A-4-3 Calculation of Loss

1. Intake
   1) Screen

Basic formula : $hr=fr*V^2/2g$ θ = 56° 58' 34" (56.97613°) ←1:0.65
$fr=\beta*\sin\theta*(t/b)^{4/3}$, β=1.6 Screen bar
t = 1cm, b= 9cm, V=Q/A

	OPK	Loss	APU	(Loss)
n×B (m) H (m²)	1 * 6.0 11.0		1 * 7.0 13.0	
A (m²) fr	66.0 $7.1659*10^{-2}$		91.0 $7.1659*10^{-2}$	
Total	$8.3932*10^{-7}$	0.002	$4.4150*10^{-7}$	0.002

   2) Inflow

Basic formula : $he=fe*V^2/2g$ $V=Q/A$ $A=\pi D^2/4$
For Bellmouth $fe=0.01\sim0.05\rightarrow0.05$

	OPK	(Loss)	APU	(Loss)
D (m) A (m²)	4.9 18.857		4.1 13.203	
Total	$7.1738*10^{-6}$	0.017	$1.4635*10^{-5}$	0.066

2. Headrace
   1) Curve

Basic formula : $hb=fb_1*fb_2*V^2/2g$ $fb_1=0.131+0.1632(D/\rho)^{7/2}$, $fb_2=(\theta/90)^{1/2}$
D: Diameter, ρ: Radius, θ° : Angle

	OPK	(Loss)	APU	(Loss)
D (m) A (m²)	4.9 18.857		———	
①Vertical θ (°) ρ (m) Coefficient	32.96657 30.00 $1.1400*10^{-5}$		———	
②Horizontal θ (°) ρ (m) Coefficient	43.65028 80.00 $1.3090*10^{-5}$		———	
③Horizontal θ (°) ρ (m) Coefficien	———		———	
Total	$2.4490*10^{-5}$	0.056	———	———

2) Friction

Basic formula : $hf=124.5n^2/D^{4/3}*L*V^2/2g$ n=0.013 Concrete
D: Diameter, L:Length

	OPK	(Loss)	APU	(Loss)
D (m) L (m)	4.9 9,661.17 *		— — — —	
Total	$3.5043*10^{-3}$	8.074	——	——

*Including intake portion

3. Friction in Vsurge tank

Basic formula : $hf=124.5n^2/D^{4/3}*L*V^2/2g$ n=0.012 Lower part of
D: Diameter, L=30.00m :Length

	OPK	(Loss)	APU	(Loss)
D (m)	4.9		——	
Total	$9.2720*10^{-6}$	0.021	——	——

4. Penstock
1) Gradual reduction

Basic formula : $hgc=fgc*V^2/2g$ V:Velocity after reduction

	OPK	(Loss)	APU	(Loss)
① D (m) L (m) θ (°) fgc Coefficient	4.9 ～ 4.1 0.70, 6.00 15.19 0.0035 $1.0245*10^{-6}$		4.1 ～ 3.8 0.86, 11.78 2.92 0.0010 $3.9667*10^{-7}$	
② D (m) L (m) θ (°) fgc Coefficient	4.1 ～ 3.6 0.77, 6.00 9.53 0.0020 $9.8488*10^{-7}$		——	
③ D (m) L (m) θ (°) fgc Coefficient	3.6 ～ 3.2 0.79, 5.91 7.74 0.0010 $7.8880*10^{-7}$		——	
Total	$2.7982*10^{-6}$	0.006	$3.9667*10^{-7}$	0.002

2) Bending

Basic formula : $hb=fb_1*fb_2*V^2/2g$ $fb_1=0.131+0.1632(D/\rho)^{7/2}$, $fb_2=(\theta/90)^{1/2}$

D: Diameter, ρ: Redius, $\theta°$: Angle

	OPK	(Loss)	APU	(Loss)
①Horizontal θ (°) D, ρ (m) Coefficient	15.38086 4.10, 40.00 $1.5858*10^{-5}$		———	
②Vertical θ (°) Dm, ρ (m) Coefficient	22.91965 3.85, 15.00 $2.5153*10^{-5}$		———	
③Vertical θ (°) Dm, ρ (m) Coefficient	13.89295 3.60, 20.00 $2.5424*10^{-5}$		———	
④Vertical θ (°) Dm, ρ (m) Coefficient	16.93690 3.40, 20.00 $3.5262*10^{-5}$		———	
⑤Vertical θ (°) Dm, ρ (m) Coefficient	53.80679 3.20, 7.00 $8.6327*10^{-5}$		45.000 3.95, 15.00 $3.1840*10^{-5}$	
Toral	$1.8802*10^{-4}$	0.433	$3.1840*10^{-5}$	0.143

3). Friction

Basic formula : $hf=124.5n^2/D^{4/3}*L*V^2/2g$ n=0.012 Penstook

D: Diameter, L:Length

	OPK	(Loss)	APU	(Loss)
① Dm (m) L (m) Coefficient	4.50 6.00 $2.9204*10^{-6}$		———	
② Dm (m) L (m) Coefficient	4.10 215.90 $1.7265*10^{-4}$		———	
③ Dm (m) L (m) Coefficient	3.85 6.00 $6.7110*10^{-6}$		——— *Incl. intake part (2m)	
④ Dm (m) L (m) Coefficient	3.60 148.26 $2.3723*10^{-4}$		4.10 265.46 * $2.1228*10^{-4}$	
⑤ Dm (m) L (m) Coefficient	3.40 5.91 $1.2827*10^{-5}$		3.95 11.78 $1.1492*10^{-5}$	
⑥ Dm (m) L (m) Coefficient	3.20 54.29 $1.6281*10^{-4}$		3.80 12.69 $1.5219*10^{-5}$	

	OPK	Loss (m)	APU	Loss (m)
Total	$5.9515*10^{-4}$	1.371	$2.3899*10^{-4}$	1.073

5. Out let (Draft Tunnel
1) Gradual expansion

Basic formula : $hge=fge*fse*V^2/2g$ V:漸拡前の流速

$fse=[1-(A_1/A_2)]^2$ fse:coefficent of sudden expansion

	OPK	Loss (m)	APU	Loss (m)
①Before expansion H(m) After expansion H(m) Section , $\sqrt{(A_1/A_2)}$ θ (°), $\sqrt{(A_2/A_1)}$ fse, fge Coefficient	4.0*1.8 6.0*2.2 5.4 , 0.74 19.95, 1.35 0.21, 0.40 $8.1338*10^{-5}$		6.2*2.0 8.0*2.5 4.5 , 0.79 23.86, 1.27 0.14, 0.55 $2.6353*10^{-5}$	
②Before expansion H(m) After expansion H(m) Section , $\sqrt{(A_1/A_2)}$ θ (°), $\sqrt{(A_2/A_1)}$ fse, fge Coefficient	6.0*2.2 6.0*3.0 6.5 , 0.86 10.71, 1.17 0.07, 0.19 $3.9563*10^{-6}$		8.0*2.5 8.0*4.0 10.0 , 0.79 13.51, 1.26 0.14, 0.23 $4.1255*10^{-6}$	
Total	$8.5294*10^{-5}$	0.197	$3.0479*10^{-5}$	0.137

2)

Basic formula : $hgc=fgc*V^2/2g$ V:Gradual reduction

	OPK	Loss (m)	APU	Loss (m)
①Before expansion H(m) After expansion H(m) A_2/A_1, Length (m) θ (°) fgc	———		8.0*4.0 5.4*2.5 0.42, 17.00 13.30 0.005	
Q^2 friction	———	———	$1.3997*10^{-6}$	0.006

3) Fricition

Basic formula : $hf=f'*(L/R)*V^2/2g$

$f'=2gn^2/R^{1/3}$

L: Length , R=A/S , S:
n: Penstock concrete

	OPK	Loss (m)	APU	Loss (m)
①Length Area A R, n f' Q^2 Coefficient	5.4, 10.2 0.729, 0.012 $3.1360*10^{-3}$ $1.1392*10^{-5}$		4.5, 26.2 1.401, 0.012 $2.5224*10^{-3}$ $6.0217*10^{-7}$	
①Length Area A S, R (m) n, f' Q^2 Coefficient	6.5, 15.6 0.907, 0.013 $3.4220*10^{-3}$ $5.1413*10^{-6}$		10.0, 26.0 1.156, 0.013 $3.1561*10^{-3}$ $2.0606*10^{-6}$	
①Length Area A S, R (m) n, f' Q^2 Coefficient	------		17.0, 22.75 1.143, 0.013 $3.1681*10^{-3}$ $4.6449*10^{-6}$	
Total	$1.6533*10^{-5}$	0.038	$7.3077*10^{-6}$	0.033

4) Outflow

Basic formula : $hse=fse*V^2/2g$

fse=1 Sudden expansion $D_1/D_2=0$
V : V before outflow

	OPK	Loss (m)	APU	Loss (m)
Area before outflow	18.0		13.5	
Q^2 friction	$1.5747*10^{-4}$	0.363	$2.7995*10^{-4}$	1.257

6. Total loss

	OPK	Loss (m)	APU	Loss (m)
Discharge m^3/s		48.0		67.0
Intake : Screen	$8.3932*10^{-7}$	0.002	$4.4150*10^{-7}$	0.002
: Inflow	$7.1738*10^{-6}$	0.017	$1.4635*10^{-5}$	0.066
Sut-tota	$8.0131*10^{-6}$	0.019	$1.5077*10^{-5}$	0.068
Headrace : Bend	$2.4490*10^{-5}$	0.056		
: Friction	$3.5043*10^{-3}$	8.074		
Sut-tota	$3.5288*10^{-3}$	8.130	———	———
Surge tank friction	$9.2720*10^{-6}$	0.021	———	———
Penstock : Reduction	$2.7982*10^{-6}$	0.006	$3.9667*10^{-7}$	0.002
: Bend	$1.8802*10^{-4}$	0.433	$3.1840*10^{-5}$	0.143
: Frilction	$5.9515*10^{-4}$	1.371	$2.3899*10^{-4}$	1.073
Sut-tota	$7.8597*10^{-4}$	1.810	$2.7123*10^{-4}$	1.218
Outlet : Expansion	$8.5294*10^{-5}$	0.197	$3.0479*10^{-5}$	0.137
: Reduction	———	———	$1.3997*10^{-6}$	0.006
: Friction	$1.6533*10^{-5}$	0.038	$7.3077*10^{-6}$	0.033
: Outflow	$1.5747*10^{-4}$	0.363	$2.7995*10^{-4}$	1.257
Sut-tota	$2.5930*10^{-4}$	0.598	$3.1914*10^{-4}$	1.433
Total	$4.5914*10^{-3}$	10.578	$6.0545*10^{-4}$	2.719
Other : 10%	(10.6%)	1.122	(10.3%)	0.281
Grand Total		11.70 m		3.00 m

Intak Water Level	1,095.7 m	922.7 m
Tail Water Level	929.0 m	707.90 m
(Reservoir)		(700.00 m)
Gross Head	166.7 m	214.8 m
		(222.7 m)
Loss of Head	12.0 m	3.00 m
(by tunnel gradient)		(7.90 m)
Effective Head	154.7 m	211.8 m

A-4-4 Alternative Design

As described in Chapter 9 Development Plans, various studies were made regarding the Oltu Project with comparison studies carried out upon setting up alternatives layouts for the respective Projects, and from among these the most economically advantageous alternatives were selected as the layouts for the Project and preliminary designing was done. This preliminary design is described in Chapters 9 and 11. The project alternative layouts which had ranked second in the comparison studies will be described herein.

(1) Olur Project

Regarding the location of the dam in the Olur Project, two sites, upstream and downstream, were compared and studied, and as a result, the upstream dam site was selected as described in Chapter 11.

Regarding the comparison study on the powerhouse location including the waterway route, the four alternatives of OPM, OPJ, OPT, and OPK were formulated and compared as described in Chapter 9. The OPK alternative was selected from among these as being the most advantageous, and this has been discussed up to and including the preceding chapter. The difference with the OPT alternative which was second best in the economic comparisons was small so that detailed investigations were made of topography and geology regarding the OPT alternative, and a comparison study was made in fairly great detail. The OPT alternative is described below.

In the OPT alternative, the greater part of the head race tunnel route was the same as in the OPK alternative, but diverged from the route of the basic proposal downstream of the Bacelik Dere to be connected to the powerhouse in the OPT alternative by a surge tank and penstock.

(a) Outline of Geology

The geologies of the headrace and powerhouse are practically the same as in the OPK alternative with there being distributions of Ayvali Volcanic Rocks, terrace deposits, and talus deposits, and the deposits at the powerhouse site are of considerable thickness. Further, concerning this powerhouse site, geological investigation works consisting of seismic prospecting and boring were carried out. According to these, the thickness of the deposits at the powerhouse location is about 15 m.

(b) Design

Since the headrace tunnel route as far as the downstream side of the Bacelik Dere is in common with the OPK alternative, upstream of this point will not be discussed. Downstream of the Bacelik Dere, as shown in Fig. A-4-9, the route would be changed toward the powerhouse in the OPT alternative. Next, the waterway would go by the surge tank and penstock to reach the powerhouse, and water used for power generation would be discharged into the Oltu River via a tailrace.

The diameter of the headrace tunnel would be 4.9 m, the same as in the OPK alternative, and this would be a circular cross section pressure tunnel 9,358 m in length.

The surge tank would be an orifice type similarly to the OPK alternative, the dimensions and specifications being almost the same as in the OPK alternative. The penstock would also be the same as in the OPK alternative, with a steel penstock of ring girder-supported type installed at the surface. The diameter

would range between 4.9 m and 3.2 m, while the length would be 403 m.

The power generation water leaving the powerhouse would be discharged into the Oltu River by a concrete culvert 181 m in length.

The powerhouse would be provided on a rock foundation approximately 400 m upstream of the OPK alternative. The construction of the powerhouse would be practically the same as in the OPK alternative.

The specifications of power generating equipment would be almost the same as in the basic plan. That is, the power discharge would be 48 m^3/s, the same as in the OPK alternative, with output reduced by the amount of reduction in effective head. The output would be 64.5 MW.

An outline of the OPT proposal is shown in Fig. A-4-9, A-4-10, A-4-15 and A-4-16.

The construction cost is given in Table A-4-2

(2) Ayvali Project

With regard to the dam location for the Ayvali Project, there is no prospective site other than the presently projected one.

Regarding comparison studies of powerhouse sites including waterway routes, including the site given in the Master Plan, the four alternative of APM, APU (basic proposal), APL, and the Ayvali Project plus the Sakartepe Project were formulated and comparison studies made as described in Chapter 9. The APU alternative was selected from among these as being the most economically advantageous and has

been discussed in detail up to and including the preceding chapter. The APL alternative which was second best in the economic comparison is considerably higher in construction cost compared with the APU alternative, but will be described in detail herein.

In the APL alternative the dam would be the same as in the APU alternative, but the waterway system from the intake and beyond would be different from that in the APU alternative. The APL alternative is for the head from Ayvali Reservoir to be utilized providing a headrace tunnel and a tailrace tunnel. The powerhouse would be an underground type to be provided in the Pugey Formation (sedimentary rock) at the right-bank side of the Anzav Dere.

(a) Outline of Geology

The geology of the headrace tunnel route consists of Ayvali Volcanic Rocks of lava, rhyolite, tuff, volcanic breccia, etc. and the Pugey Formation composed of alternations of limestone and marl bounding the former at the downstream side by a fault. Both formations are sound excluding the fault portion.

The powerhouse and its appurtenant facilities would be provided in the Pugey Formation. The route of the tailrace tunnel at the downstream side of the powerhouse would pass through the Pugey Formation consisting of alternations of limestone and marl.

The engineering geological evaluation of the geology is as described in Chapter 7.

(b) Design

The headrace tunnel would pass through the

mountainland at the left-bank side of the Oltu River in the form of a circular pressure tunnel of inside diameter 4.8 m and length of 7,669 m. Two or three work adits and access roads would be required to carry out the headrace tunnel work.

The surge tank would be an orifice type, the dimensions being diameter of 20 m and height of 64 m.

The penstock would be an embedded steel pipe type, the diameter ranging from 4.1 m to 3.8 m with the length being 309 m.

Power generation water leaving the powerhouse would be led to Yusufeli Reservoir by a horseshoe-shaped tunnel of diameter 5.4 m and length 2,141 m which will pass through the foundation rock under the Anzav Dere at an ample depth.

The powerhouse would be 19 m in width, 44.5 m in height, and 42 m in length same as to the APU alternative and would be provided as an underground type in the mountain body consisting of the Pugey Formation.

The specifications of electrical equipment would be practically the same as of the APU alternative. That is, the power discharge would be 67 m^3/s, the same as the APU alternative, the output being different due to the change in the effective head. The output would be 124.7 MW.

An outline of the APL alternative is shown in Figs. A-4-17, A-4-18 and A-4-21.

The construction cost is given in Table A-4-3

Table A-4-2 Construction Cost of Alternative Design of Olur Project

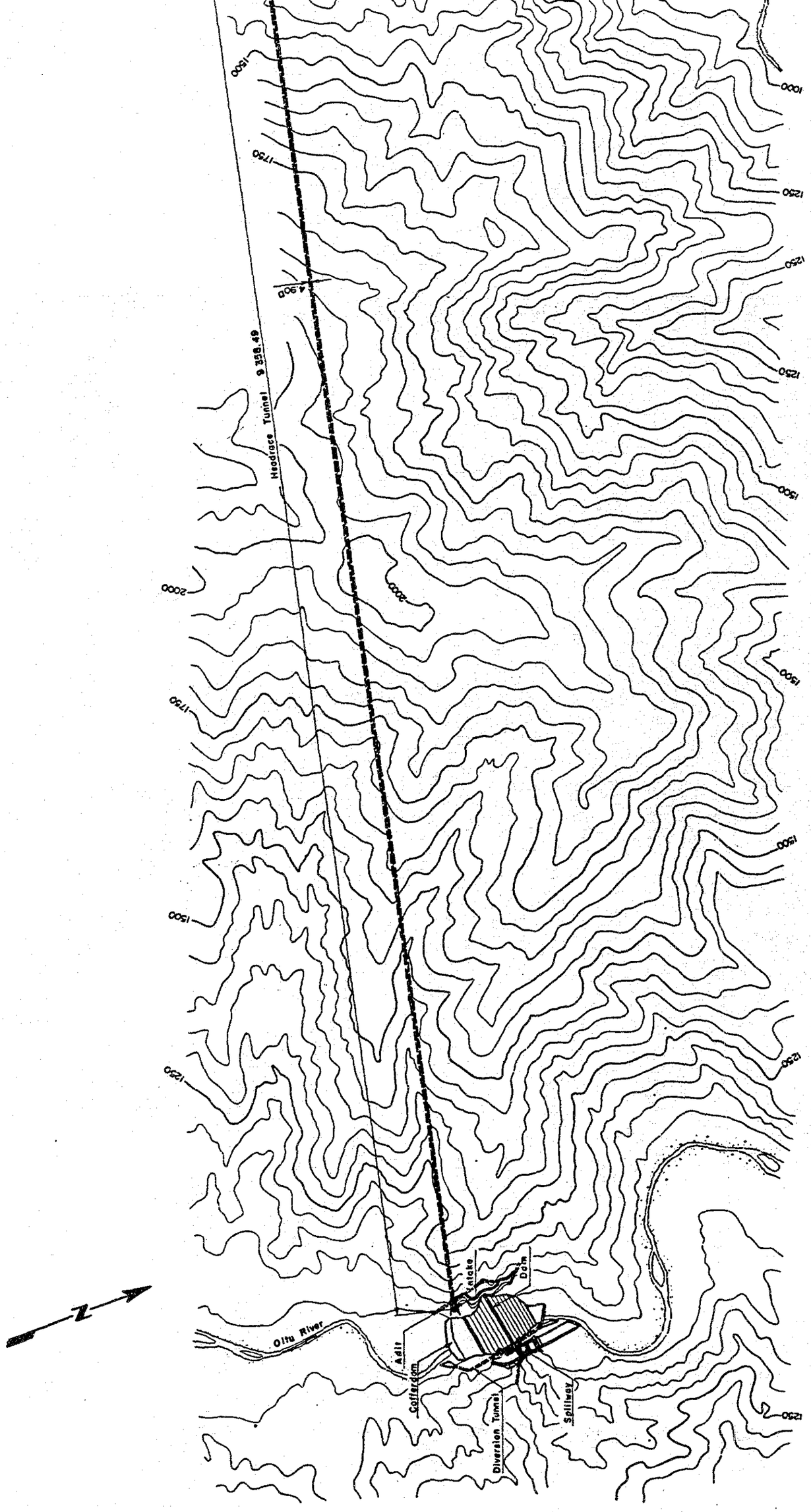
Unit: 10^6 TL

Item	OPK	OPT
Intake	4,959	4,959
Headrace Tunnel	115,001	111,469
Surge Tank	6,670	6,670
Penstock	2,568	7,344
Powerhouse	7,031	13,099
Tailrace	0	4,577
Switchyard	770	770
Hydraulic Equipment	15,230	14,088
Total	152,229	162,976

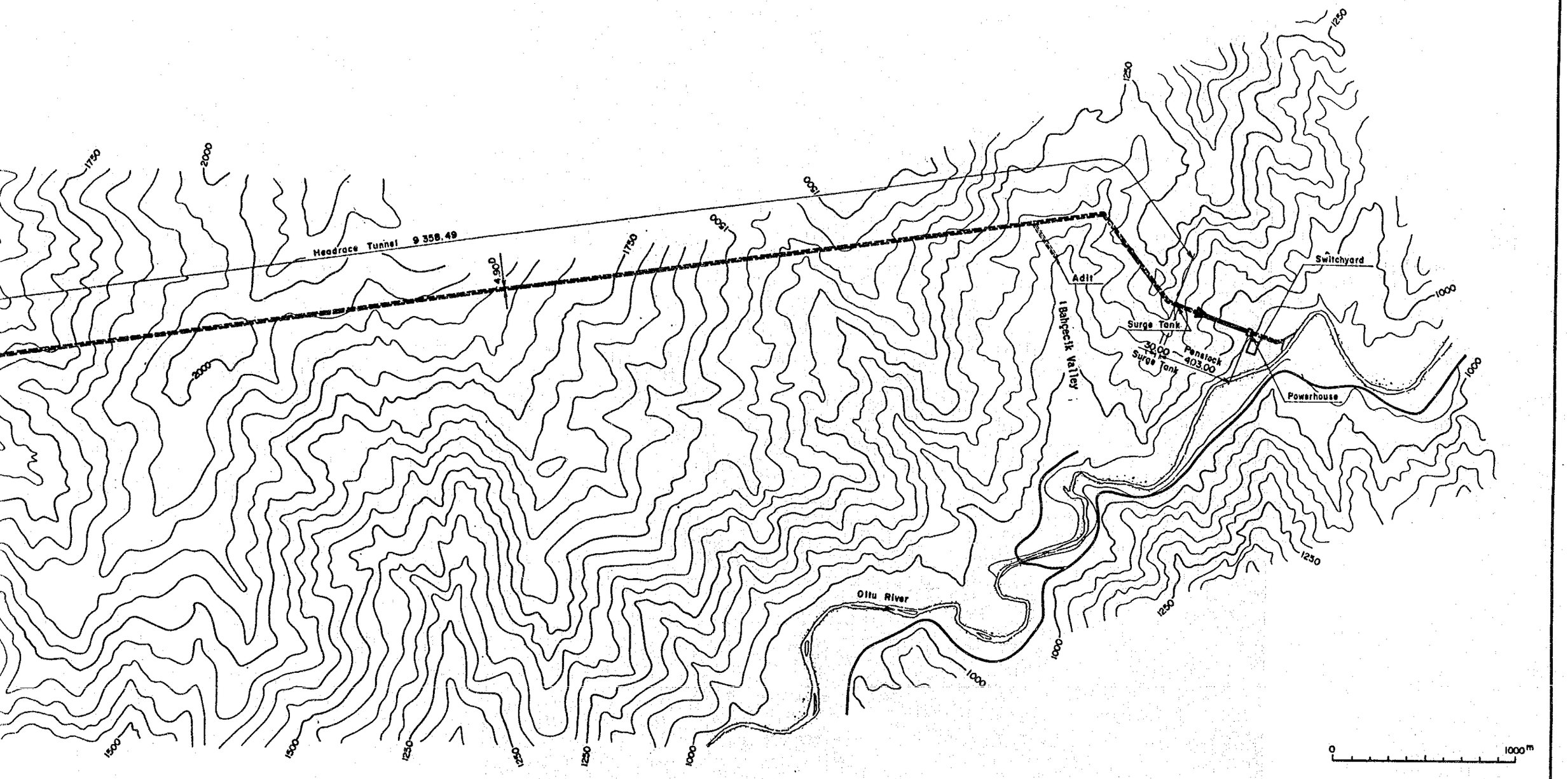
Table A-4-3 Construction Cost of Alternative Design of Ayvali Project

Unit: 10^6 TL

Item	APU	APL
Intake	5,510	5,510
Headrace Tunnel	0	112,385
Surge Tank	0	6,412
Penstock	2,334	2,286
Powerhouse	20,484	16,511
Tailrace	121,260	34,062
Hydraulic Equipment	10,337	20,822
Total	159,925	197,988

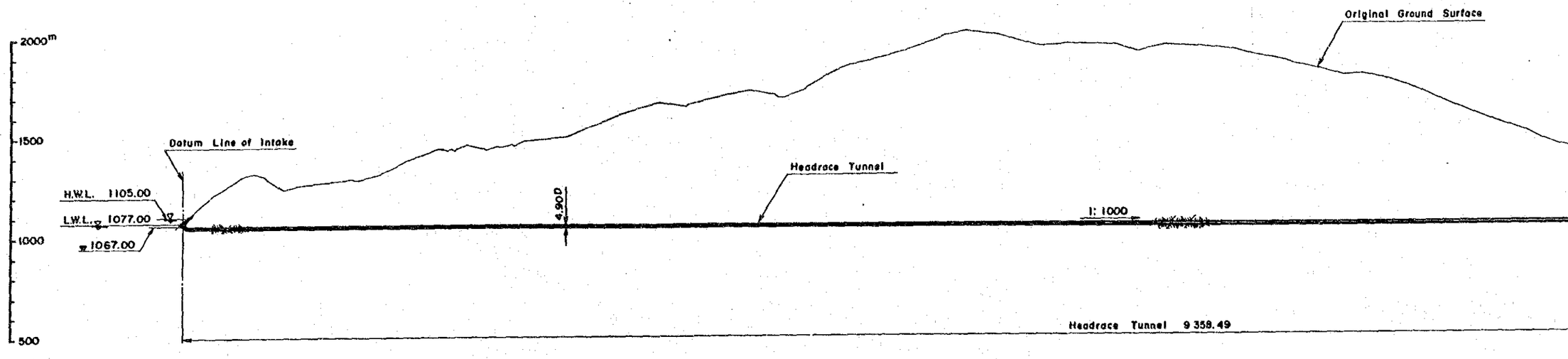

Headrace Tunnel 9 358.49
Intake
Dam
Otiu River
Adit
Cofferdom
Diversion Tunnel
Spillway
N
1000
1250
1500
1750
2000

アペンディクス

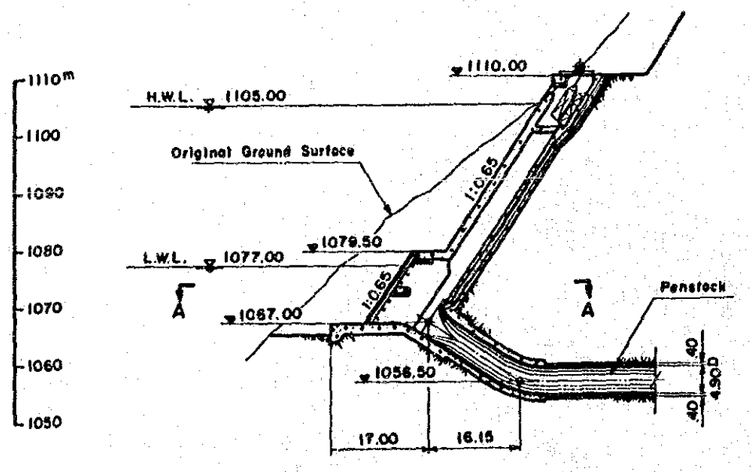


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT	
OLUR PROJECT GENERAL PLAN (ALTERNATIVE)	
Fig. A-4-9	

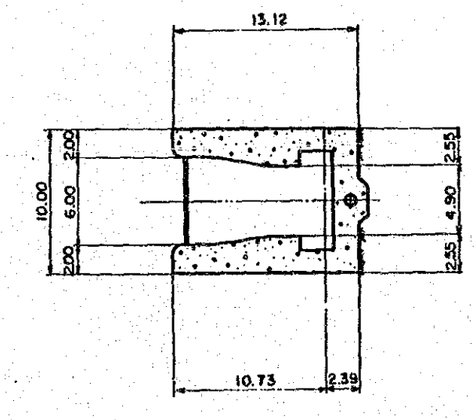
PROFILE



TYPICAL SECTION OF INTAKE



SECTION A – A



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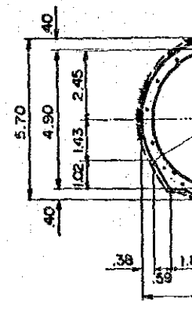
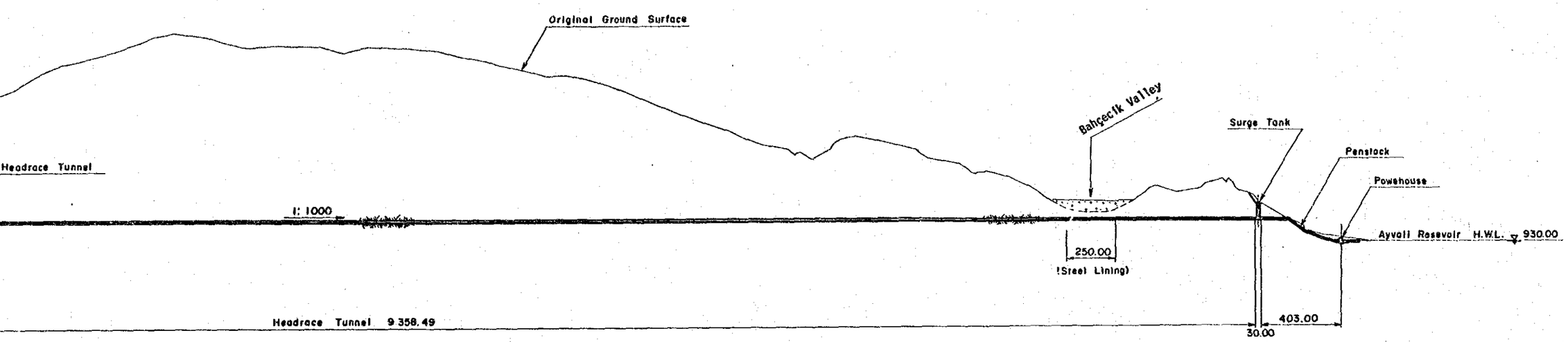


PROFILE



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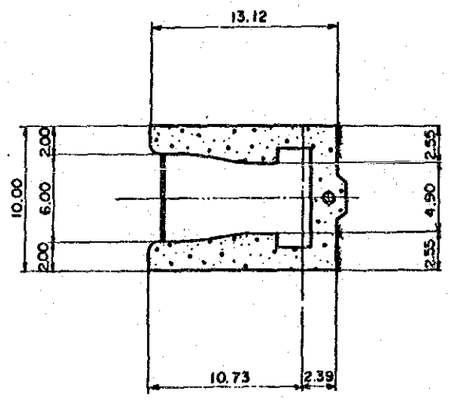
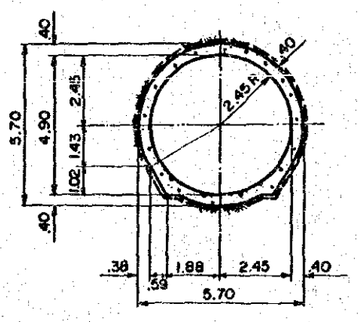
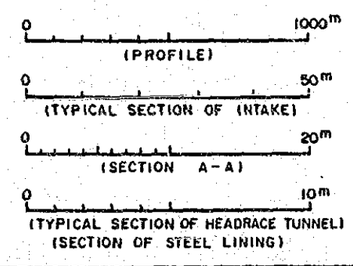


TYPICAL SECTION OF HEADRACE TUNNEL

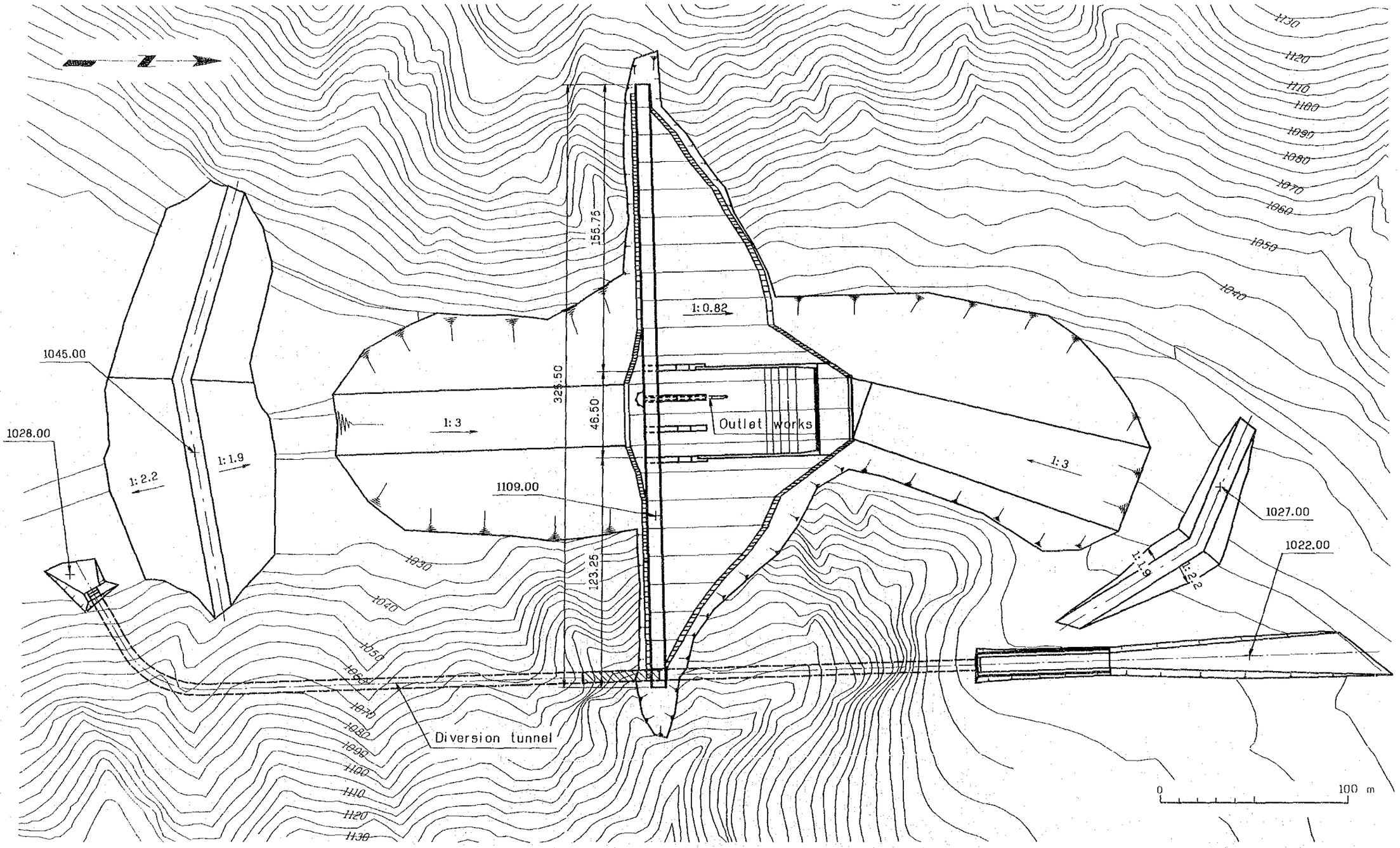




OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

OLUR PROJECT
WATERWAY
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig. A-4-10

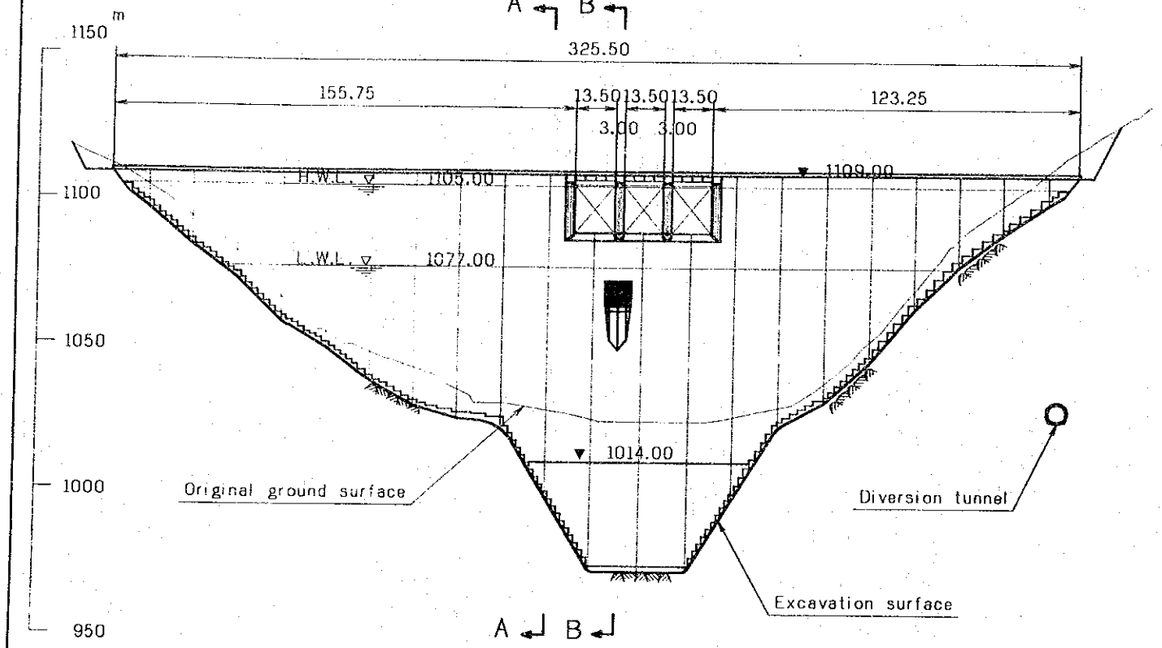


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

OLUR PROJECT
CONCRETE GRAVITY DAM
GENERAL PLAN
(ALTERNATIVE)

Fig.A-4-11

PROFILE OF DAM
(UP-STREAM)



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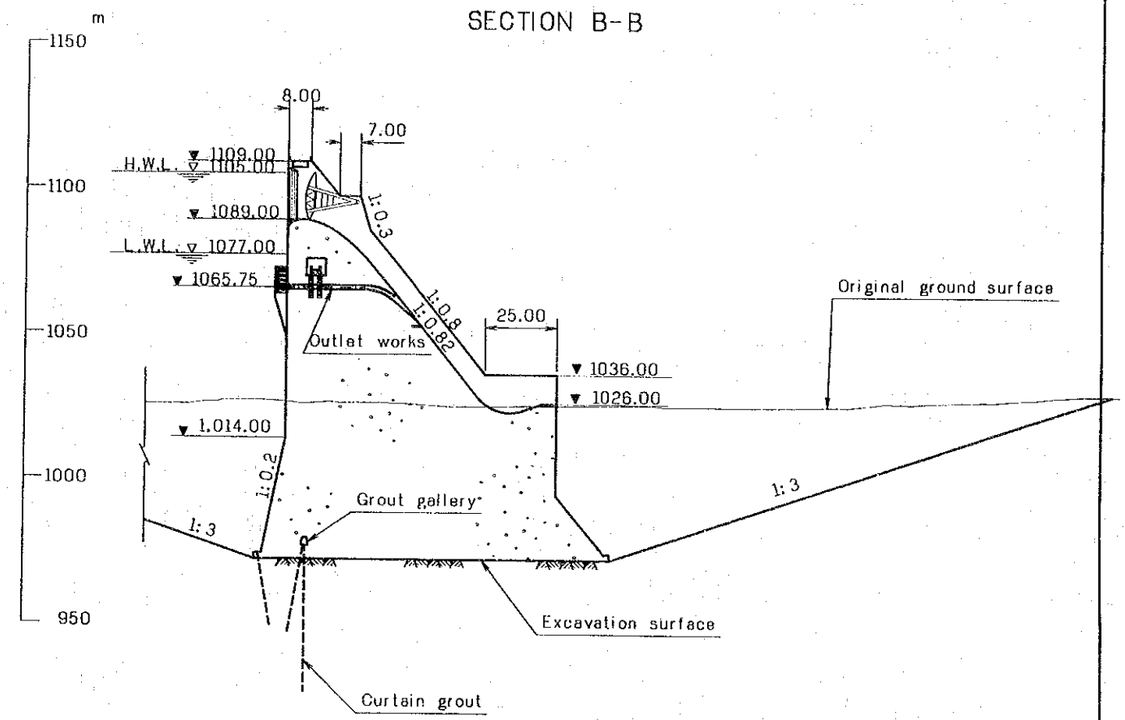
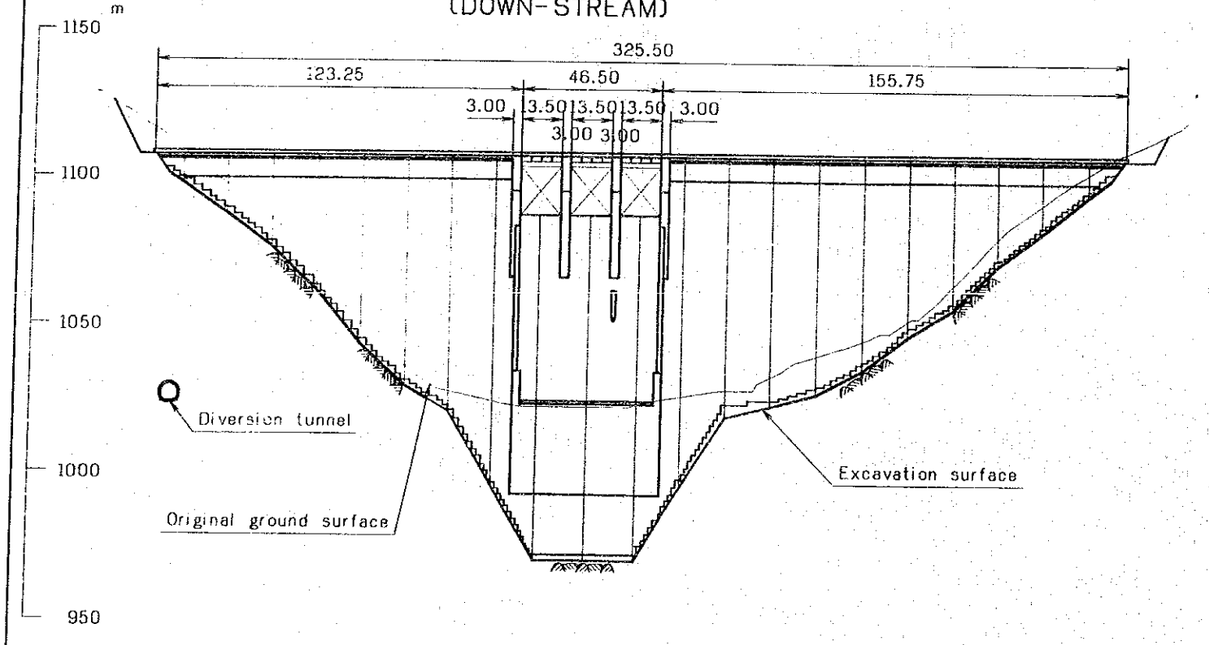
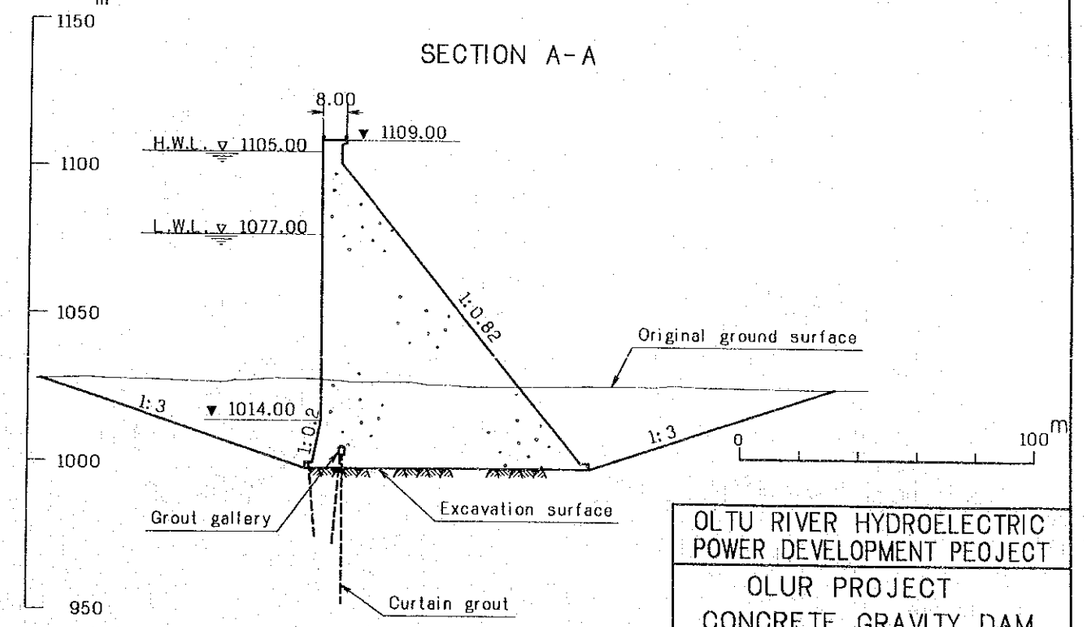


PROFILE OF DAM
(DOWN-STREAM)



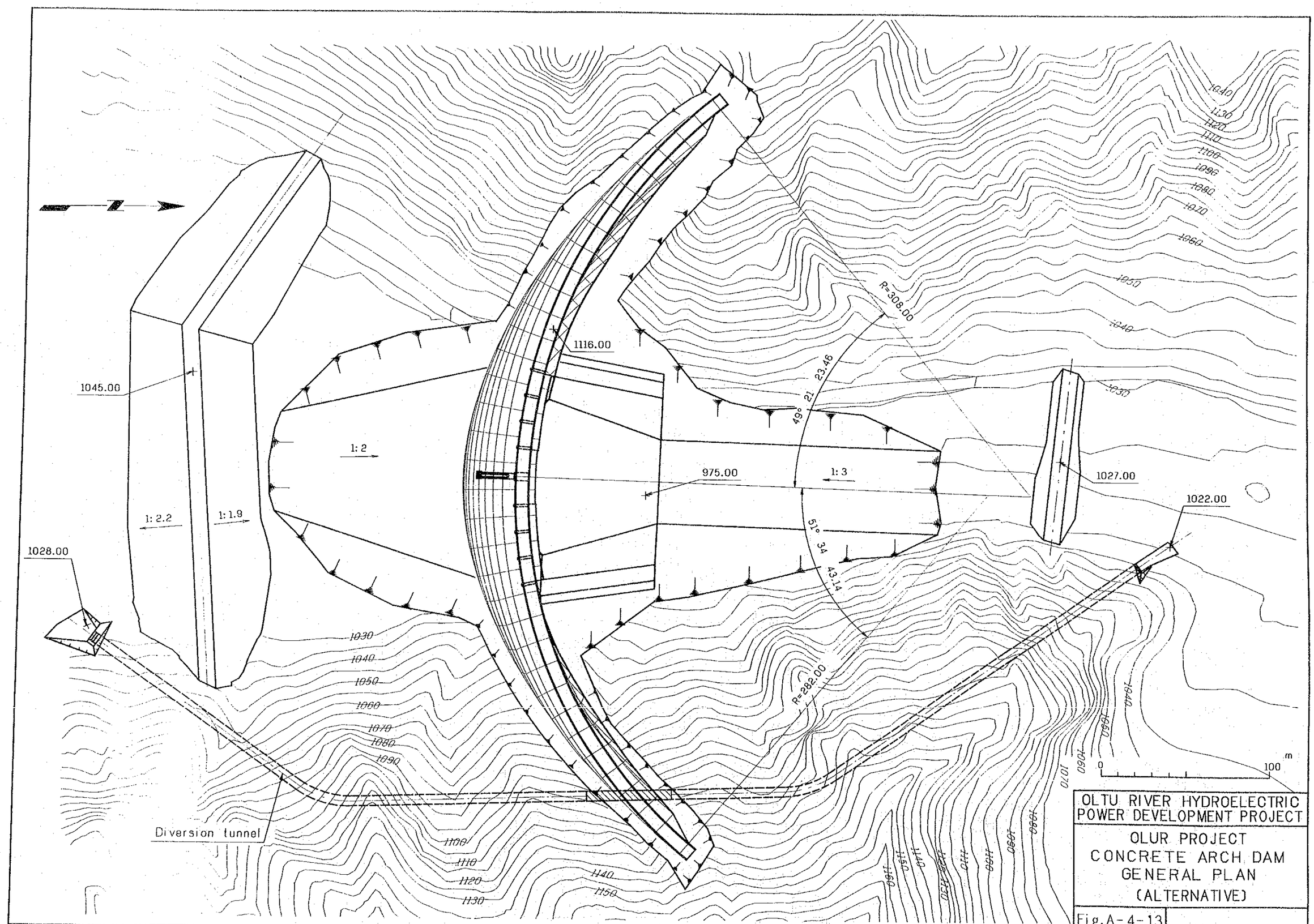
SECTION A-A



OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PEOJECT

OLUR PROJECT
CONCRETE GRAVITY DAM
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig.A-4-12

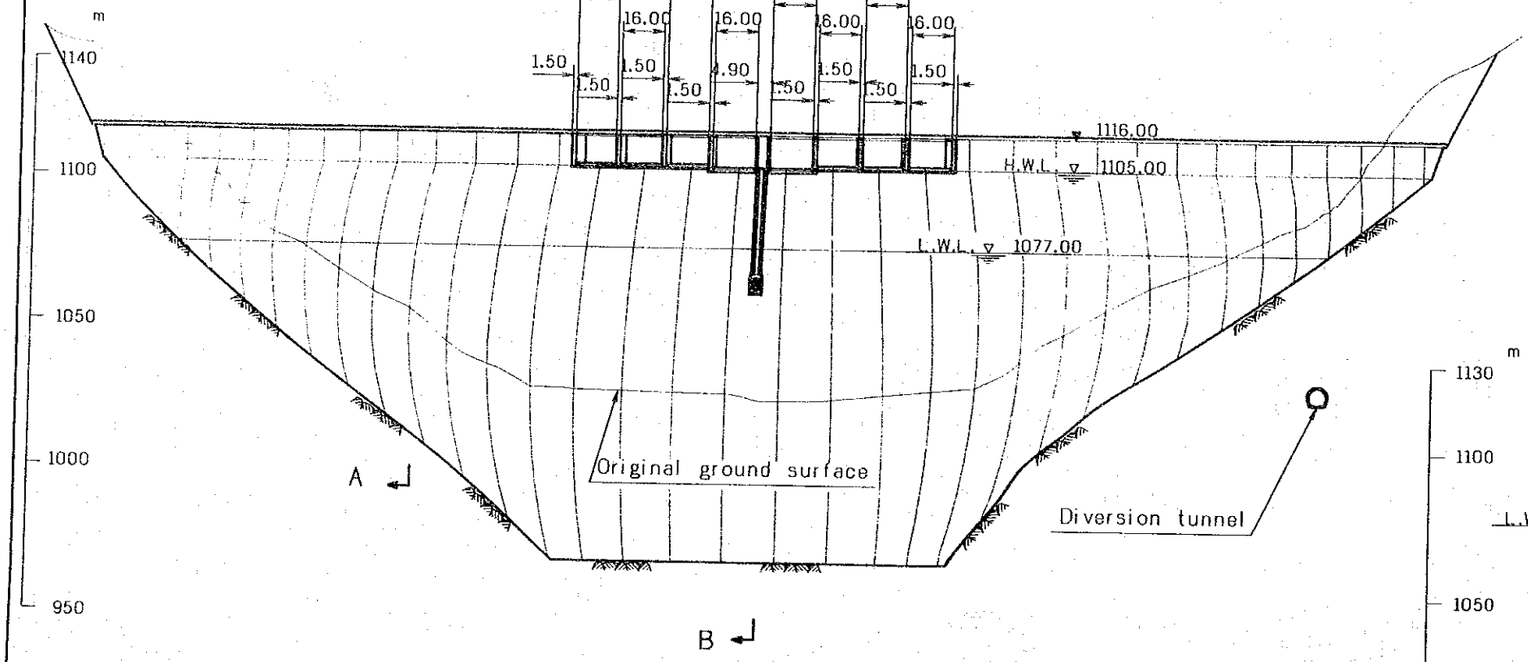


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

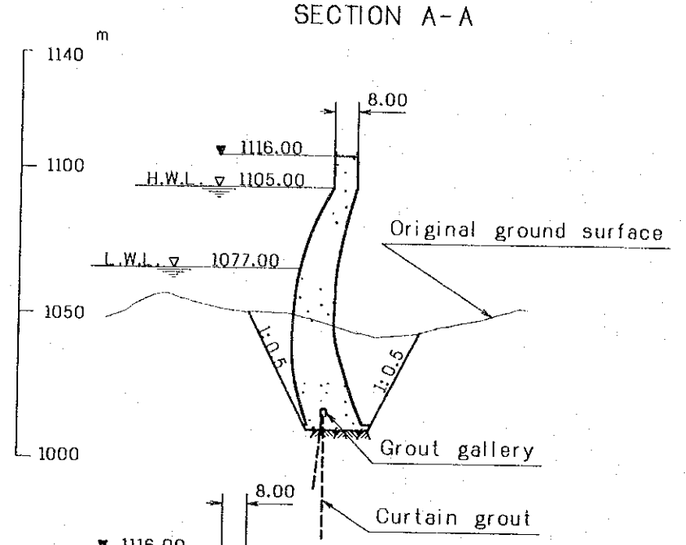
OLUR PROJECT
CONCRETE ARCH DAM
GENERAL PLAN
(ALTERNATIVE)

Fig. A-4-13

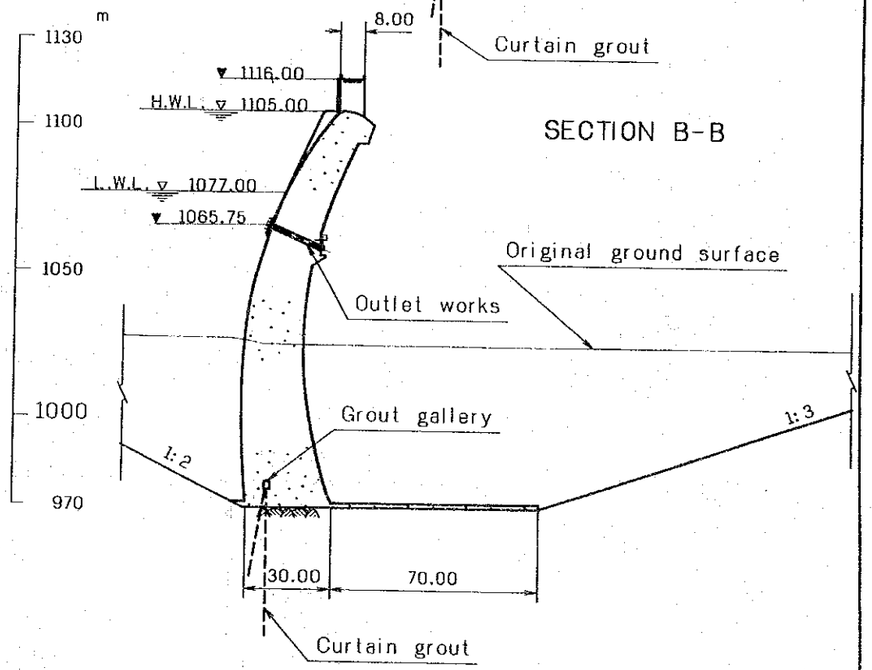
PROFILE OF DAM
(UP-STREAM)



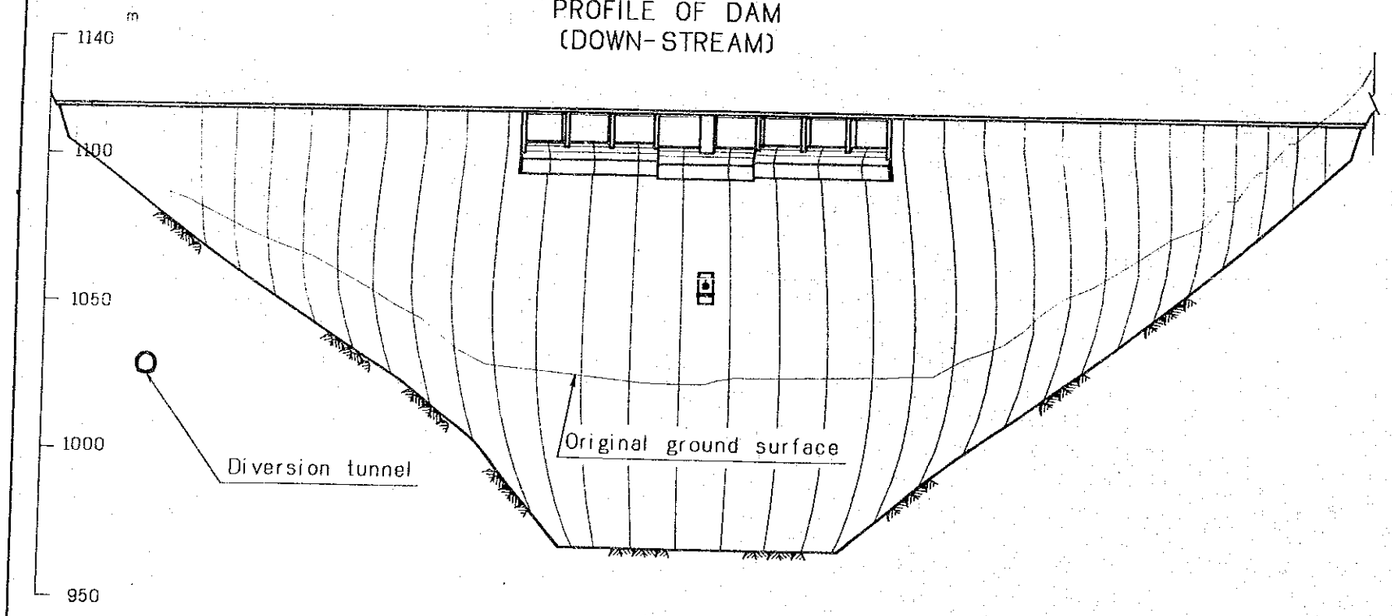
SECTION A-A

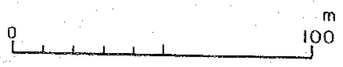


SECTION B-B



PROFILE OF DAM
(DOWN-STREAM)



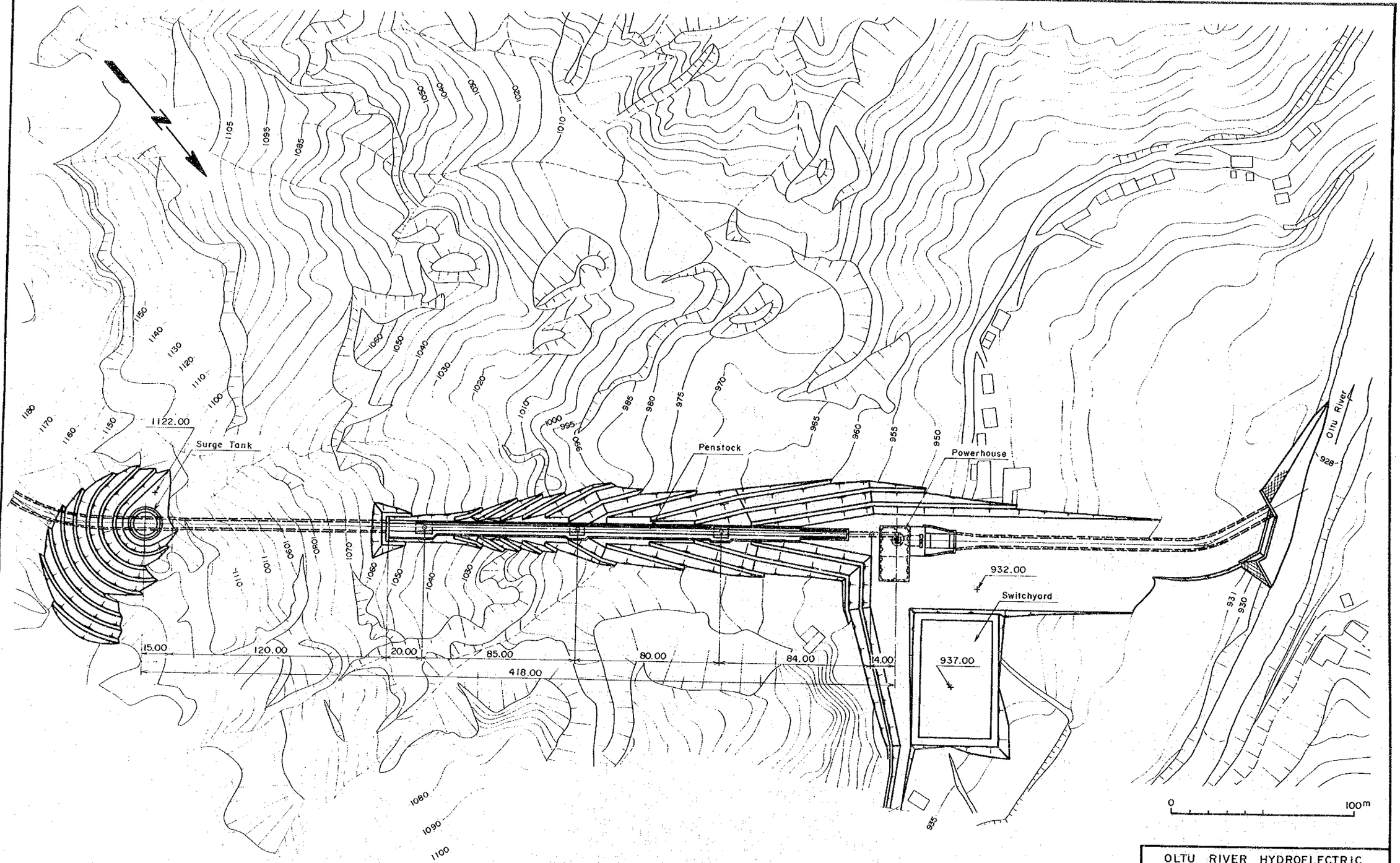


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

OLUR PROJECT

CONCRETE ARCH DAM
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig. A-4-14

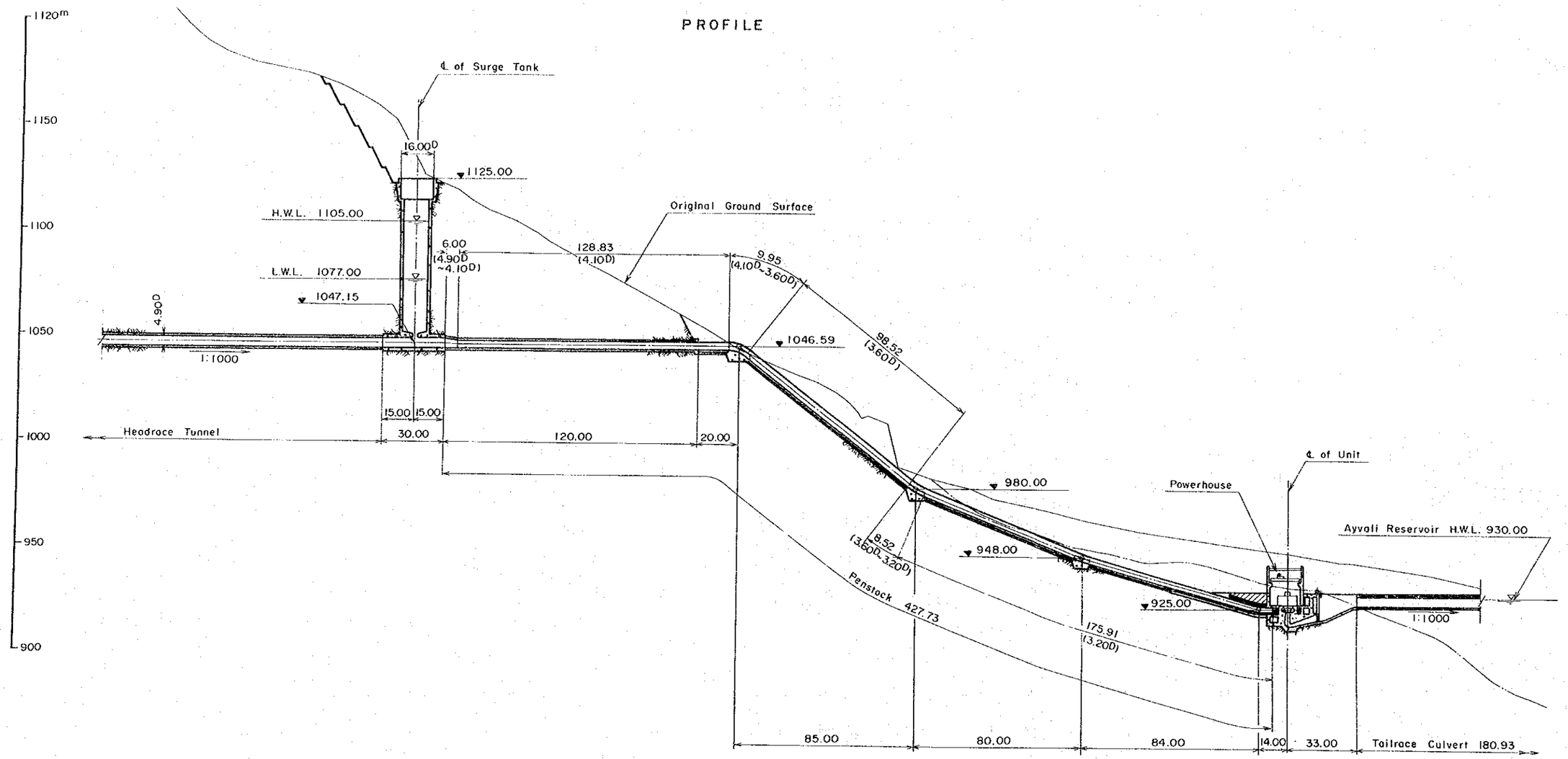


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

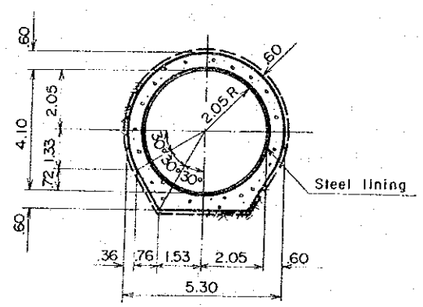
OLUR PROJECT
SURGE TANK, PENSTOCK AND POWERHOUSE PLAN (ALTERNATIVE)

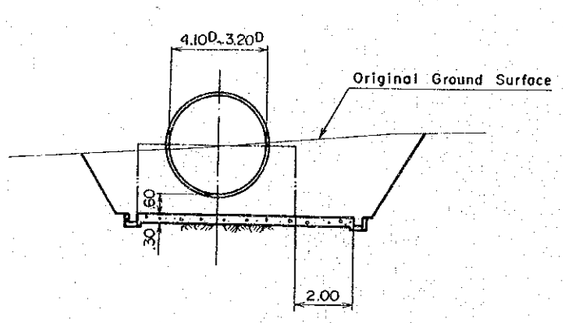
Fig. A-4-15

PROFILE



TYPICAL SECTION OF PENSTOCK





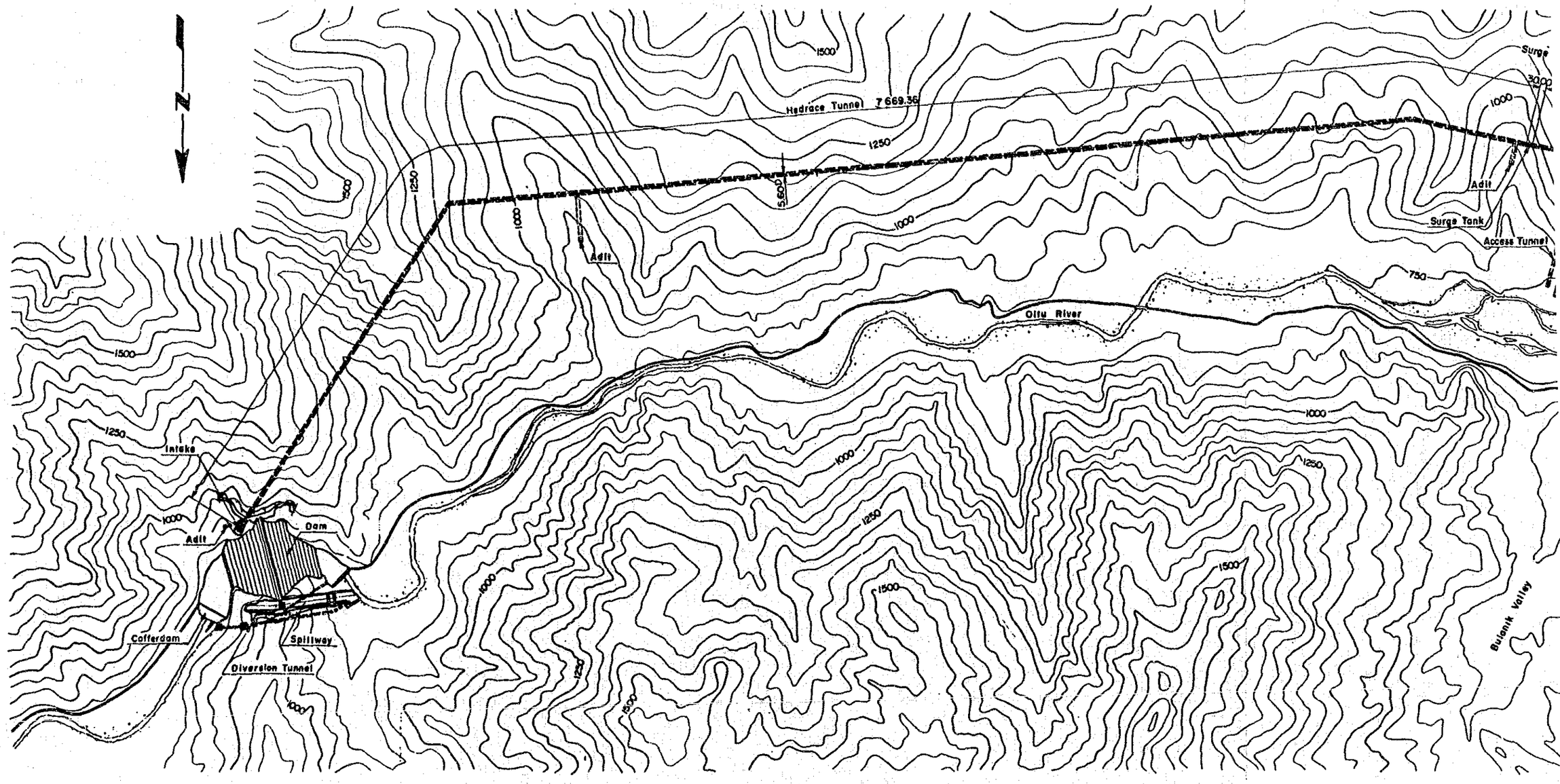
0 100m (PROFILE)

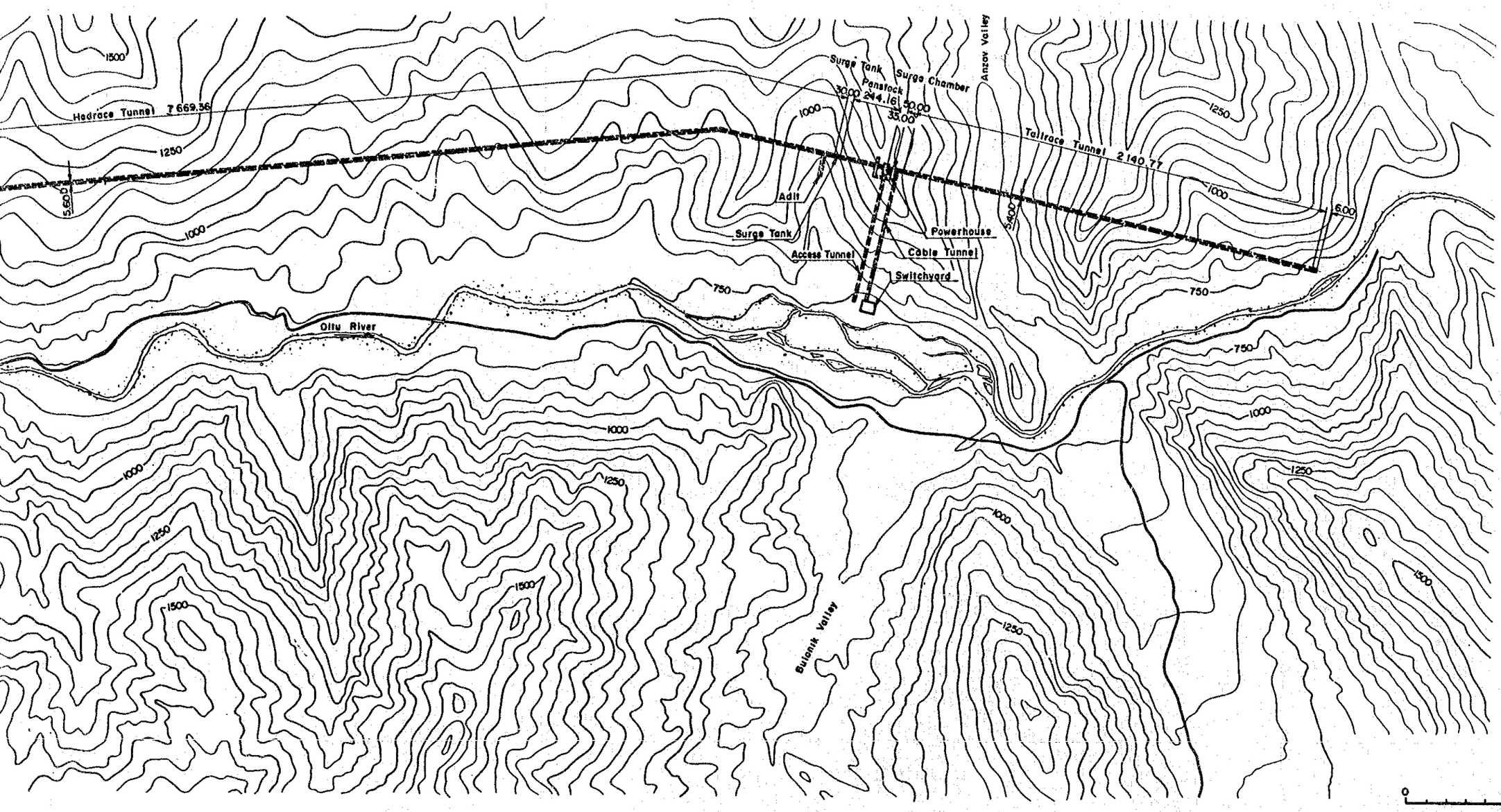
0 10m (TYPICAL SECTION OF PENSTOCK)

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

OLUR PROJECT
SURGE TANK AND PENSTOCK
PROFILE AND SECTIONS
(ALTERNATIVE)

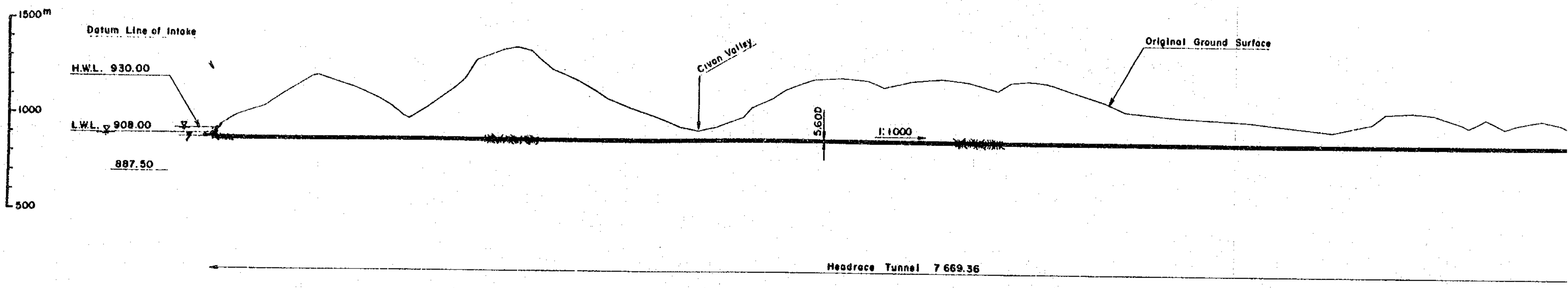
Fig. A-4-16


N
Headrace Tunnel 7669.36
5600
Adit
Surge
3000
1000
Surge Tank
Access Tunnel
750
Olitu River
1500
1250
Intake
Adit
Dam
Cofferdam
Spillway
Diversion Tunnel
Butamik Valley

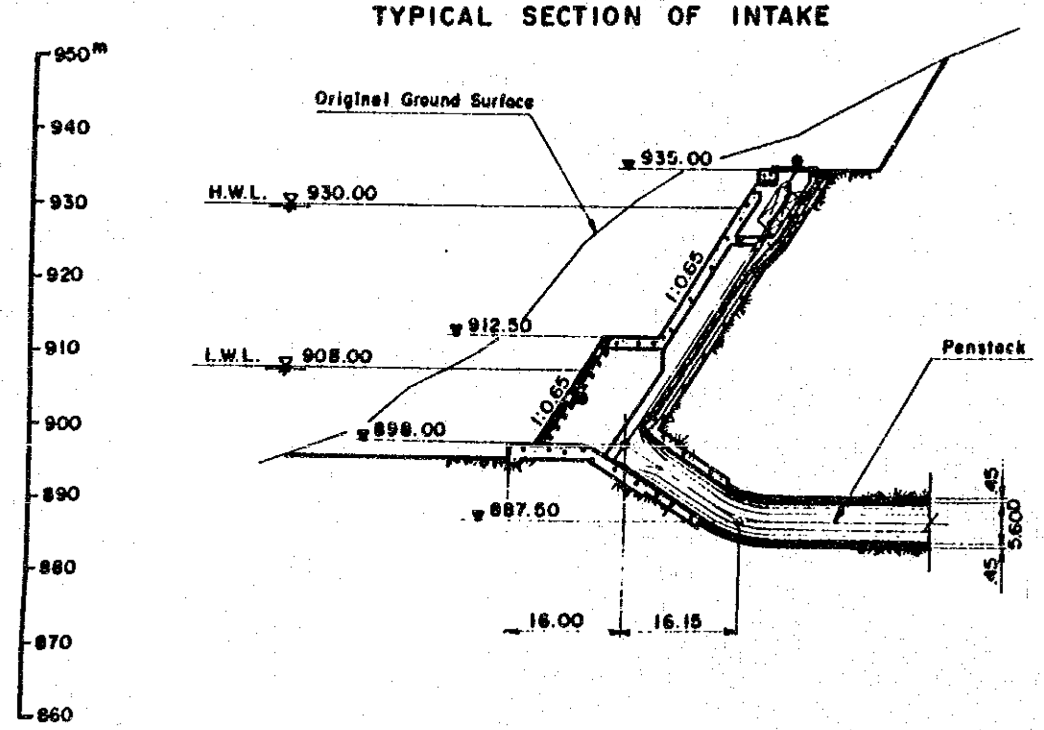


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT	
AYVALI PROJECT GENERAL PLAN (ALTERNATIVE)	
Fig. A-4-17	

PROFILE

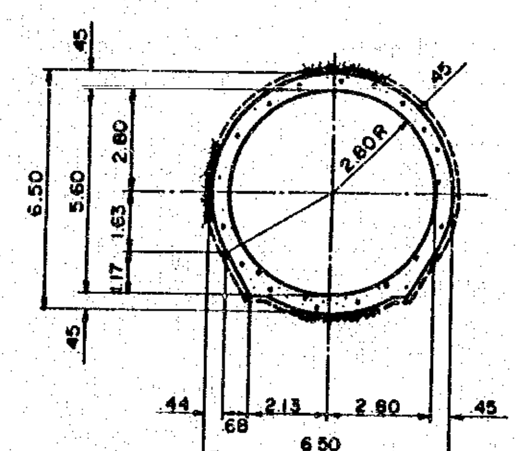


TYPICAL SECTION OF INTAKE

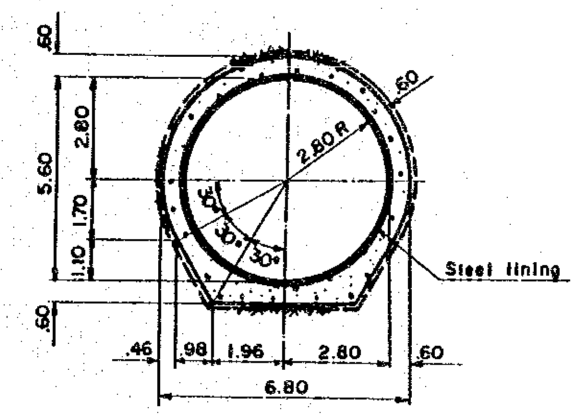


TYPICAL SECTION OF TUNNEL

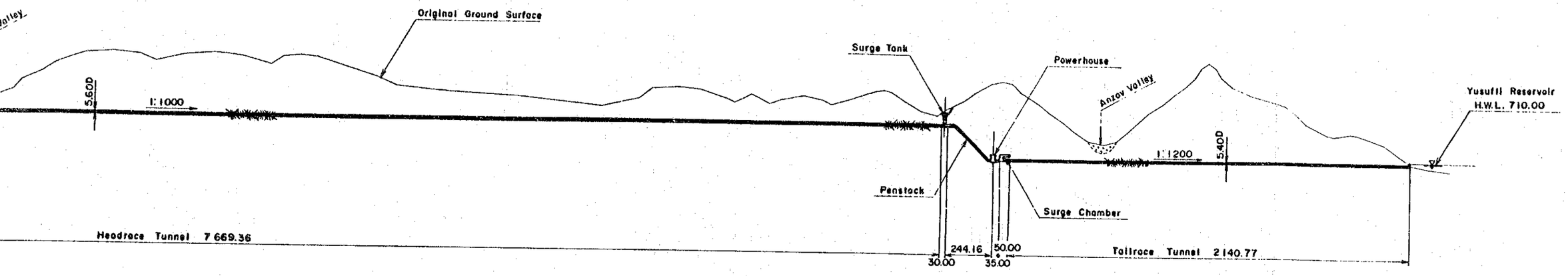
HEADRACE



PENSTOCK

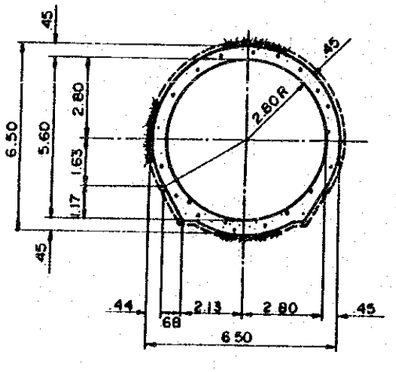


PROFILE

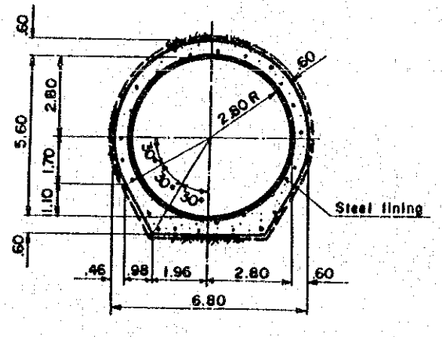


TYPICAL SECTION OF TUNNEL

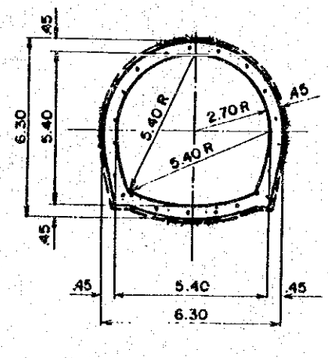
HEADRACE



PENSTOCK



TAILRACE TUNNEL



0 — 1000m (PROFILE)

0 — 50m (TYPICAL SECTION OF INTAKE)

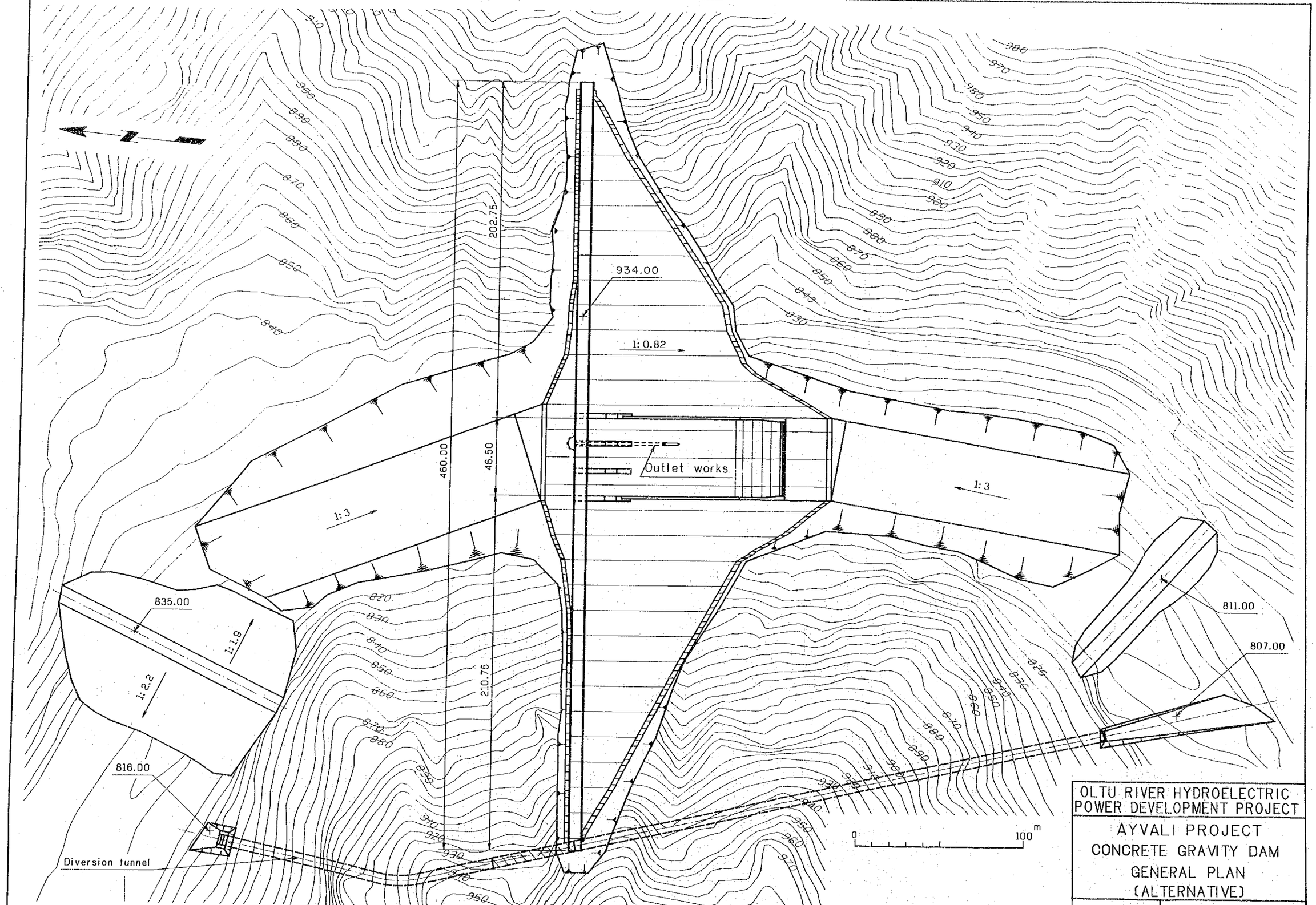
0 — 20m (SECTION A-A)

0 — 10m (TYPICAL SECTION OF TUNNEL)

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

AYVALI PROJECT
WATERWAY
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig. A-4-18

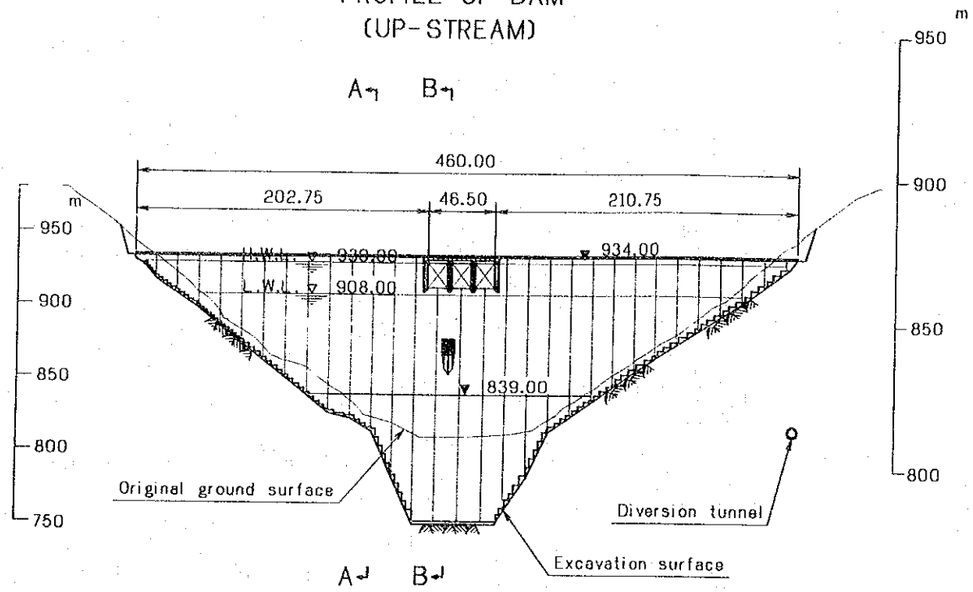


OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

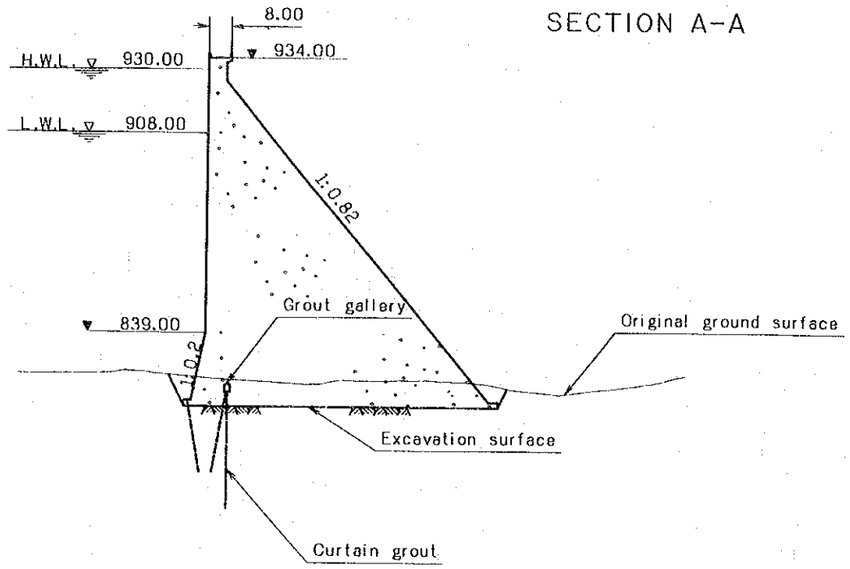
AYVALI PROJECT
CONCRETE GRAVITY DAM
GENERAL PLAN
(ALTERNATIVE)

Fig.A-4-19

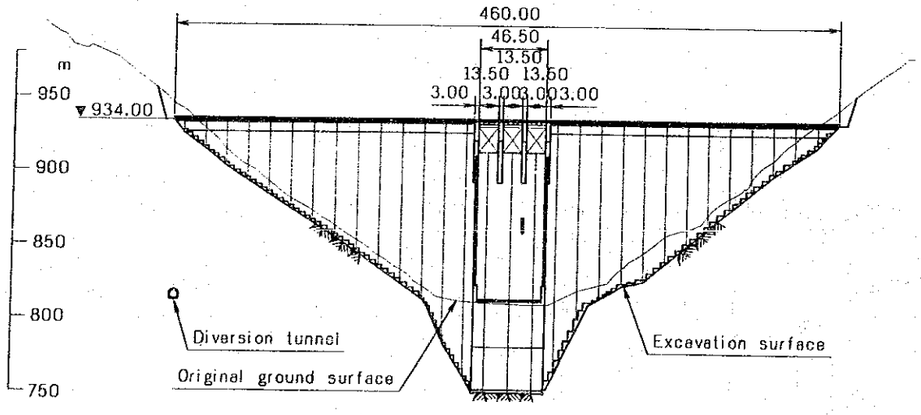
PROFILE OF DAM
(UP-STREAM)



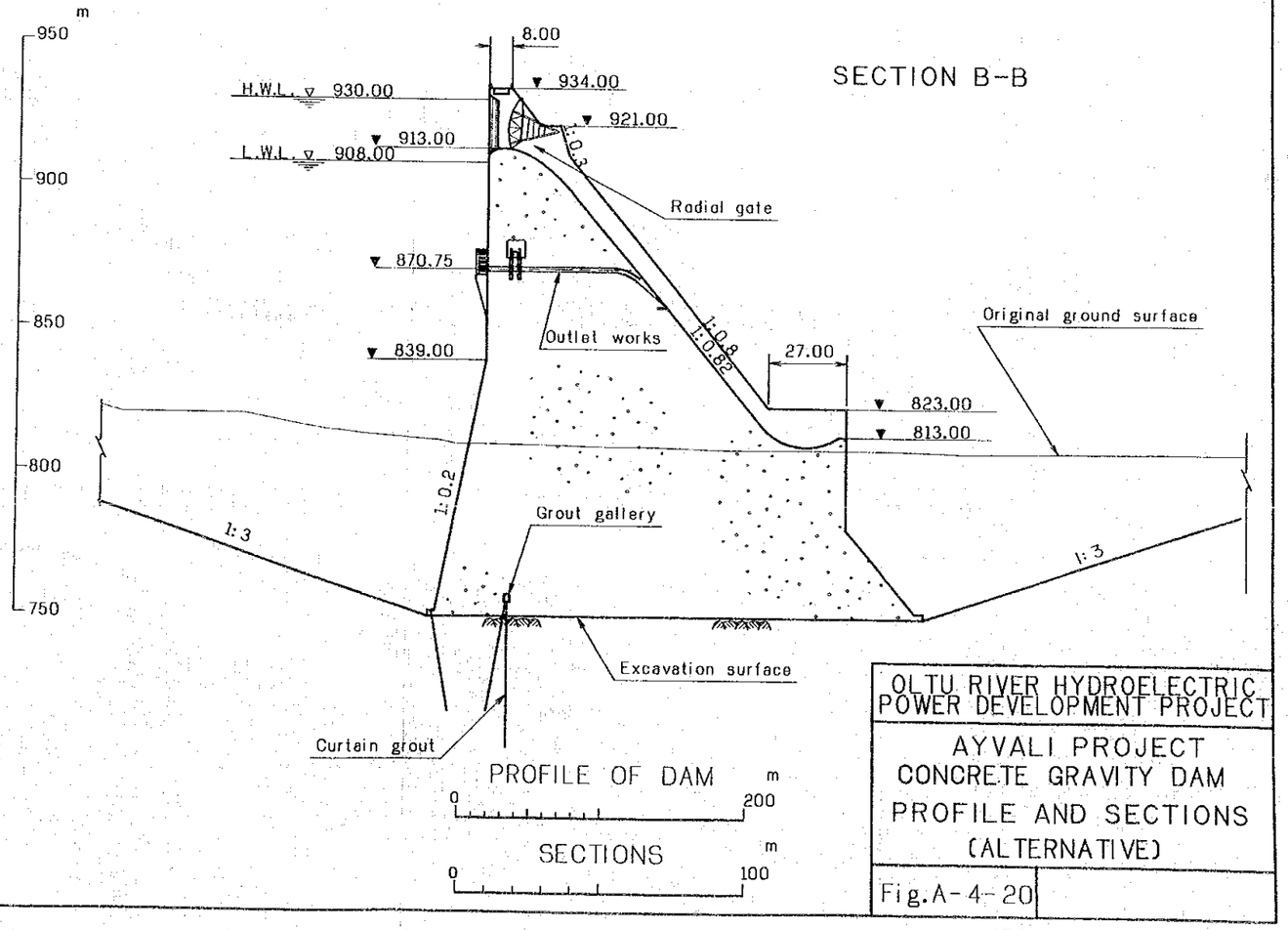
SECTION A-A



PROFILE OF DAM
(DOWN-STREAM)



SECTION B-B



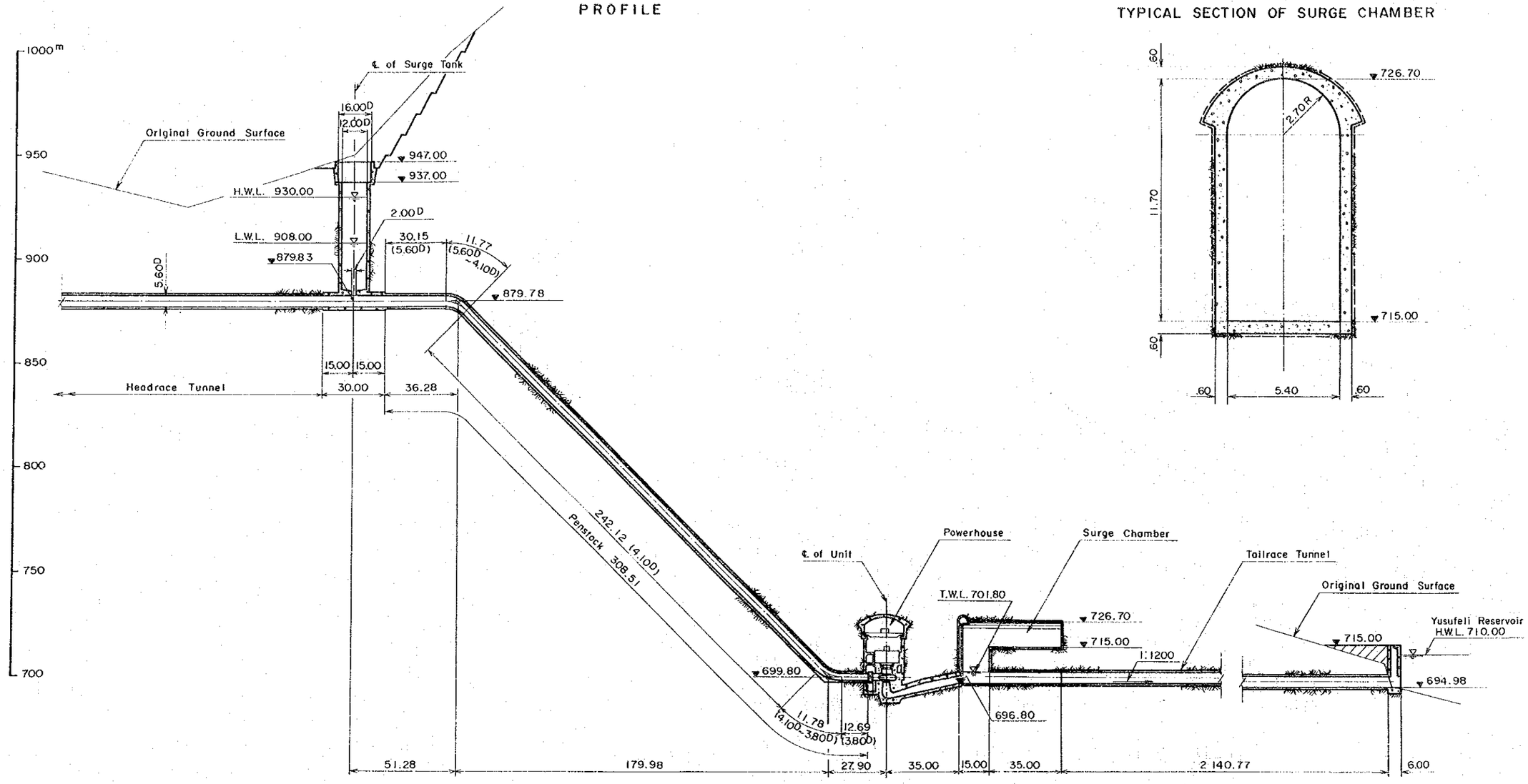
PROFILE OF DAM m
0 200
SECTIONS m
0 100

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

AYVALI PROJECT
CONCRETE GRAVITY DAM
PROFILE AND SECTIONS
(ALTERNATIVE)

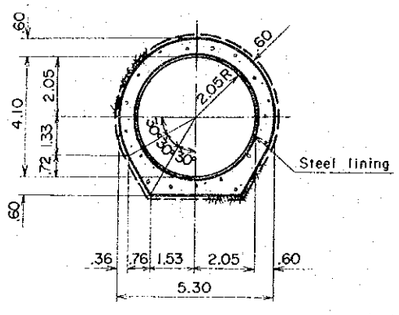
Fig.A-4-20

PROFILE

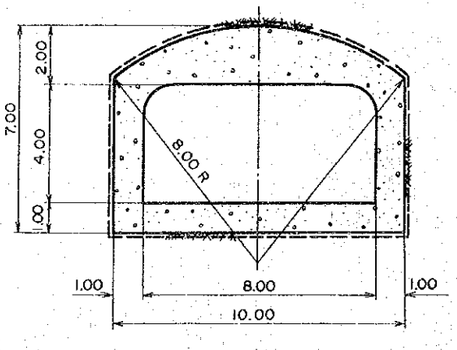


TYPICAL SECTION OF SURGE CHAMBER

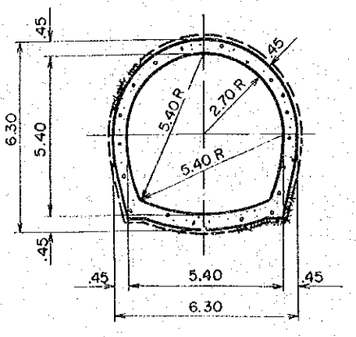
TYPICAL SECTION OF PENSTOCK



TYPICAL SECTION OF DRAFT TUNNEL



TYPICAL SECTION OF TAILRACE TUNNEL



0 100m (PROFILE)

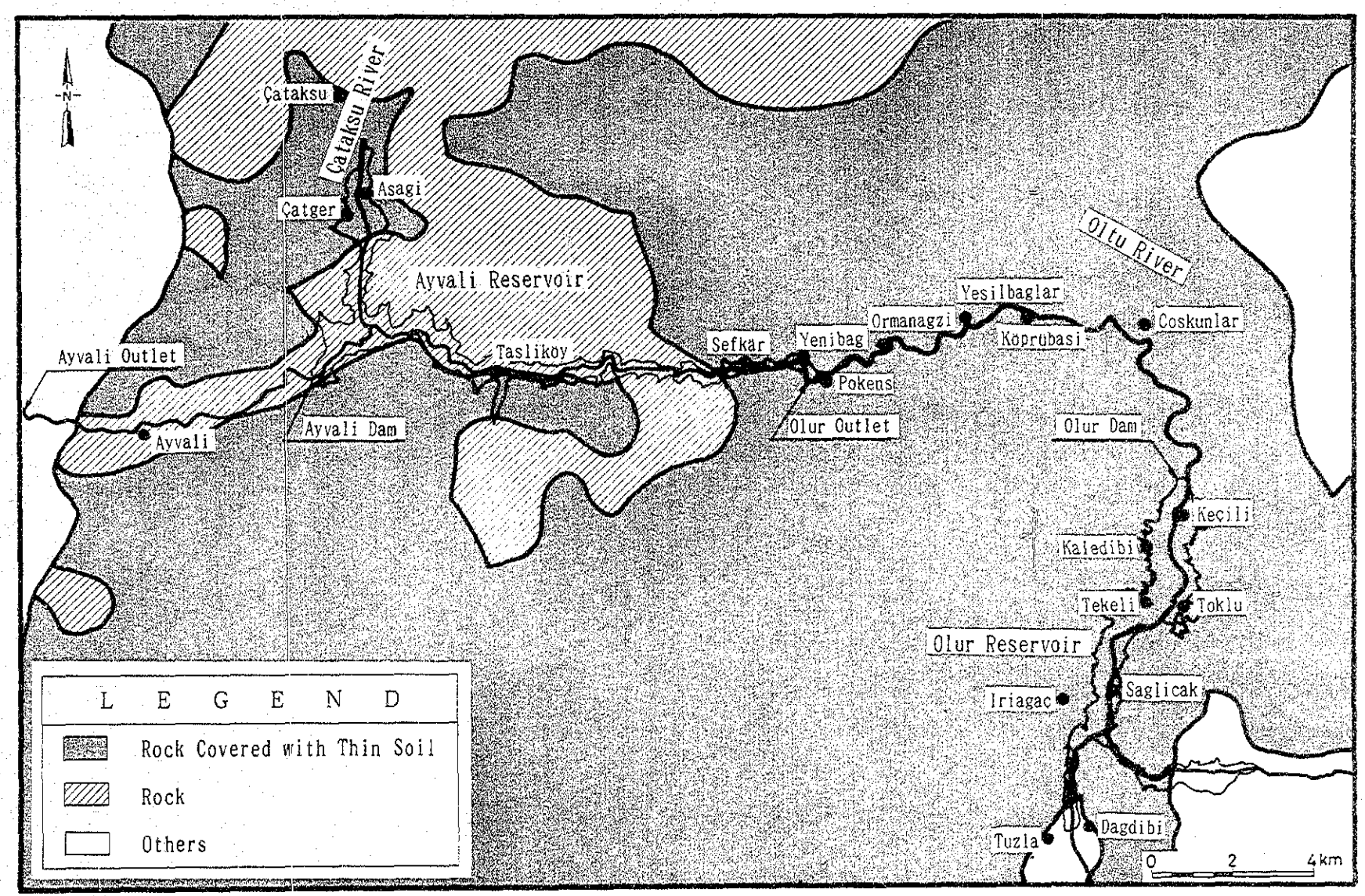
0 10m (TYPICAL SECTIONS)

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

AYVALI PROJECT
PENSTOCK AND SURGE CHAMBER
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig. A-4-21

A-5 Environment

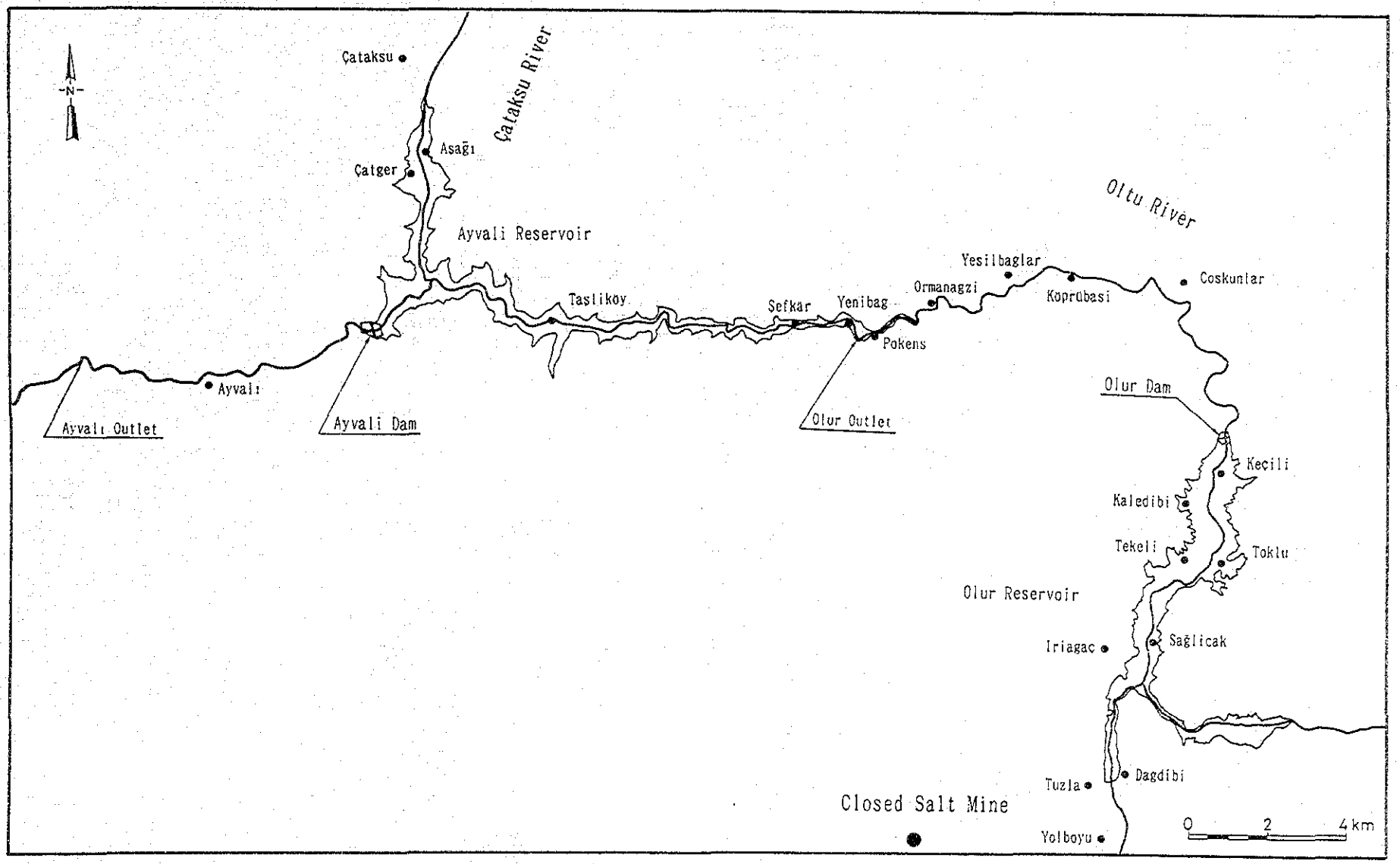


Appendix A-5-1 Composition of the Ground at Planned and Surrounding Area

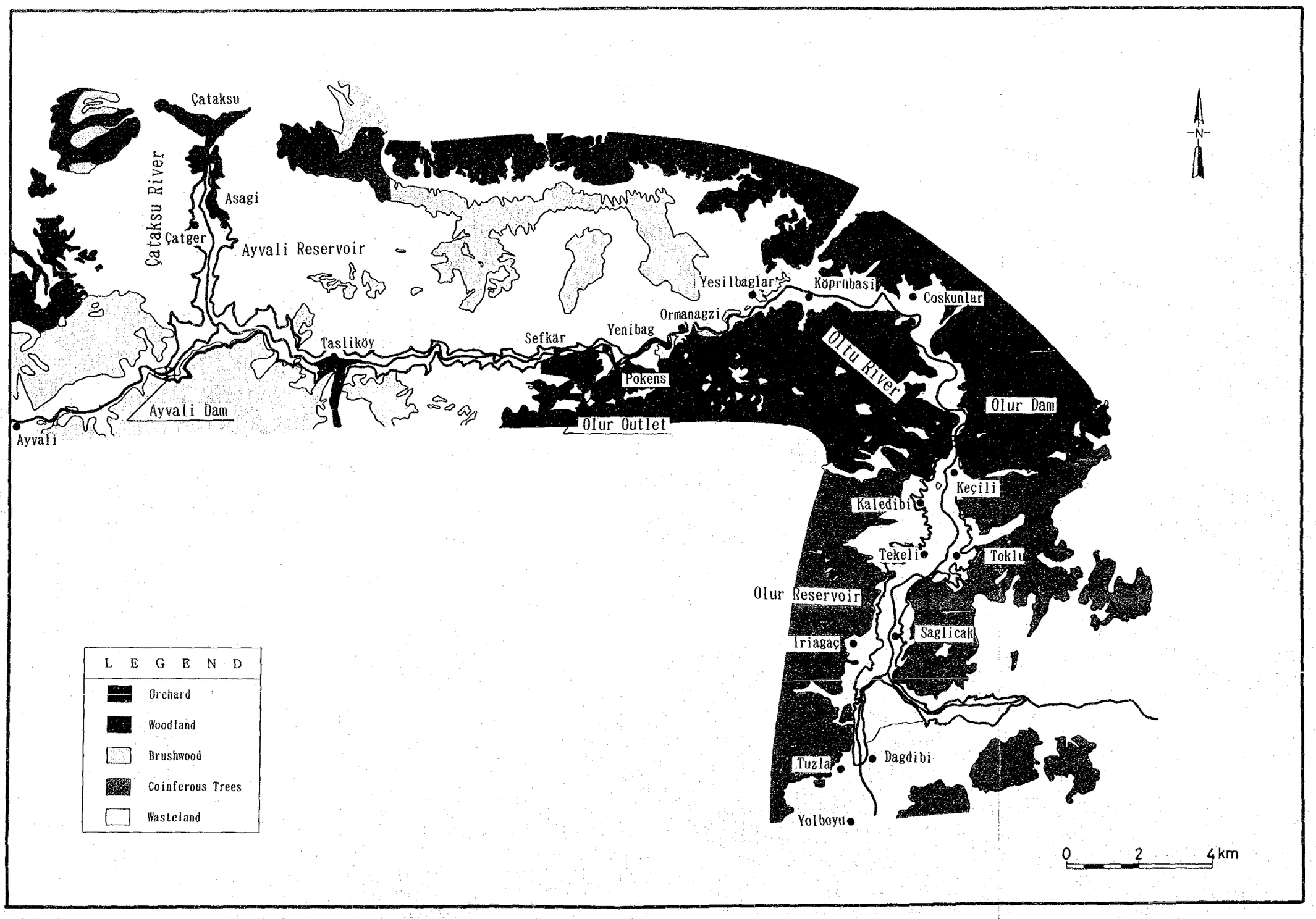
Appendix A-5-2 Distribution of Mineral Resources in Erzurm Province [2)]

Province and Districts		Erzurum Province			Narman			Oltu			Olur			Senkaya			Tortum		
Total Number of Villages		1034			43			64			40			69			60		
Number of Villages that have No Mineral or Natural Resources		905			36			47			36			51			54		
Owner of the Resource and Status of the Work		A*	B*	C*	A*	B*	C*	A*	B*	C*	A*	B*	C*	A*	B*	C*	A*	B*	C*
Mineral Resources	Total	22	18	124	1	1	10	2	2	14	1	–	5	7	–	20	1	2	3
	Lignite	7	7	53	–	–	2	2	–	6	–	–	2	1	–	6	1	–	1
	Chromium	–	5	5	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–
	Sulphur	2	–	6	1	–	1	–	–	1	–	–	–	–	–	2	–	–	–
	Cupper	8	–	20	–	–	2	–	–	1	1	–	–	3	–	8	–	–	1
	Iron	2	–	6	–	–	–	–	–	1	–	–	–	1	–	1	–	–	1
	Others	3	6	34	–	1	3	–	2	5	–	–	3	2	–	3	–	2	–

* A: Public
B: Private Sector
C: Out of Operation



Appendix A-5-3 Location of Closed Salt Mine



Appendix A-5-4 Composition of Vegetation at Planned Area and Surrounding Area

Appendix A-5-5 Species and Cover Degree of Plants in Planned Area

Olur p/s Upper Part (1050m)

Order	Class	Species	Coverage(%)
—	—	Unidentified	15
Campanulatae	Compositae	Centaurea solstitialis	15
—	—	Xeranthemum annum	5
Glumiflorae	Gramineae	Poaceae sp.	1
Campanulatae	Compositae	Asteraceae sp.	+
Rhoeadales	Cruciferae	Brassicaceae sp.	+

Olur p/s Middle Part (1030m)

Order	Class	Species	Coverage(%)
Campanulatae	Compositae	Centaurea solstitialis	25
Rhamnales	Rhamnaceae	Ziayphus jujuba	10
Geraniales	Zygophyllaceae	Tribulus terrestris	10
—	—	Xeranthemum annum	5
Centrospermae	Amaranthaceae	Amaranthus sp.	5
Centrospermae	Portulacaceae	Portulaca olearaca	+
Rhoeadales	Cruciferae	Brasaicaceae sp.	+
—	—	Unidentified	+

Olur p/s Bottom Part (1018m)

Order	Class	Species	Coverage(%)
Glumiflorae	Gramineae	Poaceae sp.	70
Salicales	Salicaceae	Salix sp.	30
—	—	Unidentified	20
—	—	Unidentified	5
—	—	Unidentified	5
Campanulatae	Compositae	Astragalus sp.	5
Campanulatae	Compositae	Xanthium strumarium	4
Umbelliflorae	Umbelliferae	Apiaceas sp.	1
Equisetales	Equisetaceae	Equisetum sp.	1
—	—	Unidentified	1
—	—	Unidentified	1
Liliiflorae	Juncaceae	Juncaceae sp.	+
Rosales	Leguminosae	Lotus corniculatus	+
Plantaginales	Plantaginaceae	Plantago lanceolata	+
—	—	Palioaria dysenterica	+
—	—	Unidentified	+

Olur Dam Upper Part (1100m)

Order	Class	Species	Coverage(%)
—	—	Xeranthemum annum	20
—	—	Unidentified	5
Geraniales	Euphorbiaceae	Euphorbia sp.	+
Glumiflorae	Gramineae	Poaceae sp.	+
Tubiflorae	Labiatae	Lamiaceae sp.	+
Centrospermae	Caryophyllaceae	Dianthue sp.	+
—	—	Actemisia sp.	+
—	—	Algssum sp.	+
—	—	Unidentified	+
—	—	Unidentified	+

Olur Dam Middle Part (1010m)

Order	Class	Species	Coverage(%)
—	—	Xeranthemum annum	35
Glumiflorae	Gramineae	Dactylis sp.	10
Tubiflorae	Labiatae	Lamiaceae sp.	+
—	—	Eryngrum sp.	+
—	—	Unidentified	+
—	—	Unidentified	+

Olur Dam Botton Part (1000m)

Order	Class	Species	Coverage(%)
Campanulatae	Compositae	Centaurea solstitalis	35
Geraniales	Zygophyllaceae	Tribulus terrestris	25
Plantaginales	Plantaginaceae	Plantago lanceolata	10
—	—	Unidentified	5
Rubiales	Rubiaceae	Rubiaceae sp.	1
—	—	Unidentified	1
Centrospermae	Amaranthaceae	Amaranthus sp.	+
Centrospermae	Portulacaceae	Portulaca oleraca	+
Campanulatae	Compositae	Asteraceae sp.	+
Malvales	Malvaceae	Malva sp.	+
Polygonales	Polygonaceae	Polygonum sp.	+

Ayvali p/s Upper Part (800m)

Order	Class	Species	Coverage(%)
Ranales	Berberidaceae	Berberis sp.	15
Campanulatae	Compositae	Asteraceae sp.	10
Glumiflorae	Gramineae	Poaceae sp.	5
Rhamnales	Rhamnaceae	Zizyphus jujuba	5
Rhoeadales	Capparidaceae	Cleome sp.	+
—	—	Xeranthemum annum	+
—	—	Artemisia sp.	+
Tubiflorae	Labiatae	Tenorium polium	+
—	—	Unidentified	+
—	—	Unidentified	+

Ayvali p/s Middle Part

Order	Class	Species	Coverage(%)
Geraniales	Zygophyllaceae	Tribulus terrestris	15
—	—	Xeranthemum annum	10
	Rhamnaceae	Zizyphus jujuba	9
—	—	Unidentified	8
—	—	Unidentified	8
Glumiflorae	Gramineae	Poaceae sp.	7
—	—	Unidentified	5

Ayvali p/s Bottom Part

Order	Class	Species	Coverage(%)
Glumiflorae	Gramineae	Poaceae sp.	20
Campanulatae	Compositae	Artemisia sp.	15
Ranales	Ranunculaceae	Clematis orientalis	10
—	—	Unidentified	10
Campanulatae	Compositae	Asteraceae sp.	5
Tubiflorae	Polemoniaceae	Cuscuta sp.	5
—	—	Xeranthemum annum	5
—	—	Unidentified	3
Campanulatae	Compositae	Asteraceae sp.	+
Rhoeadales	Resedaceae	Reseda sp.	+
Rosales	Leguminosae	Fabaceae sp.	+
Ranales	Ranunculaceae	Clematis orientalis	+
—	—	Unidentified	+

Ayvali Dam Upper Part (900m ～940m)

Order	Class	Species	Coverage(%)
—	—	Unidentified	25
—	—	Xeranthemum annum	20
Rosales	Rosaceae	Rosaceae sp.	5
—	—	Unidentified	1
Tubiflorae	Labiatae	Lamiaceae sp.	+
Tubiflorae	Labiatae	Salvia sp.	+
Campanulatae	Compositae	Asteraceae sp.	+
Campanulatae	Compositae	Carthamus sp.	+
Campanulatae	Compositae	Helichrysum sp.	+
Glumiflorae	Gramineae	Poaceae sp.	+
—	—	Unidentified	+
—	—	Unidentified	+

Ayvali Dam Middle Part

Order	Class	Species	Coverage(%)
—	—	Unidentified	15
Glumilorae	Gramineae	Poaceae sp.	5
Tubiflorae	Labiatae	Lamiaceae sp.	+
Tubiflorae	Labiatae	Salvia sp.	+
Campanulatae	Compositae	Hieracium sp.	+
—	—	Consolida sp.	+
—	—	Coasinia sp.	+
—	—	Unidentified	+
—	—	Unidentified	+

Ayvali Dam Bottom Part

Order	Class	Species	Coverage(%)
Glumiflorae	Gramineae	Poaceae sp.	35
—	—	Unidentified	30
Rosales	Leguminosae	Trifolium sp.	25
Umbelliflorae	Umbelliferae	Apiaceae sp.	15
Tubiflorae	Convolvulaceae	Convolvulus sp.	+
—	—	Unidentified	+

Appendix A-5-5 Species and Cover Degree of Plants in Planned Area

Olur p/s Upper Part (1050m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
—	—	Unidentified	15
キキョウ目 (Campanulatae)	キク科 (Compositae)	Centaurea solstitialis	15
—	—	Xeranthemum annum	5
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Poaceae sp.	1
キキョウ目 (Campanulatae)	キク科 (Compositae)	Asteraceae sp.	+
ケシ目 (Rhoeadales)	アブラナ科 (Cruciferae)	Brassicaceae sp.	+

Olur p/s Middle Part (1030m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
キキョウ目 (Campanulatae)	キク科 (Compositae)	Centaurea solstitialis	25
クロウメモドキ目(Rhamnales)	クロウメモドキ科 (Rhamnaceae)	Ziayphus jujuba	10
フウロソウ目 (Geraniales)	ハマビシ科 (Zygophyllaceae)	Tribulus terrestris	10
—	—	Xeranthemum annum	5
中心子目 (Centrospermae)	ヒユ科 (Amaranthaceae)	Amaranthus sp.	5
中心子目 (Centrospermae)	スベリヒユ科 (Portulacaceae)	Portulaca olearaca	+
ケシ目 (Rhoeadales)	アブラナ科 (Cruciferae)	Brasaicaceae sp.	+
—	—	Unidentified	+

Olur p/s Bottom Part (1018m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Poaceae sp.	70
ヤナギ目 (Salicales)	ヤナギ科 (Salicaceae)	Salix sp.	30
—	—	Unidentified	20
—	—	Unidentified	5
—	—	Unidentified	5
キキョウ目 (Campanulatae)	キク科 (Compositae)	Astragalus sp.	5
キキョウ目 (Campanulatae)	キク科 (Compositae)	Xanthium strumarium	4
傘形花目 (Umbelliflorae)	セリ科 (Umbelliferae)	Apiaceas sp.	1
トクサ目 (Equisetales)	トクサ科 (Equisetaceae)	Equisetum sp.	1
—	—	Unidentified	1
—	—	Unidentified	1
ユリ目 (Liliiflorae)	イグサ科 (Juncaceae)	Juncaceae sp.	+
バラ目 (Rosales)	マメ科 (Leguminosae)	Lotus corniculatus	+
オオバコ目 (Plantaginales)	オオバコ科 (Plantaginaceae)	Plantago lanceolata	+
—	—	Palioaria dysenterica	+
—	—	Unidentified	+

Olur Dam Upper Part (1100m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
–	–	Xeranthemum annum	20
–	–	Unidentified	5
フウロソウ目 (Geraniales)	トウダイグサ科 (Euphorbiaceae)	Euphorbia sp.	+
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Poaceae sp.	+
管状花目 (Tubiflorae)	シソ科 (Labiatae)	Lamiaceae sp.	+
中心子目 (Centrospermae)	ナデシコ科 (Caryophyllaceae)	Dianthue sp.	+
–	–	Actemisia sp.	+
–	–	Algssum sp.	+
–	–	Unidentified	+
–	–	Unidentified	+

Olur Dam Middle Part (1010m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
–	–	Xeranthemum annum	35
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Dactylis sp.	10
管状花目 (Tubiflorae)	シソ科 (Labiatae)	Lamiaceae sp.	+
–	–	Eryngrum sp.	+
–	–	Unidentified	+
–	–	Unidentified	+

Olur Dam Botton Part (1000m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
キキョウ目 (Campanulatae)	キク科 (Compositae)	Centaurea solstitalis	35
フウロソウ目 (Geraniales)	ハマビシ科 (Zygophyllaceae)	Tribulus terrestris	25
オオバコ目 (Plantaginales)	オオバコ科 (Plantaginaceae)	Plantago lanceolata	10
–	–	Unidentified	5
アカネ目 (Rubiales)	アカネ科 (Rubiaceae)	Rubiaceae sp.	1
–	–	Unidentified	1
中心子目 (Centrospermae)	ヒユ科 (Amaranthaceae)	Amaranthus sp.	+
中心子目 (Centrospermae)	スベリヒユ科 (Portulacaceae)	Portulaca oleraca	+
キキョウ目 (Campanulatae)	キク科 (Compositae)	Asteraceae sp.	+
アオイ目 (Malvales)	アオイ科 (Malvaceae)	Malva sp.	+
タデ目 (Polygonales)	タデ科 (Polygonaceae)	Polygonum sp.	+

Ayvali p/s Upper Part (800m)

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
キンポウゲ目 (Ranales)	メギ科 (Berberidaceae)	Berberis sp.	15
キキョウ目 (Campanulatae)	キク科 (Compositae)	Asteraceae sp.	10
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Poaceae sp.	5
クロウメモドキ目(Rhamnales)	クロウメモドキ科(Rhamnaceae)	Zizyphus jujuba	5
ケシ目 (Rhoeadales)	フウチョウソウ科(Capparidaceae)	Cleome sp.	+
—	—	Xeranthemum annum	+
—	—	Artemisia sp.	+
管状花目 (Tubiflorae)	シソ科 (Labiatae)	Tenorium polium	+
—	—	Unidentified	+
—	—	Unidentified	+

Ayvali p/s Middle Part

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
フウロソウ目 (Geraniales)	ハマビシ科 (Zygophyllaceae)	Tribulus terrestris	15
—	—	Xeranthemum annum	10
クロウメモドキ目(Rhamnales)	クロウメモドキ科(Rhamnaceae)	Zizyphus jujuba	9
—	—	Unidentified	8
—	—	Unidentified	8
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Poaceae sp.	7
—	—	Unidentified	5

Ayvali p/s Bottom Part

目 (Order)	科 (Class)	種 (Species)	植被率 (%)
頴花目 (Glumiflorae)	イネ科 (Gramineae)	Poaceae sp.	20
キキョウ目 (Campanulatae)	キク科 (Compositae)	Artemisia sp.	15
キンポウゲ目 (Ranales)	キンポウゲ科 (Ranunculaceae)	Clematis orientalis	10
—	—	Unidentified	10
キキョウ目 (Campanulatae)	キク科 (Compositae)	Asteraceae sp.	5
管状花目 (Tubiflorae)	ハナシノブ科 (Polemoniaceae)	Cuscuta sp.	5
—	—	Xeranthemum annum	5
—	—	Unidentified	3
キキョウ目 (Campanulatae)	キク科 (Compositae)	Asteraceae sp.	+
ケシ目 (Rhoeadales)	モクセイソウ科 (Resedaceae)	Reseda sp.	+
バラ目 (Rosales)	マメ科 (Leguminosae)	Fabaceae sp.	+
キンポウゲ目 (Ranales)	キンポウゲ科 (Ranunculaceae)	Clematis orientalis	+
—	—	Unidentified	+

Ayvali Dam Upper Part (900m ~940m)

目 (Order)		科 (Class)		種 (Species)	植被率 (%)
—		—		Unidentified	25
—		—		Xeranthemum annum	20
バラ目	(Rosales)	バラ科	(Rosaceae)	Rosaceae sp.	5
—		—		Unidentified	1
管状花目	(Tubiflorae)	シソ科	(Labiatae)	Lamiaceae sp.	+
管状花目	(Tubiflorae)	シソ科	(Labiatae)	Salvia sp.	+
キキョウ目	(Campanulatae)	キク科	(Compositae)	Asteraceae sp.	+
キキョウ目	(Campanulatae)	キク科	(Compositae)	Carthamus sp.	+
キキョウ目	(Campanulatae)	キク科	(Compositae)	Helichrysum sp.	+
頴花目	(Glumiflorae)	イネ科	(Gramineae)	Poaceae sp.	+
—		—		Unidentified	+
—		—		Unidentified	+

Ayvali Dam Middle Part

目 (Order)		科 (Class)		種 (Species)	植被率 (%)
—		—		Unidentified	15
頴花目	(Glumilorae)	イネ科	(Gramineae)	Poaceae sp.	5
管状花目	(Tubiflorae)	シソ科	(Labiatae)	Lamiaceae sp.	+
管状花目	(Tubiflorae)	シソ科	(Labiatae)	Salvia sp.	+
キキョウ目	(Campanulatae)	キク科	(Compositae)	Hieracium sp.	+
—		—		Consolida sp.	+
—		—		Coasinia sp.	+
—		—		Unidentified	+
—		—		Unidentified	+

Ayvali Dam Bottom Part

目 (Order)		科 (Class)		種 (Species)	植被率 (%)
頴花目	(Glumiflorae)	イネ科	(Gramineae)	Poaceae sp.	35
—		—		Unidentified	30
バラ目	(Rosales)	バラ科	(Leguminosae)	Trifolium sp.	25
傘形花目	(Umbelliflorae)	セリ科	(Umbelliferae)	Apiaceae sp.	15
管状花目	(Tubiflorae)	ヒルガオ科	(Convolvulaceae)	Convolvulus sp.	+
—		—		Unidentified	+

Appendix A-5-6 Animals Inhabited in Planned and Surrounding Area

(1) Mammal *1 (Vicinity of Olur Dam Site) (1991.7.23)

Common Name	Scientific Name	Habitat *2	Seasonality	Number	Relation to Resident
Cow		a	———	many	economical
Cattle		〃	———	〃	〃
Goat		a, b	———	〃	〃
Rabbit		a, b, c	Spring-Autumn	〃	———
Wolf		a, b	Winter, Summer	rare	———
Marten		〃	〃	〃	———
Bear		b	〃	〃	———
Fox		〃	〃	〃	———
Wild Goat		〃	none	some	———
Bedger		c	———	rare	economical *3
Water Sable		〃	———	〃	〃

*1 The Wild Goat hunting is forbidden
*2 a: Flat land
b: Mountainous region
c: Riverside
*3 Their leather is available

(2) Reptile and Amphibian (Vicinity of Olur Dam Site) (1991.7.23)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Snake		a, b, c	Summer	many	———
Water Snake		c	〃	〃	———
Lizard		a, b, c	〃	〃	———
Frog		a, c	〃	〃	———

Appendix A-5-6 Animals Inhabited in Planned and Surrounding Area (Continue)

(3) Bird (Vicinity of Olur Dam Site) (1991.7.23)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Sparrow		a	——	many	——
Mag-pia		a, c	——	〃	——
Parrot		〃	——	rare	——
Crow		a	——	many	——
Owl		b	——	〃	——
Eagle		〃	——	rare	——
Stork		a, c	——	some	——
Partridge		b	Summer	〃	——
Falcon		〃	——	rare	——
Sparrow-hawk		〃	——	〃	——
Peregrine falcon		〃	——	〃	——
Duck		c	——	many	——
Wild duck		〃	Summer	rare	——
Goose		〃	——	some	——
Wild goose		〃	Summer	rare	——
Pegeon		a	——	many	——
Chicken		〃	——	〃	——
Turkey		〃	——	〃	——
Woodpecker		a, b	——	some	——

Appendix A-5-6 Animals Inhabited in Planned and Surrounding Area (Continue)

(4) Insect and others (Vicinity of Olur Dam Site) (1991.7.23)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Spider		a, b, c	———	many	———
Centipede		〃	———	〃	———
Grasshopper		〃	Summer	〃	———
Ant		〃	Spring, Autumn	〃	———
Glowworn		〃	〃	some	———
(Gelinbocepi)		〃	〃	many	———
Housefly		〃	〃	〃	———
Mosquito		a, c	Spring-Autumn	〃	———
Butterfly		a, b, c	〃	〃	———
Dragonfly		〃	〃	〃	———
Scorpion		a, b	Summer	some	———
Hooked-head Scorpion		〃	〃	〃	———
Long tailed Scorpion		〃	〃	〃	———

(5) Fish (Vicinity of Olur Dam Site) (1991.7.23)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Carp		Riverside	December-February	many *1	economical *2

*1: The villagers say the number is decreacing due to turbidity.
*2: But no professional fishing activity for carp.

Appendix A-5-6 Animals Inhabited in Planned and Surrounding Area (Continue)

(6) Mammal (Vicinity of Ayvali Dam Site) (1991.7.27)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Cow		a	———	many	economical
Cattle		〃	———	〃	〃
Goat		a, b	———	〃	〃
Rabbit		a, b, c	Spring-Autumn	〃	———
Wolf		a, b	Winter, Summer	rare	———
Marten		〃	〃	〃	———
Bear		b	〃	〃	———
Fox		〃	〃	〃	———
Wild Goat		〃	none	some	———
Bedger		c	———	many	economical
Water Sable		〃	———	〃	〃

(7) Reptile and Amphibian (Vicinity of Ayvali Dam Site) (1991.7.27)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Snake		a, b, c	Summer	many	———
Water snake		c	〃	〃	———
Lizard		a, b, c	〃	〃	———
Frog		a, c	〃	〃	———

Appendix A-5-6 Animals Inhabited in Planned and Surrounding Area (Continue)

(8) Bird (Vicinity of Ayvali Dam Site) (1991.7.27)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Sparrow		a	———	many	———
Mag-pie		a, c	———	〃	———
Crow		a	———	〃	———
Owl		b	———	〃	———
Eagle		〃	———	rare	———
Partridge		〃	Summer	〃	———
Falcon		〃	———	〃	———
Sparrow-hawk		〃	———	〃	———
Peregine falcon		〃	———	〃	———
Duck		c	———	many	———
Wild duck		〃	Summer	rare	———
Goose		〃	———	some	———
Wild goose		〃	Summer	rare	———
Pegeon		a	———	many	———
Chicken		〃	———	〃	———
Turkey		〃	———	〃	———
Woodpecker		a, b	———	some	———

Appendix A-5-6 Animals Inhabited in Planned and Surrounding Area (Continue)

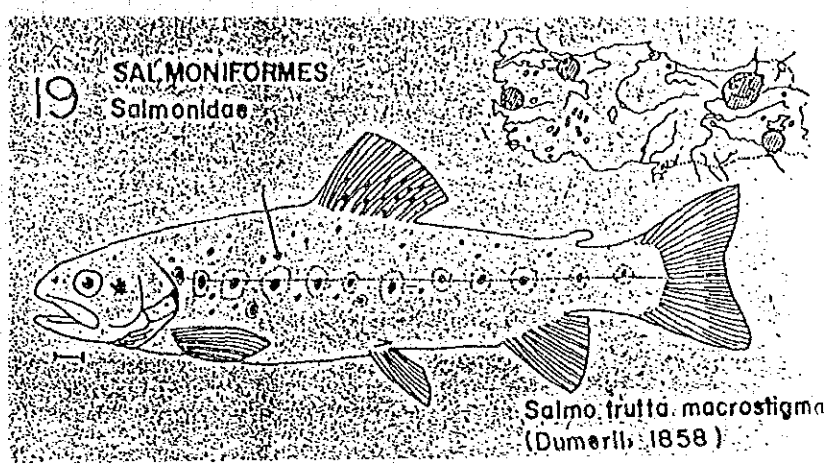
(9) Insect and others (Vicinity of Ayvali Dam Site) (1991.7.27)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Spider		a, b, c,	———	many	———
Centipede		〃	———	〃	———
Grasshopper		〃	Summer	〃	———
Ant		〃	Spring, Autumn	〃	———
Glowworm		〃	〃	some	———
(Gelinbocepi)		〃	〃	many	———
Housefly		〃	〃	〃	———
Mosquito		a, c	Spring-Autumn	〃	———
Butterfly		a, b, c	〃	〃	———
Dragonfly		〃	〃	〃	———
Scorpion		a, b	Summer	some	———
Hooked-head Scorpion		〃	〃	〃	———
Long tailed Scorpion		〃	〃	〃	———

(10) Fish (Vicinity of Ayvali Dam Site) (1991.7.27)

Common Name	Scientific Name	Habitat	Seasonality	Number	Relation to Resident
Carp		Riverside	December-February	many	economical

*1: The villagers say the number is decreacing due to turbidity.
*2: But no professional fishing activity for carp.



Appendix A-5-7 Distribution of Trout (Salmo trutta macrostigma) in Turkey [11]

Appendix A-5-8 Species of Aquatic Insects Collected in Oltu River

Species (動物名)			Ayvali Res.	Ayvali Dam	Olur Res.	Olur P/S
Arthropoda (節足動物)	Trichoptera (トビケラ目)	Hydropsychidae (シマトビケラ科)	18	7	15	2
		Psychomyidae (クダトビケラ科)		1		
	Coleoptera (甲虫目)	Dryopidae (マルトゲムシ科)			1	
	Ephemeroptera (カゲロウ目)	Ephemerellidae (マダラカゲロウ科)			4	1
		Caenidae (ヒメシロカゲロウ科)			1	
		Ecdyonuridae (ヒラタカゲロウ科)				1
Mollusca (軟体動物)	Megagastropoda (中腹足目)	Valvatidae (ミズシタダミ科)			1	2
		Hydrobilidae (イツマデガイ科)				1
	Basommatophora (基眼目)	Planorbidae (ヒラマキガイ科)				1

Appendix A-5-9　Setting Volume and Species of Plankton in Tortum Lake

		Surfice layer	Middle layer
Settling Volume (*mℓ*／*ℓ*) (沈　殿　量)		0.048	0.093
出現種	Diatoms (珪　藻　類)　(cells/*mℓ*)		
	Cyclotella sp.	542.8	86.0
	Navicula sp.	0.2	0.2
	Dinoflagellate (渦 鞭 毛 藻 類)　(cells/*mℓ*)		
	Ceratium hirundinella	4.2	0.2
	Green Algae (緑　藻　類)　(cells/*mℓ*)		
	Chlorella sp.	0.6	—
	Dictyosphaerium sp.	0.8	—
	Euglenophyta (ユーグレナ藻類)　(cells/*mℓ*)		
	Phacus sp.	54.8	0.2
	Trachelomonas sp.	48.7	0.6
	Spirotrichia (有鐘繊毛虫類)　(ind./*mℓ*)	—	0.9

Appendix A-5-10 Class of Inland Water Quality.

Water Quality Parameters		Water Quality Classes			
		I	II	III	IV
A) Physical and inorganic chemical parameters					
1-Temperature	(℃)	25	25	30	> 30
2-pH		6.5～8.5	6.5～8.5	6.0～9.0	6.0～9.0
3-Dissolved oxygen	(mg/ℓ)	8	6	3	< 3
4-Oxygen saturation	(%)	90	70	40	< 40
5-Cl	(mg/ℓ)	25	200	400	> 400
6-SO_4	(mg/ℓ)	200	200	400	> 400
7-NH_4-N	(mg/ℓ)	0.2	1	2	> 2
8-NO_2-N	(mg/ℓ)	0.002	0.01	0.05	> 0.05
9-NO_3-N	(mg/ℓ)	5	10	20	> 20
10-PO_4-P	(mg/ℓ)	0.02	0.16	0.65	> 0.65
11-Total dissolved solids	(mg/ℓ)	500	1500	5000	> 5000
12-Color		5	50	300	> 300
13-Na	(mg/ℓ)	125	125	250	> 250
B) Organic parameters					>
1-COD	(mg/ℓ)	25	50	70	> 70
2-BOD	(mg/ℓ)	4	8	20	> 20
3-Organic carbon	(mg/ℓ)	5	8	12	> 12
4-Total K-N	(mg/ℓ)	0.5	1.5	5	> 5
5-Emulsified oil & grease	(mg/ℓ)	0.02	0.3	0.5	> 0.5
6-Methylene blue active substances	(mg/ℓ)	0.05	0.2	1	> 1.5
7-Phenolic subsrance	(mg/ℓ)	0.002	0.01	0.1	> 0.1
8-Mineral oils and derivatives	(mg/ℓ)	0.02	0.1	0.5	> 0.5
9-Total pesticide	(mg/ℓ)	0.001	0.01	0.1	> 0.1
C) Inorganic pollution parameters					
1-Hg	(μg/ℓ)	0.1	0.5	2	> 2
2-Cd	(μg/ℓ)	3	5	10	> 10
3-Pb	(μg/ℓ)	10	20	50	> 50
4-As	(μg/ℓ)	20	50	100	> 100
5-Cu	(μg/ℓ)	20	50	200	> 200
6-Cr(Total)	(μg/ℓ)	20	50	200	> 200
7-Cr ($^{+6}$)	(μg/ℓ)	< N.D.	20	50	> 50
8-Co	(μg/ℓ)	10	20	200	> 200
9-Ni	(μg/ℓ)	20	50	200	> 200
10-Zn	(μg/ℓ)	200	500	2000	> 2000
11-CN	(μg/ℓ)	10	50	100	> 100
12-F	(μg/ℓ)	1000	1500	2000	> 2000
13-Cl_2	(μg/ℓ)	10	10	50	> 50
14-S	(μg/ℓ)	2	2	10	> 10
15-Fe	(μg/ℓ)	300	1000	5000	> 5000
16-Mn	(μg/ℓ)	100	500	3000	> 3000
17-B	(μg/ℓ)	1000	1000	1000	> 1000
18-Se	(μg/ℓ)	10	10	20	> 20
19-Ba	(μg/ℓ)	1000	2000	2000	> 2000
20-Al	(mg/ℓ)	0.3	0.3	1	> 1
21-Ci	(pCi/ℓ)				
α		1	10	10	> 10
β		10	100	100	> 100
D) Bacteriological parameters					
1-Fecal coliforms	(MPN/100mℓ)	10	200	2000	> 2000
2-Total coliforms	(MPN/100mℓ)	100	20000	100000	> 100000

Appendix A-5-11 Result of Water Quality Survey in Oltu River and Tortum River

(1) Oltu River

(1991.7.31)

Parameter	Unit	Olur Dam Site	Olur P Outlet	Ayvali Dam Site	Ayvali Outlet
Time	—	13:27	13:54	14:15	14:28
Temp.	℃	25.4	25.6	26.7	27.3
pH	—	8.05	8.19	8.22	8.27
Trancep.	cm	< 4	< 4	< 4	< 4
DO	mg/l	7.26	7.22	7.20	8.65
SS	〃	817.0	721.0	343.0	803.0
COD	〃	24.0	28.0	32.0	24.0
NH_4^+-N	〃	< 0.01	< 0.01	< 0.01	< 0.01
NO_2^--N	〃	0.018	0.014	0.019	0.017
NO_3^--N	〃	< 0.001	< 0.001	< 0.001	< 0.001
Kjeldahl-N	〃	0.560	0.224	0.336	0.224
T－P	〃	1.02	0.58	2.08	1.24

(2) Tortum River

(1991.7.31)

Parameter	Unit	Tortum Lake Upper Layer	Tortum Lake Middle Layer	Tortum Lake Inlet	Tortum Lake Outlet
Time	—	10:35	10:50	9:30	11:58
Temp.	℃	23.5	7.1	19.7	22.8
pH	—	8.38	7.95	8.15	8.46
Trancep.	cm	160(TR)	—	< 4	> 12
DO	mg/l	8.29	8.94	7.85	8.11
SS	〃	10.0	23.0	118.0	18.0
COD	〃	8.0	8.0	16.0	12.0
NH_4^+-N	〃	< 0.01	1.20	1.58	< 0.01
NO_2^--N	〃	0.005	0.007	0.009	0.006
NO_3^--N	〃	< 0.001	< 0.001	< 0.001	< 0.001
Kjeldahl-N	〃	0.336	1.008	0.560	0.556
T－P	〃	< 0.01	< 0.01	< 0.01	< 0.01

Note 1) Standard Method in Turkey was adapted for the chemical analysis.

Note 2) In general, K-N is measured as the sum of Organic-N and NH_4-N. According to the relation between NH_4-N value of the lake water analysis, such Concentration of NH_4-N are larger than K-N. Therefore, NH_4-N value adapted in this report is the one included in K-N.