5.8.3 Erik Power Station

Because of the weir location near the Erik Spring, the intake water level will be around 820 m, which is 145 m higher than the proposed HWL of the Ermenek Reservoir (675 m). Therefore, the water of 6.0 m^3/s to be diverted will have a potential power of about 8,500 kW. Accordingly, such a facility will be required as to dissipate this energy before pouring into the main headrace tunnel. This energy dissipater can be replaced with a generating equipment to be attached to the inlet shaft. An economic possibility of this idea was examined below:

(1) Plan of Erik Power Station

The Erik Power Station has the following features:

(A) Water Levels

- Erik Spring elevation : 817 m
- Intake water level : 820 m
- Desilting basin water level: 815.6 m
- Head tank water level : 812 m
- HWL of Ermenek Reservoir : 675 m
- Max. tailwater level during up-surging : 694 m
- Normal tailwater level : 675 m

(B) Head and discharge

- Gross head : 145 m
- Net head : 133 m
- Design discharge : 6.0 m^3/s
- Mean diversion discharge : 3.44 m^3/s

(C) Generating equipment

- Installed capacity (load range 35 to 100 %)	:	6.7 MW x 1 unit
- Combined efficiency	:	77.0 % at 35 % load
		85.5 % at full load

(D) Power output

- Mean power	:	3.64 MW
- Firm power	:	2.15 MW
- Firm energy	:	18.8 GWh
- Secondary energy	:	13.1 GWh
- Annual energy	:	31.9 GWh

As listed above, the Erik Power Station would have an installed capacity of 6.7 MW and annual energy output of 31.9 GWh in addition to the power generation by the Erik water at the Ermenek Power Station. The Erik water will be utilized for the gross head of 487 m in total.

(2) Additional cost and benefit of Erik Power Station

In order to examine the economic merit of the Erik Power Station, the extra cost to construct the Station and the extra benefit by the Station were assessed as follows:

(A) Annual power benefit (5.939 US¢/kWh for firm 2.154 US¢/kWh for secondary)	:	1.39 million US$

(B) Construction cost

- Generating equipment	:	2.42 million US$
- Excess water spillway	:	0.15
- Power house	:	0.21
- 34.5 kV transmission line	:	0.26
Total construction cost	:	3.04

(C)	Annual equivalent cost (CRF = 0.0960 at a discount rate of 9.5 %)	:	0.29 million US$ per year
(D)	Annual benefit	:	1.10 million US$

As shown above, the Erik Power Station will produce an economic net benefit of about 1.1 million US$ every year. It is thus determined to attach the power plant to the Erik Diversion Scheme.

5.8.4 Necessity of excess water spillway between head tank and inlet shaft

When the Erik Power Station is stopped for inspection, maintenance or by accidents, the Erik water cannot be poured to the main headrace tunnel unless a spillway is provided to guide the excess water from head tank to inlet shaft. However, these period is limited and, therefore, it is examined below if construction of such a spillway is justifiable or if it is better to leave the Erik water flow down the intake weir during such a period.

The annual maintenance period of Erik Power Station is assumed as follows:

-	annual inspection (a little bit high in view of low load operation)	:	7 days
-	overhaul	:	30 days in 7 years = 4.3 days per year
	Total		11.3 days per year

Annual loss at Ermenek Power Station due to no water from Erik is estimated as shown below:

- mean discharge during maintenance: 2.9 m^3/s (90 % dependable discharge)

- net head at Ermenek P.S. : 308 m
- mean power : 7.84 MW
- annual energy loss : 2.13 GWh
- annual monetary loss (US$0.02679/kWh) : 57,000 $/yr

Possible investment for the spillway is approximately 10 times the above loss, or US$ 570,000. While the construction cost is estimated at US$ 550,000, being slightly lower than this possible investment as shown below:

- concrete, 3,200 m^3 x 75 $:	240,000 $
- reinf. bar, 320 t x 720 $:	230,000 $
- rock excavation, 8,000 m^3 x 10 $:	80,000 $
Total	550,000 $

Meanwhile, when bypass waterway is not constructed, the wall height around the head tank should be raised to avoid water spilling from the head tank. This extra cost can be saved when the bypass is constructed.

Accordingly, it is judged that the bypass waterway should be provided.

5.8.5 Necessary area of head tank

A free water surface area of the head tank is determined to be 60 m^2 as 10Q, where Q = 6 m^3/s; and the effective capacity to be 120 m^3 as 20Q.

Accordingly, the basic dimension of head tank is determined as follows:

B x L = 4.0 m x 15.0 m = 60 m^2
Drawdown = 2.0 m ----------> 120 m^3

5.8.6 Overflow depth from head tank

The maximum water level in the head tank during overflow is better to be limited so that the flow condition in the diversion tunnel can be maintained as a free flow. When the design discharge of 6 m^3/s is flowing in the diversion tunnel, the clearance between the arch crown and water surface is about 0.7 m. Accordingly, the maximum overflow depth is set at about 0.4 m by keeping an allowance of 0.3 m during the overflow at 6.0 m^3/s. The required length of overflow crest is then be determined to be 12.0 m.

The type of overflow structure is determined as a side-overflow by using the longitudinal side wall of the head tank.

5.8.7 Type of excess water spillway

The overflowing water from the head tank will have the following energy to be dissipated:

812 m - 675 m = 137 m when enters in the tailrace chamber

812 m - 600 m = 212 m when enters directly into inlet shaft and when the Ermenek reservoir water level is at LWL. This is equivalent to potential power of 12.3 MW.

Since the potential power is high, it is planned to dissipate the energy by 2 steps: firstly for the head of 137 m by the time entering the tailrace chamber; secondly for the head of 75 m in the inlet shaft. A normal head to be dissipated on the second step is about 10 m to 25 m.

The energy dissipation mechanism is complicated and its design needs a hydraulic model test. In the case of 2-step dissipation, the top elevation of inlet shaft can be set at the up-surge water level, which will be realized during a full load shutdown of Ermenek Power Station.

Three alternative types are conceivable for the bypass waterway:

- Surface fish ladder type
- Pipe with a hollow jet valve and a stilling basin (the stilling basin may be designed by using the tailrace chamber)
- Branch pipe from the downstream end of penstock with a hollow jet valve and stilling basin

Merits and demerits of each type may be as described below:

(1) Surface type affects more or less environment. Since it will be used only during maintenance, the open structure would give such an impression to a visitor as useless. This type has the highest reliability for its gravity flow without mechanical equipment.

(2) Penstock pipe of Erik Power Station (D1.2 m, 94 ton) costs US$329,000, which is lower than the cost of surface type. But this type need a hollow jet valve and may need a larger chamber for stilling basin than a tailrace chamber. So it would be costly.

(3) The branch type may not function in the case of full load shutdown of Ermenek and Erik power stations, resulting in a spilling from the head tank, although such a probability is very low.

The fishway type was then adopted.

CHAPTER 6. OPTIMUM DEVELOPMENT SCALE

The development scale was represented in this study by HWL of the Ermenek Reservoir. HWL was selected in place of dam height or dam crest elevation as HWL can be an independent parameter from the extra dam height above HWL and from the foundation elevation.

The firm and secondary energies are dependent on HWL, and the installed capacity is, in this study, dependent on the firm energy. Thus, the development scale was represented by HWL.

HWL was studied for 11 cases from 645 m to 695 m at an interval of 5 m.

Based on the preliminary designs of the Project components as described in the foregoing Sub-sections, the Project benefit and cost were estimated.

These are shown in Figs. D21 and D22 with the alternative HWL as abscissa. The benefit capitalized with a discount rate of 9.5 per cent has a peak at HWL of 675 m; and starts to decrease thereafter. This is due to the initial filling period. The capitalized cost increases almost in proportion to the HWL.

The capitalized net benefit curve shows that the HWL of 675 m yields the maximum net benefit, or is the optimum development scale.

CHAPTER 7. CONCLUSIONS

The following conclusions were obtained through the optimization studies described in this ANNEX-D:

(1) The Ermenek Dam will be of concrete arch type located at the I-Cc dam axis. The site is in the Görmel Gorge created in a limestone block.

(2) The Ermenek Project will be developed as a dam-waterway type with a single dam at the I-Cc axis, and the Erik Diversion Scheme will be included as part of the Project. The Nadire Scheme should not be combined with the Project, and the development scale of Ermenek should be optimized not taking account of the Nadire Scheme.

(3) The spillway discharge capacity will be about 2,600 m^3/s including those of bottom outlets and crest overflow spillway, and the maximum flood water level of reservoir will be El. 678.3 m, being 3.3 m above HWL.

(4) The drawdown of the Ermenek Reservoir will be 60 m, which is 17.5 per cent of the gross head of 342 m.

(5) The economic diameter of headrace and tailrace tunnels is 6.1 m. The route of headrace tunnel will be Bb.

(6) The pressure shaft consists of 2 inclined tunnels, which divert immediate downstream from the headrace surge tank. The economic diameter of each pressure shaft is 3.6 m.

(7) The penstock and power station will be of underground type, and the tailrace tunnel will be extended to lower

the tailwater level up to 333 m, which is the HWL of downstream Gezende Reservoir.

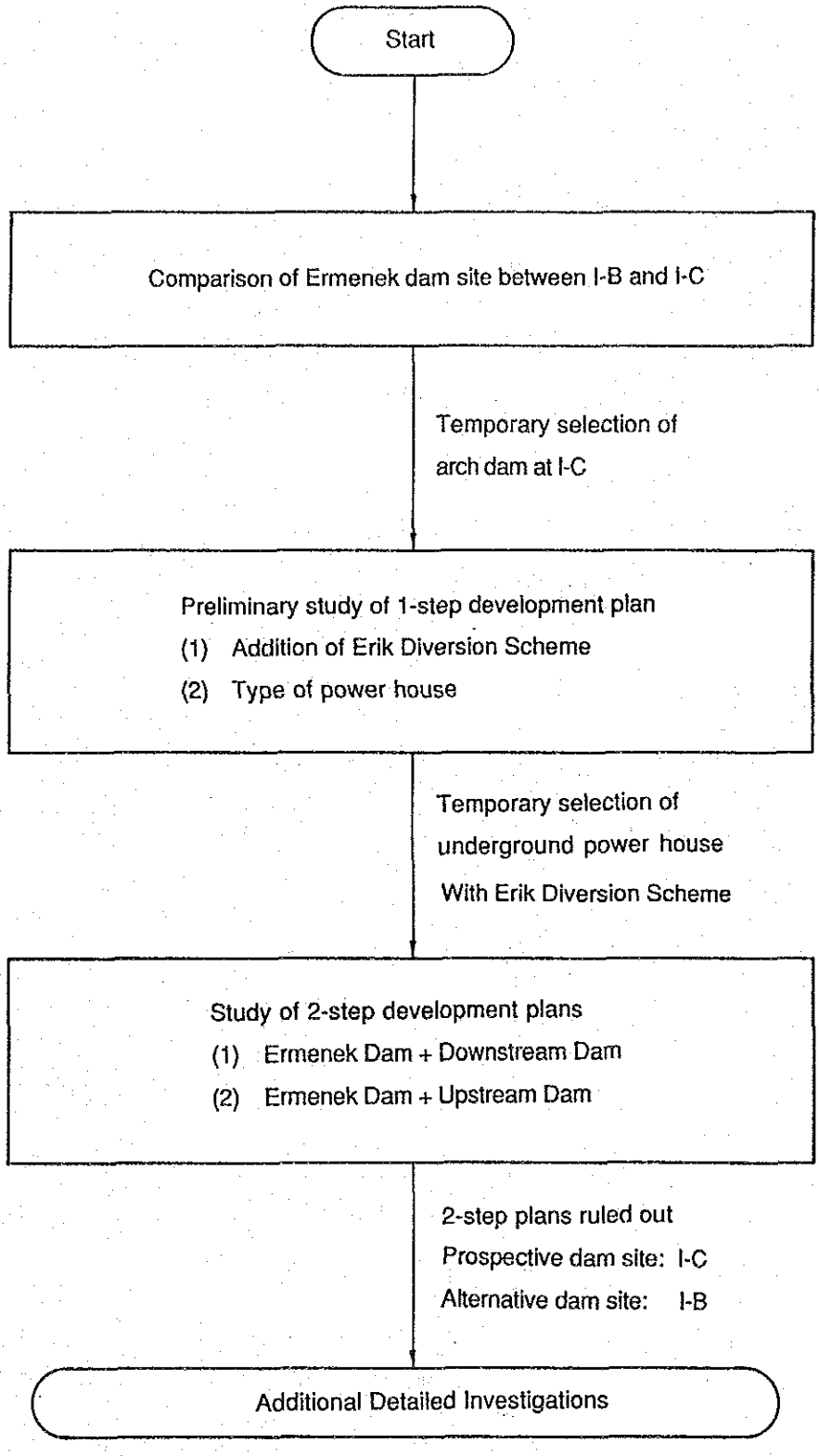
(8) The design discharge of the Erik Diversion Scheme is 6.0 m^3/s. The Erik diversion tunnel is of free-flow type, having a width of 2.2 m and a height of 2.3 m. The Erik Power Station having an installed capacity of 6.7 MW will be added to the end of the diversion tunnel to utilize the head of 134 m available between the head tank and the HWL of Ermenek Reservoir.

(9) The HWL of 675 m AMSL is optimum. Accordingly, the principal features of the Project are as listed below:

- dam crest elevation	:	El. 680.0 m
- design flood water level	:	El. 678.3 m
- HWL	:	El. 675.0 m
- LWL	:	El. 615.0 m
- dam height above foundation	:	190 m
- installed capacity	:	320 MW
- 90% dependable power	:	294 MW

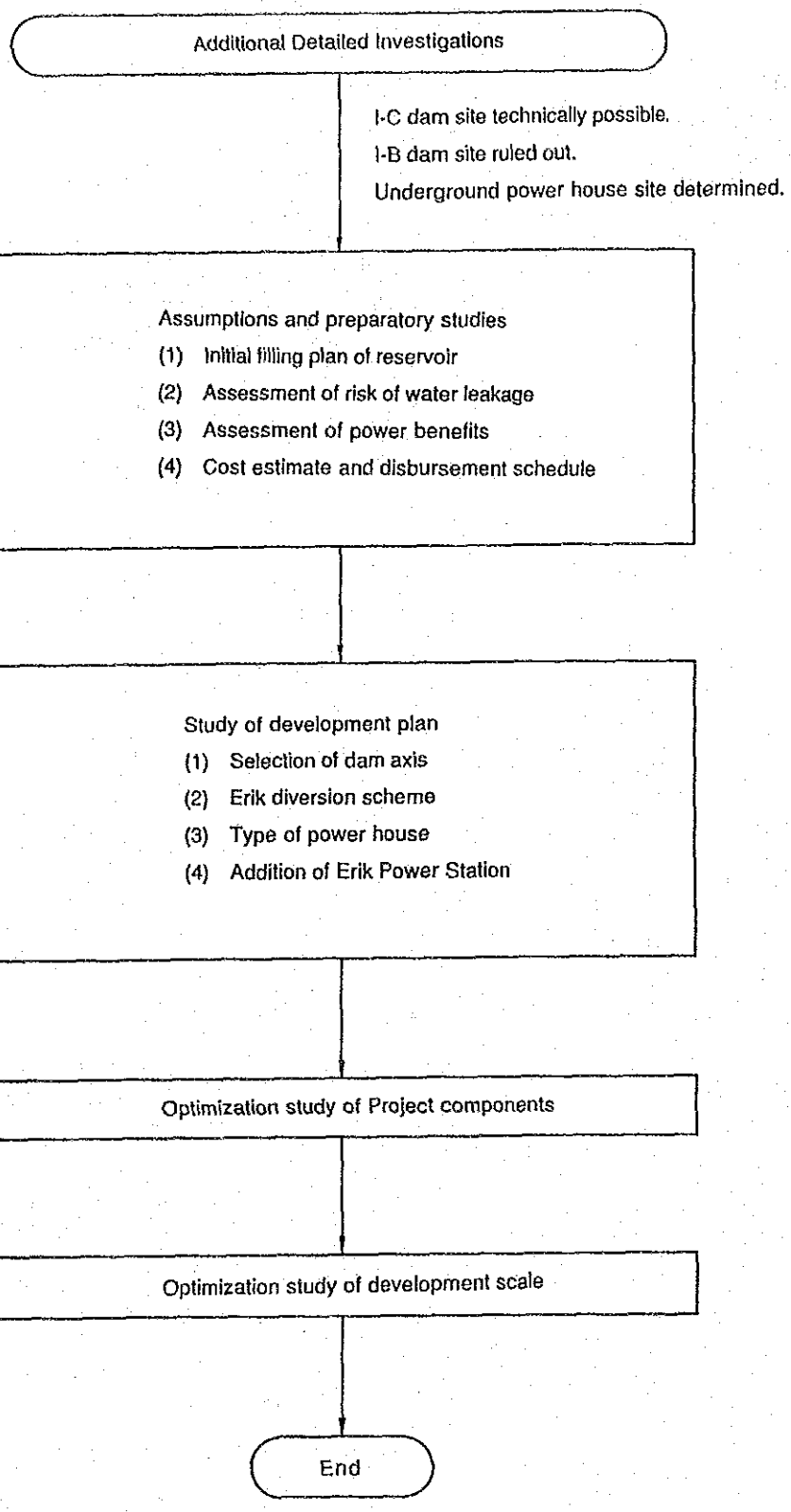
FIGURES

FIG. NO.



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. D1** **Flow Chart** **of Preliminary Study**

FIG. NO.



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. D2** **Flow Chart of Optimization Study**

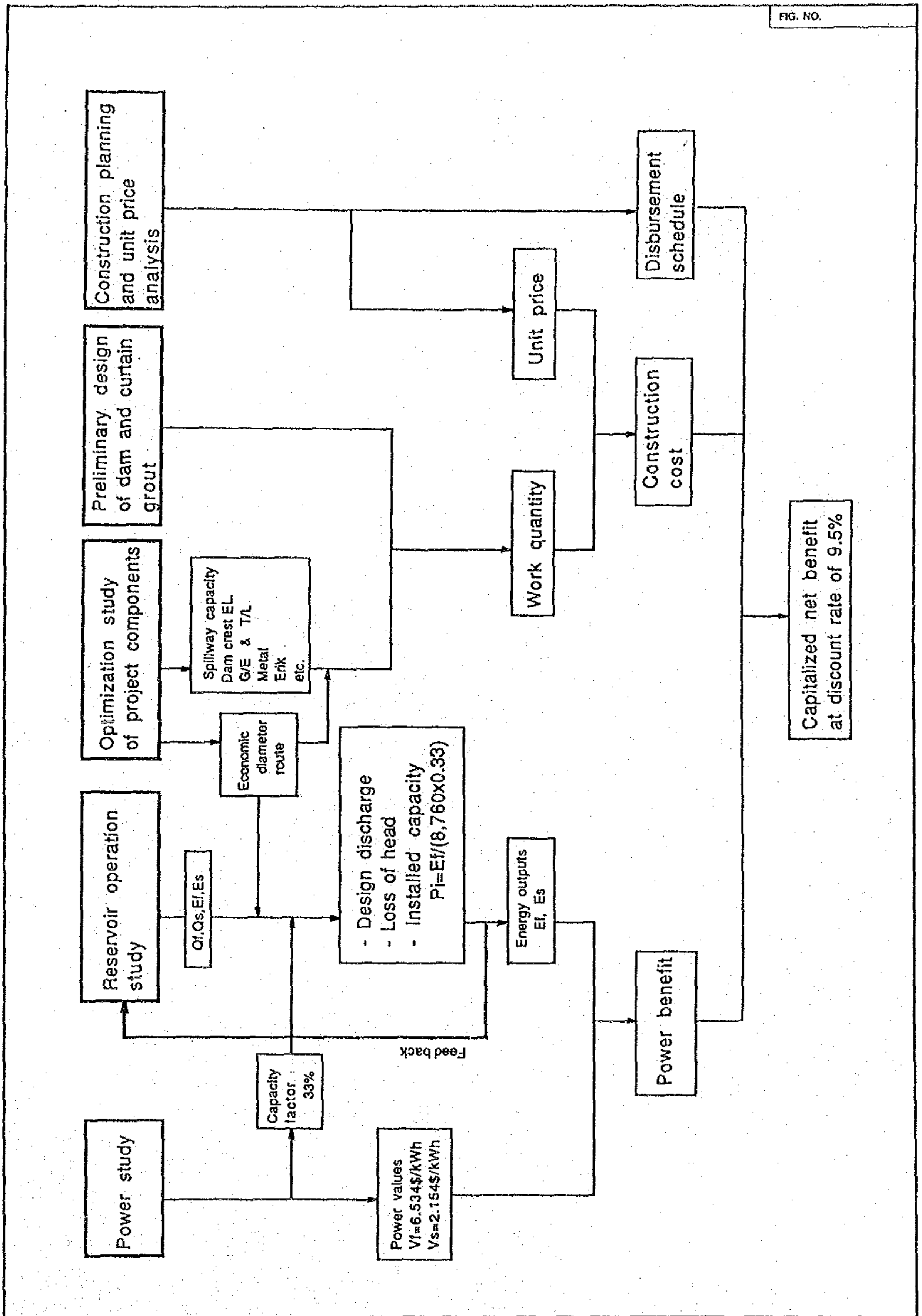


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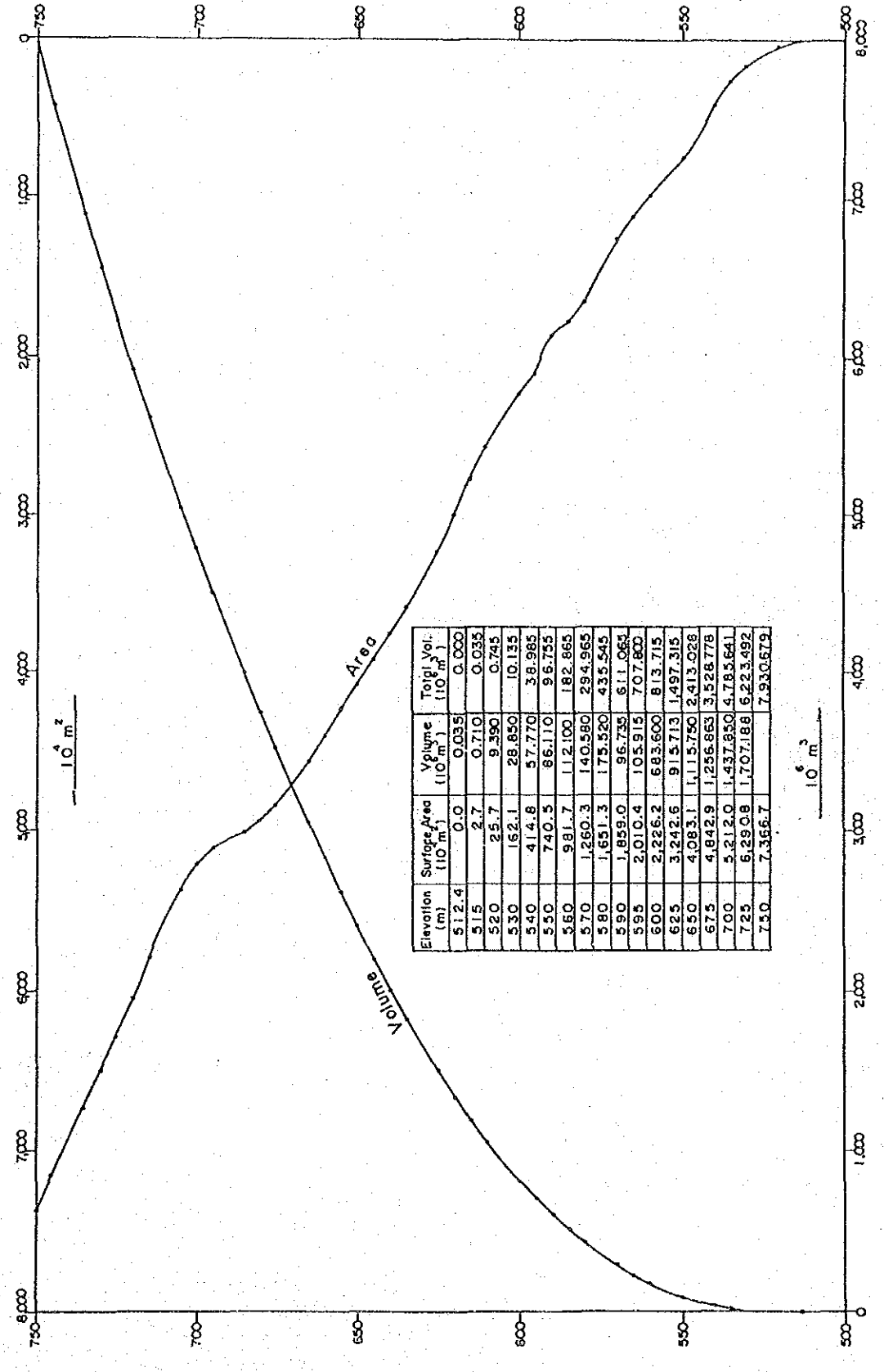
FIG. NO.



Elevation (m)	Surface Area ($10^4 m^2$)	Volume ($10^6 m^3$)	Total Vol. ($10^6 m^3$)
512.4	0.0	0.035	0.000
515	2.7	0.710	0.035
520	25.7	9.390	0.745
530	162.1	28.850	10.135
540	414.8	57.770	38.985
550	740.5	86.110	96.755
560	981.7	112.100	182.865
570	1,260.3	140.580	294.965
580	1,651.3	175.520	435.545
590	1,859.0	96.735	611.065
595	2,010.4	105.915	707.800
600	2,226.2	603.600	813.715
625	3,242.6	915.713	1,497.315
650	4,083.1	1,115.750	2,413.028
675	4,842.9	1,256.863	3,528.778
700	5,212.0	1,437.850	4,785.641
725	6,290.8	1,707.188	6,223.492
750	7,366.7		7,930.679

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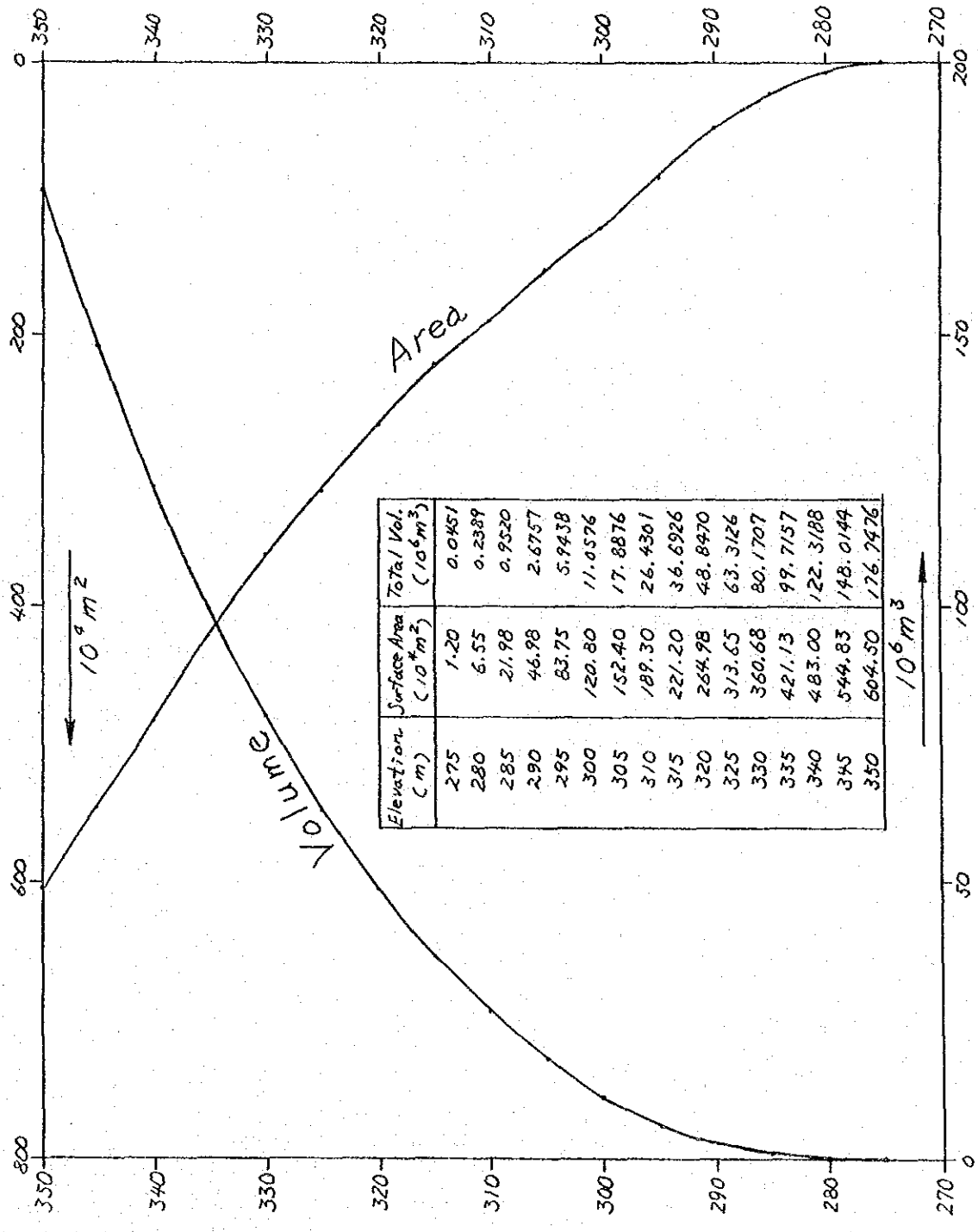
FIG. NO.



Elevation (m)	Surface Area ($10^4 m^2$)	Total Vol. ($10^6 m^3$)
275	1.20	0.0451
280	6.55	0.2389
285	21.98	0.9520
290	46.98	2.6757
295	83.75	5.9438
300	120.80	11.0576
305	152.40	17.8876
310	189.30	26.4301
315	221.20	36.6926
320	264.98	48.8470
325	313.65	63.3126
330	360.68	80.1707
335	421.13	99.7157
340	483.00	122.3188
345	544.83	148.0144
350	604.50	176.7476

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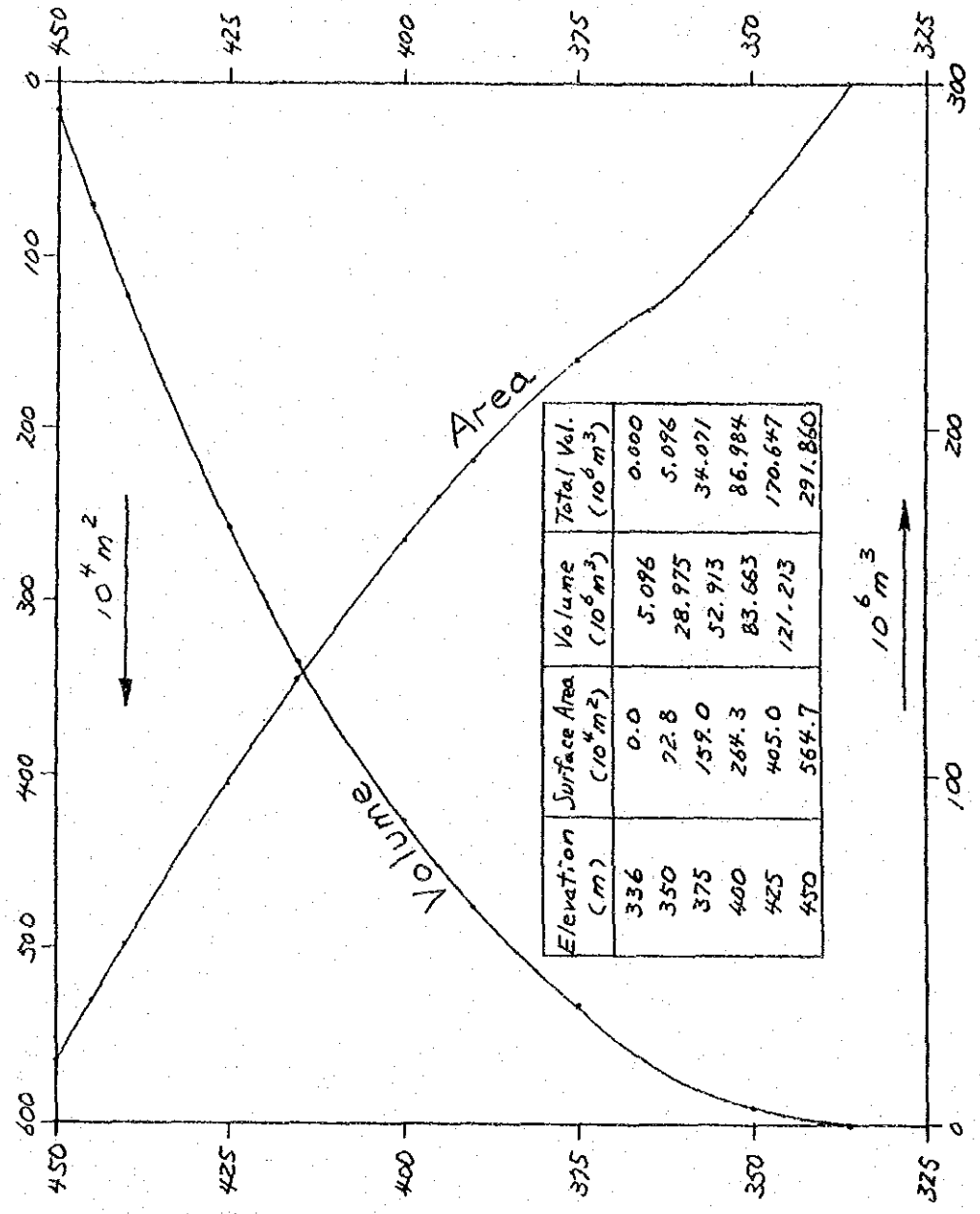
TITL D5
Surface Area and Capacity Curves of Gezende Reservoir

FIG. NO.



Elevation (m)	Surface Area ($10^4 m^2$)	Volume ($10^6 m^3$)	Total Vol. ($10^6 m^3$)
336	0.0	5.096	0.000
350	22.8	28.975	5.096
375	159.0	52.913	34.071
400	264.3	83.663	86.984
425	405.0	121.213	170.647
450	564.7		291.860

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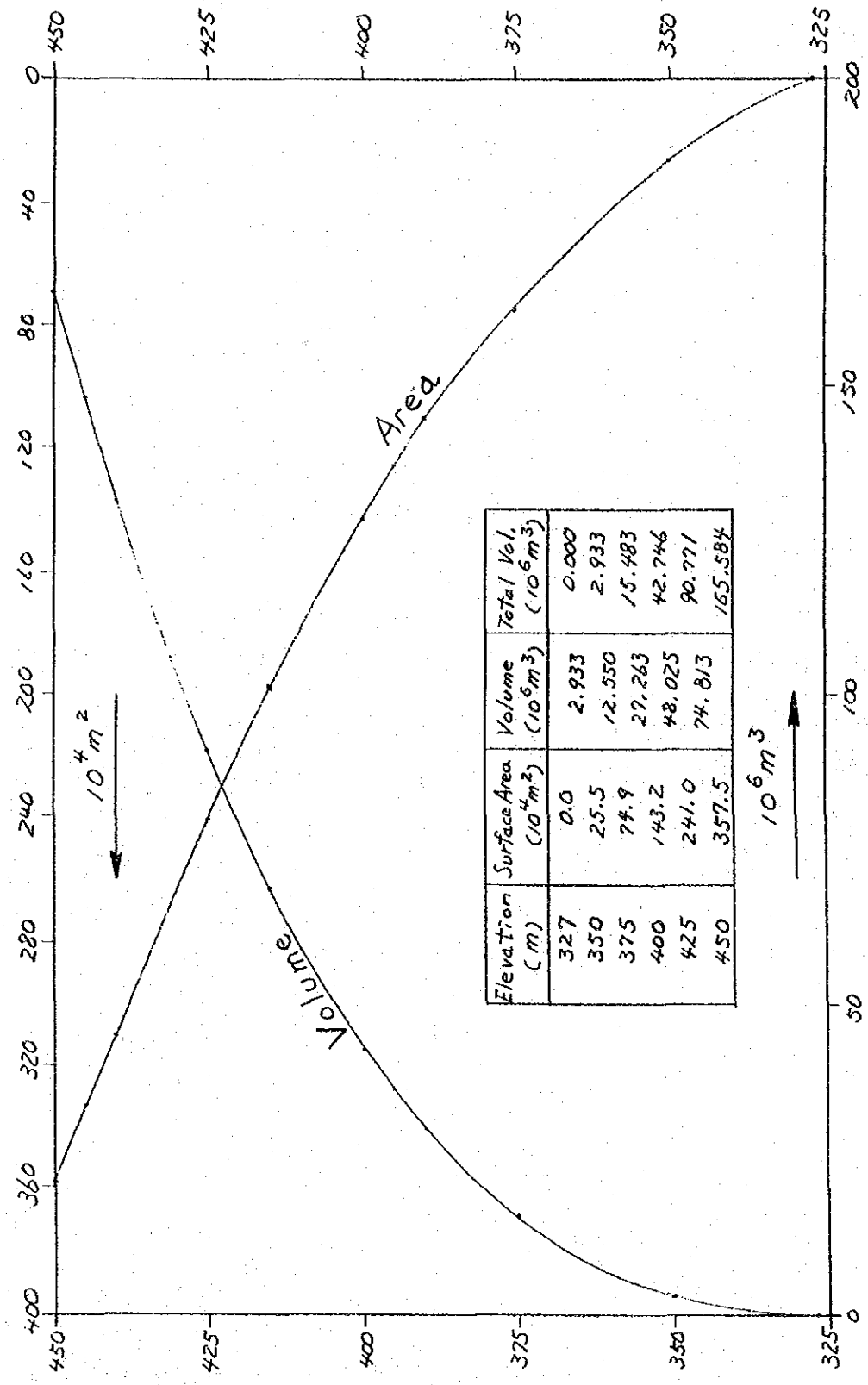
FIG. NO.



Elevation (m)	Surface Area ($10^4 m^2$)	Volume ($10^6 m^3$)	Total Vol. ($10^6 m^3$)
327	0.0	2.933	0.000
350	25.5	12.550	2.933
375	74.9	27,263	15.483
400	143.2	48,025	42.746
425	241.0	74,813	90.771
450	357.5		165.584

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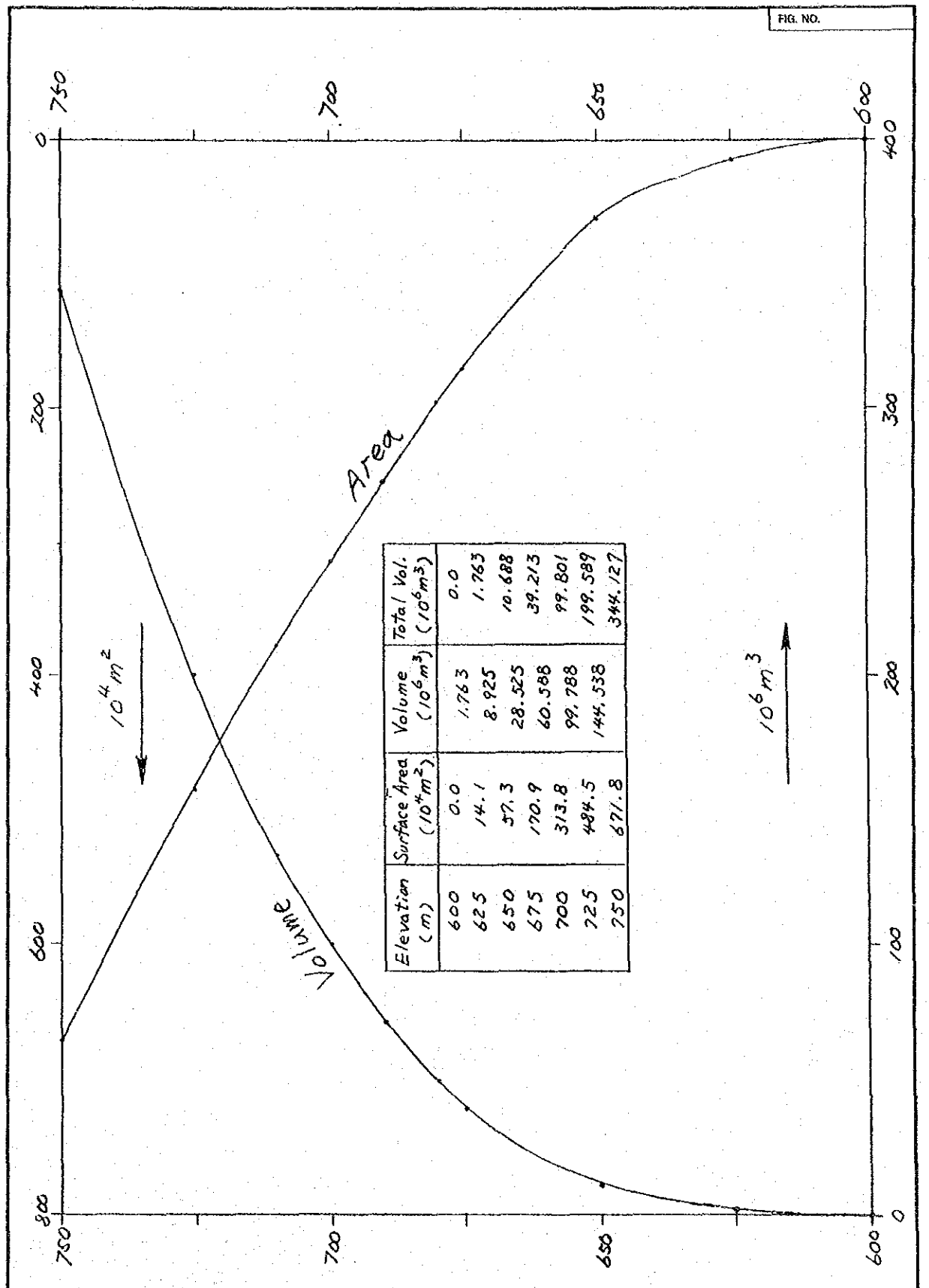
TITLE D7
Surface Area and Capacity Curves of II-B Reservoir

FIG. NO.



Elevation (m)	Surface Area ($10^4 m^2$)	Volume ($10^6 m^3$)	Total Vol. ($10^6 m^3$)
600	0.0		0.0
625	14.1	1.763	1.763
650	57.3	8.925	10.688
675	170.9	28.525	39.213
700	313.8	60.588	99.801
725	484.5	99.788	199.589
750	671.8	144.538	344.127

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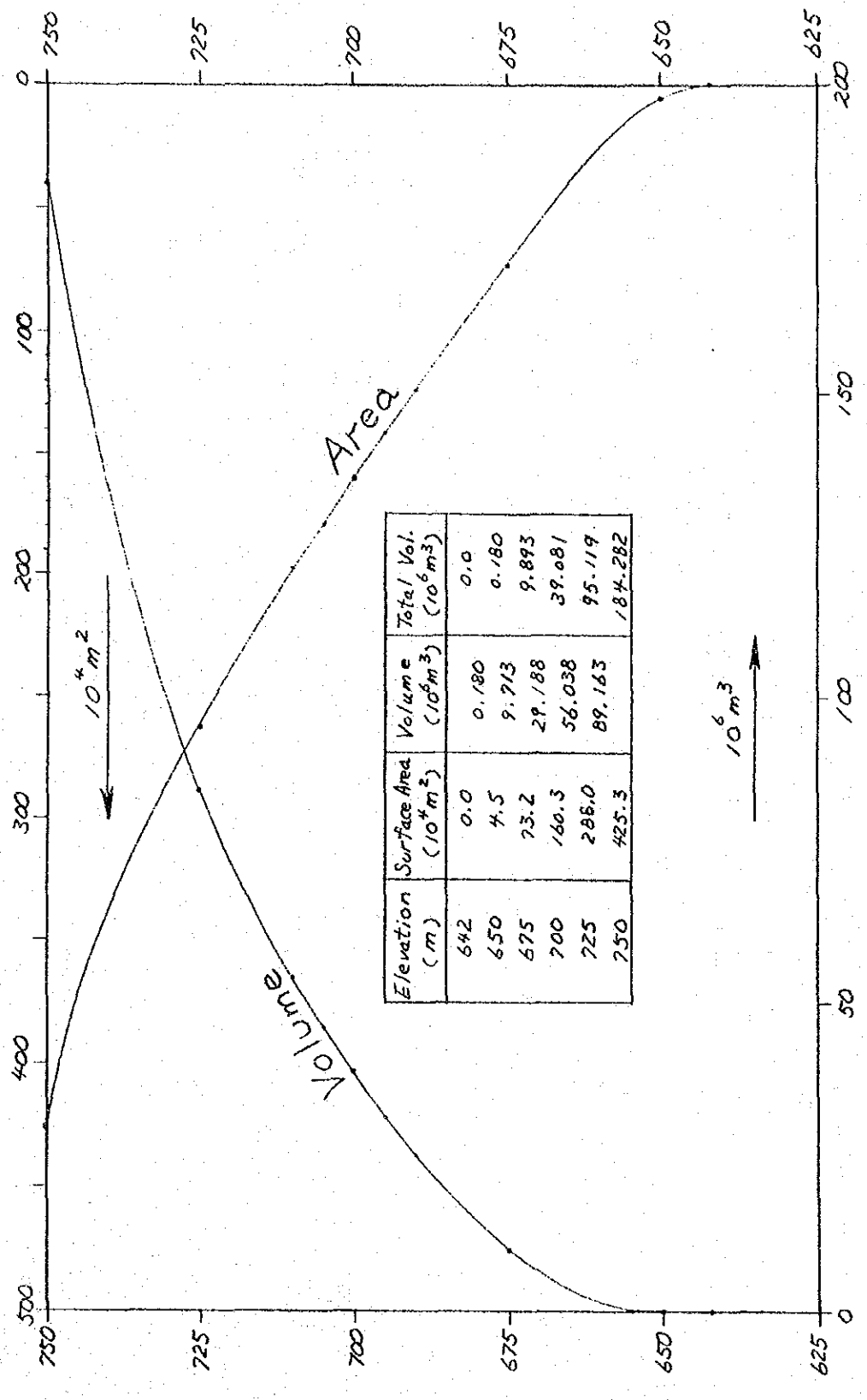
TI D8
Surface Area and Capacity Curves of Downstream Nadire Reservoir

FIG. NO.



Elevation (m)	Surface Area ($10^4 m^2$)	Volume ($10^6 m^3$)	Total Vol. ($10^6 m^3$)
642	0.0		0.0
650	4.5	0.180	0.180
675	73.2	9.713	9.893
700	160.3	29.188	39.081
725	286.0	56.038	95.119
750	425.3	89.163	184.282

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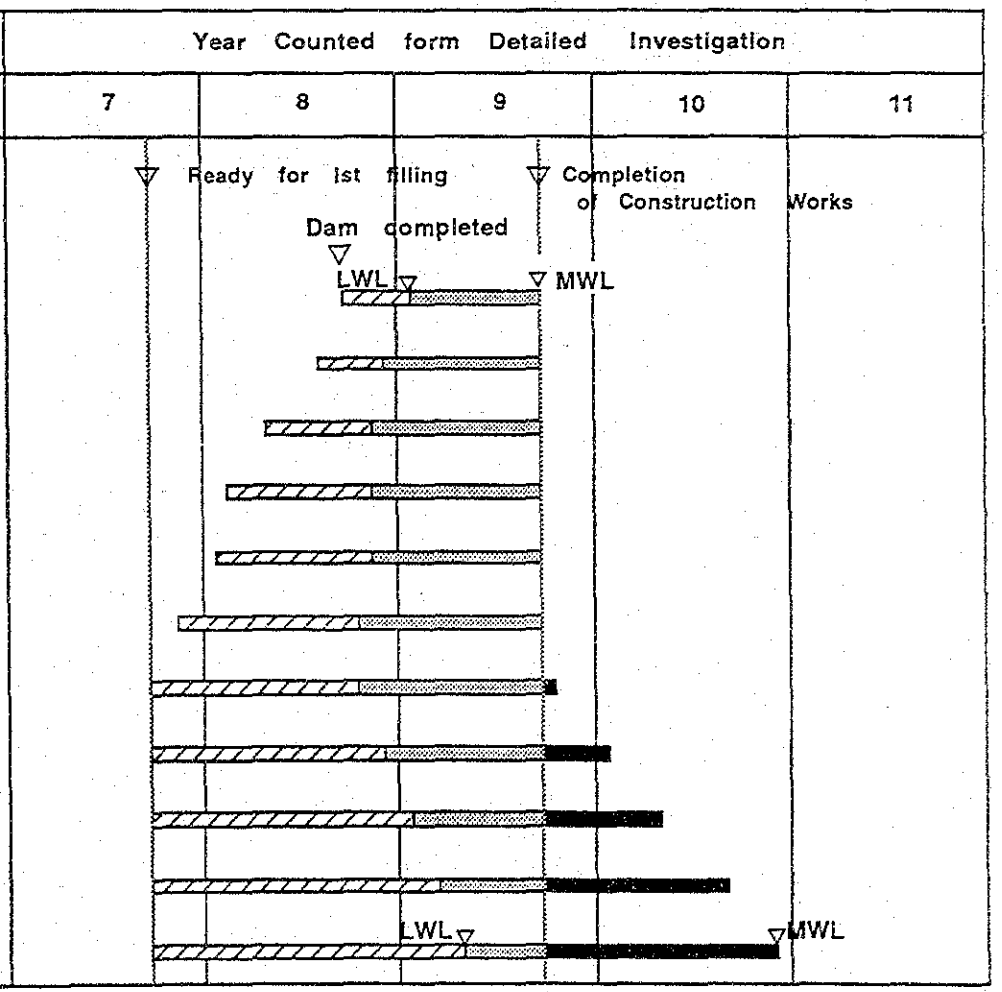
D10 Initial Filling Period by Alternative HWL.

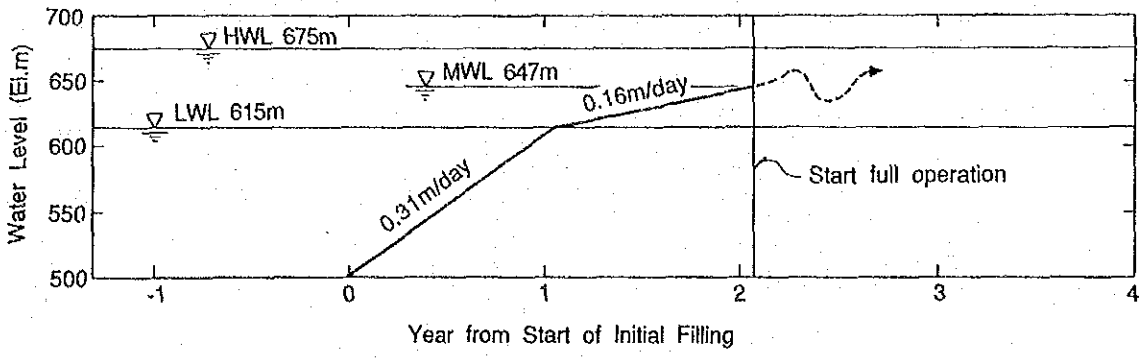
HWL (m)	Filling Period (month)			Total
	1st filling up to LWL	2nd filling up to Commissioning	3rd filling by 50% load operation	
645	5.4	8.7	—	14.1
650	6.3	9.3	—	15.7
655	7.4	9.9	—	17.3
660	8.5	10.5	—	18.9
665	9.7	11.0	—	20.7
670	11.0	11.6	—	22.6
675	12.4	11.6	0.8	24.8
680	14.0	10.0	4.0	28.0
685	15.7	8.3	7.3	31.3
690	17.4	6.6	10.8	34.8
695	19.2	4.8	14.5	38.5



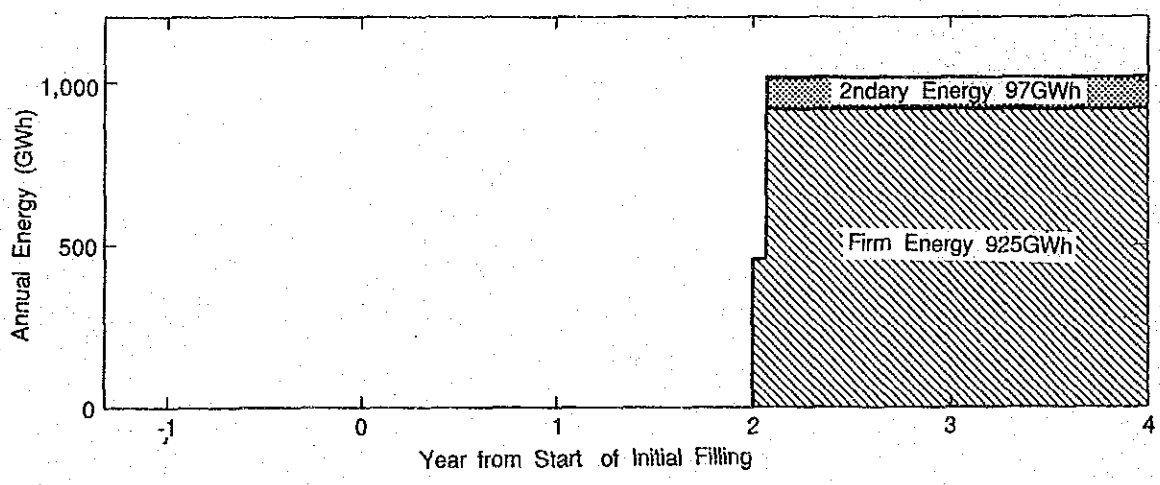
1st filling up to LWL
2nd filling up to Commissioning
3rd filling by 50% load operation

FIG. NO.

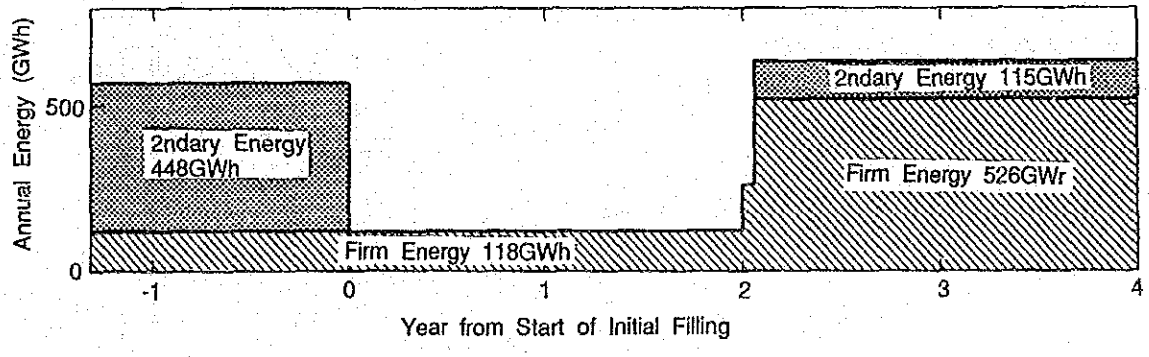
FIG NO.



Water Level Rising Speed of Ermenek Reservoir



Energy Generation of Ermenek Power Station



Energy Generation of Gezende Power Station

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FIG. NO.

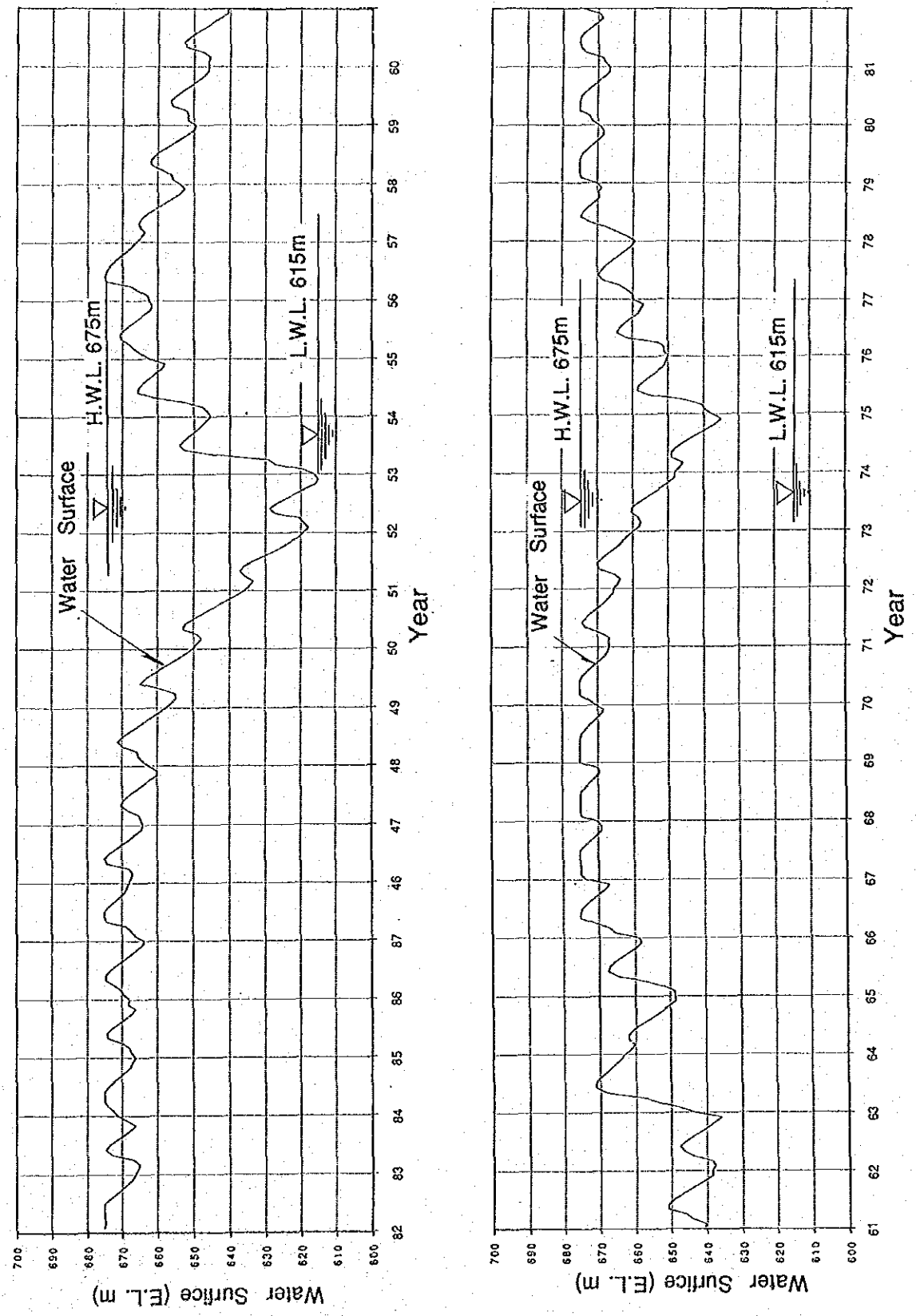

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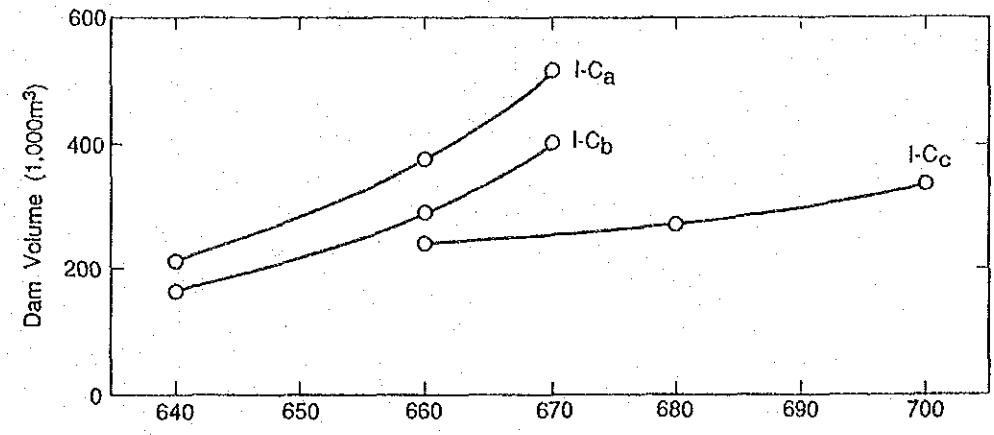
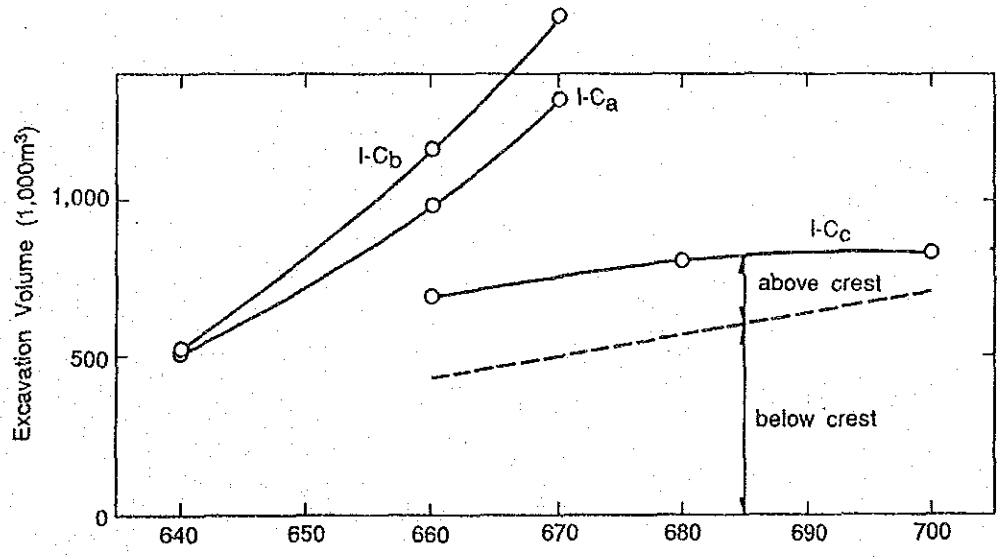
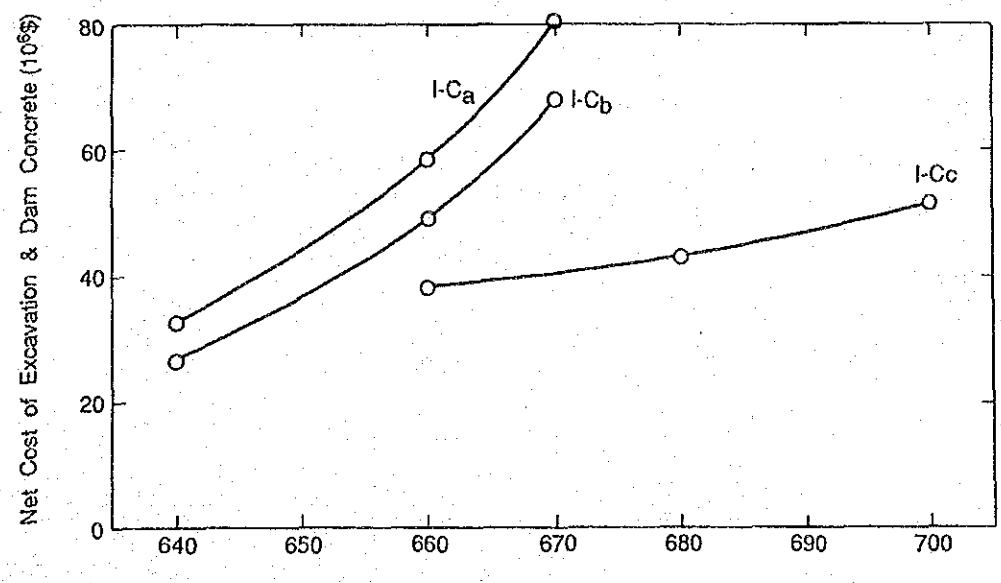
FIG NO.

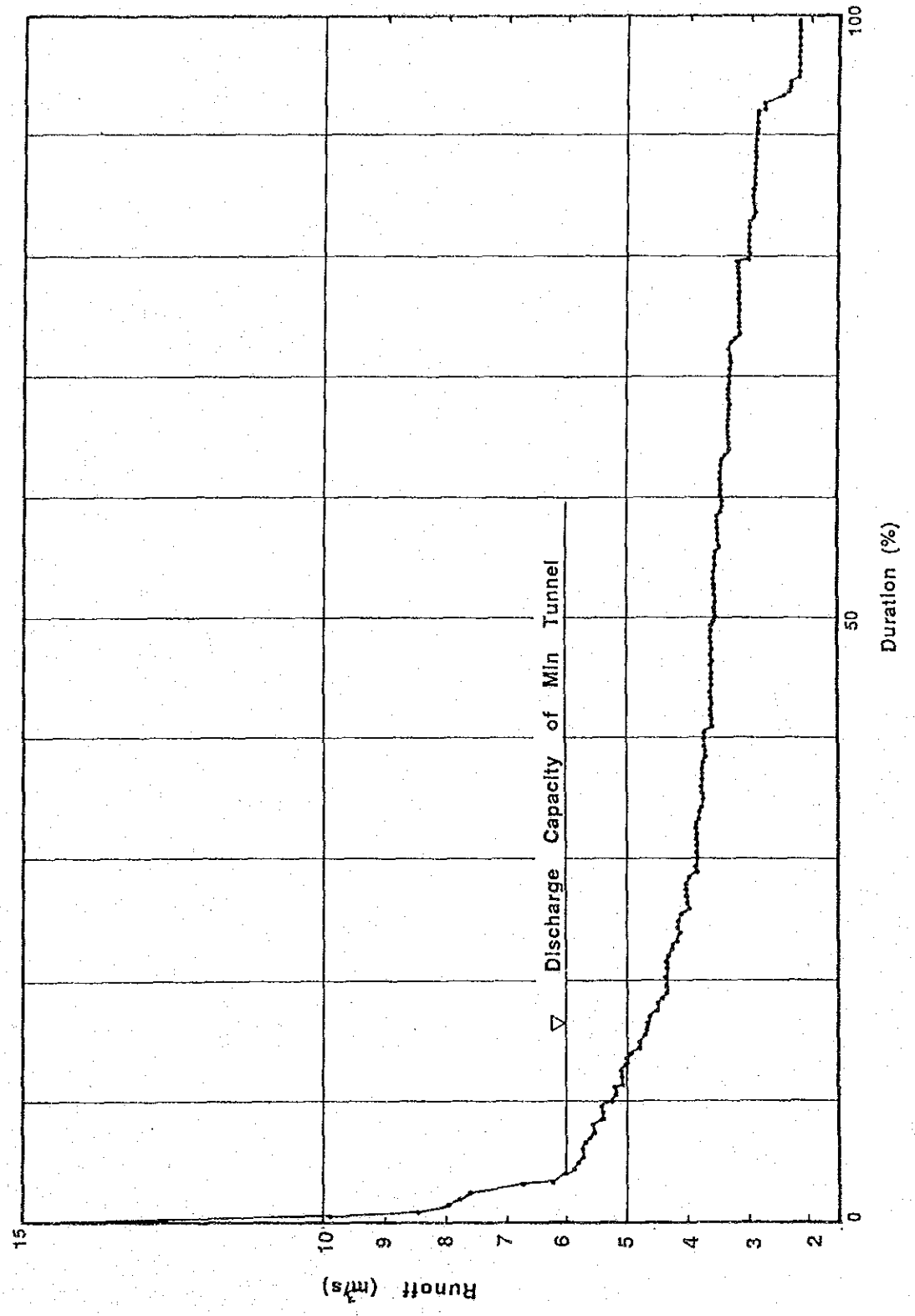






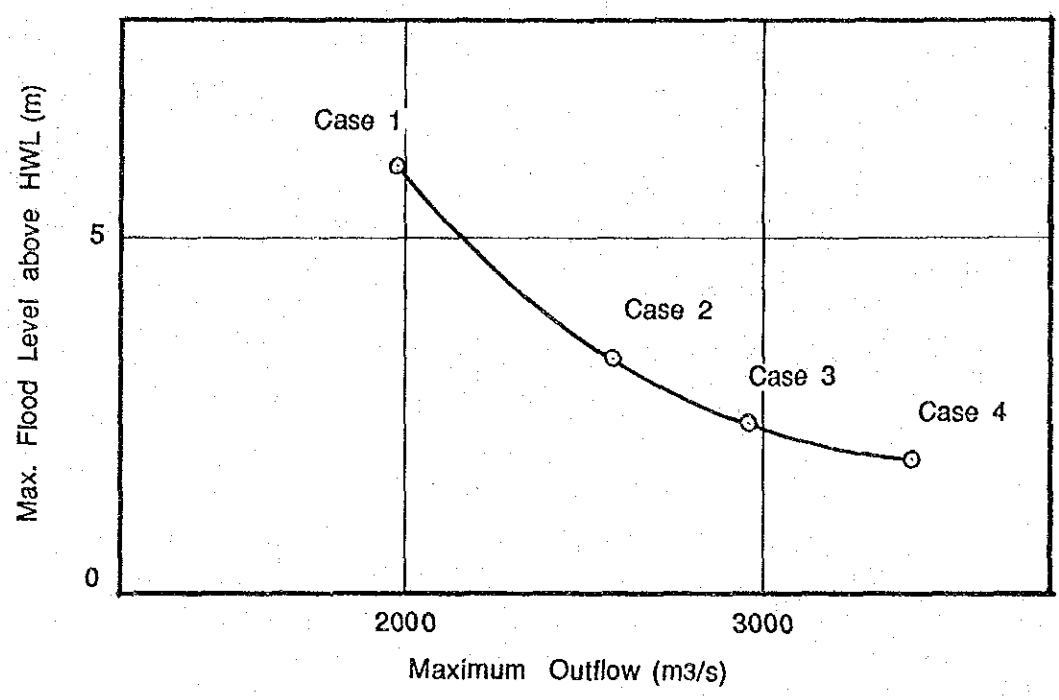
	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	D13 **Dam Volume, Excavation Volume, and Construction Cost Curves for 3 Axes in the Görmel Gorge**

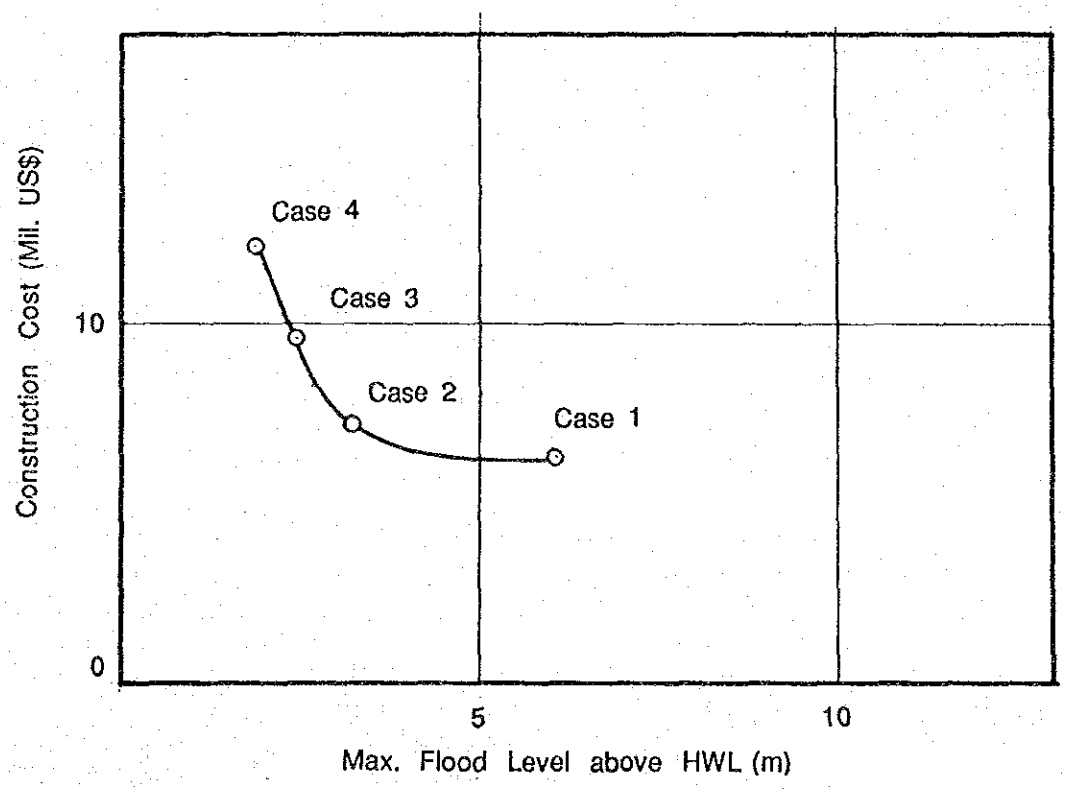
FIG. NO.



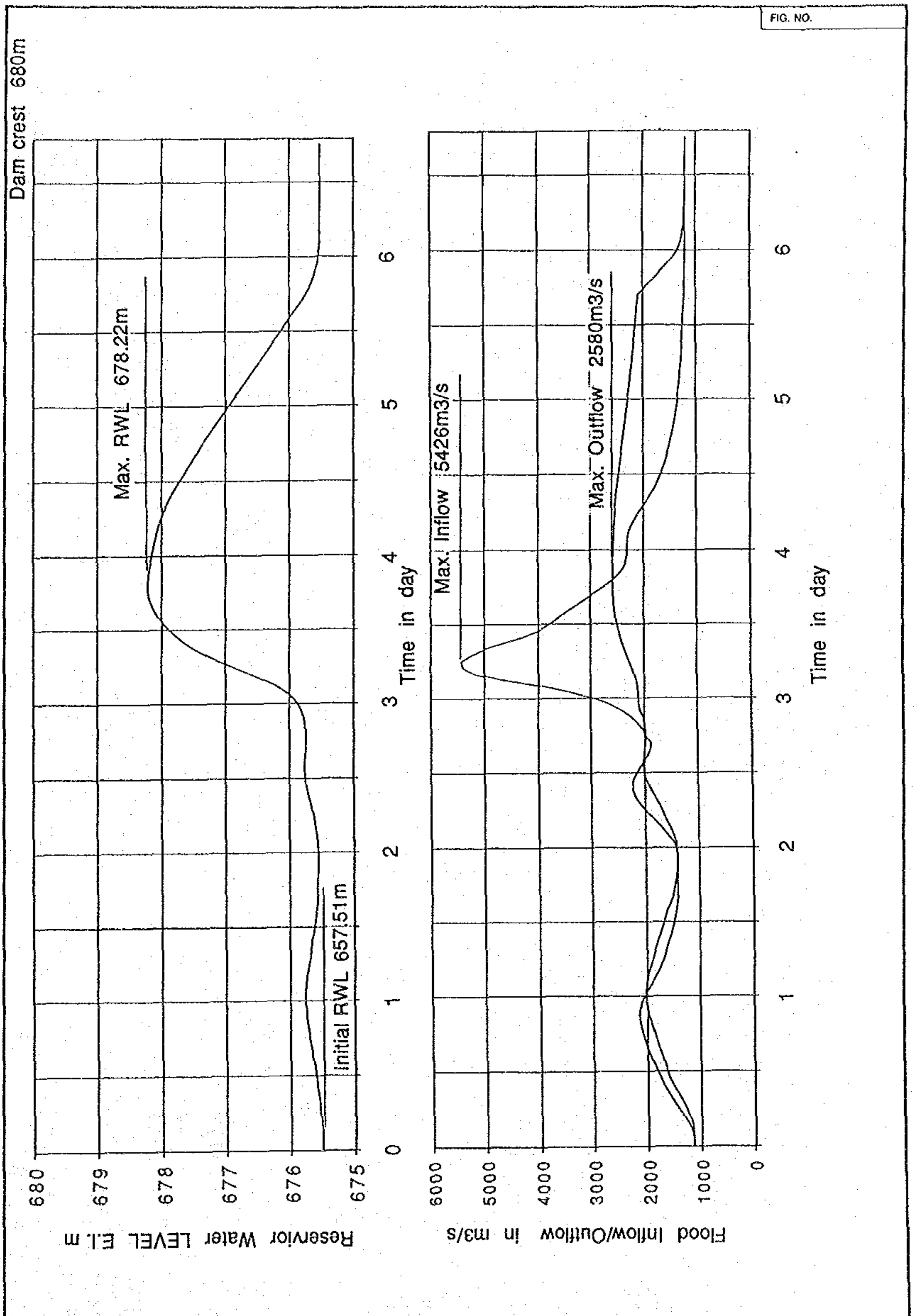
THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **D14** **Flow Duration Curve of Erik River**

FIG. NO.



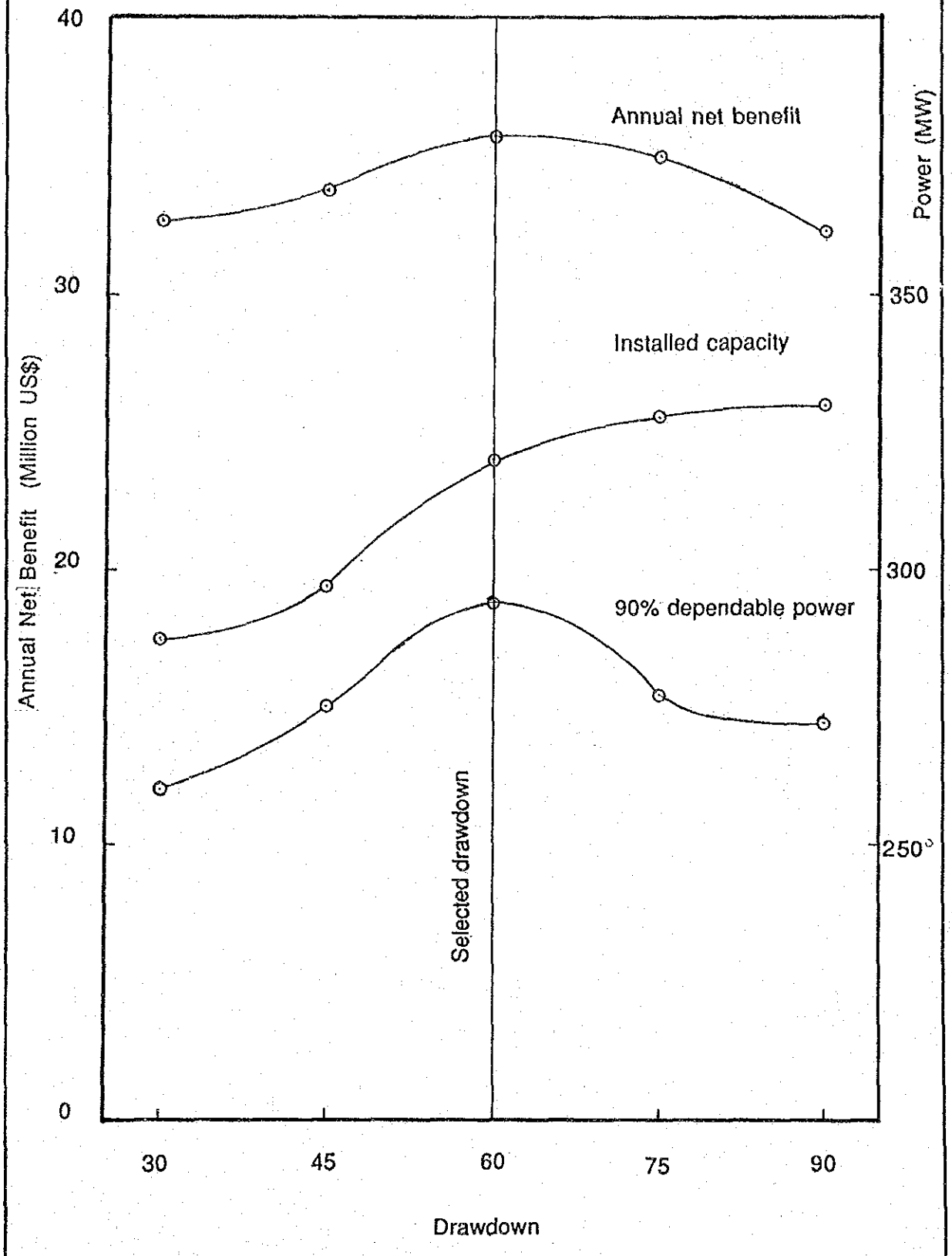


	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE D15 Relationship Between Spillway Capacity and Necessary Flood Storage



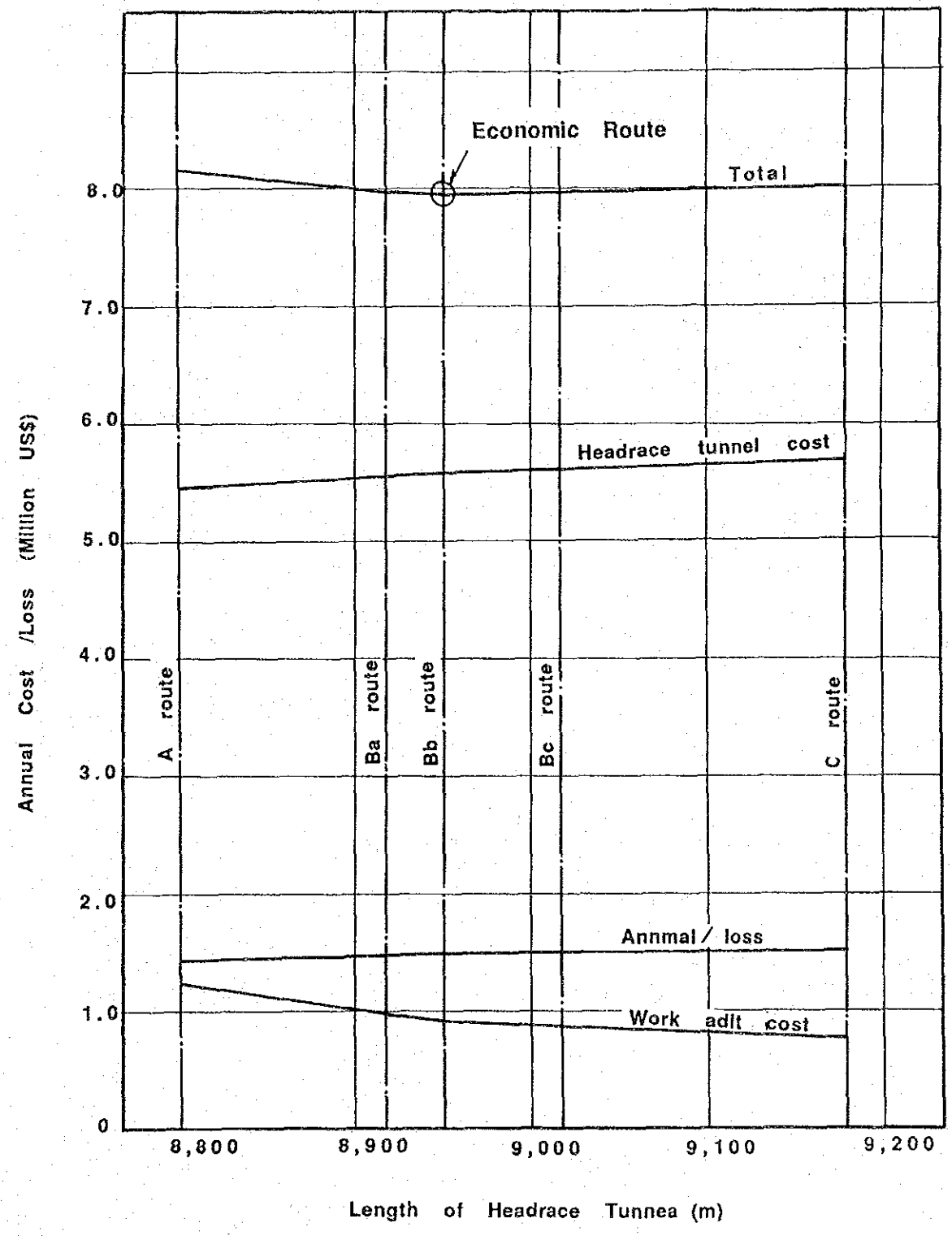
	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITL D16 Reservoir Routing of PMF for April with Spillway Case 2

FIG. NO.



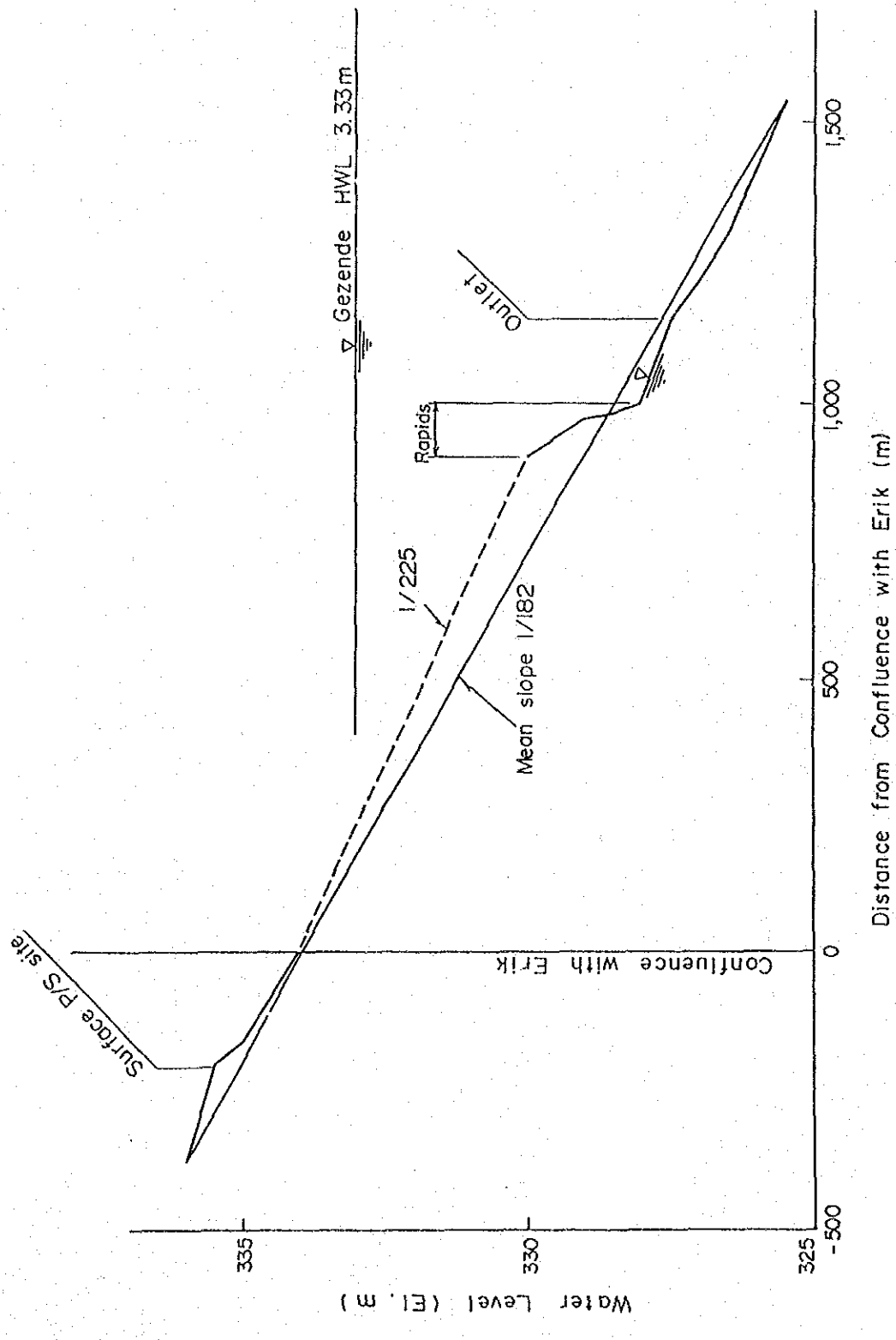
THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE D17 Optimum Drawdown of Reservoir	

FIG. NO.



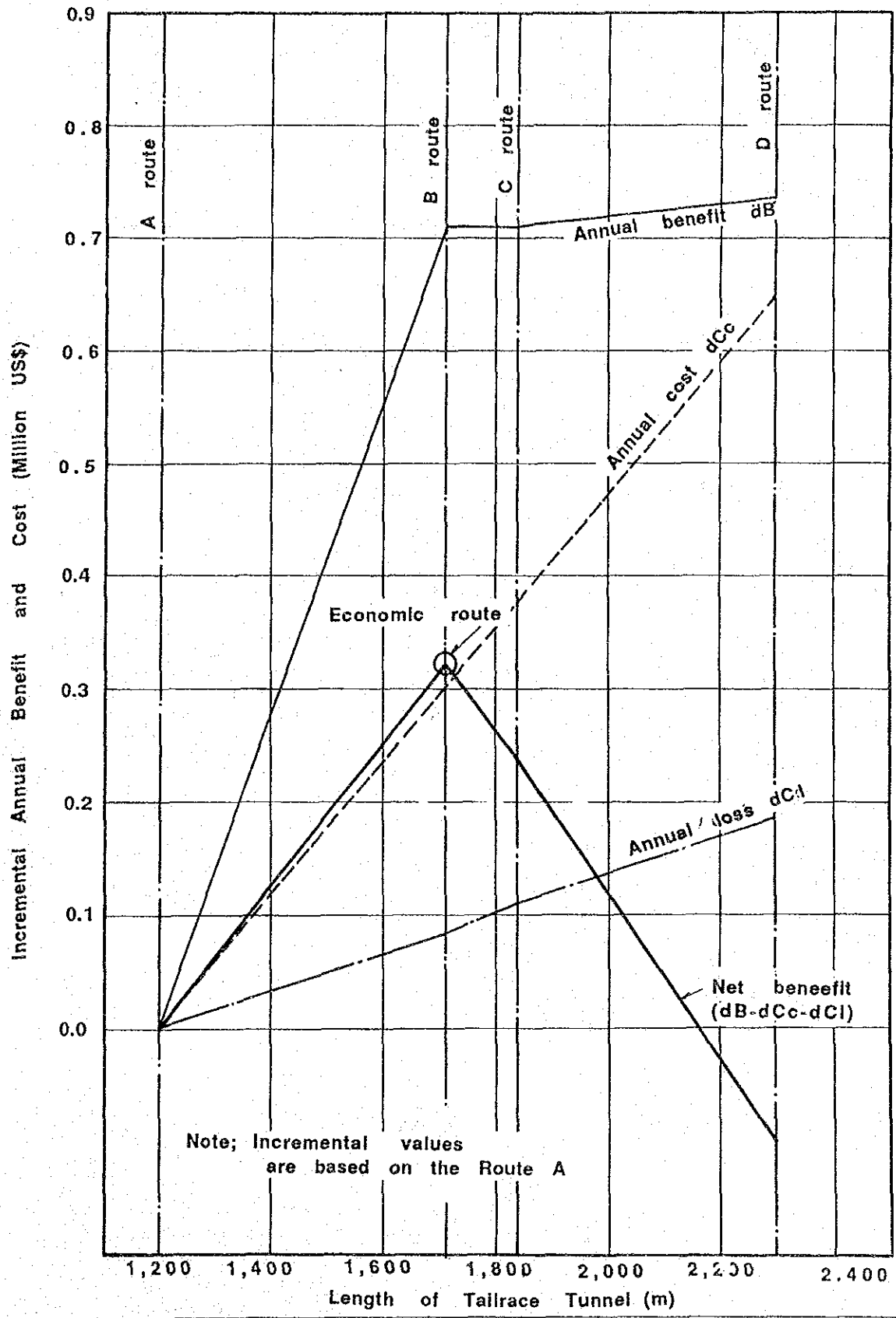
	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE D18 Optimum Route of Headrace Tunnel

FIG. NO.

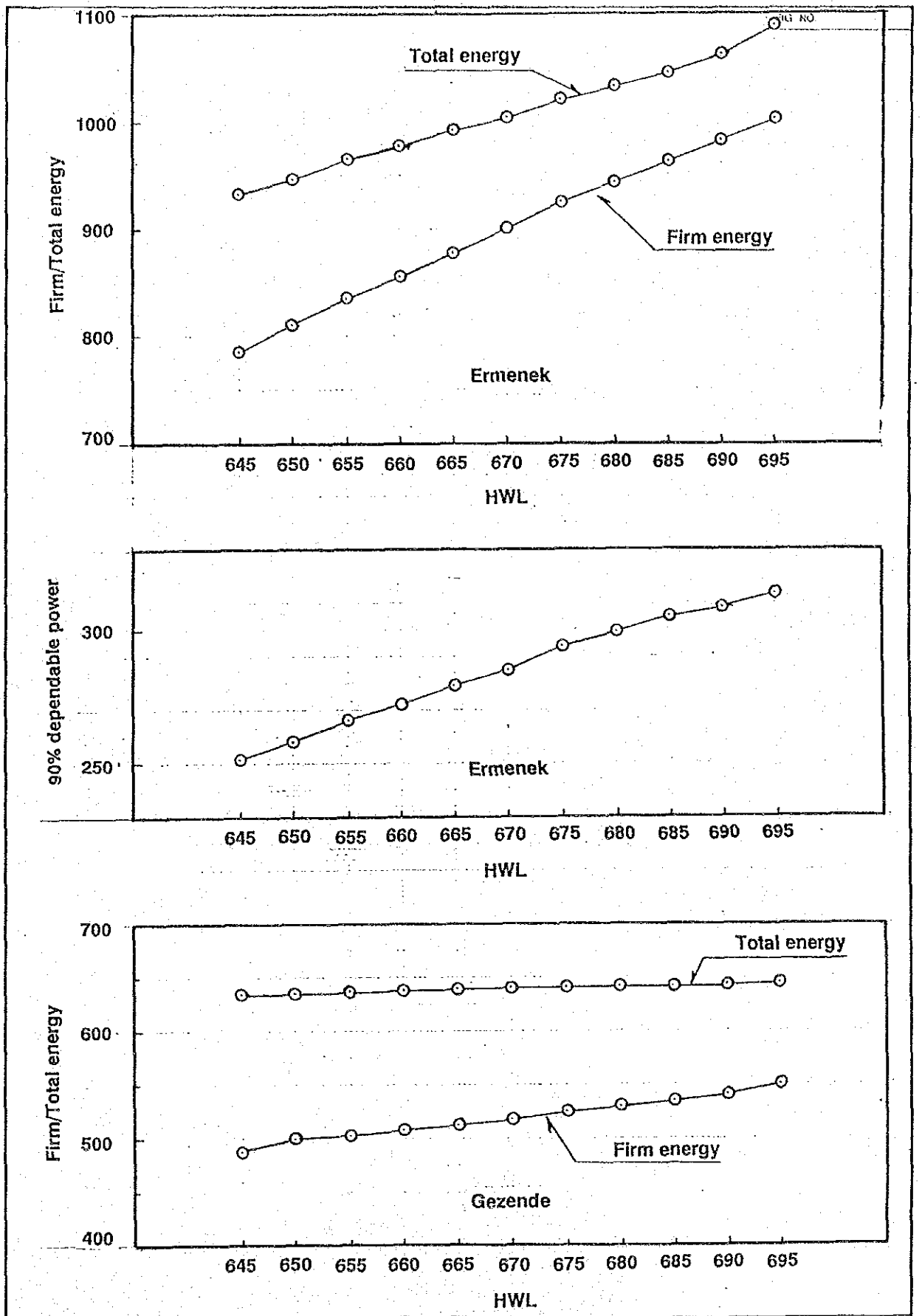


THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **D19** **River Profile** **Around Tailrace Outlet**

FIG. NO.

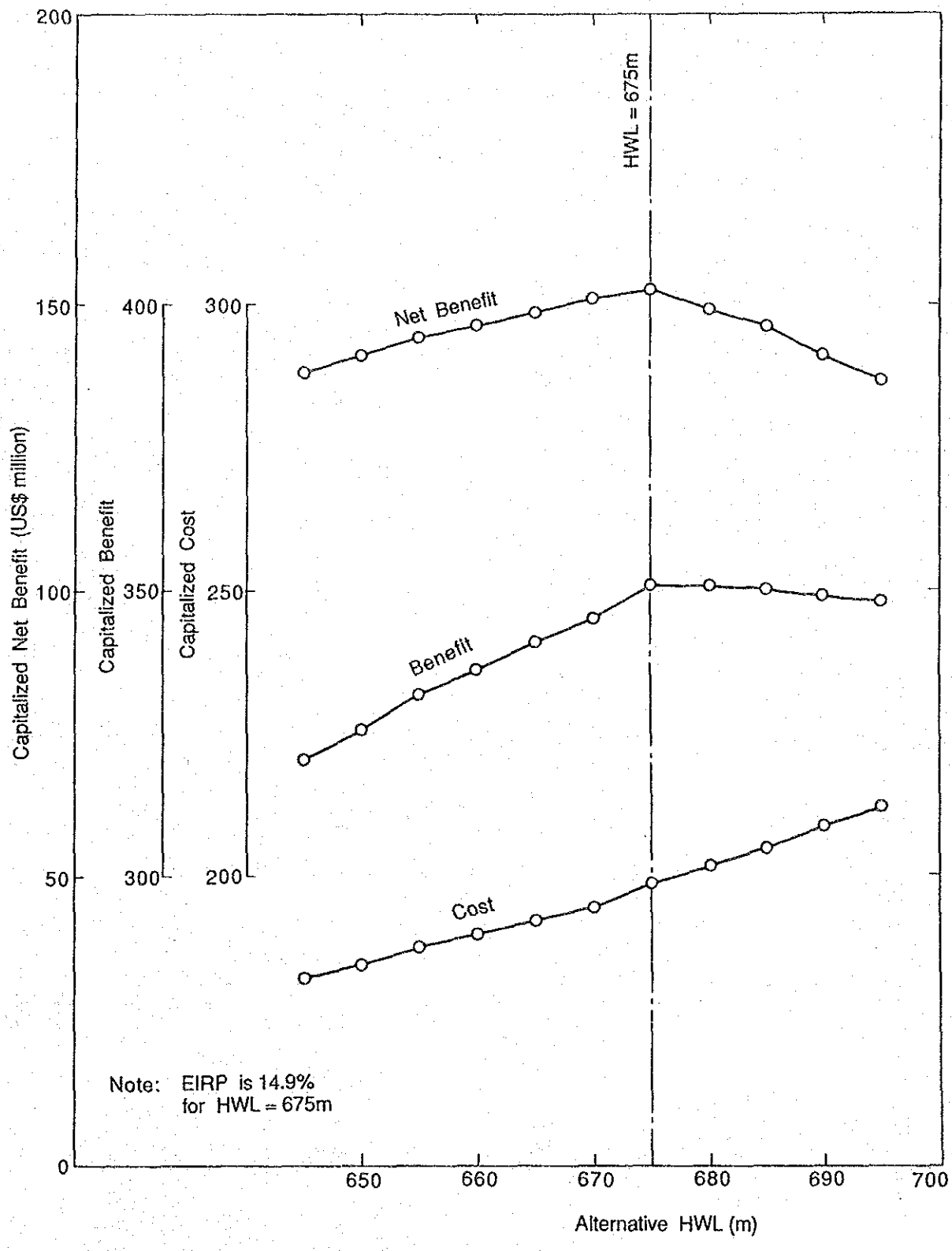


	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE D20 Optimum Location of Tailrace Outlet



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE D21 HWL - Power Output Curves

FIG NO.



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE D22 Optimum Development Scale of the Project

ANNEX-E COMPENSATION SURVEY

ANNEX-E COMPENSATION SURVEY

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CHAPTER 1. PURPOSE OF THE COMPENSATION SURVEY

The compensation survey has been carried out to determine the value of non-movables that would be eventually covered by the reservoir and it is intended to provide a good approximation of the costs that would be incurred as a consequence of the relocation of the inhabitants and the eventual impoundment of the reservoir area.

The compensation survey for the proposed reservoir area was first conducted by EİE in September 1988 for the elevation range up to 650 m. In the Additional Detailed Investigation stage between August and September 1989, the survey was supplemented by EİE for the elevation range between 650 and 750 m, since it was found through the preliminary study that a prospective HWL would exceed 650 m. The survey covered 7,367 ha in total between 510 m and 750 m in elevation.

The prices reflect the conditions of 1988, during which the mid-year average exchange rates were TL 1,682 per US$. However, the compensation cost and income were updated in July 1990 by EİE to the 1989 price levels, for which the exchange rate of TL 2,300 per US$ was applied.

CHAPTER 2. THE SURVEY AREA

The area that would be affected by the proposed reservoir is located in the Ermenek District of Karaman Province, on the Ermenek River. The survey area covers an area of approximately 7,367 ha between the 510 and 750 m in elevations.

The total population of the area within the survey area has been estimated to be about 900 with a single village settlement (Çavusköyü), which has a population of 200, made up of 42 households (1985 Population Census). The remainder of the 700 persons live in scattered settlements along the river reaches.

Major economic activity of the inhabitants of the reservoir area is mixed farming with some animal husbandry activity. Some of the younger males find employment in the district center of Ermenek and in the lignite coal mines scattered throughout the higher slopes of the Ermenek River plain.

Agriculture forms the major portion of household incomes. Crops that are most common in this area include wheat, barley, chickpeas and groundnuts. There is also some vegetable farming, orchards and poplar plantations. Farming activity, including poplar plantations, is carried out in only 1,192 ha of the total 7,367 ha, or 16 per cent of the survey area. Forests cover 4,233 ha, or 57 per cent, and the remaining 1,942 ha or 26 per cent are mostly water surfaces, abandoned land and settlements.

CHAPTER 3. SURVEY METHODOLOGY

3.1 Legal Basis of the Survey

(1) Law Number 6200: Establishment of the DSİ

The DSİ was established in 1953 with the responsibility to implement irrigation, energy and urban water infrastructure projects. As a consequence of these National responsibilities, the DSİ has been involved in many expropriation activities since its establishment.

Under Article 2 of Law Number 6200, the authority to purchase and/or to expropriate privately owned land for project implementation purposes has been given to DSİ. For implementing such expropriation activities, the article refers to Law Number 6830, which is the Law of Expropriation.

(2) Law Number 6830: Expropriation Law

This law establishes the procedures for transferring the ownership of privately owned "unmovables" or land to state ownership and/use. In it explanations are given for the procedures and means by which compensation values can be assessed. The most important requirement for the applicability of this law is that the "unmovable" or land must be owned by "real" person or persons or their legally recognized representatives.

(3) Assessment of value

This law also sets the necessary requirements and expertise necessary to assess compensation values for

such "unmovables" or land. Since the amount of the compensation value will influence the investment analysis and the subsequent decision, guidance is provided by this law to arrive at a realistic assessment of the values of the "unmovables" or land.

It is stated in this law that the assessed value ought to be as realistic as possible based on prevailing economic conditions.

3.2 Method

The compensation survey, carried out by EİE, is based on the "Manual for Expropriation Studies", prepared by the Planning and Analysis Division of the DSİ (Yunus Dogramaci, DSİ, 1984). This manual presents interpretations and examples of expropriation studies previously carried out by DSİ based on the legal requirements of Law Number 6200 and Law Number 6830 as summarized in the preceding paragraphs. Therefore, the compensation survey carried out by EİE can be considered totally consistent with these basic legal requirements.

In the compensation survey no questionnaire forms were distributed. The field observations and interviews conducted by the EİE experts, assisted by the agricultural engineers of the Ermenek District, Ministry of Agriculture, Forestry and Rural Affairs, forms the essence of the survey. The field findings have been tested against prevailing regional conditions as represented in the "Agricultural Structure and Production" and "Prices Received by Farmers", published by the State Institute of Statistics.

3.3 Area Estimations

Landuse, the number of buildings and their area coverage were delineated using 1:5,000 scale topographic maps

(base year 1986). A planimeter was used to estimate the various landuses, while a scaled ruler was used for the estimation of building areas. A schematic presentation of the reservoir area is shown in Fig. E1.

3.4 Summary of Unit Prices

The unit prices which have been used to evaluate expropriation and compensation values, based on 1988 price levels, are presented in Table E4.

3.5 Land Value Estimates

The technique used for determining land values is based on the capitalization of the rate of return on land, which is reviewed below:

(1) Capitalization rate (CR) method used for determining land values in the Ermenek Dam Reservoir Area:

	TL Million, 1988	
Land classification	Average value	Net income
ST1 : Irrigated, first class land	15.000 TL/ha	0.600 TL/ha
MbK : Orchard	30.000 "	1.220 "
KTT2: Unirrigated, second class land	8.000 "	0.313 "

$$CR = \frac{0.6 + 1.22 + 0.313}{15.0 + 30.0 + 8.0}$$

$$= 0.04$$

It is assumed here that the three classes of land are representative of the area's purchase and sale values.

(2) To estimate land value (LV)

$$LV = \frac{\text{Net Income}}{CR}$$

3.6 Crop Yields and Prices

The field survey formed the basis of the yields and the prices that existed in the area. These findings were checked against regionally established yields and prices of previous years. The local representatives of the Ministry of Agriculture, Forestry and Rural Affairs were consulted and concurrence was reached.

3.7 Income

Income estimates based on the various types of landuses relied on farmgate prices and prevailing input cost structures that existed in the area during 1988. Yields, by-products, sale prices, and input costs were used to derive net crop production incomes. Average net incomes, discussed in more detail in Section 4.2, were then derived for each of the different landuses.

3.8 Resettlement

Resettlement of households displaced by a reservoir is the responsibility of the Ministry of Agriculture, Forestry and Rural Affairs (MAFRA). This implementation is based on the by-laws of the Resettlement Law No. 2510.

Resettlement of displaced households is conducted on a voluntary basis, based on information gathered by a 100%

survey of the affected households. Based on this survey the MAFRA determines alternative settlement sites, housing designs and has the responsibility to conduct their implementation.

Resettlement activities in Turkey have been in general carried out without complications. Possible resettlement activities during the implementation of expropriation in the proposed Ermenek reservoir area is expected to be realized without serious disputes.

The number of households which may prefer resettlement instead of monetary compensation is expected to be approximately 20, or 20% of total number of the households. This estimate has been provided by DSİ experts, based on previous resettlement experiences in the Kayraktepe (Mersin), Karakaya (Elazig), and Tahtal (Izmir) reservoirs in which 9.7%, 4.0% and 31.5% of all households respectively had been resettled.

A summary table of these past resettlement implementations is shown below:

Dam	Household Displaced	Household Resettled
Kayraktepe, Mersin	2,000	194 (9.7%)
Karakaya, Elazig	6,300	249 (4.0%)
Tahtal, Izmir	1,257	396 (31.5%)

Source: Department of Real Estate and Expropriation, DSİ, 1990

It is considered that the relatively high rate of household resettled for the Tahtal reservoir was due to its location close to Izmir and the affected people wanted to live within the region.

CHAPTER 4. SUMMARY

4.1 Land and Building Values

Most of the area above 600 m in elevation is covered by pine forests with patches of bare rock. Of the total area of 5,141 ha which is above the 600 m in elevation, 4,233 ha or 82 per cent is classified as forests.

Irrigated farming is conducted on 596 ha of the total 1,192 ha of cultivable land.

The single most largest cluster of houses, numbering 47, is located in the village of Çavusköyü, which is located at the elevations of 550-570 m. Other small settlements are scattered throughout the reservoir area.

Houses in the area are constructed of piled rocks with wood framing and compacted dirt roofs. The average size of the area's homes including covered barns are approximately 146 m^2. There is a single mosque and a primary level school in the village of Çavusköyü serving the local population. Also in the village, the General Directorate of Forestry (GDF) has a building, approximately 60 m^2, used to house one of its local personnel (Table E1).

The lignite coal mine (Komur Isletmeleri A.S.), located 2 km northwest of where Küçük River joins with Ermenek River, has a shaft opening and loading ramp at the 600 m in elevation. The mining activity at this level is expected to be terminated within the next ten years (interview with operations manager Mr. Turgut Agar and mining engineer Mr. Turhan F. Kayikci).

The assessed expropriation value of the reservoir area, between 510 m and 750 m, in 1988 unit prices (Table E2), has been determined to be TL 21,581 million. Actual payment, after the deduction of the movables, is estimated to be TL 21,247 million. Housing compensation values have been estimated to be TL 1,506 million, which is only 7 per cent of the total actual compensation value (Table E2).

4.2 Income Estimates

Income earnings in the proposed reservoir area are primarily made up of agricultural activities. Net average income estimates are based on 1988 price levels.

The annual income estimates, as seen in Table E1, for orchards and vegetable gardening ranks the highest with TL 1.121 million/ha and TL 0.953 million/ha respectively. The total cumulative income of the reservoir area in 1988 prices in the survey area up to 750 m in elevation is TL 1,124 million (Table E3).

4.3 Compensation Cost in 1989 Price Levels

The compensation costs and net income losses were adjusted to the 1989 price levels by EİE in July 1990. The results are summarized in Table E5 for the elevation range up to 675 m.

TABLES

Table E1 LANDUSE IN THE PROPOSED RESERVOIR AREA (1/2)

Elevation (m)	Classification (1) (ha)															Total Area in Reservoir (2)	
	ST1	ST2	ST3	KTT1	KTT2	KTT3	KT1	KT2	KT3	Sb	MbK	Kv	Forest	Settlement	Other	Area (ha)	(Cumul.)
510 - 520	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7	25.7	25.7
520 - 530	12.7	21.3	0.0	10.1	0.0	0.0	0.0	3.6	2.3	0.1	0.0	2.1	0.0	0.0	84.2	136.4	162.1
530 - 540	3.0	82.3	0.0	1.1	28.0	0.0	0.0	12.0	7.0	2.7	12.9	2.0	0.0	0.0	101.9	252.7	414.8
540 - 550	0.0	57.9	0.0	0.0	37.7	0.0	0.0	1.6	10.7	2.5	9.8	7.8	0.0	0.0	197.8	325.7	740.5
550 - 560	0.0	22.0	3.2	0.0	10.3	0.0	0.0	4.6	13.1	0.4	7.3	2.5	0.0	0.7	177.8	241.2	981.7
560 - 570	0.0	31.4	17.5	0.0	0.6	0.0	0.0	6.6	18.2	0.6	7.3	2.5	0.0	1.3	194.1	278.6	1,260.3
570 - 580	0.0	26.3	17.8	0.0	0.5	2.6	0.0	2.1	12.3	0.5	7.4	1.5	0.0	0.0	320.1	391.0	1,651.3
580 - 590	0.0	27.3	11.2	0.0	1.4	0.4	4.1	3.0	9.7	0.1	10.8	5.7	0.0	0.0	133.9	207.7	1,859.0
590 - 600	0.0	21.8	0.4	0.0	0.5	0.0	1.5	3.4	4.6	0.0	5.7	2.9	0.0	0.0	326.4	367.2	2,226.2
600 - 610	0.0	10.9	11.2	0.0	0.0	0.0	0.9	1.5	4.1	0.0	7.6	4.0	298.9	0.0	19.6	358.8	2,585.0
610 - 620	0.0	5.0	5.0	0.0	0.0	0.0	0.0	1.7	3.7	0.0	4.3	3.7	345.8	0.0	45.9	415.0	3,000.0
620 - 630	0.0	5.0	1.6	0.0	0.0	0.0	0.0	3.0	5.7	0.0	5.3	3.7	166.6	0.0	9.0	200.0	3,200.0
630 - 640	0.0	4.7	0.7	0.0	0.0	0.0	0.0	1.3	2.3	0.0	1.6	1.9	479.1	0.0	83.6	575.0	3,775.0
640 - 650	0.0	10.3	3.0	0.0	0.0	0.0	0.0	2.3	0.2	0.0	1.3	1.3	256.7	0.0	33.0	308.1	4,083.1
650 - 660	0.0	15.7	0.5	0.0	0.0	0.0	3.8	0.4	5.2	0.0	0.2	0.3	272.4	0.0	28.5	326.9	4,410.0
660 - 670	0.0	22.1	1.8	0.0	0.0	0.0	2.9	0.7	6.8	0.0	1.0	0.2	266.6	0.0	18.0	320.0	4,730.0
670 - 680	1.8	20.2	0.4	0.0	0.0	0.0	3.1	2.8	9.5	0.0	2.4	0.1	179.6	0.0	0.0	220.0	4,950.0
680 - 690	0.0	22.9	0.0	0.0	0.0	0.0	3.4	3.3	16.0	1.0	2.3	0.1	91.0	0.0	0.0	140.0	5,090.0
690 - 700	0.0	15.2	0.0	0.0	0.0	0.0	5.0	2.2	14.7	2.5	1.6	0.2	80.6	0.0	0.0	122.0	5,212.0
700 - 710	0.0	16.4	0.0	0.0	0.0	0.0	4.2	2.2	14.9	2.6	1.7	0.2	281.6	0.0	14.3	338.0	5,550.0
710 - 720	0.0	13.2	0.0	0.0	0.9	0.0	4.2	8.1	8.1	2.0	3.8	0.3	416.6	0.0	42.8	500.0	6,050.0
720 - 730	0.0	14.3	0.0	0.0	0.0	0.4	2.9	4.1	7.8	1.1	5.7	0.1	374.9	0.0	38.8	450.0	6,500.0
730 - 740	0.0	19.7	0.0	0.0	0.0	0.0	1.1	3.8	10.8	0.8	6.6	0.1	333.3	0.0	23.8	400.0	6,900.0
740 - 750	0.0	18.2	0.0	0.0	0.0	0.0	7.1	4.3	13.9	0.5	10.4	0.0	388.9	0.0	21.5	466.7	7,366.7
Total	17.5	504.2	74.3	12.3	79.8	3.4	44.1	78.4	201.3	17.4	116.9	43.1	4,232.7	2.0	1,939.5	7,366.7	

(1) Compensation Survey, EIE, August 1989.
(2) Progress Report 1, EIE/JICA, July 1989.
(3) The GDF housing at the 570 m elevation is 60 m2.
Note: The "Other" landuse has been estimated as residual of total area in reservoir.

Table E1 LANDUSE IN THE PROPOSED RESERVOIR AREA (2/2)

Elevation	Buildings (1)					
	House		Mosque		School	
(m)	No.	m2	No.	m2	No.	m2
510 - 520		0.0				
520 - 530		0.0				
530 - 540	9	800.0				
540 - 550	17	1,900.0				
550 - 560	17	3,158.0	1	131	1	80
560 - 570	30	5,781.0 (3)				
570 - 580	23	3,362.0				
580 - 590	14	1,943.0				
590 - 600	7	762.5				
600 - 610	5	562.0				
610 - 620	6	775.0				
620 - 630	8	1,287.0				
630 - 640		0.0				
640 - 650		0.0				
650 - 660	1	50.0				
660 - 670	4	197.5				
670 - 680	4	473.0				
680 - 690	5	274.3				
690 - 700	11	1,002.5				
700 - 710	15	1,312.0				
710 - 720	7	663.0				
720 - 730	7	643.0				
730 - 740	5	337.0				
740 - 750	35	5,142.5				
Total	230	30,425.3	1	131	1	80

Table E2 EXPROPRIATION AND COMPENSATION VALUES (1/2)

Elevation (m)	Classification																	
	ST1	ST2	ST3	KTT1	KTT2	KTT3	KT1	KT2	KT3	Sb	MbK	Kv	Forest	Settlement	Other	House	Mosque	School
510 - 520	0.0	0.0	0.0	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
520 - 530	266.8	384.4	0.0	109.3	0.0	0.0	0.0	16.1	7.7	2.9	0.7	41.5	0.0	0.0	0.0	0.0	0.0	0.0
530 - 540	62.5	1,481.5	0.0	11.6	262.9	0.0	0.0	54.1	23.6	76.6	472.7	40.0	0.0	0.0	0.0	39.6	0.0	0.0
540 - 550	0.0	1,042.3	0.0	0.0	354.8	0.0	0.0	7.2	36.2	70.9	358.7	155.7	0.0	0.0	0.0	94.1	0.0	0.0
550 - 560	0.0	397.0	49.2	0.0	96.4	0.0	0.0	20.7	44.2	10.6	267.7	50.1	0.0	24.9	0.0	156.3	24.6	15.0
560 - 570	0.0	565.1	267.0	0.0	5.4	0.0	0.0	29.6	61.3	17.5	267.2	49.4	0.0	46.5	0.0	286.2	0.0	0.0
570 - 580	0.0	473.8	272.2	0.0	4.7	19.7	0.0	9.2	41.5	14.2	269.3	29.7	0.0	0.0	0.0	166.4	0.0	0.0
580 - 590	0.0	492.1	171.4	0.0	13.4	2.8	24.2	13.3	32.7	3.7	396.2	114.9	0.0	0.0	0.0	96.2	0.0	0.0
590 - 600	0.0	393.4	5.5	0.0	4.7	0.0	8.8	15.4	15.5	0.0	209.6	57.7	0.0	0.0	0.0	37.7	0.0	0.0
600 - 610	0.0	196.5	170.8	0.0	0.0	0.0	5.1	6.9	13.7	0.0	278.7	81.1	108.6	0.0	0.0	27.8	0.0	0.0
610 - 620	0.0	89.4	76.8	0.0	0.0	0.0	0.0	7.4	12.6	0.0	157.4	74.0	125.6	0.0	0.0	38.4	0.0	0.0
620 - 630	0.0	90.5	24.7	0.0	0.0	0.0	0.0	13.5	19.1	0.0	195.7	75.0	60.5	0.0	0.0	63.7	0.0	0.0
630 - 640	0.0	84.4	9.9	0.0	0.0	0.0	0.0	5.6	7.6	0.0	57.2	38.2	174.0	0.0	0.0	0.0	0.0	0.0
640 - 650	0.0	185.5	46.1	0.0	0.0	0.0	0.0	10.1	0.8	0.0	47.2	27.0	93.2	0.0	0.0	0.0	0.0	0.0
650 - 660	0.0	282.3	7.6	0.0	0.0	0.0	22.0	1.7	17.5	0.0	6.4	6.5	98.9	0.0	0.0	2.5	0.0	0.0
660 - 670	0.0	398.1	26.7	0.0	0.0	0.0	16.7	3.2	22.9	0.0	35.7	4.5	96.8	0.0	0.0	9.8	0.0	0.0
670 - 680	38.3	364.3	6.5	0.0	0.0	0.0	18.4	12.6	32.1	0.0	86.0	2.5	65.2	0.0	0.0	23.4	0.0	0.0
680 - 690	0.0	412.4	0.0	0.0	0.0	0.0	20.0	15.0	53.8	29.1	85.7	1.2	33.0	0.0	0.0	13.6	0.0	0.0
690 - 700	0.0	273.9	0.0	0.0	0.0	0.0	29.5	10.0	49.4	72.6	57.9	3.2	29.3	0.0	0.0	49.6	0.0	0.0
700 - 710	0.0	294.9	0.0	0.0	0.0	0.0	24.7	10.0	50.3	74.3	60.7	3.3	102.3	0.0	0.0	64.9	0.0	0.0
710 - 720	0.0	238.1	0.0	0.0	8.5	0.0	24.7	36.7	27.2	57.7	138.4	6.4	151.3	0.0	0.0	32.8	0.0	0.0
720 - 730	0.0	258.1	0.0	0.0	0.0	2.8	16.7	18.3	26.2	31.4	208.0	1.3	136.2	0.0	0.0	31.8	0.0	0.0
730 - 740	0.0	355.4	0.0	0.0	0.0	0.0	6.5	17.1	36.5	22.9	240.7	1.0	121.0	0.0	0.0	16.7	0.0	0.0
740 - 750	0.0	327.5	0.0	0.0	0.0	0.0	41.9	19.5	46.7	14.3	381.5	0.6	141.2	0.0	0.0	254.6	0.0	0.0
Total	367.7	9,080.9	1,134.6	132.2	750.7	25.4	259.3	353.5	679.3	498.6	4,279.3	865.0	1,537.1	71.4	0.0	1,506.0	24.6	15.0

(1) A 20% have been added to actual estimates.
(2) Scrap wood value at 1.556 million TL/ha in orchards (MbK) and movables estimated as 10% of buildings have been deducted from total compensation amounts.
(3) The 60 m2 GDF building estimated as 81,000 TL/m2. All others estimated as 41,250 TL/m2.

Table E2 EXPROPRIATION AND COMPENSATION VALUES (2/2)

Elevation (m)	Expropriation Value (1)		Actual Compensation (2)	
	Total	Cumulative	Total	Cumulative
510 - 520	11.3	11.3	11.3	11.3
520 - 530	829.4	840.7	829.4	840.7
530 - 540	2,525.1	3,365.8	2,501.0	3,341.7
540 - 550	2,119.7	5,485.6	2,095.1	5,436.8
550 - 560	1,156.6	6,642.2	1,125.7	6,562.5
560 - 570	1,595.3	8,237.5	1,557.7 (3)	8,120.2
570 - 580	1,300.7	9,538.2	1,272.7	9,392.9
580 - 590	1,361.1	10,899.3	1,334.6	10,727.5
590 - 600	748.5	11,647.8	735.8	11,463.3
600 - 610	889.2	12,537.0	874.6	12,337.9
610 - 620	581.5	13,118.6	571.0	12,908.9
620 - 630	542.8	13,661.4	528.2	13,437.1
630 - 640	377.0	14,038.4	374.6	13,811.6
640 - 650	409.9	14,448.4	407.9	14,219.6
650 - 660	445.6	14,893.9	445.0	14,664.6
660 - 670	614.5	15,508.4	612.0	15,276.6
670 - 680	649.4	16,157.7	643.4	15,919.9
680 - 690	663.8	16,821.6	658.8	16,578.8
690 - 700	575.4	17,397.0	568.0	17,146.8
700 - 710	685.4	18,082.4	676.3	17,823.1
710 - 720	721.7	18,804.1	712.5	18,535.6
720 - 730	731.0	19,535.1	719.0	19,254.6
730 - 740	817.8	20,352.9	805.9	20,060.5
740 - 750	1,227.8	21,580.7	1,186.1	21,246.6
Total	21,580.7		21,246.6	

Table E3 INCOME BEING PRODUCED IN THE RESERVOIR AREA

Elevation (m)	Landuse (TL) ST1	ST2	ST3	KTT1	KTT2	KTT3	KT1	KT2	KT3	Sb	MbK	Kv	Forest	Total TL	Cumulative TL
510 - 520	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
520 - 530	8.9	12.8	0.0	3.6	0.0	0.0	0.0	0.5	0.3	0.1	0.0	1.2	0.0	27.5	27.9
530 - 540	2.1	49.4	0.0	0.4	8.8	0.0	0.0	1.8	0.8	2.6	15.8	1.2	0.0	82.7	110.6
540 - 550	0.0	34.7	0.0	0.0	11.8	0.0	0.0	0.2	1.2	2.4	12.0	4.7	0.0	67.0	177.6
550 - 560	0.0	13.2	1.6	0.0	3.2	0.0	0.0	0.7	1.5	0.4	8.9	1.5	0.0	31.0	208.6
560 - 570	0.0	18.8	8.9	0.0	0.2	0.0	0.0	1.0	2.0	0.6	8.9	1.5	0.0	41.9	250.5
570 - 580	0.0	15.8	9.1	0.0	0.2	0.7	0.0	0.3	1.4	0.5	9.0	0.9	0.0	37.7	288.3
580 - 590	0.0	16.4	5.7	0.0	0.4	0.1	0.8	0.4	1.1	0.1	13.2	3.4	0.0	41.8	330.0
590 - 600	0.0	13.1	0.2	0.0	0.2	0.0	0.3	0.5	0.5	0.0	7.0	1.7	0.0	23.5	353.5
600 - 610	0.0	6.5	5.7	0.0	0.0	0.0	0.2	0.2	0.5	0.0	9.3	2.4	36.2	61.1	414.6
610 - 620	0.0	3.0	2.6	0.0	0.0	0.0	0.0	0.2	0.4	0.0	5.2	2.2	41.9	55.6	470.2
620 - 630	0.0	3.0	0.8	0.0	0.0	0.0	0.0	0.5	0.6	0.0	6.5	2.2	20.2	33.9	504.1
630 - 640	0.0	2.8	0.3	0.0	0.0	0.0	0.0	0.2	0.3	0.0	1.9	1.1	58.1	64.7	568.8
640 - 650	0.0	6.2	1.5	0.0	0.0	0.0	0.0	0.3	0.0	0.0	1.6	0.8	31.1	41.6	610.4
650 - 660	0.0	9.4	0.3	0.0	0.0	0.0	0.7	0.1	0.6	0.0	0.2	0.2	33.0	44.5	654.8
660 - 670	0.0	13.3	0.9	0.0	0.0	0.0	0.6	0.1	0.8	0.0	1.2	0.1	32.3	49.2	704.1
670 - 680	1.3	12.1	0.2	0.0	0.0	0.0	0.6	0.4	1.1	0.0	2.9	0.1	21.8	40.5	744.5
680 - 690	0.0	13.7	0.0	0.0	0.0	0.0	0.7	0.5	1.8	1.0	2.9	0.0	11.0	31.6	776.1
690 - 700	0.0	9.1	0.0	0.0	0.0	0.0	1.0	0.3	1.6	2.4	1.9	0.1	9.8	26.3	802.5
700 - 710	0.0	9.8	0.0	0.0	0.0	0.0	0.8	0.3	1.7	2.5	2.0	0.1	34.1	51.4	853.9
710 - 720	0.0	7.9	0.0	0.0	0.3	0.0	0.8	1.2	0.9	1.9	4.6	0.2	50.5	68.4	922.3
720 - 730	0.0	8.6	0.0	0.0	0.0	0.1	0.6	0.6	0.9	1.0	6.9	0.0	45.5	64.2	986.5
730 - 740	0.0	11.8	0.0	0.0	0.0	0.0	0.2	0.6	1.2	0.8	8.0	0.0	40.4	63.1	1,049.6
740 - 750	0.0	10.9	0.0	0.0	0.0	0.0	1.4	0.6	1.6	0.5	12.7	0.0	47.1	74.9	1,124.4
Total	12.3	302.7	37.8	4.4	25.0	0.8	8.6	11.8	22.6	16.6	142.6	25.9	513.2	1,124.4	

TL Million, 1988

Table E4 EXPROPRIATION AND INCOME UNIT VALUES

TL million, 1988

Classification		Income TL/ha	Land TL/ha	Buildings TL/m^2
ST1	: Irrigated, first class land	0.700	17.509	
ST2	: Irrigated, second class land	0.600	15.010	
ST3	: Irrigated, third class land	0.509	12.733	
KTT1	: Unirrigated, first class land	0.360	8.995	
KTT2	: Unirrigated, second class land	0.313	7.837	
KTT3	: Unirrigated, third class land	0.253	6.322	
KT1	: First class barren land	0.196	4.896	
KT2	: Second class barren land	0.150	3.757	
KT3	: Third class barren land	0.112	2.812	
Sb	: Vegetable farm land	0.953	23.813	
MbK	: Mixed orchard	1.220	30.512	
Kv	: Poplars	0.600 (1)	16.733 (3)	
Forest		0.121 (2)	0.303 (4)	
Settlement			30.512 (5)	
Other	: Water surface, abandoned land		0.000	
House (6)				0.041
Mosque				0.156
School				0.156

Source : Estimated from Compensation Survey, EİE/JICA, August 1988.
Building values : Official Gazette, 3/4/1988, p. 26.

(1) Rental value of ST2 (Irrigated, second class land).

(2) Estimated income from annual volume increase of 13,250 m3/ha.

(3) Includes wood compensation of 1,723,800 TL/ha.

(4) Includes only the lumber compensation of 302,630 TL/ha.

(5) Assumed equivalent to value of MbK (Orchard land).

(6) GDF building value is 81,000 TL/m2. The remainder of house values are 41,250 TL/m2.

Note : US$ 1.00 = TL 1,682 (1988 mid-year average).

Table E5 UPDATED SUMMARY (1989 PRICE LEVEL)

(1) in TL 1,000

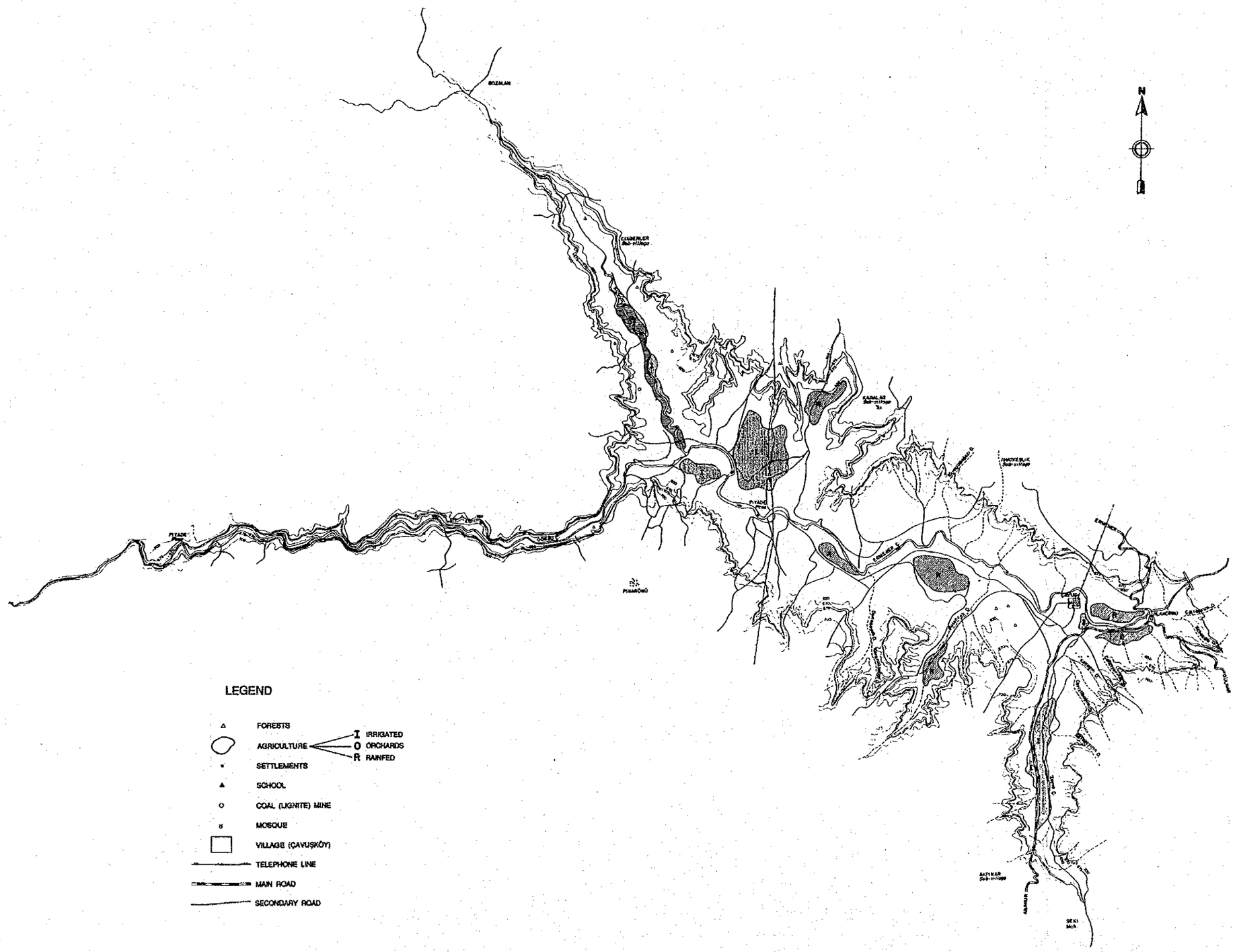
Elevation	Expropriation Values	Actual Payment	Net Income Losses
520	16080.9	16080.9	723.6
530	1150385.3	1149508.1	41457.6
540	4266194.8	4240117.6	193138.3
550	7376946.6	7292803.7	334437.0
560	9629394.6	9493126.3	444297.8
570	11889764.9	11692038.3	560154.8
580	14024337.2	13785112.7	666213.3
590	15566914.0	15306537.2	739807.3
600	16529600.3	16243196.0	784581.3
610	17565758.1	17257083.5	882718.1
620	18463010.2	18137555.4	983194.7
630	19243345.5	18897950.4	1049043.6
640	20101478.3	19744960.0	1168244.4
650	20823601.0	20448801.9	1243791.0
660	21536751.1	21144969.4	1321154.9
670	22384020.7	21955712.4	1403724.4
675	22590342.7	22156990.5	1435684.2

(2) in million US$ (US$1.00 = TL2,300, Nov. 1989)

Elevation	Expropriation Values	Actual Payment	Net Income Losses
520	0.01	0.01	0.00
530	0.50	0.50	0.02
540	1.85	1.84	0.08
550	3.21	3.17	0.15
560	4.19	4.13	0.19
570	5.17	5.08	0.24
580	6.10	5.99	0.29
590	6.77	6.66	0.32
600	7.19	7.06	0.34
610	7.64	7.50	0.38
620	8.03	7.89	0.43
630	8.37	8.22	0.46
640	8.74	8.58	0.51
650	9.05	8.89	0.54
660	9.36	9.19	0.57
670	9.73	9.55	0.61
675	9.82	9.63	0.62

FIGURES

PLATE NO.



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Fig. E1 Schematic Landuse in Reservoir Area

ANNEX-F ENVIRONMENTAL STUDY

ANNEX-F ENVIRONMENTAL IMPACT STUDY

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TEXT

CHAPTER 1. OBJECTIVES AND SCOPE

1.1 Objectives of the Study

An environmental impact study (the Study) has been carried out as part of the feasibility study of the Ermenek Hydroelectric Power Development Project. The objectives of the Study are:

(1) to assess at a preliminary level possible environmental impact associated with the implementation of the Project, and

(2) to recommend possible countermeasures to be taken and/or further studies to be carried out, following the feasibility study.

1.2 Scope of the Study

(1) Study area

The Study covers the areas that may be affected by the implementation of the Project. Depending on the data availability and types of effects related to different aspects of the environment, the Study area has been defined at several different levels. First, the Study area is defined at two broad levels: the Project provinces and the Project area. The Project provinces are the old province of Konya, the Içel and Antalya provinces, which partly fall in the Göksu river basin and may be more widely affected by the Project than other provinces. A new province of Karaman has been created in June 1989 separated from the old Konya province, but the entire territory of the old Konya is taken as the Project province due to data availability.

The Project area is broadly defined as the Göksu river basin, with particular attention paid to the upper catchment of the Ermenek river.

Second, in evaluating possible environmental impact, the Study area is sometimes narrowed down to the sites of the project works and their vicinity, which will be more directly affected by the Project. These sites include the following :

i) Dam sites I-C and I-B,

ii) Erik diversion weir site,

iii) Sites for the above-ground facilities related to the underground power plant, and

iv) Reservoir areas corresponding to the alternative dam sites and high water levels.

(2) Scope of work

The Study has been carried out covering the following tasks :

1) Clarification of the base-line conditions of the environment that may be affected by the implementation of the Project;

2) Assessment of possible environmental effects related to the Project and identification of more important/ significant adverse effects;

3) Formulation of possible counter-measures to alleviate the more important/significant adverse environmental effects identified; and

4) Recommendation of further studies to be carried out and follow-up actions to be taken, necessary to clarify the environmental effects more precisely and/or to formulate more specific counter-measures.

CHAPTER 2. METHODS

2.1 Study Level

The Study carried out at this time is the first one of this kind related to the Project. Naturally it is a preliminary one. The level of the Study corresponds to what is generally called a "preliminary environmental impact analysis (PEIA)." Following this, another study called an "environmental impact analysis (EIA)" may be carried out, possibly focusing on more important aspects of the environment identified through the PEIA. Its preliminary nature dictates the methods used for the Study that can be easily adopted, given the time constraint.

2.2 Methods of the Study

The tasks listed in Section 1.2 have been carried out by the methods described below.

(1) Base-line survey

Scope

The survey of base-line conditions of the environment covers the following aspects :

i) Socio-economy, including public health and sanitation,
ii) Natural/physical conditions, including water quality, and
iii) Terrestrial and aquatic fauna and flora.

Methods

The survey has been conducted principally based on existing data and study reports (see "Reference"). Field surveys were also carried out to cover some of the aspects of the environment. A survey on socio-economic aspects has been supplemented by interviews with local people and officials. Surveys on other aspects have been supplemented by field observations. Consultation was made also to scholars at research institutes to clarify particularly ecological aspects of the environment.

(2) Environmental impact assessment

Scope

The scope of environmental impact assessment was determined on the basis of the base-line survey results. All the important aspects identified by the base-line survey are included in the scope.

Methods

Different aspects of the environment clarified by the base-line survey were examined as to whether they would be strongly related to any of the following.

a) improvement of health and sanitary conditions of the local people,
b) promotion of industry and tourism development,
c) creation of job opportunities,
d) development of inland fishery,
e) change in traditional life style of the local people,
f) resettlement of the people to be affected,

g) relocation of houses, public facilities, cultural assets and historical remains,
h) damage to economic activities such as forestry, fishery, tourism and navigation,
i) deterioration of water quality of rivers and lakes,
j) eutrophication of lakes and reservoirs,
k) damage to the existing water use,
l) deterioration of wildlife habitats,
m) effects on the existing ecosystem,
n) proliferation of vectors of water-borne parasitic diseases.

The method of Modified Leopord Matrix is used as a basic tool for the environmental impact assessment of the Study. The matrix called a risk resultant matrix is constructed by taking those selected aspects of the environment as rows, and the Project activities in time periods as columns. At this time, the time periods are broadly classified into preconstruction, construction and operation periods. Entries of the risk resultant matrix are possible/probable impact of the Project activities on particular aspects of the environment during respective time periods.

(3) Countermeasures formulation

From the risk resultant matrix prepared in the task described above, more important aspects of the environment have been identified that may be adversely affected by the planned Project activities. For each of them, possible countermeasures are formulated to alleviate the adverse environmental effects. The countermeasures include precautions to be taken, adaption of particular design and/or construction methods, corrective structural measures, and policy measures.

(4) Recommendation

The Study has clarified the aspects which need to be further looked into as well as potential environmental impact. Follow-up studies are defined to cover these aspects in more detail. Recommendation is made also on other follow-up actions to be taken in order to clarify the environmental effects more precisely and/or to formulate more specific counter-measures.

CHAPTER 3. EXISTING ENVIRONMENTAL CONDITIONS

3.1 Socio-economy

(1) Population and settlements

The Project area consists of most part of Ermenek and Hadım districts and part of Karaman district in the Karaman province, most part of Mut district and part of Silifke, Gülnar and Anamur district in the Içel province, and part of Alanya district in the Antalya province. The three Project provinces are growing relatively faster than Turkey as a whole primarily due to the progress of urbanization in major cities (Table F1).

Subdistricts, cities and villages located within the Project area are listed in Table F2, together with the population of each settlement (Fig. F2). Total population and its density in the Göksu river basin in 1985 are estimated at about 250 thousand and 24 per km^2, and those in the Ermenek river basin are estimated at about 70 thousand and 20 per km^2. The population density of the Göksu and the Ermenek river basins is lower than that of all the three Project provinces, reflecting rural characteristics of the Project area.

(2) Economy

Gross regional product

The gross regional product (GRP) of the three Project provinces is compared (Table F3). Agriculture is the dominant sector in two of the Project provinces, Konya and Antalya, claiming over 30 % share in the respective provincial GRP. The high share of industry in the

provincial GRP of Içel is primarily due to manufacturing activities in the city of Mersin. Considering most trade and transportation activities are agriculture-related, agriculture contributes directly or indirectly to over 50 % of the GRP and some 80 % of the total employment in the Project provinces.

Per capita product in 1986 was TL 552 thousand in Konya, TL 951 thousand in Içel, and TL 670 thousand in Antalya, as compared with TL 757 thousand in Turkey as a whole. Per capita product in the Project area, which does not contain any major urban center, must be substantially lower than the national average.

Agriculture

Major crops cultivated and fruits produced in the Project provinces are summarized (Tables F4 and F5). Wheat is the most dominant crop in all the three provinces. Most important industrial crops are cotton on the Mediterranean side and sugarbeet in the inland area.

Citrus fruits are dominant in the Mediterranean region but virtually non-existent in the inland, where grapes are cultivated extensively. Other important fruits in the Project provinces include apple, pear, peach and cherry. Vegetables production is on a small scale in the Project area for domestic consumption and marketing in nearby towns.

Livestock activities in the Project area are dominated by extensive grazing or small-scale operation by individual households.

More detailed production data for the Ermenek district are given in Tables F6 through F9.

Industry

The Project area is predominantly rural, and only a few major urban centers exist in and around the area. No large-scale manufacturing industry is in operation in and around the Project area, except a cement factory, SEKA sugar company, and a paper manufacturer in Silifke. An industrial estate is planned in the suburbs of the Konya city.

Lumbering industry operates on a small scale on the basis of pine trees and fast growing tree plantations in the Project area. Also small coal mines exist in the Project area (see Section 4.1 (3)).

Tourism

Tourism networks in Turkey connect mainly coastal areas of Mediterranean, Aegean and Black sea and a few major inland tourism objects to the gateway cities of Ankara and Istanbul. The Project area is not part of any major tourism network. Some spectacle seekers, from Europe and other parts of the world, visit Ermenek to see the canyon created by the Göksu/Ermenek river, usually on the way from/to main destinations on the Mediterranean coast. However, tourism-related activities in the Project area are minimal with insufficient accommodations and related facilities and services.

Main economic activities

Main economic activities in larger towns in the Project area are summarized below.

Town	Agriculture	Industry
Ermenek	Cereals, Fruits Animal husbandry	Coal
Hadìm	Cereals, Viniculture	
Bozkìr	Animal husbandry Cereals, Viniculture	
Karaman	Cereals, Viniculture Animal husbandry	Weaving, Wine Boiled and cracked wheat
Mut	Fruits, Rice, Pulses Cereals, Sesame, Groundnut Animal husbandry	Iron Coal
Günder	Cereals, Pulses, Fruits Early season vegetables Almond	Barite Quartz
Silifke	Animal husbandry Groundnut, Olive, Rice Early season vegetables	Quartz, Barite Dolomite, Paper Hydroelectric power

Source: Compiled by the JICA Study Team based on hearings from local people and officials as well as statistics.

(3) Land use

Project provinces

A broad land use classification primarily for agriculture is indicated for the Project provinces.

(Unit : %)

Province	Agricultural land	Forests	Grassland	Area unsuited to agriculture
Konya	59.0	17.4	15.3	8.3
Içel	24.5	55.9	13.9	5.7
Antalya	18.3	58.3	2.3	21.1

Source: Compiled by the JICA Study Team from SIS statistics.

As shown, large forest areas remain in the provinces of Içel and Antalya, while the majority of area in Konya is already used for agriculture.

Project area

Land use data for the Ermenek district may be indicative of the land use in the Project area (Table F10, Figs. F3 and F4). In the Ermenek district, forest area is extensive, covering 69.4 % of the total district land. Cultivated land and pasture/meadow occupy respectively 13.8 % and 13.5 %.

(4) Public health and sanitation

Medical facilities

There is only one hospital in the Ermenek city serving the Project area with 50 beds and four doctors plus an intern and a dentist (as of November, 1989). The total number of staff at the hospital is 25, including 15 nurses. The bed occupancy ratio was 71 % in 1988. There are six health service units serving rural population at Basyayla, Tepesazı, Kazançı, Sariveliler, Göktepe and Güneyyurt. Services provided at each unit are mainly simple treatment of outpatients and preventive

injections against prevalent diseases. For higher level treatment, major hospitals are available in Konya and Mersin.

Diseases

More prevalent diseases in the Project area may be indicated by the following statistics for patients hospitalized in 1989 (upto October) at the Ermenek hospital.

Disease	No. of patients
Infectious hepatitis	23
Rabies	37
Tuberculosis	2
Diarrhoea	277
Death of the new born by diarrhoea	2

In addition, Goitre and Rheumatism are reported by the Ermenek health office as dominant diseases.

Sanitation

Most drinking water supply in the Project area depends on springs or groundwater. The quality of water is generally good. In the Ermenek city, 2,796 households are presently served by the public water supply system fed by spring water. Based on the metered amount of water in the month of October 1989, 22,846 m^3, per capita water consumption is about 50 litres. There is no sewerage system for the Ermenek city as well as other settlements.

3.2 Natural/physical Aspects

(1) Topography

The Project area is located in the middle of the Taurus ranges, which run through the southern part of Anatolia and divide the Anatolian plateau from the Mediterranean coast. The Taurus ranges in the Project area reach 1,500-2,000 meters at several peaks.

The valley corroded by the Ermenek river over hundreds of million years is some 700 meters deep in the Project area below the Ermenek city. Additional 300 meters rise above the city.This topography itself is a unique environmental feature of the Project area.

(2) Geology

The Taurus ranges, of which the Project area constitutes a part, are upheaved limestone deposits of the Mesozoic age corroded by rivers and reshaped by the Tertiary deposits to make complex matrices. The Görmel formation is composed mainly of marl, claystone, siltstone, clayey limestone, sandstone and conglomerate alternations. The Ermenek ophiolithic melange consists of heterogenic blocks of various sedimentary rocks and matrix including these blocks.

A large portion of the proposed reservoir area is an impervious Görmel formation. The limestones of the Ermenek melange outcrop in several places including Çavus village and the upstream end of the reservoir area.

Slope movements have been reported in the reservoir area. These have been developed in the form of rockfall, planar block slide and rotational slide. Due to

these movements, huge limestone blocks of the Ermenek formation outcropped at high elevations have slided down on the slope of Görmel formation. These blocks are reported to be stable at present.

A recent landslide occurred in the middle reach of the Erik stream, a right tributary of the Ermenek river. This forced several houses to resettle on an upper plateau nearby.

(3) Vegetation

In terms of botanical geography, the project area belongs to the Mediterranean region (Fig. F5). Within the region, vegetation cover varies widely depending on geological, topographic and soil conditions as well as climate.

The upper catchment of the Ermenek river is fairly well covered with vegetation, except where calcareous rocks are outcropped. However primary forests are not widespread, and most parts of vegetation are relatively sparse. Substantial areas are secondary afforested. Tree crops cover the lower part of the upper catchment as well as small poplar plantations. Tree crops are mostly fruit trees, including olive, peach, apple, fig and grape.

(4) Meteoro-hydrology

The climate of the Project area exhibits a transition from the Mediterranean to the continental characteristics. The precipitation is the highest (over 1,000 mm and upto 2,000 mm per year) on the southern slopes of the Mediterranean coast, followed by the coastal plains (800-1,000 mm per year). Within the Taurus ranges, the mean annual precipitation ranges from 400 to 800 mm

(Table F11, Fig. F6). The precipitation is highest during December-February and lowest during June-September. More detailed meteorological data for the Ermenek station are given in Table F12.

The runoff coefficient in the Ermenek river basin is generally in the range of 0.6-0.7. The mean annual runoff of the river is 62.4 m^3/sec at Kirkyalan near the confluence with the Göksu river.

Due to the geological and topographic characteristics outlined above, groundwater reserves are substantial in the Project area. There exist many springs in and around the proposed reservoir area. Nadire spring is located near the upstream end of the reservoir and has a discharge of some 3 m^3/sec observed in a dry month of July, 1989. Many small streams are fed by springs and most of them are completely dry in dry season (after May).

(5) Water quality

Due to the rocky terrain and the otherwise good vegetation cover, the amount of sediments transported by surface runoff is small (Table F13). The total annual transport of sediments into the planned reservoir has been estimated to be 0.28 million m^3.

Water quality data for the Ermenek river show that the upstream reaches of the river are almost intact of any contamination by human activities (Table F14, Fig. F6). Total dissolved solids are very low, and the conductivity levels are comparable to those of natural spring water. Relatively high concentration of Ca/Mg ions is due to the calcareous rocks constituting the basin, and corresponds to the high concentration of CO /HCO ions.

The biological oxygen demand (BOD) is higher during rainy seasons, but still at very low level of 1-2 mg/l, as compared with saturation level of oxygen which is generally around 8 mg/l. No or trace ammonia/nitrate/nitrite is also indicative of the intact conditions of the river.

The good water quality of the Ermenek river is due to several factors. They include dispersed population, low per capita water consumption even in the Ermenek city, non-existence of major industries, and low fertilizer utilization. The last factor is indicated by the following.

Fertilizer Use in the Project Area and in Turkey, 1985

	Nitrogenous	Phosphate	Potassium
Total use (tons) Project area	3,965	1,271	0
Unit use (kg/ha of cultivated area)			
Project area	124	40	0
Turkey	199	141	2.63

Source: Ermenek District Agricultural Office

3.3 Fauna and Flora

(1) Terrestrial fauna and flora

Terrestrial fauna

It is reported that in Turkey some 120 species of mammals live wild at present. The Project area contains much smaller number of mammals (Table F15). Those dominant in number are moles, rabbits, rats, voles and squirrels.

The number of bird species observed in Turkey is believed to be in the vicinity of 450. They include many migratory birds which pass through Turkey on the way to the south and the north. Probably most important are species of falcon, which are widespread in Turkey and commonly observed in the Project area, but decreasing in number in Europe.

The Ermenek Regional Office of the General Directorate of Forestry has confirmed the presence in the Project area of several bird species including the following:

Accipitridae	Vulture (Akbaba in Turkish), Sparrow-hawk (Atmaca) Eagle (Kartal)
Falconidae	Peregrine (Sahin)
Ciconidae	Stork (Leylek)
Fringillidae	Goldfinch (Saka)

Terrestrial flora

A wide range of tree species are observed in the Mediterranean region, of which the Project area is a part according to botanical geography. However, the Project area is separated from the Mediterranean coast by the southern-most range of Taurus mountains, and therefore dominant plants are different from those on the Mediterranean coast (Table F16).

Most kinds of shrubs widely observed on the Mediterranean coast are not dominant in the Project area. More varieties of hardwood are observed in the coastal area, while poplar is the predominant hardwood in the Project area. Conifers such as black pine and various junipers

are comparatively more dominant in and around the Project area.

(2) Aquatic fauna and flora

Aquatic fauna

It has been established by past studies and researches that 192 species and subspecies of fish belonging to 26 families live in inland waters of Turkey. A study based on 4,596 specimens collected over a three year period in the Southern Anatolian region has identified 28 genera, 32 species and 10 subspecies of fish belonging to 13 families (Table F17).

Fish species which may be found in the Göksu river system include the following.

	Scientific name	English name	Turkish name
*	Anguilla anguilla	Eel fish	Yılan balığı
*	Salmotrutta macrostigma	Trout	Dere alası
*	Cyprinus carpio	Carp	Sazan balığı
*	Vimba vimba tenella		Tahta balığı, Karagöz
	Acanthorutilus anatolicus		Yag balığı
	Pararhodeus kervilleri		
*	Chondrostoma nasus		Kababurun
*	Leuciscus cephalus	Chub	Tatlısu kefali
	L.borysthenicus		Tatlısu kefali
	L.lepidus		Akbalık
*	Barbus capito pectoralis	Barbel fish	Bıyıklı balık
*	B.plebejus escherichi	Barbel fish	Bıyıklı balık
	Capoeta capoeta angorae		Karabalık
	Cobitis taenia	Spined loach	Tasyiyen balığı

	Scientific name	English name	Turkish name
	Nemacheilus angorae	Ankara stone loach	Cöpcü balìgì
*	Silurus glanis	Wels	Yayìn balìgì
	Aphanius chantrei fontinalis		Dislisazapcìk balìklarì
	A. sophiae mentoides		"
*	Mugil cephalus	Mullet	Deniz kefali
*	M. ramade	Mullet	Deniz kefali
*	Stizastedion lucioperca	Pike perch	Aklevrek (Sudak)
	Blennius fluviatilis		Horos bina balìgì

Source: Table F17

Those fish species marked by the asterisk (*) above are considered to have economic value.

Aquatic flora

As the Ermenek river is a kind of mountain stream without still waters or marshy areas along the flow, aquatic florae are observed to a very limited extent. Due to its water quality, the population of phytoplankton is expected to be comparatively small.

CHAPTER 4. ENVIRONMENTAL IMPACT ASSESSMENT

4.1 Socio-economic Impact

(1) Regional development impact

The Project will provide employment opportunities primarily for common laborers during construction period. Service industries will also benefit from the influx of the Project-related people during construction and also preconstruction to a small extent.

Agricultural activities in the Project area will be negatively affected by the Project due to inundation of some agricultural land (see "Compensation Study"). Effects, however, will be relatively small as more extensive agricultural land exists in the upper catchment of the Ermenek river. Improved electricity supply will greatly contribute to the promotion of industries in and around the Konya and Karaman Provinces. Good prospect exists for fishery development by aquaculture in the reservoir. This will be a long-term possibility requiring further investigation. The reservoir may provide easy and cheap media of transportation for local villagers, which may encourage trade activities.

Tourism may be promoted significantly. Although the reservoir will submerge part of the canyon, the large water body will provide potentially attractive tourism area. Also the access to the area in general and to the gorge in particular will be improved related to the Project works. These favourable factors may be combined with other tourism resources in the area such as a stone grave, old village and stalactite cave, which have not been exploited yet, for effective tourism

development.

(2) Çavusköyü village

The Çavusköyü village is located in the planned reservoir area. At present, about 200 people live in the village, but about as many men as living in the village have emmigrated to other cities such as Konya, Karaman and Mersin. Main economic activities are crop cultivation and stock raising. Main crops are wheat, vegetables (tomato, eggplant, sesame, green pepper), fruits (apple, grape, peach), and cotton. Farm land, totalling some 300 ha, is located in the lowland and on the hill around the village. Each family usually owns 10 to 15 cows to produce milk, cheese and butter for sales in the Ermenek town.

This village will have to be relocated and people resettled. Other than houses, facilities to be relocated include a primary school,mosque and village community center (köy odasi) as well as water supply system, which all exist at present in the village.

(3) Coal mines

There exist small coal reserves between the Ermenek city and the prospective reservoir area at the altitude of 700-1000 m. A few mines are operational. The largest one is a TKI mine operating on the total estimated reserve of 7 million tons. The mine is located furthest from the reservoir area some 12 km away from it.

Two other mines are closer to the reservoir area. The Akpinar mine, started in 1983, is operating at the altitude of 760-820 m. It is an open pit mine, producing 200 tons/day on the remaining reserve of only 15,000 tons (as of August, 1989). It will cease to

operate after a few more months. This private company employing 35 workers has already acquired another permit for Canakkale/Can mines.

The Coal Mine Corporation is a joint venture with the participation of the State Sugar Company (58 % equity), TKI (38 %), and a private company. It is producing 170 tons/day or 55,000 tons/year. The reserve is estimated at 800,000 tons by geological investigations already completed. The corporation employs 218 workers and 6 other staff, relatively large as the mine operates underground. Currently the operation reaches the elevation 300 m, starting from 705 m on the surface, which is lower than the groundwater table at 550-560 m.

The mine of the Coal Mine Corporation may be affected by the creation of the reservoir. Although the mine currently operates below the groundwater table, no water gushing problem has been encountered presumably due to impervious marl zone surrounding the reserve. As the groundwater table is raised by the planned reservoir, the mining operation may be affected.

Prices of coal and clients for the two mines near the planned reservoir are as follows (as of July, 1989).

	Clients	Prices (TL/ton)
Akpinar Mine	Cement factory	55,000 + KDV
		36,000 (dust)
	Private users	55,000 + KDV
Coal Mine Corporation	Sugar company	52,000
	Private companies	65,000 - 75,000

If the average coal price of the Coal Mine Corporation is taken to be TL 60,000, their annual gross income is at TL 3.3 billion. This is approximately one-tenth of the gross agricultural income of the Ermenek district