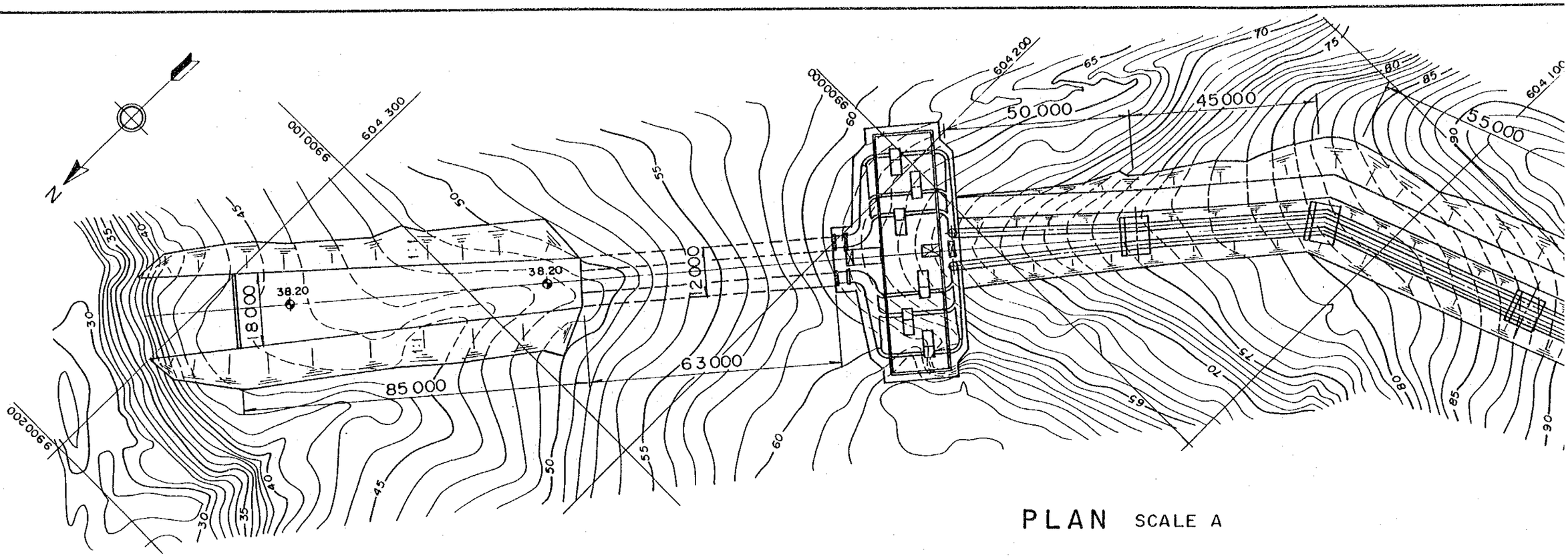
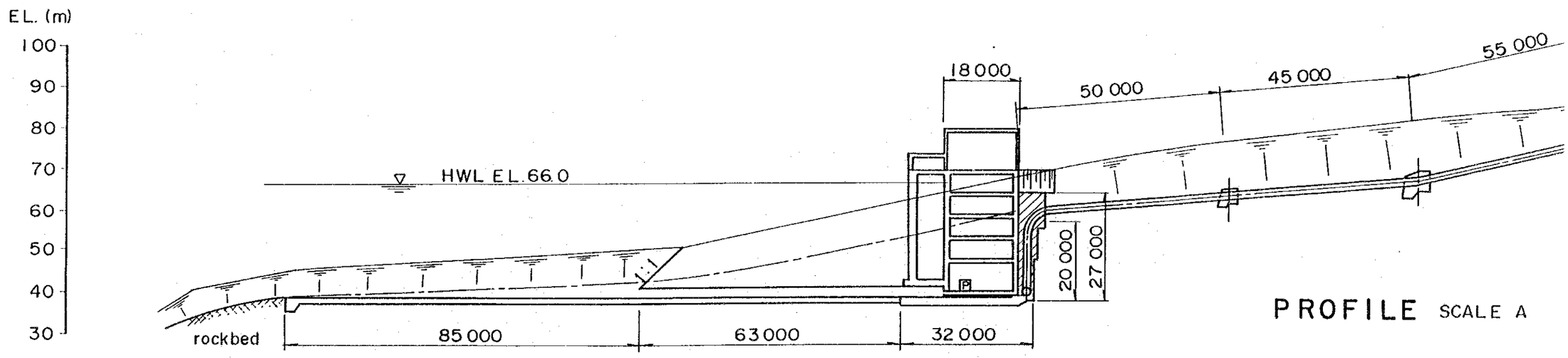
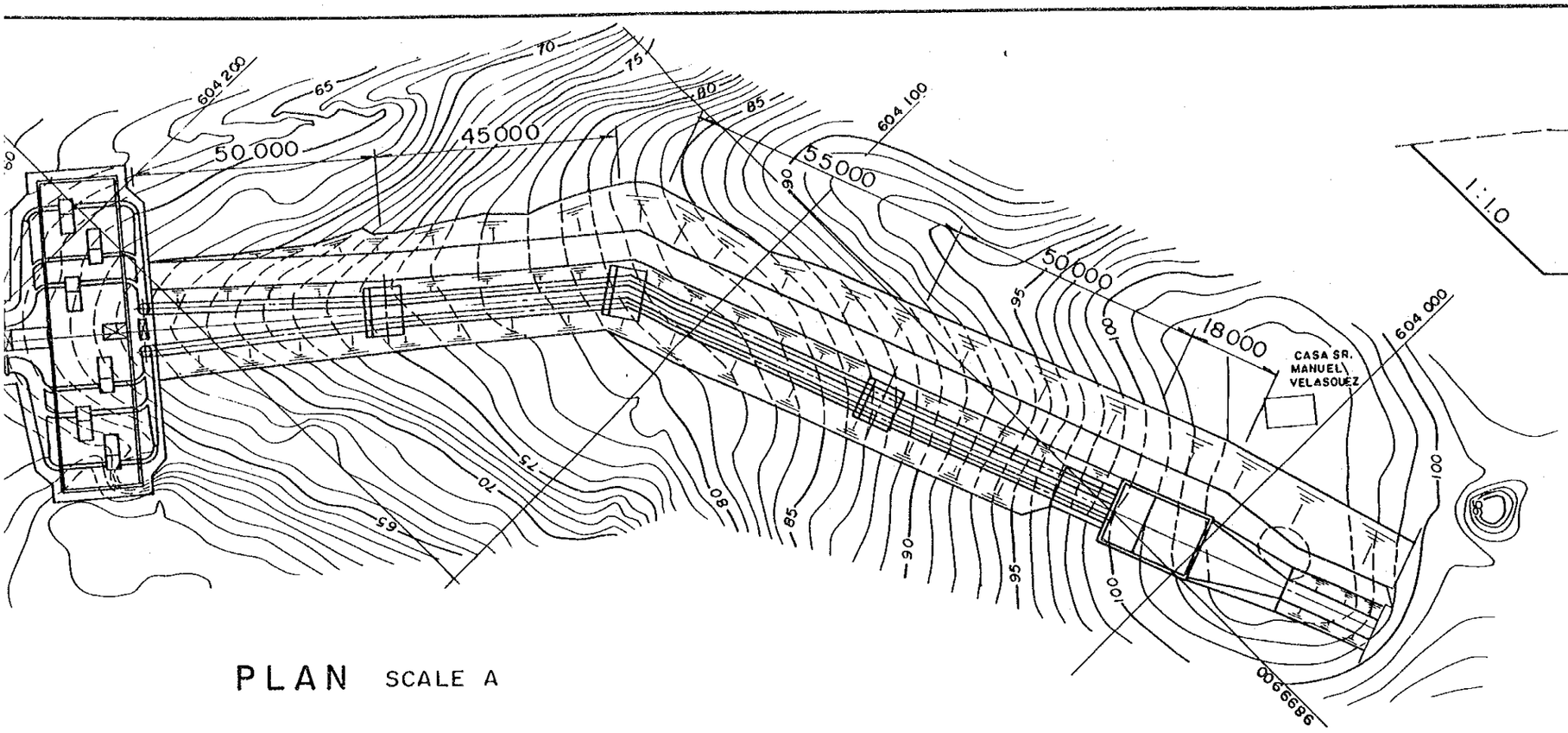


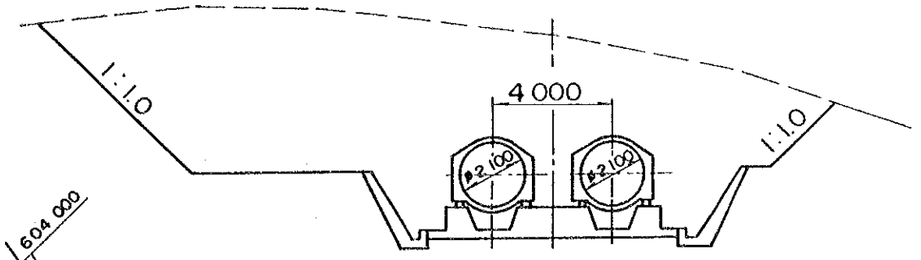
PLAN SCALE A



PROFILE SCALE A



PLAN SCALE A



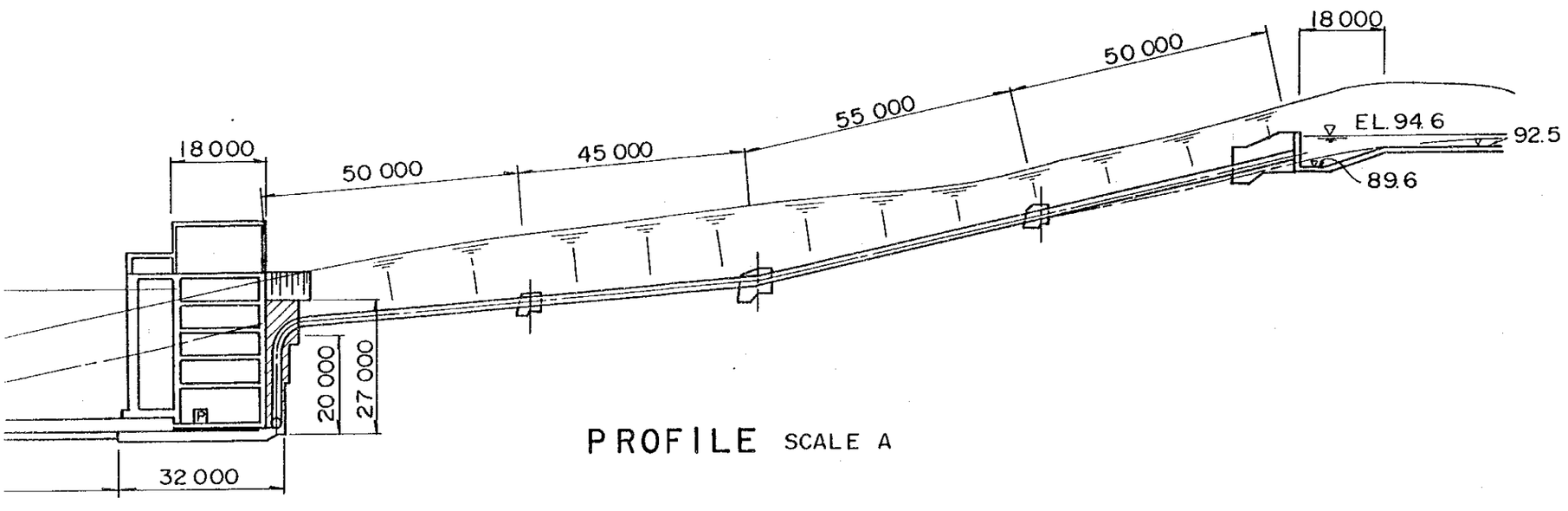
TYPICAL SECTION SCALE B

SCALE A

0 50m

SCALE B

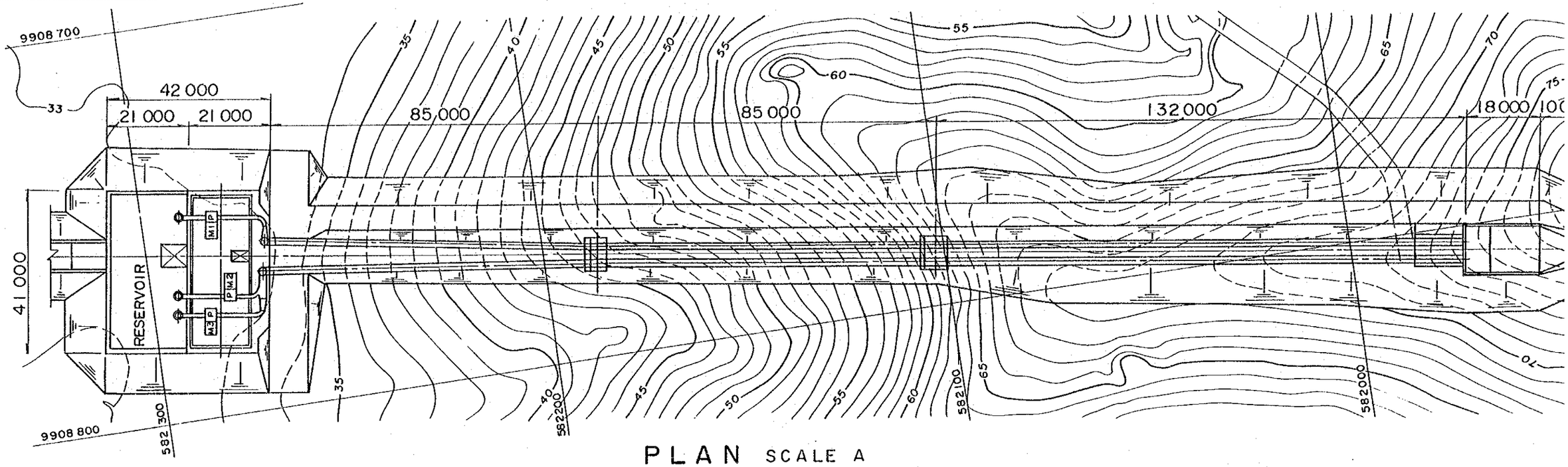
0 5 10m



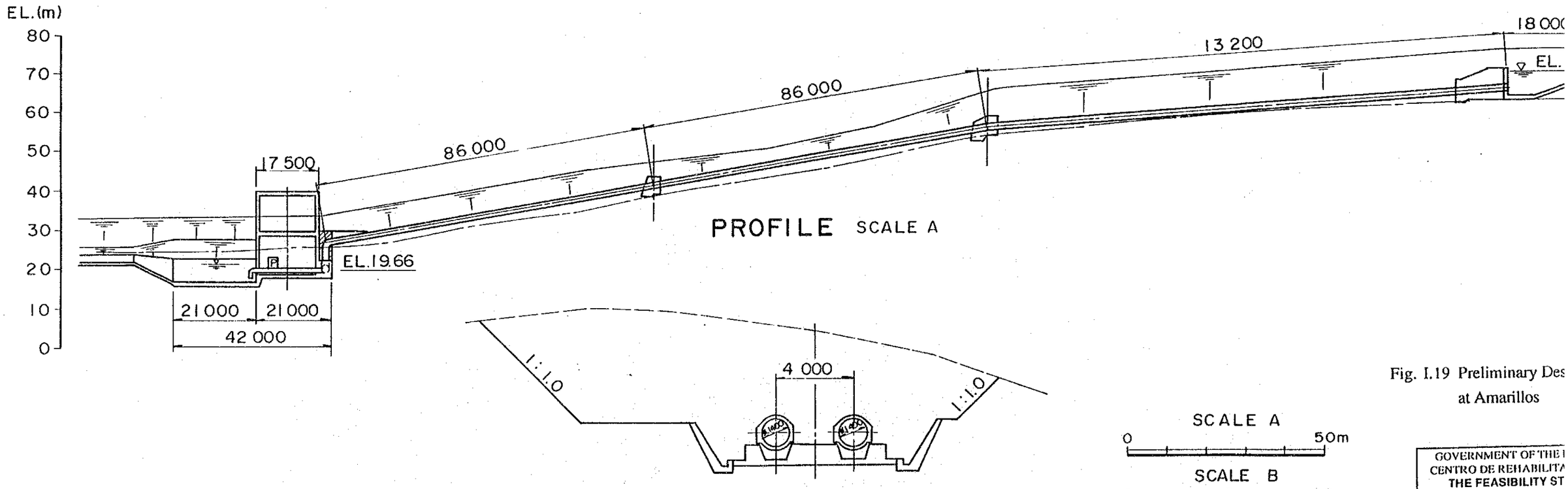
PROFILE SCALE A

Fig. I.18 Preliminary Design of Intake Scheme at Altamira

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



PLAN SCALE A



PROFILE SCALE A

TYPICAL SECTION SCALE B

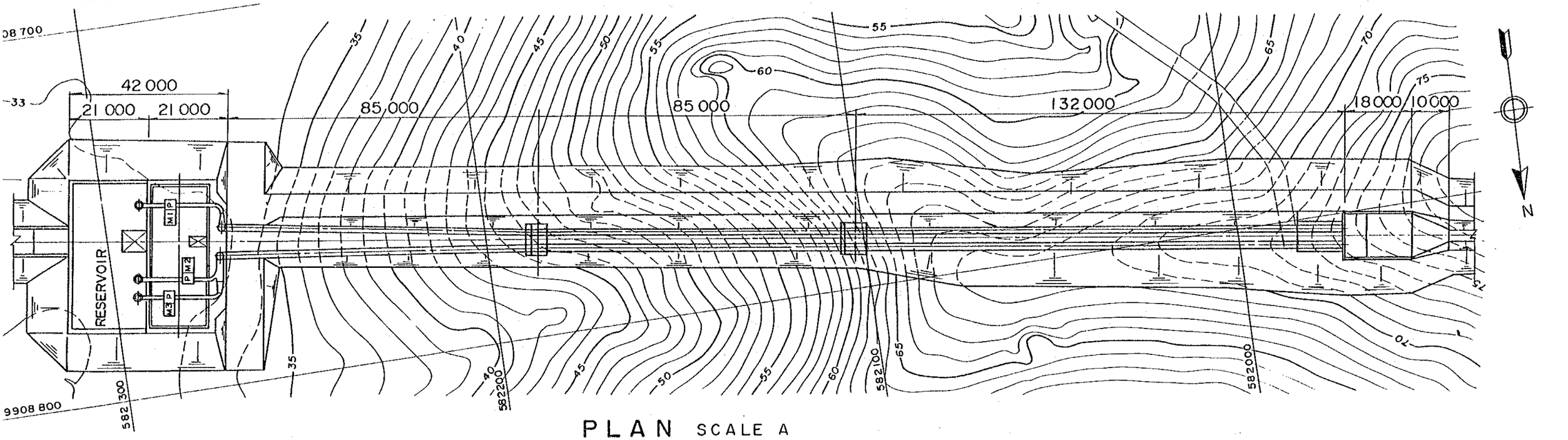
SCALE A
0 50m

SCALE B
0 5 10m

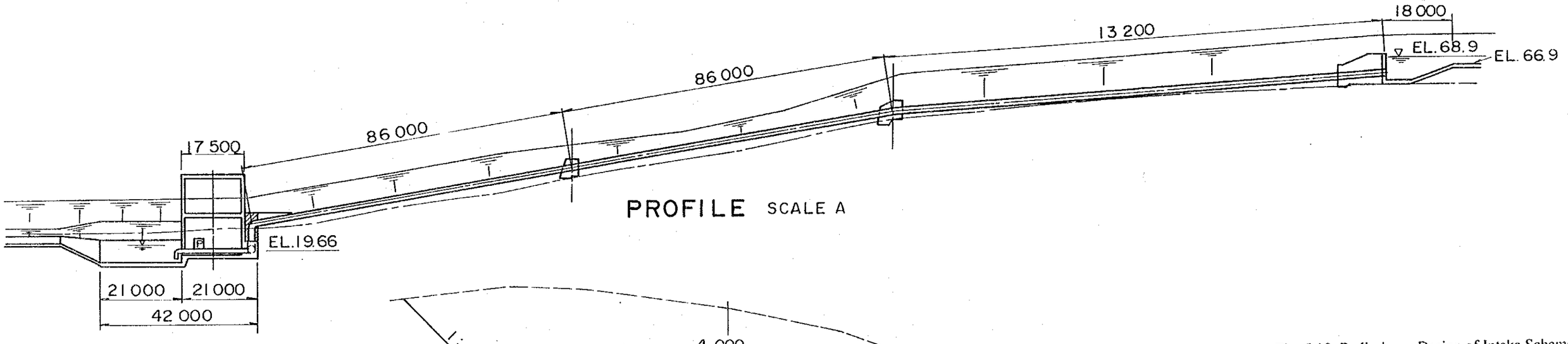
Fig. I.19 Preliminary Des
at Amarillos

GOVERNMENT OF THE I
CENTRO DE REHABILITA
THE FEASIBILITY ST
RESOURCES DE
CHONE-PORTOVI

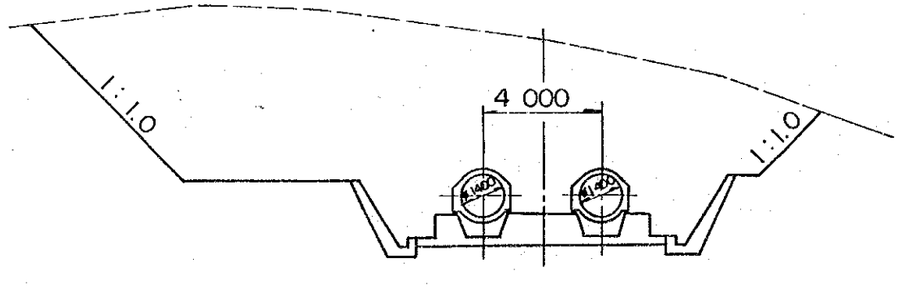
JAPAN INTERNATIONAL



PLAN SCALE A



PROFILE SCALE A



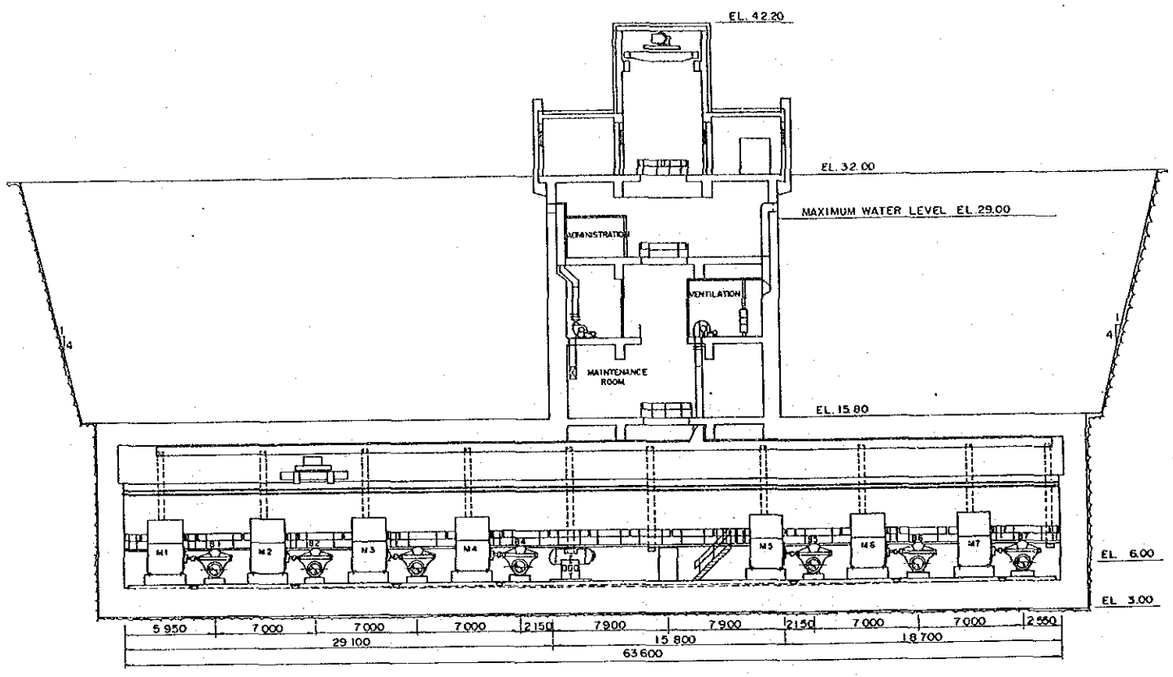
TYPICAL SECTION SCALE B

SCALE A
0 50m

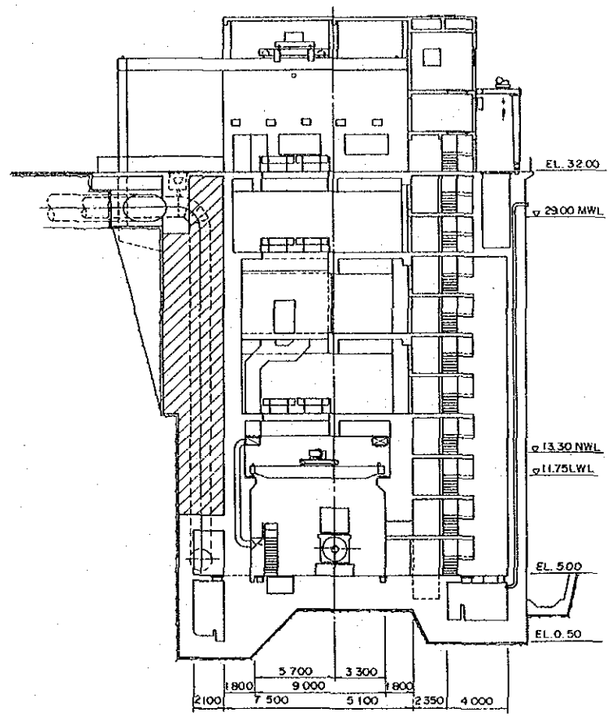
SCALE B
0 5 10m

Fig. I.19 Preliminary Design of Intake Scheme at Amarillos

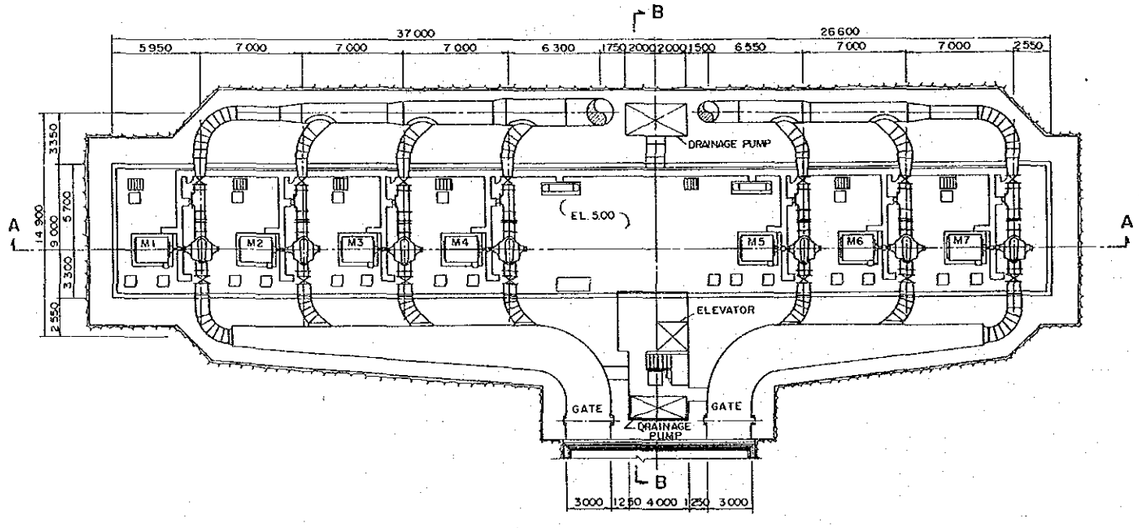
GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



SECTION A - A



SECTION B - B



PLAN

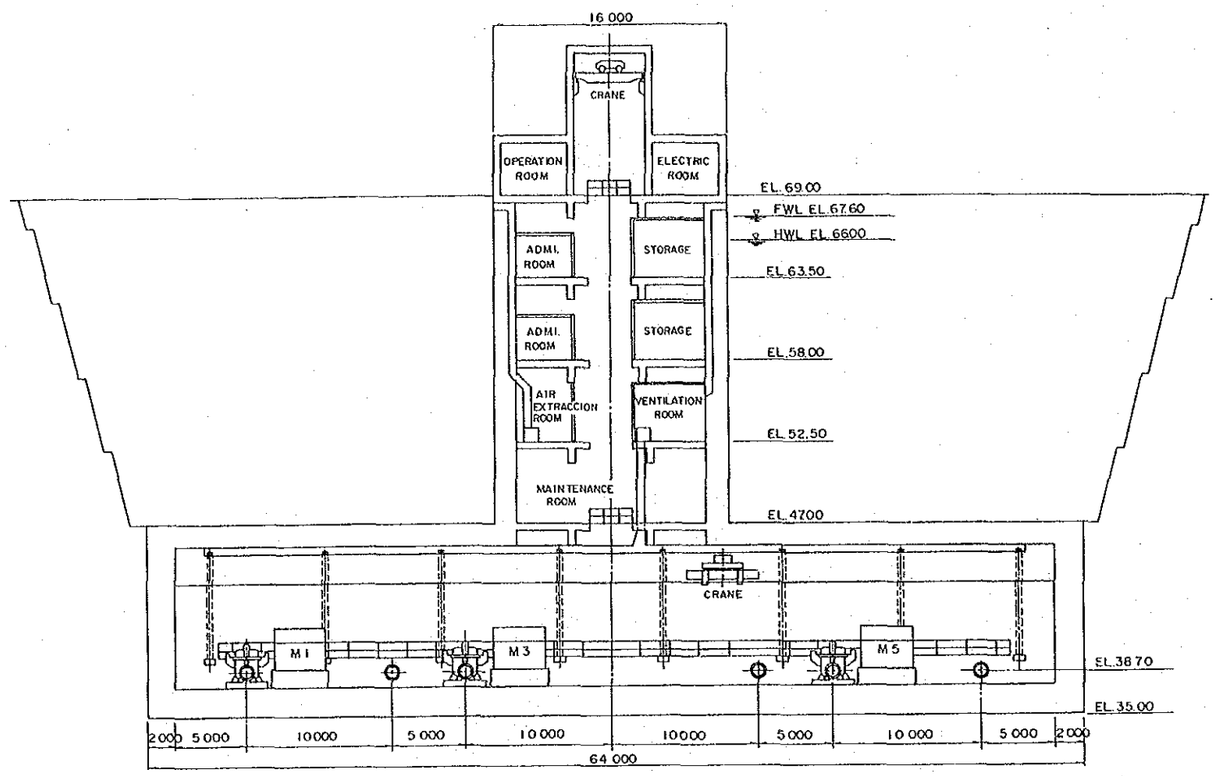
SCALE

0 10 20 m

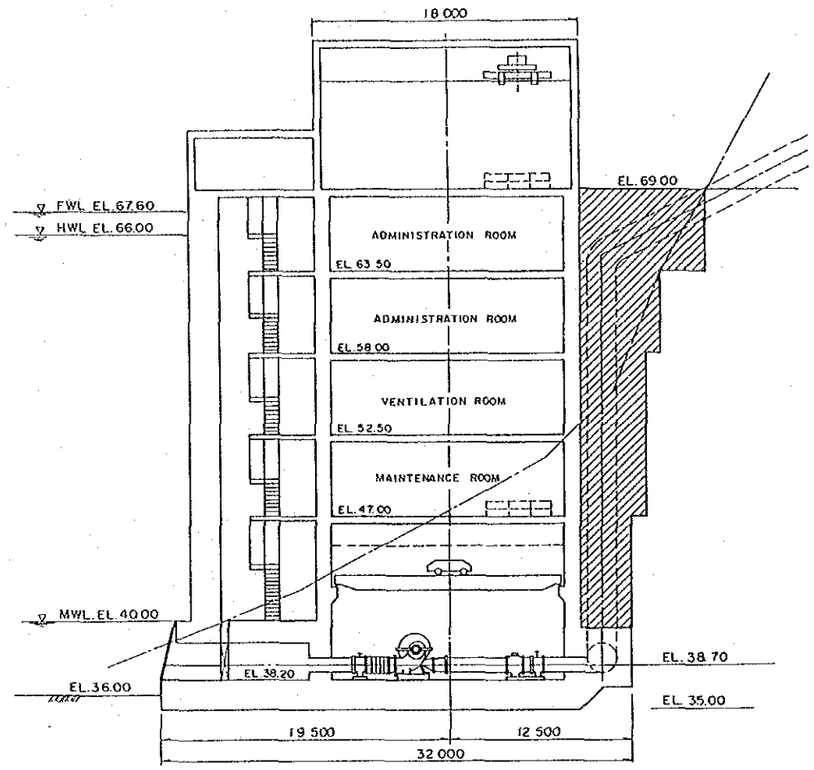
Fig. I.20 Preliminary Design of Pumping Station at Tirga (Rio Daule)

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS

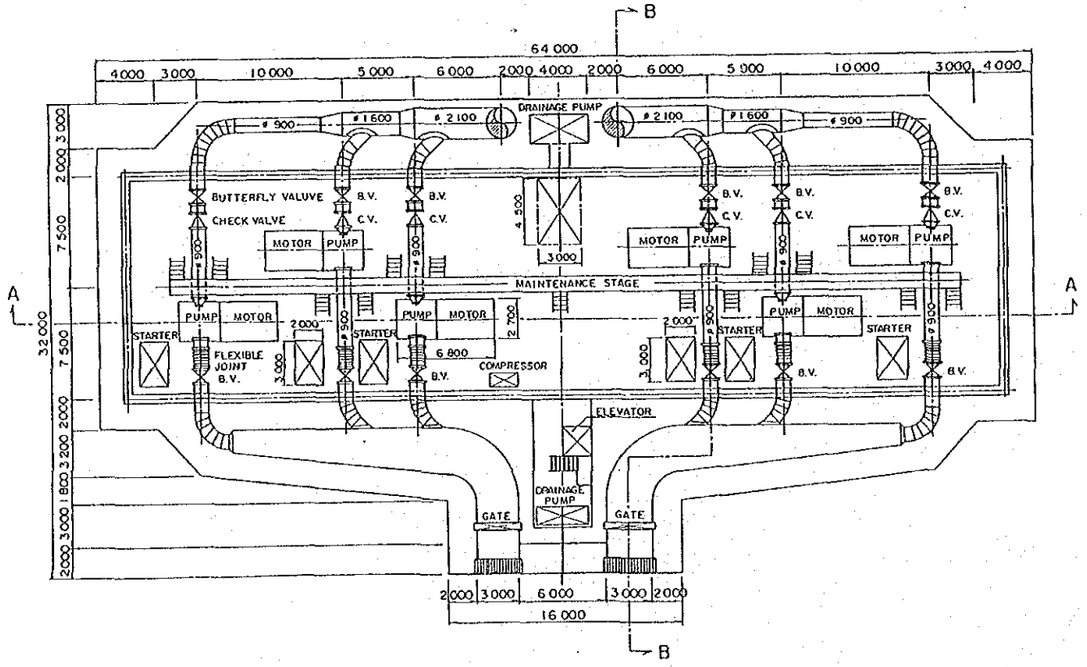
JAPAN INTERNATIONAL COOPERATION AGENCY



SECTION A-A



SECTION B-B

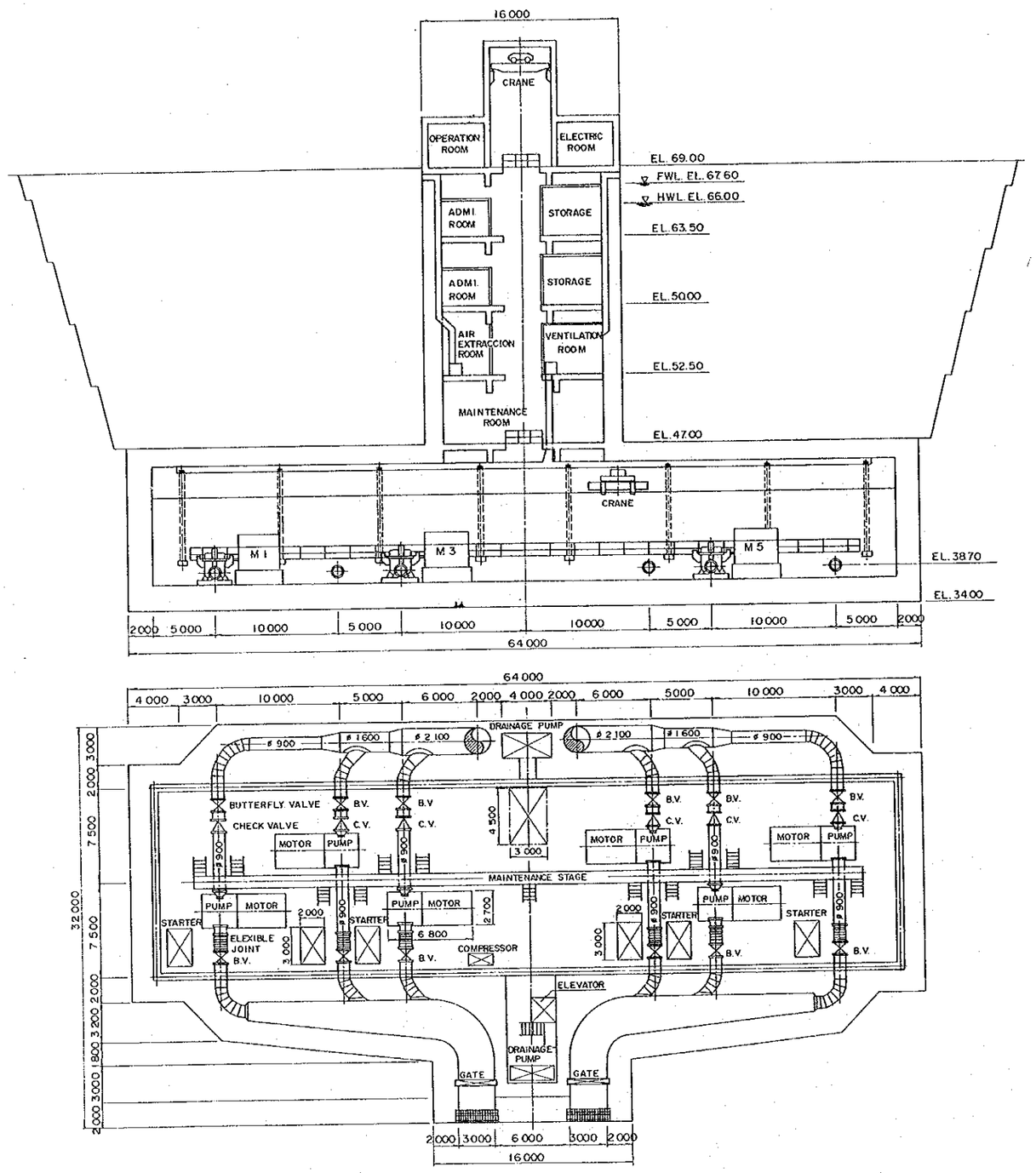


PLAN

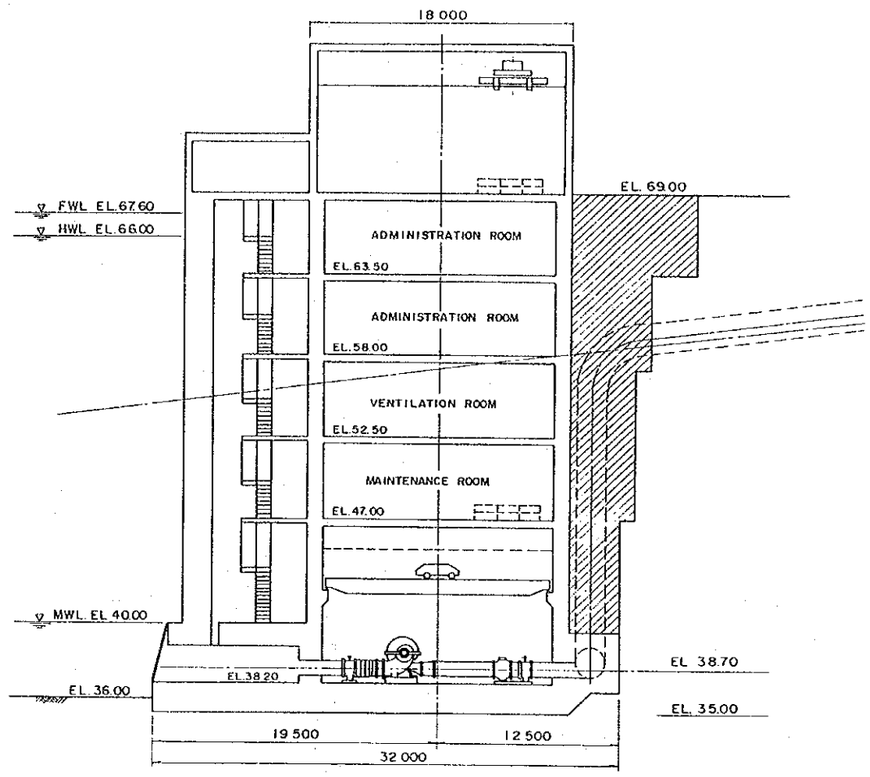
SCALE
0 10 20 m

Fig. I.21 Preliminary Design of Pumping Station at Severino

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



PLAN

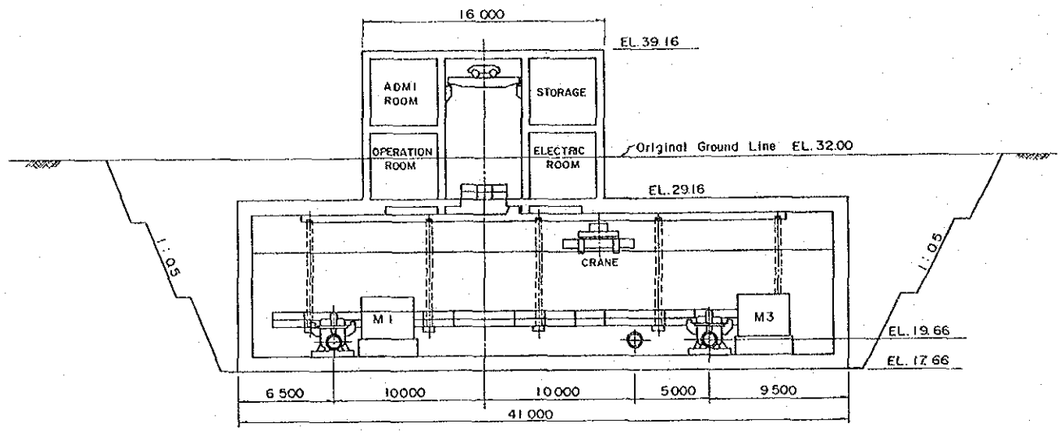


SECTION B - B

Fig. I.22 Preliminary Design of Pumping Station at Altamira

SCALE
0 10 20 m

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



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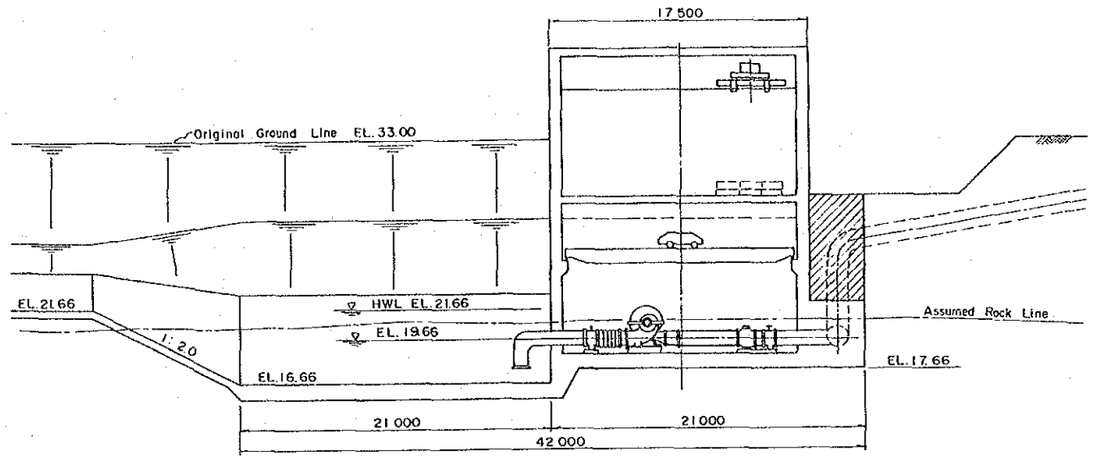
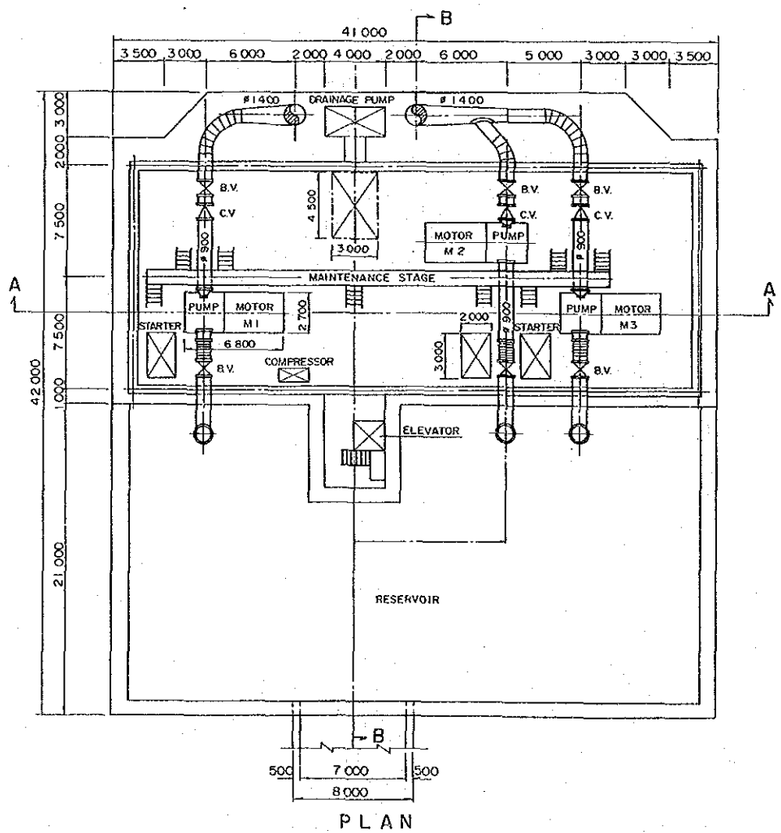


SECTION B- B



PLAN

Fig. I.23 Preliminary Design of Pumping Station at Amarillos

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

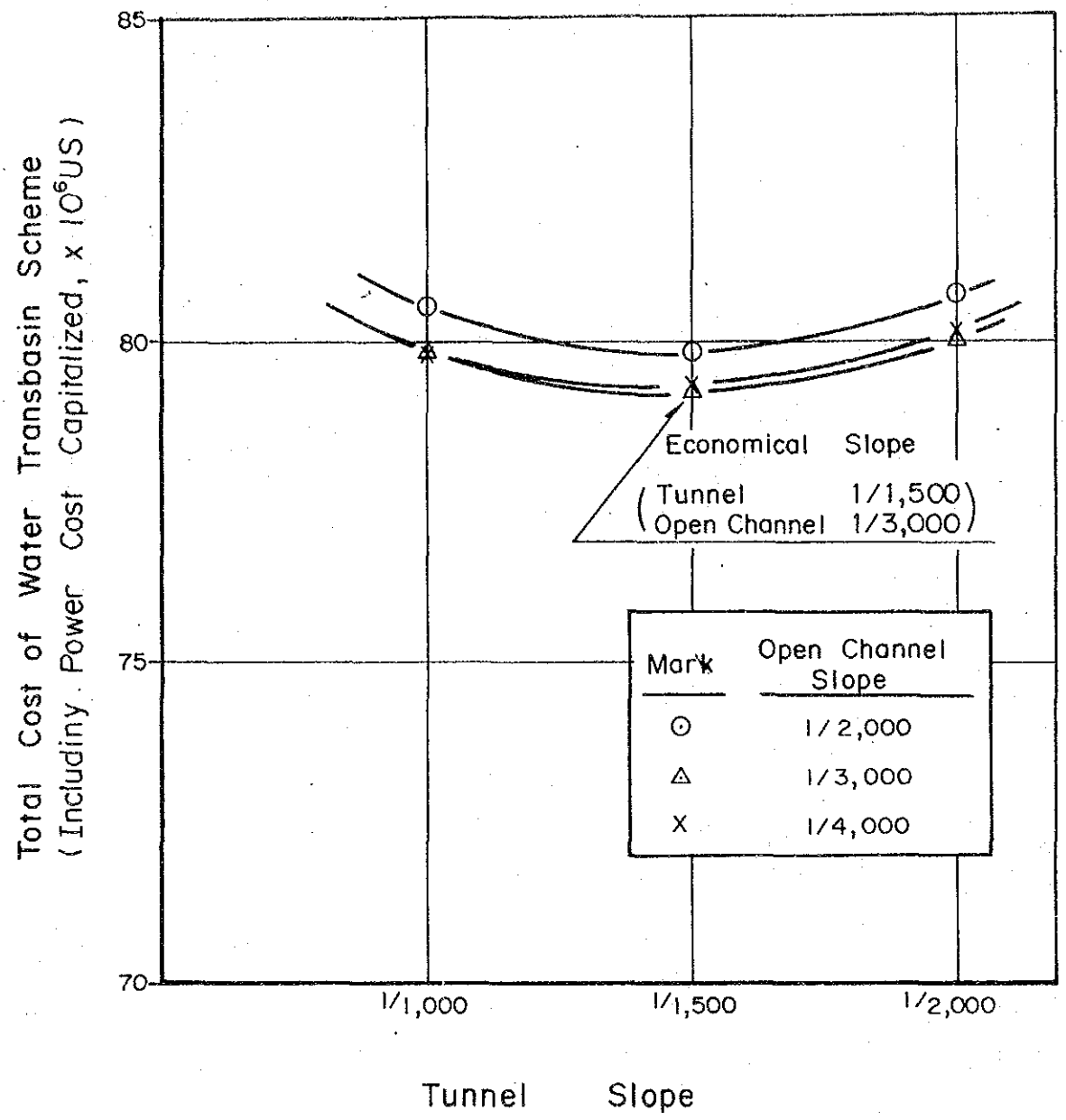
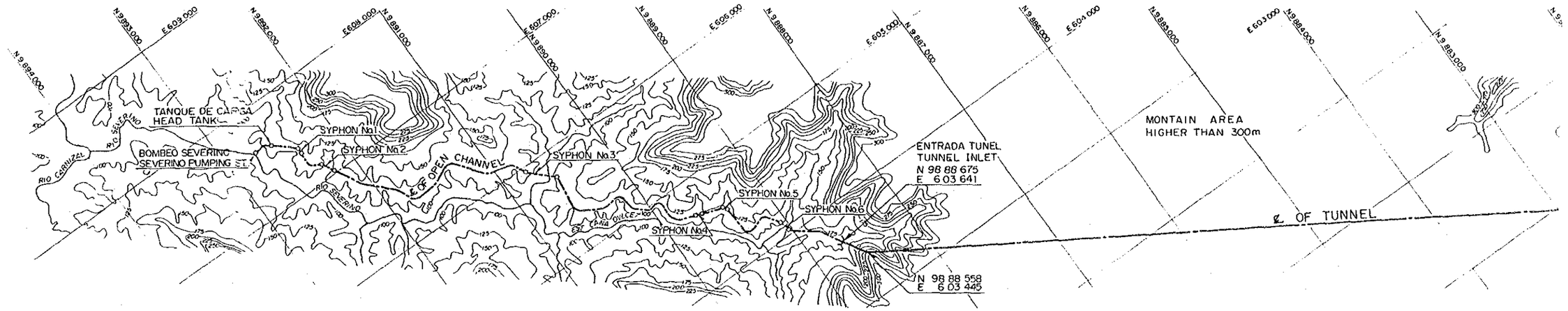
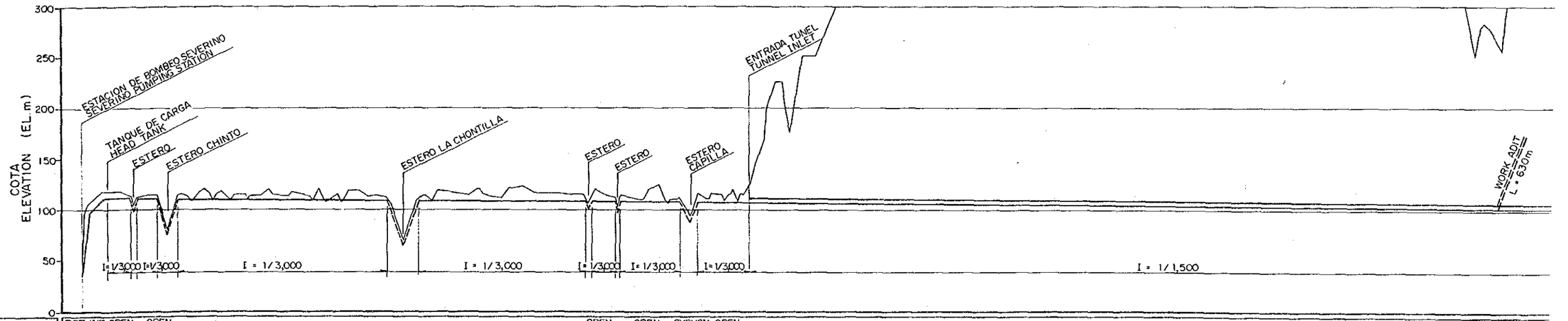


Fig. I.24 Economic Slopes of Tunnel and Open Channel (Severino - Poza Honda Scheme)

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

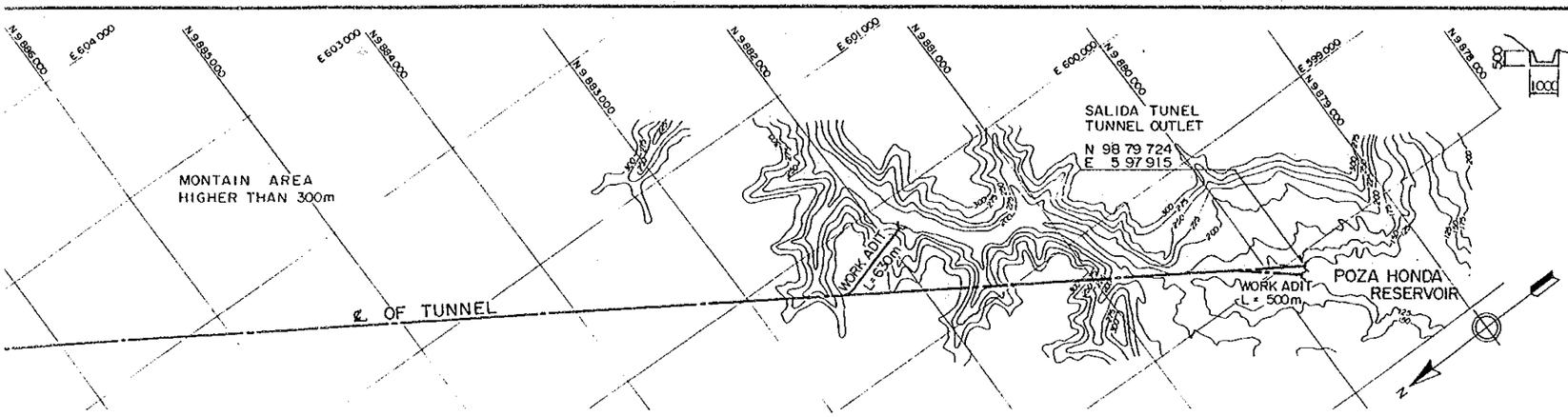


PLATA
PLAN SCALE A

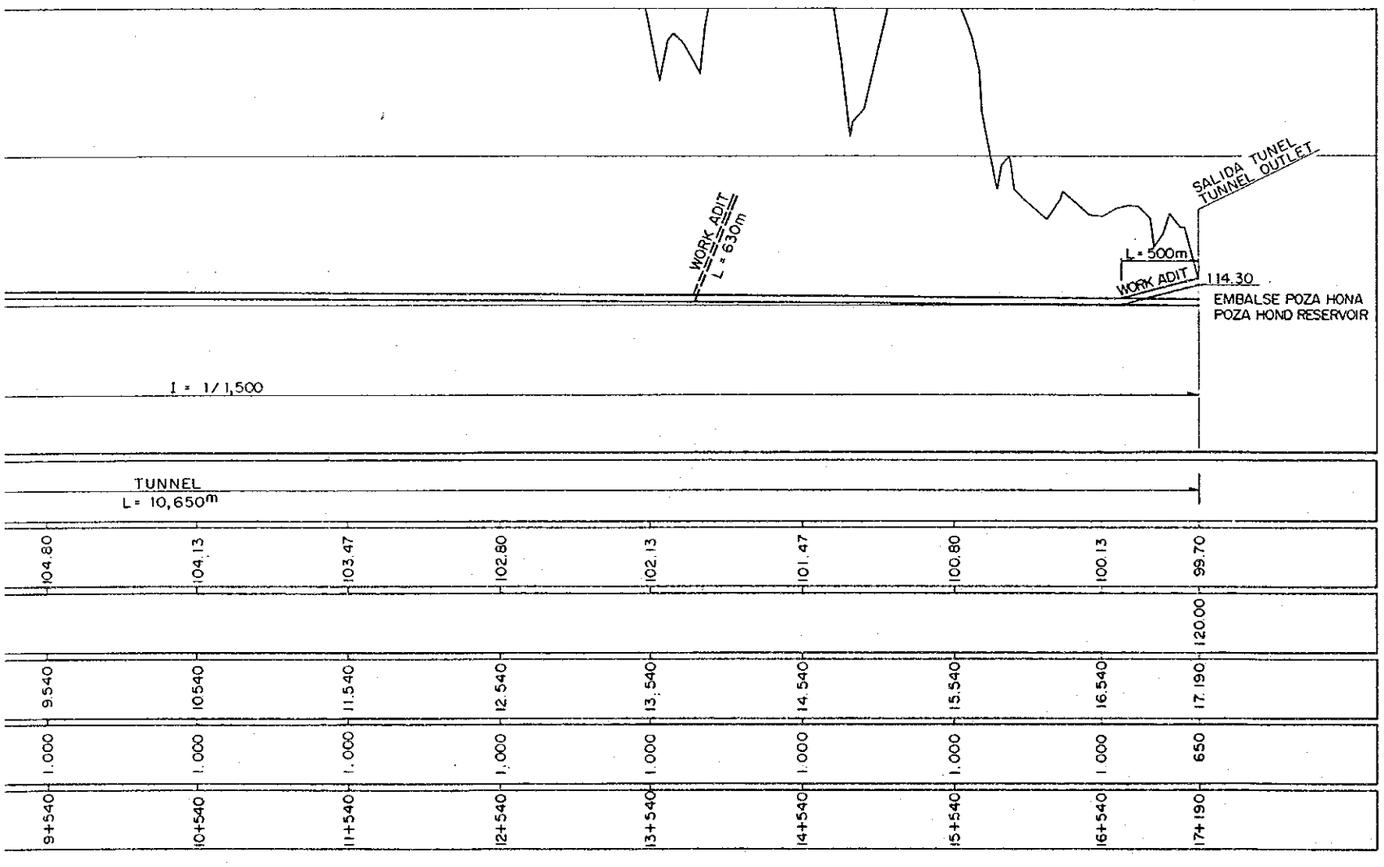


TIPOS DE ESTRUCTURAS / TYPE OF STRUCTURE	PIPELINE	OPEN CHANNEL	SYPON	SYPON	OPEN CHANNEL	SYPHON	OPEN CHANNEL	OPEN CHANNEL	SYPON	SYPON	OPEN CHANNEL	TUNNEL L = 10,650m						
COTA DE ESTRUCTURAS / ELEVATION OF STRUCTURE (EL. m)	38 20	111.199	111.129	110.893	110.829	110.436		109.760	109.282		108.734	108.502	108.422	108.195	107.998	107.673	107.503	106.800	106.13	105.47	104.80	104.13	103.47	102.80	102.13
COTA DE TERRENO / ELEVATION OF GROUND (EL. m)	36	119	114	113	113	114		112	113		114	113	114	113	112	117	125								
DISTANCIA ACUMULADA / ACCUMULATE DISTANCE (m)	0	250 270	480 535		725	935		2965	3275		4920 4970		5210 5255		5845	6030	6540	7.540	8 540	9.540	10.540	11.540	12 540	13. 540	
DISTANCIA / DISTANCE (m)	0	250 20	210 55		190	210		2030	310		1645 50		240 45		590	185	510	1,000	1.000	1.000	1.000	1.000	1,000	1 000	
ESTACION / STATION	0+000	0+250 0+270	0+480 0+535		0+725	0+935		2+965	3+275		4+920 4+970		5+210 5+255		5+845	6+030	6+540	7+540	8+540	9+540	10+540	11+540	12+540	13+540	

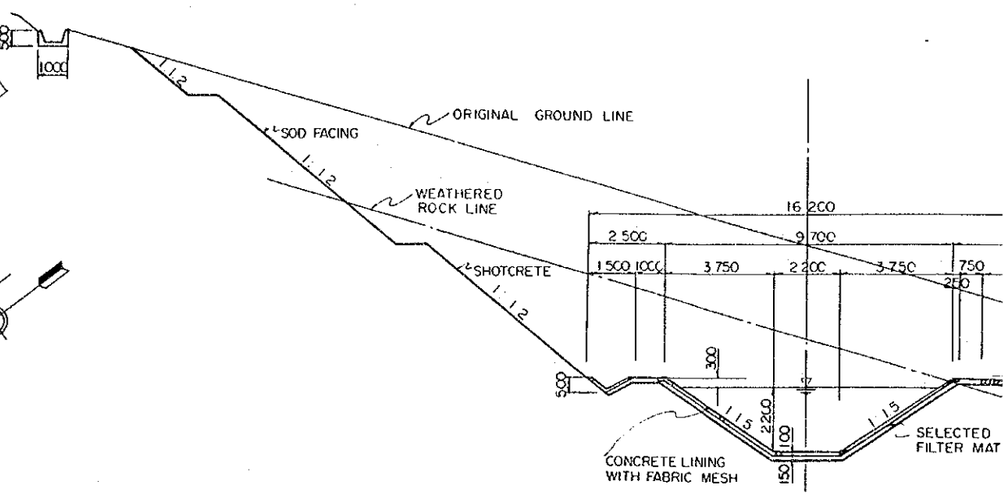
PERFIL
PROFILE H ; SCALE A
V ; SCALE B



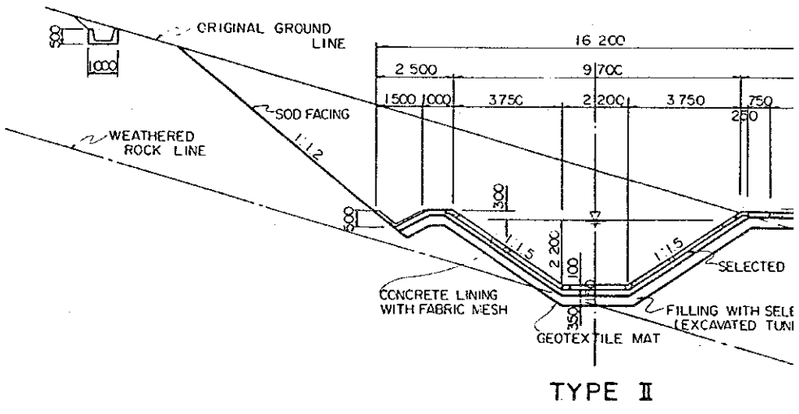
PLATA
PLAN SCALE A



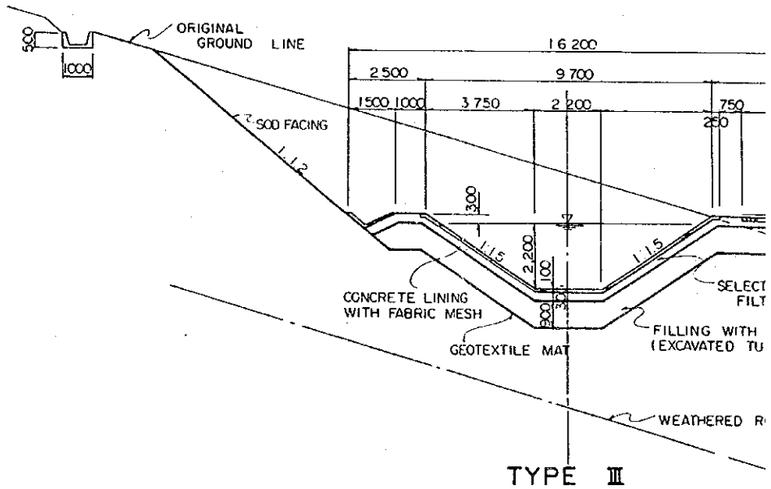
H ; SCALE A
V ; SCALE B



TYPE I

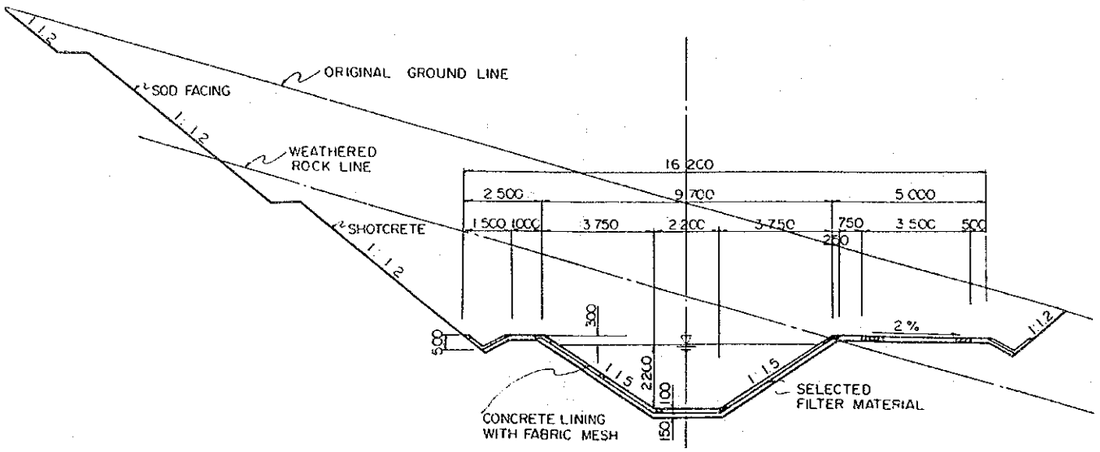


TYPE II

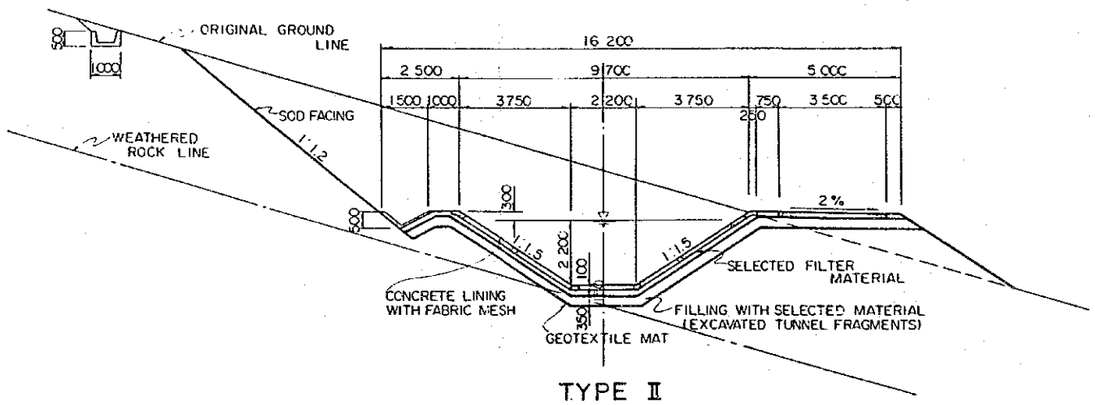


TYPE III

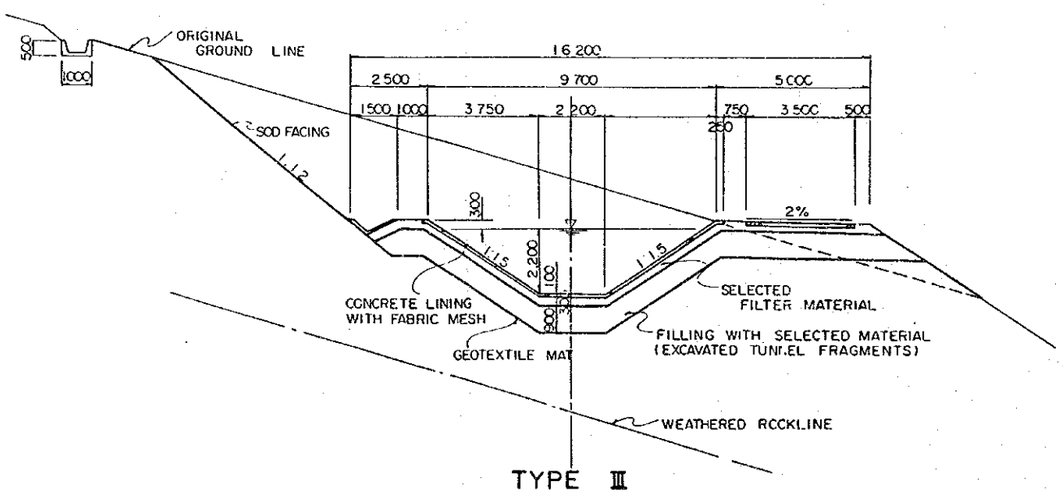
OPEN CHANNEL SECTION SC



TYPE I

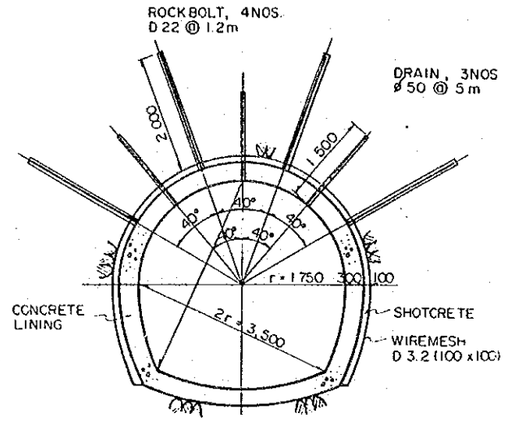


TYPE II

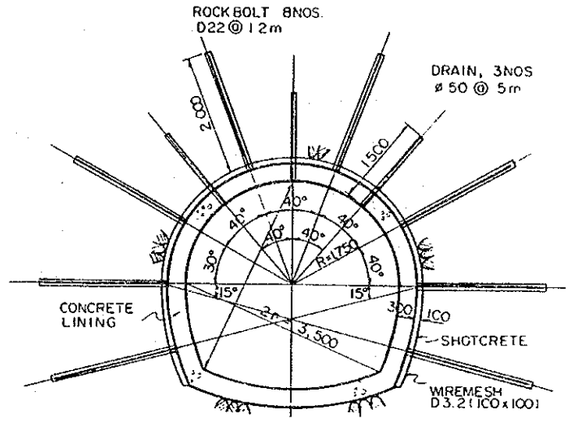


TYPE III

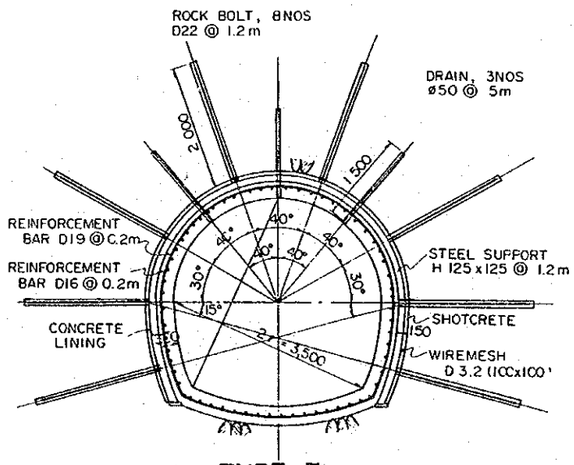
OPEN CHANNEL SECTION SCALE C



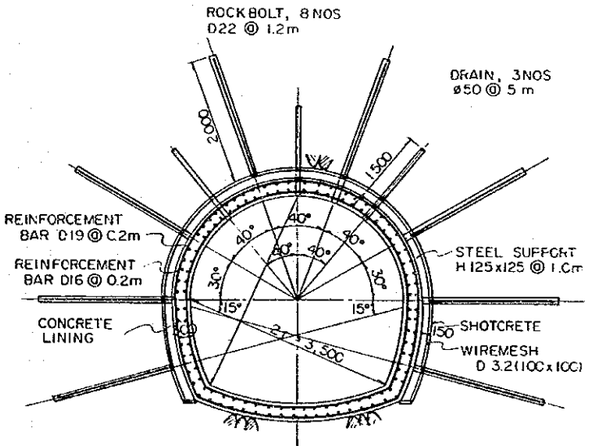
TYPE I



TYPE II



TYPE II



TYPE IV

TUNNEL SECTION SCALE D

SCALE A 0 1,000 2,000m

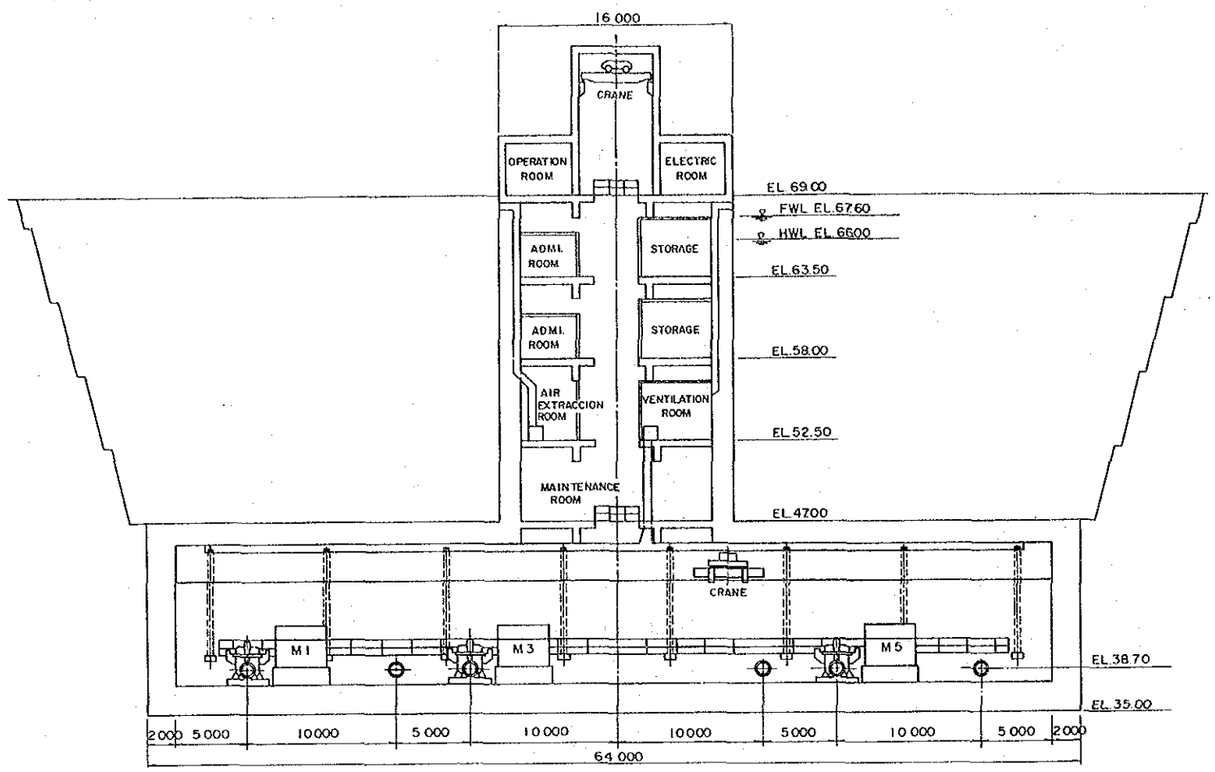
SCALE B 0 100 200m

SCALE C 0 5 10m

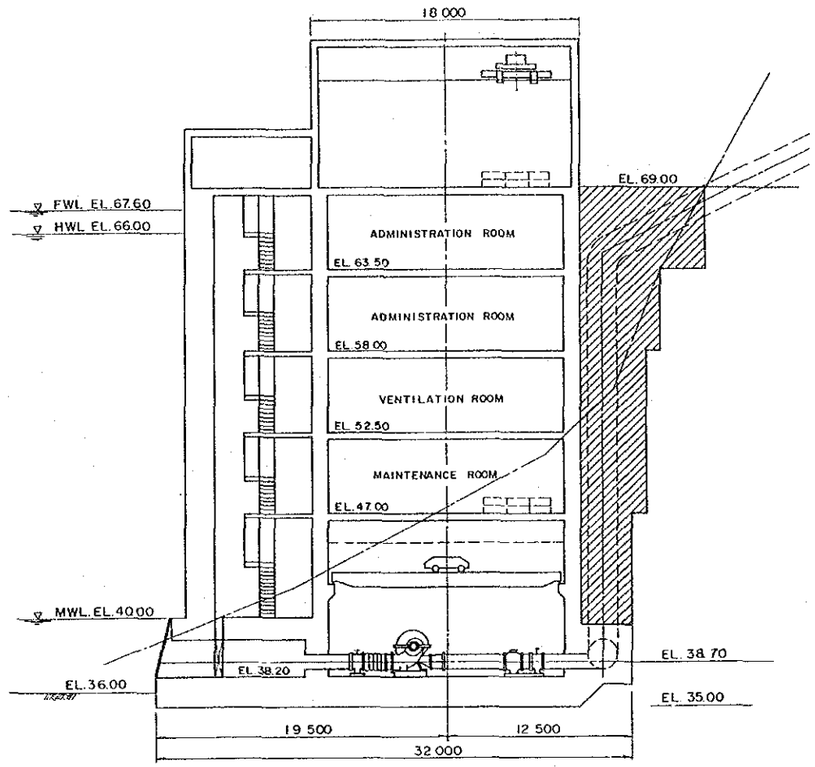
SCALE D 0 1 2 3 4 5m

Fig. I.25 Basic Design of Water Transbasin Scheme "Esperanza (Severino) - Poza Honda Dam"

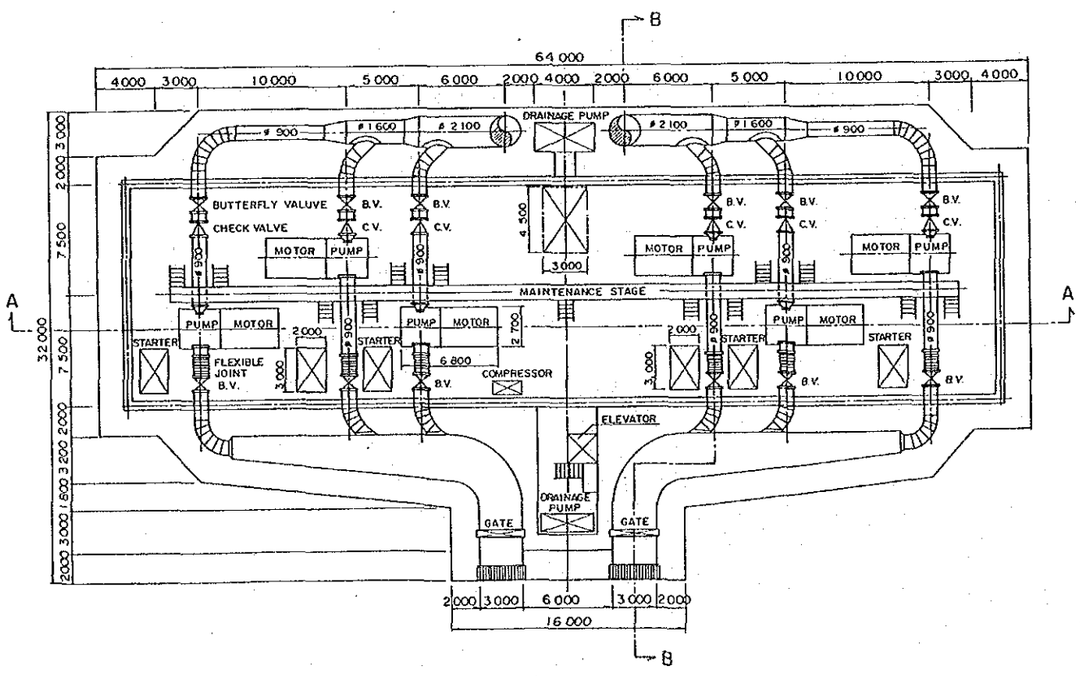
GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



SECTION A-A



SECTION B-B



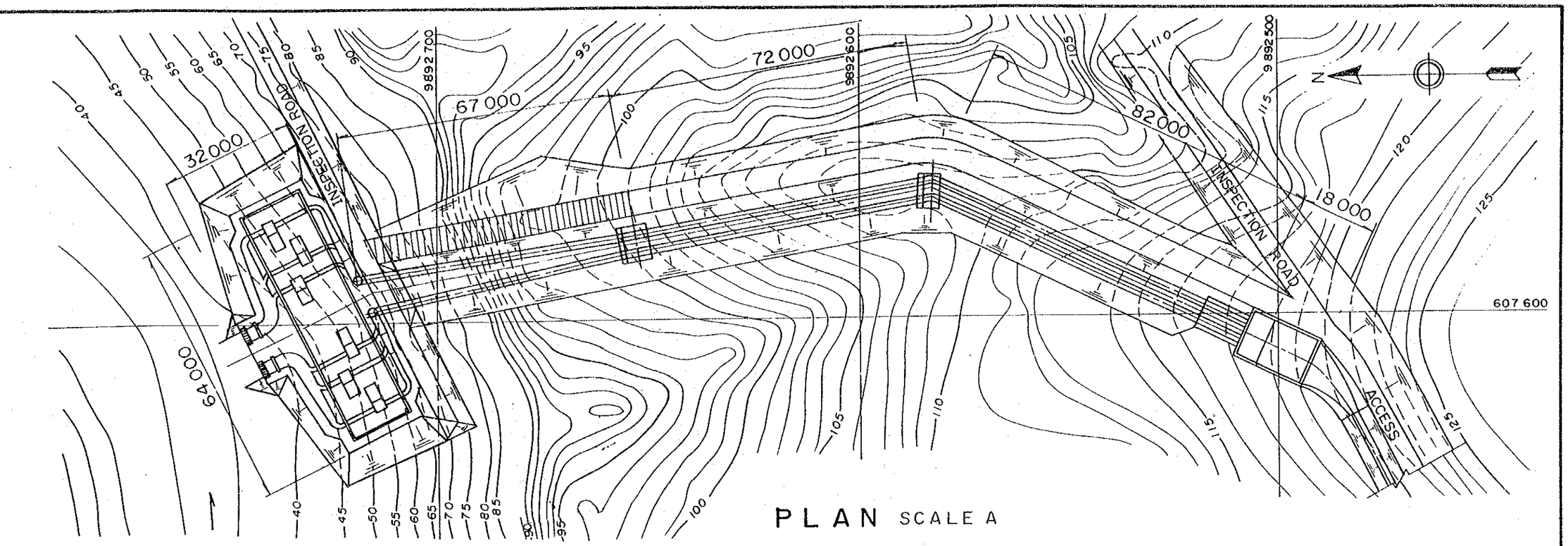
PLAN

SCALE

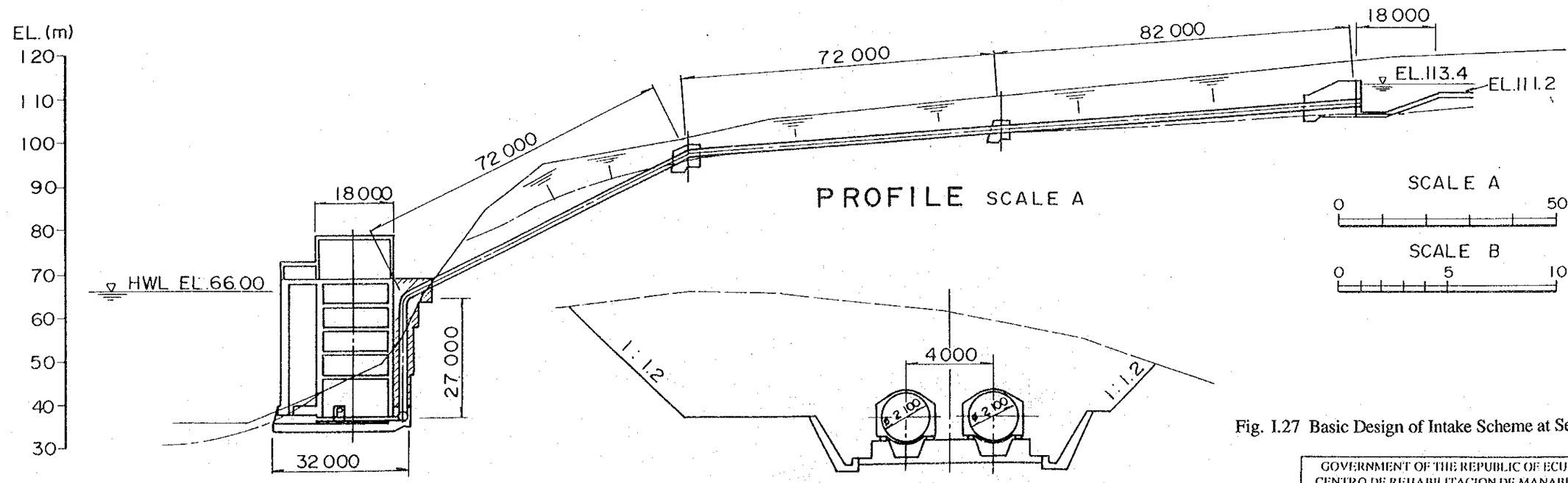
0 10 20 m

Fig. I.26 Basic Design of Pumping Station at Severino

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



PLAN SCALE A



PROFILE SCALE A

SCALE A
0 50m

SCALE B
0 5 10m

TYPICAL SECTION SCALE B

Fig. I.27 Basic Design of Intake Scheme at Severino

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

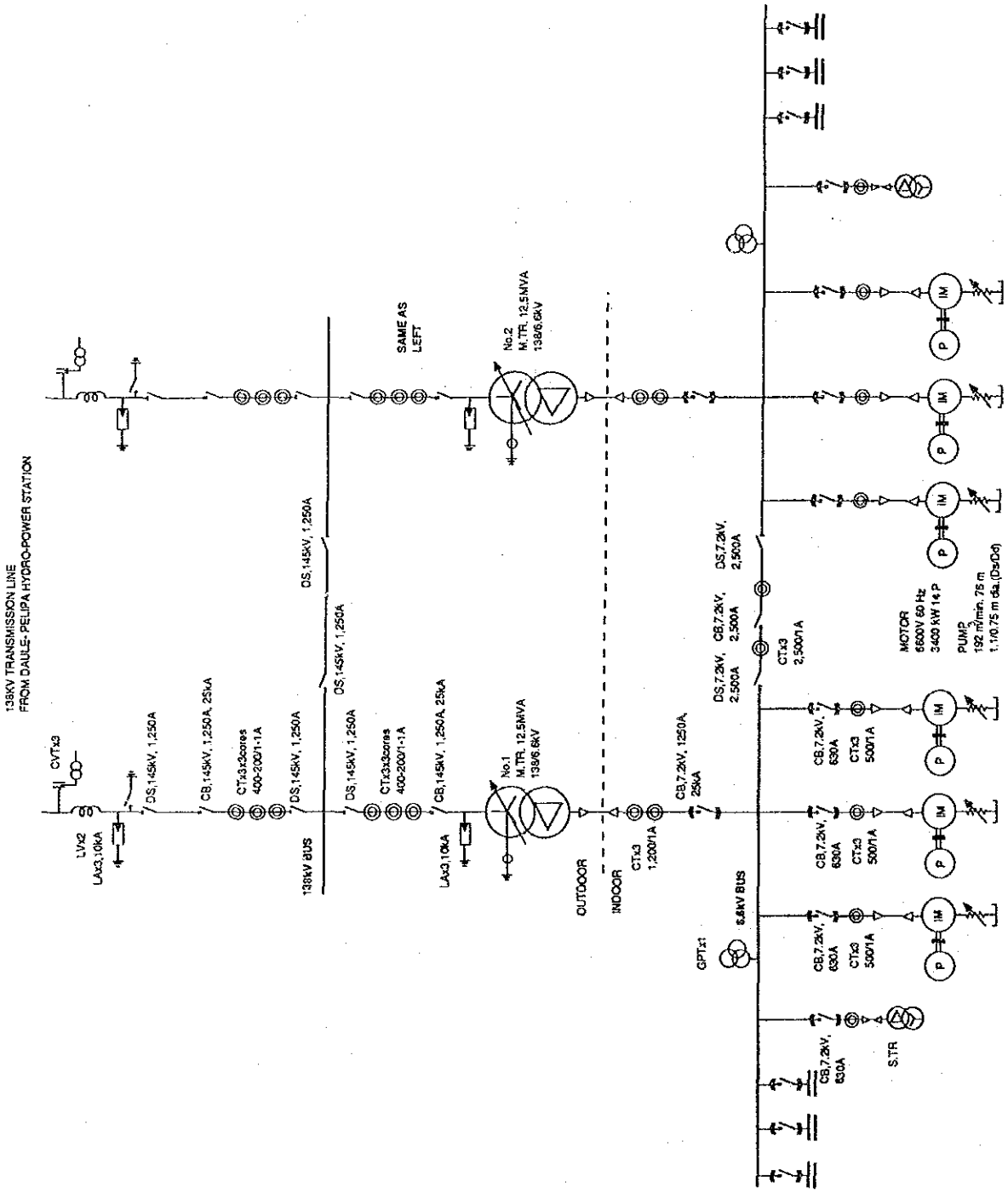
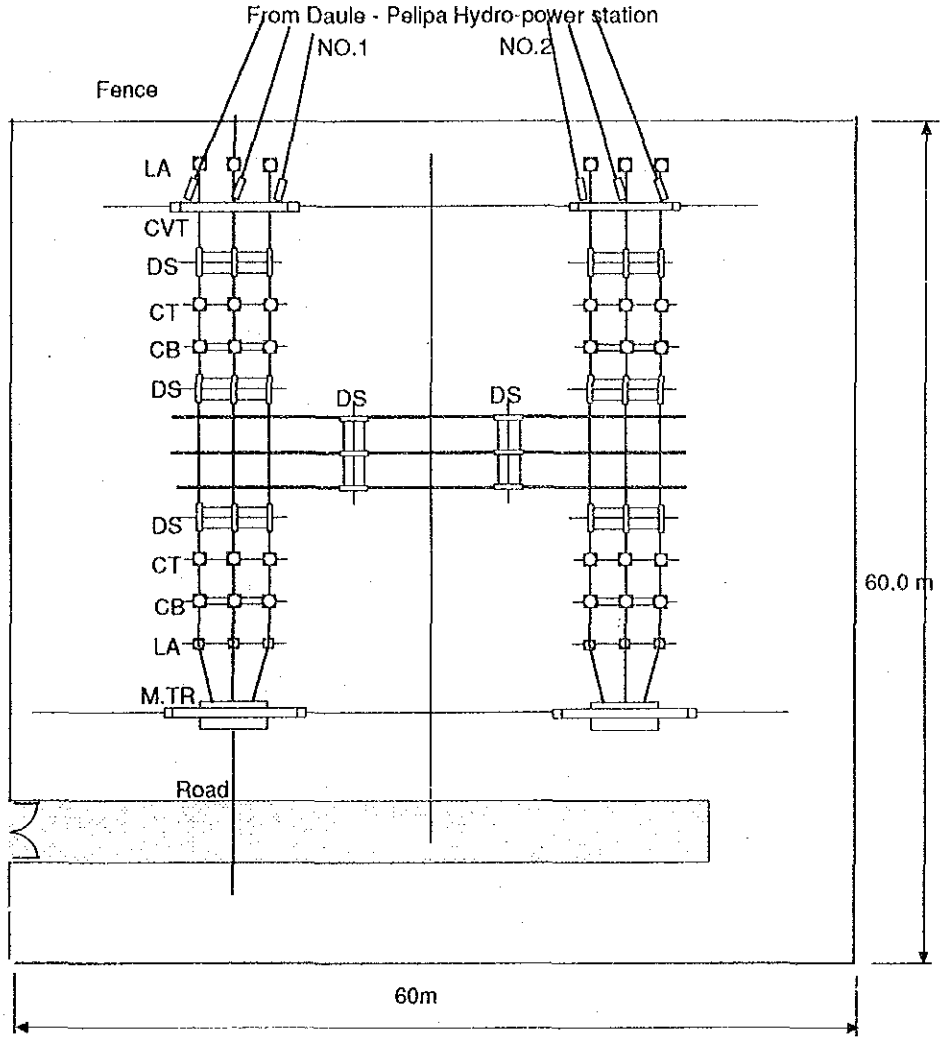


Fig. I.28 Single Line Diagram
for Severino Pumping Station

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



LA: Lightning Arrester
CVT: Capacitance Voltage Transformer
DS: Disconnecting Switch
CT: Current Transformer
CB: Circuit Breaker
M.TR Main Transformer

Fig. I.29 Layout of Outdoor Equipment

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

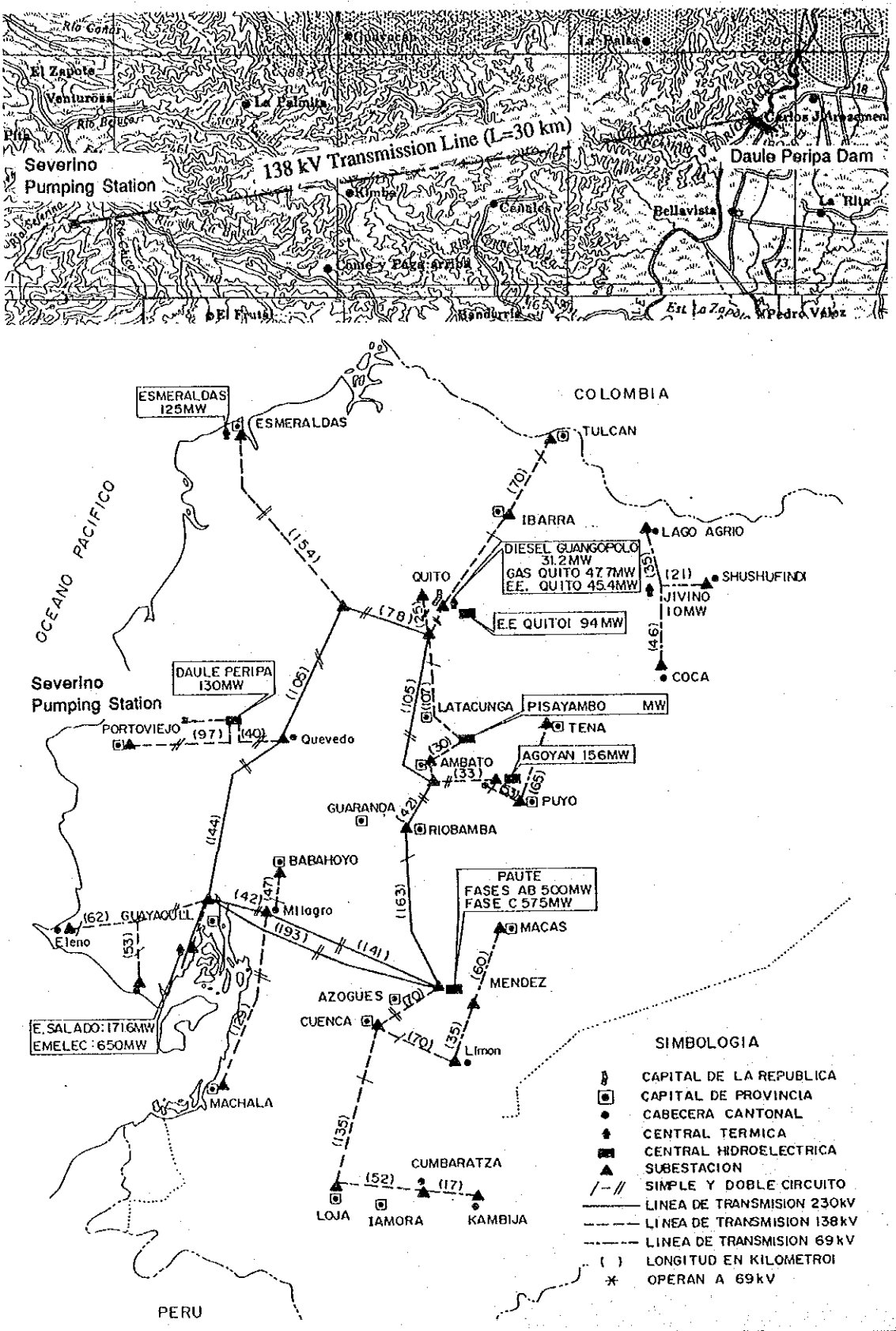


Fig. I.30 Route Map of 138 kV Transmission Line

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS

JAPAN INTERNATIONAL COOPERATION AGENCY

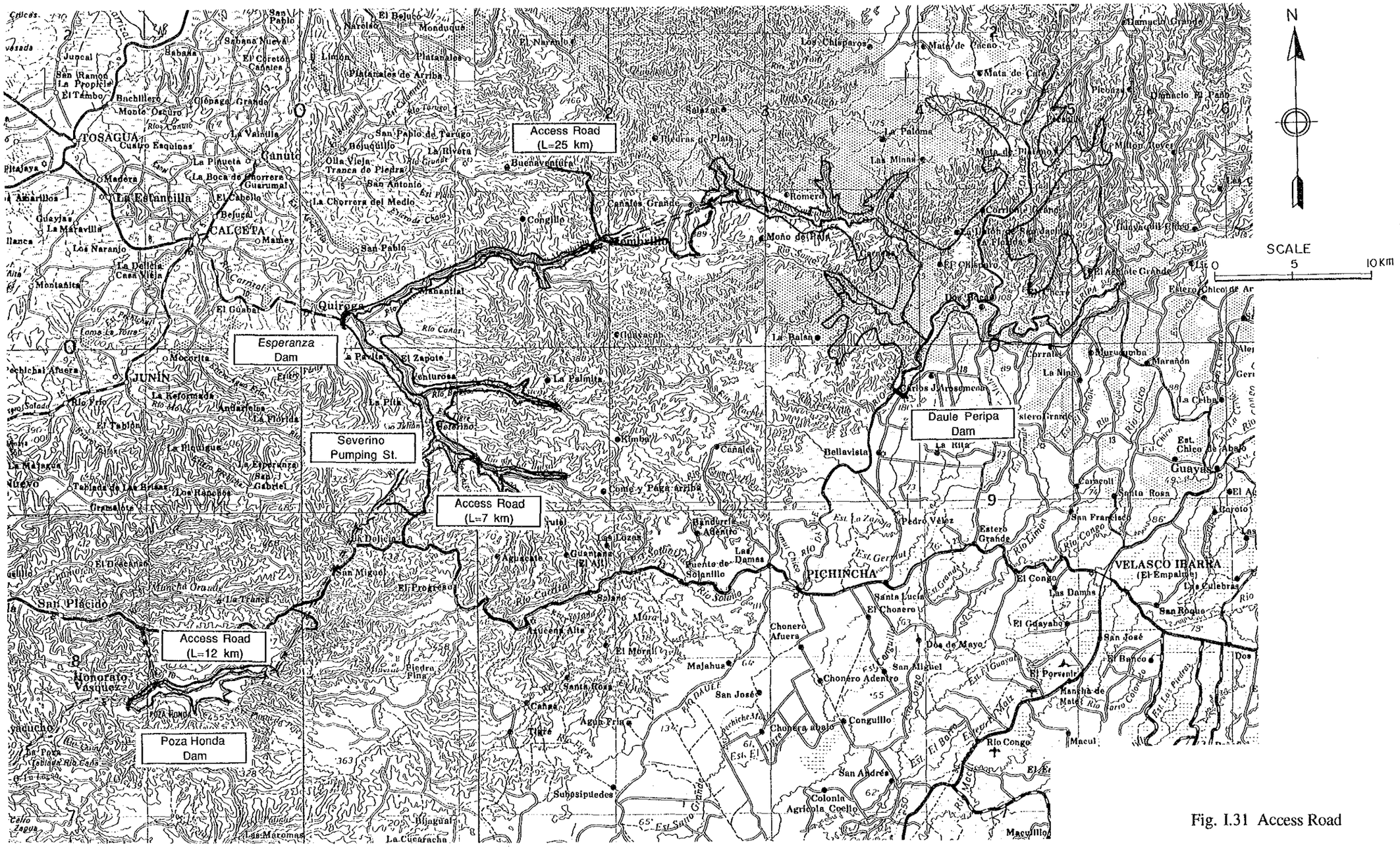
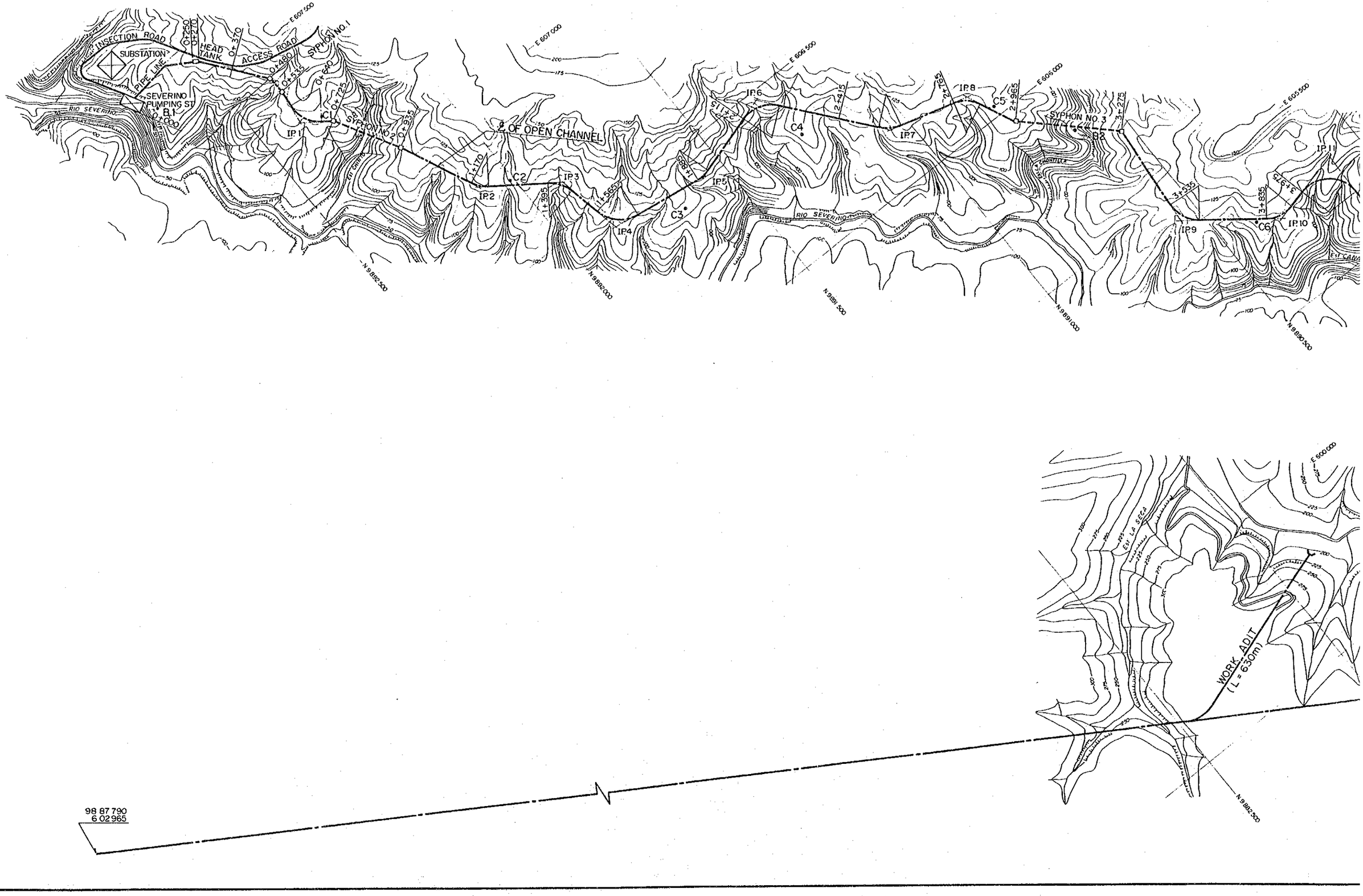
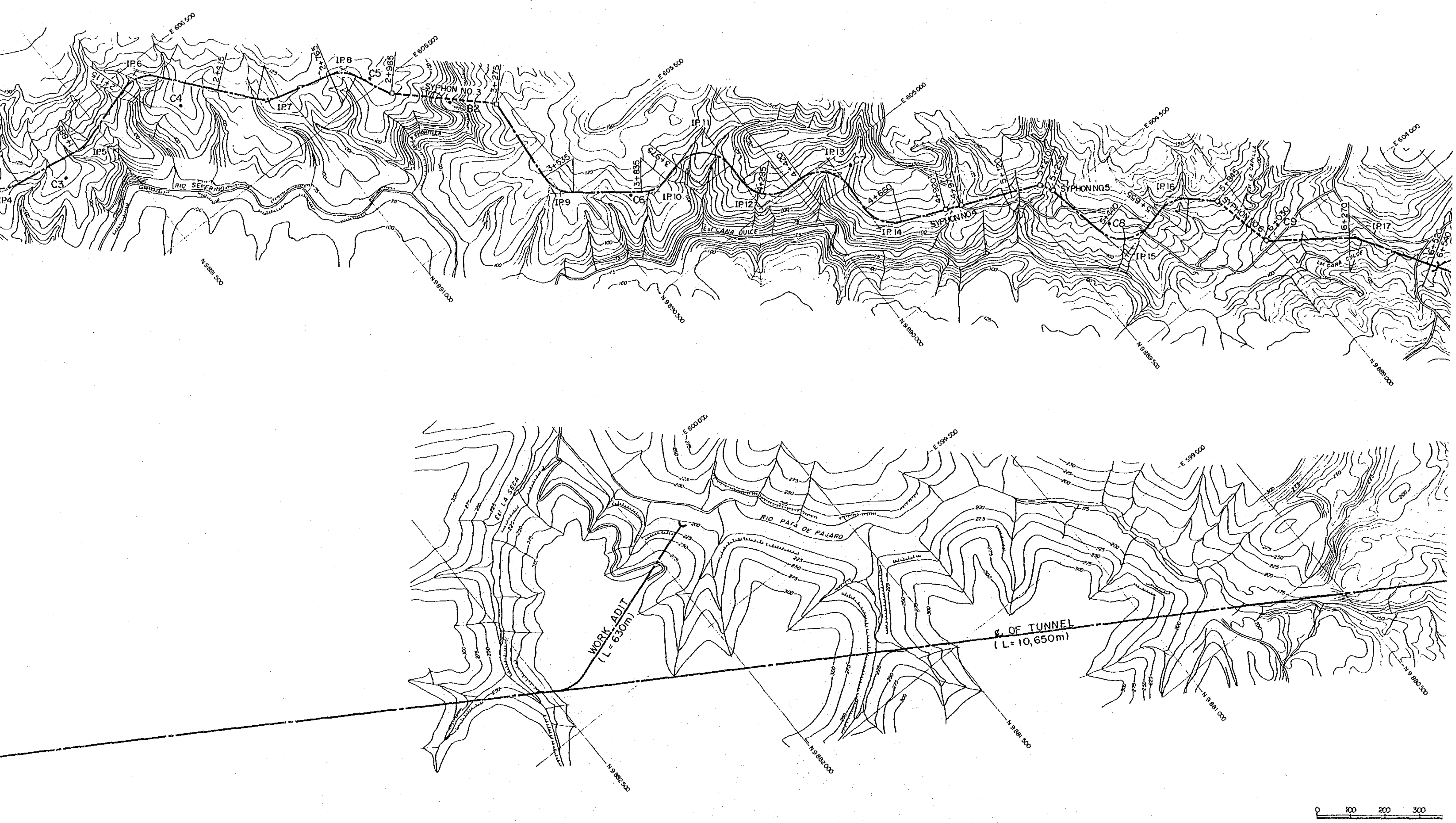


Fig. I.31 Access Road

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS

JAPAN INTERNATIONAL COOPERATION AGENCY


INSECTION ROAD
SUBSTATION
PIPE LINE
SEVERINO PUMPING ST
B1
0+000
RIO SEVERINO
0+250
0+270
HEAD TANK
0+370
ACCESS ROAD
0+480
SYPHON NO 1
0+535
0+640
0+725
E 607 500
E 607 000
E 606 500
E 606 000
E 605 500
N 9892 500
N 9892 000
N 9891 500
N 9891 000
N 9890 500
IP1
IP2
IP3
IP4
IP5
IP6
IP7
IP8
IP9
IP10
IP11
C1
C2
C3
C4
C5
C6
1+170
1+395
1+565
1+689
1+915
2+415
2+765
2+965
3+225
3+535
3+835
SYPHON NO 2
SYPHON NO 3
2 OF OPEN CHANNEL
RIO SEVERINO
FRONTERA
B2
WORK ADIT
(L = 630m)
E 600 000
N 9882 500
98 87 790
6 02 965



IP.4
IP.5
IP.6
IP.7
IP.8
IP.9
IP.10
IP.11
IP.12
IP.13
IP.14
IP.15
IP.16
IP.17
C3
C4
C5
C6
C7
C8
C9
B2
SYPHON NO. 3
SYPHON NO.4
SYPHON NO.5
2+415
2+765
2+965
3+275
3+535
3+835
4+285
4+660
4+920
5+210
5+440
6+030
6+270
RIO SEVERINO
EST. CANA DULCE
E 606 500
E 606 000
E 605 500
E 605 000
E 604 500
E 604 000
N 9 891 500
N 9 891 000
N 9 890 500
N 9 890 000
N 9 889 500
N 9 889 000
E 600 000
E 599 500
E 599 000
EST. LA SECA
RIO PATA DE PAJARO
WORK ADIT
(L = 630m)
℄ OF TUNNEL
(L = 10,650m)
N 9 882 500
N 9 882 000
N 9 881 500
N 9 881 000
N 9 880 500
0
100
200
300

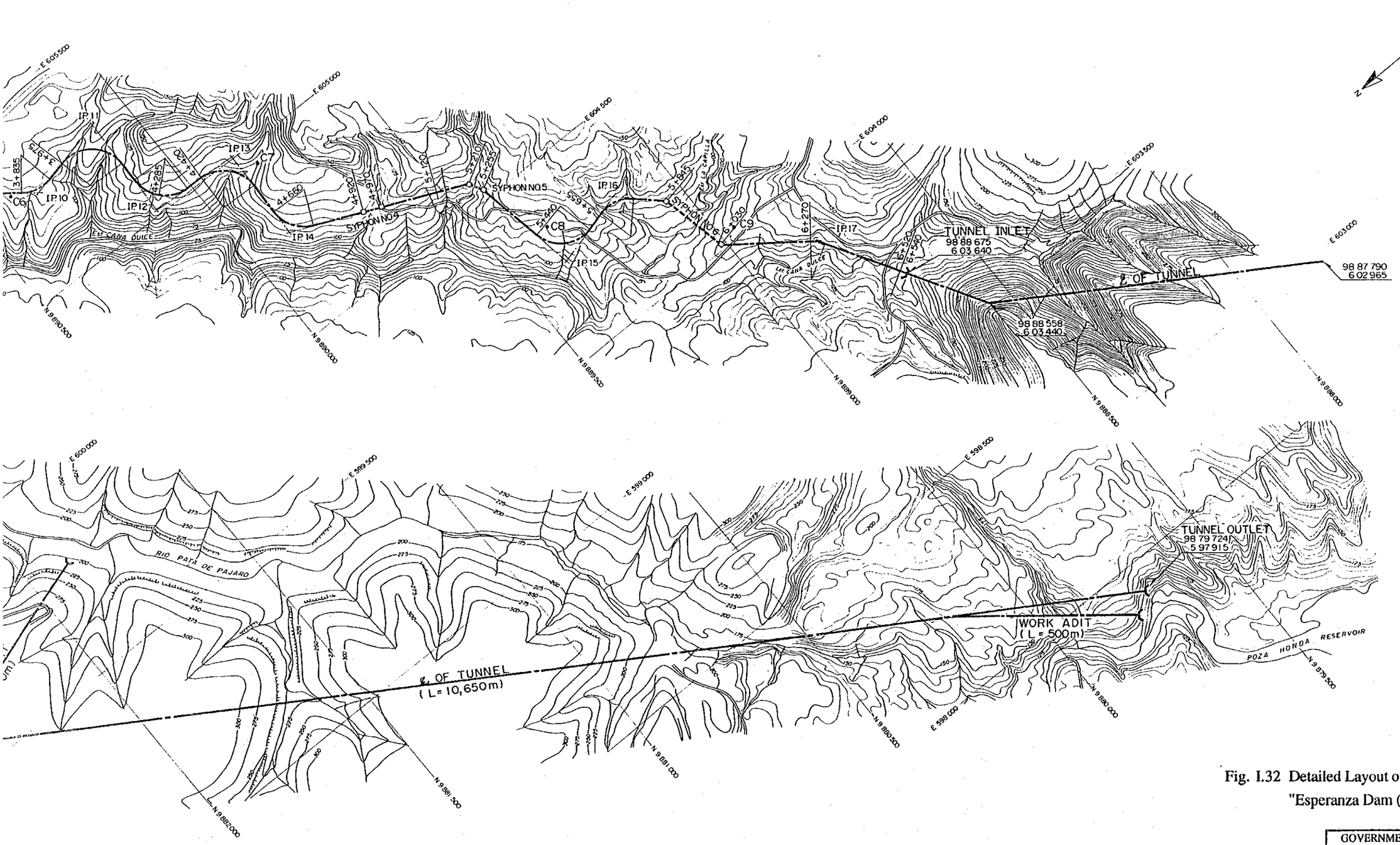
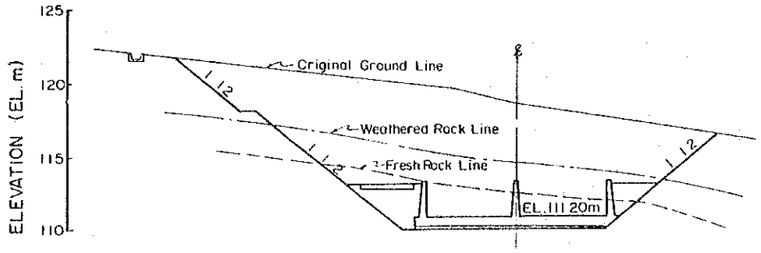


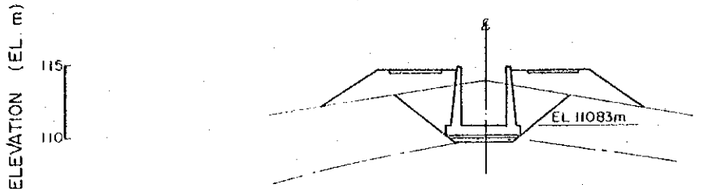
Fig. I.32 Detailed Layout of Water Transbasin Scheme
"Esperanza Dam (Severino) - Poza Honda Dam"

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS

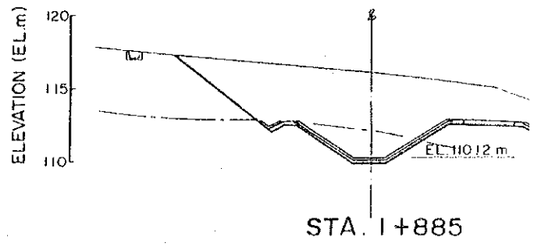
JAPAN INTERNATIONAL COOPERATION AGENCY



STA. 0+270



STA. 0+725



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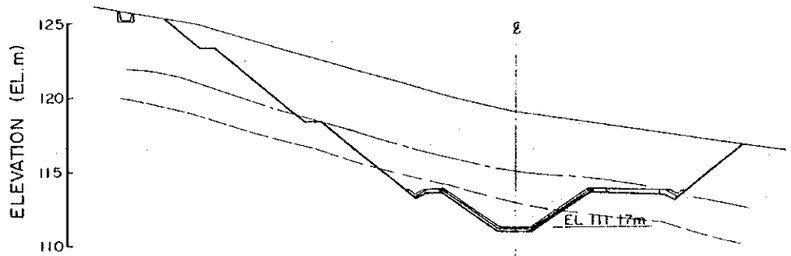

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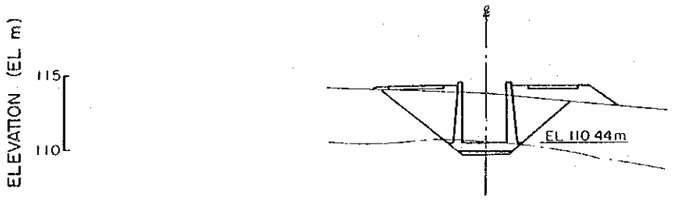
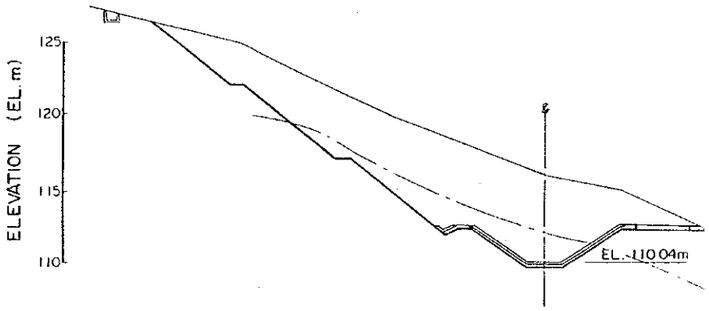
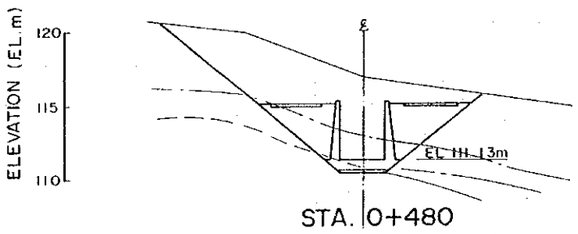


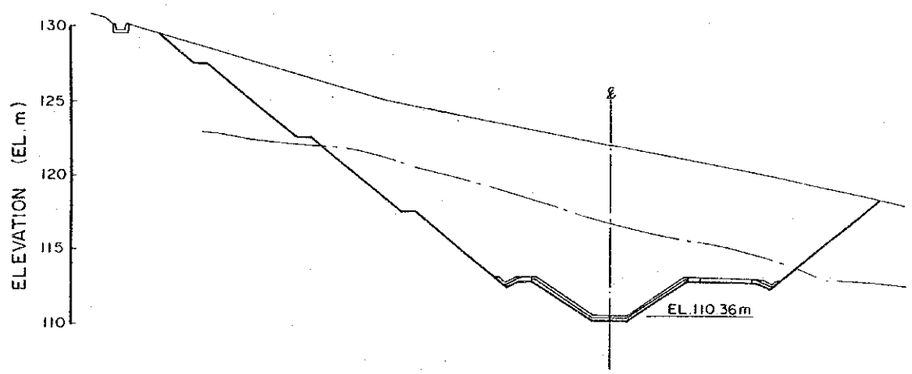
STA. 0+935



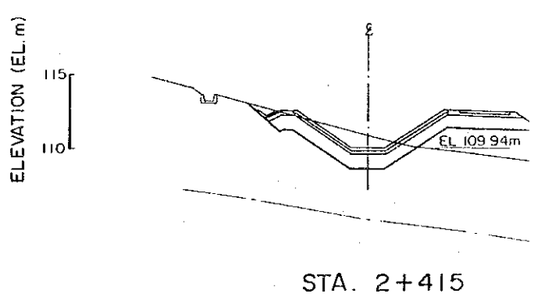
STA. 2+115



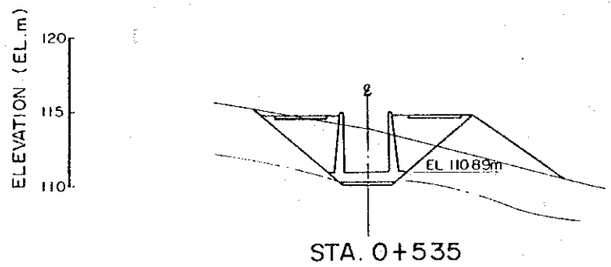
STA. 0+480



STA. 1+170



STA. 2+415



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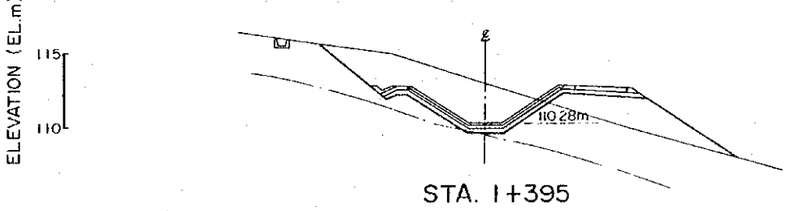
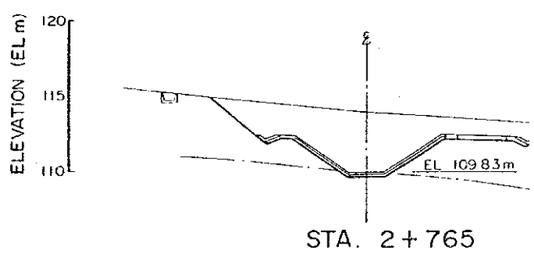


STA. 1+395



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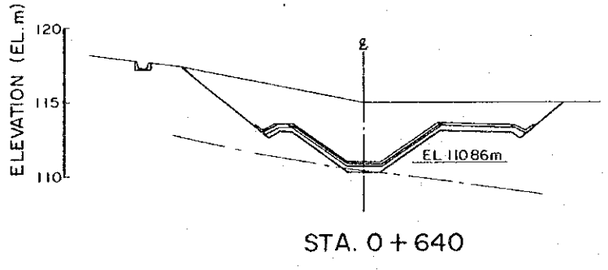

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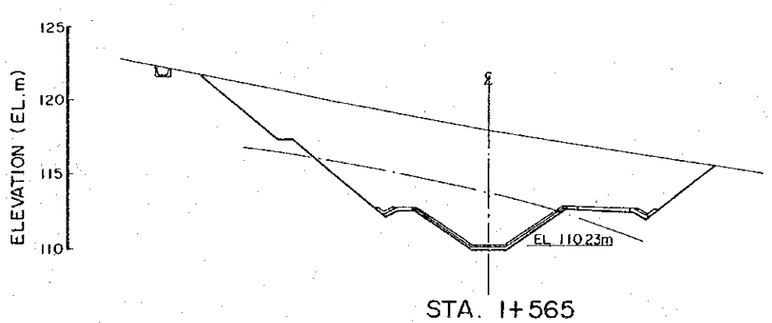

STA. 1+565

Fig. I.33 Cross Section of

SCALE
0 5 10 20m

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CENTRO DE REHABILITAC
THE FEASIBILITY STU
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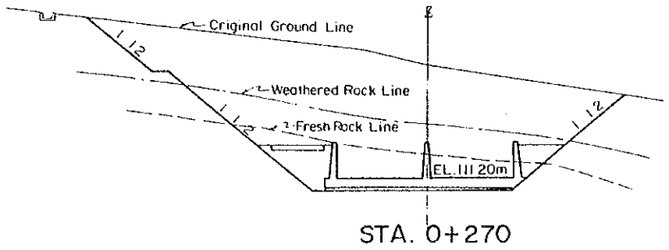

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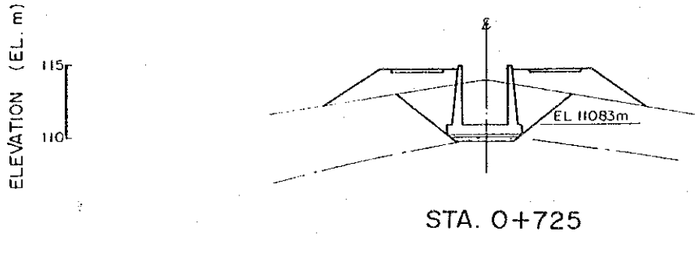

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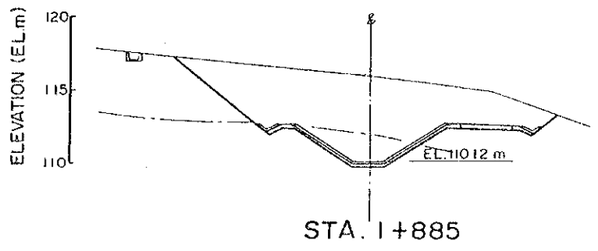

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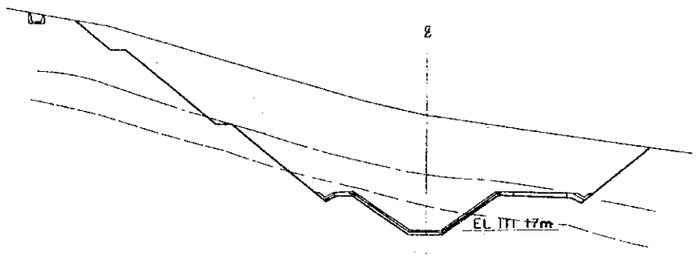

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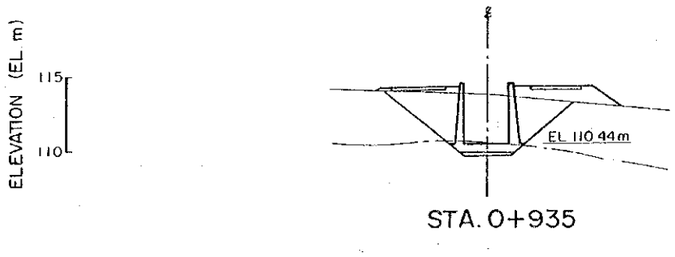

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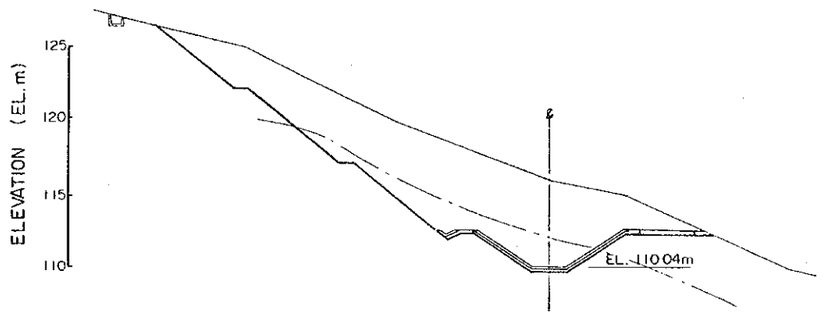

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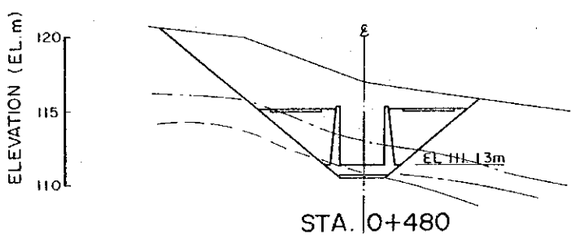

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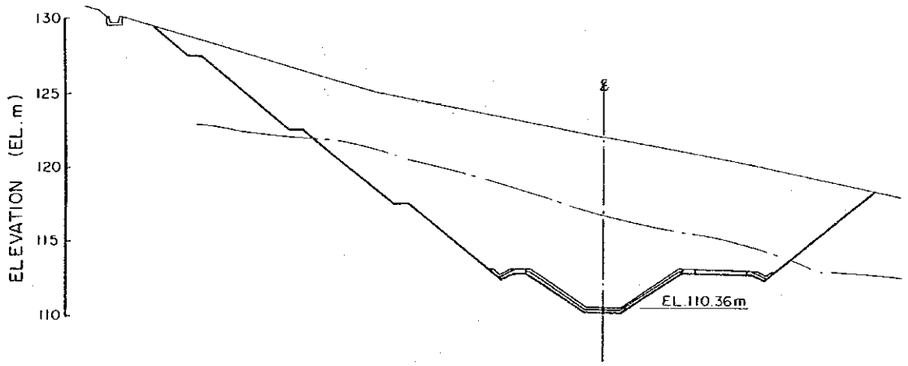

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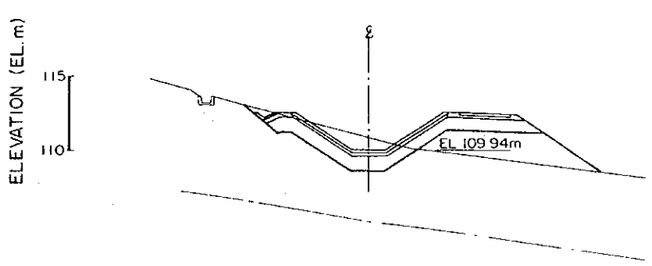

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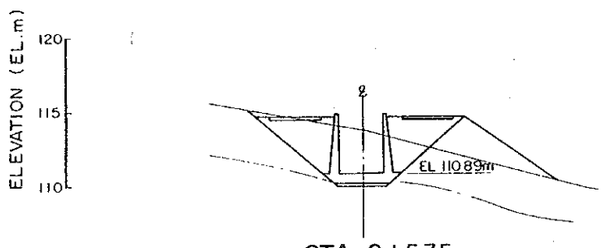

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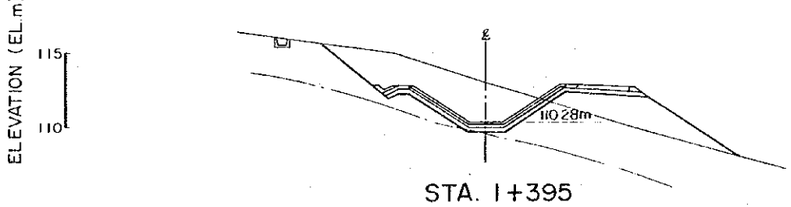

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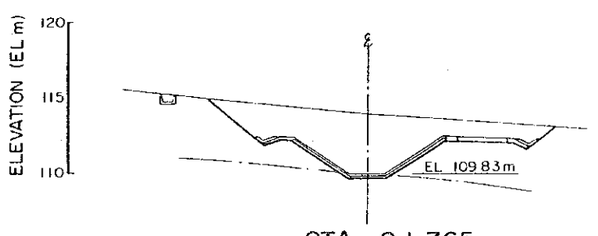

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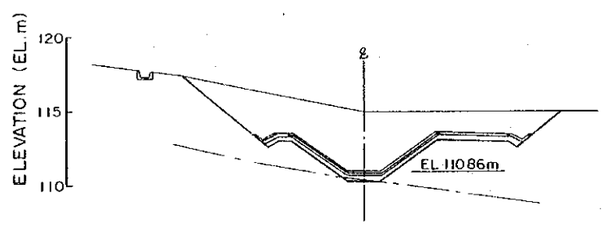

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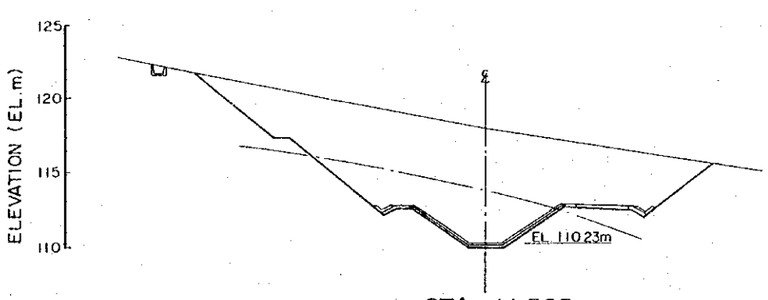
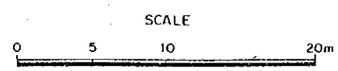


STA. 1+565

Fig. I.33 Cross Section of Open Channel (1/2)



GOVERNMENT OF THE REPUBLIC OF ECUADOR
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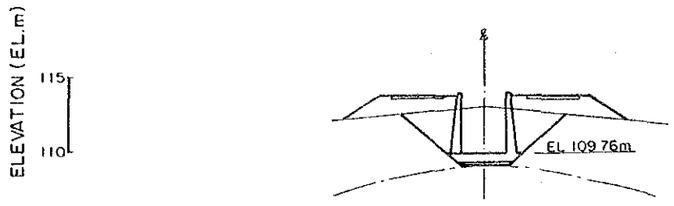
JAPAN INTERNATIONAL COOPERATION AGENCY



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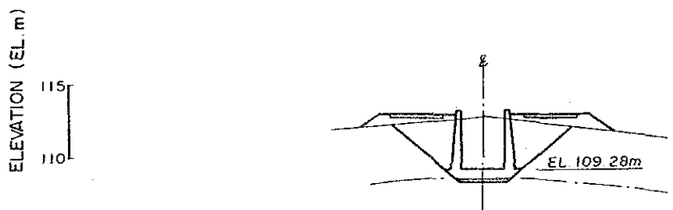

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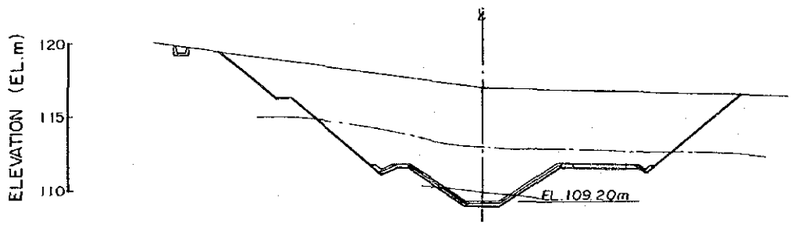

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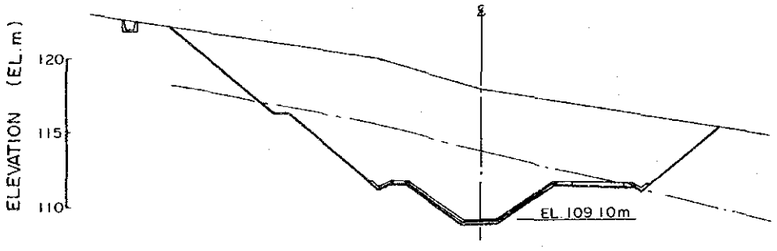

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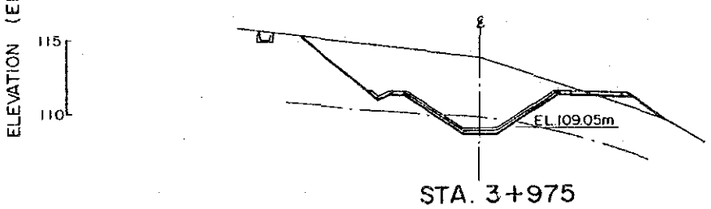

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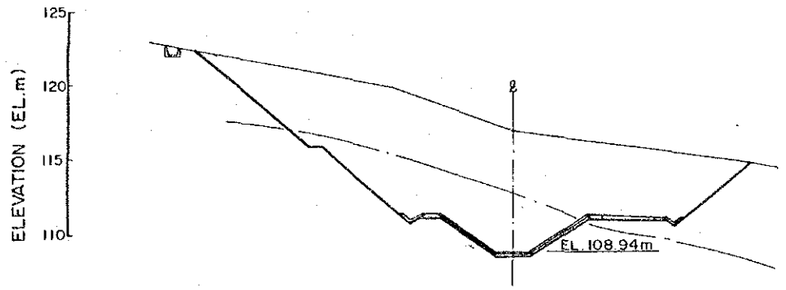
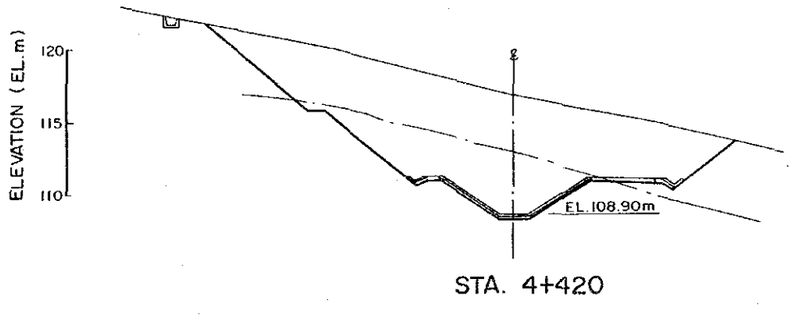


STA. 4+295



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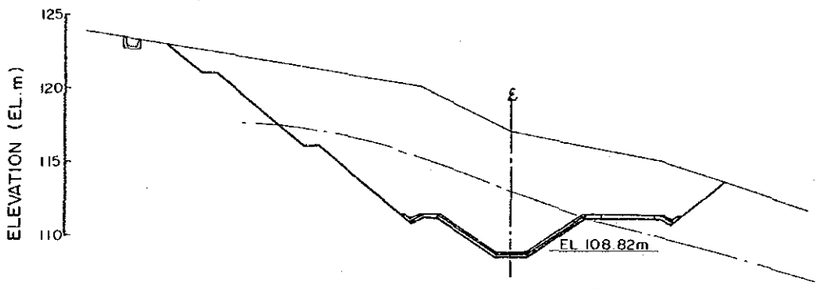
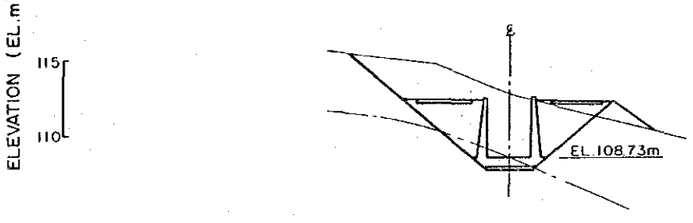
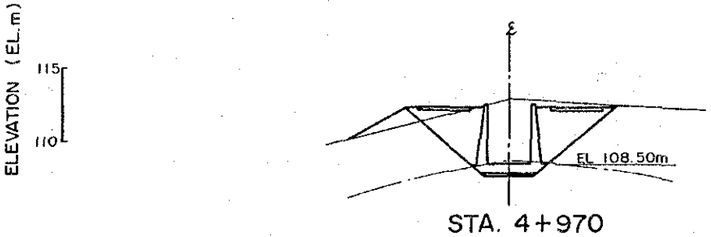


STA. 4+660



STA. 4+920



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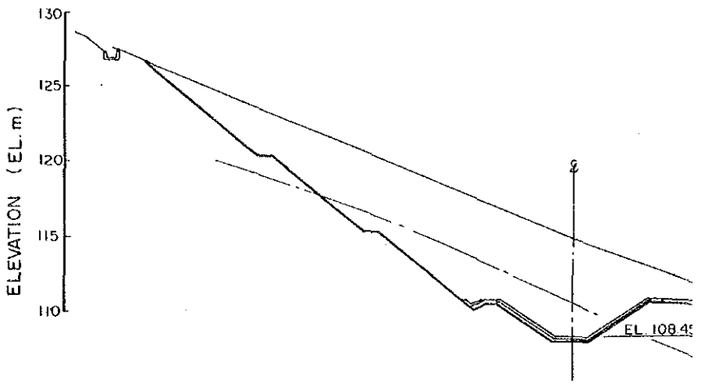

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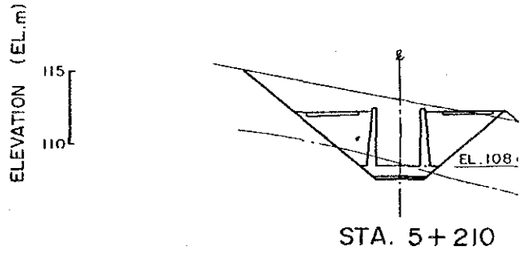

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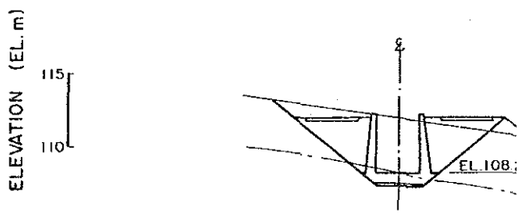

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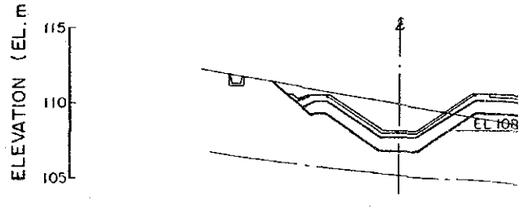

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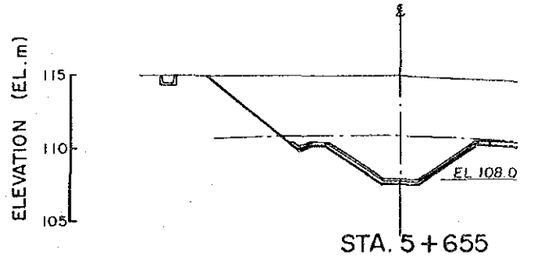

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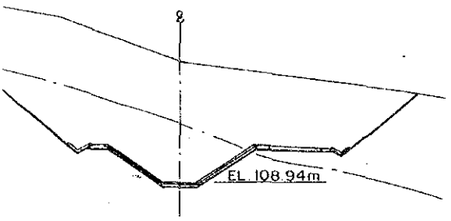
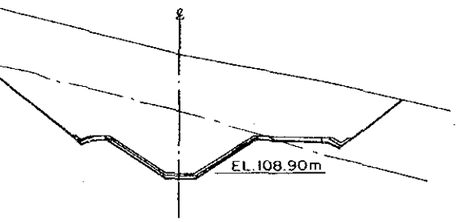
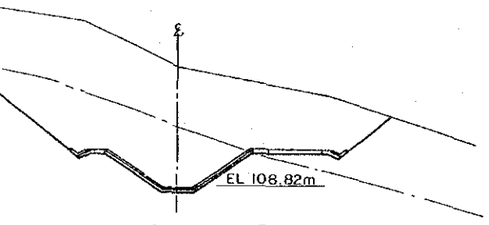


STA. 4+295



STA. 4+420



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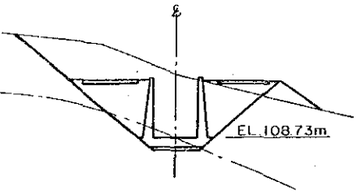
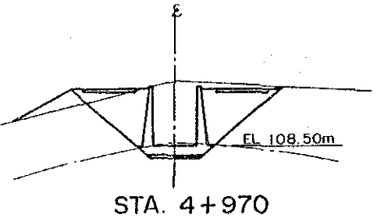
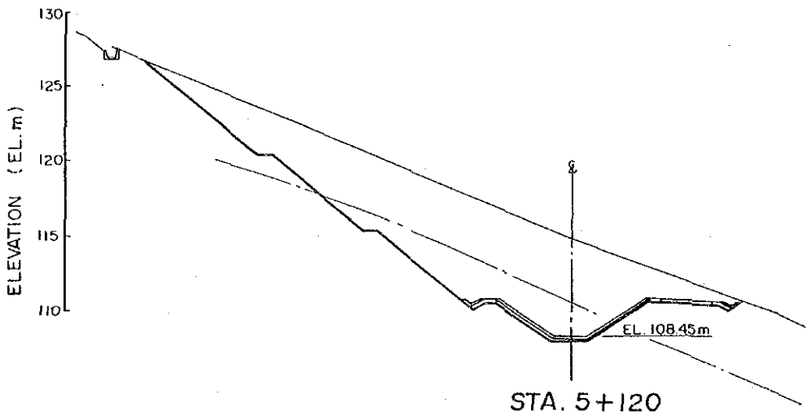


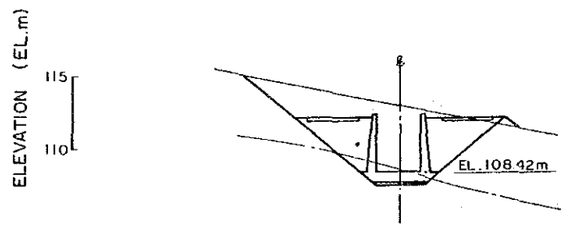
STA. 4+920



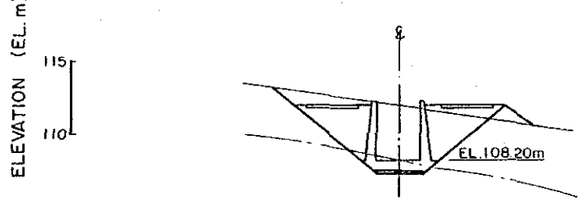
STA. 4+970



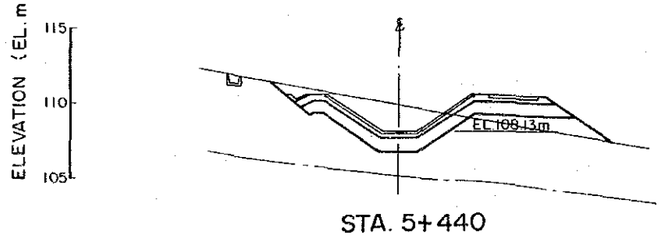
STA. 5+120



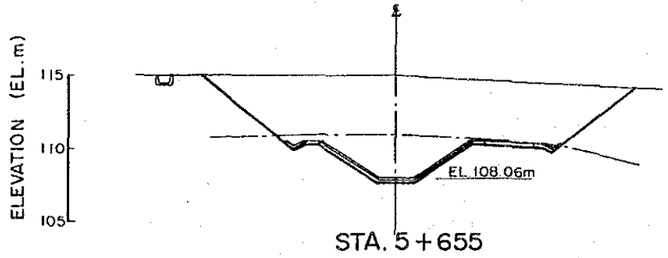
STA. 5+210



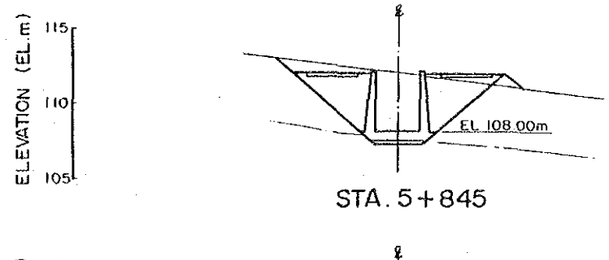
STA. 5+255



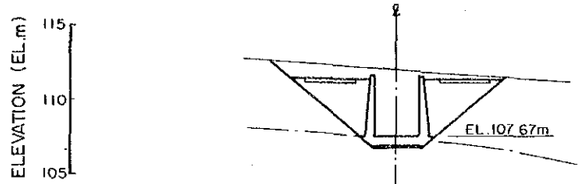
STA. 5+440



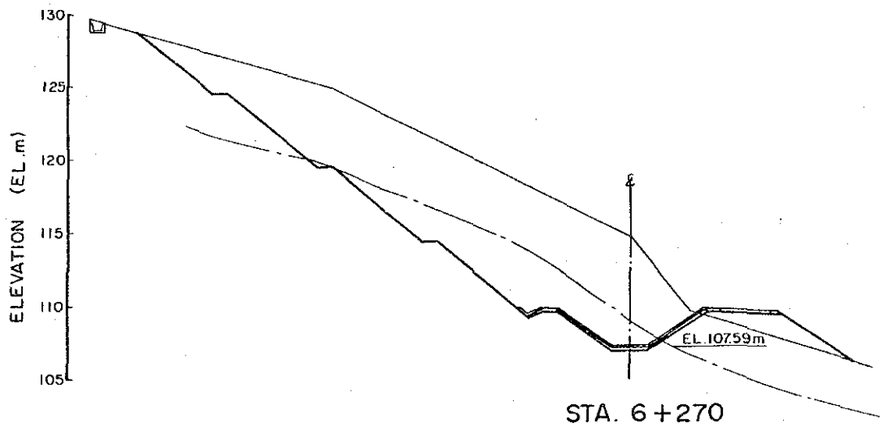
STA. 5+655



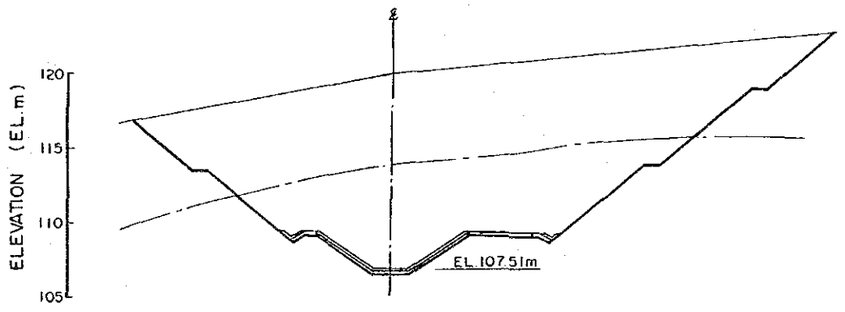
STA. 5+845



STA. 6+030

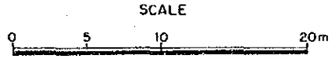


STA. 6+270



STA. 6+520

Fig. I.33 Cross Section of Open Channel (2/2)



GOVERNMENT OF THE REPUBLIC OF ECUADOR
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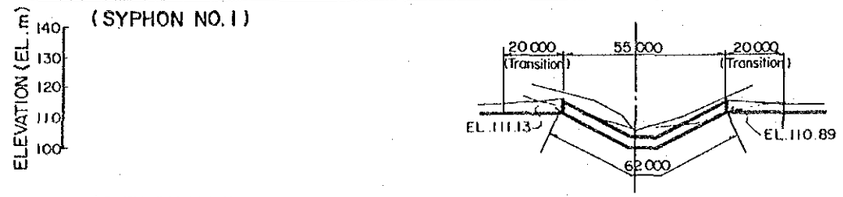
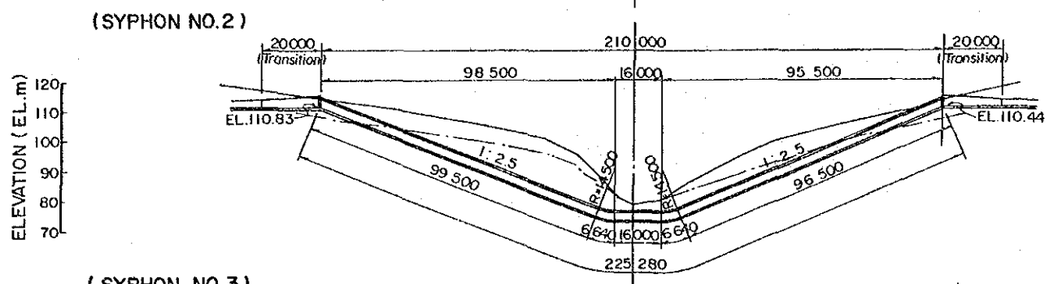
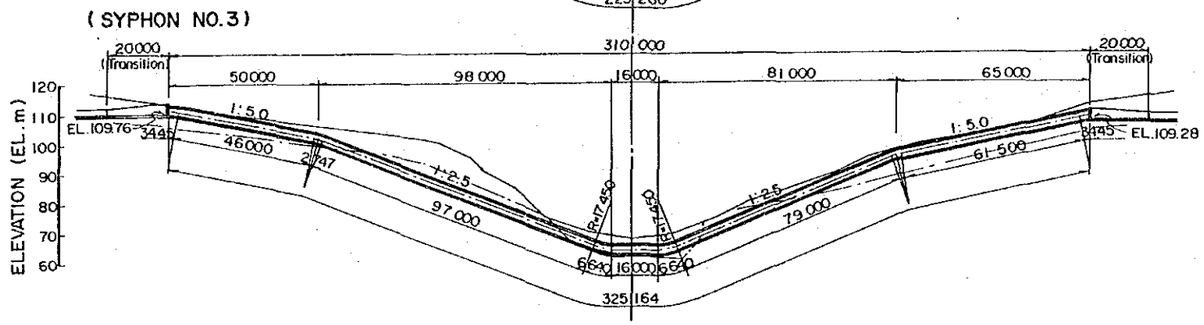
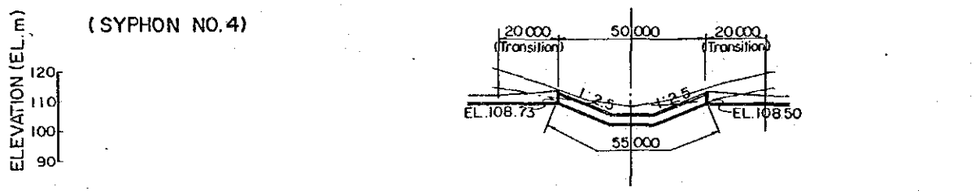
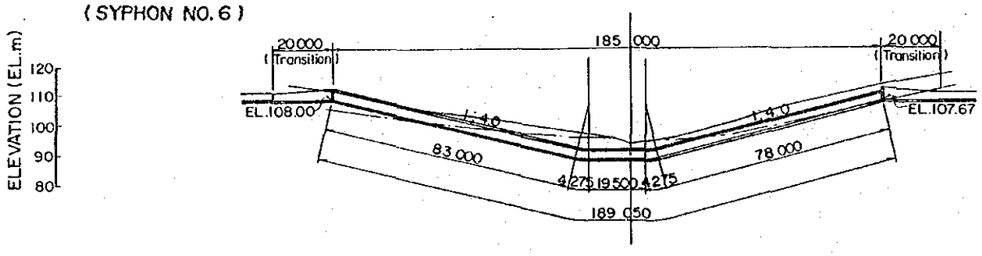
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR *CHONE-PORTOVIEJO RIVER BASINS*
JAPAN INTERNATIONAL COOPERATION AGENCY



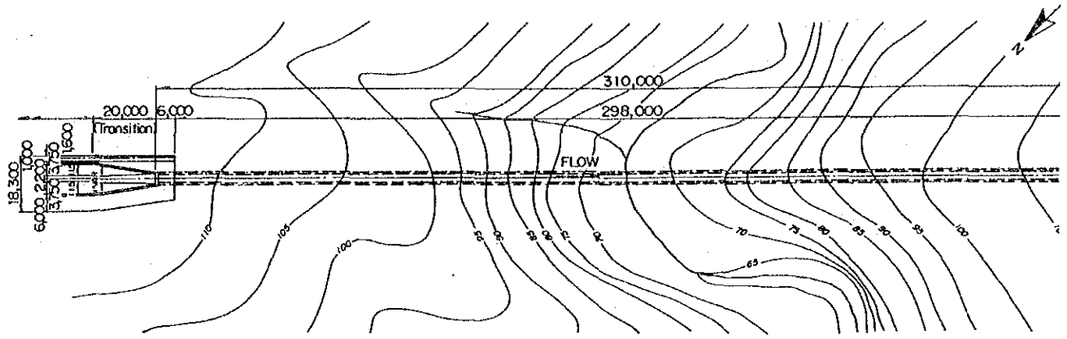




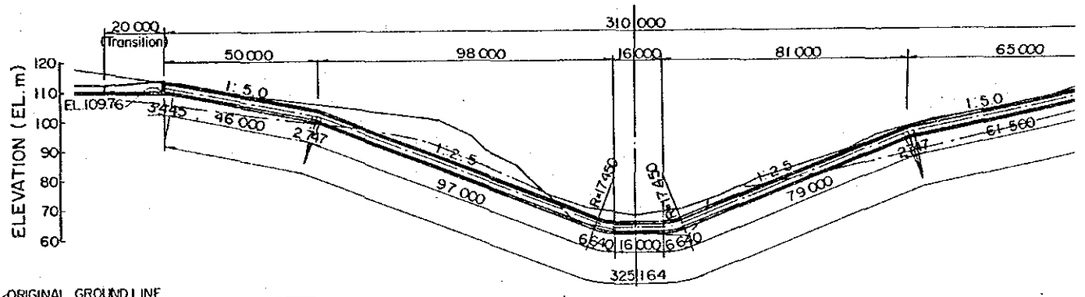




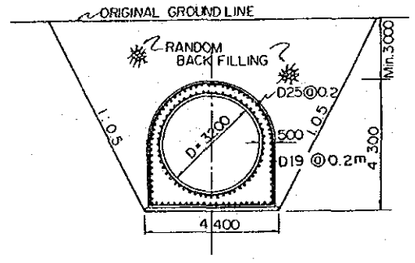
PROFILE OF SYPHON (No.1 - No.6) SCALE A



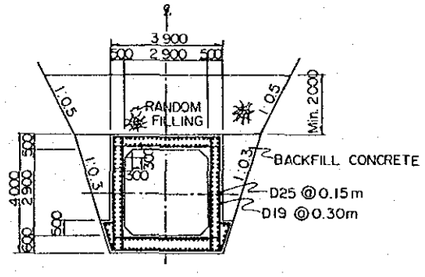
PLAN OF SYPHON No.3 SCALE A



PROFILE OF SYPHON No.3 SCALE A



TYPICAL SECTION OF SYPHON NO.2 AND NO.3
SCALE B



TYPICAL SECTION OF SYPHON NO.1, NO.4 - NO.6
SCALE B

SCALE A 0 10 20 30 40 50

SCALE B 0 1 2 3 4 5

Fig. I.34 B

GOVERNMENT
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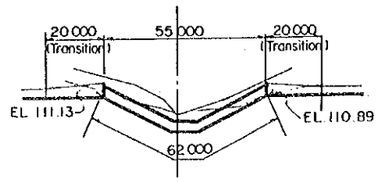
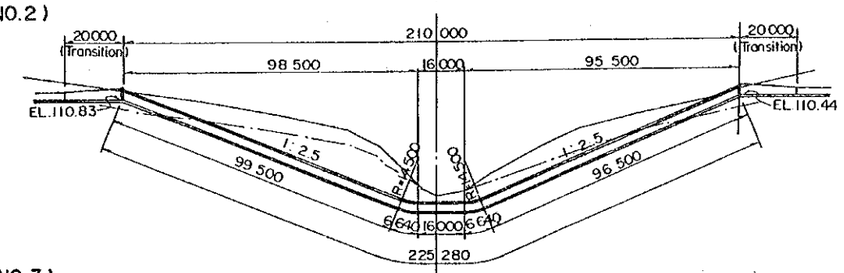
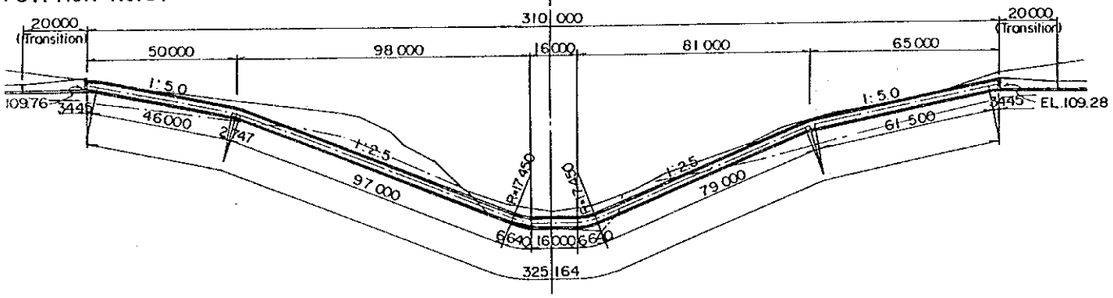
(SYPHON NO.1)



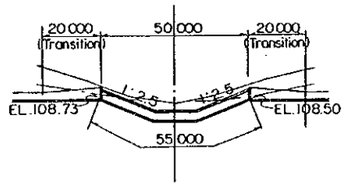
(SYPHON NO.2)



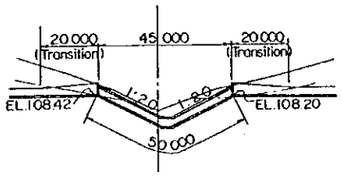
(SYPHON NO.3)



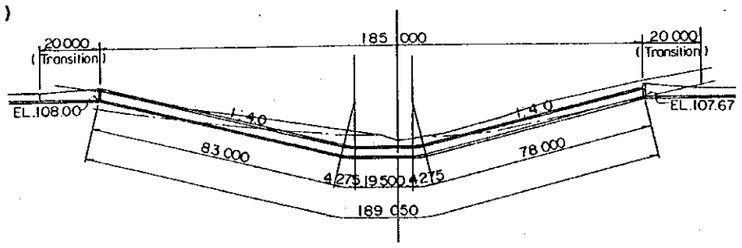
(SYPHON NO.4)



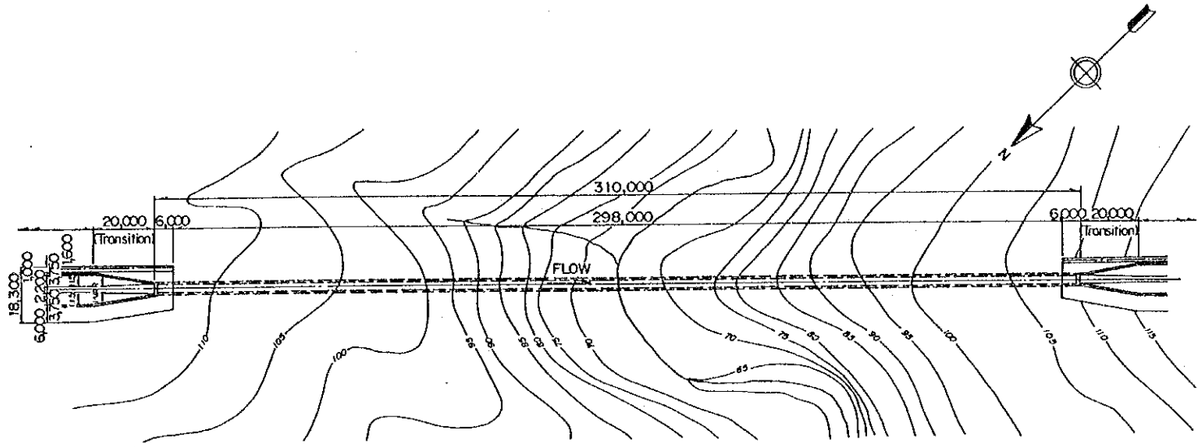
(SYPHON NO.5)



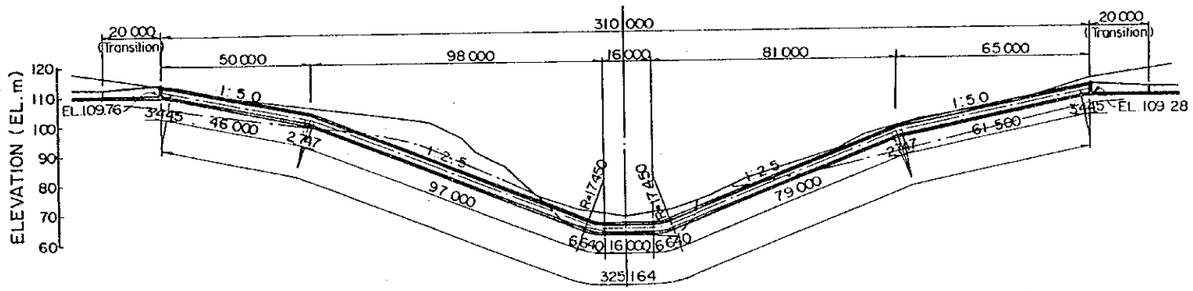
(SYPHON NO.6)



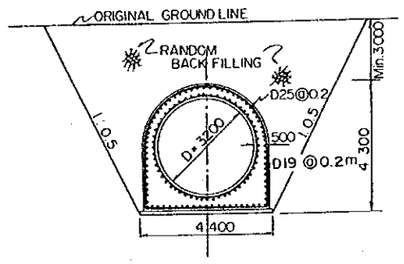
PROFILE OF SYPHON (No.1 - No.6) SCALE A



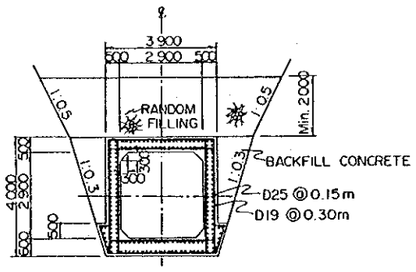
PLAN OF SYPHON No.3 SCALE A



PROFILE OF SYPHON No.3 SCALE A



TYPICAL SECTION OF SYPHON NO.2 AND NO.3
SCALE B



TYPICAL SECTION OF SYPHON NO.1, NO.4 - NO.6
SCALE B

SCALE A 0 10 20 30 40 50 100m

SCALE B 0 1 2 3 4 5 10m

Fig. I.34 Basic Design of Syphons

GOVERNMENT OF THE REPUBLIC OF ECUADOR
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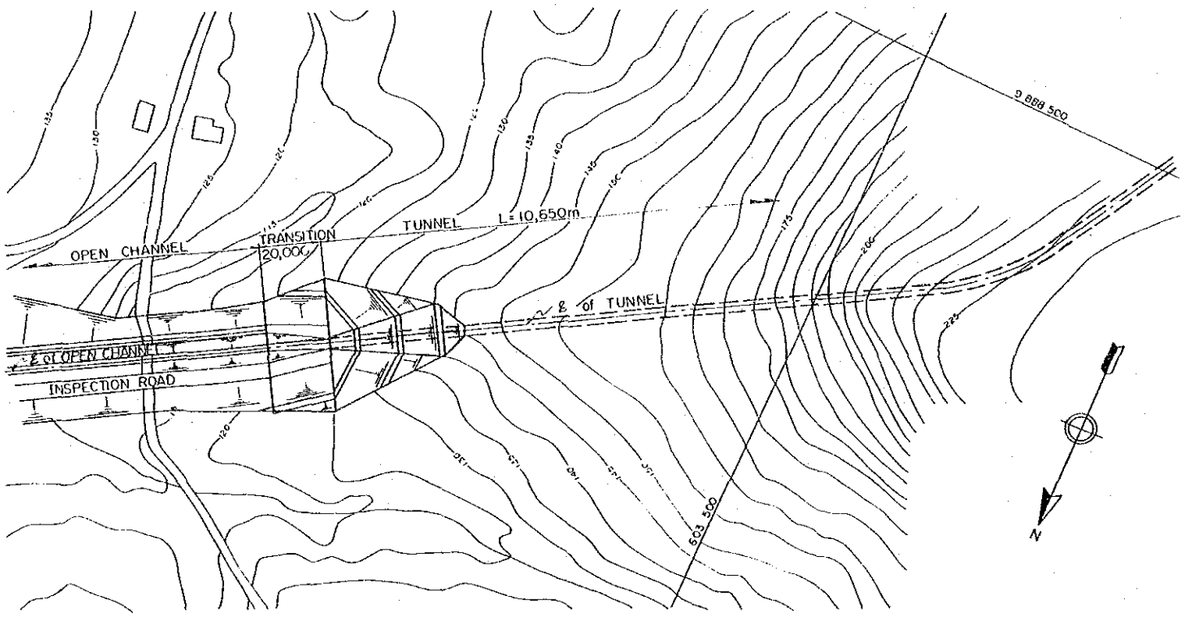
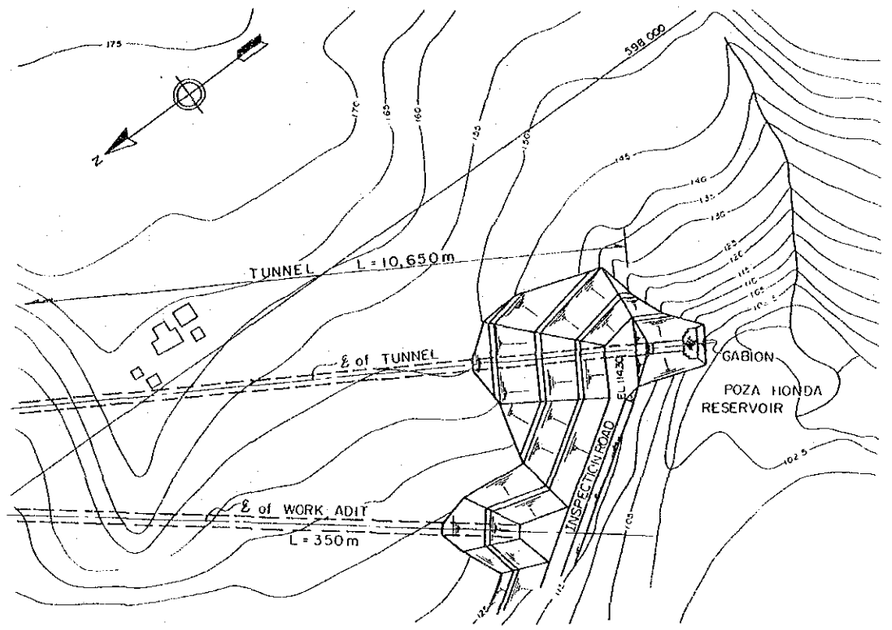
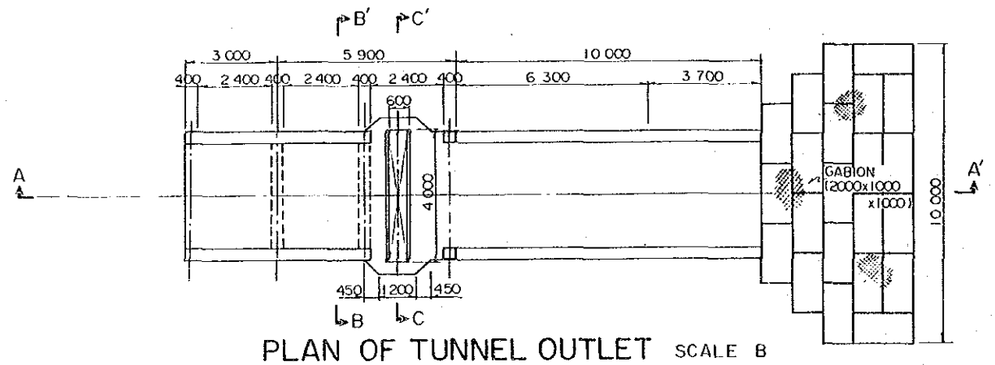
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



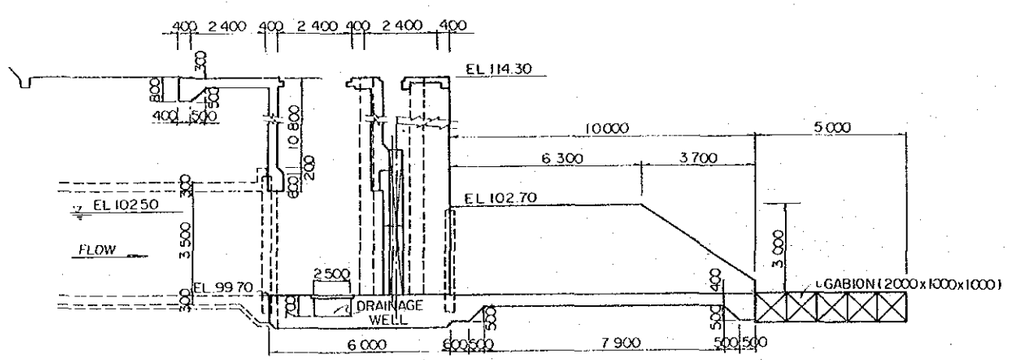
LAYOUT PLAN OF TUNNEL INLET SCALE A



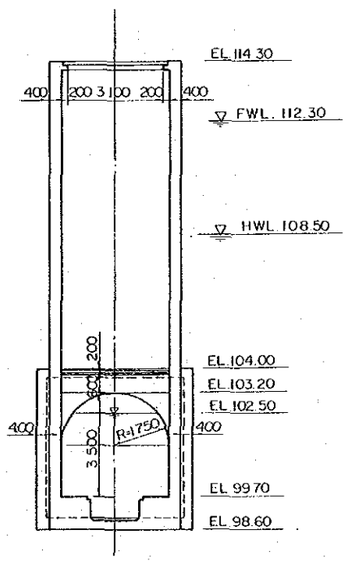
LAYOUT PLAN OF TUNNEL OUTLET SCALE A



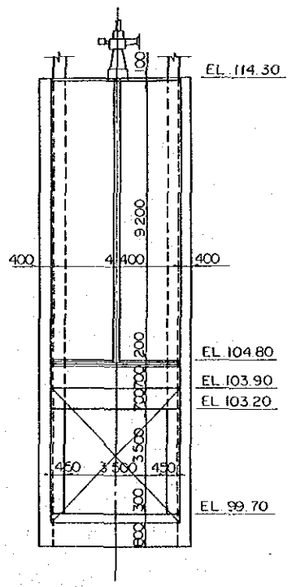
PLAN OF TUNNEL OUTLET SCALE B



SECTION A – A′ SCALE B



SECTION OF OUTLET B – B′
SCALE B



SECTION OF OUTLET C–C′
SCALE B

SCALE A 0 50 100m

SCALE B 0 5 10m

Fig. I.35 Basic Design of Tunnel Inlet and Outlet for Water Transbasin Scheme "Esperanza (Severino) - Poza Honda Dam"

GOVERNMENT OF THE REPUBLIC OF ECUADOR
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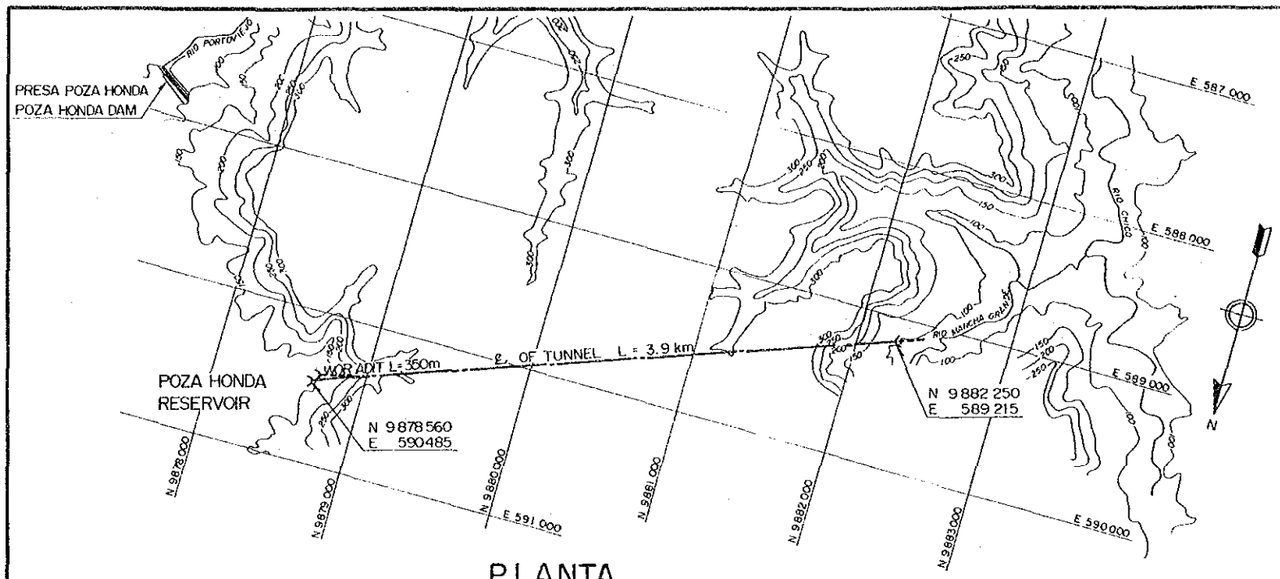
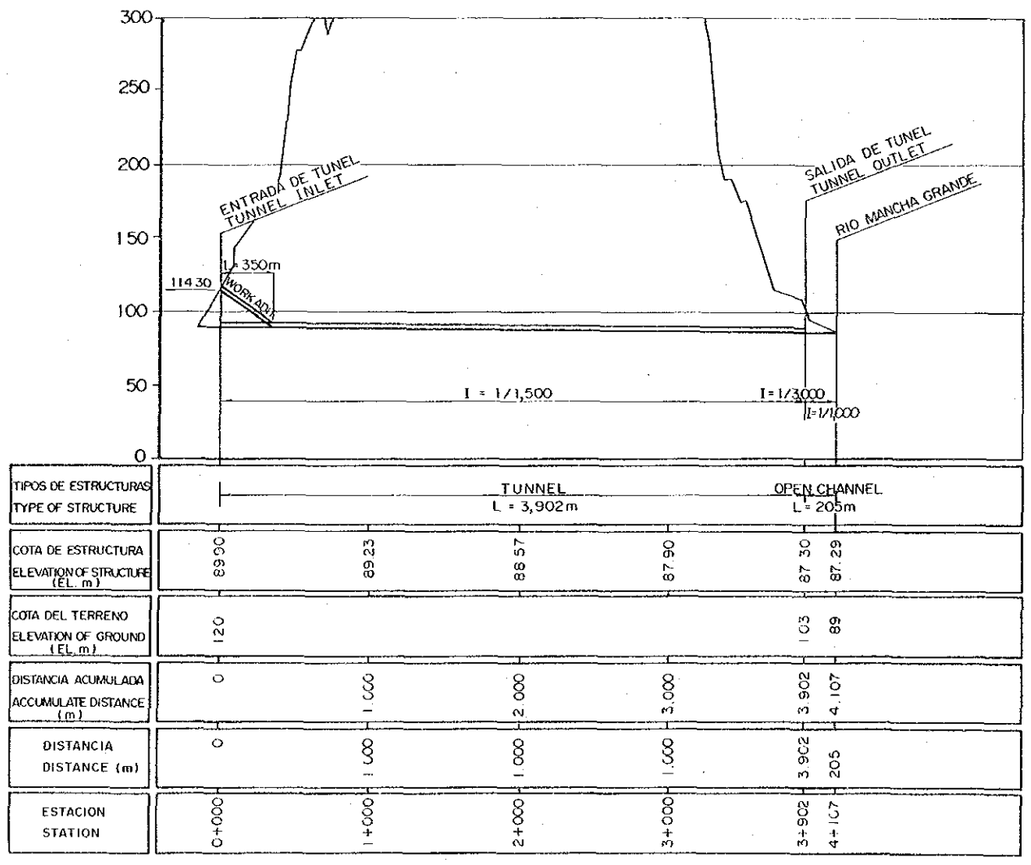
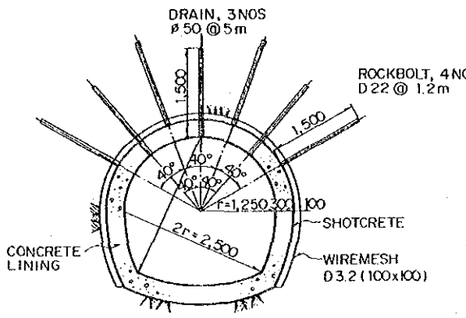
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



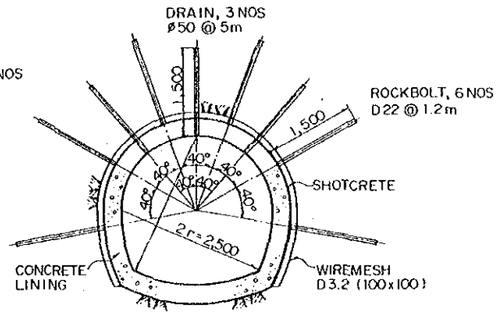
PLANTA
PLAN SCALE A



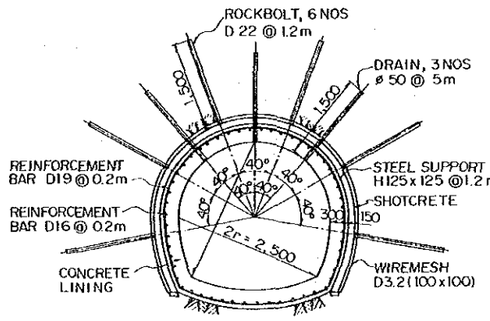
PERFIL
PROFILE H; SCALE A
V; SCALE B



TYPE I



TYPE II



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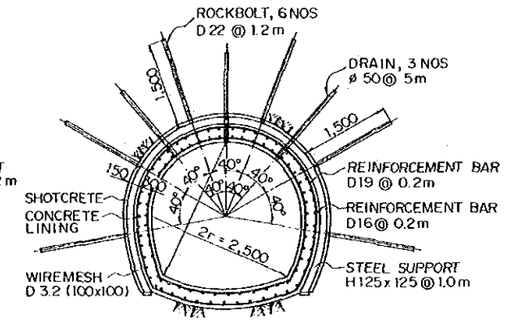

TYPE IV

TUNNEL SECTION SCALE C

SCALE A 0 500 1,000 2,000m

SCALE B 0 50 100 200m

SCALE C 0 1 2 3 4 5m

Fig. I.36 Basic Design of Water Transbasin Scheme "Poza Honda Dam - Rio Mancha Grande"

GOVERNMENT OF THE REPUBLIC OF ECUADOR
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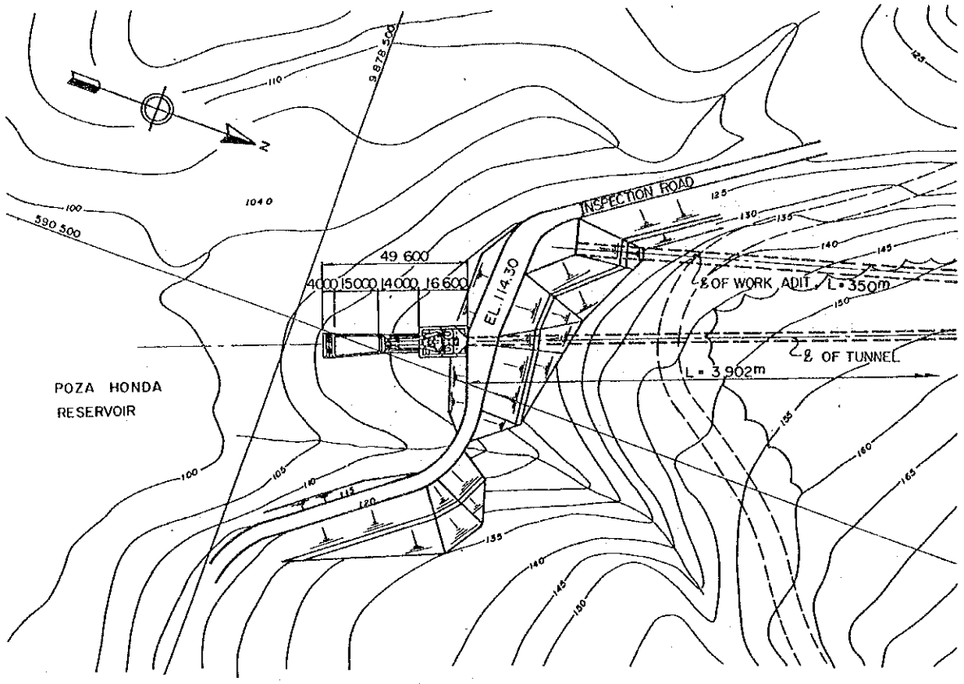
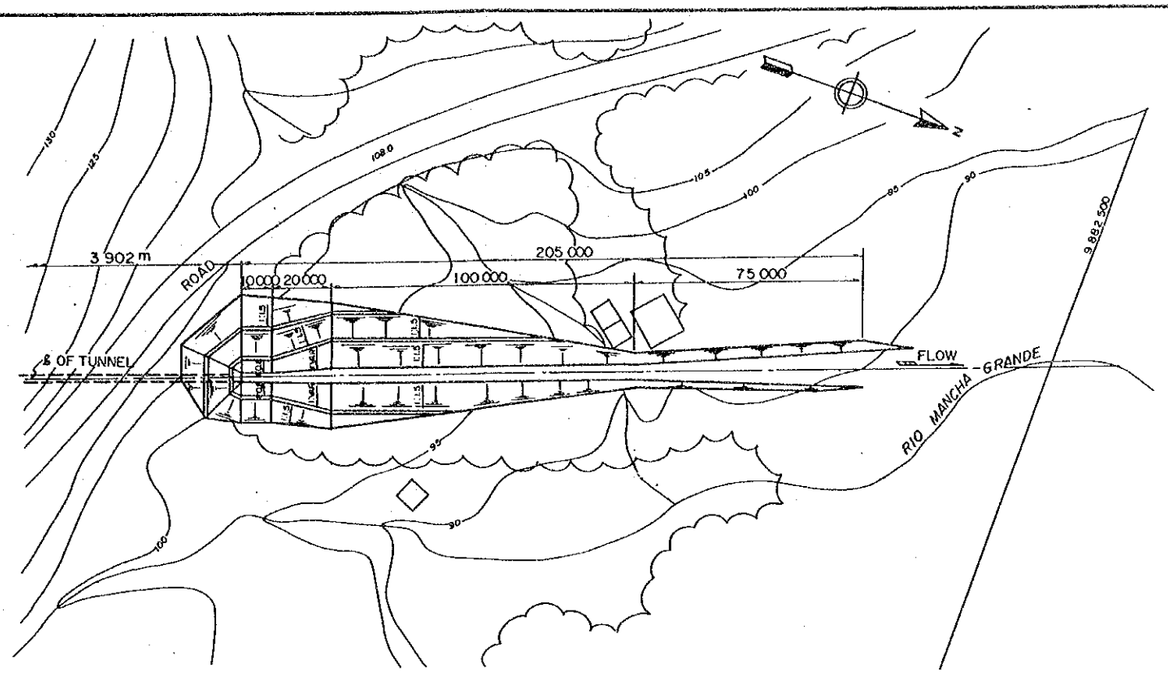
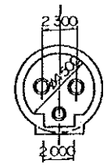
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY



LAYOUT PLAN OF TUNNEL INLET SCALE A

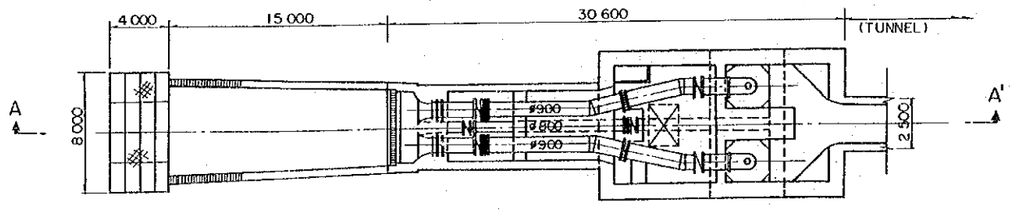


LAYOUT PLAN OF TUNNEL OUTLET SCALE A



SECTION B-B' SCALE B

SECTION A – A' SCALE B



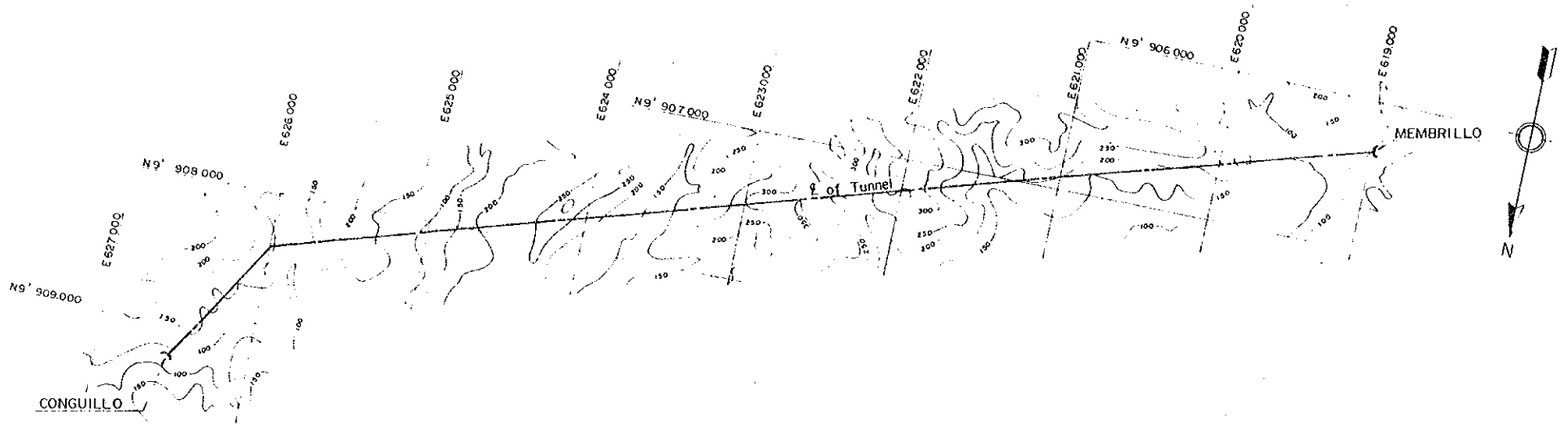
PLAN OF TUNNEL INLET SCALE B

SCALE A 0 10 20 30 40 50 100m

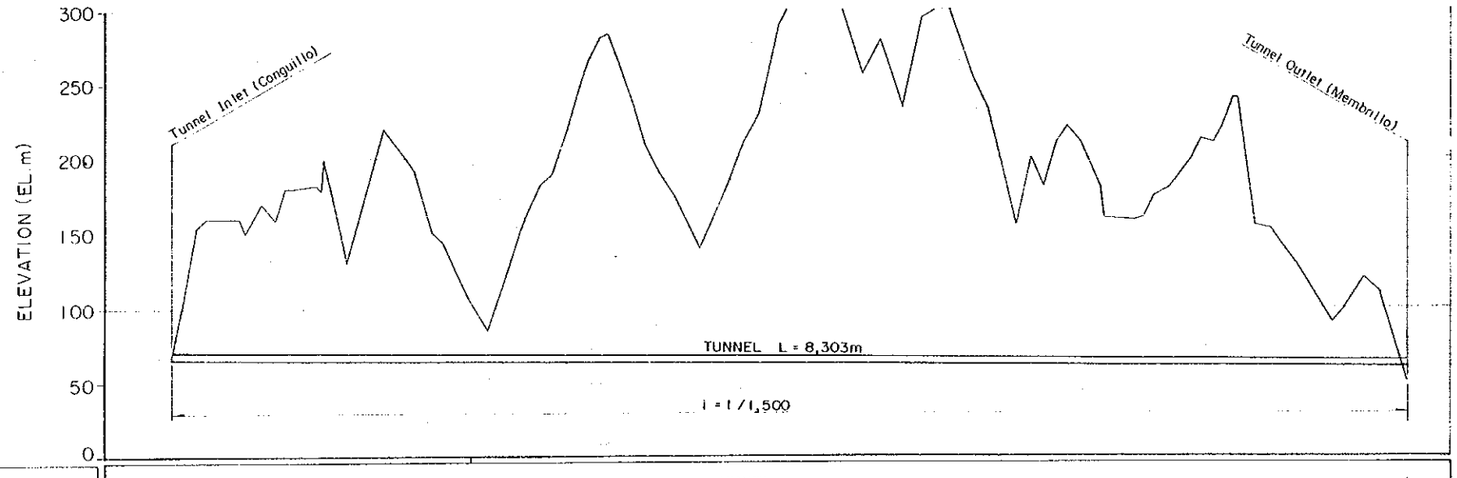
SCALE B 0 5 10 20m

Fig. I.37 Basic Design of Tunnel Inlet and Outlet for Water Transbasin Scheme "Poza Honda Dam - Rio Mancha Grande"

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE FEASIBILITY STUDY ON THE WATER RESOURCES DEVELOPMENT FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

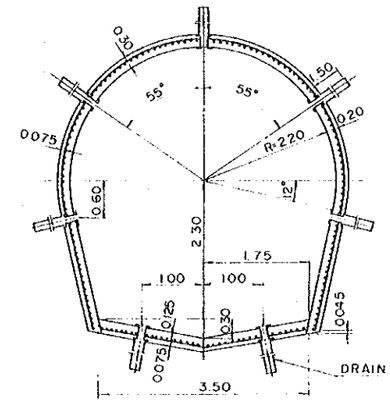


PLAN SCALE A



TYPE OF STRUCTURE	TUNNEL								
ELEVATION OF FORMATION (EL.m)	64.00	65.35	64.70	64.05	63.40	62.75	62.10	61.45	58.50
ELEVATION OF GROUND (EL.m)	66.00	180.00	105.00	264.00	258.00	290.00	220.00	212.00	60.60
ACCUMULATED DISTANCE (m)	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,303
DISTANCE (m)	0	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,303
STATION	0+000	1+000	2+000	3+000	4+000	5+000	6+000	7+000	8+303

PROFILE H : SCALE A
V : SCALE B



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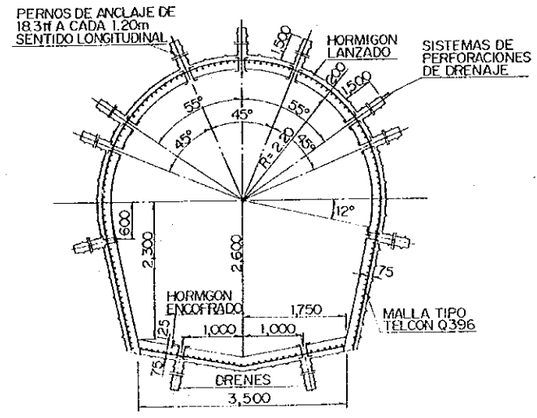

TYPE II

TYPICAL SECTION SCALE C

SOURCE : DETAILED DESIGN BY BRAZILIAN TEAM IN 1989

SCALE A 0 500 1,000 2,000m

SCALE B 0 50 100 200m

SCALE C 0 1 2 3 4 5m

Fig. I.38 Design by BrasilianTeam in 1989 for Water Transbasin Scheme "Daule Peripa - Esperanza Dam"

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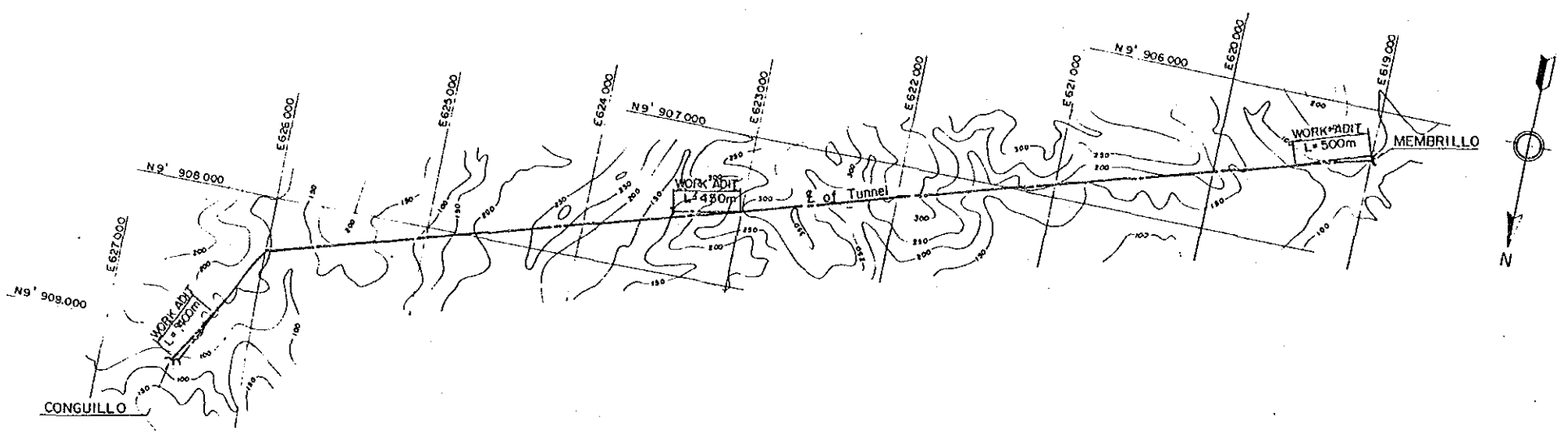
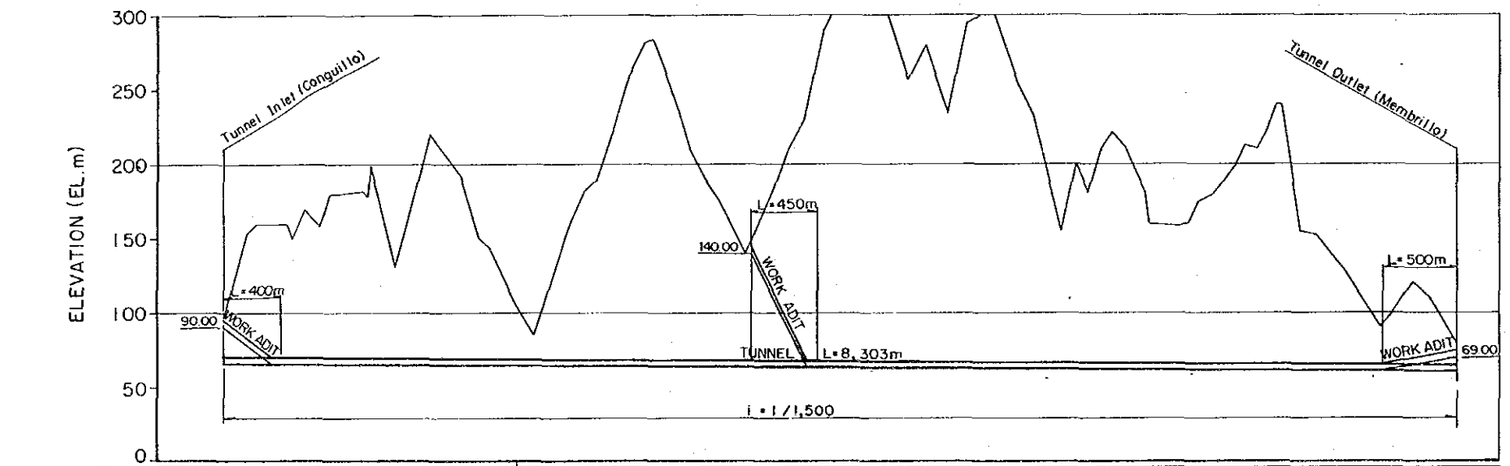
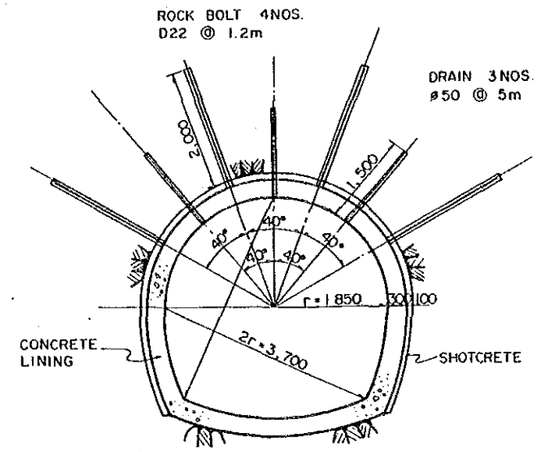


PLAN SCALE A

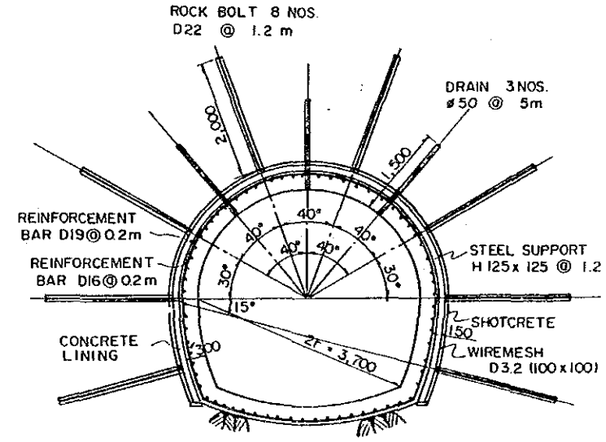


TYPE OF STRUCTURE	TUNNEL									
ELEVATION OF FORMATION (EL.m)	66.00 64.00	65.35	64.70	64.05	140.0	63.40	62.75	62.10	61.45	58.50
ELEVATION OF GROUND (EL.m)	95.00	180.00	105.00	264.00	150.00	258.00	290.00	220.00	212.00	80.00
ACCUMULATED DISTANCE (m)	0	1 000	2 000	3 000	3 580	4 000	5 000	6 000	7 000	8 303
DISTANCE (m)	0	1 000	1 000	1 000	580	420	1 000	1 000	1 000	1 303
STATION	0+000	1+000	2+000	3+000	3+580	4+000	5+000	6+000	7+000	8+303

PROFILE H : SCALE A
V : SCALE B



TYPE I



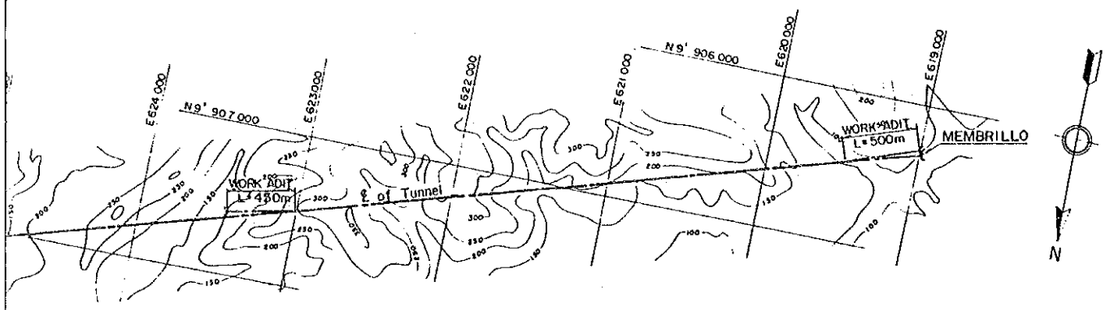
TYPE III

TUNNEL S

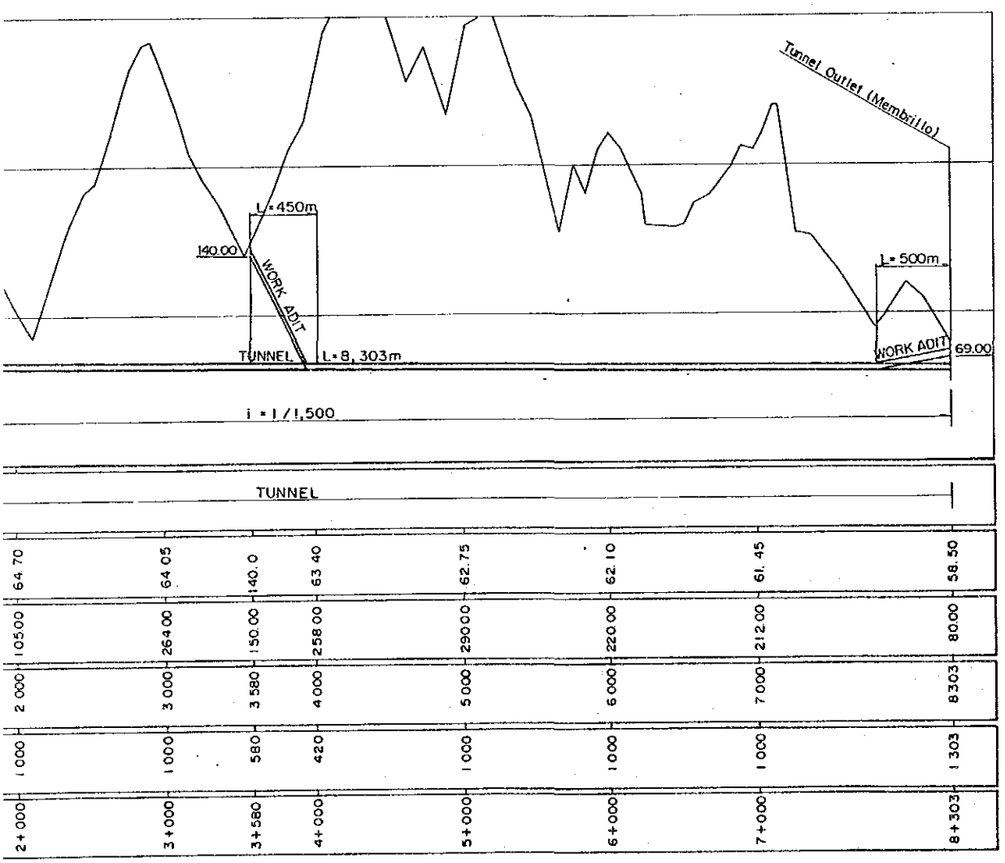
SCALE A 0 500 1,000 2,000m

SCALE B 0 50 100 200m

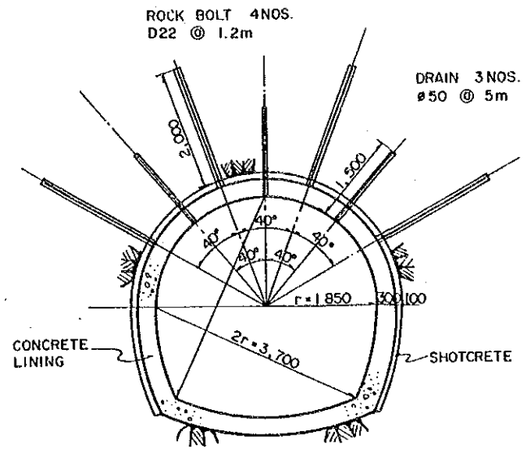
SCALE C 0 1 2 3 4 5m



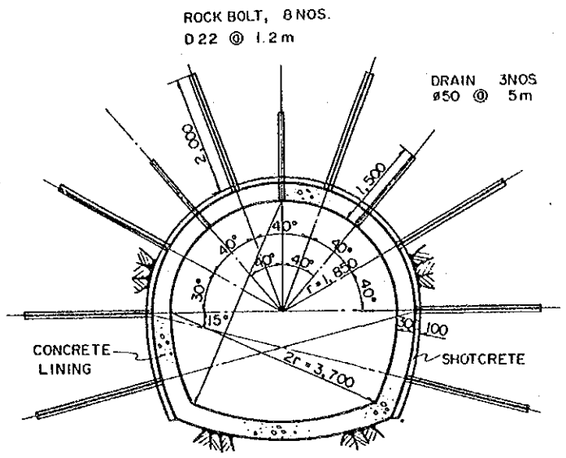
PLAN SCALE A



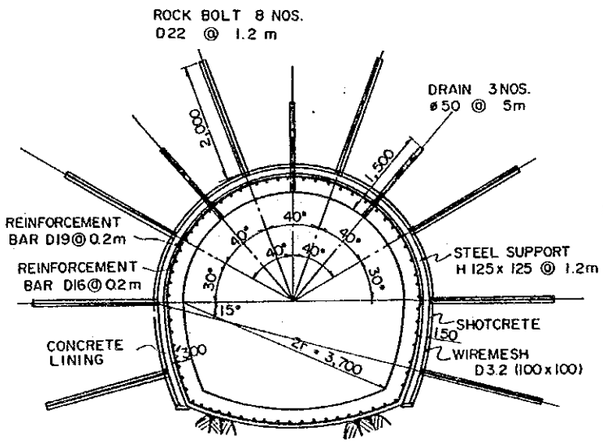
PROFILE H : SCALE A
V : SCALE B



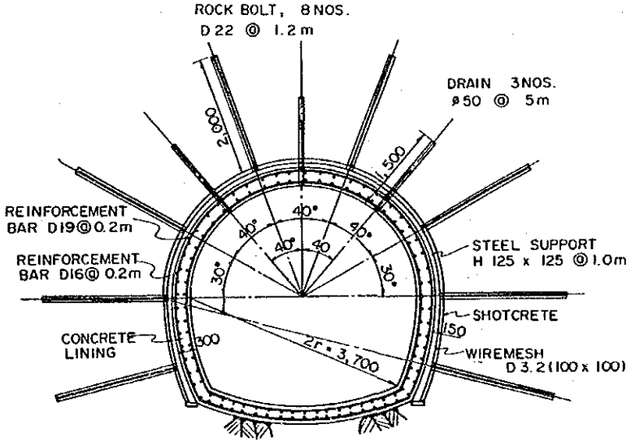
TYPE I



TYPE II



TYPE III



TYPE IV

TUNNEL SECTION SCALE C

SCALE A 0 500 1,000 2,000m

SCALE B 0 50 100 200m

SCALE C 0 1 2 3 4 5m

Fig. I.39 Basic Design of Water Transbasin Scheme "Daule Peripa - Esperanza Dam"

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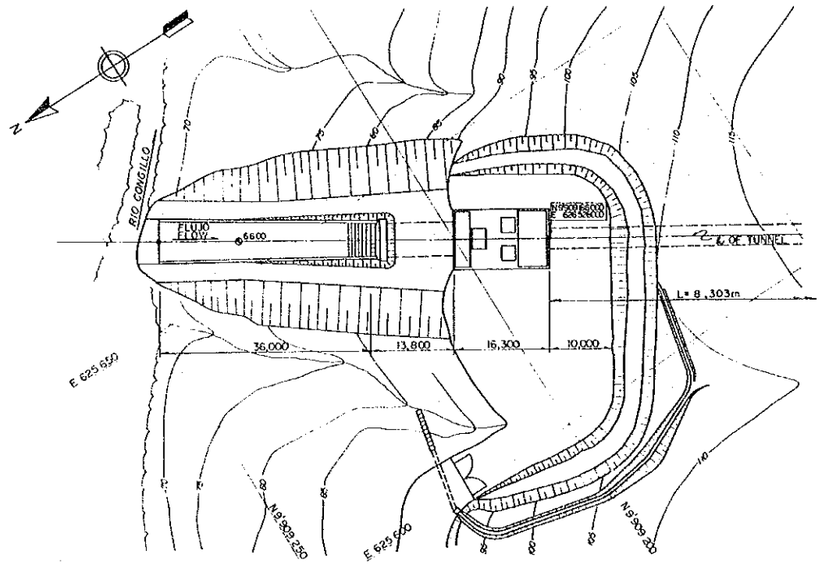
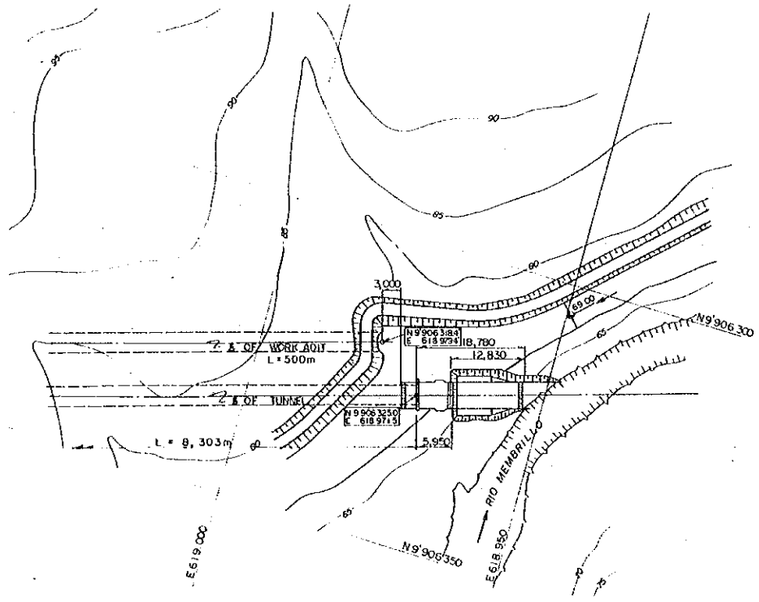
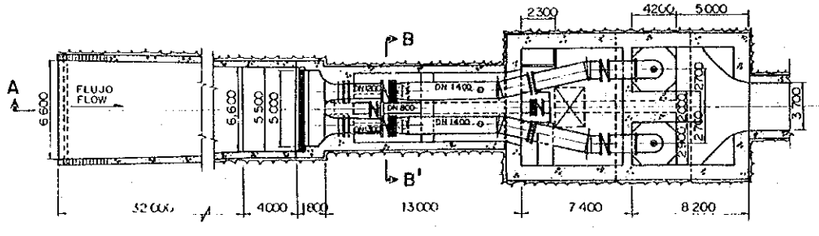


LAYOUT PLAN OF TUNNEL INLET SCALE A



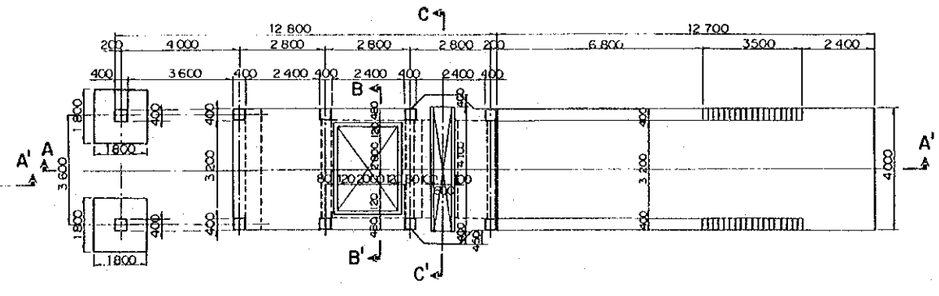
LAYOUT PLAN OF TUNNEL OUTLET SCALE A

SECCION A-A' ESCALA B
SECTION A-A' SCALE B

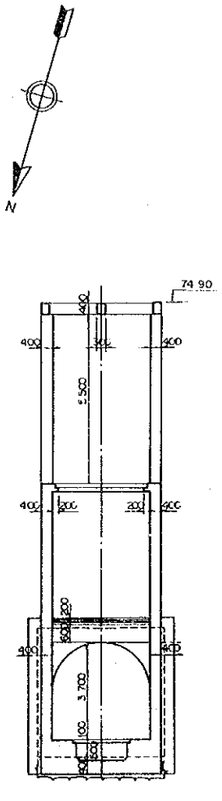


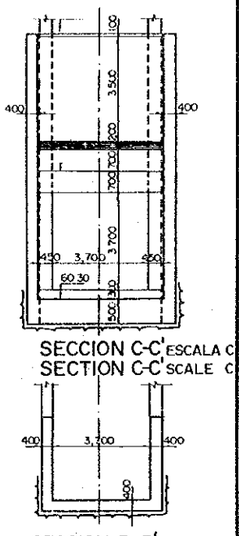
PLANTA DE ENTRADA DE TUNEL ESCALA B
PLAN OF TUNNEL INLET SCALE B

SECCION A-A' ESCALA C
SECTION A-A' SCALE C



PLANTA DE SALIDA DE TUNEL A LA COTA 69.00 ESCALA C
PLAN OF TUNNEL OUTLET AT EL. 69.00 SCALE C





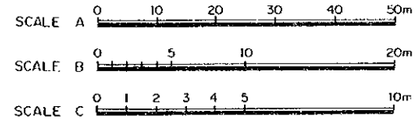


Fig. I.40 Basic Design of Tunnel Inlet and Outlet for Water Transbasin "Daule Peripa - Esperanza Dam"

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Annex J

CONSTRUCTION PLAN AND COST ESTIMATES

ANNEX J CONSTRUCTION PLAN AND COST ESTIMATE

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1. CONSTRUCTION PLAN AND SCHEDULE

1.1 Introduction

A construction plan of the project is prepared on the basis of the preliminary design discussed in the preceeding Annex I, giving an outline of possible procedures, construction sequences, methods and types of plant and equipment to implement the construction works. The construction works will be divided into two packages shown below and will be executed by the contractor selected by international competitive tenders for respective packages including prequalification. As for the engineering services, a consultant will be required for the execution of the project on the detailed design stage and the construction supervision stage, respectively.

(1) Lot 1 construction works: Esperanza – Poza Honda and Poza Honda – Rio Mancha Grande Tunnel Construction

A. Esperanza – Poza Honda tunnel works include the construction of pumping station, steel pipeline, open channel and syphon, inlet and outlet, tunnel, work adits, access road, transmission line and substation as well as preparatory works. The pumping station includes pumps and motors, valves, overhead cranes and operation and control equipments.

B. Poza Honda – Rio Mancha Grande tunnel works include the construction of inlet and outlet, tunnel and work adits as well as preparatory works.

(2) Lot II construction works: Daule Peripa – Esperanza Tunnel Construction

Lot II works include the construction of inlet and outlet, tunnel, work adits and access road as well as preparatory works.

1.2 Construction Plan

1.2.1 Basic conditions

The construction method and sequence are planned on the basis of the mode of construction and the target schedule of construction. Availability of construction forces,

weather condition, geological and topographic conditions at the site and the mechanized construction method are as well taken into consideration besides the matters mentioned above. Major plant and equipment used for construction are listed in Table J.1.

The commencement of the construction works is scheduled in September, 1995 after contract award. The project is planned to be completed by the end of February, 2000, giving a time period of 4.5 years (54 month).

With regard to the workable days, 275 days are assumed in a year for earthworks. While, workable days for concrete and tunnel works are planned to be 280 days and 276 days per year respectively. As for the daily working hours, one 8 hours shift per day is applied for earthwork and concrete work, and two 10 hours shift per day is applied for tunnel work.

1.2.2 Preparatory works and construction facilities

(1) Access road

Lot I construction site consisting of the Esperanza – Poza Honda tunnel and Poza Honda – Rio Mancha Grande tunnel is connected from the existing pavement roads i.e., Carretera Manta – Quevedo route and Santa Ana – Honorato Vasquez route. While, the Lot II construction site is located far from the existing earthroad of Canuto – Buenaventura.

The permanent access road of pumping station of Lot I is planned to be 7 km. The existing road to reach to the outlet structure of Esperanza – Poza Honda tunnel through the inlet of Poza Honda – Rio Mancha Grande tunnel will be required to be widen and improved as a permanent access road.

Since there are no available roads to the inlet and outlet for the Daule Peripa – Esperanza tunnel (Lot II), the permanent road of 25 km are planned to be connected from Buenaventura.

(2) Temporary buildings

The temporary buildings required for the construction works are divided into three tunnel sites, i.e., the Esperanza – Poza Honda tunnel, the Poza Honda – Rio Mancha Grande tunnel and Daule Peripa – Esperanza tunnel.

The temporary buildings consists of a contractor's office, quarters, a repair shop, a warehouse, labor quarters and so forth. Those areas are provided at the Severino pumping station site, the Honorato Vasquez (Poza Honda), the San Placido (Rio Mancha Grande) and the Membrillo.

(3) Water supply

Water required for the construction and the base camp is planned to be taken from the tributaries such as the Severino river, the Pata de Pajaro river, the Poza Honda lake, the Chamotete river, the Membrillo river and the Conguillo river. Water supply facilities will be required separately at each project site and work adit portal.

(4) Power supply

Electric power for the construction and base camp is planned to be supplied by diesel generator sets.

(5) Telecommunication

Wireless telecommunication system will be provided for construction use to connect each project site, since each project site is located separately. However, the wired telephone facilities will be required within each tunnel work site including work adits, internal tunnel section, open construction sites, etc.

1.2.3 Major construction works

(1) Pumping station

The pumping station is planned to be located at Severino, upstream of the Esperanza reservoir. The pumping station construction work is affected by the Esperanza dam impounding. The Esperanza dam is scheduled to be completed by the end of May 1996 and the dam impounding will be made for two rainy seasons in 1997 and 1998.

The reservoir operation of the Esperanza dam will be required for the pumping station and the mean water level of EL 40.00 will be kept during excavation and concrete works. Furthermore, the coffering work and temporally stoplogs are planned to be located infront of the intake portion. The construction method and design in relation with the Esperanza dam reservoir will be studied on the detailed design stage.

Access road to the pumping station is newly planned to be 7 km long from the Carretera Manta – Quevedo route. The temporary haul road to the spoil bank are planned to be located along the open channel route. The excavation works will be carried out using 10 m^3/min crawler drills, 32 ton bulldozers with ripper, 2.3 m^3 tractor shovels and 11 ton dump trucks.

Concrete works for the substructure and the superstructure will be carried out using 3.2 m^3 agitator trucks, 45 m^3/hr concrete pump cars, 1.0 m^3 concrete buckets with the 30 ton truck crane. The concrete will be produced by a 0.75 m^3 x 2 concrete plant located at the tunnel portal, which will be used for the concrete works of tunnel, open channel, syphon, etc. as well.

Hydromechanical works including pumps & motors, gates, pipes and valves will be carried out in 1998 and 1999. While the overhead crane will be installed after the completion of the superstructure concrete work.

(2) Steel pipeline

2-lanes of steel pipeline with 2.1 m dia. are planned to supply the water to the open channel, consisting of the vertical portion of 27 m long and the inclined open portion of 473 m long. As for the vertical portion, the backfill concrete will be placed. Open cut excavation will be carried out using 10 m^3/min crawler drills, 21 ton bulldozers, 32 ton bulldozers with ripper, 2.3 m^3 tractor shovels and 11 ton dump trucks. Concrete placing of anchors, blocks and saddles will be carried out using 1 m^3 buckets with the 30 ton truck crane and 45 m^3/hr concrete pump cars.

Before starting installation works, preparatory works of 6 months will be required for all the hydromechanical works. The steel pipe segment of 6 m long transported from the Guayaquil port to the stock yard of the project will be transported to the installation site by 20 ton trailers. The steel pipe segments will be installed using incline machines with the carrier and 30 ton truck cranes.

(3) Open channel and syphon

Open channel is planned to be a trapezoidal channel section of concrete lining and steel mesh with bottom width of 2.2 m and 6.9 km long. The excavation work above the top of channel will be carried out using the same equipment of the steel pipeline excavation. The excavation within the channel will be made by 11 ton bulldozers, 0.6 m^3 backhoes and 11 ton

dump trucks. The final stage excavation adjacent to the final slope will be made by 2.7 m^3/min jack hammers and the slope grading will be carried out using pick hammers and barring not to shutter the exposed surface.

The concrete will be transported from a 0.75 m^3 x 2 concrete plant by 3.2 m^3 agitator truck. The bottom slab concrete will be placed first, and then the slope concrete will be placed behind the assembling form of 6 m in length. The concrete will be handled by 1.0 m^3 buckets with the 30 ton crawler crane and 45 m^3/hr concrete pump car.

3.0 m dia. reinforcement concrete syphon of 640 m long in total is planned along the open channel route. The circular type box culvert is to be an in-situ concrete structure using the assembling form and the concrete placing will be made using 45 m^3/hr concrete pump cars.

(4) Inlet and outlet

Inlet and outlet works will be carried out considering with a respective water level of the related rivers and the existing dam reservoirs. Before starting the excavation works, the coffering dike will be provided infront of the inlet and outlet portions. As for the tunnel excavation, the excavation work will be mainly made from the work adit side to the intake and outlet portals and the broken rock will be hauled through the work adits.

The open excavation work will be carried out using the same equipment of the pumping station. A pilot shaft enlargement method is applied for the inlet shaft excavation. The pilot shaft of 2.0 x 2.0 m will be driven upward from the bottom tunnel, using 2.7 m^3/min stoper drills with portable decks. The broken rock will be heaped in the bottom tunnel and hauled by 0.4 m^3 muck loader, 3.0 m^3 muck cars with 8 ton battery locomotives through work adits. After finishing the pilot shaft excavation, the whole section will be enlarged downward by 7 m^3/min craller drills and 2.7 m^3/min jack hammers.

Concrete works of inlet and outlet structures will be carried out using 3.2 m^3 agitator truck, 1.0 m^3 bucket with the 30 ton truck crane and 45 m^3/hr concrete pump cars.

(5) Tunnel

A horseshoe type tunnel with concrete lining is planned for all tunnel construction such as Esperanza – Poza Honda tunnel (10,700 m long, 3.5 m dia.), Poza Honda – Rio Mancha Grande tunnel (4,000 m long, 2.5 m dia.) and Daule Peripa – Esperanza tunnel (8,300 m long, 3.7 m dia.). Three tunnels are mainly aligned in massive and soft sandy

mudstone with a compressive strength of about 100 kg/cm^2 and anticipated to encounter neither fault nor water problem. The tunnel construction will be a critical path of each Lot work. In order to shorten the construction period, the following work adits are required for each tunnel considering with the construction sequences:

(a)	Esperanza – Poza Honda tunnel:	No. 1 adit (650 m) and No. 2 adit (500 m)
(b)	Poza Honda – Rio Mancha Grande tunnel:	No. 1 adit (350 m)
(c)	Daule Peripa – Esperanza tunnel:	No. 1 adit (400 m), No. 2 adit (450 m) and No. 3 adit (500 m)

Typical tunnel cross section is planned to be four sections such as type I, II, III and IV according to the geological conditions and NATM tunnel supporting system. A full-face attack method is recommended to apply for driving the tunnel, while hauling of broken rocks is by a rail haulage method. A driving rate is planned to be 130 m per month for each tunne face. Three tunnel faces will be attacked simultaneously for Esperanza – Poza Honda and Daule Peripa – Esperanza tunnels using three sets of tunnel equipment crew. As for the Poza Honda – Rio Mancha Grande tunnel, two tunnel faces will be provided.

Tunnel excavation work will be carried out using an arm type mechanical tunneling machine with a cutting head, considering with the geological conditions and a following supporting system comprising of rock bolting and shotcreting. Broken rocks will be loaded into 3 m^3 muck cars with the 8 ton battery locomotives for hauling. The broken rocks carried to the open yard by those equipment will be loaded by 1.2 m^3 tractor shovels into 8 ton dump trucks and will be carried to the spoil bank.

Just after finishing one cycle excavating operation of 1.2 m progress, a primary shotcrete of 100 mm thick with 100 x 100 wire mesh and rock bolts of 2.0 m long will be made. As for the lower compressive strength sections and fault zones, steel H beam ribs and additional shotcreting are required.

A concrete lining thickness is designed to be 300 mm except for the shotcrete supporting thickness. The concrete lining work will be performed in parallel with the tunnel excavation works for Esperanza – Poza Honda tunnel and Daule Peripa – Esperanza tunnel. The concrete lining work of Poza Honda – Rio Mancha Grande tunnel will be made after the completion of whole tunnel excavation works according to the tunnel internal working space area.

An arch and then invert concrete lining method is applied through the whole tunnel length. The concrete lining progress rate is planned to be 138 m per month with 12.0 m long concrete lining span. The lining progress rate of the Poza Honda – Rio Mancha Grande tunnel is planned to be 276 m per month. The concrete will be transported by 3.2 m^3 agitator trucks from the concrete batcher plant provided at the work adit portal, and then discharged into 3 m^3 concrete placer with 6 ton battery locomotive to transport to the placing spot in the tunnel. The concrete will be placed behind sliding forms of 12.0 m long by means of compressed air from the concrete placer. The invert concrete placing will be carried out using 3 m^3 agitator cars and invert sliding forms.

Selection of NATM method and Conventional method

To achieve an safety ground supporting system, an economical construction and an efficient construction period, the NATM method and concrete lining method are essentially employed. As a result of the comparison study, the NATM method is more advantage than the conventional method with blasting. The reasons employed the NATM method are below.

– Direct Construction cost

	NATM (1,000 US$)	Conventional Blasting (1,000 US$)
• Esperanza – Poza Honda tunnel	77,921	81,895
• Poza Honda – Rio Mancha Grande tunnel	11,903	12,636

– Construction cost for tunnel excluding work adits

	NATM (1,000 US$)	Conventional Blasting (1,000 US$)
• Esperanza – Poza Honda tunnel	25,949	29,682
• Poza Honda – Rio Mancha Grande tunnel	7,682	8,348

– Construction period

	NATM (Month)	Conventional Blasting (Month)
• Esperanza – Poza Honda tunnel	54	59
• Poza Honda – Rio Mancha Grande tunnel	39	42

1.3 Construction Schedule

1.3.1 Project schedule

The target date for the commissioning of pumping station is planned to be March, 2000. Main construction works of the project is planned to be 4.5 years from September, 1995 to February, 2000, while 7 years will be required for the project after the completion of the feasibility study as shown in Figure J.1. The financial arrangement required for the detailed design stage and the construction work stage shall be made by the CRM.

The following basic schedule shall be kept in order to secure the commissioning target of the project:

(a)	Financial arrangement for the detailed design and construction work	:	10 months from January 1993 to October 1993
(b)	Selection of a consultant	:	3 months from November 1993 to January 1994
(c)	Detailed design and preparation of tender documents	:	12 months from February 1994 to January 1995
(d)	Tendering and contracts including prequalification	:	10 months from November 1994 to August 1995
(e)	Main constriction works	:	54 months (4.5 years) from the commencement of September 1995 to the completion of February 2000
(f)	Commissioning of the pumping station	:	Beginning of March 2000

1.3.2 Construction schedule

Figure J.1 shows the construction schedule of the project. The land acquisition and compensation for the project will be settled by the CRM prior to the commencement of the construction. The work schedule for the major items are summarized by year as follows:

1995

(a) Award of contracts for Lot I and Lot II
(b) Mobilization and construction of site facilities
(c) Construction of the base camp and access roads
(d) Excavation work of the pumping station (Lot I)

1996

(a) Construction of site facilities
(b) Construction of the base camp and access roads
(c) Excavation and concrete works of the pumping station (Lot I)
(d) Excavation of the work adits (Lot I)
(e) Excavation and concrete works of the Esperanza – Poza Honda tunnel (Lot I)
(f) Excavation and concrete works of the Poza Honda – Rio Mancha Grande tunnel (Lot I)
(g) Excavation of the work adits (Lot I and Lot II)

1997

(a) Building works of the pumping station (Lot I)
(b) Installation of the overhead crane for the pumping station (Lot I)
(c) Excavation and concrete works of the open channel and syphon (Lot I)
(d) Excavation and concrete works of the three tunnels (Lot I and Lot II)

1998

(a) Installation of the pumping equipment (Lot I)
(b) Excavation and concrete works of the steel pipeline (Lot I)
(c) Installation of the steel pipeline (Lot I)
(d) Installation of inlet and outlet equipment for the Poza Honda – Rio Mancha Grande tunnel (Lot I)
(e) Excavation and concrete works of the open channel and syphon (Lot I)
(f) Excavation and concrete works of the inlet and outlet for the Esperanza – Poza Honda (Lot I) and Daule Peripa – Esperanza tunnel (Lot II)
(g) Excavation and concrete works of the three tunnels (Lot I and Lot II)

1999

(a) Installation of the pumping equipment and commissioning test (Lot I)

(b) Excavation and concrete works of the Esperanza – Poza Honda tunnel (Lot I) and Daule Peripa – Esperanza tunnel (Lot II)

(c) Erection of the transmission line and substation equipment (Lot I)

(d) Installation of the inlet and outlet equipment for the Daule Peripa – Esperanza tunnel (Lot II) and commissioning test.

2000

(a) Commissioning test (Lot I and Lot II)

(b) Demobilization

2. COST ESTIMATE

2.1 Introduction

Construction costs for the Project are estimated on the basis of the preliminary design. Unit prices for each work item are established considering local conditions, available construction equipment and materials and suitability of the construction method and referring to similar international projects.

The foreign and local currency portions of the project costs are estimated on basis of US Dollar and Ecuadorian Sucre respectively, and the foreign currency portion expressed in US Dollar is converted to Ecuadorian Sucre for assessing the total cost.

Assumptions and conditions applied for the cost estimate as follows:

(a) Price level : Price as of July 1992

(b) Exchange rate : US Dollar 1.00 = Ecuadorian Scure S/. 1,550
= Japanese Yen 128
(or Yen 1.00 = S/. 12.11)

(c) Work quantity : Quantities estimated from the preliminary design for the work items given in Table J.9

(d) Construction works will be carried out by the contractor selected through an international competitive bidding.

(e) Construction cost are divided into direct construction cost and indirect construction cost. The direct construction costs (contract cost) are the cost for Lot I construction work and Lot II construction work. Lot I construction work includes hydromechanical equipment of pumping station and steel pipeline, and transmission line and substation equipment. While, the indirect construction costs are the ones required for land acquisition and compensation, administration expenses, engineering services and contingencies.

2.2 Direct Construction Cost

2.2.1 Preparatory works

The costs for the preparatory works comprise of the costs for insurance of works, temporary buildings including Engineers use, water supply system, electric power supply system, telecommunication system, provision of medical facilities, inland transportation, testing laboratory and temporary access roads.

The costs for preparatory works of Esperanza – Poza Honda tunnel (Lot I) are estimated at about 6.5 percent of the sum of direct cost (10 percent of the sum of direct cost except for pumping equipment, transmission line and substation equipment).

Each cost for preparatory works of Poza Honda – Rio Mancha Grande tunnel and Daule Peripa – Esperanza tunnel is estimated at 10 percent of the sum of direct construction cost.

2.2.2 Civil works

The costs of civil works are estimated by adopting unit rates including labor cost, material cost, equipment cost and contractor's overhead expenses and profits.

(1) Labor cost

The wages obtained in Portoviejo and Guayaquil (refer to Table J.2) are based on the direct daily wages in 8-hour shift of labor.