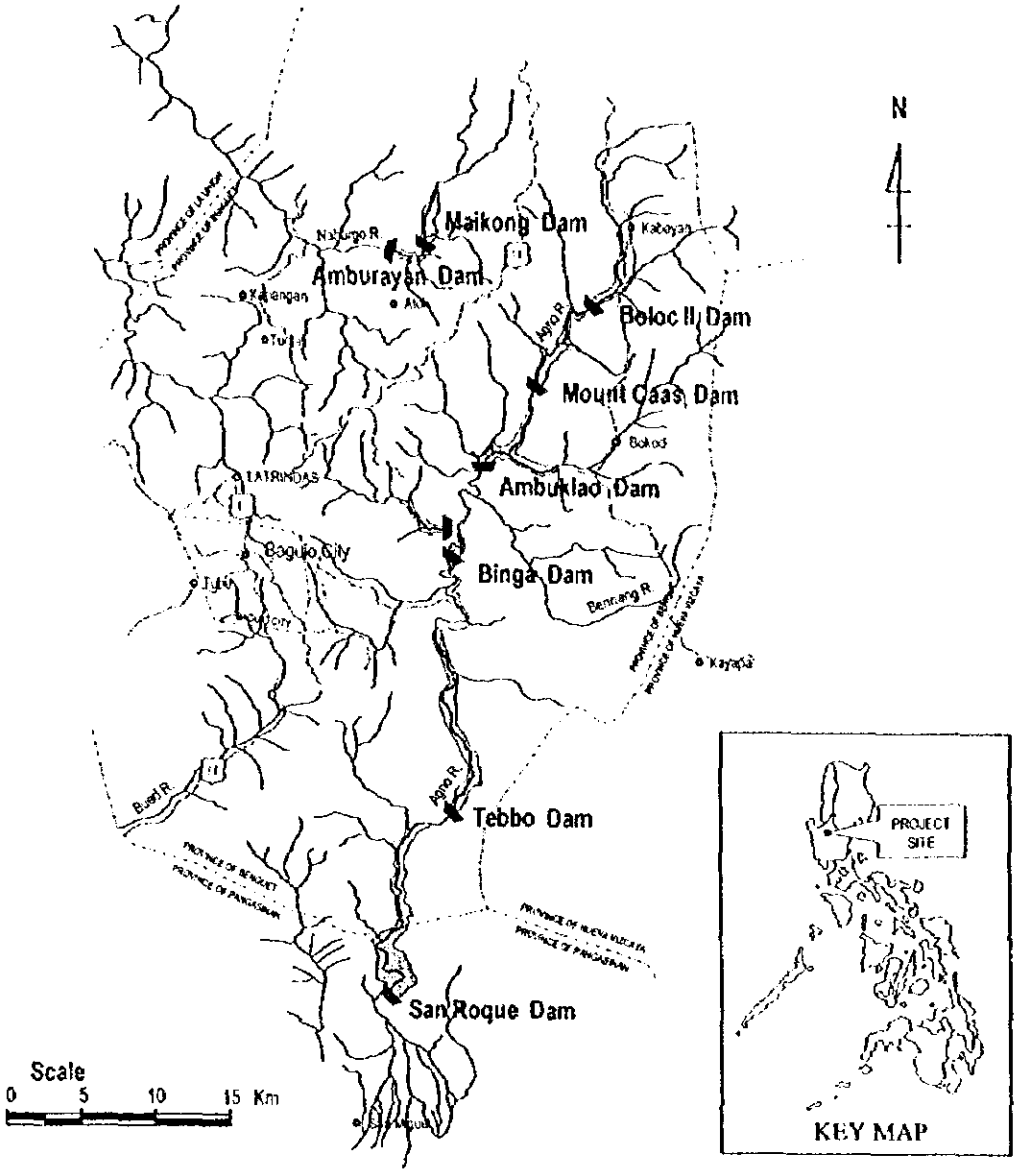
TYPICAL CROSS-SECTION

WRR III River System: Amburayan Province: Benguet

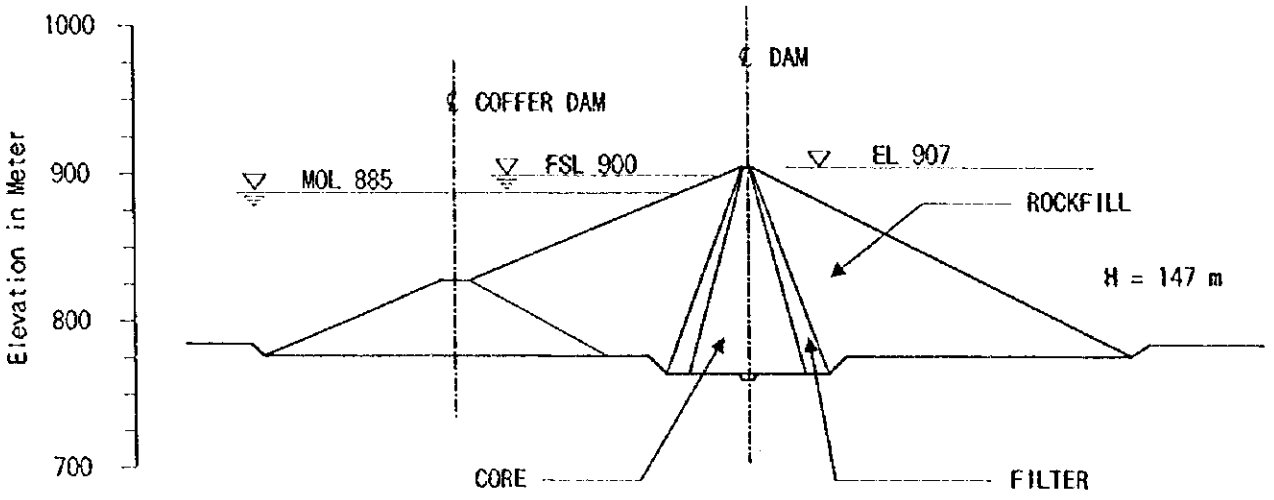
MAIKONG AND AMBURAYAN

In order to secure a firm and reliable water sources for Baguio City, these two dam schemes have been formulated. A firm discharge of 5.0 m^3/s will be secured.

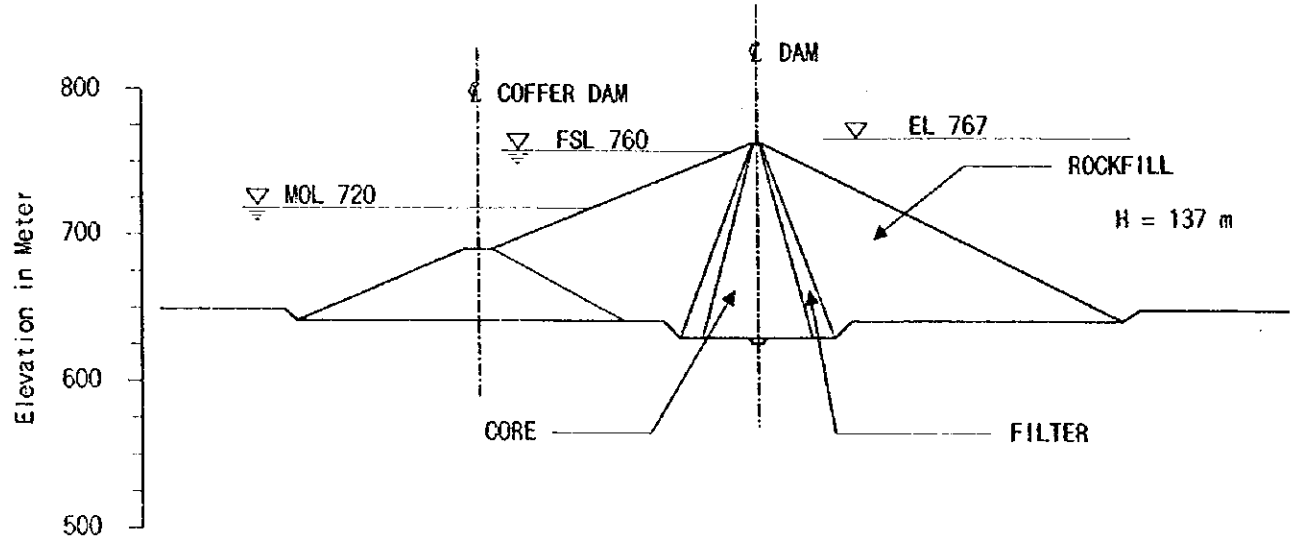
	Maikong	Amburayan
Purpose	Water Supply To Baguio	Ditto
Status	Map Study	Ditto
Hydrological Information		
Catchment Area (km^2)	100	135
Annual Basin Rainfall (mm)	3,000	3,000
Mean Annual Run-off (m^3/s)	4.88	6.59
Specific run-off ($m^3/s/100\ km^2$)	4.88	4.88
Denudation rate (mm/yr)	6.0	6.0
Dam		
Geological Condition	NI/UV	NI/UV
Type	Rockfill	Rockfill
Crest EL (EL. m)	907	767
Height (m)	147	137
Crest length (m)	400	400
Volume ($10^6 m^3$)	9.5	8.0
Reservoir		
Full Supply WL (WL. m)	900	760
Min. Ope. WL (WL. m)	885	720
Draw down (m)	15	40
Storage Volume ($10^6 m^3$)		
Gross	102	104
Active	26	64
Dead	76	40
Surface Area at FSWL (km^2)	1.9	2.1
Firm Discharge (m^3/s)	2.2	2.8
Construction Cost (US $ x 10^6)	400	400



PROJECT LOCATION MAP



TYPICAL CROSS SECTION OF MAIKONG DAM



TYPICAL CROSS SECTION OF AMBURAYAN DAM

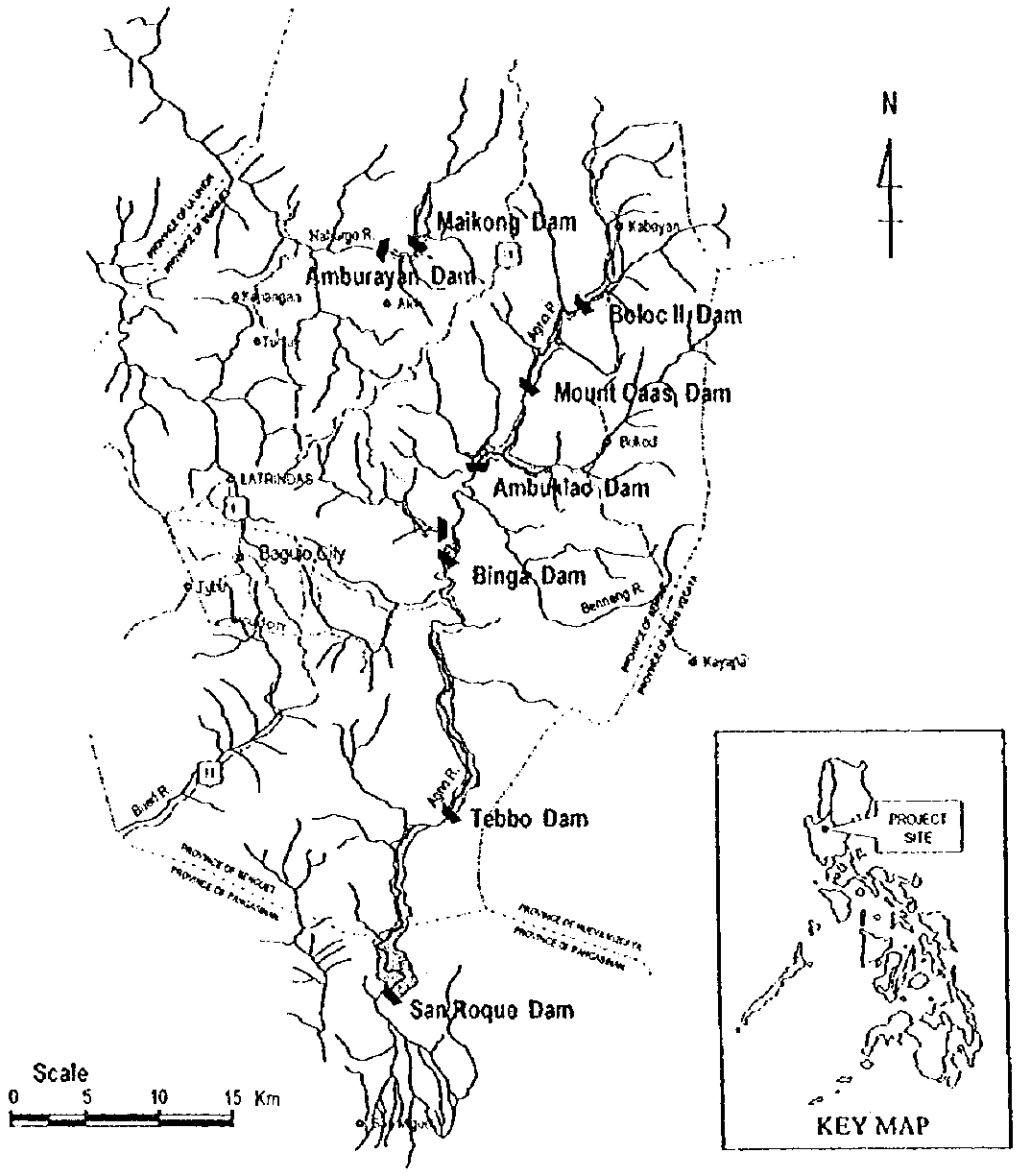
WRR III **River System: Agno** **Province: Benguet**

BOLOC II and MOUNT CAAS

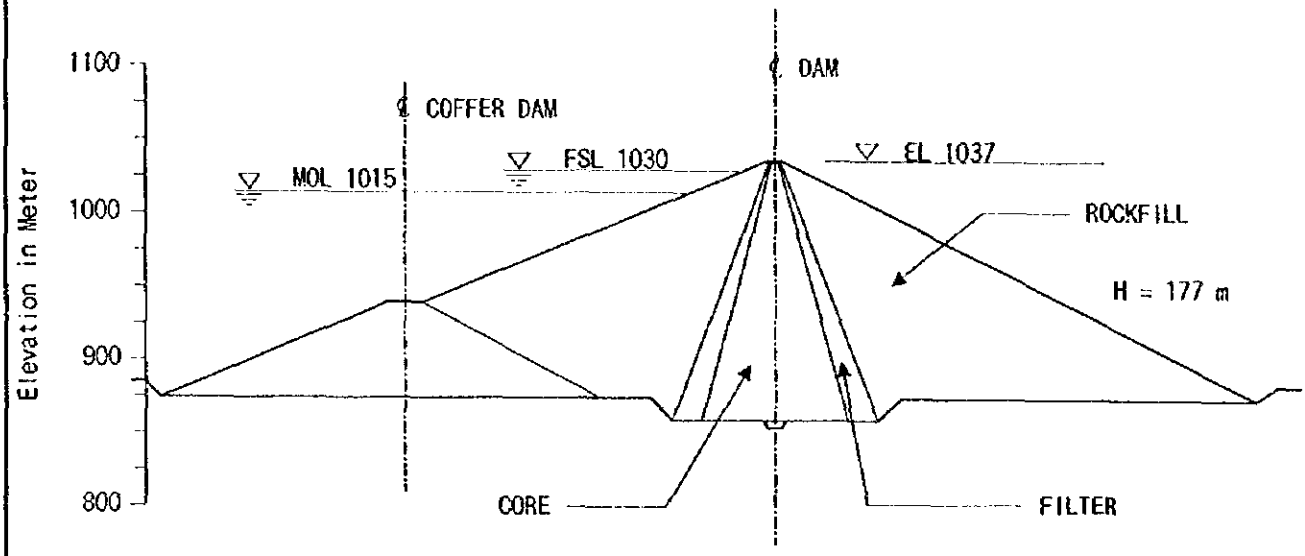
In order to rescue the Ambuklao, the captioned two dams are proposed in the upper reaches of the Ambuklao aimed at sand arrest and power generation.

Purpose: Sand Arrest, Power **Status :** Map Study

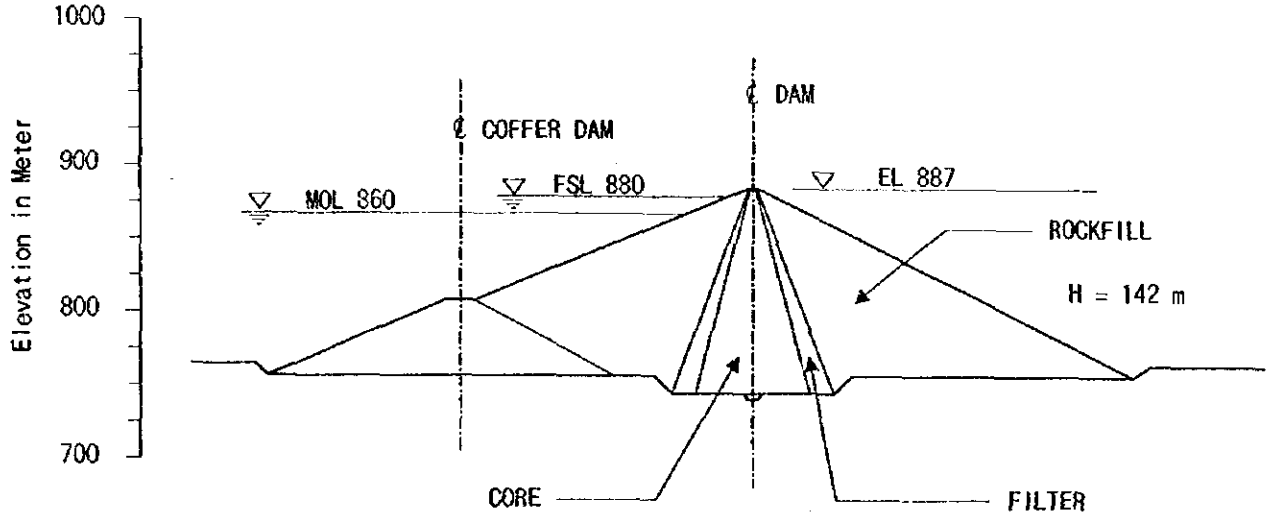
	Boloc II	Mount Caas
Hydrological Information		
Catchment Area (km^2)	306	390
Annual Basin Rainfall (mm)	3,000	3,000
Mean Annual Run-off (m^3/s)	15.1	19.3
Specific run-off ($m^3/s/100\ km^2$)	4.93	4.95
Denudation rate (mm/yr)	6.0	6.0
Dam		
Geological Condition	UV	UV/NI
Type	Rockfill	Rockfill
Crest EL (EL.m)	1,037	887
Height (m)	177	142
Crest length (m)	570	400
Volume ($10^6 m^3$)	20	9.0
Reservoir		
Full Supply WL (WL. m)	1,030	880
Min. Ope. WL (WL. m)	1,015	860
Draw down (m)	15	20
Storage Volume ($10^6 m^3$)		
Gross	280	120
Active	64	46
Dead	216	74
Surface Area at FSWL (km^2)	4.6	2.8
Hydropower		
Type	Conventional	Conventional
Installed Capa. (MW)	36	40
Plant Max. Q (m^3/s)	29	42
Rated Net Head (m)	150	115
Tail WL (WL.m)	870	750
Energy (GWh) Firm	66	73
Construction Cost: (US$ x 10^6)	614	326



PROJECT LOCATION MAP



TYPICAL CROSS SECTION OF BOLOC II DAM



TYPICAL CROSS SECTION OF MOUNT CAAS DAM

WRR III River System: Agno Province: Benguet

AMBUKLAO AND BINGA

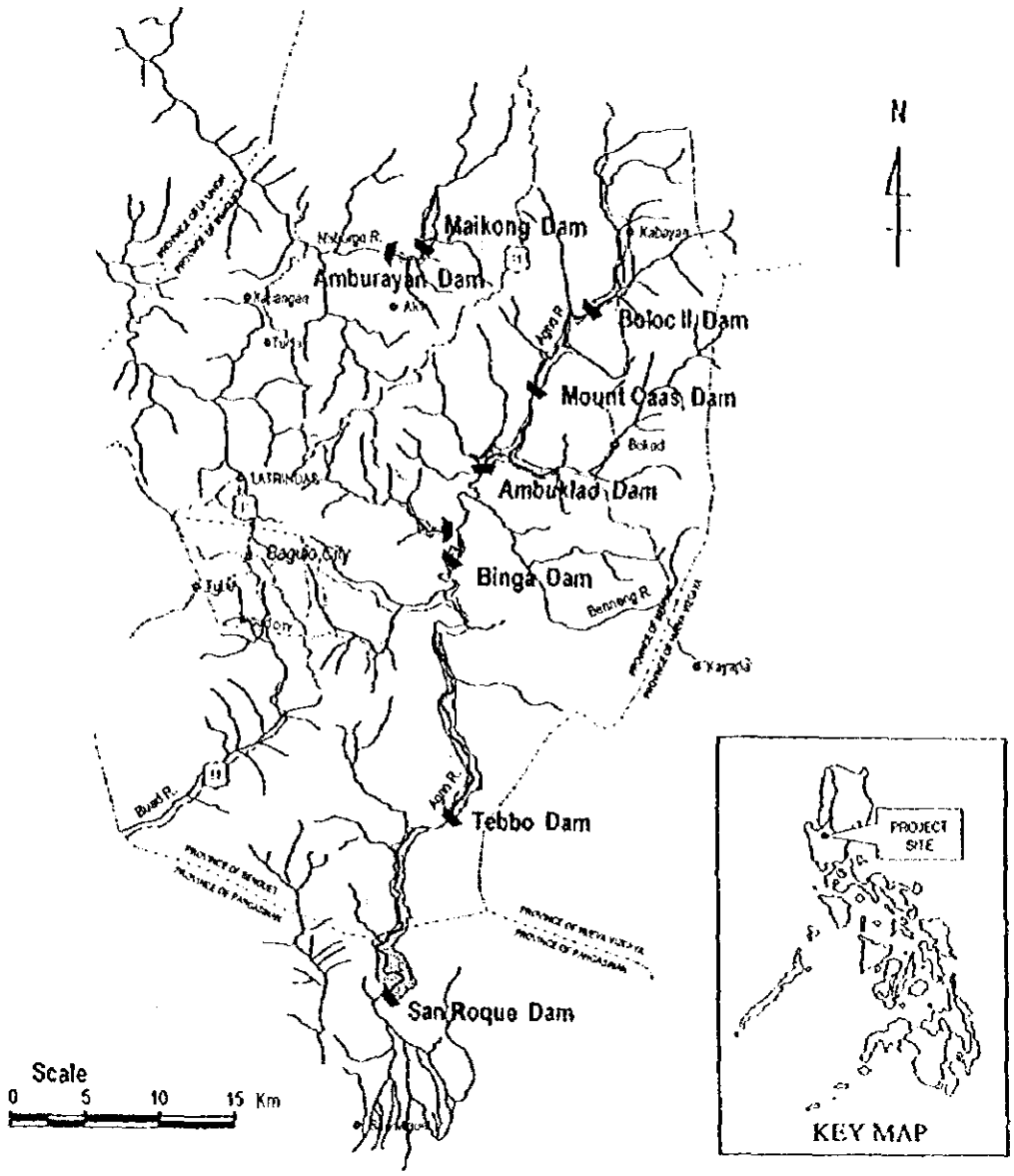
Client: NPC **Consultant:** Harza

Purpose: Power **Status :** Existing

	Ambuklao	Binga
Commission	1956	1960
Hydrological Information		
Catchment Area (km^2)	612	854
Annual Basin Rainfall (mm)	3,000	3,000
Mean Annual Run-off (m^3/s)	30.0	52.3
Specific run-off ($m^3/s/100\ km^2$)	4.90	6.12
Denudation rate (mm/yr)	6.0	6.0
Dam		
Geological Condition	NI	UV
Type	Rockfill	Rockfill
Crest EL (EL.m)	758	586
Height (m)	129	107.4
Crest length (m)	452	215
Volume ($10^6 m^3$)	5.8	1.9
Reservoir		
Full Supply WL (WL. m)	752.2	575
Min. Ope. WL (WL. m)	694	555
Draw down (m)	58.2	20
Storage Volume ($10^6 m^3$)		
Gross	327.2	90.6
Active	258	33.0
Dead	69.2	57.6

Hydropower	Ambuklao	Binga
Type	Underground	Underground
Installed Capa. (MW)	75	100
Plant Max. Q (m^3/s)	61.4	84.8
Rated Net Head (m)		149
Tail WL (WL.m)	574	416.5
Energy (GWh)		
Annual		516
Firm	300	481
2-nd		35

Source: HPPS App. - C by Nippon Koei/JICA, 1987



PROJECT LOCATION MAP

Laboy II

Purpose: Water Supply to Baguio

Status: Map study

Hydrological Information

Catchment Area	48.6 km^2	Annual Basin Rainfall	3,800 mm
Mean Annual Run-off	4.4 m^3/s	Specific Run-off	9.0 $m^3/s/100km^2$
Denudation rate	6.0 mm/yr		

Dam

Geological Condition:	NI		
Type	Rockfill	Crest EL:	EL 826 m
Height	75 m	Crest Length:	500 m
		Volume:	5.3 x $10^6 m^3$

Reservoir

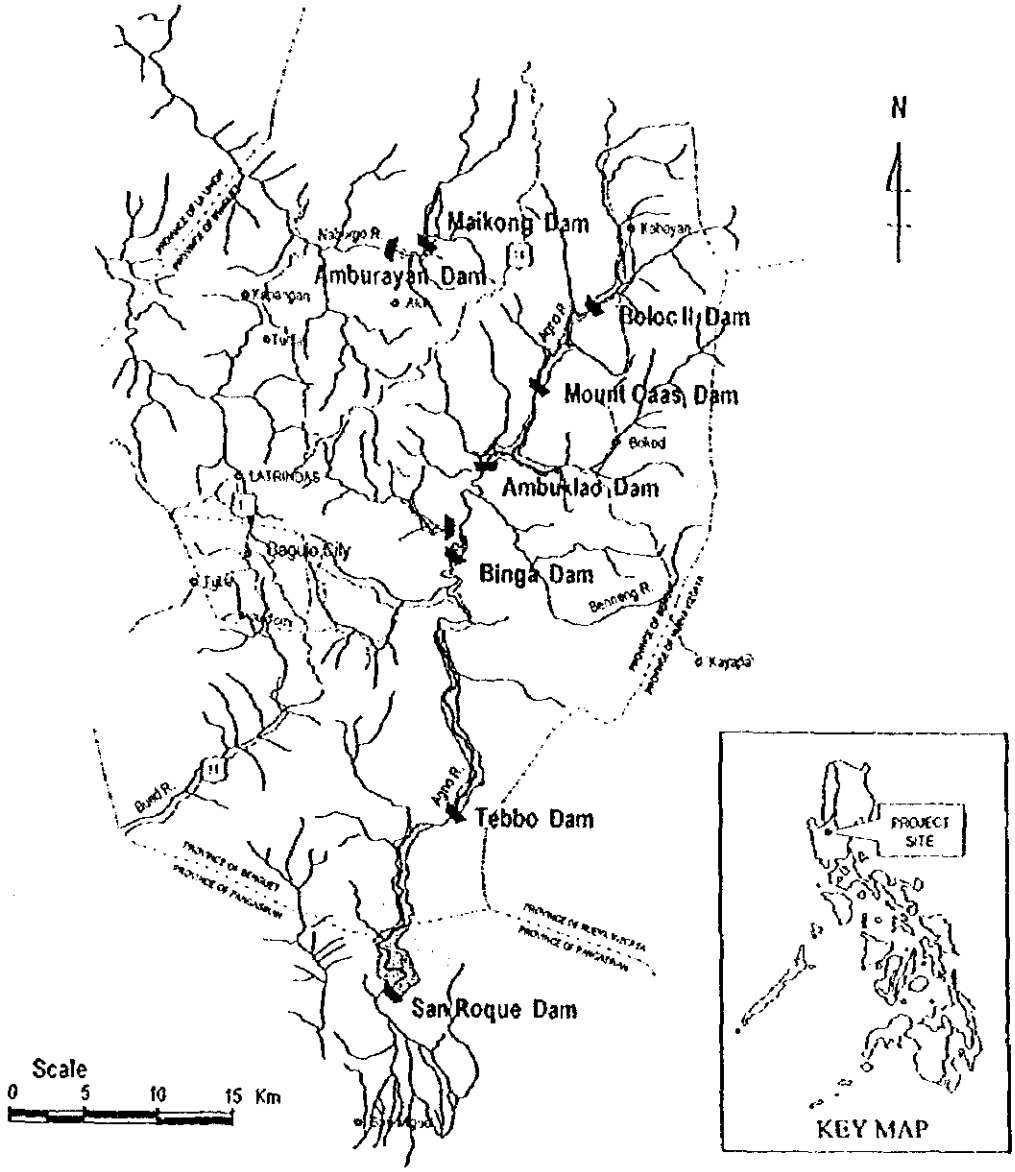
		Storage Volume ($10^6 m^3$)	
Full Supply WL:	WL 818 m	Gross:	13.9
Min. Ope. WL:	WL 811 m	Active:	3.0
Draw down :	7 m	Dead :	10.9

TEBBO AND SAN ROQUE

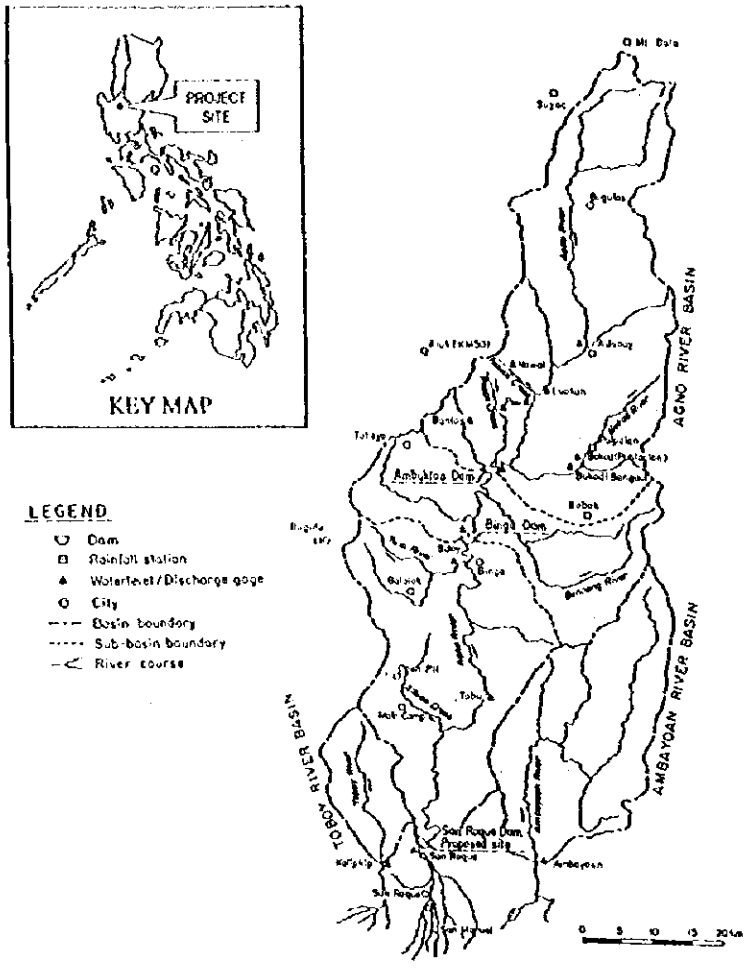
Now San Roque Multipurpose dam is about to be built as a BOT. Between Binga and San Roque, a head of 136m remains. Tebbo scheme will harness this remaining available head.

	Tebbo	San Roque
Client:	NPC	NPC/NIA
Consultant:		ELC/EDCOP
Purpose:	Power	Multi-
Status:	Map Study	On-Going
Hydrological Information		
Catchment Area (km^2)	1,072	1,235
Annual Basin Rainfall (mm)	3,000	3,000
Mean Annual Run-off (m^3/s)	66.3	83.6
Specific run-off ($m^3/s/100\ km^2$)	6.18	6.77
Denudation rate (mm/yr)	6.0	6.0
Dam		
Geological Condition	UV	NI
Type	Rockfill	Rockfill
Crest EL (EL.m)	422	297
Height (m)	112	200
Crest length (m)	250	1,130
Volume ($10^6 m^3$)	3.2	38.5
Design Flood (m^3/s)		15,600
Reservoir		
Surcharge WL (WL.m)	-	290
Full Supply WL (WL. m)	415	280
Min. Ope. WL (WL. m)	395	225
Draw down (m)	20	55
Storage Volume ($10^6 m^3$)		
F/C Space	-	140
Gross	280	850
Active	110	530
Dead	175	320
Surface Area at FSWL (km^2)	6.6	12.8

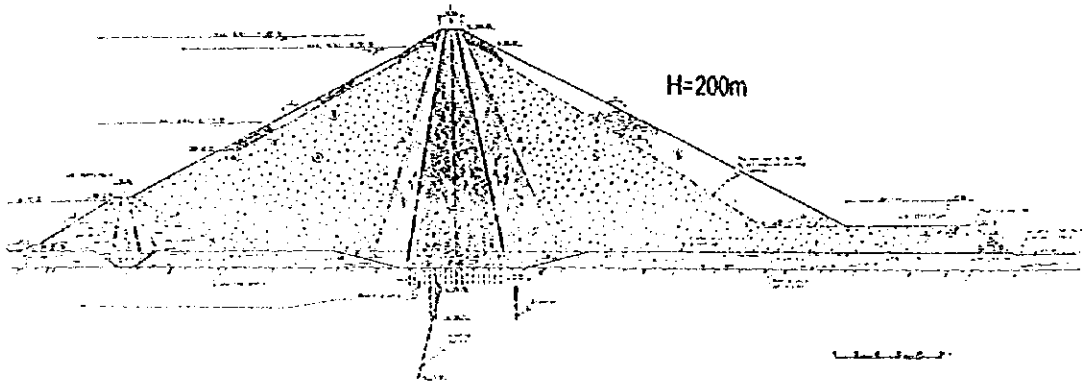
Hydropower	Tebbo	San Roque
Type	Conventional	Conventional
Installed Capa. (MW)	120	345
Plant Max. Q (m^3/s)	120	260
Rated Net Head (m)	120	
Tail WL (WL.m)	280	
Energy (GWh)		
Annual		1,030
Firm	219	638
2-nd		392
Irrigation: (ha)		87,000
Construction Cost: (US$ x 10^6)	287	1,050



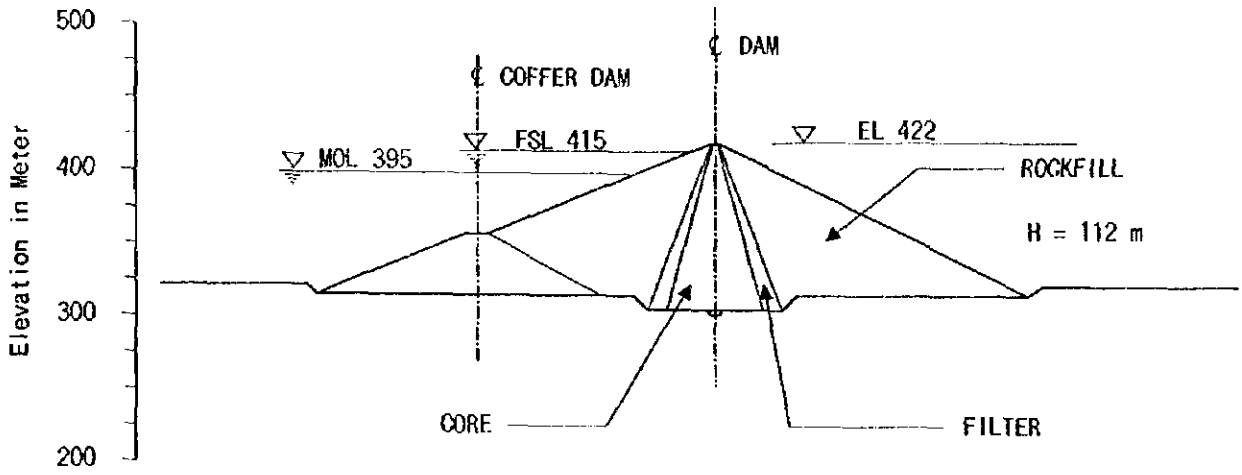
PROJECT LOCATION MAP



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION



TYPICAL CROSS SECTION OF TEBBO DAM

WRR III **River System:** Balincaguin **Province:** Pangasinan

MABINI

Client: NIA
Purpose: Irrigation

Consultant:
Status: F/S

Hydrological Information
Catchment Area: 225 km^2

Dam

Type:	Rockfill	Crest EL	: EL 68.5 m
Height :	88.5 m	Crest length	: 530 m
Design Flood:	3,100 m^3/s	Volume	: 4.1 x $10^6 m^3$

Reservoir

Full Supply WL:	WL 65 m
Min. Ope. WL:	WL 38 m
Draw down:	27 m
Surface Area at FSWL:	15 km^2

Storage Volume ($10^6 m^3$)

Gross:	345
Active:	240
Dead:	

Irrigation: 11,500 ha

WRR III **River System:** Agno/Tarlac **Province:** Tarlac

BALOG-BALOG

Client: NIA **Consultant:** ELC

Purpose: Irrigation, Power, Flood Control **Status:** F/S 1980

Hydrological Information

Catchment Area:	283 km^2	Annual Basin Rainfall:	2,500 mm
Mean Annual run-off:	20 m^3/s	Specific Run-off:	7.06 $m^3/s/100km^2$
Denudation rate:	2.6 mm/yr		

Dam

Geological Condition: NI (Diovite)

Type:	Rockfill	Crest EL	: EL 245.5 m
Height :	113.5m	Crest length	: 1,400 m
Design Flood:	4,000 m^3/s	Volume	: 11.8 x $10^6 m^3$

Reservoir

		Storage Volume ($10^6 m^3$)	
Surcharge WL:	WL 240.5 m	F/C Space:	45
Full Supply WL:	WL 238 m	Gross:	625
Min. Ope. WL:	WL 180 m	Active:	575
Draw down:	58 m	Dead:	50
Surface Area at FSWL:	18 km^2		

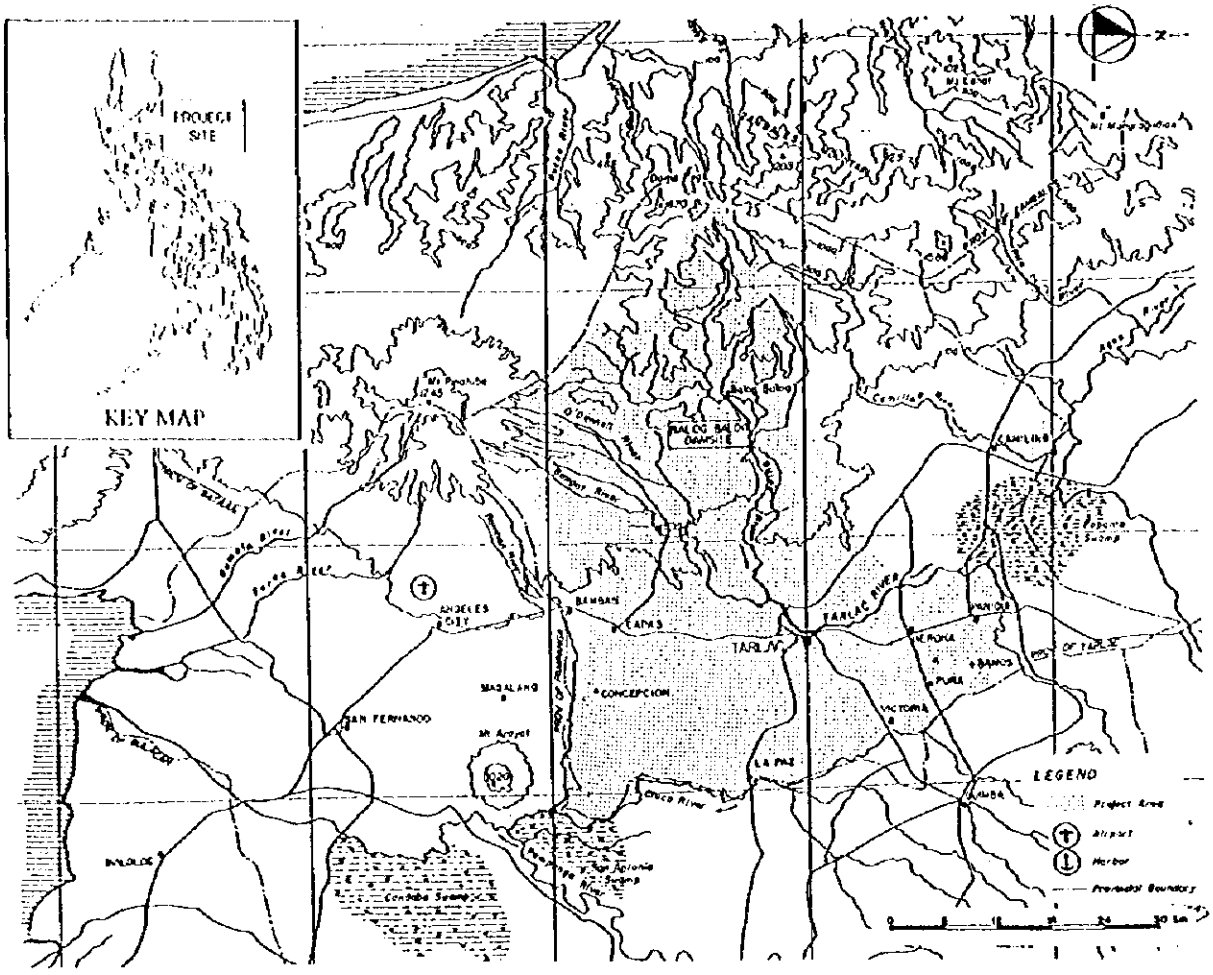
Hydropower

Type	: Conventional	Energy (GWh)	
Installed capa. :	33 MW	Annual:	98.5
		Firm:	32.5
		2-nd:	66

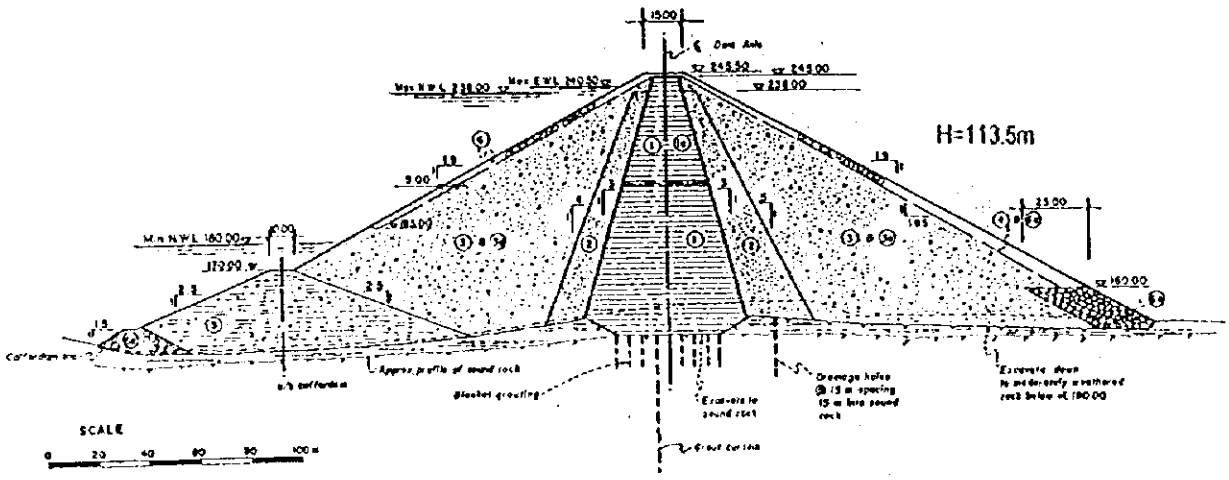
Irrigation: 44,350 ha

Construction Cost: US$ 292 x 10^6

Source: 1) F/S Main Report by ELC in 1980
2) Reconnaissance Report by Nippon Koei in 1987



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR III **River System:** Pampanga **Province:** Nueva Ecija

PANTABANGAN

Client: Philippine Government **Consultant**: ECI

Purpose: Multi- **Status:** Existing (1977)

Hydrological Information

Catchment Area : 853 km^2 Annual Basin Rainfall: 2,200 mm

Mean Annual run-off : 44.6 m^3/s Specific Run-off: 5.23 $m^3/s/100km^2$

Dam

Type: Earthfill Crest EL : EL 232 m

Height: 107 m Crest length : 1,615 m

Design Flood: 4,200 m^3/s Volume : 12.0 x 10^6m^3

Reservoir

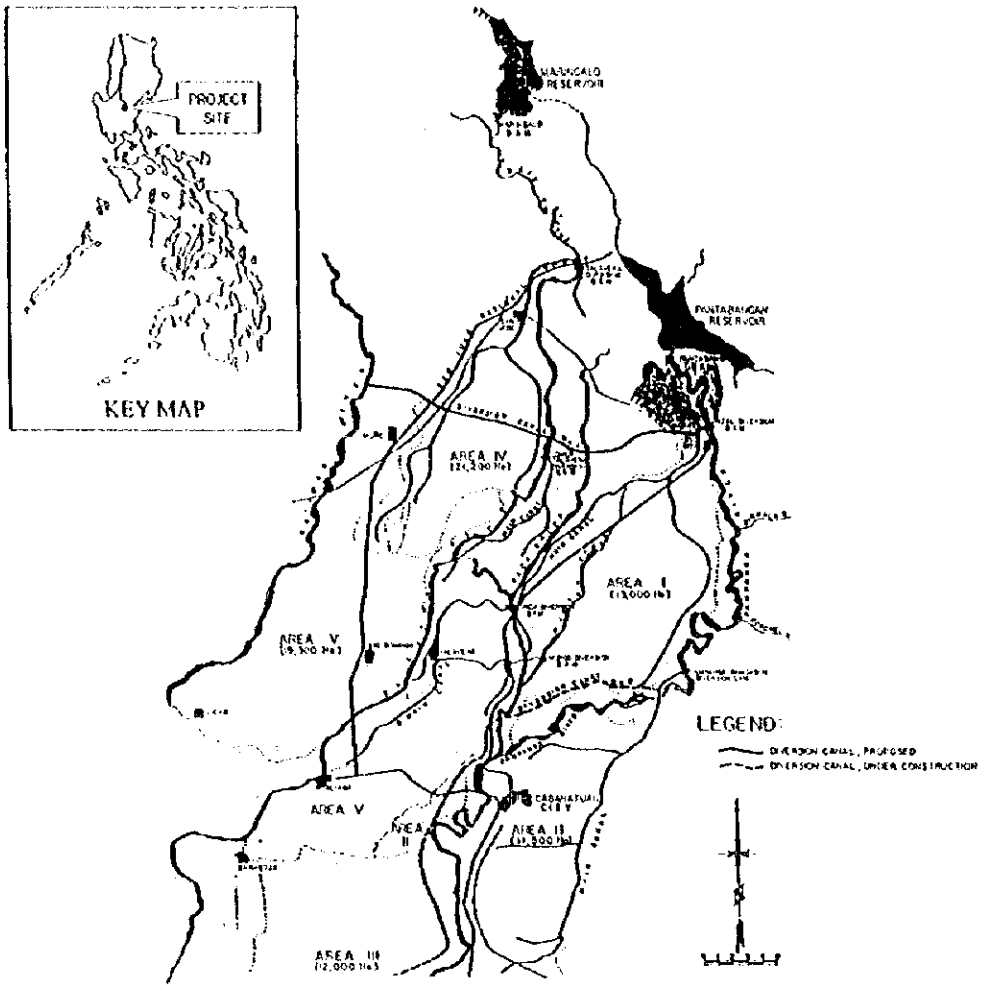
		Storage Volume (10^6m^3)	
Surcharge WL:	WL 230 m	F/C Space:	
Full Supply WL:	WL 221 m	Gross:	2,310
Min. Ope. WL:	WL 177 m	Active:	1,973
Draw down:	44 m	Dead:	337

Hydropower

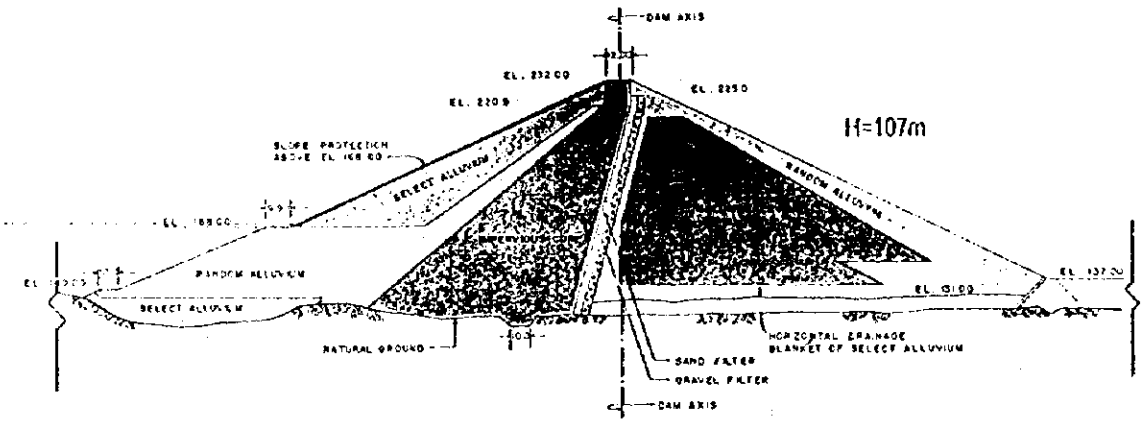
		Energy (GWh)	
Installed capa. :	100 MW	Annual :	230
Tail WL :	WL 128 m	Firm :	122
		2-nd :	108

Irrigation: 102,000 ha

Source: Souvenir Brochure



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR II/III **River System:Cagayan/Pampanga** **Province:**

CASECNAN TRANSBASIN
ABACA and CONWAP

Client: NPC
Purpose:

Consultant: ELC/IBRD
Status : Underconstruction/STOPPED

	Abaca	Conwap
Hydrological Information		
Catchment Area (km^2)	590	1,150
Annual Basin Rainfall (mm)	2,642	2,642
Mean Annual Run-off (m^3/s)	27.9	66.4
Specific run-off ($m^3/s/100\ km^2$)	4.72	5.77
Denudation rate (mm/yr)	0.5	1.3
Dam		
Type	Rockfill	Rockfill
Crest EL (EL.m)	505	399
Height (m)	107	168.5
Crest length (m)	500	913
Volume ($10^6 m^3$)	4.2	19.4
Design Flood (m^3/s)	5,900	10,000
Reservoir		
Surcharge WL (WL.m)	499	394
Full Supply WL (WL. m)	490	390
Min. Ope. WL (WL. m)	473	375
Draw down (m)	17	15
Storage Volume ($10^6 m^3$)		
F/C Space		
Gross	130	1,207
Active	58	321
Dead	72	888

Transbasin Tunnel	Abaca→Pantabangan
Dia	6.0 m
Length	19.1 km + 2.9 km
Q max	150 m^3/s

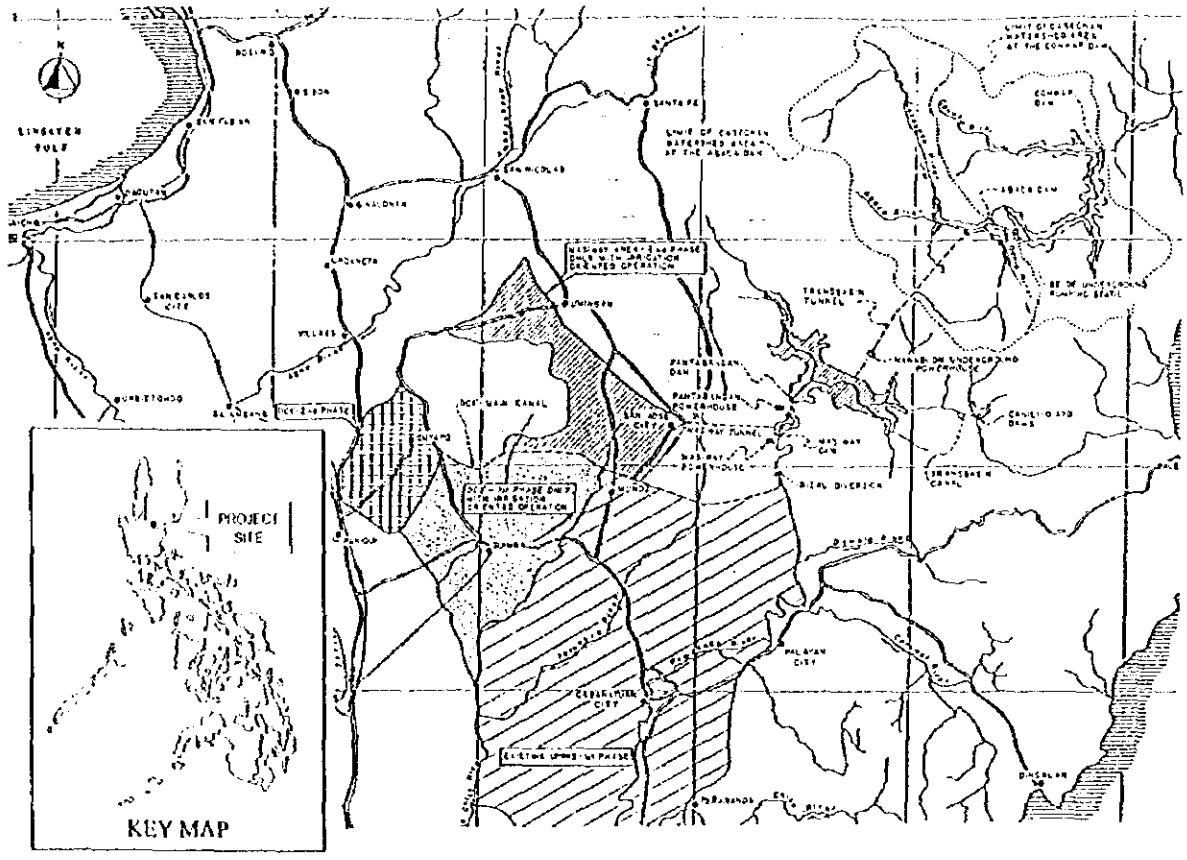
Power Station:

Type	Underground
Installed Capa. (MW)	270 MW
Energy (GWh)	
Annual	495
Firm	315
2-nd	180

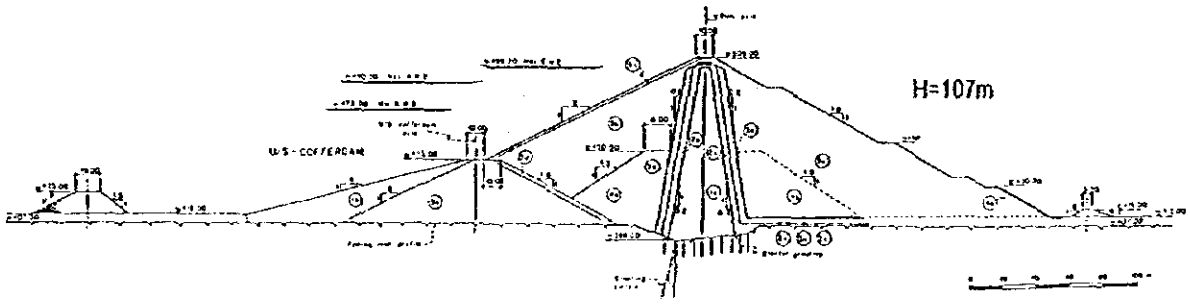
Be-De Pumping Plant	Conwap →Abaca
Installed Capacity	90 MW
Annual Energy	415 GWh

Construction Cost: US$652 x 10^6 US$ 591 x 10^6

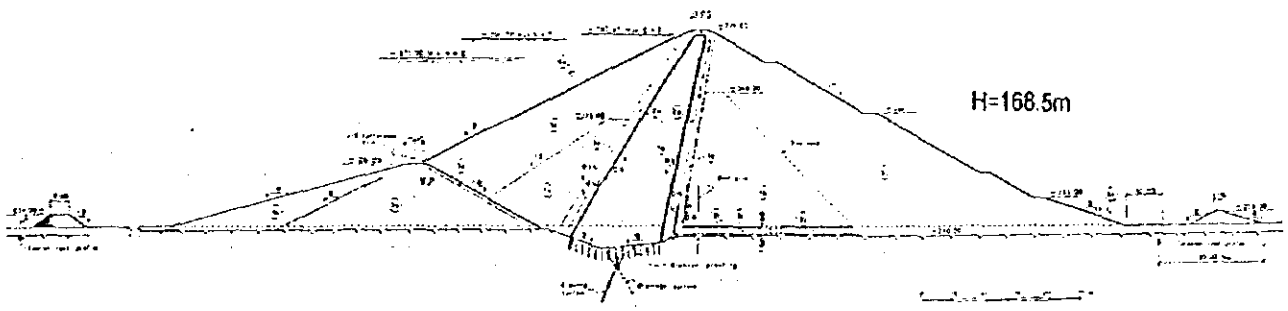
Source: F/S Main Report by ELC/IBRD 1994



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION



TYPICAL CROSS-SECTION

WRR III **River System:** Pampanga/Angat **Province:** Bulacan

ANGAT

Client: NPC **Consultant:** Harza

Purpose: Power, Irrigation, Municipal Supply, Flood Control **Status:** Existing (1967)

Hydrological Information

Catchment Area : 568 km^2

Mean Annual run-off : 75.8 m^3/s Specific Run-off: 13.4 $m^3/s/100km^2$

Dam

Type: Rockfill

Height: 131 m

Design Flood: 5,800 m^3/s

Crest EL : EL 223.5 m

Crest length : 568 m

Volume : 7.1 x $10^6 m^3$

Reservoir

Surcharge WL: WL 219 m

Full Supply WL: WL 217 m

Min. Ope. WL: WL 180 m

Draw down: 37 m

Surface Area at FSWL: 23 km^2

Storage Volume ($10^6 m^3$)

Gross: 1,075

Active: 850

Dead: 225

Hydropower

Installed capa. : 218 MW

Energy (GWh)

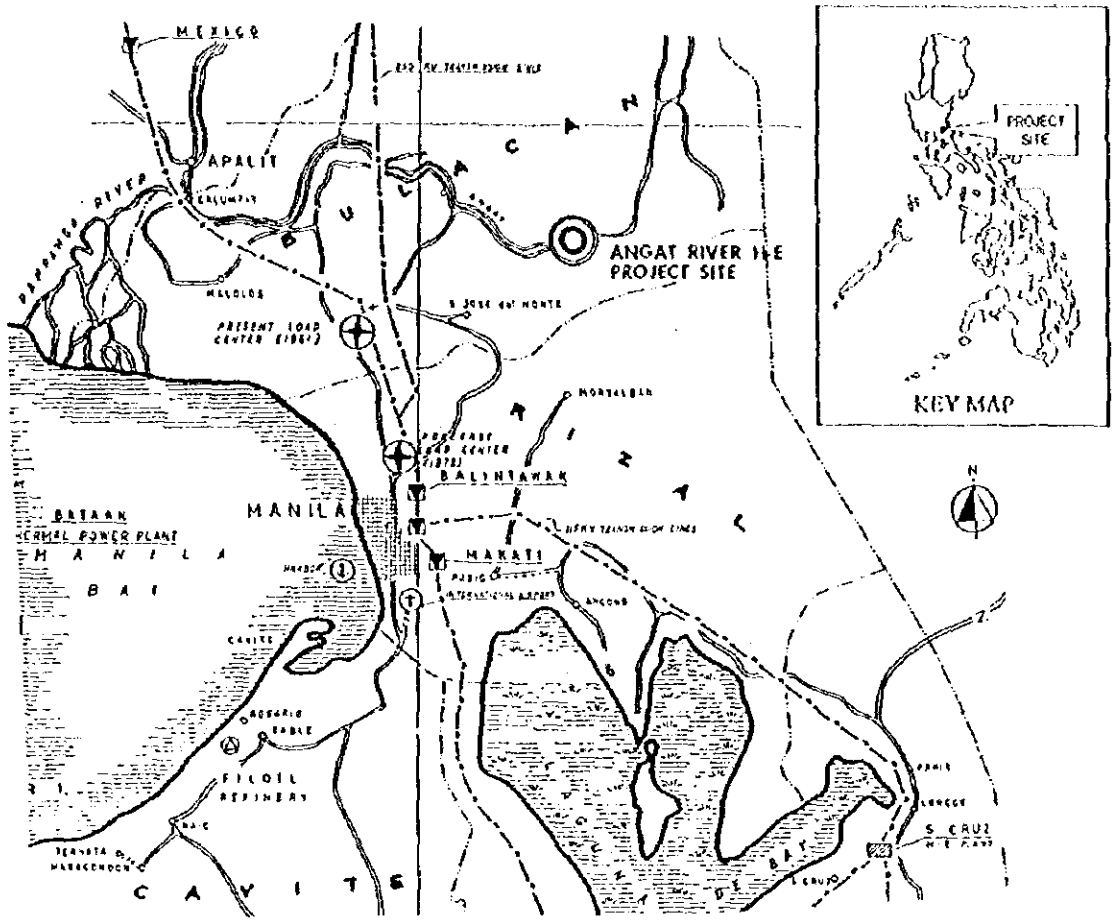
Annual : 398

Firm : 280

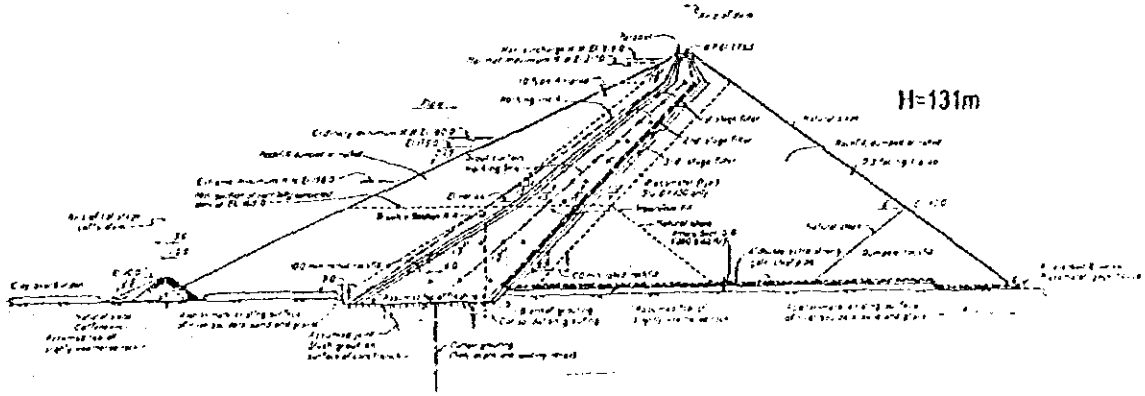
2-nd : 118

Irrigation: 30,000 ha

Source: Leaflet: The Angat River Hydroelectric Project, 1967



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR III **River System: Umiray** **Province:**

Umiray

Client: MWSS **Consultant: C. Lotti/ADB**

Purpose: Water Supply to Manila **Status: On-going**

Hydrological Information

Catchment Area	:	160 km^2	Annual Basin Rainfall: 5,000 mm
Mean Annual run-off:		15.6 m^3/s	Specific Run-off: 9.75 $m^3/s/100km^2$

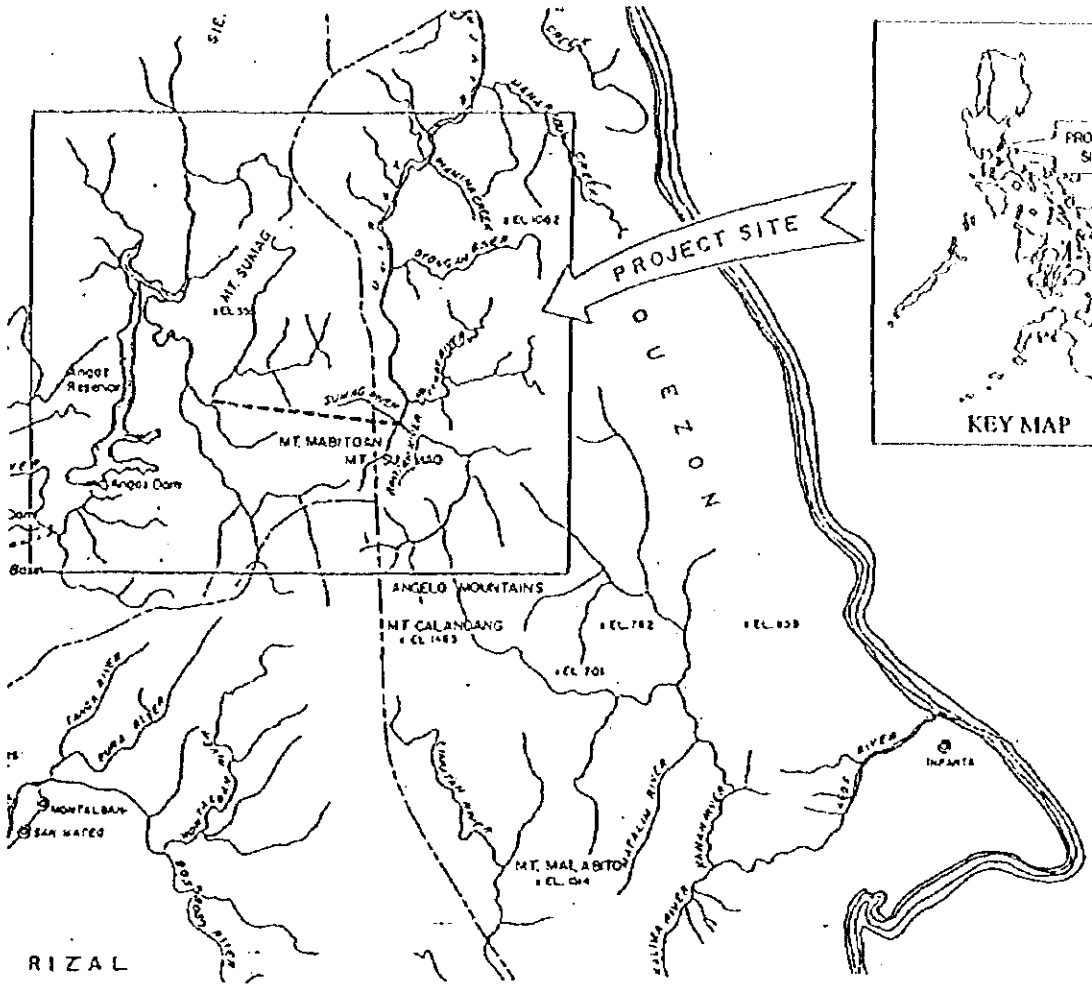
Weir: 3 places

Interbasin Tunnel: Free Flow, Circular

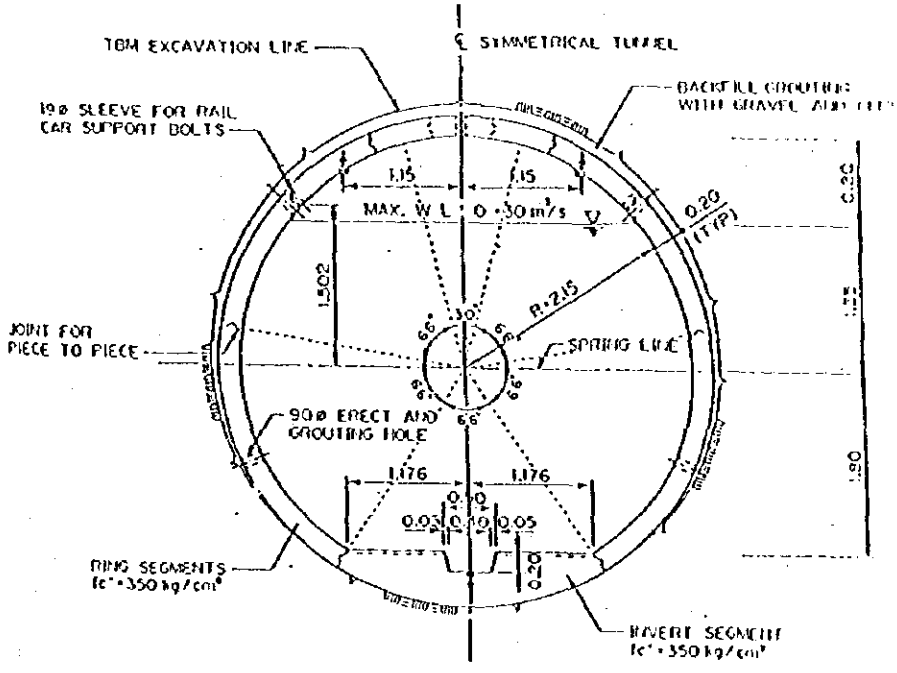
Dia	:	4.30 m
Length	:	13.1 km
Gradient	:	1.48 m/1 km

Mean Annual Diverted Discharge : about 12 m^3/s

Source: F/S Main Report by C. Lotti/ADB 1992.



PROJECT LOCATION MAP



TYPICAL TUNNELCROSS-SECTION

WRR III **River System:** Sumacbao **Province:** Nueva Ecija

BALINTINGON

Client: NIA
Purpose: Irrigation/Power

Consultant:
Status: F/S

Hydrological Information
Catchment Area: 228 km^2
Mean Annual run-off : 20.4 m^3/s Specific Run-off: 9.0 $m^3/s/100km^2$

Dam
Type: Earthfill Crest length : 490 m
Height : 128 m Volume : 8.4 x 10^6m^3

Reservoir
Surface Area at FSWL: 13.9 km^2

Storage Volume (10^6m^3)
Gross: 559
Active: 463
Dead: 96

Hydropower
Installed capa. : 40 MW
Plant Max. Q : 54 m^3/s

Energy (GWh)
Annual: 132
Firm: 17
2-nd: 115

Irrigation: 18,800 ha

WRR III **River System:** Pampanga **Province:** Bulacan

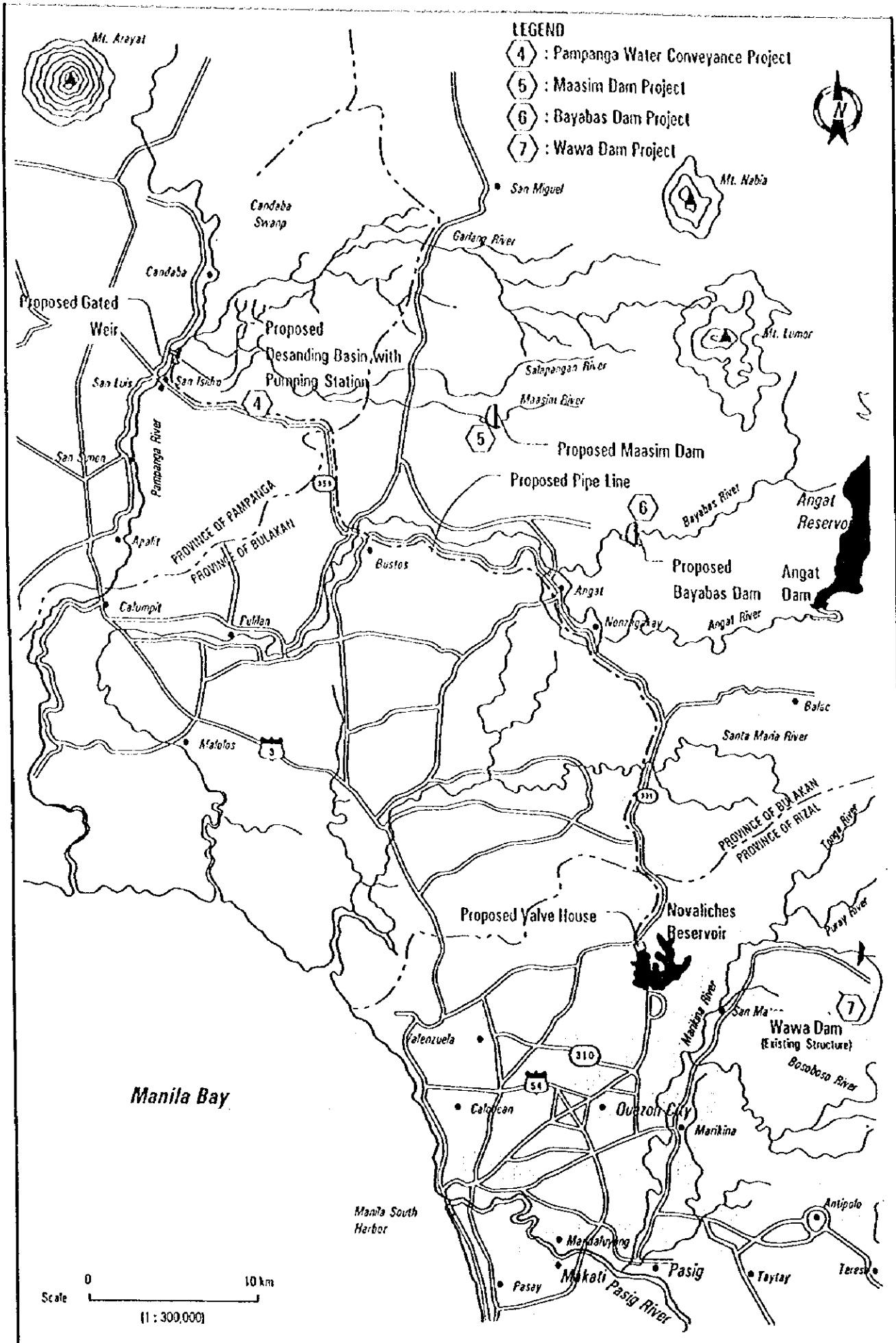
BAYABAS and MAASIM

Client: NIA/NWRB **Consultant:** ELC/Asiatic/World Bank

	Bayabas	Maasim
River	Bayabas	Maasim
Purpose	Irrigation	Irrigation
Status	Pre-F/S 1994	Pre-F/S 1994
Hydrological Information		
Catchment Area (km^2)	50	53.5
Mean Annual Run-off (m^3/s)	13.65	3.05
Specific run-off ($m^3/s/100\ km^2$)	27.3	5.70
Denudation rate (mm/yr)	3.0	3.0
Dam		
Type	Rockfill	Rockfill
Crest EL (EL.m)	197	87
Height (m)	107	52
Crest length (m)	620	1,400
Design Flood (m^3/s)	367	130
Reservoir		
Surcharge WL (WL. m)	190.66	81.63
Full Supply WL (WL.m)	187	80
Min. Ope. WL (WL. m)	120	55
Draw down (m)	67	25
Storage Volume ($10^6 m^3$)		
F/C Space	48	10
Active	148	100
Surface Area at FSWL (km^2)	4.8	9.0

Source: Water Resources Development Project, Draft Final Report
General Summary,
Task 5: Pre-F/S Main Report
Task 5: Pre-F/S Annexes

By ELC and Asiatic/The World Bank 1994



LOCATION MAP OF WATER SUPPLY FOR METRO MANILA (3/3)

WRR III **River System:**Agos/Kaliwa **Province:**

LAIBAN

Client: MWSS **Consultant:** Electrowatt

Purpose: Water Supply **Status:**

Hydrological Information

Catchment Area : 276 km^2

Mean Annual run-off : 25.2 m^3/s Specific Run-off: 9.1 $m^3/s/100km^2$

Dam

Geological Condition: Shale/Limestone

Type: Rockfill Crest EL : EL 281 m

Height: 141 m Crest length : 588 m

Design Flood: m^3/s Volume : 9.7 x 10^6m^3

Reservoir

Surcharge WL: WL 278 m

Full Supply WL: WL 270 m

Min. Ope. WL: WL 235 m

Draw down: 35 m

Surface Area at FSWL: 20 km^2

Storage Volume (10^6m^3)

Active: 472

Construction Cost: US$ 1,104 x 10^6

Source: Summary Report by Electrowatt, 1979
Summary Engineering Report by Electrowatt, 1984

WRR IV **River System : Agos, Kanan** **Provunce : Quezon**

KANAN DAM

Client: NPC **Consultant:** NipponKoei/JICA

Purpose: (originally Power) Water Supply to Manila

Status: Master Plan in 1987

Hydrological Information

Catchment Area	286 km^2	Annual Basin Rainfall	5,798 mm
Mean Annual Run-off	48.1 m^3/s	Specific Run-off	16.8 $m^3/s/100km^2$
Denudation rate	1.4 mm/yr		

Dam

Geological Condition:	PG_2 (Andesite)		
Type :	Concrete Gravity	Crest EL:	EL 317.7 m
Height :	157.7 m	Crest Length:	430 m
Design Flood :	5,733 m^3/s	Volume:	2.0 x 10^6m^3

Reservoir

		Storage Volume (10^6m^3)	
Flood WL :	WL 317.2 m		
Full Supply WL:	WL 316 m	Gross:	1,526
Min. Ope. WL:	WL 267.3m	Active:	1,137
Draw down :	48.7 m	Dead :	389

Source: Report for HPPS App. B & C by Nippon Koei/JICA 1987

WRR IV **River System:Pasig** **Province: Laguna**

CALIRAYA (KARAYAAN)

Client: NPC **Consultant:**

Purpose: Power **Status:** Existing (1947; 1982)

Hydrological Information

Catchment Area:	129 km^2	Annual Basin Rainfall:	3,000 mm

Dam

Type:	Earthfill	Crest EL	: EL 292 m
Height :	42 m	Crest length	: 500 m

Reservoir

		Storage Volume ($10^6 m^3$)	
Full Supply WL:	WL 288 m	Gross:	86
Min. Ope. WL:	WL 276 m	Active:	78
Draw down:	12 m	Dead:	8

Hydropower

Type	:	Pumped
Installed capa.	:	300 + 32 MW
Plant Max. Q	:	120 m^3/s
Rated Net Head:		290 m
Tail WL	:	WL -1.5 m

Source: NPC's list.

WRR IV **River System:** Amnay-Patric **Province:** Occidental Mindro

AMNAY

Client: **Consultant:**

Purpose: Power, Irrigation, Flood Control **Status:** Map Study on 1/250,000

Hydrological Information

Catchment Area:	145 km^2	Annual Basin Rainfall:	2,300 mm
Mean Annual run-off:	7.4 m^3/s	Specific Run-off:	5.10 $m^3/s/100km^2$
Denudation rate:	3.0 mm/yr		

Dam

Geological Condition:	BC		
Type:	Rockfill	Crest EL :	EL 207 m
Height :	97 m	Crest length :	1,400 m
		Volume :	14.0 x 10^6m^3

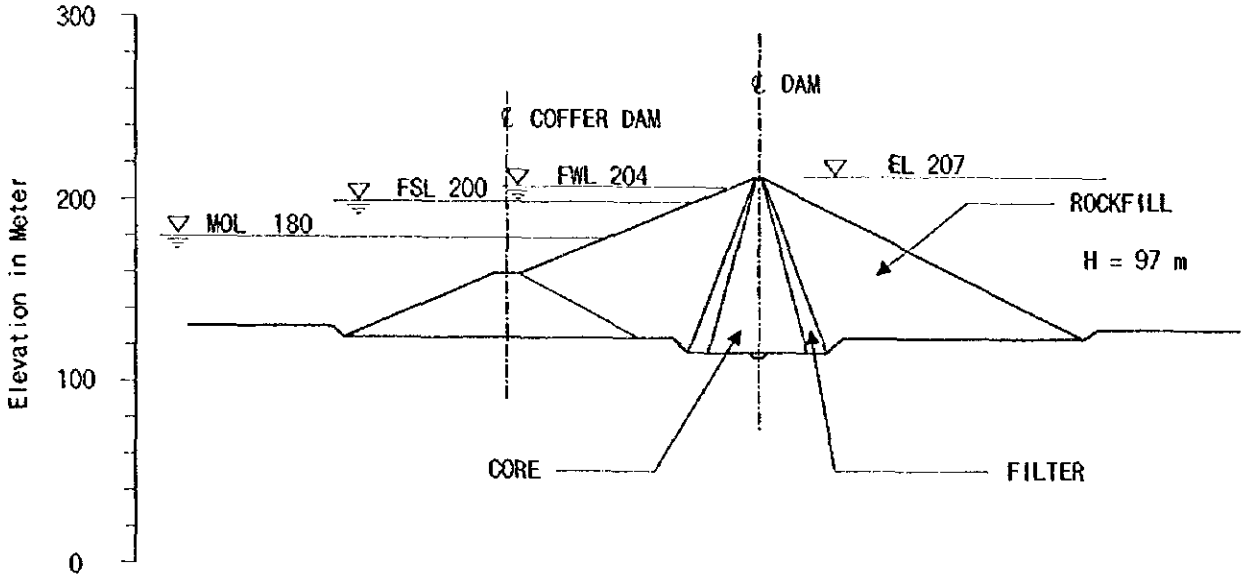
Reservoir

		Storage Volume (10^6m^3)	
Surcharge WL:	WL 204 m	F/C Space:	20
Full Supply WL:	WL 200 m	Gross:	155
Min. Ope. WL:	WL 180 m	Active:	80
Draw down:	20 m	Dead:	75
Surface Area at FSWL:	3.8 km^2		
Firm Q :	4.2 m^3/s		

Hydropower

Type :	Conventional	Energy (GWh)	
Installed Capa. :	15 MW	Annual:	
Plant Max. Q :	21 m^3/s	Firm:	26
Rated Net Head:	88 m	2-nd	
Tail WL :	WL 98 m		

Construction Cost: US$ 445 x 10^6



TYPICAL CROSS SECTION OF AMNAY DAM

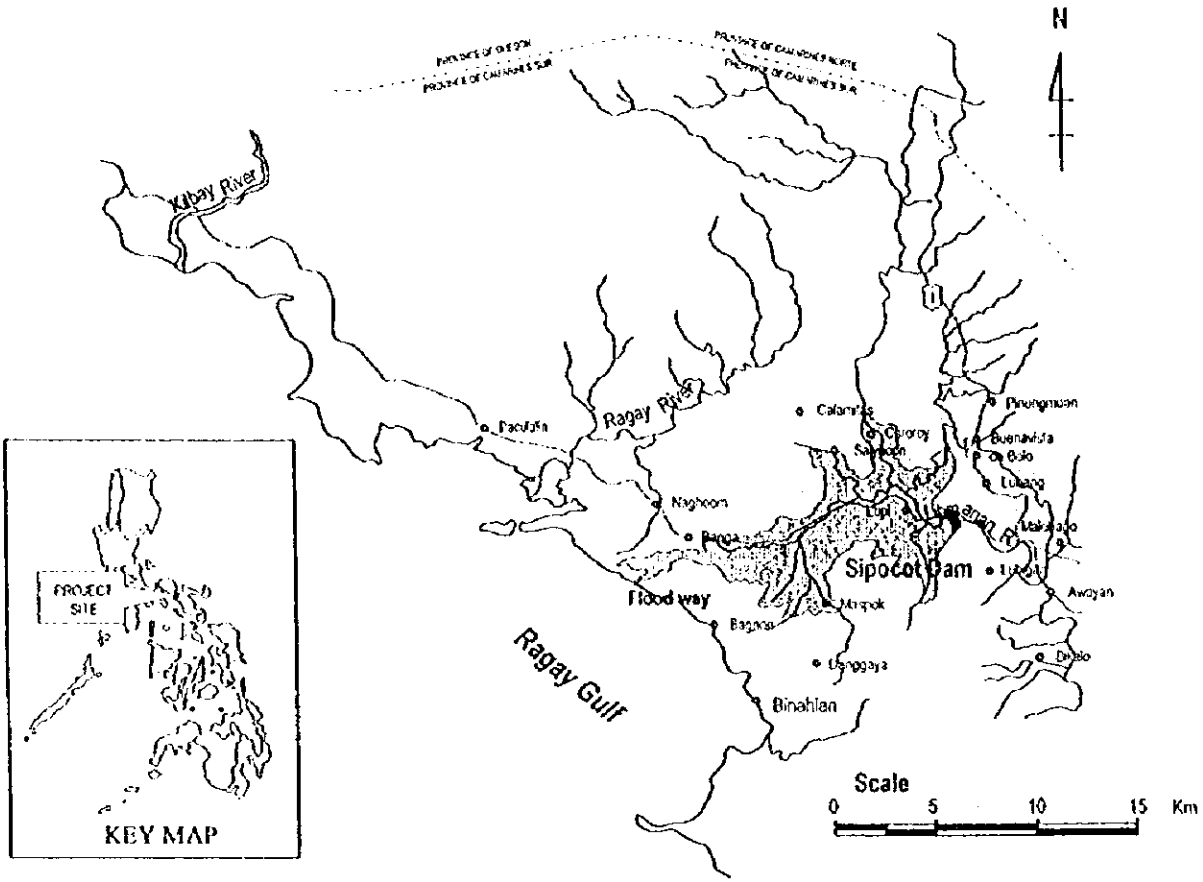
Talisay and Sipocot Dams

Bicol River Basin, whose drainage area is 3,771 km^2, is characterized by vast paddy fields of 86,000 ha and habitual inundation over 40,000 ha. At the eastern corner of the basin, the active Mayon Volcano rises. Near the Legazpi City, which is developed on the foot of the Mayon Volcano outside the Bicol basin, Tiwi geothermal power plant with installed capacity of 330 MW is now under operation. Within the Bicol basin there are three big lakes, Lake Buhi (NWL 90^m), Lake Bato (NWL 5^m) and Lake Baao (NWL 3^m). At the outlet of the Lake Buhi, Barit hydropower plant with installed capacity of 1.8 MW has been operated since 1957. These lakes function as flood control and irrigation water sources, however, the basin has habitually suffered from floods and droughts. TAMS carried out the comprehensive water resources development study for the Bicol River Basin as a pre-feasibility level financed by USAID in 1976. Referring to the Report, JICA Study Team formulated the following two dam schemes in the basin aimed at flood control, including the flood way to the Bagay Gulf, and irrigation water supply on the 1/50,000 topo map and 1/1,000,000 geological map level study. Geological conditions of dam foundation and reservoir area should be thoroughly investigated in the further stage. Hydropower schemes attached to the two dams were formulated only on a preliminary basis.

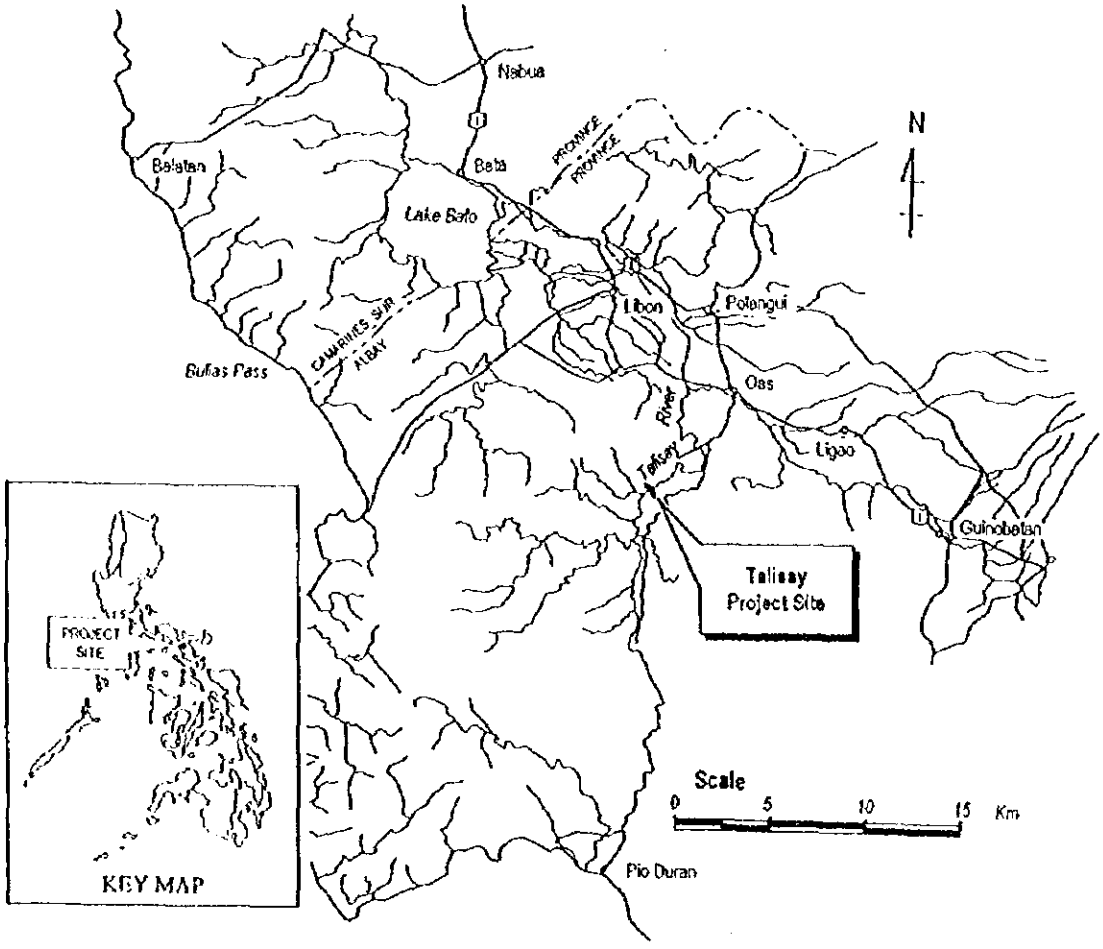
	Sipocot	Talisay
Province	Camarines Sur	Albay
Purpose	Multi-	ditto
Status	Map Study	ditto
Hydrological Information		
Catchment area (km^2)	447	100
Annual basin rainfall (mm)	2,700	2,200
Mean Annual run-off (m^3/s)	23.0	3.5
Specific run-off ($m^3/s/100km^2$)	5.13	3.5
Denudation rate (mm/yr)	3.0	3.0
Dam		
Geological condition	N_3+Q_1	N_2
Type	Rockfill	Rockfill
Crest EL (EL.m)	64	95
Height (m)	64	58
Crest Length (m)	600	400
Volume (10^6m^3)	2.3	1.2
Design Flood (m^3/s)	4,000	1,800

Reservoir		Sipocot	Talisay
Surcharge WL (WL.m)		60	90
Full Supply WL(WL.m)		57	85
Min. Ope. WL (WL.m)		35	70
Drawdown (m)		22	15
Storage Volume ($10^6 m^3$)			
F/C Spare		150	125
Gross		1,270	315
Active		870	231
Dead		400	84
Surface Area at FSWL (km^2)		52	25
Flood Way		Short cut only To Ragay Gulf $Q = 4{,}000\ m^3/s$	possible to Ragay Gulf through two add'l dams.
Hydropower			
Type	:	Conventional	ditto
Installed Capa.	(MW) :	30	4.4
Firm Q	(m^3/s) :	18.0	3.0
Plant Max Q	(m^3/s) :	94.0	15.0
Rated Net Head	(m) :	39	36
Tail WL	(WL m) :	5	40
Energy			
Annual Firm	(GWh) :	55	8
Irrigation	(ha) :	18,000	3,000
Construction Cost	(US$ 10^6)	133	56

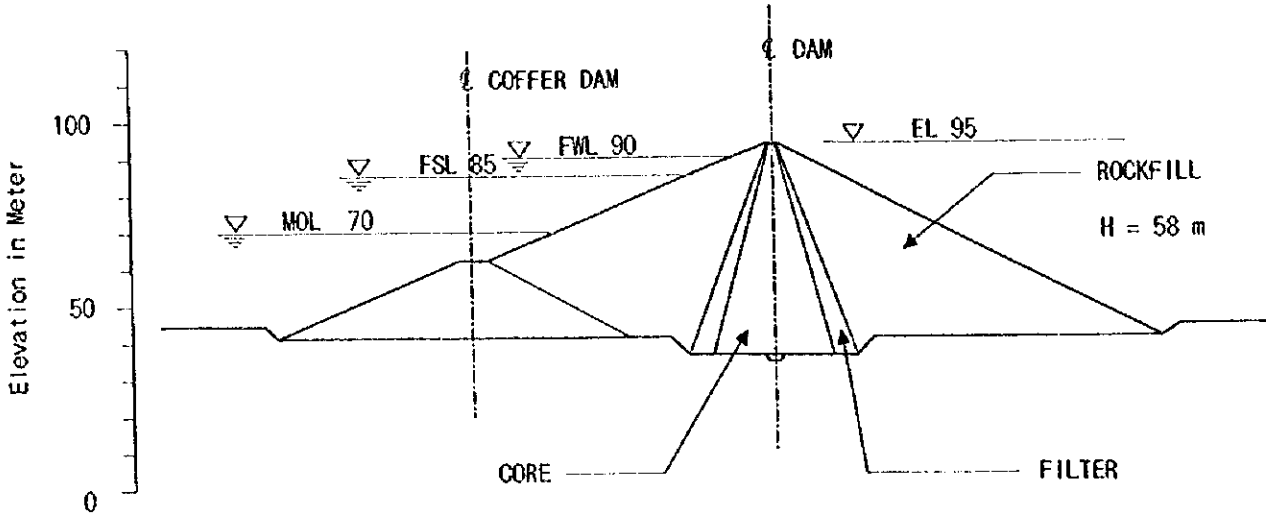
Reference: Bicol River Basin, Comprehensive Water Resources Development Study Volume I Summary by TAMS/USAID in 1976



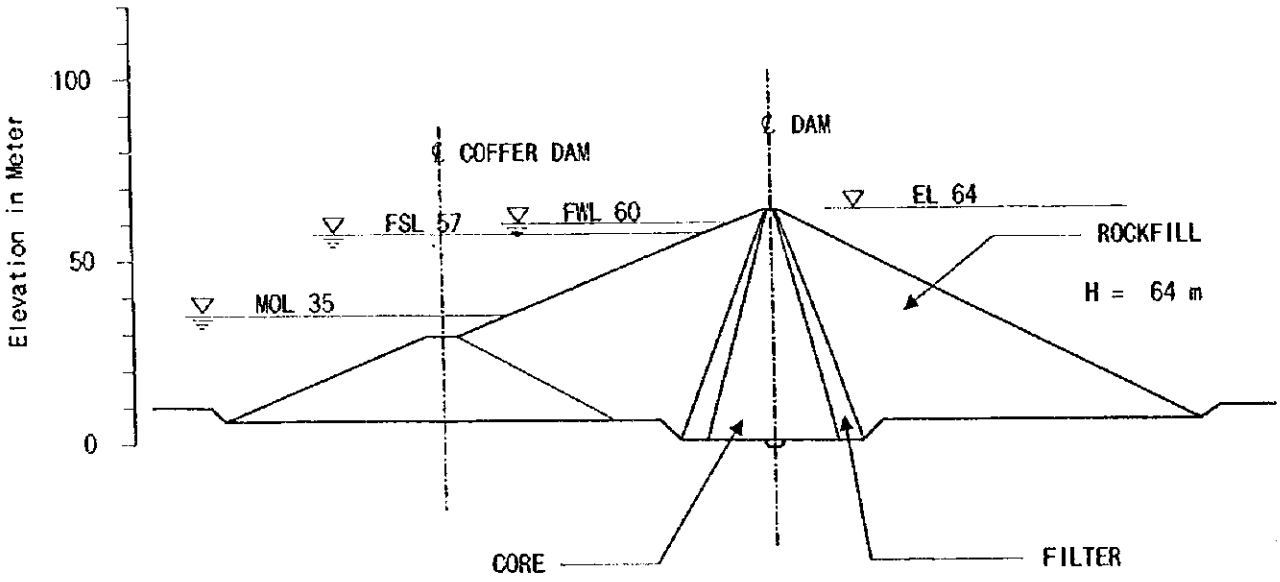
PROJECT LOCATION MAP



PROJECT LOCATION MAP



TYPICAL CROSS SECTION OF TALISAY DAM



TYPICAL CROSS SECTION OF SIPOCOT DAM

WRR VI **River System: Panay** **Province: Capiz**

PANAY

Client: MPWH

Consultant: Nippon Koei/JICA

Purpose: Power

Status: Basin-Wide Study 1985

Hydrological Information

Catchment Area: 239 km^2
Mean Annual run-off : 14.3 m^3/s
Denudation rate: 1.4 mm/yr

Annual Basin Rainfall: 3,200 mm
Specific Run-off: 5.98 $m^3/s/100km^2$

Dam

Geological Condition: Volcanic breccia
Type: Conc. Gravity
Height: 52.4 m

Crest EL : EL 77.4 m
Crest length : 160 m

Reservoir

Surcharge WL: WL 74.9 m
Full Supply WL: WL 65.0 m
Min. Ope. WL: WL 56.7 m
Draw down: 8.3 m

Storage Volume ($10^6 m^3$)

Gross: 96
Active: 30.5

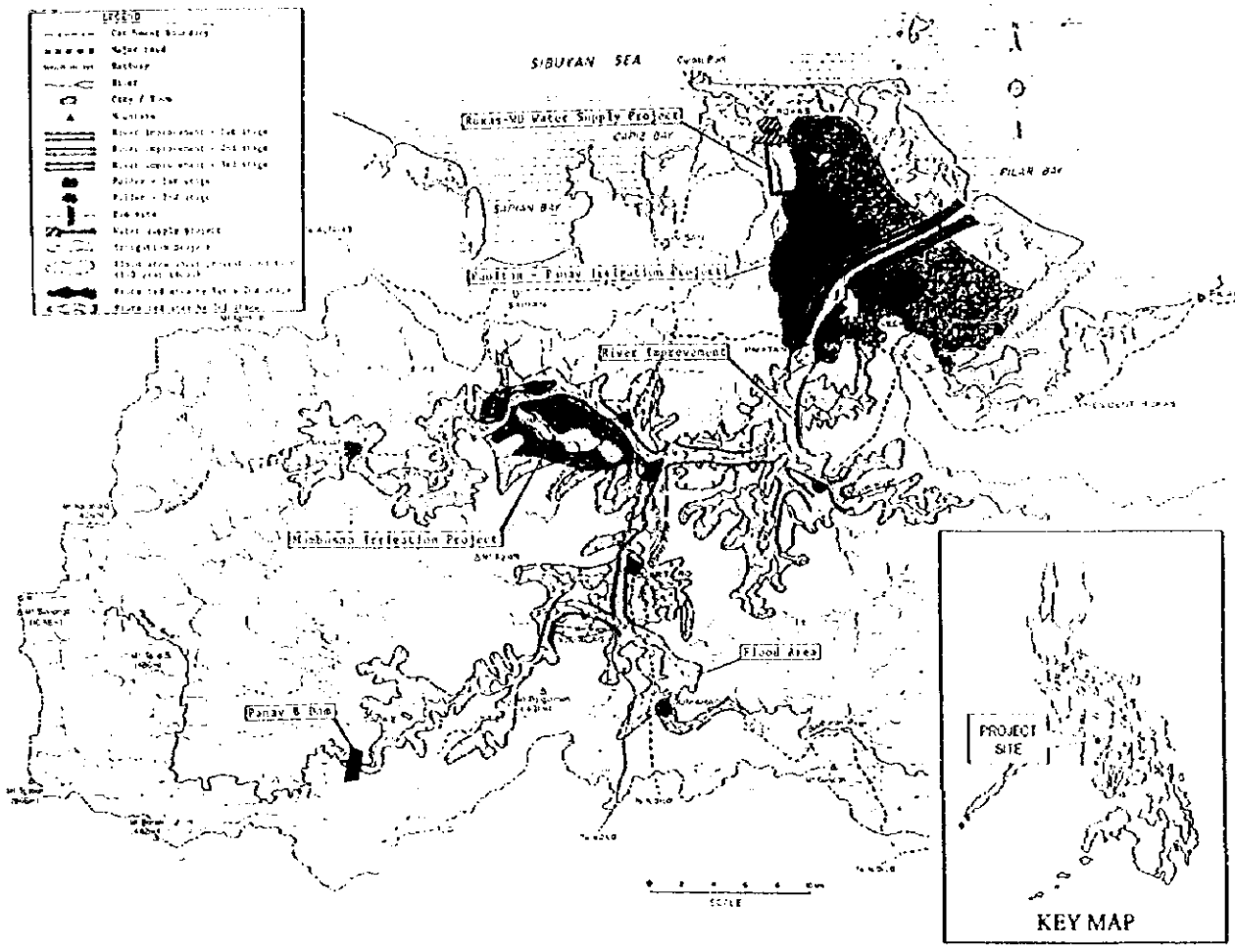
Hydropower

Type : Conventional
Installed capa. : 7.1 MW
Plant Max. Q : 27.2 m^3/s
Rated Net Head: 31.7m
Tail WL : WL 30 m

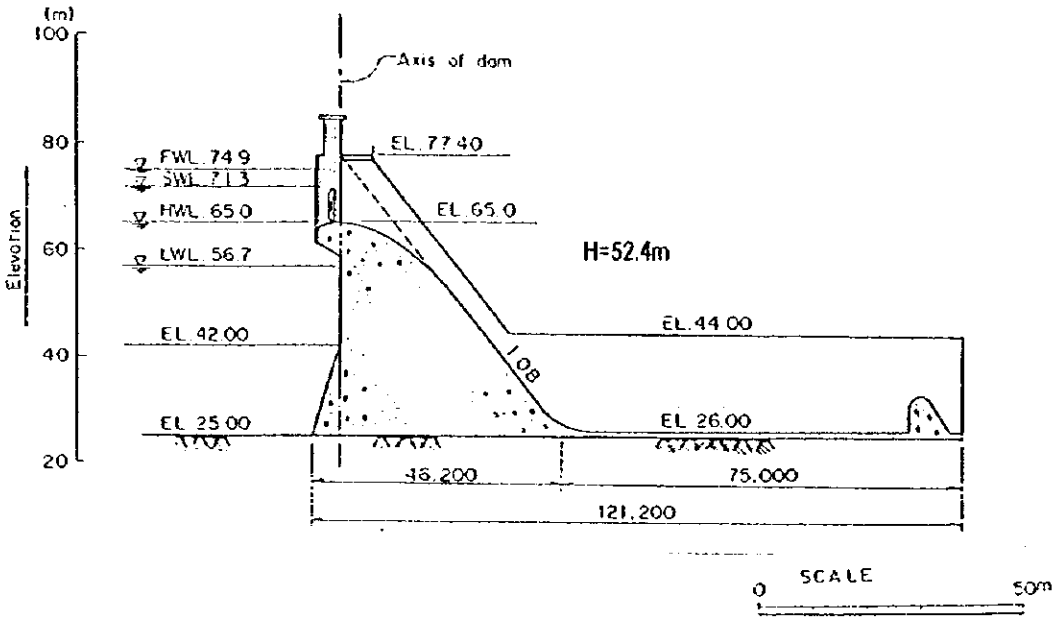
Energy (GWh)
Annual: 31.4

Construction Cost: US$ 40 x 10^6

Source: The Panay River Basin-Wide Flood Control Study, Main Report by Nippon Koei/JICA 1985.



PROJECT LOCATION MAP



TYPICAL CROSS-SECTION

WRR VI **River System : Jalaur** **Province: Iloilo**

JALAUR

Client: NPC **Consultant:** *ELC/NK*

Purpose: Power **Status:** D/D

Hydrological Information

Catchment Area : 109 km^2

Mean Annual run-off : 7.64 m^3/s Specific Run-off: 7.01 $m^3/s/100km^2$

Dam

Type: Conc. Arch Crest EL : EL 228 m

Height: 145 m Crest length : 405 m

Design Flood: 1,570 m^3/s

Reservoir Storage Volume ($10^6 m^3$)

Full Supply WL: WL 221 m

Min. Ope. WL: WL 158.7m Active: 337

Draw down: 62.3 m

Hydropower

Type : Conventional Energy (GWh)

Installed capa. : 20 MW Annual : 58

Plant Max. Q : 21.6 m^3/s

Rated Net Head: 105 m

Source: NPC's information

WRR VI **River System: Bago** **Province: Negros Occidental**

BAGO

Client: NPC **Consultant:** Shawinigan/ADB

Purpose: Power **Status:** F/S 1982

Hydrological Information

Catchment Area: 402 km^2

Mean Annual run-off: 25.1 m^3/s Specific Run-off: 6.24 $m^3/s/100km^2$

Dam

Type:	Rockfill	Crest EL	: EL 305 m
Height :	125 m	Crest length	: 605 m
		Volume	: 5.3 x $10^6 m^3$

Reservoir

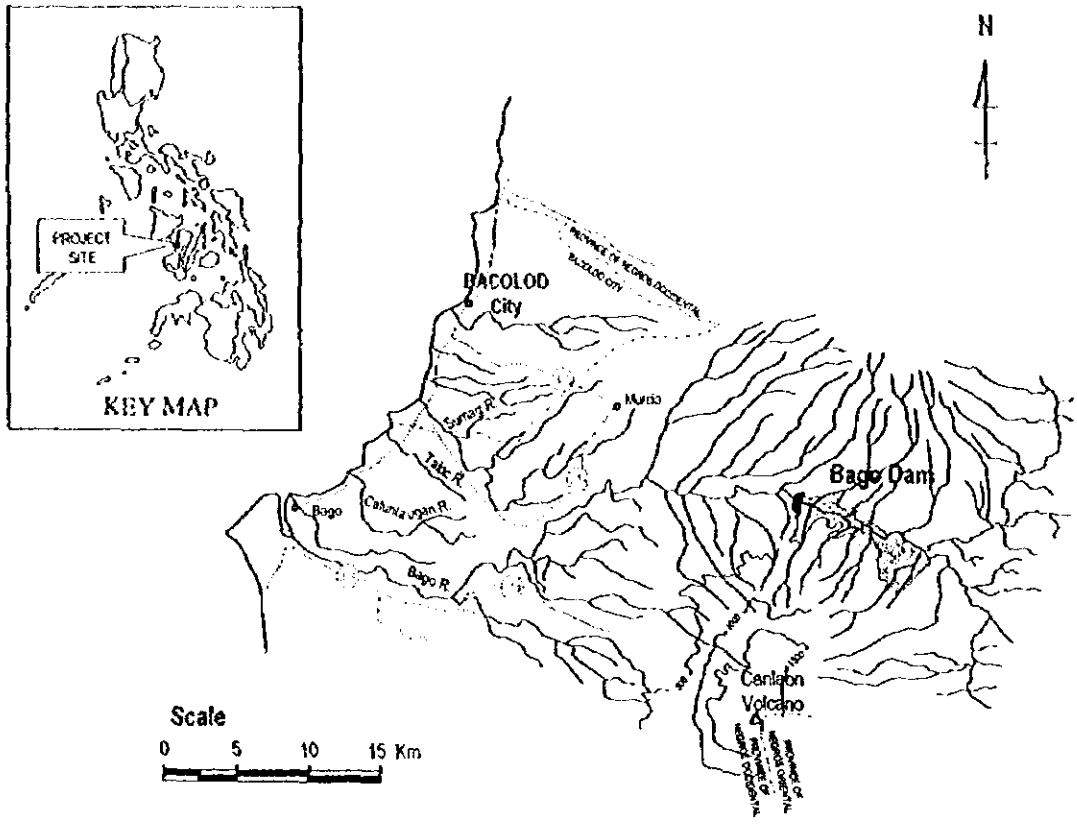
		Storage Volume ($10^6 m^3$)	
Full Supply WL:	WL 300 m	Gross:	164
Min. Ope. WL:	WL 255 m	Active:	64
Draw down:	45 m	Dead:	100

Hydropower

Type	: Conventional	Energy (GWh)	
Installed capa.	: 183 MW	Annual:	497

Construction Cost: US$ 267 x 10^6

Source: F/S Main Report by Shawinigan, 1982



PROJECT LOCATION MAP

WRR VI **River System : Ilog-Hilabangan** **Province:** Negros Occidental

ILOG NO. 1

Client: DPWH **Consultant:** /JICA

Purpose: Flood Control **Status:** Interim

Hydrological Information

Catchment Area : 1,389 km^2 Annual Basin Rainfall: 2,000 mm

Mean Annual run-off : 39.6 m^3/s Specific Run-off: 2.85 $m^3/s/100km^2$

Denudation rate: 1.5 mm/yr

Dam

Geological Condition: N3 + Q1

Type: Rockfill Crest EL : EL 83 m

Height: 81 m Crest length : 750 m

Design Flood: 6,400 m^3/s Volume : 5.0 x $10^6 m^3$

Reservoir

Surcharge WL: WL 80 m

Full Supply WL: WL 75 m

Min. Ope. WL: WL 55 m

Draw down: 20 m

Surface Area at FSWL: 25 km^2

Storage Volume ($10^6 m^3$)

F/C Space: 110

Gross: 650

Active: 370

Dead: 280

Hydropower

Type : Conventional

Installed capa. : 52 MW

Firm Q : 24 m^3/s

Plant Max. Q : 120 m^3/s

Rated Net Head: 53 m

Tail WL : WL 10 m

Energy (GWh)

Annual :

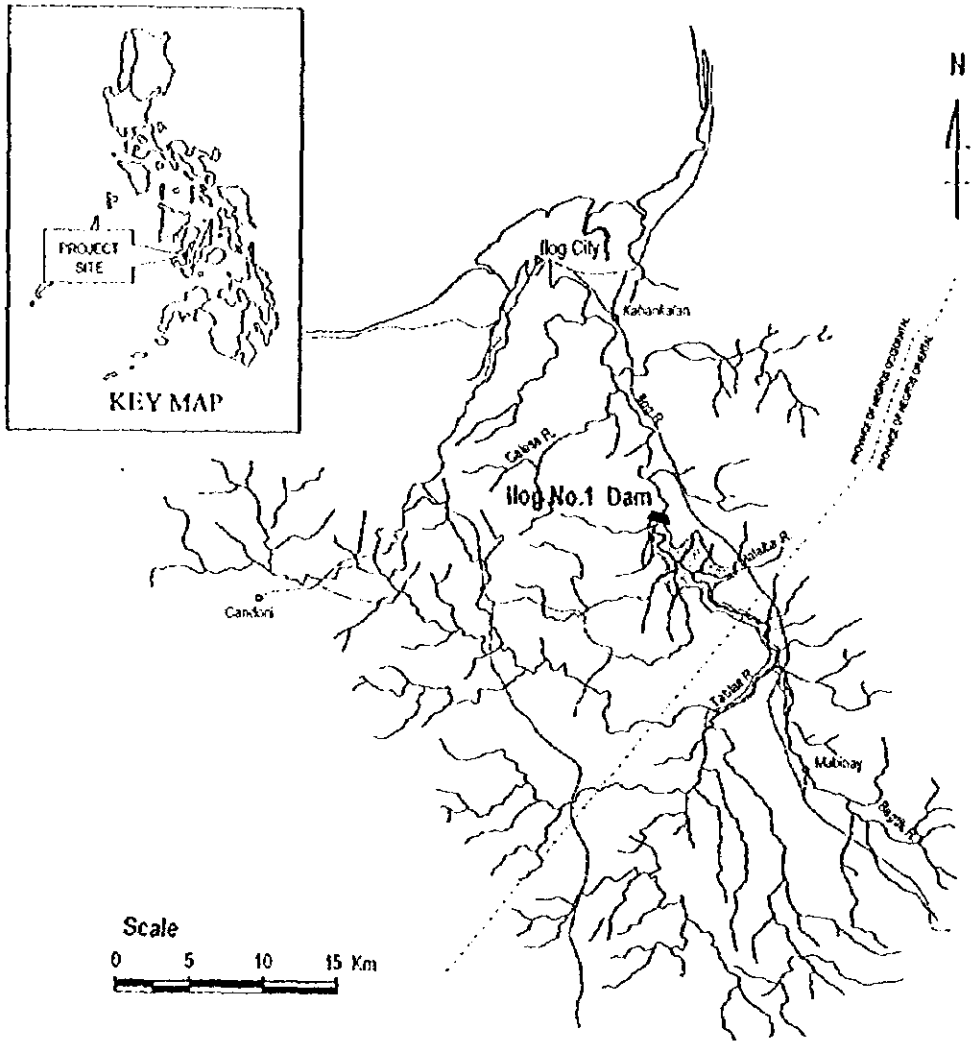
Firm : 95

2-nd :

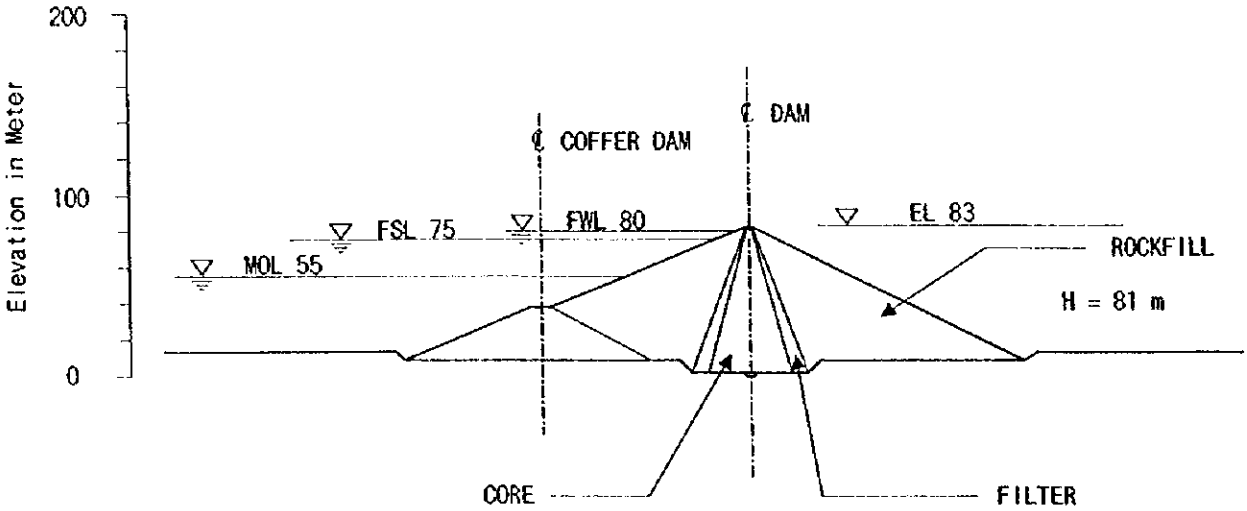
Irrigation: 24,000 ha

Construction Cost: US$ 237 x 10^6

Source: Interim Report on Ilog-Hilabangan F/C Project JICA, 1991



PROJECT LOCATION MAP



TYPICAL CROSS SECTION OF ILOG NO.1 DAM

WRR VII **River System:** **Province: Cebu City**

BUHISAN DAM

Client: MCWD **Consultant:**

Purpose: Water Supply **Status:** Existing (1910)

Hydrological Information

Catchment Area:	5.9 km^2	Annual Basin Rainfall:	2,000 mm
Mean Annual run-off:	0.15 m^3/s	Specific Run-off:	2.54 $m^3/s/100km^2$
Denudation rate:	3.0 mm/yr		

Dam

Geological Condition: Malubog Formation

Type:	Conc. Double Arch	Crest EL	: EL 98 m
Height :	26 m		

Reservoir

Surface Area at FSWL: 0.09 km^2

Storage Volume ($10^6 m^3$)

Active: 0.26

Water Supply: 3,000 ~ 4,000 m^3/day

Source: MCWD's information.

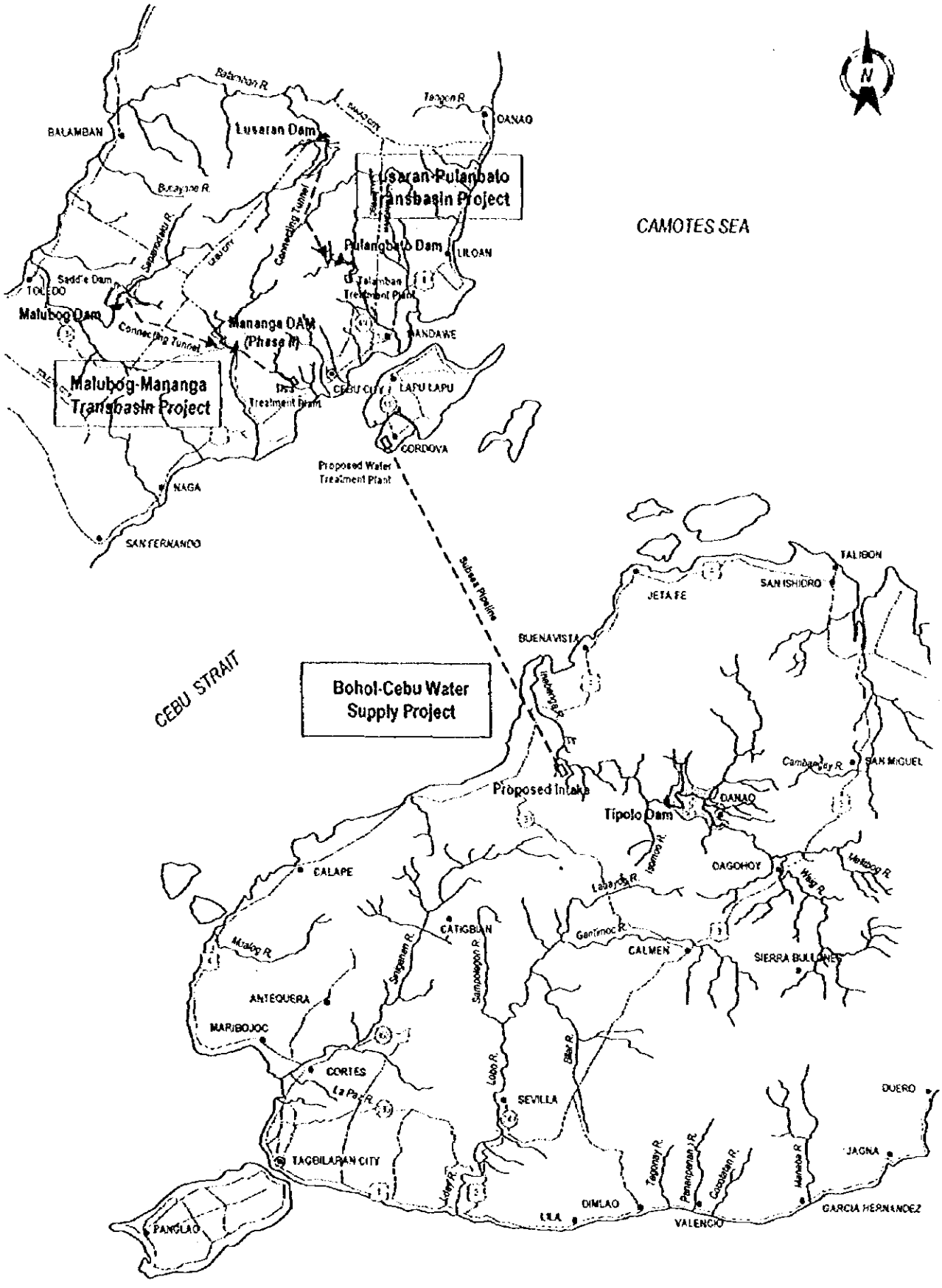
WRR VII River System: Province: Cebu

MALUBOG and MANANGA II

	Malubog	Mananga II
Client:		MCWD
Consultant:		Electrowatt
Purpose:	Water Supply	Water Supply
Status:	Map Study	F/S
Hydrological Information		
Catchment Area (km^2)	70	68
Annual Basin Rainfall (mm)		1,772
Mean Annual Run-off (m^3/s)	1.43	1.39
Specific Run-off ($m^3/s/100\ km^2$)	2.04	2.04
Denudation rate (mm/yr)	3.0	3.7
Dam		
Geological Condition	Basalt/Limestone	Pyroclastics
Type	Combine	Conc. Gravity
Crest EL (EL.m)	185	160
Height (m)	65	90
Crest length (m)	520	240
Volume ($10^6 m^3$)		0.50
Reservoir		
Surcharge WL (WL.m)		161.5
Full supply WL (WL.m)	180	153.5
Min. Ope. WL (WL.m)	162	110.0
Draw down (m)	18	43.5
Storage Volume ($10^6 m^3$)		
Gross	81	48.2
Active	47	40.8
Dead	21	7.4
Surface Area at FSWL (km^2)	3.1	1.5
Water Supply (m^3/s)	1.39	1.43

Source: CEBU Water Supply Final Report by Electrowatt/ADB, 1991

Remark:
Malubog dam scheme is to heighten the existing Malubog dam (H=32m, concrete gravity) owned by the Atlas Consolidated Mining and Development Corporation.



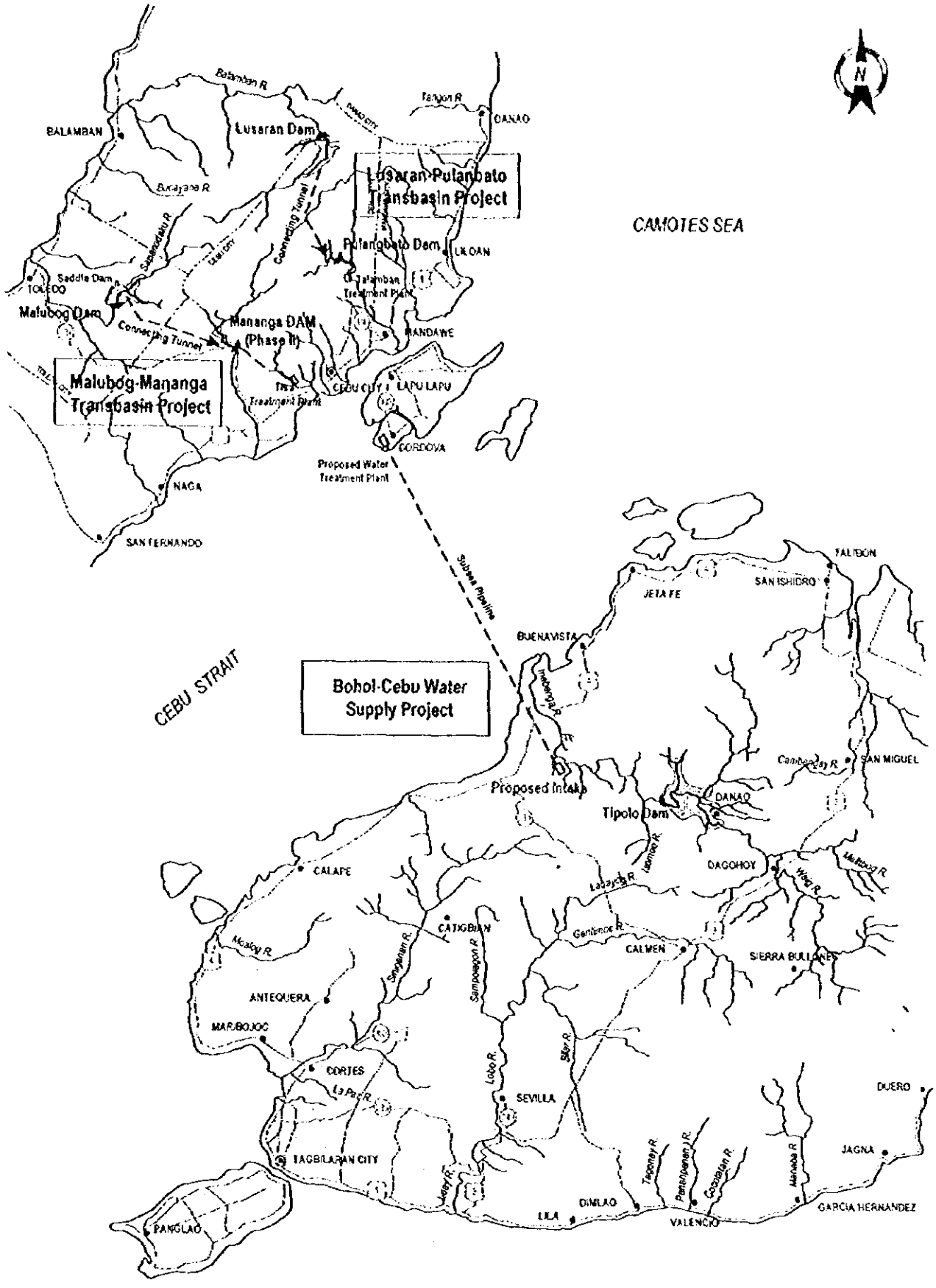
LOCATION MAP OF WATER SUPPLY PLAN FOR METORO CEBU

WRR VII **River System:** **Province:** Cebu City

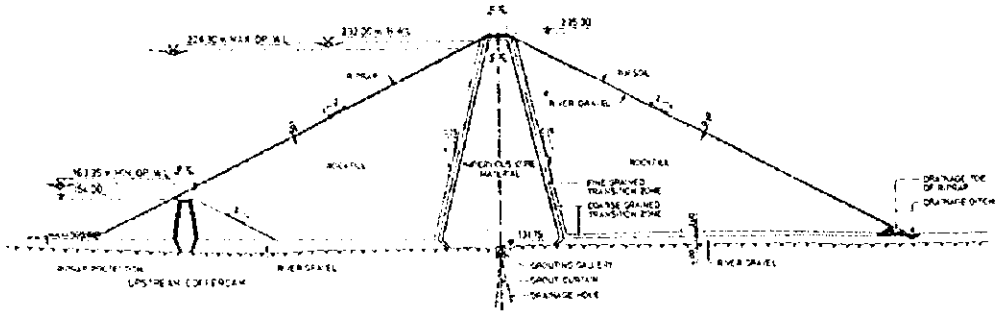
LUSARAN and PULAMBATO (Cebu F_0)

	Lusaran	Cebu F_0
Client:	MCWD	MCWD
Consultant:	Camp Dresser	
Purpose:	Water Supply	Water Supply
Status:	F/S	Map Study
Hydrological Information		
Catchment Area (km^2)	67	21
Annual Basin Rainfall (mm)	1,400	
Mean Annual Run-off (m^3/s)	2.05	0.42
Specific Run-off ($m^3/s/100\ km^2$)	3.06	2.00
Denudation rate (mm/yr)		3.0
Dam		
Geological Condition	Basalt	Diorite
Type	Rockfill	Conc. Gravity
Crest EL (EL.m)	235	100
Height (m)	100	55
Crest length (m)	315	300
Volume ($10^6 m^3$)	3.15	
Design Flood (m^3/s)	1,360	
Reservoir		
Surcharge WL (WL.m)	232	98
Full supply WL (WL.m)	228.3	95
Min. Ope. WL (WL.m)	163.3	85
Draw down (m)	65	10
Storage Volume ($10^6 m^3$)		
F/C space		0.9
Gross	126	5.6
Active	116	2.4
Dead	10	3.2
Surface Area at FSWL (km^2)		0.3
Water Supply (m^3/s)	2.0	0.42

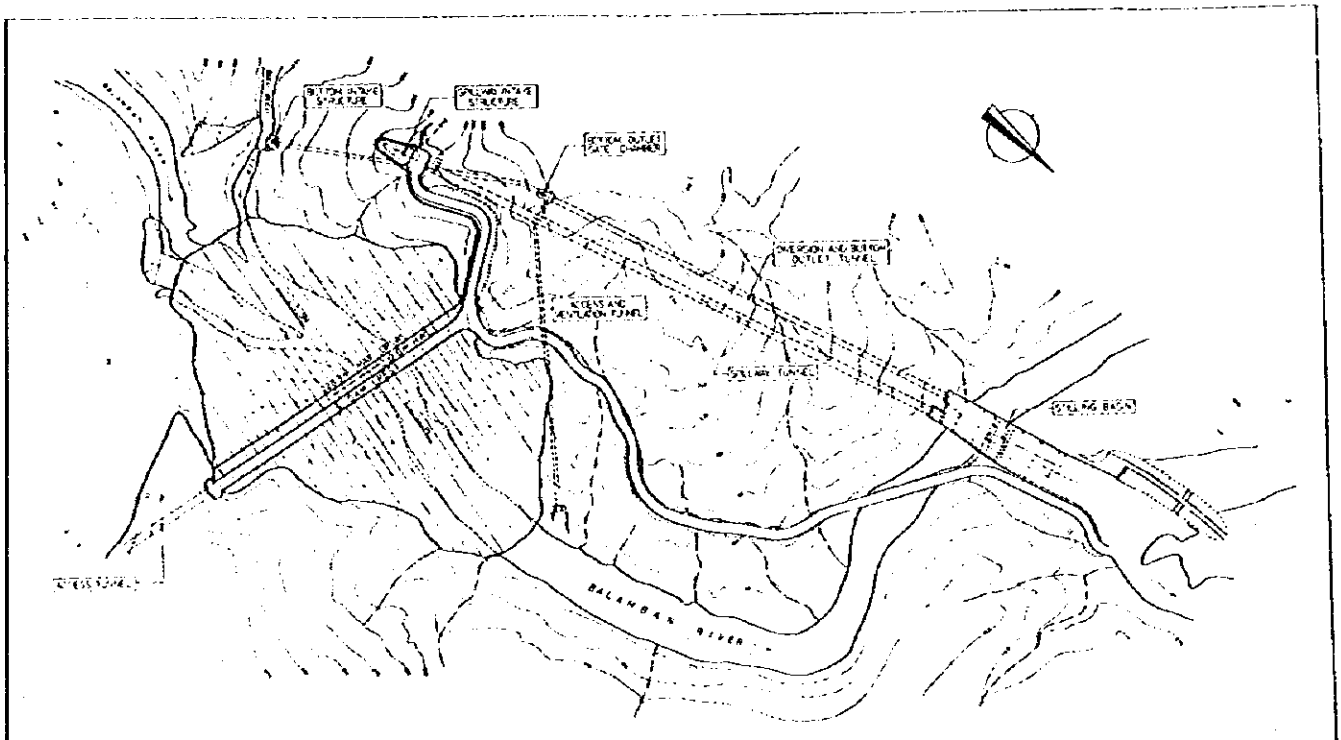
Source: Cebu Integrated Master Plan, Final Report, JICA, 1994



LOCATION MAP OF WATER SUPPLY PLAN FOR METORO CEBU



TYPICAL CROSS SECTION



LUSARAN DAM

WRR VII **River System:** Inabanga **Province:** Bohol

TIPOLO DAM

Client: **Consultant:**

Purpose: Water Supply for Cebu **Status:** Map Study

Hydrological Information

Catchment Area : 500 km^2 Annual Basin Rainfall: 1,400 *mm*

Mean Annual run-off : 8.88 m^3/s Specific Run-off: 1.8 $m^3/s/100km^2$

Dam

Geological Condition: N_2

Type: Rockfill Crest EL : EL 82 m

Height: 62 m Crest length : 160 m

Design Flood: m^3/s Volume : 1.0 x $10^6 m^3$

Reservoir

Full Supply WL: WL 75 m

Min. Ope. WL: WL 65 m

Draw down: 10 m

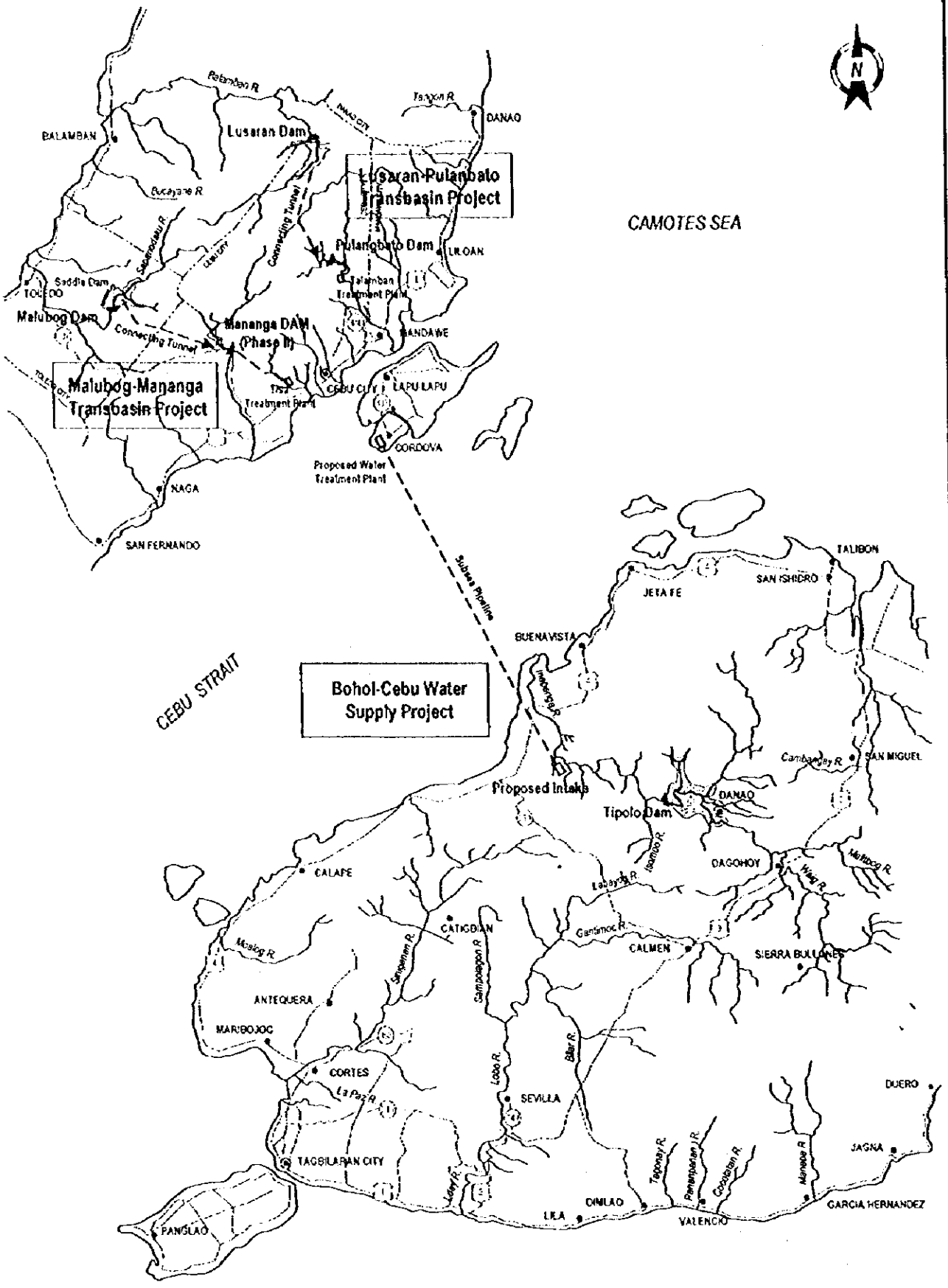
Storage Volume ($10^6 m^3$)

Gross: 210

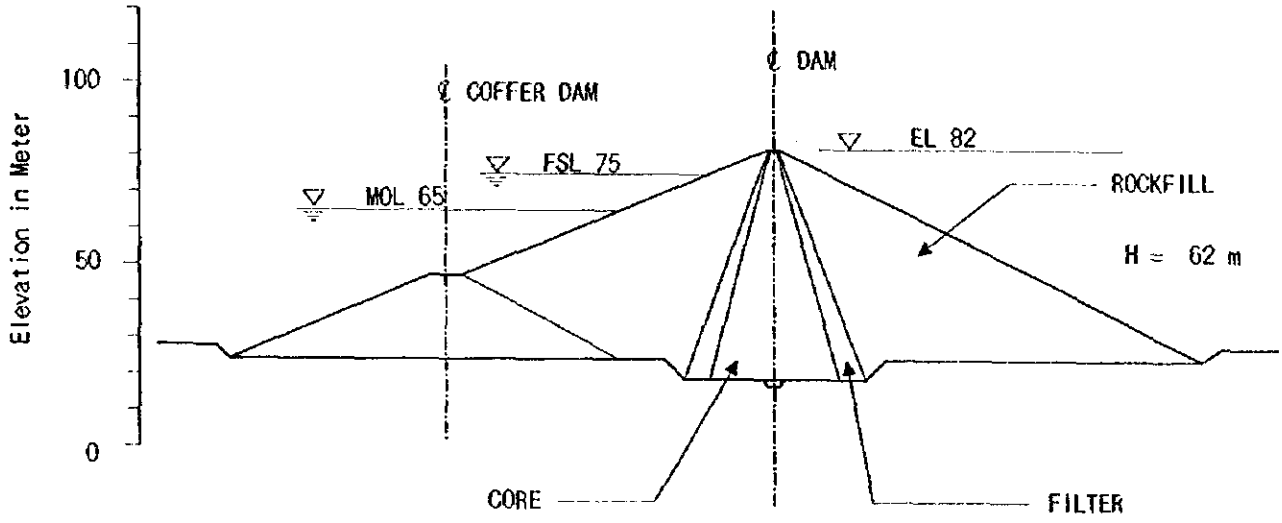
Active: 120

Dead: 90

Firm Discharge : about 4.0 m^3/s



LOCATION MAP OF WATER SUPPLY PLAN FOR METORO CEBU



TYPICAL CROSS SECTION OF TIPOLO DAM

WRR IX **River System: Tumaga** **Province: Zamboanga**

PASONACA

Client: **Consultant:**

Purpose: Water Supply **Status:** Map Study

Hydrological Information

Catchment Area: 101 km^2 Annual Basin Rainfall : 1,200 mm

Mean Annual run-off: 3.1 m^3/s Specific Run-off: 3.0 $m^3/s/100km^2$

Dam

Geological Condition : N_2

Type : Rockfill

Height : 86 m

Crest EL : EL 116 m

Crest length : 650 m

Volume : 5.0 x $10^6 m^3$

Reservoir

Full Supply WL: WL 109 m

Min. Ope. WL: WL 95 m

Draw down: 14 m

Surface Area at FSWL: 1.3 km^2

Storage Volume ($10^6 m^3$)

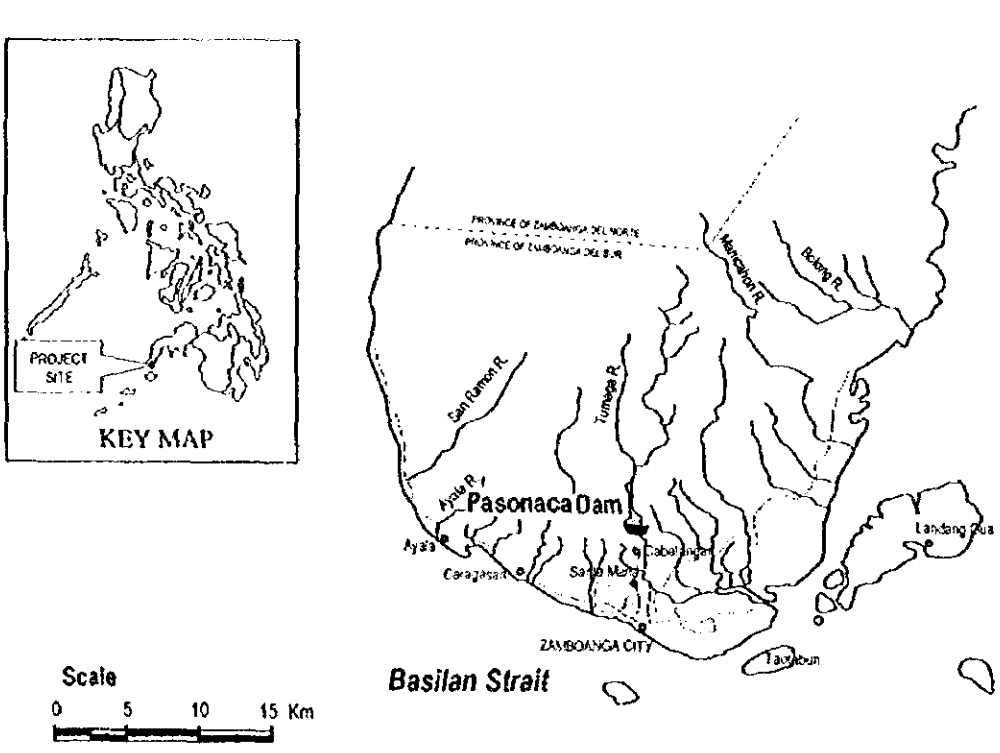
Gross: 44.0

Active: 13.7

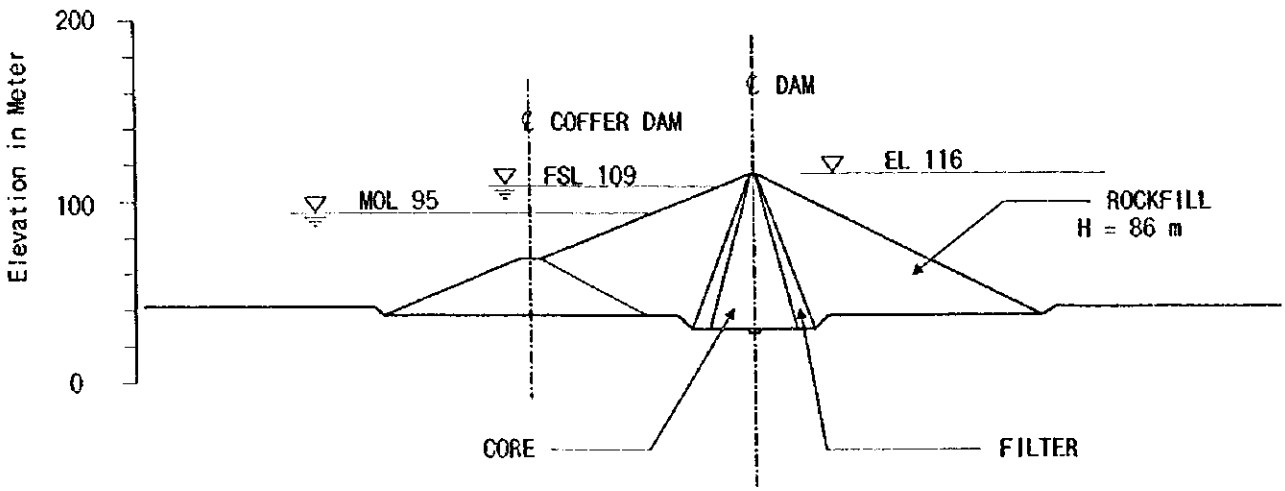
Dead: 30.3

Construction Cost: US$ 170 x 10^6

Source: Survey/Inventory on Water Impounding Reservoirs, NWRC, 1978



PROJECT LOCATION MAP



TYPICAL CROSS SECTION PASONACA DAM

WRR X **River System: Cagayan** **Province: Bukidnon**

BULANOG-BATANG

Client: NPC **Consultant: ELC**

Purpose: Power **Status: D/D**

Hydrological Information

Catchment Area: 533 km^2

Mean Annual run-off: 40.8 m^3/s Specific Run-off: 7.65 $m^3/s/100km^2$

Denudation rate: 1.7 mm/yr

Dam

Geological Condition: Plateau Basalt

Type: RCC Crest EL : EL 475 m

Height : 126 m Volume : 1.4 x $10^6 m^3$

Reservoir Storage Volume ($10^6 m^3$)

Full Supply WL: WL 475 m

Min. Ope. WL: WL 460 m Active: 28.3

Draw down: 15 m

Hydropower

Installed capa. : 132 MW Energy (GWh)

Plant Max. Q : 93.4 m^3/s Annual: 491

Rated Net Head: 160.9 m Firm: 259

Source: NPC's Information

WRR X **River System:** Tagoloan **Province:** Bukidnon

TAGOLOAN

Client: **Consultant:**

Purpose: Power, Irrigation, Flood Control **Status:** Map Study

Hydrological Information

Catchment Area:	288 km^2	Annual Basin Rainfall:	2,500 mm
Mean Annual run-off:	16 m^3/s	Specific Run-off:	5.55 $m^3/s/100km^2$
Denudation rate:	3.0 mm/yr		

Dam

Geological Condition:	KPg		
Type:	Rockfill	Crest EL :	EL 527 m
Height :	117 m	Crest length :	500 m
		Volume :	8.0 x 10^6m^3

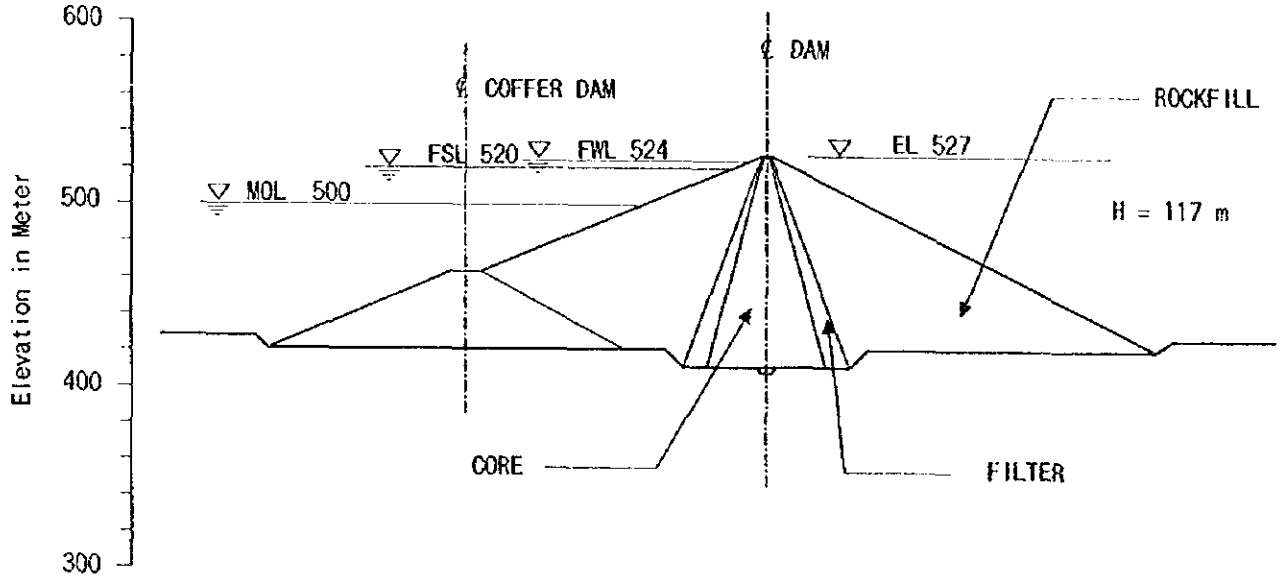
Reservoir

		Storage Volume (10^6m^3)	
Surcharge WL:	WL 524 m	F/C Space:	16
Full Supply WL:	WL 520 m	Gross:	184
Min. Ope. WL:	WL 500 m	Active:	83
Draw down:	20 m	Dead:	101
Surface Area at FSWL:	5 km^2		
Firm Q	5.6 m^3/s		

Hydro Power

		Energy (GWh)	
Type :	Conventional	Firm:	38
Installed Capa. :	22 MW		
Plant Max. Q :	28 m^3/s		
Rated Net Head:	95 m		
Tail WL :	WL 412 m		

Construction Cost: US$ 282 x 10^6



TYPICAL CROSS SECTION OF TAGOLOAN DAM

WRR XI **River System:** Tagum-Libuganon **Province:** Davao

BUBONAO

Client: **Consultant:**

Purpose: Power, Irrigation, Flood Control **Status:** Map Study

Hydrological Information

Catchment Area:	666 km^2	Annual Basin Rainfall:	2,000 mm
Mean Annual run-off:	30 m^3/s	Specific Run-off:	4.50 $m^3/s/100km^2$
Denudation rate:	3.0 mm/yr		

Dam

Geological Condition: N_2

Type:	Rockfill	Crest EL	: EL 132 m
Height :	80 m	Crest length	: 400 m
		Volume	: 2.5 x $10^6 m^3$

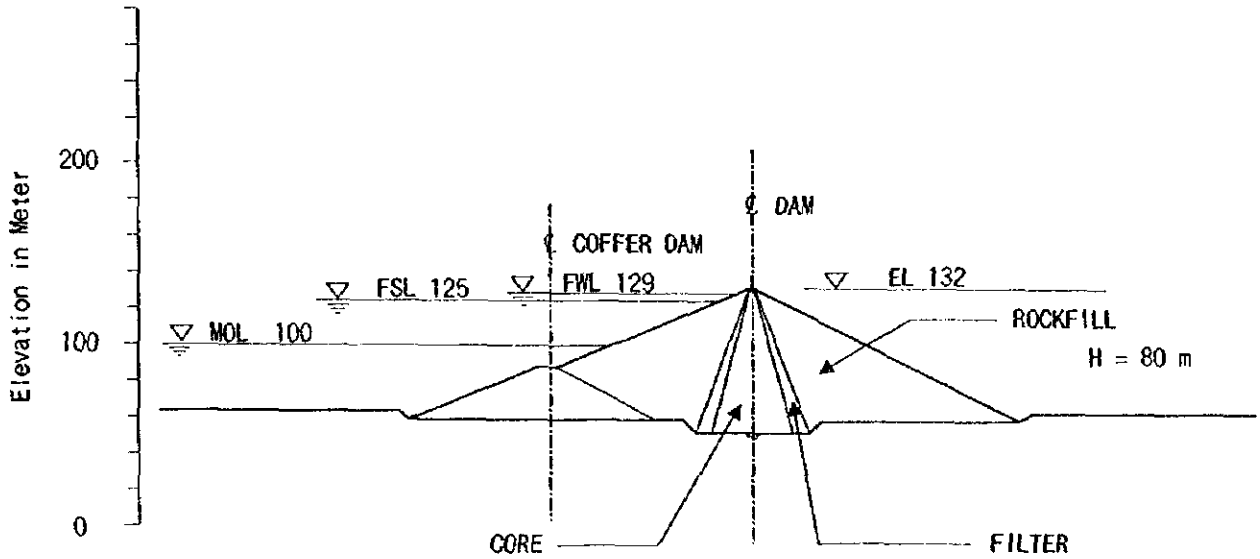
Reservoir

		Storage Volume ($10^6 m^3$)	
Surcharge WL:	WL 129 m	F/C Space:	150
Full Supply WL:	WL 125 m	Gross:	1,020
Min. Ope. WL:	WL 100 m	Active:	720
Draw down:	25 m	Dead:	300
Surface Area at FSWL:	40 km^2		
Firm Q	28 m^3/s		

Hydro Power

Type	: Conventional	Energy (GWh)	
Installed Capa. :	63 MW	Annual:	100
Plant Max. Q :	140 m^3/s	Firm:	100
Rated Net Head:	55 m		
Tail WL	: WL 58 m		

Construction Cost: US$ 180 x 10^6



TYPICAL CROSS SECTION OF BUBONAO DAM

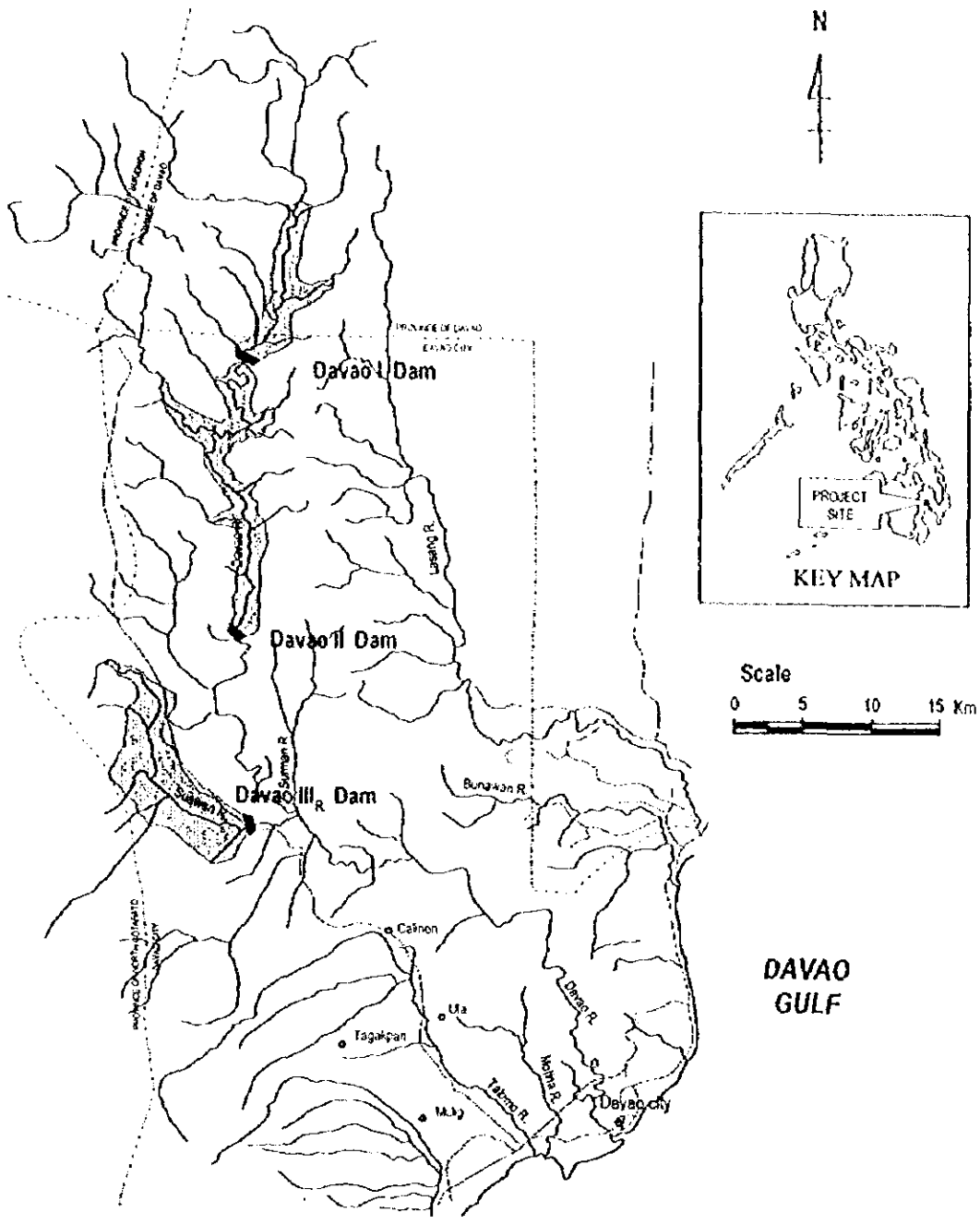
WRR XI River System: Davao Province:

Davao I, II and III

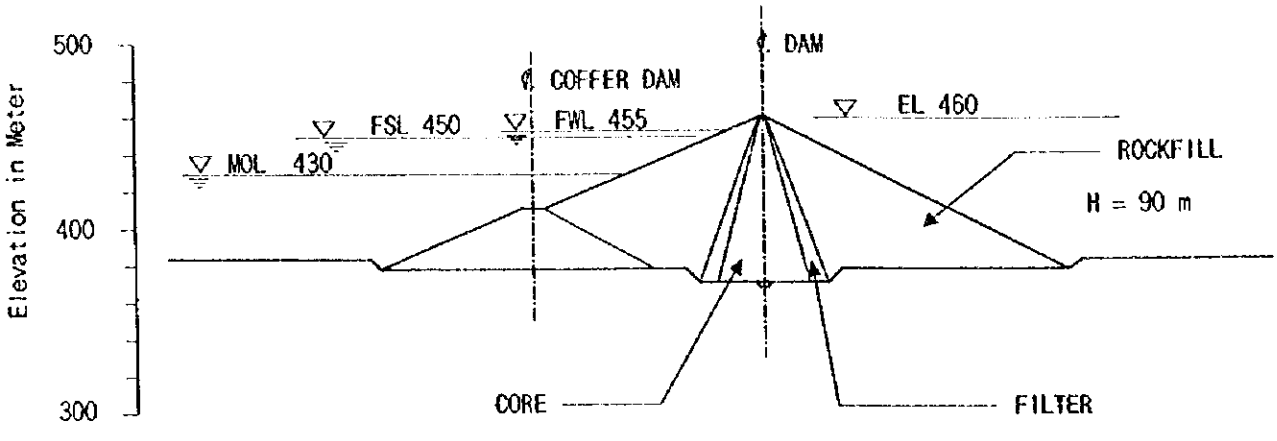
Client: Consultant:

Purpose: Multi Status : Map Study

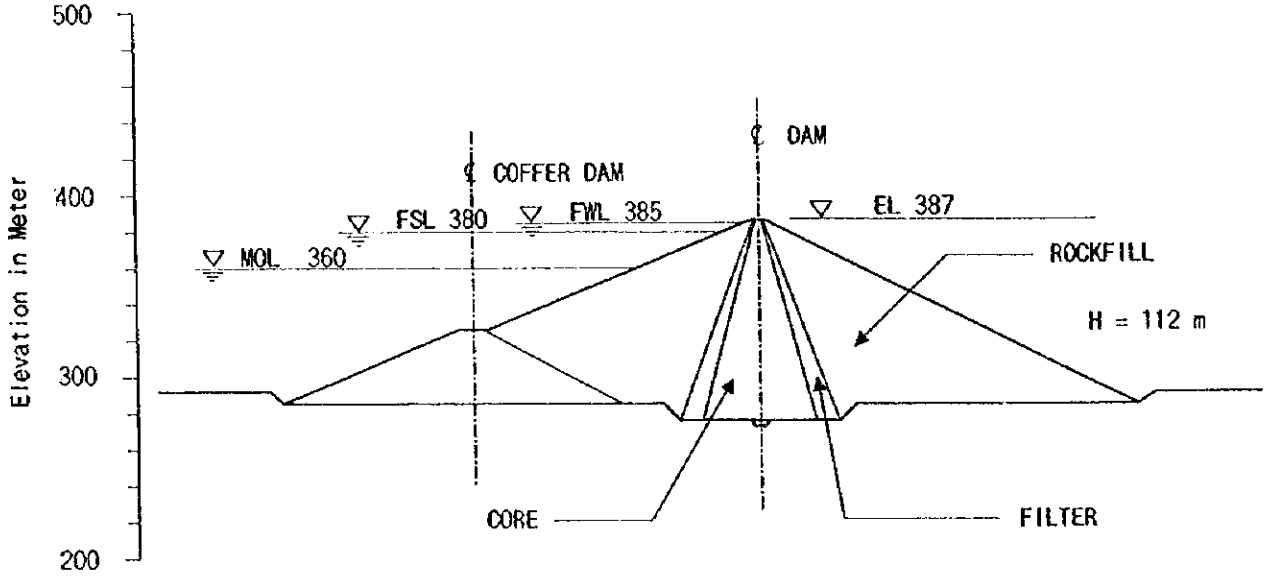
	Davao I	Davao II	Davao III R
Hydrological Information			
Catchment Area (km^2)	367	820	163
Annual Basin Rainfall (mm)	2,150	2,150	2,150
Mean Annual Run-off (m^3/s)	17.5	39.1	4.77
Specific run-off ($m^3/s/100\ km^2$)	4.77	4.77	4.77
Denudation rate (mm/yr)	3.0	3.0	3.0
Dam			
Geological Condition	N_2	N_2	N_2
Dam Type	Rockfill	Rockfill	Rockfill
Crest EL (EL.m)	460	387	472
Dam Height (m)	90	112	132
Crest length (m)	450	350	430
Volume ($10^6 m^3$)	4.0	5.0	7.5
Reservoir			
Surcharge WL (WL. m)	455	385	
Full Supply WL (WL. m)	450	380	465
Min. Ope. WL (WL. m)	430	360	445
Draw down (m)	20	20	20
Storage Volume ($10^6 m^3$)			
F/C Space	135	60	
Gross	740	436	111
Active	405	224	56
Dead	335	212	55
Surface Area at FSWL (km^2)	26	14	3.5
Hydropower			
Type	Conventional	Conventional	Conventional
Installed Capa. (MW)	36	100	24
Plant Max Q (m^3/s)	80	150	25
Rated Net head (m)	55	80	115
Tail WL (WL m)	380	285	335
Annual Energy (GWh)	66	180	44
Construction Cost (US$ x 10^6)	189	265	268



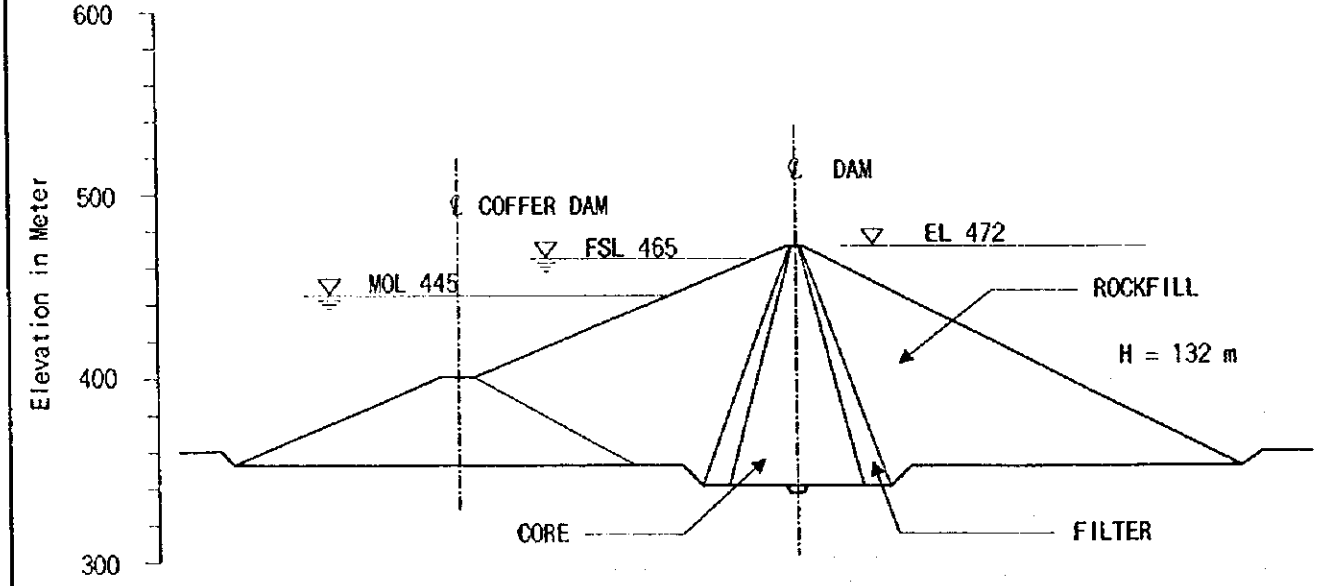
PROJECT LOCATION MAP



TYPICAL CROSS SECTION OF DAVAO I DAM



TYPICAL CROSS SECTION OF DAVAO II DAM



TYPICAL CROSS SECTION OF DAVAO III R DAM

WRR XI **River System:** Buayan-Malungun **Province:** Davao Sur

DIMULOC

Client:

Consultant:

Purpose: Irrigation, F/C

Status: Map Study

Hydrological Information

Catchment Area : 98.7 km^2
Mean Annual run-off : 1.88 m^3/s
Denudation rate: 4.0 mm/yr

Annual Basin Rainfall: 1,500 mm
Specific Run-off: 1.90 $m^3/s/100\ km^2$

Dam

Geological Condition: N_1
Type: Rockfill
Height: 120 m

Crest EL : EL 387 m
Crest length : 430 m
Volume : 6.0 x $10^6 m^3$

Reservoir

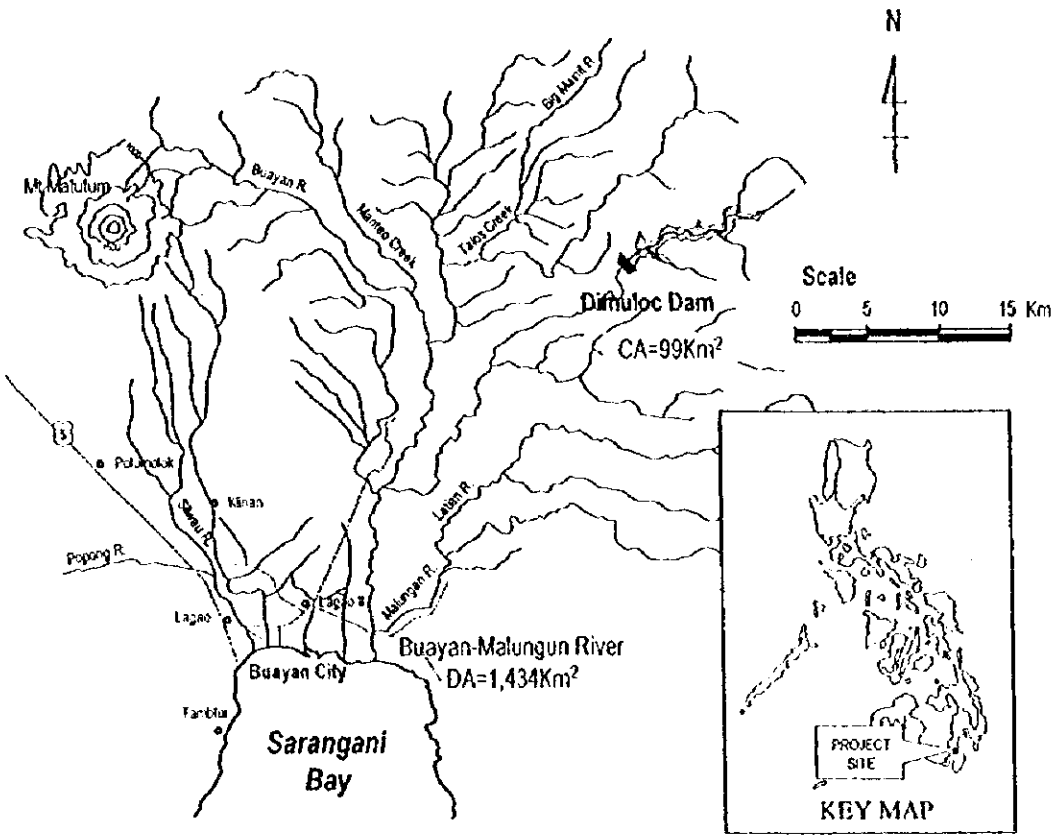
Surcharge WL: WL 384 m
Full Supply WL: WL 380 m
Min. Ope. WL: WL 350 m
Draw down: 30 m
Surface Area at FSWL: 9 km^2

Storage Volume ($10^6 m^3$)

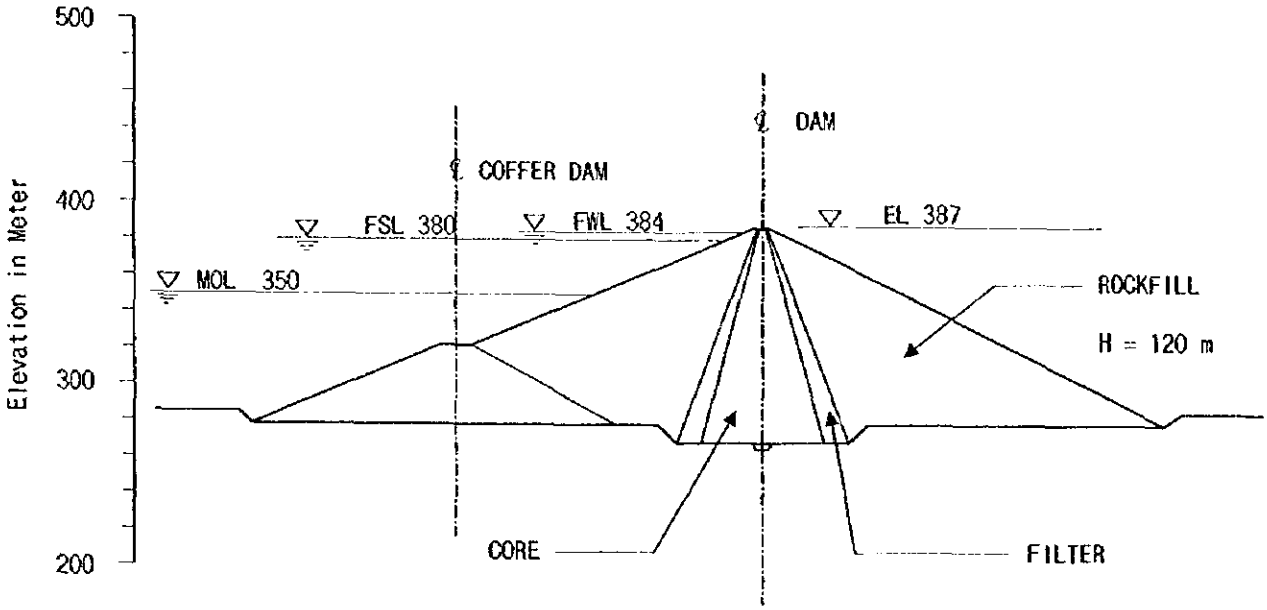
F/C Space: 45
Gross: 293
Active: 193
Dead: 100

Construction Cost: US$ 200 x 10^6

Source: Survey/Inventory on Water Impounding Reservoirs NWRC, 1978



PROJECT LOCATION MAP



TYPICAL CROSS SECTION OF DIMULOC DAM

WRR XII River System: Agus Province: Lanao del Sur

AGUS I and AGUS II

Client: NPC
Purpose: Power

Consultant:
Status : Existing (1980/79)

	AGUS I (Lake Lanao)	AGUS II
Hydrological Information		
Catchment Area (km^2)	1,645	
Dam		
Type		Earthfill
Height (m)		29
Reservoir		
Storage Volume ($10^6 m^3$)		
Active	1,715	
Hydropower		
Type	Under Ground	
Installed Capa. (MW)	80	180
Rated Net Head (m)	62	113
Energy (GWh)		
Annual	456	756

Source : NPC's Information and "Survey/Inventory on Water Impounding Reservoir" NWRC 1978

WRR XII **River System:** Agus **Province:** Lanao del Norte

AGUS III

Client: NPC
Purpose: Power

Consultant: Lavalin
Status: F/S in 1990

Hydrological Information
Catchment Area: 1,844 km^2

Dam
Type: Rockfill
Height: 58 m
Design Flood: 2,770 m^3/s

Crest EL : EL 530 m
Crest length : 180 m

Reservoir
Full Supply WL: WL 524 m
Min. Ope. WL: WL 516 m
Draw down: 8 m

Storage Volume ($10^6 m^3$)
Active: 0.7

Hydropower
Type : Conventional
Installed capa. : 225 MW
Rated Net Head: 158.5 m

Energy (GWh)
Annual: 1,065

Source: NPC's Information

WRR XII **River System:** Agus **Province:** Lanao del Norte

AGUS IV and AGUS V

Client: NPC
Purpose: Power

Consultant:
Status : Existing (1985)

	AGUS IV	AGUS V
Dam		
Type	Rockfill	Conc. Gravity
Height (m)	32	
Storage Volume ($10^6 m^3$)		
Active	24	
Hydropower		
Installed Capa. (MW)	158	55
Rated Net Head (m)	117	46
Energy (GWh)		
Annual	762	265

Source : NPC's Information and "Survey/Inventory on Water Impounding Reservoir" NWRC 1978

WRR XII **River System:** Agus **Province:** Lanao del Norte

AGUS VI and AGUS VII

Client: NPC
Purpose: Power

Consultant:
Status : Existing (1977/83)

	AGUS VI (Maria Cristina)	AGUS VII
Dam		
Type	Rockfill	Conc. Gravity
Height (m)	12.5	37.5
Reservoir		
Storage Volume ($10^6 m^3$)		
Active	1.2	
Hydropower		
Installed Capa. (MW)	200	54
Rated Net Head (m)	164	38
Energy (GWh)		
Annual	1,016	274

Source : NPC's Information and "Survey/Inventory on Water Impounding Reservoir" NWRC 1978

WRR XII **River System:** Mindanao/Pulangi **Province:** Bukidnon

PULANGI I and PULANGI II

Client: NPC **Consultant:** Sofrelex
Purpose: Power **Status :** Pre-F/S

	PULANGI I	PULANGI II
Hydrological Information		
Catchment Area (km^2)	376	737
Mean Annual Run-off (m^3/s)	15.7	38.6
Specific run-off ($m^3/s/100\ km^2$)	2.41	5.24
Dam		
Type	Rockfill	Rockfill
Height (m)	100	110
Design Flood (m^3/s)	2,700	3,000
Reservoir		
Full Supply WL (WL. m)	660	557
Min. Ope. WL (WL. m)	626	523
Draw down (m)	34	34
Storage Volume ($10^6 m^3$)		
Active	1,715	535
Hydropower		
Type	Conventional	Conventional
Installed Capa. (MW)	24	70
Plant Max. Q (m^3/s)	45	40
Rated Net Head (m)	99.5	99.5
Energy (GWh)		
Annual	105	257

Source : NPC's Information

WRR XII **River System:** Mindanao/Pulangi **Province:**Bukidnon

PULANGI III

Client: NPC
Purpose: Power

Consultant: MERALCO/EDC
Status: F/S in 1982

Hydrological Information

Catchment Area: 1,339 km^2
Mean Annual run-off : 64 m^3/s
Denudation rate: 0.14 mm/yr

Annual Basin Rainfall: 2,525 mm
Specific Run-off: 4.78 $m^3/s/100km^2$

Dam

Geological Condition: UV
Type: Rockfill
Height: 90 m
Design Flood: 4,230 m^3/s

Crest EL : EL 420 m
Crest length : 632 m
Volume : 7.6 x $10^6 m^3$

Reservoir

Full Supply WL: WL 417 m
Min. Ope. WL: WL 380 m
Draw down: 37 m
Surface Area at FSWL: 71.4 km^2

Storage Volume ($10^6 m^3$)
Active: 1,150

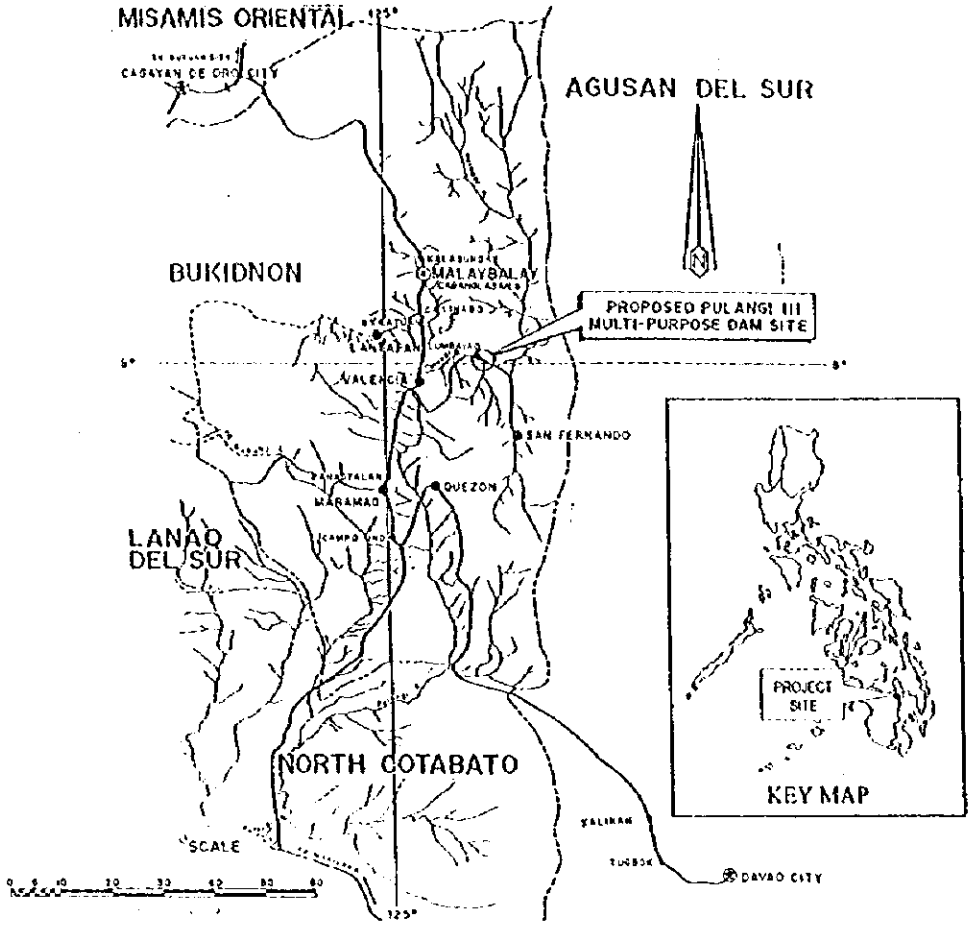
Hydropower

Type : Conventional
Installed capa. : 90 MW
Plant Max. Q : 150 m^3/s
Rated Net Head: 69 m
Tail WL : WL 332 m

Energy (GWh)
Annual: 382
Firm: 304
2-nd: 60

Construction Cost: US$ 477 x 10^6

Source: F/S on Pulangi III, Main Report by MERALCO/EDC, 1982



PROJECT LOCATION MAP

WRR XII River System: Mindanao/Pulangi Province:Bukidnon

PULANGI IV

Client: NPC
Purpose: Power

Consultant:
Status: Existing(1985)

Dam
Height: 115 m

Hydropower
Type : Conventional
Installed capa. : 255 MW
Plant Max. Q : 276 m^3/s

Energy (GWh)
Annual: 1,012

Source: NPC's Information

WRR XII River System: Mindanao/Pulangi Province: Bukidnon

PULANGI V and PULANGI VI

Client: NPC
Purpose: Power

Consultant: Sofrelex
Status : Pre-F/S

	PULANGI V	PULANGI VI
Hydrological Information		
Catchment Area (km^2)	4,652	5,216
Mean Annual Run-off (m^3/s)	214.1	233
Specific run-off ($m^3/s/100\ km^2$)	4.60	4.46
Dam		
Type	Conc. Gravity	Conc. Gravity
Crest EL (EL.m)	165	50
Height (m)	125	30
Crest length (m)	228	139
Design Flood (m^3/s)	12,200	12,000
Reservoir		
Full Supply WL (WL. m)	160	
Min. Ope. WL (WL. m)	123	
Draw down (m)	37	
Storage Volume ($10^6 m^3$)		
Active	1,190	
Hydropower		
Type	Conventional	Conventional
Installed Capa. (MW)	348	70
Plant Max. Q (m^3/s)	375	400
Rated Net Head (m)	105.5	20
Energy (GWh)		
Annual	1,310	340

Source : NPC's Information

WRR XII **River System:** Mindanao/Cabilanan **Province:** Sultan Kudarat

MAGANOY MULTI

Client: NPC
Purpose: Power

Consultant: Asiatic
Status: Pre-F/S 1985

Hydrological Information
Catchment Area: 550 km^2

Dam

Type:	Earthfill	Crest EL	: EL 695 m
Height :	45 m	Crest length	: 226 m
Design Flood:	750 m^3/s		

Reservoir

		Storage Volume ($10^6 m^3$)	
Full Supply WL:	WL 687 m	Active:	62
Min. Ope. WL:	WL 660 m		
Draw down:	27 m		

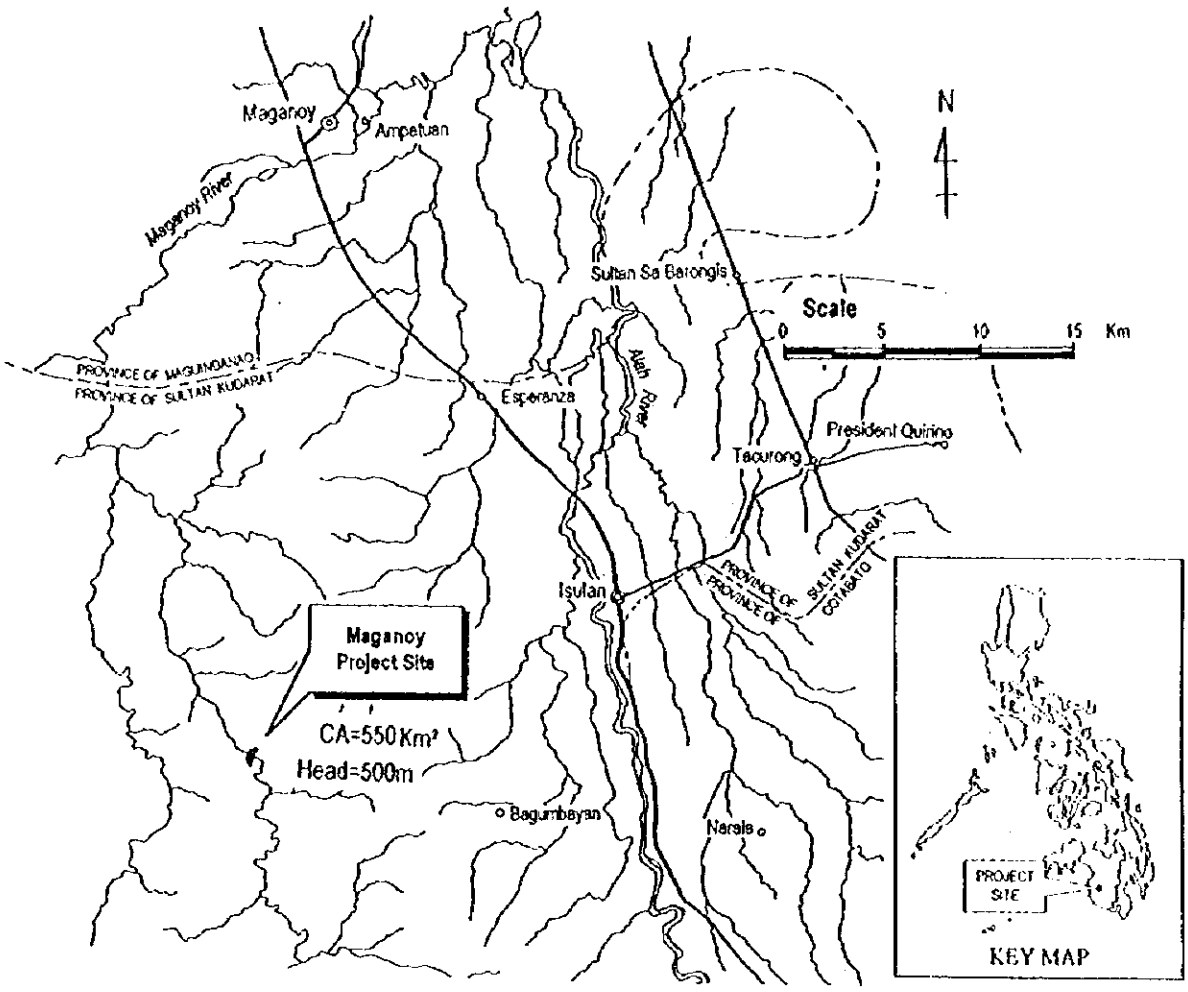
Hydropower

Type	: Conventional	Energy (GWh)	
Installed capa.	: 66 MW	Annual:	315
Plant Max. Q	: 15.3 m^3/s		
Rated Net Head:	500 m		

Irrigation: 13,000 ha

Construction Cost: US$ 34 x 10^6

Source: Proposed Hydroelectric Projects NPC 1988.



PROJECT LOCATION MAP