10.2.1 Financial analysis

Financial cash flow shows project expenditures for investment, and operation and maintenance. (Table 10.2.1). In order to obtain the 1993 average price for the financial and economic analyses, the estimated investment and operation and maintenance (O&M) costs are deflated by the general whole sale price index since their base time is February 1, 1994. (Table 10.2.2 and 10.2.3) Total amount, investment cost, and O&M cost are USD 18,087,184, USD 13,340,597, and USD 4,746,587 respectively. NPV of the costs discounted by 3% interest rate is USD 16,067,359.

10.2.2 Economic analysis

(1) Basic Consideration

For the calculation of the economic cost and benefit, distortion of the Turkish economy and the factor of transfer within the economy are to be identified. Use of standard or sector particular conversion factor(s) for the economic valuation are desirable for the economic analysis. At present, however, there is no reliable conversion factor applicable to this project. Governmental interventions such as subsidies, taxation, export and import regulation and/or special arrangements, etc. are so widely applied in Turkey. As far as examined the planning reports and confirmed with the related international and Turkish governmental organization, efforts to figure out conversion factor have not been materialized recently except electric power sector. Due to complex and too fluid economic measure application, identification of the influence of the governmental intervention is almost impossible. The conversion factors employed by the planning reports are not reliable for present conditions.

Concerning the value added tax (VAT), which is representative transfer factor, almost all inputs of the project are subject to 15 % VAT. This figure is applicable to value the financial cost to economic cost. In Turkey, current exchange rate reflects current currency value. Shadow exchange rate is not required for economic valuation.

For the benefit side, identification of influence of the governmental intervention is very difficult, too, from the same reason stated above. Comparing to the scale of this study, detailed investigation for the clarification of the influence is too much burdensome. Available data are not ready for distinguishing whether distorted or not. In this circumstance, no adjustment is made for the calculation of the economic benefit.

(2) Economic Cost and Benefit

Economic costs incorporating VAT factor are shown in Table 10.2.2 and 10.2.3.

As stated in 10.1.4, items of the economic benefits of the project are the following items:

(a) Substitution effect of the personnel related to the flood forecasting and warning by the system,
(d) Decrease in flood areas/damages by proper dam operations, and
(e) Maximization of reservoir water use by more flexible and appropriate dam operations.

Economic value of the item (a) is calculated by the reduced number of personnel for water gauging station record reading and reporting and their salaries. Total 8 personnel paid with TL 117,600 thousand per year are substituted by the system (Table 10.2.4).

Items (d) decrease in flood areas/damages by proper dam operations is calculated by identifying the difference between expected damages/loss without project and with project respectively. Assessed extent of the inundation areas and the economic loss differentiated by the discharge volume of the Seyhan Dam are shown in Table 10.2.5. Table 10.2.6 shows comparison of with and without project losses and expected annual economic benefits discounted by the flood probability. Total expected annual benefit categorized in this item is USD 669,725.

Additional electric power generation is the effect of the item (e). Expected additional electricity by the Çatalan Hydro Power Plant and the Seyhan Hydro Power Plant, their economic, and per annum values discounted by the flood probability USD 595,379 in total are listed in Table 10.2.7.

(3) Economic Analysis

Economic cash flow and result of economic analysis including EIRR (Economic Internal Rate of Return), comparison of nominal values of cost and benefit, and NPV (Net Present Value) discounted by the real interest rate of 3% per annum are shown in Table 10.2.8.

Direct interpretation of the figures of the EIRR and NPV, which are 4.75% and USD 1,722,735 respectively, is that the project is not so beneficial for the society in economic term. Comparing to the other sectors' EIRR criteria for the implementation such as the agricultural development project's 5%, the domestic water supply project's 7%, and the electric power development project's 9.5%, this 4.75% figure is still a little bit lower than the agriculture's

5% which is the lowest among them. Although the economic figures are not favorable for the project implementation, following points have to be born for the project evaluation and the decision making for the implementation.

Measurement of the project benefit in economic term has limitation; economic measurement of beneficial impacts by the main direct project effects including reliability and accuracy increase, and speed up in flood forecasting is not suitable for the monetary valuation. At the same time, the project benefit items such as

(h) increase in social safety feelings by reliable information, decision making, and proper public sector's action, and decision making for the implementation, and

(i) decrease in possibility of potential risk realization and increase in social safety feelings by reduced discharge water volume from the Seyhan Dam during the flood time

stated in 10.1.4 are virtually not measurable in monetary term.

Furthermore, the economic evaluation/analysis is only part of the project evaluation and/or the decision making factors of the project implementation. Even though the case in which the project is only the cost for the society in economic term, the implementation of the project is legitimately possible if the expenses for the project is reasonable for the society. Economic feasibility is one of the indicators for the society to decide whether the burden for realization of the desirable results is acceptable or not. Judgment of the EIRR figure is relative to the society's value system.

(4) Sensitivity Analysis

The sensitivity analysis is conducted in four cases; a) benefit is increased by 10% , b) benefit is decreased by 10%, c) investment cost is increased by 10% , and d) investment cost is decreased by 10%. The result is the following.

(Unit: USD)

	EIRR	NPV(Benefit)	NPV(Cost)
Case a)	6.33%	18,146,756	14,774,316
Case b)	3.08%	14,847,346	14,774,316
Case c)	3.55%	16,497,051	15,920,253
Case d)	6.16%	16,497,051	13,618,952
Original	4.75%	16,497,051	14,774,316

*NPV is discounted by 3% interest rate.

The result of shows that project's EIRR figures are sensitive to the fluctuation the benefit and the investment cost. 10% change in benefit affects the EIRR value by approximately 35% in points. 10% changes in the investment cost varies the EIRR results by 25 to 30%.

NPVs of the benefits discounted by 3% per annum interest rate constantly exceeds the NPVs of the respective costs.

10.3 Technological and Social Evaluation

The Seyhan River drains into the Mediterranean Sea through the city center of Adana and the meandering downstream area.

Although the river improvement works of this peculiar meandering downstream will be executed in the future, consistent river administration from the upstream area to the river mouth is indispensable for public welfare.

Under these conditions, Flood Control, Forecasting and Warning System not only contributed to the social environment, but also pays a significant role in this district.

10.3.1 Technological evaluation

In order to protect the living environment in a basin from successive floods, like that in 1980, radical countermeasures, such as levee and dam construction work, were vigorously developed.

The Çatalan Dam and the levee in the city center of Adana are near completion, therefore, powerful flood control facilities have been eventually implemented.

Under these conditions, the dependable flood forecasting system is technically evaluated as follows:

(1) Instead of the conventional system, telephone and telegram method, etc., the introduction of a new automatic telemeter system is expected to greatly improve flood forecasting.

(2) Precise information on flooding is indispensable for flood fighting action which is aimed at protecting security of all the basin's levees.

(3) For the purpose of synthesized operation of the Seyhan and Çatalan Dams close to the residential areas, a telemeter system is evidently much more effective.

(4) The valuable experience of DSİ in regard to the Seyhan River will help to secure the spread Seyhan River of the up-to-date river administration throughout the country.

The introduction of new technology concerning flood forecasting and the telemeter system is also significant from the viewpoint of friendly relations between both countries.

10.3.2 Social evaluation

(1) A lot of people surrounding the river are living together with the Seyhan River. Flood forecasting is a serious issue for them.

That is to say, the precise transmission of flood information among them is connected with the saving of lives and stabilization of public sentiment no doubt.

(2) More than 10,000 people who reside in HWC, depending on the circumstances, must evacuate due to the scale of flooding.

Accurate transmission is directly related to their evacuation and people's lives.

(3) Flood fighting information is used to assist the flood fighting action to ensure the public welfare of the whole basin.

As mentioned above, the Flood Forecasting and Warning System not only controls the floods by means of optimum operation, but also supports the flood fighting action of the whole basin, so makes a great contribution to stabilization of public welfare.

Further discussion to support the project's raison d'être is the amount of the investment made for the flood protection of the Lower Seyhan Reaches. As stated in Chapter 2, from the Seyhan Dam to the lower regulating structure, the Adana Municipality Government has been constructing the new concrete levees designed by the DSİ, which has 1,800 to 2,000 m^3/s capacity, immediate to the low water channel within a few years. Based on the above stated condition, the present HWC land area has been getting many buildings and facilities including a large shopping mall, a huge mosque, leisure and entertainment facilities, sports grounds, and a garden park. Some of them are already in service. Some are under construction and some are in a design stage.

Since it is the artificial protection measure, however, there is still possibility of an occurrence of the damages caused by human error in design, construction, or operations. Considering the amount of the huge capital investment being poured in and expected various prosperous activities in this area, implementation of every possible effort for preventing materialization of the potential risk to become a real disaster is indispensable. Lowering the discharge volume from the Seyhan Dam during flood times, which is enabled by optimal operations of the two dams with the new flood forecasting and warning system, is one of these essential efforts.

Furthermore, prior to the new levee construction, the Çatalan Dam construction had been started. One of the main purposes of this huge project, of which investment cost is 453 million US. dollar including hydropower facilities, is flood control. Flood control and protection of the Adana City and agricultural land in Çukurova have long time been a problem for the society to be solved. The Seyhan Dam and the levees in the lower reach are the efforts paid by the society.

Considering the above stated investments and social acceptance of them, the investment of the system may acceptable for the society to have its contribution to more accurate and faster flood forecasting aiming the reliable dam operation and the reliable information provision to the society.

10.4 Synthetic Evaluation

This project does not exert an important influence upon the natural environment of this district, rather it greatly contributes to preserving the social and natural environment by protecting the whole basin from flooding.

If this project is implemented, information related to flooding, such as the rainfall condition of the basin, water level of the river channel, forecasting value of flooding and other information will be presented in real-time to the general public.

Such function become the eye and the ear of the general public and attract public attention.

Therefore this project is appreciated not only as a result of the immediate economic effect, but because it greatly contributes to society.

The benefit of the project cannot be estimated in monetary terms but in terms of the saving of human life, stabilization of living conditions, and advancement of flood forecasting techniques.

11. RECOMMENDATION

11.1 Organization and Administration

11.1.1 Proposed organization and administration on flood control, forecasting and warning system for Seyhan River Basin

The existing legal, organizational and administrative functioning system detailed in the previous section seems to be compatible with the envisaged aims. The organization chart and administrative structure implemented by DSİ in flood control and fighting measures (see Figure 2.3.3) have a scope that can best serve the system to be proposed.

11.1.2 Staffing

The proposed staffing and the operating system appear to be safer and more economical provided that reliable warning systems are employed.

Organization and management flow chart for the flood control, forecasting and warning system to be designed for the Seyhan River Basin is dependent upon the model suggested at the end of the feasibility study.

After the identification of the model to be proposed, further technical and administrative staff may be needed. In our opinion this possibility must be considered.

The existing organization chart (Figure 2.3.2) which is used by General Directorate of DSİ and Regional Directorates for flood protection and fighting measures will be adequate if it is equipped by additional staff and equipment.

11.2 Hydrometeorological Observation

Both DSİ and EİE carry out the observation of flood in the main stream together with the major tributaries. The observed data are valuable for the establishment of the flood forecasting model with higher accuracy.

The storage function basin and river models and simple snowmelt runoff model are established for the Seyhan River basin through the past major flood records by the Study. And the estimated flood hydrographs show the sufficient goodness of fit to the observed ones from the forecasting viewpoints.

However, it is considered that more accurate and reliable models shall be developed and established against several types of flood before the forecasting system is installed where the updated models are to be loaded in the proposed computer system.

In view of the above, the following works and studies are to be carried out by both DSİ and EİE:

(1) Continuation of flood observation
(2) Continuation of periodical discharge measurement
(3) Updating of rating curves
(4) Continuation of snow depth and related observations

11.3 Maintenance Management System

11.3.1 Establishing maintenance and management system

To efficiently operate the flood forecasting and warning system in the Seyhan River basin and make this system develop its maximum performance, it becomes important to establish a maintenance and management system that matches to the particular configuration of the facility. Figure 11.3.1 shows an example of a maintenance personnel system that is recommended for the maintenance and management of flood forecasting and warning system. It is necessary that seeing Figure 11.3.1, the DSİ 6 th regional directorate should secure personnel, then educate/train them, and establish a maintenance and management system.

11.3.2 Training maintenance personnel

Prior to introducing the flood forecasting and warning system, it is important to secure necessary maintenance personnel and provide them with appropriate, prior education and training. It is not the rare case with conventional users, however, that the promotions, replacements, etc. of the initially educated and trained maintenance personnel cause the lack of sufficiently educated and trained maintenance personnel and thus result in an unsatisfactory situation. This is due to the fact that the education of new personnel or the transfer of technology has not been sufficiently executed. The measures listed below, therefore, should be undertaken.

- Establishing and executing periodic education/training programs
- Executing periodic education by special engineers such as those of the manufacturer of the system

- Establishing and executing the programs for periodic education in the factories of the manufacturer of the system
- Introducing simulation systems for education and training
- Other necessary measures

Since the execution of the measures listed above incurs expenses, the appropriate budges should be set on an annual schedule and on a perennial schedule.

11.3.3 Establishing maintenance and management procedures

Standards for failure recovery and periodic maintenance procedures, for emergency and normal contact routes, for report documentation, and for all other necessary items, should be clearly provided for and executed. The following lists standards that should be established as maintenance management procedures:

- Routine check and periodic check items, and standards for these checks
- Execution standards for failure or abnormal recovery actions
- Standards that specify control procedures concerning various reports and log lists, and their submission routes
- Standards that specify full details of repair request forms and routes
- Standards that specify storage, control, and replenishment procedures concerning spare and consumable parts
- Standards for the control of various maintenance documents and drawings
- Other necessary standards

11.3.4 Budgeting maintenance and operation expenses

It is particularly important that prior to the startup of the flood forecasting and warning system, budgeting and other necessary measures should be set up by estimating maintenance and operation expenses. The appropriate budgets should be set before continued smooth operation of the flood forecasting and warning system can be achieved.

12. TRANSFER OF TECHNICAL KNOWLEDGE

The transfer of technical knowledge is one of the objectives of the Study and has already been successfully carried out between the officials of DSİ and Study Team throughout the Study.

Each member of the Study Team tries to comprehend Turkish history and culture as well as the high technical level in the relevant fields and aims to promote daily amity and mutual understanding.

Through the daily technical exchange and on-the-job training, the way of thinking of Japan has been presented at all times.

In particular, the radio wave propagation test which involved actual site investigation in the mountainous area continued for two and a half months significantly.

Such experience greatly contributed to the promotion of knowledge, related to this telemeter project and it will be useful with the electric wave test in the future.

Mr. Adil Akyatan (VIth Regional Directorate of DSİ, Director of Planning Section), from July 11 to August 11, 1993 and Mr. Ayhan Teker (Investigation and Planning Department, Chief of Hydrometric Observation Section), from June 13 to July 3, 1994 attached the overseas training in Japan for approximately one month.

All the while the Ministry of Construction and relevant organizations carried out the transfer of technology concerning the flood forecasting and warning system, river administration, and so on.

By means of site investigation and the introduction of hardware and software, friendly technical exchange was carried out.

The considerable experience of the key experts is a significant factor in the transfer of technical knowledge.

In Turkey the technical foundation for the introduction of a new telemeter system has been established in stages.

Tables

Table 1.1.1 List of Members of JICA Advisory Committee

Designation	Name	Position and Agency
Chairman	Kohzo Hukunari	Senior Officer for Water Management, River Division, Kanto Reginal Construction Bureau, Ministry of Construction (Mar. 1993 - Jul. 1993)
Chairman	Wataru Watanabe	Minister's Secretariat, Ministry of Construction, Director for Policy Planning (Aug. 1993 - Sep. 1994)
Member (Flood Forecasting)	Hajime Kubota	Flood Forecasting Chief for River Works, River Department, Kyushu Regional Construction Bereau, Ministry of Construction
Member (Communication System)	Wataru Kobayashi	Senior Researcher, System Division, Construction Management Engineering Center, Public Works Research Institute, Ministry of Construction (Mar. 1993 - Jul. 1993)
Member (Communication System)	Hideto Goshu	Chief for Telecommunication Section, River Department, Tohoku Regional Construction Bereau, Ministry of Construction (Aug. 1993 - Sep. 1994)

Table 1.1.2 List of Turkish and Japanese Counterparts

Name	Position	Speciality
(1) Study Team		
Eiichi Yoshitake	Team Leader	Team Leader
Masayuki Shiraishi	Member	Deputy Team Leader/Chief Hydrologist
Toshihisa Nakatsukuma	Member	Hydrologist/Hydraulic Engineer
Tetsuo Funayama	Member	Telecommunication Expert
Shigeru Maruyama	Member	River Engineer
Takayasu Otake	Member	Economist
Seyfettin Aydın	Member	Management Expert
Toshiaki Kawagishi	Member	System Engineer
Hideyuki Tanaka	Member	Telecommunnication System Engineer
(2) General Directorate of State Hydraulic Works(DSİ)		
Investigation and Planning Department		
Hüseyin Yavuz	Director	
Dinçer Kulga	Deputy Head	Team Leader
Şen Sülün	Deputy Head	
Tuncay Soysal	Chief of Planning Section	Deputy Team Leader/Chief Hydrologist
Ayhan Teker	Chief of Hydrometric Observation Section	Management Expert
Zekiye Kulga	Meteorological Engineer	Hydrologist/Hydraulic Engineer
D. Ali Çelik	Agro-Economist	Economist
Mustafa Tanrıverdi	Civil Engineer	System Engineer
Operation and Maintenance Department		
Coşkun Temizbal	Electronical Engineer	Telecommunication Expert
Fikret Erdoğan	Meteorological Engineer/Hydrologist	River Engineer
(3) VIth Regional Directrate of DSİ		
Hasan Mert	Deputy General Director of VIth DSİ	Team Leader
Adil Akyatan	Director of Planning Section	Deputy Team Leader/Chief Hydrologist
Halil Altınok	Chief Engineer of Observation Section	Hydrologist/Hydraulic Engineer
Ali Dertsiz	Meteorological Engineer	Telecommunication Expert
Mustafa Bakşi	Civil Engineer	River Engineer
Cahit Süğücük	Agro-Economist	Economist
İlgün Toksuk	Civil Engineer	Management Expert
Tuna Alemdar	Irrigation Engineer	System Engineer
Aytekin Erdoğan	Electronical Engineer	Telecommunnication System Engineer
(4) General Directorate of Electrical Power Survey and Development Administration (EİE)		
Hayati Hançer	Meteorological Engineer/Hydrologist	Hydrologist/Hydraulic Engineer

Table 2.2.1 Yearly Peak Discharge

	Seyhan River Main Stem				Körkün River		Eğlence River		Çakıt River	
	Sta.No. 1806	Sta.No. 1805	At Confluence	Sta.No. 1818	Sta. No. 1820		Sta. No. 1821		Sta. No. 1817	
Date	(m3/s)	(m3/s)	(m3/s)	(m3/s)	Date	(m3/s)	Date	(m3/s)	Date	(m3/s)
17 Mar. '39	214.1	590.6	804.7	890.0						
3 Apr. '40	382.0	567.4	949.4	1,050.0						
29 Jan. '41	203.2	578.2	781.4	870.0						
2 Apr. '42	271.8	464.8	736.6	820.0						
5 Apr. '43	319.0	569.6	888.6	990.0						
8 Mar. '44	335.8	678.4	1,014.2	1,130.0						
7 Apr. '45	182.0	198.8	380.8	410.0						
15 Feb. '46	192.2	550.9	743.1	830.0						
14 Mar. '47	140.6	443.2	583.8	650.0						
27 Nov. '48	340.0	826.4	1,166.4	1,300.0						
19 Apr. '49	276.0	440.5	716.5	800.0						
6 Mar. '50	289.0	385.0	674.0	760.0						
21 Jan. '51	190.0	543.0	733.0	819.0						
13 Dec. '52	327.4	670.0	997.4	1,120.0						
4 Apr. '53	329.5	543.0	872.5	970.0						
20 Jan. '54	276.0	719.0	995.0	1,120.0						
31 Jul. '55	224.6	801.0	1,025.6	1,140.0						
4 Feb. '56	167.9	410.8	578.7	645.0						
3 Mar. '57	490.0	926.0	1,416.0	1,600.0						
9 Jan. '58	750.0	1,187.4	1,937.4	2,200.0						
15 Apr. '59	235.0	464.8	699.8	780.0						
26 Apr. '60	245.0	503.4	748.4	840.0						
6 Feb. '61	103.0	158.0	261.0	285.0						
17 Dec. '62	202.0	675.0	877.0	980.0						
19 Dec. '63	970.0	1,440.0	2,410.0	2,700.0						
25 Mar. '64	151.0	198.0	349.0	385.0					25 Mar. '64	41.6
18 Apr. '65	253.0	485.0	738.0	820.0					'65	-
5 Jan. '66	363.0	1,150.0	1,513.0	1,700.0			23 Jan. '66	68.5	29 Jan. '66	74.7
16 Dec. '67	279.0	570.0	849.0	1,046.0			20 Dec. '67	52.6	3 May '67	119.0
14 Mar. '68	249.0	870.0	1,119.0	1,224.0			3 Nov. '68	139.0	6 Jun. '68	96.4
28 Dec. '69	313.0	676.0	989.0	1,331.0			27 Nov. '69	153.0	'69	-
18 Dec. '70	277.0	870.0	1,147.0	1,258.0	24 Feb. '70	40.3	'70	-	'70	-
17 Apr. '71	180.0	330.0	510.0	705.0	8 Aug. '71	138.0	2 Nov. '71	190.0	27 Nov. '71	88.0
30 Apr. '72	330.0	461.0	791.0	672.0	30 Apr. '72	273.0	30 Apr. '72	195.0	30 Apr. '72	143.0
26 Feb. '73	154.0	253.0	407.0	405.0	12 Jul. '73	94.0	27 Feb. '73	233.0	12 Jul. '73	33.0
15 Mar. '74	283.0	386.0	669.0	934.0	15 Mar. '74	135.0	14 Mar. '74	144.0	26 Sep. '74	146.0
29 Apr. '75	789.0	1,043.0	1,832.0	1,957.0	18 Apr. '75	210.0	9 Jan. '75	320.0	18 Apr. '75	195.0
12 Apr. '76	190.0	510.0	700.0	759.0	24 Jun. '76	55.8	16 Apr. '76	106.0	25 May '76	66.0
23 Apr. '77	372.0	608.0	980.0	1,208.0	23 Apr. '77	356.0	23 Apr. '77	228.0	23 Apr. '77	124.0
1 Jan. '78	201.0	450.0	651.0	988.0						
3 Jan. '79	519.0	1,963.0	2,482.0	3,348.0						
28 Mar. '80	576.0	2,000.0	2,576.0	3,800.0						
Max.	970.0	2,000.0	2,576.0	3,800.0		356.0		320.0		195.0
Avg.	312.7	670.4	983.2	1,148.5		162.8		152.4		80.5
Min.	103.0	158.0	261.0	285.0		40.3		0.0		0.0
Catchment Area (km2)	8,698	4,242		13,846		1,441		690		1,910

Table 2.2.2 Historical Flood Damage

No.	Date	Rainfall Location(mm)	Max. Discharge Sta.No.	Max. Discharge (m3/s)	Seyhan Dam Outflow	Damages Area(ha)	Damages Villages	Damages Dead	No.	Description
1	5 Dec. '37			2,550		45,000	15 nos.	0	1	
2	10 May '46						15 nos.	0	2	
3	9 Nov. '47	Dörtyol(60.7) Feke(56.1)	1805	504		5,000		11	3	Adana city and Seyhan plain were inundated. Houses of 277 nos. were damaged, 234 animals were lost.
4	27 Nov. '47	Ceyhan(66.2) Feke(54.0)	1805	825		(Some villages)		0	4	
5	5-6 Dec. '47	Feke(54.0) Adana(52.8)						0	5	Adana city was inundated.
6	6-22 Feb. '48	Tarsus(74.6) Adana (65.5)	1805	478		70,000	115 nos.	26	6	Maximum discharge was 2,100 m3/s. Adana city and Seyhan plain were inundated. 170 houses were damaged.
7	12-17 May '50	Adana(41.7)	1805	280				1	7	Adana city and Seyhan plain were inundated.
8	10-11 Feb. '52	Feke(87.5) Kozan(84.5)	1805	635		(Çukurova plain)		0	8	
9	17-18 Mar. '52	Feke(40.0)	1805	592		(Tarsus plain)		0	9	
10	3 Apr. '52		1805	559				0	10	
11	3-4 Apr. '53	Mersin(66.6) Feke(33.4)	1805	530				0	11	
12	14 Jun. '57					(Ulukışla city)		0	12	
13	28 Jun. '57					84 ha at Çakıt river		0	13	
14	26-29 Jun. '57					85 ha at Yenice river		0	14	
15	2 Jul. '57					83 ha at Yenice river		0	15	
16	2 Dec. '58	Adana(102.5)	18-004	3,600	563			0	16	Seyhan dam was completed in 1956. The flood was controlled by the dam. Farm land between levees was flooded.
17	8-17 Dec. '61	Karaisalı(67.2) Adana(65.7)	18-001	1,400	831	960 ha at Çukurova		0	17	
18	25 Dec.-2 Jan.'69	Karaisalı(154) Adana(110)	1818	1,331	1,186			0	18	Reservoir water level was at 68.81 m. Total damage was of 41 million TL.
19	9 Jun. '72	Pozantı(40.5)	Besaplanan	74		(Çakıt river)		0	19	
20	29 May '73	Orman(98.5)				114		4	20	
21	17 Apr.-9 May '75	Adana(110.7 in total)	Dam	1,992	1,188	4,700 ha at Çukurova		0	21	Reservoir water level was at 69.07 m. Total damage was of 51 million TL.
22	3 Jan. '79								22	Reservoir water level was so low that the flood was controlled by the dam.
23	27 Mar.-7 Apr.'80	Pozantı(148.7)	Dam	6,040	2,671	47,000 ha at Çukurova		1	23	Adana city has little damages. Flood water was over-topped the levee. The worst damage was recorded.
24	21-25 Dec. '87	Karaisalı(231)	Dam	1,884	1,179	(None)		0	24	

Table 2.2.3 Highway Road Flood Damage

(unit : billion T.L)

Flood Year	Road Line	Bridge		Road		Total
		Name	T.L	L(km)	T.L	
1980	Tarsus-Pozantı	Çakıt 15	2.4	4.0	16.0	18.4
1980	Tarsus-Pozantı	Taşobası	1.0	-	-	1.0
1991	Tarsus-Pozantı	Tarihi	2.8	3.0	12.0	14.8
1980	İmamoğlu-Karsantı	Eğner	4.4	1.0	2.5	6.9
1980	Karaisalı -Aladağ	Eğlence	1.3	0.5	1.5	2.8
1980	Kozan-Feke	Göksu	3.2	1.0	2.5	5.7
1980	Kozan-Feke	Feke	1.3	-	-	1.3
1980	Feke-Mansurlu	Mansurlu	1.2	2.0	5.0	6.2
1980	Feke-Saimbeyli	Işıklı	0.6	0.5	1.5	2.1
1980	Kozan-Mansurlu	Gökdere	1.2	2.0	5.0	6.2
		Total	19.4	14.0	46.0	65.4

Table 2.2.4 Railway Flood Damage

Flood Year	Km Location	Description
<Km 271+500 - Pozanti>		
1980	271+600/800	Embankment was washed away.
1991	271+700/800	Embankment was washed away.
1980	271+900/272+300	Retaining wall was fallen down.
1980	272+300	Retaining wall was damaged.
1991	272+800/273+350	Inundated.
	273+300/350	Embankment was washed away.
1980	273+500/700	Embankment and retaining wall was damaged.
1980,1991	273+900/274+700	Retaining wall was fallen down.
1980,1991	274+700/275+200	Inundated.
1988	275+744	Train slided out.
1980	276+300/400	Embankment was damaged.
<Pozanti - Belemedik>		
1980,1991	283+500/600	Embankment was damaged. Retaining wall was fallen down.
1980	283+600/700	Embankment was damaged.
1980,1991	284+550/600	Embankment was damaged. Retaining wall was fallen down.
1980,1991	284+900/285+200	Embankment was damaged. Retaining wall was fallen down.
1991	285+210/250	Retaining wall was fallen down.
1980	285+250/400	Retaining wall was damaged.
1991	285+400/450	Retaining wall was fallen down.
1991	285+450/500	Embankment was damaged.
1980	285+600/750	Embankment was damaged.
1980	286+100/400	Embankment was damaged.
1980	287+300/600	Embankment was damaged.
1991	287+700/750	Embankment was damaged.
1980,1991	288+000/400	Embankment was damaged. Retaining wall was fallen down.
1991	288+400/600	Embankment was damaged.
1980	289+000/050	Embankment was damaged.
1980	289+200/250	Embankment was damaged.
1980,1991	289+800/290+500	Railway was washed away. Retaining wall was fallen down.
<Belemedik - Hacıkırı>		
	291+200/800	Scouring.
1983	291+926	Conduit was collapsed.
1980	292+000/100	Embankment was damaged.
1981	292+500/700	Embankment was slided.

Table 2.2.5 Major Characteristics of Seyhan Dam and Çatalan Dam

Item	Seyhan Dam	Çatalan Dam
Purpose *1	F.C + H.P + Irr.	F.C + H.P + C.W.
(Note *1 F.C=Flood control, H.P=Hydro power, Irr.=Irrigation, C.W=City water)		
Completion year	1956	1995 (Schedule)
Dam type	Earth fill dam	Earth fill dam
Dam slope	Upstream 1:2.5	Upstream 1:4.0
	Downstream 1:2.0	Downstream 1:3.0
Dam volume (m^3)	7,500,000	14,000,000
Height (m)	77.0	82.0
Crest length (m)	1,955.0	894.0
Reservoir Volume (x 10^6 m^3)		
Dead volume	159	1,422
Active volume	720	704
(Flood control volume)	(366)	(526)
Total	879	2,126
Reservoir surface area (km^2)	68.69	84.50
Elevation (m)		
Minimum operation level	49.0	115.0
Spillway crest	61.0	110.0
Flood season high water level	61.0	118.0
Normal high water level	67.5	125.0
Dam crest	72.7	130.0
Water use (m3/s)		
Irrigation	32	-
City water	-	16.7
Power Plant		
Design discharge	231	360
Unit numbers	3	3
Installed capacity (MW)	3x18=54	3x56.3=168.9
Annual energy generation (GWh)	350	596

Table 2.2.6 Seyhan Dam Reservoir Surface Area and Volume

1. Reservoir Water Surface Area (x mil. m2)

Elv. (m)	1956	1966		1971		1976		1980		1986	
	Area	Area	Decrs.	Area	Decrs.	Area	Decrs.	Area	Decrs.	Area	Decrs.
75.0	100.00										
72.5	91.30										
70.0	83.00	78.20	4.80	77.20	5.80	75.80	7.20	79.44	3.56	78.16	4.84
67.5	75.00	73.10	1.90	69.20	5.80	68.20	6.80	68.98	6.02	68.69	6.31
65.0		66.70		61.60		60.90		58.52		58.31	
62.5	61.70	60.50	1.20	53.10	8.60	53.30	8.40	51.20	10.50	50.39	11.31
60.0		48.10		45.60		45.60		43.88		43.38	
57.5	48.90	42.30	6.60	40.70	8.20	38.40	10.50	36.22	12.68	35.17	13.73
55.0		37.80				31.40		28.56		26.99	
52.5	37.00	33.60	3.40	29.50	7.50	26.90	10.10	25.32	11.68	22.56	14.44
50.0		30.10		24.40		22.70		22.67		18.16	
47.5	27.50	25.60	1.90	21.10	6.40	20.30	7.20	19.21	8.29	16.10	11.40
45.0		21.00		18.40		18.00		16.55		14.16	
42.5	19.70	17.80	1.90	15.60	4.10	14.80	4.90	12.77	6.93	11.50	8.20
40.0		16.00		12.60		11.40		8.99		9.15	
37.5	12.00	12.00	0.00	9.10	2.90					6.54	5.46
35.0				6.10						3.54	
32.5	4.00	4.00	0.00	3.20						0.66	3.34
30.0	0.00	0.00	0.00	0.00		0.00		0.00		0.00	0.00

2. Reservoir Storage Volume (x mil. m3)

Elv. (m)	1956	1966		1971		1976		1980		1986	
	Volume	Volume	Decrs.	Volume	Decrs.	Volume	Decrs.	Volume	Decrs.	Volume	Decrs.
75.0											
72.5											
70.0	1,415.0	1,333.0	82.0	1,209.0	206.0	1,100.0	315.0	1,069.0	346.0	1,063.6	351.4
67.5	1,217.0	1,145.0	72.0	1,028.0	189.0	920.0	297.0	883.5	333.5	878.9	338.1
65.0		968.0		866.0		762.0		724.1		720.1	
62.5	886.0	809.0	77.0	720.0	166.0	620.0	266.0	586.9	299.1	583.7	302.3
60.0	742.0	677.0	65.0	595.0	147.0	495.0	247.0	468.1	273.9	465.9	276.1
57.5	620.0	565.0	55.0	486.0	134.0	392.0	228.0	367.9	252.1	367.1	252.9
55.0	500.0	464.0	36.0	395.0	105.0	304.0	196.0	287.0	213.0	290.0	210.0
52.5	400.0	378.0	22.0	312.0	88.0	235.0	165.0	219.6	180.4	228.1	171.9
50.0	303.0	298.0	5.0	247.0	56.0	175.0	128.0	160.4	142.6	177.2	125.8
47.5	225.0	225.0	0.0	190.0	35.0	119.0	106.0	108.7	116.3	134.9	90.1
45.0	158.0	171.0	-13.0	138.0	20.0	71.0	87.0	63.8	94.2	96.7	61.3
42.5	94.0	122.0	-28.0	94.0	0.0	29.0	65.0	27.2	66.8	64.6	29.4
40.0	72.0	78.0	-6.0	61.0	11.0	0.0	72.0	0.0	72.0	38.6	33.4
37.5				36.0						19.0	
35.0	16.0	20.0		17.0						5.9	
32.5										1.5	
30.0	0.0	0.0		0.0						0.0	

Note;
"Decrs" stands for decreased value of area or volume in comparison with the original reservoir in 1956.

Table 2.2.7 Low Water Channel Water Profile

Sec. Name	Km Distance	Single Distance	Accum. Distance	Lowest Elev.	Shoulder Elev.			Channel Width	Water Surface Profile (m3/s)				Shoulder - W.Surface
					Left	Right	Min.		200	300	400	500	
Sec-26A	85 + 980	0	0	-2.82	1.90	2.23	1.90	92	0.75	1.92	2.11	2.25	-0.35
Sec-25A	85 + 120	860	860	-2.77	1.91	2.31	1.91	90	0.93	2.04	2.25	2.38	-0.47
Sec-24A	82 + 400	2,720	3,580	-2.66	2.58	3.06	2.58	100	1.49	2.43	2.63	2.65	-0.07
Sec-23A	80 + 910	1,490	5,070	-1.76	3.01	2.98	2.98	89	1.81	2.69	2.79	2.88	0.10
Sec-22A	79 + 970	940	6,010	-2.10	3.03	2.72	2.72	98	1.97	2.84	3.03	3.23	-0.51
Sec-21A	77 + 350	2,620	8,630	-1.30	3.29	3.76	3.29	87	2.35	3.08	3.29	3.44	-0.15
Sec-20A	74 + 700	2,650	11,280	-0.54	4.03	3.80	3.80	98	2.81	3.56	3.80	3.80	0.00
Sec-19A	73 + 575	1,125	12,405	-1.80	3.46	3.89	3.46	83	2.99	3.74	3.84	4.17	-0.71
Sec-16A	71 + 324	2,251	14,656	0.41	4.23	4.12	4.12	121	3.37	3.96	4.12	4.24	-0.12
Sec-14A	69 + 680	1,644	16,300	-1.10	4.36	4.35	4.35	68	3.58	4.21	4.30	4.36	-0.01
Sec-12A	67 + 900	1,780	18,080	0.63	4.82	4.38	4.38	105	3.90	4.53	4.80	4.55	-0.17
Sec-10A	66 + 340	1,560	19,640	1.05	4.88	5.06	4.88	119	4.12	4.64	4.93	4.82	0.06
Sec-9A	64 + 900	1,440	21,080	0.19	5.21	5.40	5.21	105	4.30	4.86	5.20	5.28	-0.07
Sec-8A	63 + 450	1,450	22,530	-0.85	6.48	5.65	5.65	172	4.50	5.10	5.51	5.71	-0.06
Sec-6A	62 + 200	1,250	23,780	1.74	6.32	6.32	6.32	88	4.68	5.30	5.73	5.91	0.41
Sec-5A	60 + 195	2,005	25,785	1.70	6.78	6.96	6.78	119	5.02	5.68	6.18	6.50	0.28
Sec-4A	58 + 600	1,595	27,380	-0.85	7.00	6.88	6.88	113	5.20	5.88	6.40	6.76	0.12
Sec-2A	57 + 180	1,420	28,800	1.49	7.50	7.33	7.33	148	5.42	6.10	6.63	7.02	0.31
Sec-1	55 + 650	1,530	30,330	2.97	7.95	7.87	7.87	203	5.79	6.41	6.93	7.32	0.55
Sec-4	53 + 550	2,100	32,430	3.41	8.08	8.16	8.08	130	6.10	6.68	7.17	7.56	0.52
Sec-6	52 + 450	1,100	33,530	3.28	8.03	8.37	8.03	95	6.26	6.83	7.30	7.68	0.35
Sec-7	51 + 225	1,225	34,755	4.26	9.05	9.03	9.03	152	6.66	7.23	7.72	8.12	0.91
Sec-16	43 + 110	8,115	42,870	5.71	10.47	10.34	10.34	125	9.08	9.56	10.00	10.34	0.00
Sec-16A	42 + 20	1,090	43,960	5.97	10.61	10.65	10.61	114	9.32	9.84	10.30	10.67	-0.06
Sec-17	40 + 510	1,510	45,470	6.16	11.39	11.18	11.18	157	9.55	10.11	10.60	10.99	0.19
Sec-17A	39 + 320	1,190	46,660	6.59	11.61	11.63	11.61	100	9.76	10.33	10.82	11.22	0.39
Sec-18	37 + 950	1,370	48,030	7.60	11.74	11.80	11.74	128	10.11	10.69	11.19	11.61	0.13
Sec-19	34 + 380	3,570	51,600	6.39	13.27	12.82	12.82	113	10.95	11.52	12.01	12.45	0.37
Sec-19A	33 + 400	980	52,580	8.52	13.90	14.00	13.90	108	11.35	11.87	12.33	12.75	1.15
Sec-20	29 + 100	4,300	56,880	8.10	14.31	14.00	14.00	81	13.83	14.15	14.46	14.77	-0.77
Sec-21	27 + 150	1,950	58,830	8.14	14.64	15.28	14.64	97	13.92	14.22	14.55	14.79	-0.15
Sec-21A	26 + 110	1,040	59,870	8.84	15.21	15.10	15.10	101	13.98	14.33	14.69	14.80	0.30
Sec-42	24 + 200	1,910	61,780	10.10	16.31	15.40	15.40	153	14.07	14.48	14.89	15.08	0.32
Sec-41	22 + 800	1,400	63,180	8.43	15.65	15.73	15.65	93	14.17	14.63	15.07	15.32	0.33
Sec-39	20 + 650	2,150	65,330	11.09	16.56	17.16	16.56	144	14.52	15.07	15.57	15.93	0.63
Sec-38	18 + 750	1,900	67,230	10.85	17.91	17.24	17.24	124	14.96	15.56	16.07	16.47	0.77
Sec-35	17 + 710	1,040	68,270	12.70	18.06	18.53	18.06	174	15.30	15.90	16.42	16.83	1.23
Sec-27	14 + 700	3,010	71,280	13.29	18.92	18.60	18.60	238	16.32	16.92	17.40	17.82	0.78
Min.								68					-0.77
Max.								238					1.23
Avg.								119					

Table 2.2.8 High Water Channel Water Profile

Sec. Name	Km Distance	Single Distance	Accum. Distance	Levee Elevation	Channel Width	Water Profile 1,200	Water Profile 1,600	Water Profile 2,000	Free Board 1,200	Free Board 2,000
Sec-26A	51 + 90	0	0	3.73	1,952	2.65	2.96	3.27	1.08	0.46
Sec-25A	50 + 750	340	340	3.80	2,160	2.78	3.07	3.36	1.02	0.44
Sec-24A	50 + 120	630	970	3.91	2,210	2.95	3.22	3.50	0.96	0.41
Sec-23A	49 + 410	710	1,680	4.12	2,069	3.20	3.45	3.70	0.92	0.42
Sec-22A	48 + 600	810	2,490	4.33	2,258	3.46	3.71	3.94	0.87	0.39
Sec-21A	47 + 850	750	3,240	4.54	2,260	3.71	3.94	4.16	0.83	0.38
Sec-20A	47 + 125	725	3,965	4.66	2,098	3.92	4.15	4.36	0.74	0.30
Sec-19A	46 + 670	455	4,420	4.73	1,548	3.97	4.20	4.42	0.76	0.31
Sec-16A	44 + 275	2,395	6,815	5.12	1,411	4.44	4.75	5.02	0.68	0.10
Sec-14A	43 + 30	1,245	8,060	5.41	1,488	4.74	5.06	5.34	0.67	0.07
Sec-12A	41 + 925	1,105	9,165	5.87	1,545	5.03	5.35	5.63	0.84	0.24
Sec-10A	40 + 710	1,215	10,380	6.11	2,119	5.31	5.62	5.90	0.80	0.21
Sec-9A	40 + 300	410	10,790	6.59	2,255	5.51	5.79	6.04	1.08	0.55
Sec-8A	39 + 560	740	11,530	6.61	2,092	6.02	6.24	6.43	0.59	0.18
Sec-6A	38 + 190	1,370	12,900	7.51	2,188	6.34	6.61	6.84	1.17	0.67
Sec-5A	37 + 180	1,010	13,910	8.17	1,880	6.86	7.09	7.29	1.31	0.88
Sec-4A	36 + 700	480	14,390	8.51	1,768	7.26	7.47	7.66	1.25	0.85
Sec-2A	35 + 750	950	15,340	8.73	1,350	7.71	7.95	8.15	1.02	0.58
Sec-1	34 + 260	1,490	16,830	8.99	1,673	7.92	8.21	8.46	1.07	0.53
Sec-4	32 + 600	1,660	18,490	9.10	1,950	8.07	8.39	8.66	1.03	0.44
Sec-6	31 + 525	1,075	19,565	9.59	1,097	8.56	8.86	9.11	1.03	0.48
Sec-7	30 + 180	1,345	20,910	10.47	1,138	9.40	9.69	9.94	1.07	0.53
Sec-16	24 + 400	5,780	26,690	12.03	1,355	11.26	11.59	11.88	0.77	0.15
Sec-16A	23 + 550	850	27,540	12.65	1,360	11.68	11.98	12.25	0.97	0.40
Sec-17	22 + 810	740	28,280	12.98	1,626	11.99	12.28	12.54	0.99	0.44
Sec-17A	22 + 95	715	28,995	13.20	1,759	12.20	12.49	12.74	1.00	0.46
Sec-18	21 + 255	840	29,835	13.54	2,426	12.52	12.78	13.02	1.02	0.52
Sec-19	20 + 425	830	30,665	13.92	2,141	12.86	13.10	13.32	1.06	0.60
Sec-19A	19 + 550	875	31,540	14.57	2,289	13.52	13.72	13.90	1.05	0.67
Sec-20	18 + 810	740	32,280	15.01	1,735	14.08	14.28	14.45	0.93	0.56
Sec-21	17 + 915	895	33,175	15.24	1,731	14.33	14.58	14.79	0.91	0.45
Sec-21A	17 + 190	725	33,900	15.89	1,634	14.63	14.88	15.10	1.26	0.79
Sec-42	16 + 360	830	34,730	16.16	2,270	15.12	15.36	15.58	1.04	0.58
Sec-41	15 + 680	680	35,410	16.58	2,018	15.62	15.82	16.00	0.96	0.58
Sec-39	15 + 0	680	36,090	17.37	1,990	16.33	16.52	16.69	1.04	0.68
Sec-38	14 + 90	910	37,000	18.37	1,405	17.13	17.38	17.58	1.24	0.79
Sec-35	13 + 580	510	37,510	18.63	1,498	17.46	17.72	17.93	1.17	0.70
Sec-27	12 + 380	1,200	38,710	19.36	2,224	18.30	18.56	18.77	1.06	0.59
Min.					1,097				0.59	0.07
Max.					2,426				1.31	0.88
Avg.					1,841				0.98	0.48

Table 2.3.1 List of Weather Information, Hydrometeorological Data and Dam Data Collection

Kind of Data	Contents of Data	Media of Data	Intervals of Observation	Intervals of Transmission	Means of Transmission	Origin of Transmission	Remarks
Upper part of weather	- Wind direction - Temperature	Picture	------	02:00, 14:00 GMT	FAX	Frankfurt	From DMİ Ankara to DMİ Adana
Ground Weather Map	- Weather map	Picture	00:00, 06:00, 12:00 18:00 GMT	—	FAX	Adana (İncirlik)	To DMİ Adana
Surface Weather (Type 1)	- Wind direction - Wind speed - Max. and min. temperature - Temperature - Rainfall - Cloudiness	- Letter - Numerical number	07:00, 14:00, 21:00 In flood, every one hour for rainfall	Once a day (After 07:00) Every one hour	Urgent telegram Telephone	Small climatological station	Hourly rainfall to DSİ Adana
Surface Weather (Type 2)	In addition to data of type 1, - Evaporation (some) - Pressure (some) - Soil temperature (some) - Cloud type and heights	- Letter - Numerical number	07:00, 14:00, 21:00 In flood, every one hour	Once a day (After 07:00) Every one hour	Urgent telegram Telephone	Great climatological station	Hourly rainfall to DSİ Adana
Surface Weather (Type 3)	- Wind direction - Wind speed - Air pressure - Temperature - Rainfall - Type of clouds and height of clouds - Horizontal sightseeing distance - Meteorological events	- Letter - Numerical number	Every one hour except rainfall and events Twice a day for rainfall In flood, every one hour for rainfall	Every one hour	TELEX (PTT line and UHF radio)	Synoptic station - Anamur - Silifke - Mersin - İskenderum - Adana(Sakirpaşa) - Adana (İncirlik)	These data are transmitted DMİ Ankara by PTT line TELEX and HF radio as backup
Rainfall data of DSİ	- Rainfall	- Numerical number	Once a day In flood, every 1H	Daily rainfall Hourly rainfall	Monthly mail Telephone	DSİ gauging points	
Water level data of DSİ	- Water level	- Numerical number	Once a day. In flood, every 1H, 30M, 15M	Water level	Monthly mail	DSİ gauging points	Due to small rivers
Water level data of EİE	- Water level	- Numerical number	08:00, 16:00 In flood, every 2H/1H	Water level (Discharge is concerted in office)	Monthly mail Telephone (In flood)	EİE gauging points	Informed to DSİ
Snow depth of DSİ	- Snow depth	- Numerical number	Every 15 days (December - March)	Snow depth	Taken back	DSİ gauging points	
Snow depth of EİE	- Snow depth	-Numerical number	Once a month January - May)	Snow depth	Taken back	EİE gauging points	
Reservoir level of Seyhan dam	- Reservoir level	- Numerical number	08:00, 21:00 In flood, every 1H/30M	Reservoir level	VHF radio (in voice)	DSİ dam	

Table 2.3.2 List of Kind of Data and Information Transmitted in Present Conditions

Kind of Information		Intervals of Transmission	Transmission Media	Content of Information
	Rainfall	Every 1 H	Numerical (Telephone)	Hourly rainfall by gauge read
Hydrometeorological information	Water level	Every 2/1 H	Numerical (Telephone)	Present water level by gauge read
	Discharge	Every 2H/1H	Numerical (Telephone)	Present discharge by conversion table
Flood protection information		At any time	Voice (VHF)	Necessary information of flood protection action
Flood protective facility information		At any time	Numerical/voice (Telephone/VHF)	Information of flood discharge
		At any time	Letter/voice (FAX/Teleohone)	Villages to be evacuated
Evacuation information			Voice (Çukurova radio broadcasting station)	People downstream to be evacuated

Table 3.3.1 The Results of Field Survey for Multiplex Radio Link

	Span	Summary of Test Result	Remarks
1.	DSİ Adana - Ziyaret T.	1) Line-of-sight was confirmed at each station by mirror test. 2) Antenna height at DSİ Adana should be high enough to clear trees in the site of DSİ Adana.	
2.	Çatalan dam - Ziyaret T.	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed within the path.	
3.	Çatalan dam - Karlık T.	1) Line-of-sight was confirmed at each station by mirror test. 2) The height of antenna tower should be determined by considering a hill which is existed in the front of Çatalan dam.	
4.	Karlık T. - Nernek T.	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed within the path.	
5.	Nernek T. - Feke Dağı	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed within the path.	
6.	Seyhan dam - Ziyaret T.	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed between the path. 3) Since the path is over the water with unblocked reflective paths, the design should take ground-reflected multipath fading into consideration.	

Table 3.3.2 Problems and Countermeasures for Simplex Radio Link (1/2)

(1) Telemetry Radio Link

Span	Problems	Countermeasures
Karsantı - Karlık T.	The radio link quality is not sufficient because a steep slope of mountain blocks the radio path in the front of Karsantı. The terrain profile and result of calculated data suggest that it is less possibility to establish a radio link between the sites even if Karsantı's antenna is located at a height of 20m or more.	Karsantı should be moved to an alternative location where the radio link is possible to establish. Hasandede, as an alternative point, is selected and tested. The result of test, the radio link can be connected to Karlık T..
Çamardı - Bileğe T.	The radio link quality is not sufficient because the path is obstructed by a mountain.	Since the ridge of mountain in the path is high (about EL 2.170m), Çamardı (EL 1,490m) should be moved to a higher place within an allowable area in view of hydrometeorological technique. Çamardı (EL 1,670m), as an alternative point is selected and studied. The result of theoretical calculation suggests that the radio link can be connected to Bileğe T. It is advisable to do a further study including a radio wave propagation test in the future.
Mansurlu - Feke Dağı	The radio link quality is not sufficient because the path is obstructed by some mountains.	It is necessary to place a repeater station between the sites, or move to an alternative location where the radio link is possible to establish. Since the gauging station which is situated at the bottom of a mountain in mountain chains, it is difficult to find an alternative location in the vicinity of site. A location of repeater station, Karataş T., is selected for the study.
Saimbeyli - Feke Dağı	The radio link quality is not sufficient because the path is obstructed by some mountains.	It is necessary to place a repeater station between the sites, or move to an alternative location where the radio link is possible to establish. Since the gauging station which is situated at the bottom of a mountain in mountain chains, it is difficult to find an alternative location in the vicinity of site. A location of repeater station, Süt T., is selected for the study.

Table 3.3.3 Problems and Countermeasures for Simplex Radio Link (2/2)

(2) UHF Radio Link

Span	Problems	Countermeasures
DSİ Adana - Taşcı	Radio paths extending toward the down stream of Seyhan river from the DSİ 6th regional directorate is completely blocked by tall buildings(10 to 12 story). This results in the radio link quality insufficient.	The antenna of UHF radio system in the DSİ 6th regional directorate should be high enough so that the obstructions of these buildings are cleared.

Table 3.3.4 The Results of Radio Wave Propagation Test for Simplex Radio Link (1/3)

(1) Telemetry Radio Link

No.	Span	Receiving Voltage Calculated Value (dBμv)	Receiving Voltage Measured Value (dBμv)	Result of Evaluation
1.	Karlık T. - 1806 WL	38.6	35.0	Possible
2.	Karlık T. - 1805 WL	38.7	37.0	Possible
3.	Karlık T. - 1818 (Eğner)	46.7	63.0	Possible
4.	Karlık T. - Karsantı	14.7	-	The radio link cannot be established because of obstruction. Karsantı should be moved to an alternative location (Hasandede).
5.	Karlık T. - Hasandede (Alternative point)	32.4	25.5	The radio link can be connected to Karlık T. repeater station.
6.	Feke Dağı - 1801 WL	31.7	47.0	Possible
7.	Feke Dağı - Saimbeyli	25.2	22.0	The radio link cannot be connected directly to Feke Dağı repeater station. Therefore, it is necessary to place a repeater station to extend communication range. Süt Tepe was selected as a repeater station.
8.	Feke Dağı - Mansurlu	-14.0	13.0	The radio link cannot be connected directly to Feke Dağı repeater station. Therefore, it is necessary to place a repeater station to extend communication range. Karataş T. was selected as a repeater station.
9.	Feke Dağı - Karataş T.	45.9	-	The result of theoretical calculation suggests that the radio link is possible.
10.	Feke Dağı - Feke	25.4	-	-
11.	Karataş - Mansurlu	51.3	-	-
12.	Süt Tepe - Saimbeyli	29.6	-	-
13.	Süt Tepe - Tufanbeyli	31.2	-	-
14.	Sallangaç T. - Çatalan dam	56.5	70.0	Possible
15.	Sallangaç T. - 1820 WL	45.9	50.0	Possible
16.	Sallangaç T. - 1825 WL	26.3	39.0	Possible
17.	Sallangaç T. - 1817 WL	36.4	48.0	Possible
18.	Sallangaç T. - 1828 WL	37.0	-	-

Table 3.3.5 The Results of Radio Wave Propagation Test for Simplex Radio Link (2/3)

(1) Telemetry Radio Link

No.	Span	Receiving Voltage Calculated Value (dBμv)	Receiving Voltage Measured Value (dBμv)	Result of Evaluation
19.	Sallangaç T. - Karaisalı	56.2	57.0	Possible
20.	Bileğe T. - Çiftehan	36.5	52.0	Possible
21.	Bileğe T. - Kamışlı	16.9	38.0	Possible
22.	Bileğe T. - Çamardı	12.9	18.0	The radio link cannot be established because of obstruction. Çamardı should be moved to an alternative location.
23.	Bileğe T. - Çamardı (Alternative point)	29.7	-	The result of theoretical calculation suggests that the radio link is possible.
24.	Bileğe T. - Çatalan dam	31.7	-	-
25.	Bileğe T. - Pozantı	41.5	-	-
26.	Kılkoyak T. - Sarız	44.7	-	-
27.	Kılkoyak T. - Sırvan Dağı	51.0	-	-
28.	Kılkoyak - Süt T	48.9	-	-
29.	Sırvan Dağı - Pınarbaşı	62.0	-	-
30.	Sırvan Dağı - Toklar	48.3	-	-
31.	Sırvan Dağı - Kazancık	48.3	-	-
32.	Feke Dağı - Alayli (Ziyaret T.)	52.1	-	-
33.	Alaylı (Ziyaret T.) - Tomarza	49.9	-	-
34.	Alaylı (Ziyaret T.) - 1822 WL	43	-	-
35.	Alaylı (Ziyaret T.) - Kuzören T.	32.5	-	-
36.	Kuzören T. - Seyhlı (Sıhlı)	50.6	-	-

Note: The evaluation was made by considering the receiving voltage (calculated and measured value), fading, terrain profile, and antenna patterns (horizontal and height pattern), and external noise in all their aspects.

Table 3.3.6 The Results of Radio Wave Propagation Test for Simplex Radio Link (3/3)

(2) UHF Radio Link

No.	Span	Receiving Voltage Calculated Value (dBμv)	Receiving Voltage Measured Value (dBμv)	Result of Evaluation
1.	DSİ Adana - Taşcı	32.5	16.0	Receiving voltage of measured valuewas a quite low level compared with calculated one because the path was blocked by tall buildings which have surrounded the test antenna at DSİ Adana. If the antenna at Adana is located at 40m above the ground, the radio link will be possible.
2.	DSİ Adana - Kuranşa	38.5	9.0	ditto
3.	DSİ Adana - Yenice	22.6	-	ditto
4.	DSİ Adana - Doğankent	33.3	-	ditto
5.	DSİ Adana - Karayusufulu	29.5	-	ditto
6.	Kuranşa - Baharlı	41.5	-	-
7.	Kuranşa - Tabaklar	43.3	-	-

Note: The evaluation was made by considering the receiving voltage (calculated and measured value), fading, terrain profile, and antenna patterns (horizontal and height pattern), and external noise in all their aspects.

Table 5.1.1 Correlation Matrix for Simple Linear Regression Analysis

	Adana	Çatalan	Feke	Kamışlı	Karaisalı	Karsantı	Kozan	Mansurlu	Pozantı	Saimbeyli	Seyhan Brj.	Tufanbeyli	Bakırdağ	Develi	Elbaşı	Kaynar	Kazancık	Örenşehir	Pazarören	Pınarbaşı	Sarız	Şıhlı	Toklar	Tomarza	Uzunpınar	M. Başören	Göksun	Çamardı	Çiftehan	Ereğli	Niğde	Ulukışla
Adana	1.000	0.742	0.656	0.810	0.832	0.475	0.787	0.346	0.592	0.607	0.935	0.405	0.416	0.411	0.230	0.141	0.089	0.063	0.118	0.105	0.219	0.674	0.440	0.302	0.114	0.000	0.672	0.513	0.566	0.503	0.743	0.482
Çatalan		1.000	0.747	0.780	0.876	0.587	0.802	0.550	0.647	0.587	0.875	0.118	0.533	0.590	0.404	0.155	0.063	0.045	0.224	0.307	0.349	0.601	0.429	0.567	0.195	0.000	0.338	0.678	0.534	0.748	0.743	0.619
Feke			1.000	0.863	0.701	0.740	0.780	0.660	0.727	0.844	0.737	0.352	0.706	0.579	0.451	0.173	0.118	0.077	0.268	0.319	0.475	0.737	0.737	0.602	0.349	0.063	0.829	0.519	0.680	0.534	0.804	0.472
Kamışlı				1.000	0.910	0.712	0.696	0.639	0.922	0.685	0.857	0.161	0.780	0.623	0.445	0.152	0.089	0.045	0.257	0.351	0.483	0.846	0.688	0.541	0.274	0.063	0.772	0.720	0.760	0.573	0.889	0.786
Karaisalı					1.000	0.640	0.734	0.616	0.884	0.653	0.928	0.355	0.495	0.400	0.182	0.000	0.000	-0.032	0.095	0.095	0.207	0.727	0.609	0.292	0.114	-0.045	0.779	0.524	0.622	0.436	0.815	0.629
Karsantı						1.000	0.591	0.683	0.724	0.653	0.669	0.363	0.527	0.686	0.609	0.507	0.464	0.414	0.552	0.604	0.606	0.783	0.418	0.612	0.490	0.251	0.599	0.686	0.617	0.378	0.490	0.507
Kozan							1.000	0.507	0.694	0.677	0.743	0.212	0.446	0.482	0.313	0.148	0.100	0.084	0.176	0.295	0.434	0.609	0.429	0.445	0.205	0.000	0.679	0.728	0.595	0.520	0.632	0.675
Mansurlu								1.000	0.643	0.625	0.387	0.359	0.594	0.566	0.417	0.243	0.212	0.114	0.409	0.397	0.521	0.663	0.375	0.521	0.339	0.089	0.814	0.404	0.571	0.396	0.435	0.348
Pozantı									1.000	0.680	0.788	0.224	0.675	0.510	0.363	0.134	0.100	0.095	0.202	0.295	0.463	0.779	0.729	0.484	0.332	0.045	0.820	0.586	0.914	0.358	0.775	0.631
Saimbeyli										1.000	0.578	0.446	0.583	0.688	0.440	0.265	0.202	0.164	0.344	0.407	0.567	0.681	0.606	0.564	0.860	0.145	0.688	0.476	0.553	0.327	0.541	0.471
Seyhan Brj.											1.000	0.221	0.543	0.401	0.200	0.000	-0.032	-0.055	0.105	0.158	0.245	0.563	0.499	0.307	0.105	-0.055	0.688	0.734	0.608	0.414	0.829	0.819
Tufanbeyli												1.000	0.126	0.071	0.032	0.237	0.241	0.187	0.224	0.155	0.265	0.000	0.000	0.032	0.161	0.130	0.968	0.224	0.063	0.857	0.725	0.247
Bakırdağ													1.000	0.716	0.680	0.348	0.354	0.228	0.517	0.520	0.567	0.782	0.853	0.809	0.474	0.292	0.361	0.596	0.722	0.575	0.574	0.535
Develi														1.000	0.851	0.529	0.508	0.429	0.771	0.704	0.632	0.803	0.581	0.838	0.550	0.385	0.375	0.769	0.583	0.614	0.524	0.516
Elbaşı															1.000	0.694	0.661	0.556	0.749	0.806	0.666	0.756	0.724	0.872	0.683	0.578	0.202	0.572	0.545	0.559	0.333	0.303
Kaynar																1.000	0.921	0.861	0.752	0.856	0.671	0.539	0.473	0.583	0.744	0.749	0.176	0.448	0.322	0.311	0.134	0.224
Kazancık																	1.000	0.903	0.751	0.797	0.628	0.424	0.491	0.564	0.762	0.792	0.152	0.415	0.302	0.315	0.130	0.195
Örenşehir																		1.000	0.665	0.742	0.601	0.295	0.383	0.462	0.807	0.729	0.167	0.342	0.391	0.302	0.138	0.195
Pazarören																			1.000	0.834	0.691	0.563	0.553	0.737	0.723	0.638	0.298	0.497	0.348	0.453	0.316	0.235
Pınarbaşı																				1.000	0.759	0.669	0.665	0.743	0.846	0.669	0.381	0.555	0.418	0.395	0.265	0.394
Sarız																					1.000	0.694	0.689	0.700	0.784	0.523	0.603	0.572	0.517	0.456	0.374	0.462
Şıhlı																						1.000	0.701	0.820	0.527	0.302	0.647	0.727	0.696	0.505	0.537	0.599
Toklar																							1.000	0.828	0.657	0.476	0.440	0.513	0.696	0.373	0.498	0.373
Tomarza																								1.000	0.674	0.532	0.308	0.628	0.640	0.643	0.414	0.329
Uzunpınar																									1.000	0.683	0.411	0.438	0.611	0.373	0.251	0.268
M. Başören																										1.000	0.210	0.303	0.221	0.308	0.167	0.155
Göksun																											1.000	0.599	0.755	0.394	0.647	0.657
Çamardı																												1.000	0.540	0.669	0.850	0.821
Çiftehan																													1.000	0.224	0.298	0.539
Ereğli																														1.000	0.671	0.590
Niğde																															1.000	0.880
Ulukışla																																1.000

Table 5.1.2 Effective Rainfall Gauging Station and Its Area Ratio for Subbasins

Station	Catchment Area of Station			Location	Göksu up to 1801 (Alternative 1)	Göksu up to 1805 (Alternative 1)	Göksu up to 1805 (Alternative 2)	Zamantı up to 1822 (Alternative 1)	Zamantı up to 1806 (Alternative 1)	Zamantı up to 1806 (Alternative 2)	Zamantı-Göksu Joint to Çatalan HWL	Zamantı-Göksu after Çatalan HWL (without Çatalan)	Zamantı-Göksu after Çatalan HWL (with Çatalan)		Çatalan Brj. -Seyhan Brj.		Eğlence up to 1825	Eğlence up to Seyhan R. (without Çatalan)	Eğlence up to Çatalan HWL (with Çatalan)	Körkün up to 1820	Körkün up to Seyhan HWL	Üçürge	Çakıt up to 1828
	Total	(Seyhan)	(Çatalan)	River Basin																			
Çatalan	738.2	(10.0)	(124.4)	Seyhan								0.664	0.693	(0.952)	0.528	(0.138)		0.565	0.244		0.172	0.017	0.005
Karsantı	1,512.7		(6.3)	Seyhan		0.034	0.016		0.139	0.029	0.952	0.319	0.279	(0.048)			0.336	0.105	0.208				
Seyhan Brj.	200.1	(62.5)		Seyhan											0.460	(0.862)							
Çiftehan	988.4			Çakıt																0.001			0.558
Pozantı*	404.3			Çakıt																0.017		0.276	0.174
Karaisalı*	815.8			Üçürge								0.017	0.029		0.013		0.051	0.330	0.548	0.070	0.828	0.708	0.189
Kamışlı	792.1			Körkün							0.002						0.561			0.338			0.014
Çamardı*	1,266.3			Körkün					0.150	0.031	0.045						0.053			0.574			0.061
Feke	852.9			Göksu	0.074	0.326	0.194																
Mansuriu*	1,187.8			Göksu		0.227	0.108		0.388	0.081													
Saimbeyli	1,257.7			Göksu	0.310	0.260	0.286																
Tufanbeyli	1,050.4			Göksu	0.395	0.040	0.226	0.008		0.007													
Sarız*	829.5			Göksu	0.220		0.115	0.046		0.037													
Bakırdağ	733.3			Zamantı		0.113	0.054	0.070	0.004	0.056													
Elbası	511.7			Zamantı				0.073		0.058													
Kaynar	734.3			Zamantı				0.105		0.083													
Kazancık	305.5			Zamantı				0.044		0.035													
Örenşehir	491.4			Zamantı				0.070		0.056													
Pazaören	627.6			Zamantı				0.090		0.071													
Pınarbaşı*	839.9			Zamantı	0.002		0.001	0.119		0.095													
Sıhlı	812.3			Zamantı				0.033	0.319	0.092													
Toklar	794.5			Zamantı				0.114		0.090													
Tomarza	969.4			Zamantı				0.139		0.110													
Uzunpınar	433.2			Zamantı				0.062		0.049													
M. Başören	187.8			Zamantı				0.027		0.021													
Total	19,337.0	(72.5)	(130.6)		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	(1.000)	1.000	(1.000)	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* : Station with Pluviograph
( ) : Reservoir Area

Table 5.1.3 The Results of Selection of Representative Rainfall Station (Alternative 1)

Station	Catchment Area of Station			Location	Göksu up to 1801 (Alternative 1)	Göksu up to 1805 (Alternative 1)	Göksu up to 1805 (Alternative 2)	Zamantı up to 1822 (Alternative 1)	Zamantı up to 1806 (Alternative 1)	Zamantı up to 1806 (Alternative 2)	Zamantı-Göksu Joint to Çatalan HWL	Zamantı-Göksu after Çatalan HWL (without Çatalan)	Zamantı-Göksu after Çatalan HWL (with Çatalan)		Çatalan Brj. -Seyhan Brj.		Eğlence up to 1825	Eğlence up to Seyhan R. (without Çatalan)	Eğlence up to Çatalan HWL (with Çatalan)	Körkün up to 1820	Körkün up to Seyhan HWL	Üçürge	Çakıt up to 1828
	Total	(Seyhan)	(Çatalan)	River Basin	(Alternative 1)	(Alternative 1)	(Alternative 2)	(Alternative 1)	(Alternative 1)	(Alternative 2)	Çatalan HWL	(without Çatalan)	(with Çatalan)										
Gölbaşı	738.2	(10.0)	(124.4)	Seyhan								0.664	0.693	(0.952)	0.528	(0.338)		0.568	0.244		0.172	0.017	0.005
Korsantı	1,512.7		(6.3)	Seyhan		0.034	0.016		0.139	0.029	0.952	0.319	0.279	(0.048)			0.336	0.105	0.208				
Seyhan Brj.	200.1	(62.5)		Seyhan											0.460	(0.862)							
Elbistan	988.4			Çakıt																0.001			0.558
Pozantı*	404.3			Çakıt																0.017		0.276	0.174
Karaisalı*	815.8			Üçürge								0.017	0.029		0.019		0.051	0.330	0.548	0.070	0.828	0.708	0.089
Karaisalı	792.1			Körkün							0.002						0.561			0.338			0.014
Çamardı*	1,266.3			Körkün					0.150	0.031	0.045						0.053			0.574			0.061
Feke	852.9			Göksu	0.074	0.326	0.194																
Mansurlu*	1,187.8			Göksu		0.227	0.108		0.388	0.081													
Saimbeyli	1,257.7			Göksu	0.316	0.260	0.286																
Tufanbeyli	1,050.4			Göksu	0.595	0.040	0.226	0.008		0.007													
Sarız*	829.5			Göksu	0.220		0.115	0.046		0.037													
Bakırdağ	733.3			Zamantı		0.113	0.054	0.070	0.004	0.056													
Elbaşı	511.7			Zamantı				0.073		0.058													
Kaynar	734.3			Zamantı				0.105		0.083													
Kozancık	305.5			Zamantı				0.044		0.035													
Örenşehir	491.4			Zamantı				0.070		0.056													
Pazarören	627.6			Zamantı				0.090		0.071													
Pınarbaşı*	839.9			Zamantı	0.002		0.001	0.119		0.095													
Şıhlı	812.3			Zamantı				0.033	0.319	0.092													
Toklar	794.5			Zamantı				0.114		0.090													
Tomarza	969.4			Zamantı				0.139		0.110													
Uzunpınar	433.2			Zamantı				0.062		0.049													
M. Başören	187.8			Zamantı				0.027		0.021													
Total	19,337.0	(72.5)	(130.6)		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	(1.000)	1.000	(1.000)	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* : Station with Pluviograph
( ) : Reservoir Area
▒ : Selected Rainfall Gauging Station

Table 5.1.4 The Results of Selection of Representative Rainfall Station (Alternative 2)

Station	Catchment Area of Station			Location	Göksu up to 1801 (Alternative 1)	Göksu up to 1805 (Alternative 1)	Göksu up to 1805 (Alternative 2)	Zamantı up to 1822 (Alternative 1)	Zamantı up to 1806 (Alternative 1)	Zamantı up to 1806 (Alternative 2)	Zamantı-Göksu Joint to Çatalan HWL	Zamantı-Göksu after Çatalan HWL (without Çatalan)	Zamantı-Göksu after Çatalan HWL (with Çatalan)		Çatalan Brj. -Seyhan Brj.		Eğlence up to 1825	Eğlence up to Seyhan R. (without Çatalan)	Eğlence up to Çatalan HWL (with Çatalan)	Körkün up to 1820	Körkün up to Seyhan HWL	Üçtirge	Çakıt up to 1828
	Total	(Seyhan)	(Çatalan)	River Basin																			
Çatalan	738.2	(10.0)	(124.4)	Seyhan								0.664	0.693	0.952	0.526	(0.138)		0.565	0.244		0.172	0.017	0.005
Karsantı	1,512.7		(6.3)	Seyhan		0.034	0.016		0.139	0.029	0.952	0.319	0.279	0.948			0.336	0.105	0.208				
Seyhan Brj.	200.1	(62.5)		Seyhan											0.460	(0.862)							
Çiftehan	988.4			Çakıt																0.001			0.558
Pozantı*	404.3			Çakıt																0.017		0.276	0.174
Karaisalı*	815.8			Üçtirge								0.017	0.029		0.013		0.051	0.330	0.548	0.070	0.828	0.708	0.182
Karataş	792.1			Körkün							0.002						0.561			0.338			0.014
Çamardı*	1,266.3			Körkün					0.150	0.031	0.045						0.053			0.574			0.061
Feke	852.9			Göksu	0.074	0.326	0.194																
Mansurlu*	1,187.8			Göksu		0.227	0.108		0.388	0.080													
Saimbeyli	1,257.7			Göksu	0.310	0.260	0.286																
Tufanbeyli	1,050.4			Göksu	0.395	0.040	0.226	0.008		0.007													
Sarız*	829.5			Göksu	0.220		0.115	0.046		0.037													
Bakırdağ	733.3			Zamantı		0.113	0.054	0.070	0.004	0.056													
Elbası	511.7			Zamantı				0.073		0.058													
Kaynar	734.3			Zamantı				0.105		0.083													
Kazancık	305.5			Zamantı				0.044		0.035													
Örensehir	491.4			Zamantı				0.070		0.056													
Pazarören	627.6			Zamantı				0.090		0.071													
Pınarbaşı*	839.9			Zamantı	0.002		0.001	0.119		0.095													
Şıhlı	812.3			Zamantı				0.033	0.319	0.092													
Toklar	794.5			Zamantı				0.114		0.090													
Tomarza	969.4			Zamantı				0.139		0.110													
Uzunpınar	433.2			Zamantı				0.062		0.049													
M. Başören	187.8			Zamantı				0.027		0.021													
Total	19,337.0	(72.5)	(130.6)		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	(1.000)	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* : Station with Pluviograph
( ) : Reservoir Area
▨ : Selected Rainfall Gauging Station

Table 5.2.1 List of Intended Gauging Items

No.	Name of Station	Kind of Station	Hydrometeorological Gauging Items			
			Rainfall	Temperature	Water Level	Reservoir
	Seyhan River Basin					
1	Çamardı	RG Station	√			
2	Çiftehan	RG Station	√			
3	Pozantı	RG/TP Station	√	√		
4	Kamışlı	RG/TP Station	√	√		
5	Karaisalı	RG Station	√			
6	Karsantı	RG/TP Station	√	√		
7	1825	WL Station			√	
8	1820	WL Station			√	
9	1818	WL Station			√	
10	1828	WL Station			√	
11	Seyhan dam	WL Station				√
12	Çatalan dam	RG/WL Station	√			√
	Zamantı River Basin					
13	Kazancık	RG Station	√			
14	Pınarbaşı	RG Station	√			
15	Toklar	RG Station	√			
16	Tomarza	RG/TP Station	√	√		
17	Şeyhli	RG/TP Station	√	√		
18	1822	WL Station			√	
19	1806	WL Station			√	
	Göksu River Basin					
20	Tufanbeyli	RG/TP Station	√	√		
21	Saimbeyli	RG Station	√			
22	Feke	RG Station	√			
23	Sarız	RG Station				
24	Mansurlu	RG/TP Station	√	√		
25	1801	WL Station			√	
26	1805	WL Station			√	

Abbreviation
RG: Rainfall
TP: Temperature
WL: Water level

Table 5.2.2 Comparative Studies of The Terrestrial Communications Link Scheme and The Satellite Communications Link Scheme

Item	Terrestrial Communications Links Scheme	Satellite Communications Links Scheme
Outline of Scheme	Data is to be collected through VHF radio communications links or micro wave multiplex radio communications links via repeater stations.	A VSAT (Very Small Aperture Terminal) is to be installed at gauging stations and data is to be collected through a communications satellite.
System Design	System design id flexible since circuit are to be designed considering system requirement.	System design will be restricted since it should be complied with the specifications of the satellite used.
Circuit design and radio wave propagation test	Both required.	Although circuit design is required, it is easy. However, the transmitting output power, antenna type, transmission method, etc. of VSAT will be determined from the design of the satellite.
Initial investment cost	The approximate estimate of the initial investment costs for the VHF radio communications facility and micro wave multiplex radio communications facility based on hydrometeorological observation network plan 1, are as follows: VHF radio communications facility: $892,400 Micro wave multiplex radio communications facility: $2,119,800 Total $3,012,200 (Power supply facility cost included)	For the VSAT system, VSAT facility should be installed by the user. The approximate estimate of the initial investment costs for the VSAT facility based on hydrometeorological observation network plan 1, are as follows: VSAT facility: $3,491,700 Total $3,491,700 (Power supply facility cost included)
Operation cost	Maintenance expenses only.	In addition to maintenance expenses, circuit usage charges are required. The annual usage charge per one channel of the VSAT system of the Republic of Turkey is as follows: Annual usage charge: Approx. $9,600/channel (based on the monthly charge of $800, surveyed in May 1994)
Reliability	The necessary reliability level can be set during design.	Depends on the reliability of the satellite. For a system that does not have a standby satellite, dangerous situations may be encountered since the life of a satellite is usually between about 7 and 10 years. If satellite is launching fails, sudden notice on discontinuation of the services may be given.
Influence of attenuation by rainfall	Because of 2 GHz band, operation is not adversely affected by rainfall.	Because of a Ku band (12/14 GHz), operation is adversely affected by rainfall. In areas, where snow falls, installation of heaters are undertaken against the influence of icing of snow on antenna.
Maintenance expenses	Compared with those of the satellite communications link scheme, the maintenance expenses for the terrestrial communications link scheme increased by repeating links	Compared with terrestrial communications link, satellite communications link usually take slight maintenance expenses since only terminal stations are required.
Overall evaluation	O	Δ

Table 5.2.3 Comparative Studies of the Promising Installation Sites of Radar Rain Gauges

Study Item	Ziyaret T. Relay Station	Feke Dağı Relay Station
Site	• Ziyaret T., the scheduled installation location of a multiplex radio line relay station	• Feke Dağı, the scheduled installation location of a multiplex radio line relay station and a telemetering radio line relay station.
Supervisory control center	• DSİ 6th regional directorate	• DSİ 6th regional directorate
Possible ranges of rainfall gauging	• Although a quantitative gauging range of 120km is not perfect, it covers the midstream area of the Seyhan River basin. • A qualitative gauging range of 200km almost covers the intended Seyhan River basin.	• A quantitative gauging range of 120km almost covers the intended Seyhan River basin. • A qualitative gauging range of 200km almost fully covers the Seyhan River basin.
Topographical conditions of the radar site	• The relationship between the positions of neighboring mountains and the allowable emitting radar beam angle should be studied in detail.	• The relationship between the positions of neighboring mountains and the allowable emitting radar beam angle should be studied in detail.
Power receiving situation	• Power distribution lines are present nearby.	• Power distribution lines are present nearby.
Access to the radar site	• Possible by car	• Possible by car

Table 5.2.4 List of Evaluation of Related Agencies to be transmitted of Information

Information / Related Agencies	Rainfall Data	Water Level Data	Discharge Data	Flood Protection Information	Evacuation Information	Seyhan Dam Operation Information	Çatalan Dam Operation Information					Evaluation of Related Agencies	Remarks
DSİ 6 th Flood Control Committee	O	O	O	O	O	O	O					A	
DSİ General Directorate	O	O	O	O	O	O	O					A	
Seyhan Dam Office	O	O	O	-	-	-	O					A	
Çatalan Dam Office	O	O	O	-	-	O	-					A	
DMİ Adana Regional Directorate	O	-	-	-	-	-	-					A	
EİE Adana Regional Directorate	-	O	O	-	-	-	-					A	
Doğankent Office of ASO	-	-	-	O	-	-	-					A	
Yenice Office of ASO	-	-	-	O	-	-	-					A	
Adana Provincial Governor	-	-	-	-	O	-	-					A	
Seyhan District	-	-	-	-	O	-	-					B	
Yüreğir District	-	-	-	-	O	-	-					B	
Seyhan Municipality	-	-	-	-	O	-	-					C	
Yüreğir Municipality	-	-	-	-	O	-	-					C	
Feke District Office	-	-	-	-	O	-	-					C	
Pozantı District Office	-	-	-	-	O	-	-					C	
Saimbeyli District Office	-	-	-	-	O	-	-						
Tufanbeylı District Office	-	-	-	-	O	-	-						
Sarız District Office	-	-	-	-	O	-	-						
Pınarbaşı District Office	-	-	-	-	O	-	-						
Karaisalı District Office	-	-	-	-	O	-	-						
Heads of Towns and Villages downstream	-	-	-	-	O	-	-					B	

Note: Siren warning is effective for evacuation, but it is excluded because of military use.

Legend: A; Transmission media is to be installed preferentially.

B; Transmission media is good to be installed.

Table 5.2.5 List of Kinds of Information Transmission and Media Recommended

Kinds of Information \ Transmission Media		Image Information Display	Data Display	FAX	TELEX	Recording	Private Telephone	Simultaneous Messaging	Independent Messaging	General Contact Telephone	Siren Warning	Loud Speaker Broadcasting	Electric Sign Board	Rotation Alarm lamp	Remarks
Hydrometeorological Information	Rainfall	A	A	C	-	B	-	-	-	-	-	-	-	-	
	Water level	A	A	C	-	B	-	-	-	-	-	-	-	-	
	Discharge	A	A	C	-	B	-	-	-	-	-	-	-	-	
Flood Protection Information		A	A	B	-	-	B	B	B	C	-	-	-	-	
Evacuation Information		A	A	B	-	-	-	B	B	B	-	C	C	C	
Seyhan Dam Operation Information		A	A	B	-	-	A	B	B	B	-	-	-	-	
Çatalan Dam Operation Information		A	A	B	-	-	A	B	B	B	-	-	-	-	
Maintenance Management Information		A	A	B	-	-	-	-	-	A	-	-	-	-	

Note: Siren warning is effective for evacuation, but it is excluded because of military use.

Legend: A; Transmission media is to be installed preferentially.

B; Transmission media is good to be installed.

C; Transmission media is to be installed, if possible.

Table 5.2.6 List of Transmission Media Between DSİ Flood Control Committee and Related Agencies

Transmission Media / Related Agencies	Image Information Display	Data Display	FAX	TELEX	Recording	Private Telephone	Simultaneous Messaging	Independent Messaging	General Contact Telephone	Siren Warning	Loud Speaker Broadcasting	Electric Sign Board	Rotation Alarm lamp	Remarks
DSİ 6 th Flood Control Committee	A	B	B	-	A	A	-	-	-	-	-	-	-	
DSİ General Directorate	A	-	B	-	A	A	-	-	-	-	-	-	-	
Seyhan Dam Office	A	-	B	-	A	A	-	-	-	-	-	-	-	
Çatalan Dam Office	A	-	B	-	A	A	-	-	-	-	-	-	-	
DMİ Adana Regional Directorate	A	-	-	-	A	-	-	-		-	-	-	-	
EİE Adana Regional Directorate	A	-	-	-	A	-	-	-		-	-	-	-	
Doğankent Office of ASO	-	-	B	-	-	-	-	B		-	-	-	-	
Yenice Office of ASO	-	-	B	-	-	-	-	B		-	-	-	-	
Adana Provincial Governor	-	-	A	-	-	A	-	-	-	-	-	-	-	
Seyhan District	-	-	B	-	-	-	-	-	B	-	-	-	-	
Yüreğir District	-	-	B	-	-	-	-	-	B	-	-	-	-	
Seyhan Municipality	-	-	-	-	-	-	-	-	-	-	-	-	-	
Yüreğir Municipality	-	-	-	-	-	-	-	-	-	-	-	-	-	
Feke District Office	-	-	B	-	-	-	-	-	B	-	-	-	-	
Pozantı District Office	-	-	B	-	-	-	-	-	B	-	-	-	-	
Saimbeyli District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tufanbeyli District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sarız District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pınarbaşı District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Karaısalı District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Heads of Towns and Villages downstream	-	-	B	-	-	-	-	-	-	-	-	-	-	People downstream

Legend: A; Transmission media is to be installed preferentially.

B; *Transmission media is good to be installed.*

Table 5.3.1 Alternative Plans of Telemetering Gauging Stations

No.	Name of Station	Kind of Station	Alternative 1 Hydrometeorological Gauging Items				Alternative 2 Hydrometeorological Gauging Items				Alternative 3 Hydrometeorological Gauging Items			
			Rainfall	Temperature	Water Level	Reservoir	Rainfall	Temperature	Water Level	Reservoir	Rainfall	Temperature	Water Level	Reservoir
	Seyhan River Basin													
1	Çamardı	RG Station	√				√				√			
2	Çiftehan	RG Station	√				√				√			
3	Pozantı	RG/TP Station	√	√			√	√			√	√		
4	Kamışlı	RG/TP Station	√	√			√	√			√	√		
5	Karaisalı	RG Station	√				√				√			
6	Karsantı	RG/TP Station	√	√			√	√			√	√		
7	1825	WL Station			√				√				√	
8	1820	WL Station			√				√				√	
9	1818	WL Station			√				√				√	
10	1828	WL Station			√				√				√	
11	Seyhan dam	WL Station				√				√				√
12	Çatalan dam	RG/WL Station	√			√	√			√	√			√
	Zamantı River Basin													
13	Kazancık	RG Station	√											
14	Pınarbaşı	RG Station	√				√							
15	Toklar	RG Station	√											
16	Tomarza	RG/TP Station	√	√			√	√						
17	Şeyhli	RG/TP Station	√	√										
18	1822	WL Station			√								√	
19	1806	WL Station			√				√				√	
	Göksu River Basin													
20	Tufanbeyli	RG/TP Station	√	√			√	√			√	√		
21	Saimbeyli	RG Station	√				√				√			
22	Feke	RG Station	√				√				√			
23	Sarız	RG Station					√							
24	Mansurulu	RG/TP Station	√	√			√	√			√	√		
25	1801	WL Station			√				√				√	
26	1805	WL Station			√				√				√	

Abbreviation: RG; Rainfall, TP; Temperature, WL; Water level

Table 5.3.2 Comparison of Alternative Plans for The Data Collection System

Item	Plan 1	Plan 2	Plan 3	Plan 4
1. Data to be collected				
(1) Rainfall	15	13	10	10
(2) Dam rainfall	1	1	1	1
(3) River water level	8	7	8	8
(4) Dam water level	2	2	2	2
(5) Air temperature	7	6	5	5
2. Facilities				
(1) Gauging stations	25	22	20	20
(2) Radio repeater stations (Multiplex repeater stations included)	14	13	10	11
(3) Radar rain gauges	0	0	0	1
3. Basin rainfall gauging accuracy	• High accuracy is ensured even for the rainfall only in some specific areas.	• A certain degree of accuracy is ensured even for the rainfall only in some specific areas.	• High accuracy is not ensured for the rainfall only in some specific areas.	• Although Plan 3 can be complemented, further study based on stored data is required after installation of radar rain gauges.
4. Water level prediction accuracy	• Changes in regional runoff can be incorporated. • Accuracy becomes stable.	• Accuracy significantly fluctuates according to the particular scale of flooding.	Same as at left.	Same as at left.
5. VHF radio frequency required	Implementable with a minimum of 4 frequencies	Same as at left.	Same as at left.	Same as at left.
6. Behavioral monitoring of rainy zones (Prediction included)	Impossible	Impossible	Impossible	Possible

Table 5.3.3 Comparison of the Methods of Data Processing System Structuring

	Item	Plan 1 (Centralized Processing Method)	Plan 2 (Distributed Processing Method)	Remarks
1	System configuration	• Minicomputer	• Distributed processing that mainly uses engineering workstations(EWS's)	
2	Processing speed	• Under a single CPU arrangement, the speed is limited because of serial processing.	• The seed can be improved because of load distribution.	
3	Operation	• Education is required since the appropriate computer operation skill is needed.	• Education on EWS operation is required.	
4	Extendibility	• The operating system and application programs are recreated with each addition or modification of a program. • Actual addition/modification of programs is usually consigned to the manufacturer.	• Addition/modification is possible with each EWS(thus, total adverse effects are minimized). • Addition/modification of the EWS section itself by the user may become possible.	
5	Maintainability	• Various types of fault diagnostic programs are available. • After recovery, the restart of the system may require expertise. • The total maintainability of the system is not too high.	• The EWS section is almost the same as for the minicomputer method. • The total maintainability of the system is high since faults can be isolated for each EWS.	
6	Reliability	• The hardware is highly reliable. • Errors in the CPUs result in immediate system failures. • Various types of fault detection are provided. Memory protection is also provided. • Duplexing of the system becomes expensive.	• The hardware is highly reliable. • System failures can be minimized by localizing faults.	
7	Installation conditions	• Installation conditions are slightly strict, and a special room is usually required. • Noise arises from the operation of heat release fans. • It is preferable that the system should be powered from a CVCF unit.	• There are not too many limitation on installation conditions, and the system can be installed even in the living room of an office(in terms of power requirements, dimensions, and noise). • Power consumption is not significant, a heat release fan is not required, nor does noise almost occur.	
8	Economy	• High initial investment cost(compared with that of the distributed processing method) • Significant power consumption(compared with that of the distributed processing method) • Large quantity of related facility	• Low initial investment cost because of standardization of each functional module • Insignificant power consumption • Very high cost performance	
9	Other factors	• Terminal equipment extendible for operation in other rooms. • (Limited functions) With appropriate memory, operating system, and processing capability margins, programs separate from those of the intended system can be operated	• Operation possible even in the living room of the section in charge • The EWS can be disconnected from the system at any appropriate time to be operated as a personal computer.	
10	Overall evaluation	Δ	O	

Table 5.3.4 Alternative Plans of Related Agencies To Be Transmission of Information

Information / Related Agencies	Rainfall Data	Water Level Data	Discharge Data	Flood Protection Information	Evacuation Information	Seyhan Dam Operation Information	Çatalan Dam Operation Information					Evaluation of Related Agencies	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Remarks
DSİ 6 th Flood Control Committee	O	O	O	O	O	O	O					A	O	O	O	
DSİ General Directorate	O	O	O	O	O	O	O					A	O	O	O	
Seyhan Dam Office	O	O	O	-	-	-	O					A	O	O	O	
Çatalan Dam Office	O	O	O	-	-	O	-					A	O	O	O	
DMİ Adana Regional Directorate	O	-	-	-	-	-	-					A	O	O	O	
EİE Adana Regional Directorate	-	O	O	-	-	-	-					A	O	O	O	
Doğankent Office of ASO	-	-	-	O	-	-	-					A	O	O	O	
Yenice Office of ASO	-	-	-	O	-	-	-					A	O	O	O	
Adana Provincial Governor	-	-	-	-	O	-	-					A	O	O	O	
Seyhan District	-	-	-	-	O	-	-					B		O		
Yüreğir District	-	-	-	-	O	-	-					B		O		
Seyhan Municipality	-	-	-	-	O	-	-					C			O	
Yüreğir Municipality	-	-	-	-	O	-	-					C			O	
Feke District Office	-	-	-	-	O	-	-					C		O		
Pozantı District Office	-	-	-	-	O	-	-					C		O		
Saimbeylı District Office	-	-	-	-	O	-	-									
Tufanbeylı District Office	-	-	-	-	O	-	-									
Sarız District Office	-	-	-	-	O	-	-									
Pinarbası District Office	-	-	-	-	O	-	-									
Karaısalı District Office	-	-	-	-	O	-	-									
Heads of Towns and Villages downstream	-	-	-	-	O	-	-					B	O			

Note: Siren warning is effective for evacuation, but it is excluded because of military use.

Legend: A; Transmission media is to be installed preferentially.

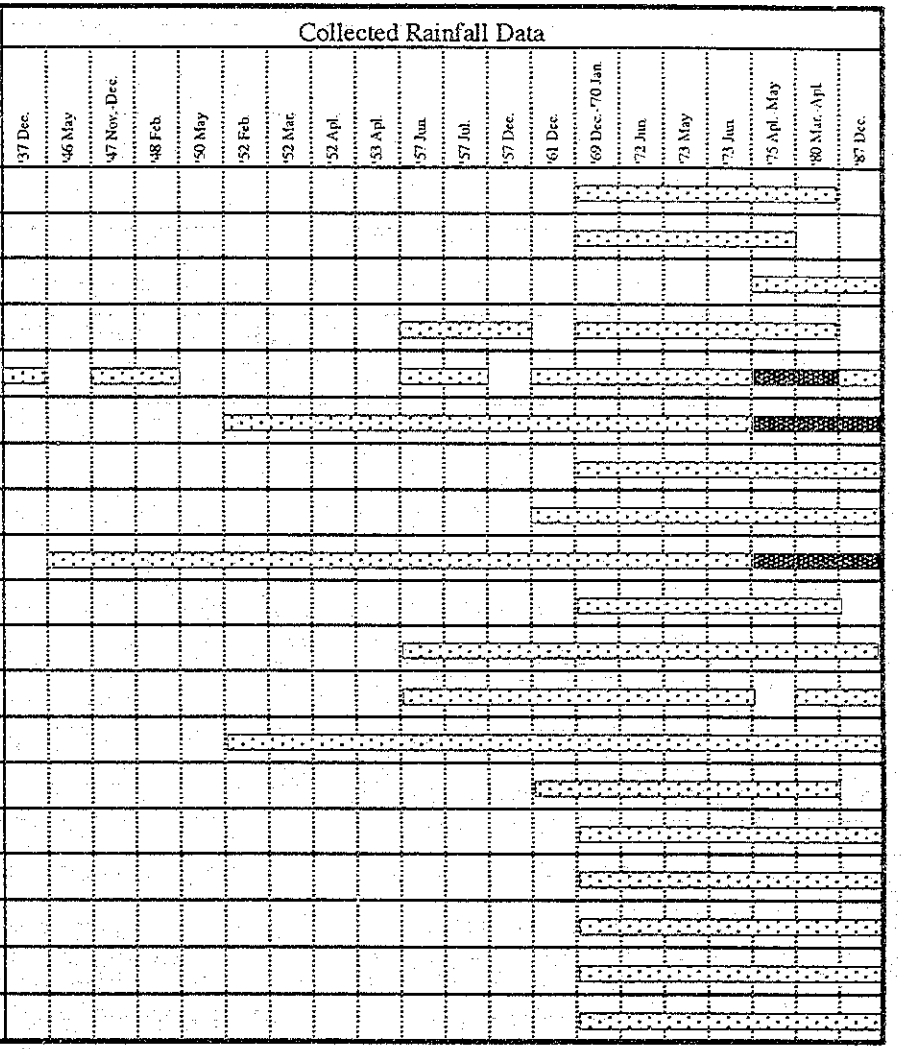
B; Transmission media is good to be installed.

Table 5.3.5 Comparison of Alternative Plans for The Data Transmission System

Item	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3
Destinations of data and information transmission	Governmental agencies: 7 places • DSİ general directorate • Seyhan dam office • Çatalan dam office • EİE Adana regional directorate • DMİ Adan regional directorate • Doğankent office of ASO • Yenice office of ASO Provincial governor: 1 place Heads of towns and villages in downstream area of Seyhan dam: 5 places	Governmental agencies: 7 places • DSİ general directorate • Seyhan dam office • Çatalan dam office • EİE Adana regional directorate • DMİ Adan regional directorate • Doğankent office of ASO • Yenice office of ASO Provincial governor: 1 place Heads of towns and villages in downstream area of Seyhan dam: 5 places Heads of official districts: 4 places	Governmental agencies: 7 places • DSİ general directorate • Seyhan dam office • Çatalan dam office • EİE Adana regional directorate • DMİ Adan regional directorate • Doğankent office of ASO • Yenice office of ASO Provincial governor: 1 place Heads of towns and villages in downstream area of Seyhan dam: 5 places Heads of official districts: 4 places Municipalities: 2 places
Flood information monitoring at the DSİ general directorate	√	√	√
Telephone private line between the DSİ 6 th flood control committee and Seyhan dam office	√	√	√
Telephone private line between the DSİ 6 th flood control committee and Çatalan dam office	√	√	√
Telephone private line between the DSİ 6 th flood control committee and Adana provincial governor	√	√	√
Liaison radio telephone link between DSİ 6 th flood control committee and ASO branch offices	√	√	√
Liaison radio telephone link between DSİ 6 th flood control committee and offices of towns and villages' head in downstream area of Seyhan dam	√	√	√
Liaison radio telephone link between DSİ 6 th flood control committee and heads of official districts		√	√
Liaison radio telephone link between DSİ 6 th flood control committee and municipalities			√

Table 6.1.1 List of Collected Rainfall Data(1/3)

Station	River Basin	EL. (m)	First Year of Record	Last Year of Record	Complete Years	Records held by	Collected Rainfall Data
Çatalan	Seyhan	65	1,954	1,992	31	DMİ	
Karsantı	Seyhan	860	1,960	1,992	-	DMİ	
Seyhan Brj.	Seyhan	55	1,974	1,992	19	DSİ	
Çiftehan	Çakıt	1,000	1,954	1,992	-	DMİ	
Pozantı*	Çakıt	778	1,937	1,988	32	DMİ	
Karaisalı*	Üçürge	400	1,950	1,992	41	DMİ	
Kamışlı	Körkün	1,225	1,963	1,992	30	DSİ	
Çamardı*	Körkün	1,500	1,961	1,992	-	DMİ	
Feke*	Göksu	620	1,942	1,992	51	DMİ	
Mansurlu*	Göksu	1,050	1,964	1,992	-	DMİ	
Saimbeyli	Göksu	1,100	1,957	1,992	36	DMİ	
Tufanbeyli	Göksu	1,350	1,957	1,992	31	DMİ	
Sarız*	Göksu	1,500	1,951	1,992	42	DMİ	
Bakırdağ	Zamantı	1,300	1,960	1,992	-	DMİ	
Elbaşı	Zamantı	1,425	1,965	1,992	28	DMİ	
Kaynar	Zamantı	1,550	1,964	1,992	29	DMİ	
Kazancık	Zamantı	1,585	1,966	1,992	27	DSİ	
Örenşehir	Zamantı	1,600	1,964	1,992	29	DMİ	
Pazarören	Zamantı	1,500	1,964	1,992	29	DMİ	



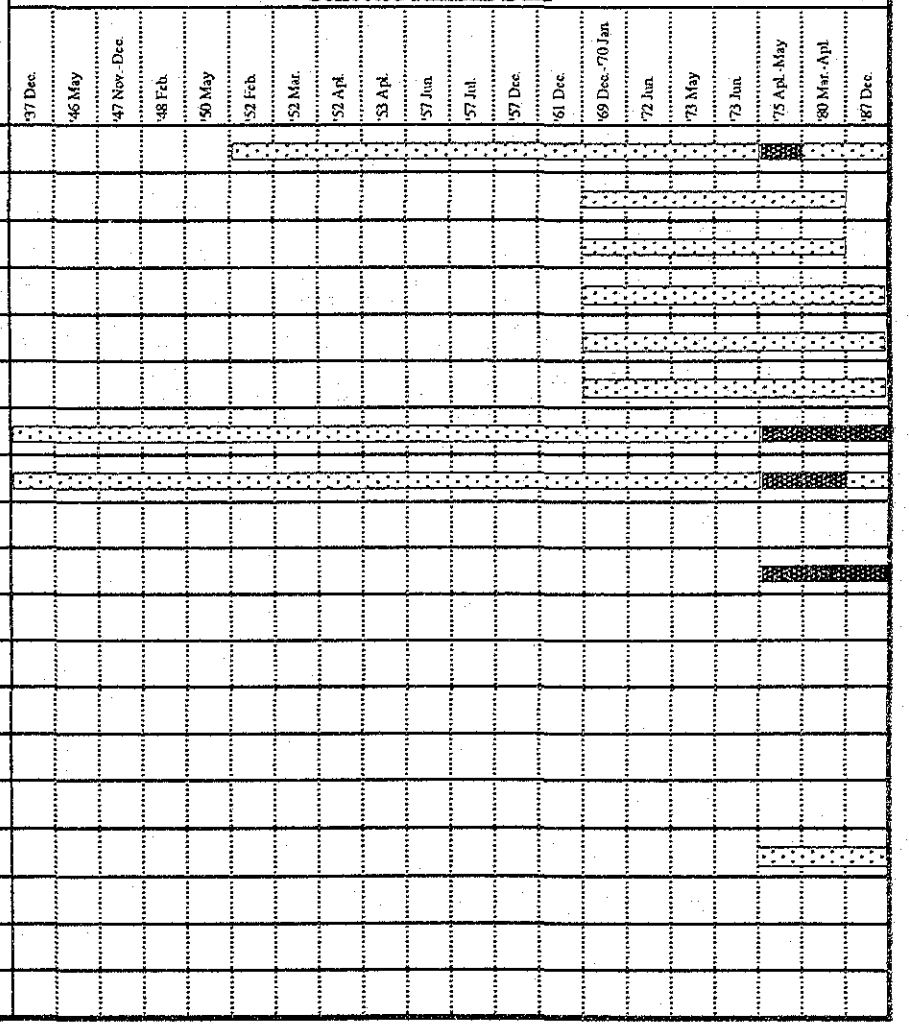
* Station with Pluviograph

Daily Rainfall

Daily and Hourly Rainfall

Table 6.1.1 List of Collected Rainfall Data(2/3)

Station	River Basin	EL. (m)	First Year of Record	Last Year of Record	Complete Years	Records held by	Collected Rainfall Data
Pınarbaşı*	Zamantı	1,470	1,950	1,992	43	DMİ	
Şıhlı	Zamantı	1,400	1,969	1,992	24	DMİ	
Toklar	Zamantı	1,400	1,965	1,988	24	DMİ	
Tomarza	Zamantı	1,400	1,963	1,992	30	DMİ	
Uzunpınar	Zamantı	1,740	1,960	1,992	33	DMİ	
M. Boşören	Zamantı	1,670	1,967	1,992	26	DSİ	
Adana*	-	20	1,929	1,992	64	DMİ	
Ulukışla*	-	1,451	1,929	1,992	59	DMİ	
Çokak	-	1,350	1,969	1,992	23	DMİ	
Kozan*	-	150	1,951	1,992	42	DMİ	
Kozan Brj.	-	150	1,967	1,992	26	DSİ	
Camlıyayla	-	625	1,964	1,992	27	DMİ	
Gülek	-	950	1,957	1,992	34	DMİ	
İmamoğlu	-	100	1,963	1,992	30	DMİ	
Tarsus	-	33	1,950	1,992	41	DMİ	
Develi*	-	1,180	1,951	1,992	42	DMİ	
Musahacılı	-	950	1,974	1,992	19	DSİ	
Yahyalı	-	1,260	1,964	1,992	28	DMİ	
Yazyurdu	-	1,750	1,965	1,992	28	DMİ	



* Station with Pluviograph

Daily Rainfall

Daily and Hourly Rainfall

Table 6.1.1 List of Collected Rainfall Data(3/3)

Station	River Basin	EL. (m)	First Year of Record	Last Year of Record	Complete Years	Records held by	Collected Rainfall Data
							'37 Dec. '46 May '47 Nov.-Dec. '48 Feb. '50 May '52 Feb. '52 Mar. '52 Apl. '53 Apl. '57 Jun. '57 Jul. '57 Dec. '61 Dec. '69 Dec.-'70 Jan. '72 Jun. '73 May '73 Jun. '75 Apl.-May '80 Mar.-Apl. '87 Dec.
Göksun*	-	1,344	1,954	1,992	39	DMİ	
Akkaya Brj.	-	1,195	1,966	1,992	27	DSİ	
Bor	-	1,100	1,964	1,992	-	DMİ	
Ereğli*	-	1,044	1,950	1,992	43	DMİ	
Gümüşler	-	1,340	1,972	1,992	21	DSİ	
Konaklı	-	1,265	1,966	1,992	-	DSİ	
Nigde*	-	1,208	1,935	1,992	58	DMİ	
Zanapa	-	1,175	1,966	1,992	27	DMİ	

* Station with Pluviograph

Daily Rainfall

Daily and Hourly Rainfall

Table 6.1.2 List of DSİ Stream Gauging Stations (Under Operation) 1/2

Station No.	Station Name	River	Latitude	Longitude	Elevation (m)	Catchment Area (km²)	Evaluated Data Period (Water Year)
18-08	Tacin	Tacin	-	-	1,536	9.9	1964 1987 1989 1991
18-12	Kamışlı	Körkün	-	-	1,109	1,065.0	1971 1979 1981 1992
18-16	Nergizlik	Üçürge	-	-	400	121.0	1978 1992
18-17	Darıdere	Göksu	-	-	1,542	315.6	1983 1991
18-18	Hasan Çavuslar	İnderesi	-	-	1,400	136.0	1982 1992
18-19	Feke	Asmaca	-	-	550	619.0	1982 1992
18-20	B. Çakır	Zamantı	-	-	586	7,769.3	1983 '86 '88
18-21	Kapuz	Kapuz	-	-	618	394.5	1986 1988
18-22	B. Sofulu	Aksu	-	-	960	98.0	1986 1992
18-23	Yeniköy	Yağdeğleme	-	-	870	23.5	1986 1992
18-24	Çamlıca	Yayla	-	-	865	173.7	1987 1988
18-25	Çamlıca Köp	Zamantı	-	-	860	7,418.0	1987 1988
18-26	Çamlıca Köyü	Zamantı	-	-	850	7,594.1	1987
18-27	Elekgölü Köp	Ecemiş	-	-	1,550	1,833.0	
18-28	Çukurbey	Ecemiş	-	-	-	-	
18-29	Değirmenocağı	Zamantı	-	-	721	7,674.6	
18-30	Mustafa Oruç	Zamantı	-	-	626	7,754.5	
18-31	Göktaş	Zamantı	-	-	500	8,291.5	
18-32	Şarköy	Göksu	-	-	1,400	752.4	1989 1992

Table 6.1.2 List of DSİ Stream Gauging Stations (Under Operation) 2/2

Station		River	Latitude	Longitude	Elevation	Catchment Area	Evaluated Data Period (Water Year)						
No.	Name				(m)	(km²)	1930	1940	1950	1960	1970	1980	1990
18-33	Akgedik	Demirözü	-	-	-	-						1990	1992
18-34	Hocalı	Deliçay	-	-	115	35.4						1991	1992
18-35	Kazaklıpınar	Bağlama	-	-	1,660	10.9							

Table 6.1.3 List of DSİ Stream Gauging Stations (Closed)

Station No.	Station Name	River	Latitude	Longitude	Elevation (m)	Catchment Area (km²)	Evaluated Data Period (Water Year)
18-01	Eğner	Seyhan	-	-	190	13,780.0	1960 1965 1968
18-03	Sol. Sh. Sul. Kn.	Seyhan	-	-	26	-	
18-04	Demirköprü	Seyhan	-	-	25	19,376.0	1959 1961
18-05	Hacılı	Körkün	-	-	255	1,454.0	1959 61 64 66 71
18-06	Şekerpınarı	Çakıt	-	-	800	1,234.0	1961 1962
18-07	Bakırdağ	Zamantı	-	-	1,297	6,158.0	1964 1968
18-09	Örencik	Beypınar	-	-	1,562	36.0	1966 1979
18-10	Yeniköy	Terece	-	-	1,494	26.9	1967
18-11	Emeğil	Zamantı	-	-	1,451	2,751.2	1967 1971
18-13	Saydere	Saydere	-	-	223	16.0	
18-14	Hacıhasanlı	Üçürge	-	-	222	144.9	1971 1972
18-15	Göl Gözlem	Seyhan	-	-	-	-	

Table 6.1.4 List of EİE Stream Gauging Stations (Under Operation)

Station No.	Station Name	River	Latitude	Longitude	Elevation (m)	Catchment Area (km²)	Evaluated Data Period (Water Year)
1801	Himmetli	Göksu	37-51'-57"N	36-03'-34"E	665	2,596.8	1936 – 1989
1805	Gökdere	Göksu	37-36'-49"N	35-36'-50"E	350	4,242.8	1939 – 1989
1818	Üçtepe	Seyhan	37-22'-19"N	35-29'-03"E	100	13,846.0	1962 – 1989
1820	Hacılıköprü	Körkün	37-17'-44"N	35-09'-04"E	170	1,440.8	1969 – 1989
1822	Fraktin	Zamantı	30-14'-41"N	35-37'-33"E	1,270	6,334.8	1969 – 1989
1823	Emeğil	Zamantı	37-39'-15"N	35-34'-35"E	1,451	2,756.0	1974 – 1989
1824	Çukurkışla	Göksu	-	-	1,200	1,526.4	1979 – 1989
1825	Eğribük	Eğlence	37-21'-50"N	35-11'-35"E	222	602.0	1987 1989
1826	Ergenuşağı	Zamantı	37-39'-54"N	35-34'-44"E	347	8,698.1	1988 1989
1827	Değirmen	Zamantı	37-51'-19"N	35-29'-08"E	760	7,718.0	1988 1989
1828	Salbaş	Çakıt	37-06'-23"N	35-06'-26"E	80	1,896.9	
1829	Kamışlı	Körkün	37-33'-23"N	34-57'-22"E	1,107	1,065.0	
1830	Karakuz	Körkün	37-29'-00"N	35-04'-10"E	900	-	

Table 6.1.5 List of EİE Stream Gauging Stations (Closed)

Station No.	Station Name	River	Latitude	Longitude	Elevation (m)	Catchment Area (km²)	Evaluated Data Period (Water Year)
1802	Faraşa	Zamantı	-	-	1,000	7,558.0	1936 1954
1803	Fraktın	Zamantı	-	-	1,265	6,788.8	1939 1944
1804	Söğütlü	Zamantı	-	-	1,345	4,389.2	1941 1955 1962 1968
1806	Ergenuşağı	Zamantı	-	-	347	8,698.4	1939 1956 1961 1979
1807	Taşköprü	Seyhan	-	-	22	19,352.4	1953 1955 1971 1972
1808	Çatalan	Seyhan	-	-	100	14,416.4	
1809	Çakıt	Çakıt	-	-	80	2,925.6	1953 1955
1810	Elekgölü	Ecemiş	-	-	1,385	289.2	1962
1811	Boztahta	Eğlence	-	-	254	546.0	1966 1970
1812	Pınarbaşı	Zamantı	-	-	1,425	2,623.2	1955 1973
1813	Çerkezkaraboğazı	Zamantı	-	-	1,521	2,144.4	1962 1974
1814	Malıhıdırlı	Seyhan	-	-	88	14,006.0	1954 1966
1815	Salbaşköy	Çakıt	-	-	125	1,826.8	1959 1963
1816	Yukarı Karagöz	Karagöz	-	-	1,450	137.2	1962 1966
1817	Arapali	Çakıt	-	-	150	1,582.4	1964 '66'68 1971 1979 1981 1989
1819	Şekerpınarı	Çakıt	-	-	800	1,220.0	1969 1970
1821	Sarımehmetli	Eğlence	-	-	75	628.8	1970 1986

Table 6.2.1 The Results of the Estimate of Hourly Rainfall Patterns of the Representative Rainfall Stations

Flood / Rainfall Gauging Station	1975 Flood		1980 Flood		1987 Flood
	Apr.17 - 23	Apr.25 - May 1	Mar.24 - 30	Apr.2 - 8	Dec.20 - 25
Available Hourly Rainfall Records					
Adana	√	√	√	√	√
Feke	√	√	√	√	√
Karaisalı	√	√	√	√	√
Kozan	√	√	√	√	√
Pozantı	√	√		√	
Pınarbaşı		√		√	
Ereğli	√	√		√	
Ulukışla	√	√		√	
Niğde		√		√	
Adopted Rainfall Pattern for the Representative Rainfall Station					
Çatalan	Karaisalı	Karaisalı	Karaisalı	Pozantı	Karaisalı
Karsantı	Feke	Feke	Karaisalı	Pozantı	Feke
Çiftehan	Pozantı	Feke	Karaisalı	Pınarbaşı	Karaisalı
Pozantı	√	√	Karaisalı	√	Karaisalı
Karaisalı	√	√	√	√	√
Kamışlı	Pozantı	Karaisalı	Karaisalı	Pozantı	Karaisalı
Çamardı	Karaisalı	Feke	Karaisalı	Pozantı	Karaisalı
Feke	√	√	√	√	√
Mansurlu	Feke	Kozan	Feke	Feke	Feke
Saimbeyli	Feke	Feke	Feke	Feke	Feke
Kazancık	Ereğli	Feke	Feke	Feke	Kozan
Pınarbaşı	Karaisalı	√	Feke	√	Kozan
Sıhlı	Karaisalı	Feke	Feke	Feke	Adana
Toklar	Kozan	Feke	Feke	Feke	Feke
Tomarza	Karaisalı	Feke	Feke	Pınarbaşı	Feke
Tufanbeyli	Feke	Feke	Feke	Feke	Kozan

√ : with Pluviograph

Table 6.2.2 Multiple Regression Coefficient of the Representative Rainfall Gauging Stations

Sub - basin	Multiple Regression Coefficient (ai)																Constant
	Çatalan	Karsantı	Çiftehan	Pozantı*	Karaisalı*	Karışlı	Çamardı*	Feke	Mansurlu*	Saimbeyli	Tufanbeyli	Kazancık	Pınarbaşı*	Şıhlı	Toklar	Tomarza	b
1 Zamantı up to 1822												0.263	0.318		0.129	0.307	0.140
2 Zamantı up to 1806		0.192							0.385					0.346			0.114
3 Göksu up to 1801										0.496	0.411						0.215
4 Göksu up to 1805								0.386	0.250	0.244							0.183
5 Zamantı - Göksu joint to Çatalan HWL		0.973															0.063
6 Eğlence up to 1825		0.367				0.608											0.017
7 Eğlence up to Seyhan R.	0.569				0.374												0.337
(7) (Eğlence up to Çatalan HWL)		(0.213)			(0.739)												(0.147)
8 Zamantı-Göksu after Çatalan HWL	0.681	0.325															-0.032
(8) (")	(0.722)	(0.289)															(-0.029)
9 Körkün up to 1820						0.425	0.571										0.008
10 Kürkön up to Seyhan HWL					0.965												0.117
11 Üçürge				0.273	0.724												0.016
12 Çatalan Brj.- Seyhan Brj.	0.534				0.462												0.024
13 Çakıt up to 1828			0.684		0.254												0.229

( ) : with Çatalan Dam

* : Station with Pluviograph

Table 6.4.1 Comparison of the Parameter for Flood Runoff Analyses

Basin No. (River Channel No.)	Parameter	'87Flood Case1	'87Flood Case2	'80Flood Case1	'80Flood Case2
1	Area (Km2)	6990	6990	6990	6990
	K value	33.5	33.5	33.5	33.5
	p value	0.85	0.85	0.85	0.85
	Tl (hr.)	11	11	3	3
	Base flow (m3/s)	31	31	31	31
	f1	0.01	0.1	0.12	0.2
	f2	1	1	1	1
	Rsa (mm)	200	200	130	130
(1)	K value	94092	94092	94092	94092
	p value	0.695	0.695	0.695	0.695
	Tl (min.)	43.28	43.28	43.28	43.28
2	Area (Km2)	1833	1833	1833	1833
	K value	47	47	40	47
	p value	0.7	0.7	0.7	0.7
	Tl (hr.)	0	3	0	3
	Base flow (m3/s)	14	14	14	14
	f1	0.17	0.2	0.98	0.98
	f2	1	1	1	1
	Rsa (mm)	200	200	130	130
3	Area (Km2)	2298	2298	2298	2298
	K value	33.5	33.5	33.5	33.5
	p value	0.85	0.85	0.85	0.85
	Tl (hr.)	11	11	11	11
	Base flow (m3/s)	24	24	24	24
	f1	0.132	0.132	0.45	0.45
	f2	1	1	1	1
	Rsa (mm)	200	200	130	130
(2)	K value	94233	94233	94233	94233
	p value	0.7	0.7	0.7	0.7
	Tl (min.)	50	50	50	50
4	Area (Km2)	2099	2099	2099	2099
	K value	28	30	28	28
	p value	0.65	0.65	0.65	0.65
	Tl (hr.)	0	3	0	0
	Base flow (m3/s)	10	10	10	10
	f1	0.25	0.25	0.85	0.85
	f2	1	1	1	1
	Rsa (mm)	200	200	130	130
(3)	K value	125000	84000	83000	84000
	p value	0.79	0.65	0.65	0.65
	Tl (min.)	50	50	50	50
5	Area (Km2)	858	858	858	858
	K value	29	35	29	29
	p value	0.5	0.65	0.5	0.5
	Tl (hr.)	1	3	1	1
	Base flow (m3/s)	2.5	2.5	2.5	2.5
	f1	0.7	0.45	0.9	0.9
	f2	1	1	1	1
	Rsa (mm)	200	200	130	130

Table 6.4.1 Comparison of the Parameter for Flood Runoff Analyses

Basin No. (River Channel No.)	Parameter	'87Flood Case1	'87Flood Case2	'80Flood Case1	'80Flood Case2
6	Area (Km2)	506	506	506	506
	K value	29.5	35	29	29
	p value	0.67	0.67	0.5	0.5
	Tl (hr.)	1	1	3	3
	Base flow (m3/s)	3.3	3.3	3.3	3.3
	f1	0.42	0.42	0.9	0.9
	f2	1	1	1	1
	Rsa (mm)	200	200	100	100
(4)	K value	60000	53000	60000	60000
	p value	0.7	0.7	0.7	0.7
	Tl (min.)	15	60	15	15
7	Area (Km2)	167	167	167	167
	K value	45	50	45	45
	p value	0.7	0.68	0.7	0.7
	Tl (hr.)	3	3	3	3
	Base flow (m3/s)	0.5	0.5	0.5	0.5
	f1	0.33	0.24	0.8	0.8
	f2	1	1	1	1
	Rsa (mm)	200	200	100	100
8	Area (Km2)	572	572	572	572
	K value	45	50	45	45
	p value	0.7	0.68	0.7	0.7
	Tl (hr.)	3	3	3	3
	Base flow (m3/s)	0.5	0.5	0.5	0.5
	f1	0.33	0.24	0.8	0.8
	f2	1	1	1	1
	Rsa (mm)	200	200	100	100
(6)	K value	210000	180000	200000	180000
	p value	0.7	0.65	0.69	0.65
	Tl (min.)	90	80	90	90
9	Area (Km2)	1427	1427	1427	1427
	K value	25	50	25	25
	p value	0.64	0.7	0.64	0.64
	Tl (hr.)	1	1	3	3
	Base flow (m3/s)	18.7	18.7	18.7	18.7
	f1	0.11	0.2	0.35	0.35
	f2	1	1	1	1
	Rsa (mm)	300	300	130	130
(5)	K value	60000	80000	80000	80000
	p value	0.7	0.7	0.75	0.7
	Tl (min.)	15	80	60	80
10	Area (Km2)	120	120	120	120
	K value	45	50	45	45
	p value	0.8	0.68	0.8	0.8
	Tl (hr.)	3	3	3	3
	Base flow (m3/s)	0.5	0.5	0.5	0.5
	f1	0.32	0.24	0.6	0.6
	f2	1	1	1	1
	Rsa (mm)	300	300	100	100

Table 6.4.1 Comparison of the Parameter for Flood Runoff Analyses

Basin No. (River Channel No.)	Parameter	'87Flood Case1	'87Flood Case2	'80Flood Case1	'80Flood Case2
11	Area (Km2)	263	263	263	263
	K value	45	50	45	50
	p value	0.8	0.68	0.8	0.68
	Tl (hr.)	3	3	3	3
	Base flow (m3/s)	1	1	1	1
	f1	0.11	0.2	0.9	0.9
	f2	1	1	1	1
	Rsa (mm)	280	300	100	100
12	Area (Km2)	435	435	435	435
	K value	40	50	40	50
	p value	0.7	0.68	0.7	0.68
	Tl (hr.)	3	3	3	3
	Base flow (m3/s)	0	0	0	0
	f1	0.2	0.24	1	1
	f2	1	1	1	1
	Rsa (mm)	270	270	100	100
13	Area (Km2)	1769	1769	1769	1769
	K value	45	50	45	50
	p value	0.7	0.68	0.7	0.68
	Tl (hr.)	3	3	3	3
	Base flow (m3/s)	2	2	2	2
	f1	0.1	0.2	0.9	0.9
	f2	1	1	1	1
	Rsa (mm)	280	280	100	100

Table 7.2.1 Flood Hydrograph for Çatalan Dam

Days	Time	2-Year (m3/s)	5-Year (m3/s)	10-Year (m3/s)	25-Year (m3/s)	50-Year (m3/s)	100-Year (m3/s)	200-Year (m3/s)	500-Year (m3/s)	Catast. (m3/s)
	0 : 00									
	24 : 00									
	48 : 00									
	96 : 00									
	120 : 00									
	144 : 00									
1st day	153 : 00	275	320	350	375	400	425	575	625	
1st day	165 : 00	285	330	375	400	425	450	600	650	
1st day	177 : 00	300	350	390	425	450	475	624	665	
2nd day	189 : 00	325	370	410	440	470	495	635	675	
2nd day	201 : 00	340	385	425	450	485	520	650	700	
3rd day	213 : 00	360	400	450	475	510	540	675	725	873
3rd day	225 : 00	375	420	470	500	550	585	690	740	883
4th day	237 : 00	400	435	495	535	580	615	720	775	1,077
4th day	249 : 00	425	470	530	610	650	700	775	825	1,189
5th day	261 : 00	450	515	600	660	725	790	860	915	1,250
5th day	273 : 00	475	575	690	760	825	925	1,000	1,065	1,260
6th day	285 : 00	525	640	800	890	985	1,085	1,210	1,280	1,689
6th day	297 : 00	600	780	900	1,065	1,190	1,300	1,475	1,550	4,338
7th day	309 : 00	740	975	1,160	1,365	1,525	1,735	1,850	1,950	9,226
7th day	321 : 00	1,175	1,740	2,130	2,650	3,045	3,455	3,850	4,375	9,376
8th day	333 : 00	760	1,000	1,185	1,380	1,535	1,725	1,850	1,950	4,730
8th day	345 : 00	610	790	900	1,075	1,200	1,300	1,410	1,525	3,234
9th day	357 : 00	530	675	800	935	1,010	1,100	1,130	1,250	2,619
9th day	369 : 00	465	575	675	775	860	930	935	1,020	2,214
10th day	381 : 00	400	500	575	655	735	800	810	865	1,931
10th day	393 : 00	380	450	500	575	600	700	725	780	1,731
11th day	405 : 00	355	410	460	520	575	625	690	745	1,523
11th day	417 : 00	350	380	430	475	530	590	675	725	1,374
12th day	429 : 00	335	370	425	455	520	575	660	710	1,106
12th day	441 : 00	325	355	400	445	500	555	645	695	975
13th day	453 : 00	310	345	390	430	480	540	630	675	883
13th day	465 : 00	300	330	375	420	475	525	625	665	
14th day	477 : 00	285	320	360	400	455	515	600	650	
14th day	489 : 00	275	300	350	385	435	500	590	640	
Peak Discharge		1,175	1,740	2,130	2,650	3,045	3,455	3,850	4,375	9,376
Flood Vol. (mil. m3)		538.1	656.4	762.5	870.3	963.7	1,063.3	1,191.5	1,286.4	2,310.4

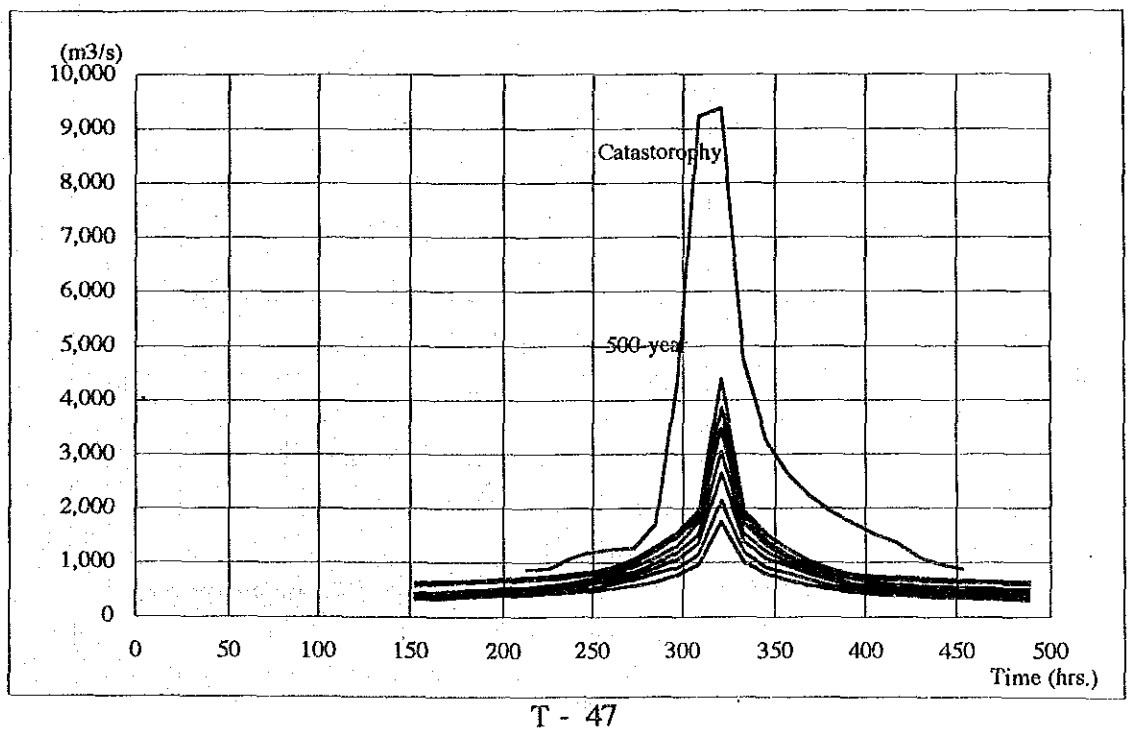


Table 7.2.2 Flood Hydrograph for Seyhan Dam

Days	Time	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year	500-Year	Catast.
1st day	0 : 00	20	32	40	46	60	69	80	110	
1st day	6 : 00	25	35	42	51	62	72	89	119	
1st day	12 : 00	27	37	45	55	65	75	100	129	
1st day	18 : 00	30	40	50	58	68	80	110	140	
1st day	24 : 00	35	45	54	64	77	86	122	158	
2nd day	30 : 00	40	50	61	74	89	102	140	170	
2nd day	36 : 00	46	60	75	84	108	129	158	190	
2nd day	42 : 00	55	73	93	110	133	160	182	214	
2nd day	48 : 00	63	88	115	140	165	197	215	255	
3rd day	54 : 00	73	106	141	175	203	235	260	305	
3rd day	60 : 00	83	128	167	210	246	280	320	368	
3rd day	66 : 00	97	155	198	253	295	335	390	440	560
3rd day	72 : 00	120	190	244	312	355	407	480	535	3,362
4th day	78 : 00	163	245	325	400	445	504	608	682	6,066
4th day	84 : 00	280	435	550	705	825	955	1,075	1,235	6,731
4th day	90 : 00	152	262	340	404	455	515	615	680	5,544
4th day	96 : 00	112	190	244	308	362	397	485	540	3,127
5th day	102 : 00	91	148	193	247	296	325	395	445	1,591
5th day	108 : 00	79	120	157	205	244	272	320	365	831
5th day	114 : 00	68	96	130	171	205	228	260	302	451
5th day	120 : 00	59	80	106	142	168	186	210	250	227
6th day	126 : 00	52	68	87	116	133	150	175	214	94
6th day	132 : 00	45	58	74	93	106	118	155	190	24
6th day	138 : 00	40	51	64	77	87	96	140	175	
6th day	144 : 00	35	47	57	71	79	86	125	162	
7th day	150 : 00	32	44	55	67	75	82	112	150	
7th day	156 : 00	30	42	52	64	72	80	100	135	
7th day	162 : 00	26	38	49	60	68	76	90	123	
7th day	168 : 00	24	35	45	56	63	73	80	115	
Peak Discharge		280	435	550	705	825	955	1,075	1,235	6,731
Flood Vol.(mil. m3)		14.1	53.4	68.7	86.0	100.8	114.0	138.0	154.9	617.9

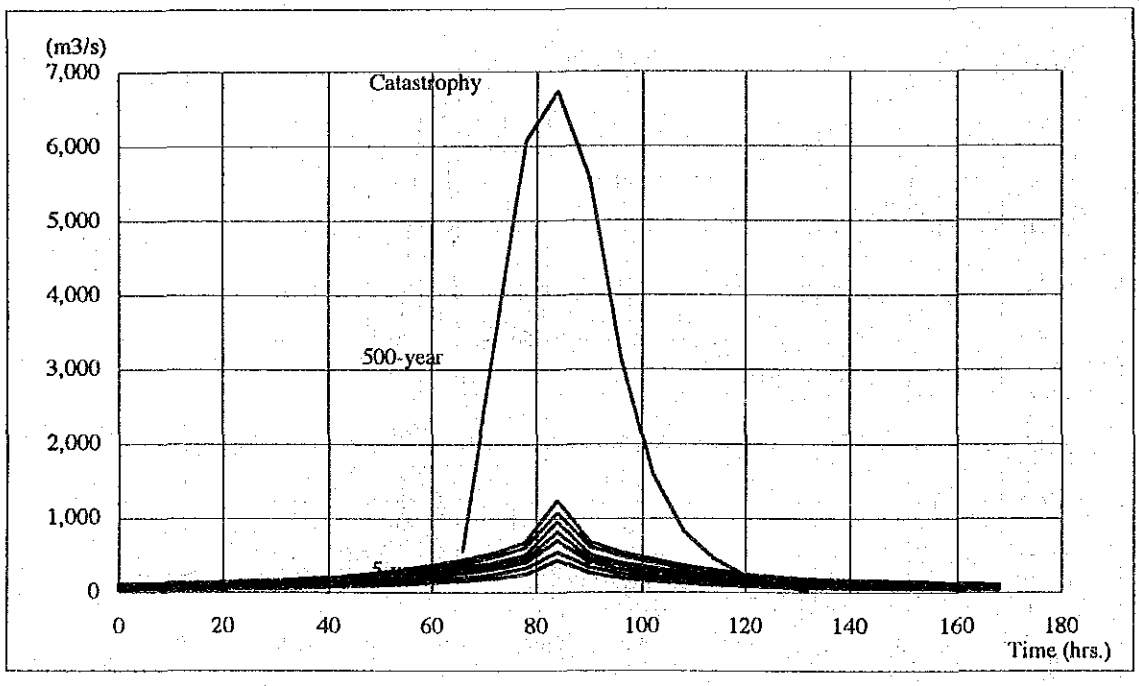


Table 7.2.3 Çatalan Dam Flood Routing for 500-year Flood (Constant Ratio Operation Qt=600m³/s)

Days	Time	Resvr. Inflow (m3/s)	Inflow Vol. (mil.m3)	Spilling Outflow Open (m)	Coef.	Disch. (m3/s)	Outflow Vol. (mil.m3)	In/Out Balance (mil.m3)	Resvr. Volume (mil.m3)	RWL (m)
1st day	0 : 00	625				600			1,644.6	118.60
1st day	12 : 00	650	27.54	1.02	0.709	602	25.96	1.58	1,646.2	118.62
1st day	24 : 00	665	28.40	1.01	0.709	598	25.90	2.50	1,648.7	118.66
2nd day	36 : 00	675	28.94	1.01	0.709	599	25.85	3.09	1,651.8	118.70
2nd day	48 : 00	700	29.70	1.01	0.710	601	25.93	3.77	1,655.6	118.75
3rd day	60 : 00	725	30.78	1.01	0.710	604	26.02	4.76	1,660.3	118.82
3rd day	72 : 00	740	31.64	1.00	0.710	601	26.02	5.62	1,666.0	118.90
4th day	84 : 00	775	32.72	1.00	0.710	604	26.04	6.68	1,672.6	118.99
4th day	96 : 00	825	34.56	0.98	0.711	597	25.96	8.60	1,681.2	119.11
5th day	108 : 00	915	37.58	0.98	0.709	566	25.14	12.45	1,693.7	119.28
5th day	120 : 00	1,065	42.77	0.97	0.712	606	25.33	17.44	1,711.1	119.52
6th day	132 : 00	1,280	50.65	0.94	0.713	600	26.05	24.61	1,735.7	119.85
6th day	144 : 00	1,550	61.13	0.92	0.714	603	25.98	35.15	1,770.9	120.33
7th day	156 : 00	1,950	75.60	0.89	0.716	604	26.08	49.52	1,820.4	120.99
7th day	168 : 00	4,375	136.62	0.82	0.720	598	25.96	110.66	1,931.1	122.42
8th day	180 : 00	1,950	136.62	0.78	0.724	604	25.96	110.66	2,041.7	123.82
8th day	192 : 00	1,525	75.06	0.76	0.723	580	25.58	49.48	2,091.2	124.42
9th day	204 : 00	1,250	59.94	0.74	0.730	600	25.50	34.44	2,125.6	124.84
9th day	216 : 00	1,020	49.03	0.73	0.731	599	25.90	23.13	2,148.8	125.12
10th day	228 : 00	865	40.72	0.73	0.731	603	25.96	14.76	2,163.5	125.30
10th day	240 : 00	780	35.53	0.73	0.732	605	26.09	9.44	2,173.0	125.41
11th day	252 : 00	745	32.94	0.72	0.732	599	26.01	6.93	2,179.9	125.50
11th day	264 : 00	725	31.75	0.72	0.732	601	25.92	5.83	2,185.7	125.57
12th day	276 : 00	710	31.00	0.72	0.732	602	25.98	5.02	2,190.7	125.63
12th day	288 : 00	695	30.35	0.72	0.732	603	26.03	4.32	2,195.1	125.68
13th day	300 : 00	675	29.59	0.72	0.733	604	26.07	3.52	2,198.6	125.72
13th day	312 : 00	665	28.94	0.72	0.733	604	26.10	2.84	2,201.4	125.75
14th day	324 : 00	650								
14th day	336 : 00	640								
		4,375	1,230.1				673.3		2,201.4	125.75
								Stored Volume=	556.8	

Table 7.2.4 Çatalan Dam Flood Routing for 500-year Flood (Constant Ratio Operation Qt=800m³/s)

Days	Time	Resvr. Inflow (m3/s)	Inflow Vol. (mil.m3)	Spilling Outflow Open (m)	Coef.	Disch. (m3/s)	Outflow Vol. (mil.m3)	In/Out Balance (mil.m3)	Resvr. Volume (mil.m3)	RWL (m)
1st day	0 : 00	625				625			1,644.6	118.60
1st day	12 : 00	650	27.54	1.06	0.708	623	26.97	0.57	1,645.2	118.61
1st day	24 : 00	665	28.40	1.07	0.708	630	27.07	1.33	1,646.5	118.63
2nd day	36 : 00	675	28.94	1.07	0.708	631	27.22	1.72	1,648.2	118.65
2nd day	48 : 00	700	29.70	1.07	0.708	632	27.27	2.43	1,650.7	118.68
3rd day	60 : 00	725	30.78	1.07	0.708	634	27.34	3.44	1,654.1	118.73
3rd day	72 : 00	740	31.64	1.06	0.709	631	27.31	4.33	1,658.5	118.79
4th day	84 : 00	775	32.72	1.06	0.709	634	27.31	5.41	1,663.9	118.87
4th day	96 : 00	825	34.56	1.06	0.709	638	27.47	7.09	1,671.0	118.97
5th day	108 : 00	915	37.58	1.05	0.710	638	27.55	10.03	1,681.0	119.11
5th day	120 : 00	1,065	42.77	1.05	0.710	645	27.71	15.05	1,696.0	119.31
6th day	132 : 00	1,280	50.65	1.05	0.711	657	28.14	22.51	1,718.6	119.62
6th day	144 : 00	1,550	61.13	1.04	0.712	668	28.62	32.51	1,751.1	120.06
7th day	156 : 00	1,950	75.60	1.04	0.713	690	29.33	46.27	1,797.3	120.68
7th day	168 : 00	4,375	136.62	1.14	0.713	805	32.28	104.34	1,901.7	122.05
8th day	180 : 00	1,950	136.62	1.07	0.716	801	34.68	101.94	2,003.6	123.34
8th day	192 : 00	1,525	75.06	1.05	0.717	803	34.64	40.42	2,044.0	123.84
9th day	204 : 00	1,250	59.94	1.04	0.718	805	34.73	25.21	2,069.2	124.16
9th day	216 : 00	1,020	49.03	1.03	0.718	803	34.74	14.29	2,083.5	124.33
10th day	228 : 00	865	40.72	1.02	0.718	798	34.59	6.13	2,089.7	124.41
10th day	240 : 00	780	35.53	1.02	0.718	798	34.49	1.04	2,090.7	124.42
11th day	252 : 00	745	32.94	1.02	0.718	798	34.48	-1.54	2,089.2	124.40
11th day	264 : 00	725	31.75	1.02	0.718	797	34.45	-2.70	2,086.5	124.37
12th day	276 : 00	710	31.00	1.03	0.718	803	34.56	-3.56	2,082.9	124.32
12th day	288 : 00	695	30.35	1.03	0.718	801	34.65	-4.30	2,078.6	124.27
13th day	300 : 00	675	29.59	1.03	0.718	800	34.58	-4.99	2,073.6	124.21
13th day	312 : 00	665	28.94	1.03	0.718	797	34.49	-5.55	2,068.1	124.14
14th day	324 : 00	650								
14th day	336 : 00	640								
		4,375	1,230.1				806.7		2,090.7	124.42
							Stored Volume=		446.1	

Table 7.2.5 Çatalan Dam Flood Routing for 500-year Flood (Constant Ratio Operation Qt=1,000m³/s)

Days	Time	Resvr. Inflow (m3/s)	Inflow Vol. (mil.m3)	Spilling Outflow Open (m)	Coef.	Disch. (m3/s)	Outflow Vol. (mil.m3)	In/Out Balance (mil.m3)	Resvr. Volume (mil.m3)	RWL (m)
1st day	0 : 00	625				625			1,644.6	118.60
1st day	12 : 00	650	27.54	1.07	0.708	629	27.09	0.45	1,645.1	118.61
1st day	24 : 00	665	28.40	1.07	0.708	629	27.18	1.22	1,646.3	118.62
2nd day	36 : 00	675	28.94	1.07	0.708	631	27.22	1.73	1,648.0	118.65
2nd day	48 : 00	700	29.70	1.08	0.708	637	27.39	2.31	1,650.3	118.68
3rd day	60 : 00	725	30.78	1.07	0.708	634	27.46	3.32	1,653.7	118.73
3rd day	72 : 00	740	31.64	1.07	0.709	636	27.43	4.22	1,657.9	118.78
4th day	84 : 00	775	32.72	1.07	0.709	639	27.54	5.18	1,663.1	118.86
4th day	96 : 00	825	34.56	1.07	0.709	643	27.69	6.87	1,669.9	118.95
5th day	108 : 00	915	37.58	1.08	0.709	654	28.01	9.58	1,679.5	119.08
5th day	120 : 00	1,065	42.77	1.09	0.709	667	28.54	14.23	1,693.7	119.28
6th day	132 : 00	1,280	50.65	1.11	0.709	691	29.33	21.32	1,715.1	119.57
6th day	144 : 00	1,550	61.13	1.13	0.710	719	30.46	30.67	1,745.7	119.99
7th day	156 : 00	1,950	75.60	1.15	0.711	755	31.85	43.75	1,789.5	120.58
7th day	168 : 00	4,375	136.62	1.45	0.709	1,002	37.95	98.67	1,888.2	121.87
8th day	180 : 00	1,950	136.62	1.37	0.711	1,001	43.27	93.35	1,981.5	123.06
8th day	192 : 00	1,525	75.06	1.35	0.712	1,004	43.32	31.74	2,013.3	123.46
9th day	204 : 00	1,250	59.94	1.33	0.713	998	43.25	16.69	2,029.9	123.67
9th day	216 : 00	1,020	49.03	1.33	0.713	1,001	43.19	5.84	2,035.8	123.74
10th day	228 : 00	865	40.72	1.33	0.713	1,000	43.23	-2.51	2,033.3	123.71
10th day	240 : 00	780	35.53	1.34	0.712	1,003	43.27	-7.74	2,025.5	123.61
11th day	252 : 00	745	32.94	1.34	0.712	998	43.23	-10.29	2,015.2	123.49
11th day	264 : 00	725	31.75	1.35	0.712	999	43.14	-11.39	2,003.9	123.34
12th day	276 : 00	710	31.00	1.36	0.712	1,000	43.18	-12.18	1,991.7	123.19
12th day	288 : 00	695	30.35	1.37	0.711	1,000	43.20	-12.85	1,978.8	123.03
13th day	300 : 00	675	29.59	1.38	0.711	1,000	43.19	-13.60	1,965.2	122.86
13th day	312 : 00	665	28.94	1.39	0.710	999	43.16	-14.22	1,951.0	122.68
14th day	324 : 00	650								
14th day	336 : 00	640								
		4,375	1,230.1				923.7		2,035.8	123.74
							Stored Volume=		391.2	

Table 7.2.6 Çatalan Dam Flood Routing for 500-year Flood (Constant Ratio Operation Qt=1,200m³/s)

Days	Time	Resvr. Inflow (m3/s)	Inflow Vol. (mil.m3)	Spilling Outflow Open (m)	Coef.	Disch. (m3/s)	Outflow Vol. (mil.m3)	In/Out Balance (mil.m3)	Resvr. Volume (mil.m3)	RWL (m)
1st day	0 : 00	625				625			1,644.6	118.60
1st day	12 : 00	650	27.54	1.07	0.708	629	27.09	0.45	1,645.1	118.61
1st day	24 : 00	665	28.40	1.07	0.708	629	27.18	1.22	1,646.3	118.62
1st day	36 : 00	675	28.94	1.07	0.708	631	27.22	1.73	1,648.0	118.65
1st day	48 : 00	700	29.70	1.08	0.708	637	27.39	2.31	1,650.3	118.68
2nd day	60 : 00	725	30.78	1.08	0.708	639	27.57	3.21	1,653.5	118.72
2nd day	72 : 00	740	31.64	1.08	0.708	641	27.66	3.99	1,657.5	118.78
2nd day	84 : 00	775	32.72	1.08	0.709	644	27.77	4.95	1,662.5	118.85
2nd day	96 : 00	825	34.56	1.09	0.709	654	28.04	6.52	1,669.0	118.94
2nd day	108 : 00	915	37.58	1.11	0.708	670	28.59	9.00	1,678.0	119.06
3rd day	120 : 00	1,065	42.77	1.13	0.709	689	29.36	13.41	1,691.4	119.25
3rd day	132 : 00	1,280	50.65	1.18	0.708	729	30.64	20.01	1,711.4	119.52
3rd day	144 : 00	1,550	61.13	1.22	0.708	770	32.38	28.74	1,740.2	119.91
4th day	156 : 00	1,950	75.60	1.28	0.708	831	34.57	41.03	1,781.2	120.47
4th day	168 : 00	4,375	136.62	1.78	0.704	1,202	43.91	92.71	1,873.9	121.69
5th day	180 : 00	1,950	136.62	1.69	0.707	1,205	52.00	84.62	1,958.5	122.77
5th day	192 : 00	1,525	75.06	1.66	0.708	1,201	51.97	23.09	1,981.6	123.07
6th day	204 : 00	1,250	59.94	1.65	0.708	1,199	51.83	8.11	1,989.7	123.17
6th day	216 : 00	1,020	49.03	1.65	0.708	1,197	51.75	-2.72	1,987.0	123.13
7th day	228 : 00	865	40.72	1.66	0.708	1,197	51.70	-10.98	1,976.0	123.00
7th day	240 : 00	780	35.53	1.68	0.707	1,200	51.76	-16.23	1,959.8	122.79
8th day	252 : 00	745	32.94	1.70	0.707	1,200	51.83	-18.89	1,940.9	122.55
9th day	264 : 00	725	31.75	1.72	0.706	1,199	51.82	-20.07	1,920.8	122.29
10th day	276 : 00	710	31.00	1.75	0.705	1,203	51.90	-20.90	1,899.9	122.02
11th day	288 : 00	695	30.35	1.77	0.704	1,199	51.90	-21.55	1,878.4	121.75
12th day	300 : 00	675	29.59	1.80	0.703	1,201	51.85	-22.26	1,856.1	121.46
13th day	312 : 00	665	28.94	1.83	0.702	1,202	51.90	-22.95	1,833.2	121.16
	324 : 00	650								
	336 : 00	640								
		4,375	1,230.1				1,041.6		1,989.7	123.17
							Stored Volume=		345.1	

Table 7.3.1 Alternative Reservoir Rule Curve for Çatalan Dam

			Case-1						Case-2						Case-3					
	HWL	CTLN Inflow	HPP Dis.	Vol	Rsv. Vol.	Cal. RWL	Adj. RWL	Adj.Res. Vol.	HPP Dis.	Vol	Rsv. Vol.	Cal. RWL	Adj. RWL	Adj.Res. Vol.	HPP Dis.	Vol	Rsv. Vol.	Cal. RWL	Adj. RWL	Adj.Res. Vol.
	(m)	(m3/s)	(m3/s)	(mil.m3)	(mil.m3)	(m)	(m)	(mil.m3)	(m3/s)	(mil.m3)	(mil.m3)	(m)	(m)	(mil.m3)	(m3/s)	(mil.m3)	(mil.m3)	(m)	(m)	(mil.m3)
Oct.	120.7	70.4	110.0	-106.1	1,737.3	119.9	119.9	1,737.3	111.1	-109.0	1,384.4	114.8	115.0	1,398.7	101.1	-82.2	1,505.2	116.6	116.6	1,505.2
Nov.	118.6	90.3	141.1	-131.7	1,605.6	118.1	118.1	1,605.6	111.1	-53.9	1,344.8	114.2	115.0	1,398.7	101.1	-28.0	1,477.2	116.2	116.2	1,477.2
Dec.	118.6	136.6	213.5	-205.8	1,399.7	115.0	115.0	1,399.7	111.1	68.3	1,467.0	116.0	116.0	1,467.0	101.1	95.1	1,572.3	117.6	117.6	1,572.3
Jan.	118.6	164.5	126.6	101.5	1,501.2	116.5	116.5	1,501.2	189.4	-66.8	1,400.2	115.0	115.0	1,400.2	199.4	-93.6	1,478.7	116.2	116.2	1,478.7
Feb.	118.6	195.6	150.6	109.0	1,610.3	118.1	118.1	1,610.3	189.4	15.1	1,415.3	115.3	115.3	1,415.3	199.4	-9.1	1,469.6	116.1	116.1	1,469.6
Mar.	120.7	285.2	219.5	176.0	1,786.3	120.5	120.5	1,786.3	189.4	256.5	1,671.8	119.0	119.0	1,671.8	199.4	229.8	1,699.4	119.4	119.4	1,699.4
Apr.	125.0	353.6	272.2	211.2	1,997.4	123.3	123.3	1,997.4	189.4	425.7	2,097.5	124.5	124.5	2,097.5	199.4	399.8	2,099.1	124.5	124.5	2,099.1
May	125.0	230.0	177.0	141.9	2,139.0	125.0	125.0	2,139.0	189.4	108.7	2,126.0	125.0	125.0	2,139.0	199.4	82.0	2,126.0	125.0	125.0	2,139.0
Jun.	125.0	105.4	164.6	-153.6	1,985.4	123.1	123.1	1,985.4	111.1	-14.9	2,124.1	124.8	124.8	2,124.1	101.1	11.0	2,150.0	125.1	125.0	2,138.6
Jul.	125.0	26.2	41.0	-39.5	1,945.8	122.6	122.6	1,945.8	111.1	-227.3	1,896.8	122.0	122.0	1,896.8	101.1	-200.5	1,938.1	122.5	122.5	1,938.1
Aug.	125.0	23.1	36.1	-34.8	1,911.0	122.2	122.2	1,911.0	111.1	-235.7	1,661.1	118.8	118.8	1,661.1	101.1	-208.9	1,729.2	119.8	119.8	1,729.2
Sep.	125.0	46.4	72.5	-67.6	1,843.4	121.3	121.3	1,843.4	111.1	-167.8	1,493.4	116.4	116.4	1,493.4	101.1	-141.9	1,587.3	117.8	117.8	1,587.3
Avg.		143.9	143.7						143.7						142.1					

Table 8.2.1 Hydrometeorological Gauging Items To Be Collected

No.	Name of Station	Kind of Station	Hydrometeorological Gauging Items			
			Rainfall	Temperature	Water Level	Reservoir
	Seyhan River Basin					
1	Çamardı	RG Station	√			
2	Çiftehan	RG Station	√			
3	Pozantı	RG/TP Station	√	√		
4	Kamışlı	RG/TP Station	√	√		
5	Karaisalı	RG Station	√			
6	Karsantı	RG/TP Station	√	√		
7	1825	WL Station			√	
8	1820	WL Station			√	
9	1818	WL Station			√	
10	1828	WL Station			√	
11	Seyhan dam	WL Station				√
12	Çatalan dam	RG/WL Station	√			√
	Zamantı River Basin					
13	Kazancık	RG Station	√			
14	Pınarbaşı	RG Station	√			
15	Toklar	RG Station	√			
16	Tomarza	RG/TP Station	√	√		
17	Şeyhli	RG/TP Station	√	√		
18	1822	WL Station			√	
19	1806	WL Station			√	
	Göksu River Basin					
20	Tufanbeyli	RG/TP Station	√	√		
21	Saimbeyli	RG Station	√			
22	Feke	RG Station	√			
23	Mansurlu	RG/TP Station	√	√		
24	1801	WL Station			√	
25	1805	WL Station			√	

Abbreviation

RG: Rainfall

TP: Temperature

WL: Water level

Table 9.1.1 Implementation Schedule for Seyhan River Basin Flood Forecasting and Warning System

Items \ Month	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21th	22th	23th
1. Detailed Design and Tender																							
(1) Detailed design	⊢	―	―	―	―	⊣																	
(2) Supplemental radio wave propagation test		⊢	―	⊣																			
(3) Tender documentation			⊢	⊣																			
(4) Tender processing				⊢	―	⊣																	
2. Civil construction work																							
(1) Preparatory work						⊢	―	⊣															
(2) Civil construction work								⊢	―	―	―	―	―	⊣									
3. Equipment Manufacture and Installation/Adjustment Work																							
(1) Design						⊢	―	⊣															
(2) Equipment manufacture								⊢	―	―	―	⊣											
(3) Inspection												⊢	⊣										
(4) Transportation and customs clearance processing													⊢	▽ FOB	⊣								
(5) Equipment installation															⊢	―	―	―	⊣				
(6) Equipment adjustment																		⊢	―	⊣	Taking Over		
(7) Acceptance test																				⊢	▽	⊣	
4. Education and Training																							
(1) Overseas OJT												⊢	⊣										
(2) Site OJT																					⊢	―	⊣

Table 9.2.1 Project Cost

Item No.	Item	Foreign Currency Unit : $	Domestic Currency Unit : 1,000 TL	Remarks
1	Direct Construction Cost			
1.1	Equipment Cost			
1)	Telemetering Facility	1,702,290	0	
2)	Data Processing Facility	1,216,960	0	
3)	Data Display Facility	1,609,790	0	
4)	Multiplex Radio Communication Facility	1,486,530	0	
5)	Voice-based Radio Communication Facility	377,180	0	
6)	Power Supply Facility	1,500,660	0	
7)	Spare Units and Parts	473,590	0	
8)	Test Equipment and Maintenance Vehicle	279,770	0	
9)	Materials	357,400	0	
Sub-total		9,004,170	0	
1.2	Civil Construction Cost			
1)	Tower Construction Cost	0	1,041,400	
2)	Housing Construction Cost	0	5,229,700	
3)	Electricity Service Lines Construction Cost	0	3,889,500	
4)	Other Attached Construction Cost	0	7,372,800	
Sub-total		0	17,533,400	
1.3	Equipment Installation and Adjustment Cost			
1)	PTT Private Line Initiate Installation Cost	0	18,400	
2)	Manpower Cost	1,002,570	780,500	
3)	Machine Cost	89,750	0	
4)	Vehicles for Installation	0	1,189,000	
Sub-total		1,092,320	1,987,900	
1.4	Inland Transportation Cost			
1)	Inland Transportation Cost	0	47,600	
2)	Unloading and Warehouse Cost	0	176,500	(9,540$)
Sub-total		0	224,100	
2	Land Acquisition Cost	0	6,600	
3	Project Overhead Fee by Government	0	197,454	
4	Engineering Fee	1,170,200	0	
5	Training Fee	148,580	0	Overseas/Site OJT
6	Provisional Preliminary Fee	554,870	2,630,010	
Grand Total		11,970,140	22,579,464	

Note: Project cost should be estimated using following foreign exchange currency rate.

(1) 1$=109.2 Yen as of February 1, 1994

(2) 1$=18,500 TL as of Febuary, 1994

Table 9.2.2 Cost Breakdown of Each Station

	Quantity	Unit Price ($)	Total ($)	Cost Composition of Each Station Facility								
				Telemetering Facility	Processing Facility	Multiplex Facility	Contact Telephone	Displaying Facility	Power Supply Facility	Spare Parts and Units	Test Equipment	Installation Materials
1. Control Center	1	2,955,991	2,955,991	0	1,216,960	171,190	111,813	1,254,947	201,081	0	0	0
2. Seyhan Dam Office	1	568,068	568,068	255,861	0	110,632	0	62,454	139,121	0	0	0
3. Çatalan Dam Office	1	475,686	475,686	79,112	0	206,722	0	62,453	127,399	0	0	0
4. Data Monitoring Station	3	111,904	335,712	0	0	0	0	76,648	35,256	0	0	0
5. Multiplex Repeater Station (Ziyaret T.)	1	333,196	333,196	0	0	243,910	0	0	89,286	0	0	0
6. Multiplex Repeater Station (Karlık T.)	1	282,253	282,253	0	0	192,967	0	0	89,286	0	0	0
7. Multiplex Repeater Station (Nemec T.)	1	234,112	234,112	0	0	144,826	0	0	89,286	0	0	0
8. Multiplex Repeater Station (Feke Dağı)	1	276,850	276,850	0	0	187,564	0	0	89,286	0	0	0
9. Multiplex Repeater Station (Meydancik)	1	224,881	224,881	0	0	135,595	0	0	89,286	0	0	0
10. Multiplex Repeater Station (Kilkoyak T.)	1	182,409	182,409	0	0	93,123	0	0	89,286	0	0	0
11. Telemetering Repeater Station (V-V)	5	63,049	315,245	49,313	0	0	0	0	13,736	0	0	0
12. Telemetering Repeater Station (μ-V)	4	44,753	179,012	44,753	0	0	0	0	0	0	0	0
13. Telemetering Repeater Station (Cross)	2	107,820	215,640	89,505	0	0	0	0	18,315	0	0	0
14. Water Level Gauging Station	8	39,533	316,264	32,482	0	0	0	0	7,051	0	0	0
15. Rainfall Gauging Station	8	33,644	269,152	26,593	0	0	0	0	7,051	0	0	0
16. Rainnfall & Temperature gauging Station	7	55,183	386,281	41,447	0	0	0	0	13,736	0	0	0
17. UHF Repeater Station & Village's Head	1	134,286	134,286	0	0	0	111,392	0	22,894	0	0	0
18. Doğ ankent/Yneice Ofiice	2	23,086	46,172	0	0	0	14,020	0	9,066	0	0	0
19. Ofiice of Village's Head	4	40,550	162,200	0	0	0	31,484	0	9,066	0	0	0
20. Spare Parts and Units	1	473,590	473,590	0	0	0	0	0	0	473,590	0	0
21. Test Equipment and Maintenance Car	1	279,770	279,770	0	0	0	0	0	0	0	279,770	0
22. Installation Materials	1	357,400	357,400	0	0	0	0	0	0	0	0	357,400
Grand Total			9,004,170									

Table 10.2.1 Financial Cash Flow

(Unit: USD)

Item	Year									
	0	1	2	3	4	5	6	7	8	9
Inv. Cost	1,137,952	12,202,646	0	0	0	0	0	0	0	0
O&M Cost	0	0	279,211	279,211	279,211	279,211	279,211	279,211	279,211	279,211
Total	1,137,952	12,202,646	279,211	279,211	279,211	279,211	279,211	279,211	279,211	279,211
	Year									
	10	11	12	13	14	15	16	17	18	
Inv. Cost	0	0	0	0	0	0	0	0	0	
O&M Cost	279,211	279,211	279,211	279,211	279,211	279,211	279,211	279,211	279,211	
Total	279,211	279,211	279,211	279,211	279,211	279,211	279,211	279,211	279,211	
Simple Sum	18,087,185									
Inv. Cost	13,340,598									
O&M Cost	4,746,587									
NPV	16,072,072									
DiscountRate	3.0%									

Table 10.2.2 Investment Cost

(TL Value Unit: 1,000 TL)

Item	Foreign		Domestic					Financial	VAT	Economic
	USD Value	Deflated	USD Val.	Deflated	TL Value	Deflated	USD Equiv	Value(USD)		Value(USD)
Equipment	9,004,170	8,756,039						8,756,039		8,756,039
Civil Works					17,533,400	13,413,969	1,196,408	1,196,408	15%	1,016,947
Installation	1,092,320	1,062,219			1,987,900	1,520,848	135,647	222,924		210,566
PTT Private Line Installation					18,400	14,077	1,256	1,256	15%	1,068
Manpower	1,002,570	974,942			780,500	597,123	53,258	53,258		53,258
Machine	89,750	87,277			0	0	0	87,277		87,277
Vehicles for Installation					1,189,000	909,647	81,133	81,133	15%	68,963
Inland Transportation					47,600	36,416	3,248	3,248	15%	2,761
Unloading and Warehouse			176,500	171,636				171,636	15%	145,891
Land Acquisition					6,600	5,049	450	450		450
Overhead					197,454	151,063	13,473	13,473		13,473
Engineering	1,170,200	1,137,952						1,137,952		1,137,952
Training	148,580	144,486						144,486		144,486
Provisional	554,870	539,579			2,630,010	2,012,095	179,461	719,040		719,040
Total		11,640,275		171,636		17,139,441	1,528,687	12,365,656		12,147,605

*Deflators for Domestic Cost and Foreign Cost are 1.3071 and 1.0283 respectively.

Table 10.2.3 O&M Cost

Item	TL Value (1,000)	Deflated (1,000)	Financial Value(USD)	VAT	Economic Value(USD)
Personnel	1,968,000	1,505,623	134,288		134,288
Fuel	137,120	104,904	9,357	15%	7,953
Repair Parts	208,460	159,483	14,224	15%	12,090
Vehicle Fuel	19,550	14,957	1,334	15%	1,134
PTT Private	755,000	577,615	51,518	15%	43,790
Electricity	470,000	359,575	32,071	15%	27,260
Management	533,720	408,324	36,419		36,419
Total	4,091,850	3,130,480	279,211		262,934

*Deflator for Domestic Cost is 1.3071.

Table 10.2.4 Cost Reduction

Item	Unit Cost (TL1,000)	Number	TL Value (1,000)	Deflated	Financial Value(USD)	Economic Value(USD)
Record Reading	117,600	8	940,800	719,761	64,196	64,196
Total			940,800	719,761	64,196	64,196

*Deflator for Domestic Cost is 1.3071.

Table 10.2.5 Expected Inundation Damage Area and Economic Loss by Discharge from the Seyhan Dam

(Unit: da for land & mill TL for Loss)

Item	Discharge Volume from the Seyhan Dam (cub. m/s)														
	500	550	600	650	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200
Right Bank	0	2,557	4,062	5,567	7,071	8,576	10,081	11,586	13,090	14,595	16,100	17,059	18,017	18,976	19,934
Left Bank	0	7,361	8,683	10,005	11,327	12,649	13,970	15,292	16,614	17,936	19,258	19,400	19,542	19,683	19,825
Total Land	0	9,918	12,745	15,571	18,398	21,225	24,051	26,878	29,705	32,531	35,358	36,458	37,559	38,659	39,759
RB Loss	0	1,016	1,848	2,746	3,708	4,423	5,203	6,049	6,960	7,936	8,978	9,683	10,410	11,160	11,933
LB Loss	0	4,971	6,583	8,311	10,152	12,048	14,057	16,180	18,417	20,767	23,230	24,008	24,790	25,577	26,369
Total Loss	0	5,987	8,432	11,056	13,860	16,471	19,261	22,229	25,377	28,703	32,209	33,690	35,200	36,737	38,301

Table 10.2.6 Expected Damage Reduction

	Damage w/o Project (mill. TL)	Avg. Exp. Damage (mill. TL)	Discharge frm Seyhan (cub. m/s)	Damage w/ Project (mill. TL)	Avg. Exp. Damage (mill. TL)	Discharge frm Seyhan (cub. m/s)	Difference (mill. TL)	Per Annum Value (mill. TL)
	0			0				
2 Years	13,804	6,902	(699)	7,992	3,996	(591)	2,906	910
5 Years	27,439	20,622	(931)	11,561	9,776	(659)	10,845	3,254
10 Years	35,261	31,350	(1,102)	15,427	13,494	(720)	17,856	1,786
50 Years	38,301	36,781	(1,288)	22,607	19,017	(856)	17,764	1,421
100 Years	38,301	38,301	(1,293)	26,242	24,424	(913)	13,877	139
							Total	7,509
							Equiv. USD	669,725

Table 10.2.7 Additional Power Generation

	Power (MWH)	Avg. Exp. Power (MWH)	Power (MWH)	Avg. Exp. Power (MWH)	Total (MWH)	Economic Value (mill. TL)	Per Annum Value (mill. TL)
Expec. Op.	w/o Project		w/ Project				
	0		0				
2 Years	717,567	358,784	715,962	357,981	803	1,067	334
5 Years	791,919	754,743	790,301	753,132	1,612	2,142	643
10 Years	996,315	894,117	992,199	891,250	2,867	3,811	381
Change Op.	Çatalan		Seyhan				
	0		0				
2 Years	5,296	2,648	1,726	863	1,785	2,373	743
5 Years	10,516	7,906	4,203	2,965	4,942	6,569	1,971
10 Years	15,157	12,837	5,780	4,992	7,845	10,429	1,043
50 Years	22,097	18,627	6,455	6,118	12,510	16,630	1,330
100 Years	24,744	23,421	5,680	6,068	17,353	23,069	231
						Total	6,675
						Equiv. USD	595,379

*Unit Economic Value of Electricity (per KWH): TL1,329

Table 10.2.8 Economic Cash Flow

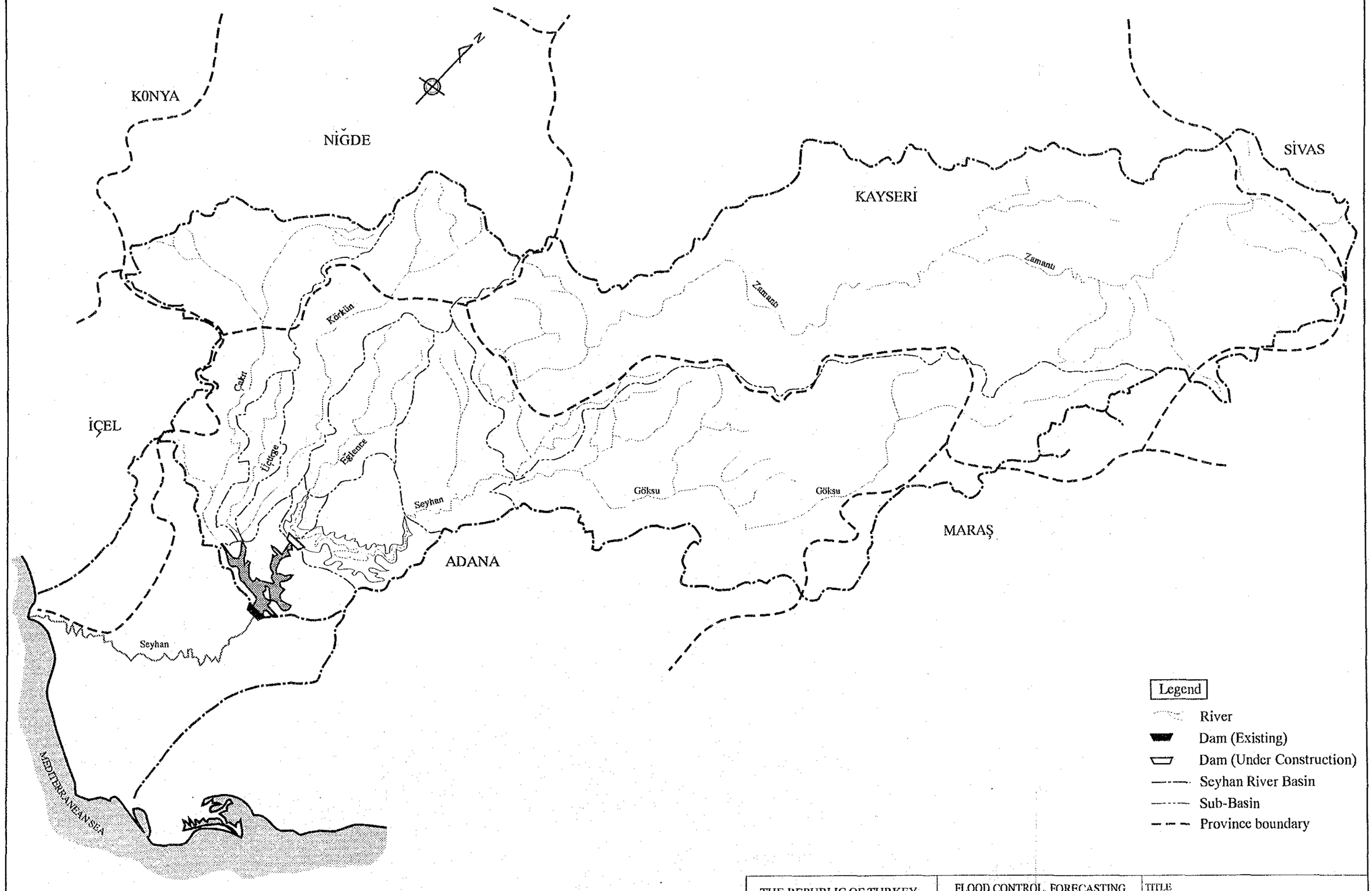
(Unit: USD)

Item	Year									
	0	1	2	3	4	5	6	7	8	9
Cost										
Inv. Cost	2,154,899	9,992,706	0	0	0	0	0	0	0	0
O&M Cost	0	0	262,934	262,934	262,934	262,934	262,934	262,934	262,934	262,934
Total	2,154,899	9,992,706	262,934	262,934	262,934	262,934	262,934	262,934	262,934	262,934
Benefit	0	0	0	0	0	0	0	0	0	
DamageReduction	0	0	669,725	669,725	669,725	669,725	669,725	669,725	669,725	669,725
Add.Electricity	0	0	595,379	595,379	595,379	595,379	595,379	595,379	595,379	595,379
Reduced Cost	0	0	64,196	64,196	64,196	64,196	64,196	64,196	64,196	64,196
TotalBenefit	0	0	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300
Net Cash Flow	-2,154,899	-9,992,706	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366

	Year								
	10	11	12	13	14	15	16	17	18
Cost									
Inv. Cost	0	0	0	0	0	0	0	0	0
O&M Cost	262,934	262,934	262,934	262,934	262,934	262,934	262,934	262,934	262,934
Total	262,934	262,934	262,934	262,934	262,934	262,934	262,934	262,934	262,934
Benefit									
DamageReduction	669,725	669,725	669,725	669,725	669,725	669,725	669,725	669,725	669,725
Add.Electricity	595,379	595,379	595,379	595,379	595,379	595,379	595,379	595,379	595,379
Reduced Cost	64,196	64,196	64,196	64,196	64,196	64,196	64,196	64,196	64,196
TotalBenefit	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300	1,329,300
Net Cash Flow	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366	1,066,366

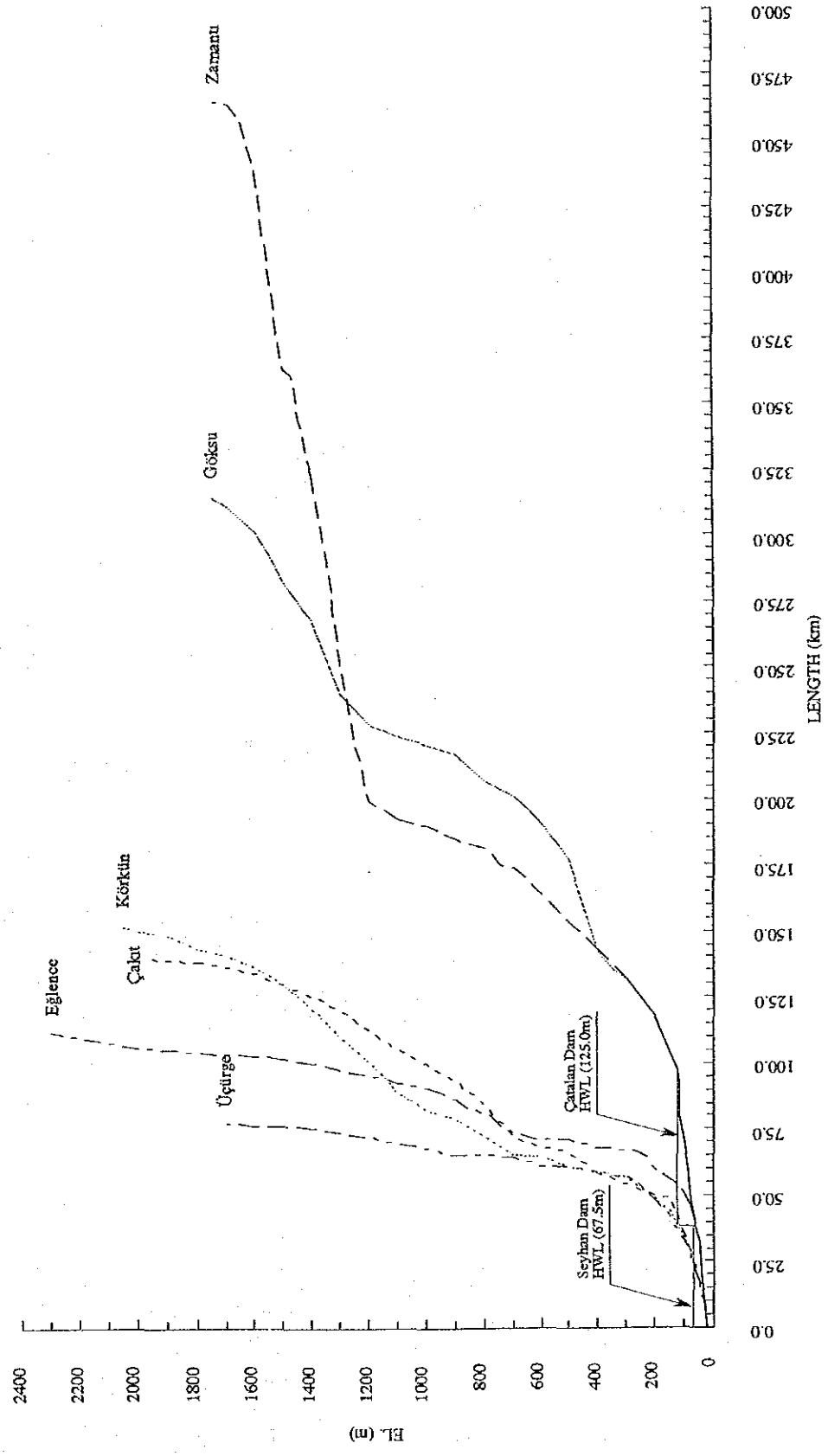
EIRR	**4.75%**
B-C (Simple Sum)	5,980,617
Cost	16,617,483
Benefit	22,598,100
B-C (NPV)	1,722,735
Cost	14,774,316
Benefit	16,497,051
DiscountRate	3.0%

Figures

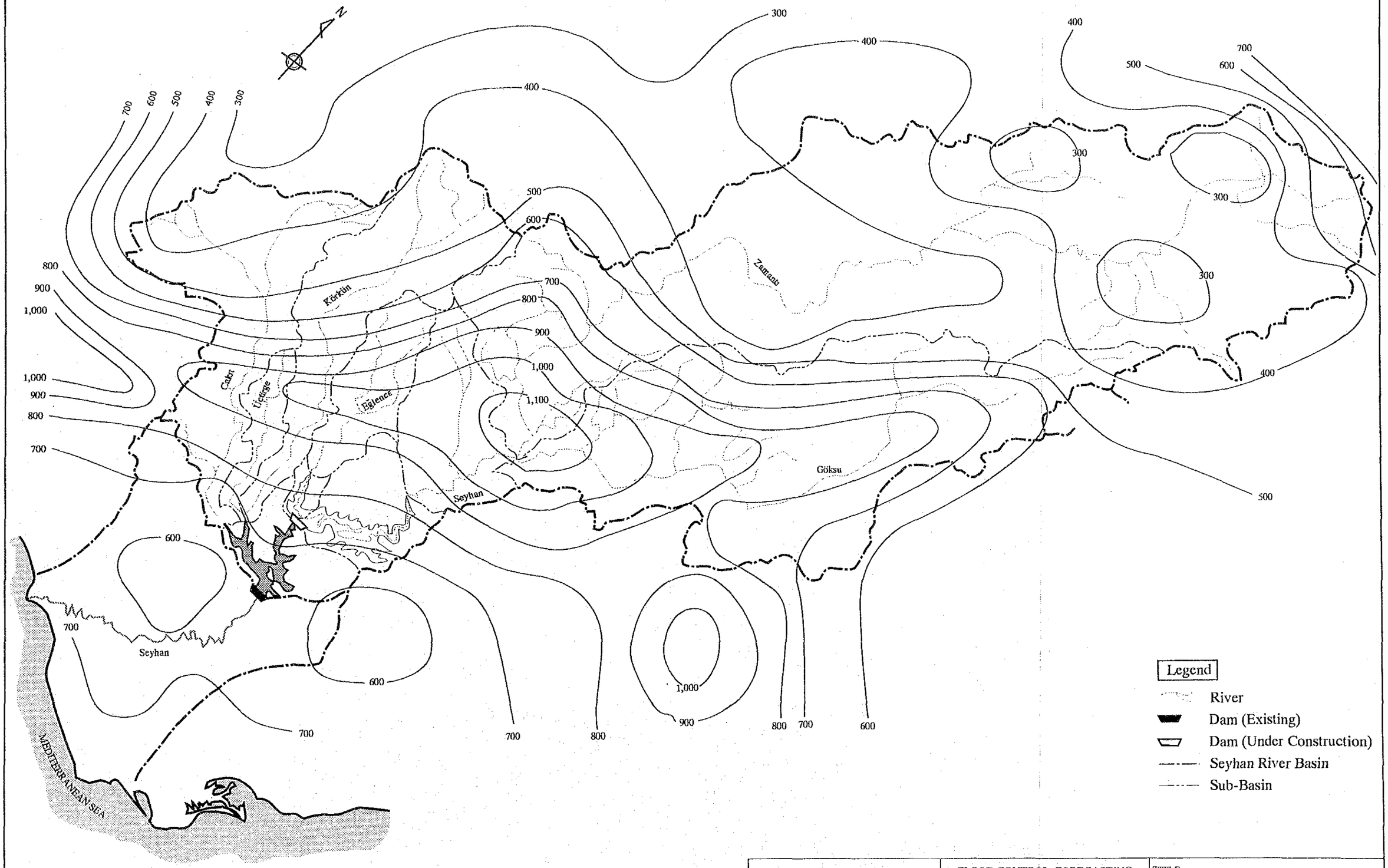


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.1.1 LOCATION MAP OF THE SEYHAN RIVER BASIN

FIG. NO.



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.1.2 RIVER PROFILE OF THE SUB-BASINS



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.1.3 ISOHYETAL MAP OF THE SEYHAN RIVER BASIN