The construction cost was estimated as 602.6 million US dollars. The breakdown of this cost as shown in the implementation plan is as follows, with the figures in parentheses giving the period of the project and the percentage of the total project cost:

First Priority Project (1997-2002) :	277.8 million US dollars (46%)
Second Priority Project (2003-2010) :	324.8 million US dollars (54%)
Total	:	602.6 million US dollars (100%)

The local currency portion of this project (indicated by L/C) expresses the cost of materials and labor procured within the country, while the foreign currency portion (indicated by F/C) expresses the cost of materials procured from foreign countries.

The above cost is steel pipe with inner mortar lining. In Supporting Report - D, the costs are compared with and without inner mortar lining. As stated in the Supporting Report, JICA study team does not recommend the without inner lining.

Please refer to Table 5.1.

5.3 Implementation Plan

As described in Chapter 1, the method for scaling down the project is as follows,

1) Use existing facilities and already-purchased machinery and equipment as far as possible.

   Abandon the construction of approximately 111 km of pipeline (diameter 1,000 mm) between Takhiatash and Kungrad, and use the existing Urgench Transgas water supply pipeline.

2) Reducing the expansion plan for water supply.

   In other words, reducing the scale of the project. More specifically, postpone the implementation of projects included in the feasibility study that are to be implemented by 2002 in the Basic Plan, and implement them by 2010, the target year for the Basic Plan.

The implementation schedule for the rescheduled project is divided into two stages.

First Priority Project : Drinking water quality improvement
To ease the tight water supply and demand of Khorezm. Leakage control, implementation of served population and bill collection, and awareness of water conservation concept in Karakalpakstan and Khorezm Vodokanal.

Second Priority Project : To ease the tight water supply and demand of Karakalpakstan.
Rehabilitation works for aged water treatment plants.

First Priority Project

(1) Water quality
To improve the quality of water, change the main water source from the Amu Darya river to the Kaparas reservoir

(2) Tight water supply and demand
Expand the Tuyamuyun-Urgench water treatment plant to ease the tight water supply and demand of Khorezm.

(3) Supply of good quality drinking water
Lay transmission pipeline up to Muynak and supply good quality drinking water.

(4) Water leakage and areas not yet supplied with water
Replace aged distribution pipelines and reduce the amount of leakage. Lay distribution pipelines in areas not receiving water supply.

(5) Water conservation and water tariff collection
Install water meters to promote conservation of water and impose correct water tariff on the residents, according to water actually consumed.

Second Priority Project

(1) To ease the tight water supply and demand
Upgrade water treatment plant in Tuyamuyun-Nukus, to ease the tight water supply and demand at Karakalpakstan.

(2) Rehabilitation works for water treatment plants
Fully rehabilitate the aged treatment plants.

(3) Water leakage and areas not yet supplied water
Same as First Priority Project

(4) Water conservation and water tariff collection
Same as First Priority Project

The expansion schedule of the supply capacity based on the project implementation schedule and the planned water demand are shown in Table 5.2 (Karakalpakstan covered by T-N system) and Table 5.3 (Khorezm covered by T-U system.)

Table 5.1 Project Cost

(unit : million USD)

Work Item	Specification	Total			First Priority Pro (FPP)			Second Priority Pro (SPP)		
		Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C
1. Kaparas Raw Water Intake System										
1.1 Kaparas Intake Station	Q=750,000 m³/d	12.9	8.0	4.9	12.9	8.0	4.9			
1.2 Raw Water Mains Pipeline										
1.2.1 Kaparas I.S. to T-N Existing Intake Station	D=1,400 L=10.7 km	18.7	4.5	14.2	18.7	4.5	14.2			
1.2.2 Kaparas I.S. to T-U Existing Intake Station	D=1,400 L= 1.0 km	1.6	0.1	1.5	1.6	0.1	1.5			
1.2.3 Kaparas I.S. to T-U Existing Intake Station	D=1,400 L= 9.0 km	12.7	1.3	11.4	12.7	1.3	11.4			
Sub-Total		45.9	13.9	32.0	45.9	13.9	32.0			
2. Tuyamuyun-Nukus Water Supply System										
2.1 Water Treatment Plant	Q=350,000 m³/d									
2.1.1 Rehabilitation	Q=200,000 m³/d	15.5	2.6	12.9				15.5	2.6	12.9
2.1.2 Expansion	Q=150,000 m³/d	44.6	13.3	31.3				44.6	13.3	31.3
2.2 Transmission and Distribution Pumping Station										
2.2.1 No. 2 Booster Pumping Station	Q=234,410 m³/d	9.5	6.3	3.2				9.5	6.3	3.2
2.2.2 Nukus North Distribution Station	Q=122,950 m³/d	10.8	5.0	5.8	10.8	5.0	5.8			
2.2.3 Kungrad Transmission and Distribution Station	Q= 42,130 m³/d	10.5	6.7	3.8	10.5	6.7	3.8			
2.3 Transmission Pipeline										
2.3.1 W.T.P. - No. 1 Pumping Station	D=1,400 L= 63.0 km	82.7	9.3	73.4				82.7	9.3	73.4
2.3.2 Nukus - Takhiatash L=21 km	D=1,200 L= 11.0 km	14.7	3.7	11.0	14.7	3.7	11.0			
2.3.3 Kungrad - Muynak (Q=8,870 m³/d)	D=500 L= 96.5 km	28.5	3.6	24.9	28.5	3.6	24.9			
2.3.4 Kegeili - Bozatau	D=400 L= 50.0 km	15.0	1.4	13.6				15.0	1.4	13.6
Sub-Total		231.8	51.9	179.9	64.5	19.0	45.5	167.3	32.9	134.4
3. Tuyamuyun-Urgench Water Supply System										
3.1 Water Treatment Plant	Q=400,000 m³/d									
3.1.1 Rehabilitation	Q=200,000 m³/d	15.5	2.5	13.0				15.5	2.5	13.0
3.1.2 Expansion	Q=200,000 m³/d	56.8	17.8	39.0	56.8	17.8	39.0			
3.2 Transmission Pipeline										
3.2.1 W.T.P. - Khazarasp Pumping Station	D=1,200 L=27.0 km	27.6	2.8	24.8	27.6	2.8	24.8			
3.2.2 Khanki - Urgench	D=1,200 L=13.2 km	8.1	0.8	7.3	8.1	0.8	7.3			
3.2.3 Yanglaryk - Khiva	D=600 L=20.0 km	7.3	0.7	6.6	7.3	0.7	6.6			
3.2.4 S.P.1 - Koshkupyr	D=600 L=14.0 km	5.2	0.7	4.5	5.2	0.7	4.5			
3.2.5 Gurlen - Shavat	D=600 L=19.5 km	3.3	0.3	3.0	3.3	0.3	3.0			
Sub-Total		123.8	25.6	98.2	108.3	23.1	85.2	15.5	2.5	13.0
4. VodoKanal Karakalpakstan										
4.1 Water Treatment Plant										
4.1.1 Nukus W.T.P (Rehabilitation)	Q= 65,000 m³/d	17.7	1.6	16.1				17.7	1.6	16.1
4.1.2 Chimbai W.T.P (Rehabilitation)	Q= 2,200 m³/d	1.6	0.1	1.5				1.6	0.1	1.5
4.1.3 Water Treatment Plant (Rehabilitation) , 3Cities	Q= 14,000 m³/d	6.6	0.5	6.1				6.6	0.5	6.1
4.2 Distribution Network										
4.2.1 Replacement D=100~D=400	L=228.8 km	53.2	31.8	21.4	20.5	12.2	8.3	32.7	19.6	13.1
4.2.2 Expansion D=100~D=400	L=119.6 km	28.0	16.8	11.2	10.8	6.5	4.3	17.2	10.3	6.9
4.3 Metering System										
4.3.1 Meter Installation D=20	N=115,960 Pieces	10.3	2.4	7.9	3.9	0.9	3.0	6.4	1.5	4.9
Sub-Total		117.4	53.2	64.2	35.2	19.6	15.6	82.2	33.6	48.6
5. VodoKanal Khorezm										
5.1 Water Treatment Plant										
5.1.1 Urgench W.T.P (Rehabilitation)	Q= 50,000 m³/d	19.7	1.5	18.2				19.7	1.5	18.2
5.1.2 Chalish (Rehabilitation)	Q= 11,000 m³/d	1.9	0.1	1.8				1.9	0.1	1.8
5.2 Distribution Network										
5.2.1 Replacement D=100~D=400	L=170.3 km	39.9	23.8	16.1	15.3	9.1	6.2	24.6	14.7	9.9
5.2.2 Expansion D=100~D=400	L= 71.5 km	16.8	10.1	6.7	6.5	3.9	2.6	10.3	6.2	4.1
5.3 Metering System										
5.3.1 Meter Installation D=20	N=60,970 Pieces	5.4	1.3	4.1	2.1	0.5	1.6	3.3	0.8	2.5
Sub-Total		83.7	36.8	46.9	23.9	13.5	10.4	59.8	23.3	36.5
Total		602.6	181.4	421.2	277.8	89.1	188.7	324.8	92.3	232.5

Note :
L/C : Local currency portion, F/C : Foreign currency portion
This construction cost is pipeline with inner cement mortar lining.

Fig. 5.1 Implementation Schedule

F/S

Description \ Year		First Priority Project						Second Priority Project							Remarks
		0 1997	1 1998	2 1999	3 2000	4 2001	5 2002	6 2003	7 2004	8 2005	9 2006	10 2007	11 2008	12 2009	13 2010	
Loan Arrangement																
Preparation of Tender (Bids, Evaluations)																
1. Kaparas Raw Water Intake System																
1.1 Kaparas Intake Station	Q=750,000 m³/d															
1.2 Raw Water Mains Pipeline																
1.2.1 Kaparas I.S. to T-N Existing Intake Station	D=1,400 L=10.7 km															
1.2.2 Kaparas I.S. to T-U Existing Intake Station	D=1,400 L= 1.0 km															
1.2.3 Kaparas I.S. to T-U Existing Intake Station	D=1,400 L= 9.0 km															
2. Tuyamuyun-Nukus Water Supply System																
2.1 Water Treatment Plant	Q=350,000 m³/d															
2.1.1 Rehabilitation	Q=200,000 m³/d															
2.1.2 Expansion	Q=150,000 m³/d															
2.2 Transmission and Distribution Pumping Station																
2.2.1 No. 2 Booster Pumping Station	Q=234,410 m³/d															
2.2.2 Nukus North Distribution Station	Q=122,950 m³/d															
2.2.3 Kungrad Transmission and Distribution Station	Q= 42,130 m³/d															
2.3 Transmission Pipeline																
2.3.1 W.T.P. - No. 1 Pumping Station	D=1,400 L= 63.0 km															
2.3.2 Nukus - Takhiatash L=21 km	D=1,200 L= 11.0 km															
2.3.3 Kungrad - Muynak (Q=8,870 m³/d)	D=500 L= 95.5 km															
2.3.4 Kegeili - Bozatau	D=400 L= 50.0 km															
3. Tuyamuyun-Urgench Water Supply System																
3.1 Water Treatment Plant	Q=400,000 m³/d															
3.1.1 Rehabilitation	Q=200,000 m³/d															
3.1.2 Expansion	Q=200,000 m³/d															
3.2 Transmission Pipeline																
3.2.1 W.T.P. - Khazarasp Pumping Station	D=1,200 L=27.0 km															
3.2.2 Khanki - Urgench	D=1,200 L=13.2 km															
3.2.3 Yangiaryk - Khiva	D=600 L=20.0 km															
3.2.4 S.P.1 - Koshkupyr	D=600 L=14.0 km															
3.2.5 Gurlen - Shavat	D=600 L=19.5 km															
4. VodoKanal Karakalpakstan																
4.1 Water Treatment Plant																
4.1.1 Nukus W.T.P (Rehabilitation)	Q= 65,000 m³/d															
4.1.2 Chimbai W.T.P (Rehabilitation)	Q= 2,200 m³/d															
4.1.3 Water Treatment Plant (Rehabilitation) , 3Cities	Q= 14,000 m³/d															
4.2 Distribution Network																
4.2.1 Replacement D=100~D=400	L=228.8 km															
4.2.2 Expansion D=100~D=400	L=119.6 km															
4.3 Metering System																
4.3.1 Meter Installation D=20	N=115,960 Pieces															
5. VodoKanal Khorezm																
5.1 Water Treatment Plant																
5.1.1 Urgench W.T.P (Rehabilitation)	Q= 50,000 m³/d															
5.1.2 Chalish (Rehabilitation)	Q= 11,000 m³/d															
5.2 Distribution Network																
5.2.1 Replacement D=100~D=400	L=170.3 km															
5.2.2 Expansion D=100~D=400	L= 71.5 km															
5.3 Metering System																
5.3.1 Meter Installation D=20	N=60,970 Pieces															

Fig. 5.2 Water demand and planned expansion capacity of W.T.P. in Karakalpakstan

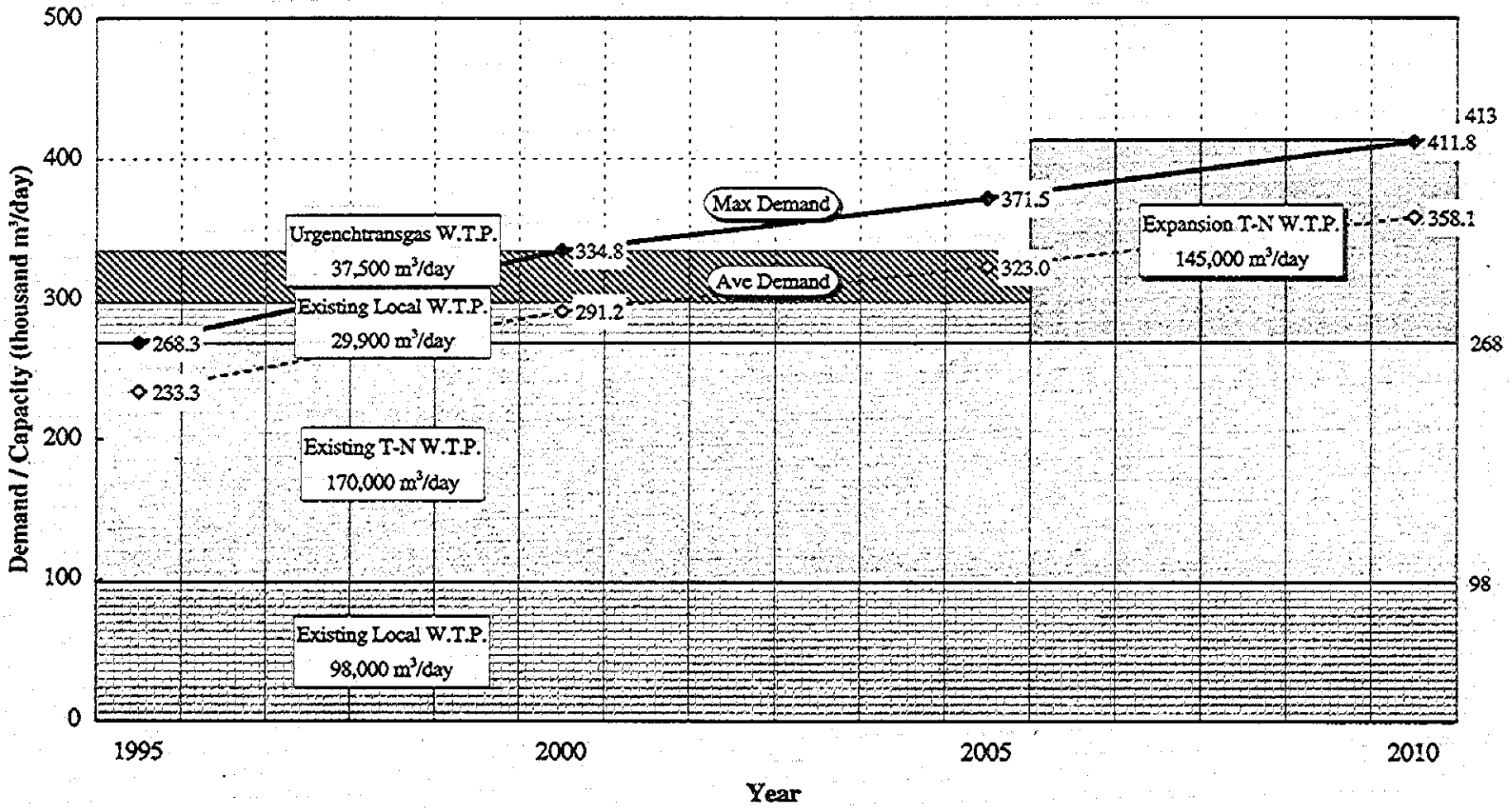
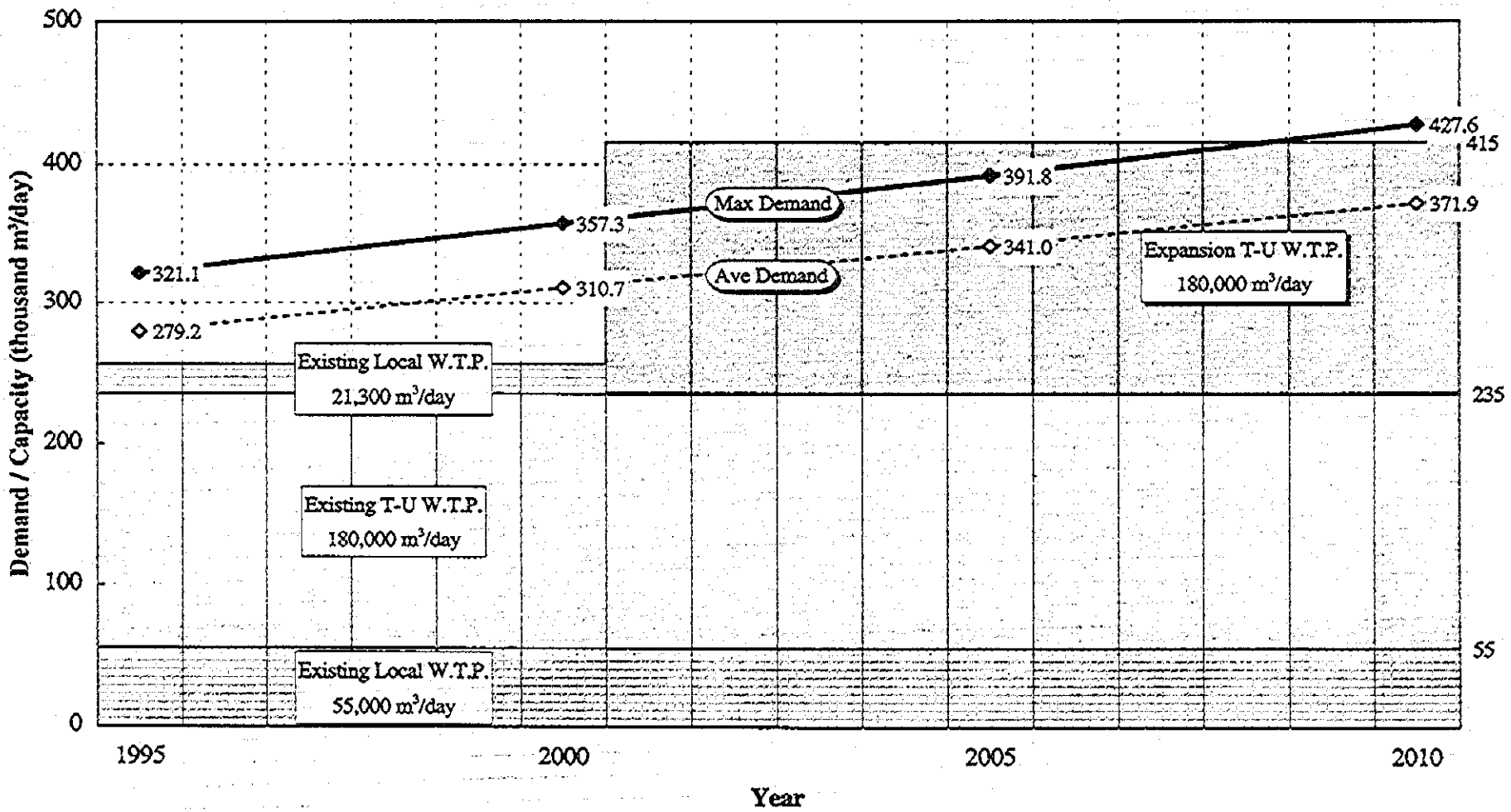


Fig. 5.3 Water demand and planned expansion capacity of W.T.P. in Khorezm



5.4 Operation and Maintenance Costs

5.4.1 Calculation Conditions

Operation and maintenance costs (O&M costs) are calculated based on the conditions below.

a) O&M costs are calculated for four water supply enterprises of Tuyamuyun and Vodokanal, in Karakalpakstan and Khorezm.
b) Using the income and expenditure reports of the four water supply enterprises, calculations are performed to predict the O&M costs in future, based on costs per unit quantity of accounted -for water (AFW).
c) Forecasted and actual O&M costs are shown in the income and expenditure reports, but here the costs are estimated based on the forecasted values that are considered to reflect the necessary and ideal operation and maintenance conditions for the water supply system.
d) The O&M costs for the Kaparas Pumping Station (Kaparas PS) and raw water main shall be added after they start operating. In addition, the costs for water treatment, particularly the cost of chemicals, can be reduced since the turbidity of the water in the Kaparas reservoir is low.
e) The electricity charges for the proposed transmission pumping stations (Proposed PS) shall be added after the start of operation.

5.4.2 Analysis of Present Operation and Maintenance Costs

(1) Tuyamuyun system

1) Present O&M costs

The main expenditure items for operation and maintenance tabulated in the income and expenditure reports of Tuyamuyun systems are as given below (for details, please refer to the Basic Plan of Chapter 7).

a) Electricity charges
b) Chemicals (materials, disinfectants)
c) Wages (labor fund)
d) Social insurance expenses
e) Fuel, gas, lubricating oils
f) Repair expenses

g) Depreciation cost

According to the actual income and expenditure reports for 1995, electricity charges accounted for the maximum share of the total expenditure: 69% in Tuyamuyun-Nukus, and 55% in Tuyamuyun-Urgench. The item with the second largest share of the expenditure was personnel expenses (10%) in Tuyamuyun-Nukus and chemicals (12%) in Tuyamuyun-Urgench. The forecasted expenses for Tuyamuyun-Nukus in 1995 showed chemicals following electricity charges and accounting for 18% of the total expenditure, but the actual expenses was only 4%, and the amount of cash actually spent was one-fourth the estimated amount. This was attributed to shortage of chemicals because of the difficulty in procuring chemicals during that period.

2) Tuyamuyun-Nukus

Table 5.2 shows the expenditure, produced water quantity, accounted-for water quantity, and expenses per unit quantity of AFW in Tuyamuyun-Nukus.

Table 5.2 Annual Expenditure/Produced Water Quantity, Water Quantity, and Expenses Per Unit Quantity of AFW

(Tuyamuyun-Nukus)

Item	Expenditure/water quantity (Forecasted values)		Expenses per unit quantity of AFW	
	1995	1996	1995	1996
Produced water qty.(ths.m^3)	43,844	46,248		
AFW qty. (ths. m^3)	34,121	37,121		
Percentage of AFW (%)	77.8	80.3		
Expenditure items	(thousand Sum)		(Sum/m^3)	
Electricity charges	58,840	87,734	1.724	2.363
Wages	9,408	18,639	0.276	0.502
Chemicals	19,425	6,678	0.569	0.180
Repairs	2,476	6,225	0.073	0.168
Social insurance	3,763	7,456	0.110	0.201
Fuel, gas, lub. oil	3,843	8,332	0.113	0.224
Others	3,160	10,112	0.093	0.272
Sub-total	100,915	145,176	2.958	3.910
Depreciation cost	8,535	14,063	0.250	0.379
Grand total	109,450	159,239	3.208	4.289

Source : Table 7.3 in the Part I of this report

3) Tuyamuyun-Urgench

Table 5.3 shows the expenditure, produced water quantity, accounted-for water quantity, and expenses per unit quantity of AFW in Tuyamuyun-Urgench.

Table 5.3 Annual Expenditure/Produced Water Quantity, Water Quantity, and Expenses Per Unit Quantity of AFW

(Tuyamuyun-Urgench)

Item	Expenditure/ water quantity (Forecasted/values)		Expenses per unit quantity of AFW	
	1995	1996	1995	1996
Produced water qty.(ths.m^3)	69,620	73,000		
AFW qty. (ths. m^3)	62,320	65,700		
Percentage of AFW (%)	89.5	90.0		
Expenditure items	(thousand Sum)		(Sum/m^3)	
Electricity charges	50,307	105,589	0.807	1.607
Wages	8,954	18,198	0.144	0.277
Chemicals	13,075	16,404	0.210	0.250
Repairs	4,700	7,254	0.075	0.110
Social insurance	3,582	7,279	0.057	0.111
Fuel, gas, lub. oil	4,639	11,756	0.074	0.179
Others	5,936	8,150	0.095	0.124
Sub-total	91,193	174,630	1.462	2.658
Depreciation cost	6,700	8,550	0.108	0.130
Grand total	97,893	183,180	1.570	2.788

Source : Table 7.4 in the Part I of this report

(2) Vodokanal

1) General conditions

Since treated water is purchased from the Tuyamuyun system, the expenses for receiving water is added to the O&M costs for Vodokanal. The breakdown of expenses varies for the Vodokanals in Karakalpakstan and Khorezm. According to the forecasted income and expenditure reports for 1995, the breakdown is as given below.

Karakalpakstan: Total expenditure - 116,931 thousand Sum
Electricity charges - 14.8%, Expenses for receiving water - 35.6%,
Repairs - 1.8.0%, wages - 7.3%

Khorezm: Total expenditure - 53,445 thousand Sum

Electricity charges - 39.0%, Expenses for receiving water - 14.3%, Wages - 13.7%, Chemicals - 9.0%

2) Karakalpakstan

Table 5.4 shows the expenditure, produced water quantity, accounted-for water quantity, and expenses per unit quantity of AFW in Vodokanal Karakalpakstan.

Table 5.4 Annual Expenditure/Produced Water Quantity, Water Quantity, and Expenses Per Unit Quantity of AFW

(Vodokanal-Karakalpakstan)

Item	Expenditure/water quantity (Forecasted values)		Expenses per unit quantity of AFW	
	1995	1996 (1st half)	1995	1996 (1st half)
Distributed water qty.	61,168	32,281		
AFW qty. (ths. m^3)	47,006	21,340		
Percentage of AFW (%)	76.8			
Expenditure items	(thousand Sum)		(Sum/m^3)	
Electricity charges	17,325	13,215	0.369	0.619
Wages	8,481	6,281	0.180	0.294
Chemicals	2,691	2,781	0.057	0.130
Repairs	20,990	7,907	0.447	0.371
Social insurance	3,392	2,512	0.072	0.118
Fuel, gas, lub. oil	2,676	1,998	0.057	0.094
Others	13,987	15,528	0.298	0.728
Sub-total	69,542	50,222	1.480	2.354
Depreciation cost	5,756	2,988	0.122	0.140
Expenses for receiving water	41,633	34,916	0.886	1.636
Grand total	116,931	88,126	2.488	4.130

Source : Table 7.1 in the Part I of this report

3) Khorezm

Table 5.5 shows the expenditure, produced water quantity, accounted-for water quantity, and expenses per unit quantity of AFW in Vodokanal-Khorezm.

Table 5.5 Annual Expenditure/Produced Water Quantity, Water Quantity, and Expenses Per Unit Quantity of AFW

(Vodokanal-Khorezm)

Item	Expenditure/water quantity (Forecasted values)		Expenses per unit quantity of AFW	
	1995	1996 (1st half)	1995	1996 (1st half)
Distributed water qty.	66,840	28,506		
AFW qty. (ths. m^3)	60,503	26,451		
Percentage of AFW (%)	90.5	92.8		
Expenditure items	(thousand Sum)		(Sum/m^3)	
Electricity charges	20,851	12,718	0.345	0.481
Wages	7,298	4,663	0.121	0.176
Chemicals	4,834	1,940	0.080	0.073
Repairs	2,296	2,091	0.038	0.079
Social insurance	2,919	1,885	0.048	0.071
Fuel, gas, lub. oil	1,099	1,354	0.018	0.051
Others	2,960	3,113	0.049	0.118
Sub-total	42,257	27,764	0.699	1.049
Depreciation cost	3,555	1,522	0.059	0.058
Expenses for receiving water	7,633	7,796	0.126	0.295
Grand total	53,445	37,082	0.884	1,402

Source : Table 7.2 in the Part I of this report

5.4.3 Estimation of Operation and Maintenance Costs after Project is implemented

Although the forecasted and actual O&M costs are calculated in the income and expenditure reports, the O&M costs after implementation of the project are to be estimated based on the forecasted values in which the necessary and ideal operation and maintenance conditions are reflected.

(1) Tuyamuyun system

After the Kaparas PS and raw water main put into operation, their O&M costs will be added afresh. Moreover, since the turbidity of the raw water of the Kaparas reservoir is low, the costs for water treatment, particularly the cost of chemicals can be reduced.

In addition, construction of the three pumping stations mentioned below is planned for the Tuyamuyun -Nukus system. After these pumping stations start operating, electricity charges for these pumping stations shall be added as additional expenses.

a) NO2 transmission pumping station
b) Nukus North pumping station
c) Kungrad pumping station

1) Increase in the O&M costs of the Kaparas PS and raw water main

When the Kaparas PS is completed in the future, the existing intake pumping stations (the existing intake PS) will be abolished or used as a standby facility. To calculate the increase in O&M costs of the Kaparas PS, the O&M costs of each existing intake PS of the two Tuyamuyun water treatment plants and the proposed Kaparas PS are compared. Table 5.6 compares the electricity costs per unit quantity of water delivered for the existing intake PS and the Kaparas PS. According to this table, the electricity costs per unit quantity of water delivered by the Kaparas PS (0.389 Sum/m^3) is 2.44 times that of the existing Tuyamuyun-Nukus intake PS (0.160 Sum/m^3) and 1.01 times that of the existing Tuyamuyun-Urgench intake PS (0.384 /Sum/m^3). Consequently, the electricity charges for Tuyamuyun-Urgench intake PS offset those of Kaparas, therefore, these costs are not considered. The difference of 0.229 Sum/m^3 in Tuyamuyun-Nukus is added to the O&M costs for Tuyamuyun-Nukus system. This value is the unit quantity of water delivered. To convert this value to unit quantity of AFW analyzed above, the ratio of AFW to total water production for Tuyamuyun-Nukus water treatment plant is taken as about 80%. Using this rate, the electricity charges per unit quantity of delivery water of Tuyamuyun-Nukus is converted to that of AFW, that is: 0.286 Sum/m^3.

Table 5.6 Comparison of Electricity Charges Per Unit Delivered Water Quantity of Existing PS and Kaparas PS

Facility	Power (kW)	Delivery rate (m^3/h)	Electricity consumption per unit quantity of delivered water (kWh/m^3)	Unit electricity charge (Sum/kWh)	Water delivery cost per unit quantity of delivered water (Sum/m^3)	Difference between electricity cost of Kaparas PS and existing PS
Kaparas PS	3,500	14,400	0.243	1.6	0.389	-
Existing intake PS						
T-Nukus	630	6,300	0.100	1.6	0.160	0.229
T-Urgench	1,200	5,000	0.240	1.6	0.384	0.005

O&M costs other than electricity charges such as repairs and wages are assumed to be covered in the O&M costs for the two existing intake pumping stations, and therefore, are not considered as additional expenses.

2) Decrease in expenses for chemicals

In the future, after the Kaparas PS and raw water main are put into operation the quality of raw water for the water treatment plants will improve. Particularly, the turbidity of raw water will improve significantly. Reduction in the turbidity of raw water leads to reduction in the quantity of coagulants used and in the cost of coagulants. The calculation process is shown in Tables 5.7, 5.8 and 5.9. The results of the calculation show that when the Kaparas reservoir is taken as the source of water, the cost of chemicals was 42% of the cost when the existing water sources are used.

Estimation Conditions

a) Unit cost of coagulants: 7,030 Sum/ton (as of July 1996; source: MPU)
b) Total cost of coagulants: 1.4 times the cost of coagulants (including cost of coagulants and coagulation aids)
c) Average improvement in turbidity: Improvement in turbidity from 90 to 2 (based on the existing turbidity)
d) Annual treated water quantity: 43,924 thousand m^3 (actual value for Tuyamuyun-Nukus in 1995)
e) Percentage of accounted-for water : 90 %
f) Chlorine feed rate: 1 mg/l
g) Chlorine cost: 34,300 Sum/ton (as of July 1996; source: MPU)

Table 5.7 Comparison of Annual Coagulant Costs

	Annual average turbidity	Annual treated water quantity (ths. m^3)	Required coagulant q'ty (ton)	Unit cost of coagulants (Sum/ton)	Coagulant cost (ths. Sum)	Total coagulants cost includ. coagulants aids (ths. Sum)
After Project	2	43,924	351	7,030	2,500	3,500
Before Project	90	43,924	1,682	7,030	11,800	16,520

Table 5.8 Calculation of Annual Chlorine Costs

Chorine feed rate (mg/l)	Annual treated water quantity (ths. m^3)	Required quantity of chlorine (ton)	Unit cost of chlorine (Sum/ton)	Chlorine cost (ths. Sum)
1	43,924	43.9	34,300	1,500

Table 5.9 Comparison of Annual Cost of Chemicals using Kaparas Reservoir and Existing Surface Water as Water Sources

Water source	Cost of chemicals (Sum)	Cost per unit quantity of treated water (Sum/m^3)	Cost per unit quantity of AFW (Sum/m^3)	Ratio
Kaparas reservoir	5,000	0.114	0.127	0.28
Existing surface water	18,020	0.410	0.456	1.00

3) Increase in electricity charges for the Proposed PS

Annual electric power consumption of the existing transmission pumps in Tuyamuyun-Nukus WTP including Kaparas PS and the Proposed PS based on the water demand in 2010 is estimated as shown in Table 5.10. In the same table, the ratio of electric power consumption for proposed PS to the existing transmission pumps in T-Nukus WTP and Kaparas PS is also shown. After these pumping stations are put into operation, the electricity charge for each proposed PS is added, based on the ratio.

Table 5.10 Annual Electric Power Consumption in 2010 and Its Ratio

Pumping Station	Annual electric power consumption (mil. kWh/year)	Ratio
Kaparas and T-Nukus WTP	175	1.00
NO 2 transmission	98	0.56
Nukus North	32	0.18
Kungrad	2	0.01

Note : Annual electric power consumption is estimated using the water demand in 2010.

4) Summary of future O&M costs

The O&M costs per unit quantity of AFW in the Tuyamuyun system after implementation of this project are summarized as given below.

1. Electricity charges: The increase in the O&M costs of the Kaparas PS is considered only in the Tuyamuyun-Nukus system. The increase in cost is 0.286 Sum/m^3. The

increase in cost of the Proposed PS is estimated from the ratio of electric power consumption as shown in the Table 5.10.

2. Wages: Present unit expense per unit quantity of AFW is used.
3. Chemicals: Forecasted cost of existing chemicals is probably lower than the appropriate cost. The cost of chemicals per unit quantity of AFW calculated in Table 5.9 is used as appropriate cost.
4. Repairs: The actual unit expense of repairs for existing facilities is used. Repair expense for new facilities is taken as 0.5% of the cost of new facilities.
5. Social insurance costs: Present unit expense per unit quantity of AFW is used.
6. Fuel, gas, lubricating oils: Present unit cost is used.
7. Others: Present unit expense per unit quantity of AFW is used.
8. Depreciation cost: For existing facilities, present fixed cost is used (T-N system; 8,494 x ths. Sum/year, T-U system; 11,104 ths. Sum/year; source: MPU). For new facilities, the depreciation cost is taken as 2.5% of the construction cost.

The O&M costs per unit quantity of AFW for each item are set as given below.

Table 5.11 O&M Costs Per Unit Quantity of AFW of Tuyamuyun System Before and After the Implementation of the Project

(units: Sum/m³)

Expenditure item	Tuyamuyun - Nukus		Tuyamuyun - Urgench	
	Before project implementation	After project implementation	Before project implementation	After project implementation
Electricity charges	2.363	2.649	1.607	1.607
Wages	0.502	0.502	0.277	0.277
Chemicals	0.456	0.127	0.456	0.127
Repairs	0.168	0.168+α	0.110	0.110+α
Social insurance	0.201	0.201	0.111	0.111
Fuel, gas, lub. oils	0.224	0.224	0.179	0.179
Others	0.272	0.272	0.124	0.124
Total	4.186	4.143+α	2.864	2.535+α

Note : The increase in the O&M costs after operation of the Proposed PS starts, is not included in the O&M costs after project implementation in the table. Only costs for the existing transmission pumps in WTP and Kaparas PS are included. The costs after completion of proposed pumping stations are calculated separately from the additional electric charges based on the ratio in Table 5.10.

α : incremental repair cost for new facilities

(2) Vodokanal system

The expenditure items tabulated in the income and expenditure report vary for each Vodokanal system, but for calculations here, the expenses for receiving water is added to the expenditure items of the income and expenditure reports for the Tuyamuyun system. Expenses for receiving water are also calculated separately in Chapter 6 "Project Evaluation" based on the O&M costs, water tariff, future water demand and extension plan for supply capacity.

The values for 1996 are used in principle, for calculating the cost per unit quantity of AFW for the Vodokanal system in the future. However, considering the present condition of the water supply facilities, the repair cost for Vodokanal-Khorezm was judged to be inappropriate, the repair cost for Vodokanal-Karakalpakstan was deemed to be appropriate, and the repair cost for Vodokanal-Khorezm was estimated based on the cost for Vodokanal-Karakalpakstan and the assets of both Vodokanals. That is;

132 mil.(Sum) / 321 mil. (Sum) x 0.371 (Sum/m^3) = 0.152 (Sum/m^3),
where 132 and 321 mil. Sum are assets of each Vodokanal of Khorezm or Karakalpakstan.

The cost per unit quantity of AFW for each expenditure item was set as shown below. Depreciation costs were estimated separately considering the depreciation costs for existing facilities and new facilities as fixed costs.

Table 5.12 O&M Cost Per Unit Quantity of AFW for Vodokanal

(units: Sum/m^3)

Expenditure item	Karakalpakstan	Khorezm
Electricity charges	0.619	0.481
Wages	0.294	0.176
Chemicals	0.130	0.073
Repairs	0.371	0.152
Social insurance	0.118	0.071
Fuel, gas, lub. oils	0.094	0.051
Others	0.728	0.118
Total	2.354	1.122

CHAPTER 6

PROJECT EVALUATION

CHAPTER 6 PROJECT EVALUATION

6.1 Technological Viability

6.1.1 Introduction

Water supply plan for the Study Area, including the selected water supply system and facilities, considered in the feasibility study has been discussed in the preceding chapters of this report. It is necessary to examine whether the plan is appropriate to the Study Area and the country as a whole, and moreover, whether it is feasible from technical, financial and economical points of view.

In this section, the selected water supply system and facilities will be examined from technical view point to verify that it suits the technological levels in Uzbekistan and to confirm that there are no problems in the project implementation from the construction, operation and maintenance aspects.

6.1.2 Technical Viability

Tuyamuyun inter-regional water supply system that will cover a vast area of the Study Area through the long distance transmission pipelines is adopted as the water supply system. Major facilities in this water supply system are; Kaparas reservoir, Kaparas pumping station, raw water mains, water treatment plants, transmission pipelines and transmission pumping stations.

When taking into consideration the conditions listed below, the proposed system and facilities are judged as technologically appropriate for the Study Area and the country as there no major problems with respect to technological aspects.

1)This type of regional bulk water supply systems are much common in Uzbekistan. The country has developed technology for the construction, operation and maintenance of such systems.

2)The existing facilities that make part of the proposed system have been managed satisfactorily and the relevant staff have gained enormous experience in planning, construction, operation and maintenance of the water supply systems and facilities.

3)The proposed system and facilities in virtue involves extensions or improvement to the existing system and facilities or new construction in line with existing/revised plans. At present, most of the facilities in the existing plans which are included in the feasibility study are either under construction or their construction being

suspended. Detail plans and designs for these facilities are already available.

4)All the proposed facilities, except the aqueduct crossing Amu Darya river, do not need special technology in construction, operation and maintenance. Construction of this aqueduct is complicated and may need special technology.

However, some consideration must be given with respect to construction aspects. Before the collapse of USSR, a large number of facilities have been constructed in Uzbekistan based on special technology of the FSU, especially from Russia. But after independence, Uzbekistan had to manage with the locally available engineering technology, construction machinery and equipment without the external support. Added with financial difficulties, most local construction companies are worried that conditions in the construction industry are getting worse in the recent years and that machinery and equipment are becoming too old and obsolete to meet the new challenges.

Taking into consideration of these circumstances, technological assistance from the developed countries is considered necessary for the construction of facilities that require special technology.

6.2 Financial Feasibility Analysis

6.2.1 Introduction

Based on the results of project evaluation made in Chapter 9 of the Part I Basic plan, and on the dissension between Uzbek side and JICA draft final mission in October, 1996, the Basic Plan was revised and reduced including practical rescheduling for implementation. The rescheduled plan for the improvement of water supply systems in the study area, especially for the emergent issues to be resolved, has been discussed in Chapter I herein in this report of part II.

Such a plan must, however, he analyzed in details not only from technical aspects, but also from the financial and economical view point.

Core portion of the Basic Plan which correspond to the phase-I was revised and rescheduled,(herein called as "Rescheduled Project") consisting of First Priority Project (FPP) during 1998~2002 and Second Priority Project (SPP) during 2003~2010.

In this chapter, the analysis was made on the following four entities regarding three different scale of project.

(a) DOMIUP - T/N (Referred to as T-N)
(b) DOMIUP - T/U (Referred to as T-U)
(c) Vodokanal - ROK (Referred to as KKP)
(d) Vodokanal - KZ (Referred to as KZ)

Case 1 • • • Phase I of Basic Plan : US$ 607.1 million.
Case 2 • • • Rescheduled Project (FPP and SPP) : US$ 602.7 million.
Case 3 • • • Rescheduled Project (FPP) : US$ 277.8 million.

These entities will be formed into two(2) Groups according to the current service area as Group-A (T-N with KKP) and Group-B (T-U with KZ).

Therefore, analysis will be done in group-wise and on the total project.

6.2.2 Method of Analysis

(1) Previous Method of Analysis

So far analysis has been made in the following manner. Method of analysis for Basic Plan in Chapter 9 Part I Report was also the same as this. Firstly, by the assumed group-wise water tariffs of Vodokanal, the water purchasing rates from DOMIWP are determined under the condition that the total revenue and expenditures of Vodokanal during the project life should be balanced under the discount rate of 7.5 %. Secondly, by such obtained water selling price as above from DOMIWP to Vodokanal, financial Viability of T-N and T-U is analyzed by calculating the Financial Internal Rate of Return (FIRR).

Feasibility of the project is then evaluated by the weighted average FIRR for the group A and B. As discussed in Chapter I Section 1.4 of this Report (Part II), preliminary Evaluation of the project corresponding to Phase I of the Basic plan was made in this Chapter 6, as a part of Financial Analysis in the same manner.

The result of the evaluation is to be discussed in Section 6.2.6.

This is an internationally orthodox approach to check the viability of this kind of project because Vodokanals' management should continuously be self sufficient, while DOMIWPS are supported entities by the GOU.

The result of the analysis was submitted by the JICA Study Team to Uzbek side in October, 1996. The assumed tariffs used in that analysis were of Group 1 seven times, while Group 2 and 3 approx. double the current water tariff.

(2) Changed method of Analysis.

According to the discussions in Oct. 1996, between Uzbek side and the JICA study team, counter-proposal was made by Uzbek side to the JICA Study Team to seek the possible level of water tariff from Vodokanals in the following manner.

Firstly, to calculate the corresponding water selling rates from DOMIWPs under the condition of total revenue and expenditures of DOMIWPs being balanced with the given discount rate during the project life. Then, to elaborate the average tariff of Vodokanals by using such obtained water purchasing rate under the condition of Vodokanals' revenue/expenditure being balanced during the project life with the given internal rate of return (IRR).

At the same time, upon the request of Uzbek side the analysis was made in two (2) cases of subsidies on the construction cost of DOMIWPs and Vodokanals, i.e.; 0 % (DOMIWPs and Vodokanals cover operation & maintenance cost and repayment of loans) and 100 % (DOMIWPs and Vodokanals cover only operation & maintenance cost without repayment of loans.)

JICA Study Team has tried to include the third case of subsidy as 50% for reference purpose and made up the due comparison table.

Also JICA has assumed this time three cases of the related discount rate of DOMIWPs as 5, 10 and 15% and IRR of Vodokanals, also as 5.10 and 15%.

6.2.3 General Assumptions for the Analysis

The following assumptions were made in the analysis.

(a) Project life : 30 years

(b) Base year : 1998 (start of construction)

(c) Base of cost estimate

: 1996 price (unescalated)

(d) Monetary unit : US Dollars (US$)

(e) Rate of Exchange : 1 US$ = 40 Sum (as of July. 1996)

(f) Water tariff : Assumed as discussed in Section 9.3 of the Main Report (Part I) and shown in Table 9.1 and 9.2 and in Section 6.2.4 of Part II.

(g) O&M cost : Operation and maintenance cost is determined based on actual expenditure shown in the financial statements and assumed to be made up of two components; O&M cost (Basic Cost) that depends on the volume of water sold (accounted-for water), and annual cost of replacement and maintenance of facilities and water meters replacement as discussed in Section 6.2.5. For details refer to Chapter 5 Section 5.4, Part II of the report.

(h) Discount rate : As discussed in Section 6.2.2 (2). adopted 3 discount rate of 5, 10, and 15%.

(i) Period of Forecasting the Financial Statement

: 15 years (Up to 2 years after the implementation)

(j) Construction Cost : (Three projects)

Case 1 • • • Phase I of Basic Plan : US$ 607.1 million.

Case 2 • • • Rescheduled Project (FPP and SPP): US$ 602.7 million.

Case 3 • • • Rescheduled Project (FPP): US$ 277.8 million.

6.2.4 Calculation Method of Water Tariffs

Basis of calculation of the assumed group-wise tariff was discussed in Chapter 9 of Part I.

Now that Uzbek side has requested the counter-method for the tariff calculation regarding the reduced and rescheduled Project, and as already discussed in Section 6.2.2.(2), average water tariffs were obtained from the water buying price of Vodokanal (KKP or KZ) with each assumed IRR under the condition of total revenue and expenditures being balanced during the project life on T-N/T-U side respectively with respective discount rate.

At the same time, analysis were made for three (3) alternatives of subsidies (i.e., 0%, 50%, 100%) although Uzbek side has requested two (2) alternatives (i.e.; 0%, and 100% on both DOMIWPs and Vodokanals).

With these average tariffs obtained as above, judgment can be made for deciding practical level of tariffs and necessary volume of subsidies.

For analysis purpose, weighted average tariff as of June, 1996 and evolution of the average tariffs up to June, 1996 are shown in Table 6.1, 6.2 and Fig. 6.1.

Current weighted average tariffs are summarized as follows;

Table 6.1 Weighted Ave. Tariff (per m^3)

As of June, 1996

	Sum	US$		Sum	US$
KKP	5.198	0.130	T-N	0.853	0.0213
KZ	3.313	0.083	T-U	0.55	0.0138

- Vodokanal -

Table.6.2 Evolution of the Average Tariff

(unit:Sum)

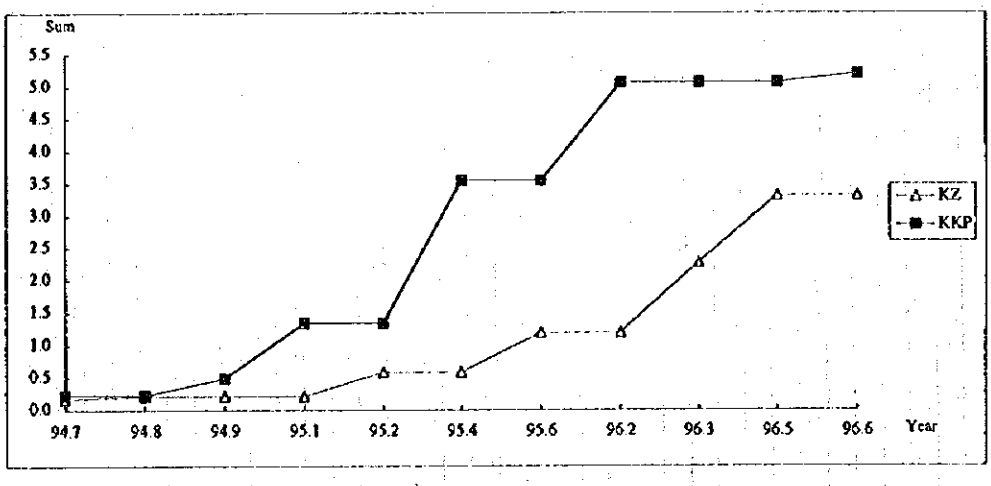
year/month / Vodokanal	94.7	94.8	94.9	95.1	95.2	95.4	95.6	96.2	96.3	96.5	96.6
KZ	0.171	0.204	0.204	0.204	0.578	0.578	1.184	1.184	2.27	3.313	3.313
KKP	0.231	0.231	0.483	1.341	1.341	3.551	3.551	5.062	5.062	5.062	5.198

Table.6.3 Evolution of Group-Wise Tariff

(unit:Sum)

Vodokanal / year/month		94.7	94.8	94.9	95.1	95.2	95.4	95.6	96.2	96.3	96.5	96.6
KKP	Grp-1	0.02		0.02	0.22		0.22		0.22			0.50
	-2	0.43		0.92	2.40		6.70		9.64			9.64
	-3	0.43		0.92	2.40		6.70		9.64			9.64
KZ	Grp-1	0.02	0.02			0.02		0.10		0.35	0.35	
	-2	0.33	0.40			Ave.1.225		Ave.2.43		Ave.4.34	Ave.6.37	
	-3	0.40	0.48			1.35		2.70		5.13	7.90	

Fig.6.1 Evolution of the Average Tariff



Note: Figures are based on the weighted average tariff.
i.e.; Aggregated figure of group-wise occasional tariff multiplied by average percentage of water consume by group.

6.2.5 Operation & Maintenance Cost

The O&M costs in this analysis are determined including the long-term construction up to 2010 year on the following assumptions.

(For details, refer to Chapter 5, section 5.4 of Part II)

(1) Basic O&M cost : unit cost per m^3 of AFW

Based on the itemized expenditure records per m^3 of the sold water (i.e.; AFW, accounted-for water), unit O&M cost are assumed, and applied to the starting year of the construction.

This cost includes electricity, wages, chemicals, repair fund, social insurance, fuel and gas excluding depreciation.

(2) Electricity and Chemicals

The unit consumption of electricity and chemicals will vary depending on the operation requirements accordingly with the progress of the construction program especially on the part of Tuyamuyun-Nukus Facilities like Kaparas intake station, Transmission and distribution Pumping Stations (Nukus north, Kungrad, No.2 booster station). As a result, basic O&M cost of T-N will increase more than double that of T-U.

As for chemicals, the consumption will decrease on the part of Tuyamuyun Facilities upon the completion of Kaparas Intake System.

(3) Repairs

Upon the completion of each of the facilities such as Kaparas Intake Station, Water Treatment Plant (Rehabilitation and expansion) and transmission/distribution pumping station except Raw Water Mains, transmission pipeline and distribution network which shall be covered by depreciation cost, 0.5% of relevant asset value of the facilities are added to the annual repair cost from the following year.

Total asset value of such facilities amounts to US$ 223.6 Million in the Rescheduled Project (total) including 4 entities. As for water meters, replacement cost is assumed to be added as a part of repairs after ten (10) years on average from the installation.

Details of the above cost information of each enterprise are referred to Table 6.4 and its' annual projection is summed up in Table 6.5 as Case of R/P -total- and Table 6.6 as Case of FPP.

Table 6.4 Basis of Calculation of O&M Cost
(For the analysis of Total Rescheduled project and F.P.P Project)

1) K K P and K Z

No.	Project	Details of assumed O M Cost to be applied				
		K K P			K Z	
		Year	Item	Description	Item	Description
1	F.P.P	From 1998	Basic Cost /m^3 · AFW	US$ 0.0589(2.354 sum) as per Table 5.12	Basis Cost /m^3 · AFW	US$ 0.0281(1.122 sum) as per Table 5.12
2	S.P.P	From 2006	Repairs (item 4.1)	US$ 25,900×10^3×0.5%per year =$ 129,500/Year	Repairs (item 5.1)	US $21,600×$10^3$×0.5% per year =$ 108,000/Year
3	F.P.P~S.P.P	From2008	Repairs	Water Meter Replacement US$ 172,500/Year	Repairs	Water Meter Replacement US$ 90,500/Year

2) T--N and T--U

No.	Project	Details of assumed O&M Cost to be applied					
		T--N			T--U		
		Year	Item	Description	Year	Item	Description
1	F.P.P	1998 ~2000	Basic Cost /m^3 · AFW	US$ 0.1047(4.186 sum) as per Table 5.11	1998 ~1999	Basis Cost /m^3 · AFW	US$ 0.0716(2.864 sum) as per Table 5.11
2	F.P.P~S.P.P	2001 ~2005	Basic Cost /m^3 · AFW	US$ 0.1162(4.646 sum) Increase of Electricity (Item 2.2.2, 2.2.3) as per Table 5.10	2000 ~2027	Basis Cost /m^3 · AFW	US$ 0.0634(2.535 sum) as per Table 5.11
3	--"--	2001 ~2027	Repaires	US$ 27,750×10^3×0.5%per year =US$ 138,750/Year (Item 1.1, 2.2.2, 2.2.3)	2001 ~2027	Repairs	US$ 63,250×10^3×0.5% per year =US$ 316,250/Year (Item 1.1, 3.1.2)
4	S.P.P	2006 ~2027	Basic Cost /m^3 · AFW	US$ 0.1532(6.130 sum) Increase of Electricity (Item 2.2.1) as per Table 5.10	—	—	—
5	S.P.P	2007 ~2027	Repairs	US$ 69,600×10^3×0.5% =US$ 348,000/Year (Item 2.1, 2.2.1)	2007 ~2027	Repairs	US $15,500×$10^3$×0.5% =US$ 77,500/Year (Item 3.1.1)

Note : FPP (First Priority Project) : Year 1998~2002
SPP (Second Priority Project) : Year 2003~2010
AFW : Accounted-for Water
For the Item No. see Table 5.1

TABLE.6.5 PROJECTION OF OPERATION AND MAINTENANCE COST (Case of 100% subsidies to the construction cost)

(Assumed Basic OM cost in 1998 is calculated from 1996 OM cost-unescalated-)

Unit : 1,000 Dollars

entity / year	T−N			T−U		394	KKP				K Z			
	Basic Cost	Addition	Total	Basic Cost	Addition	Total	Basic Cost	Addition	Water Purchase	Total	Basic Cost	Addition	Water Purchase	Total
1998	5,423		5,423	4,707		4,707	4,560		8,412	12,972	1,683		2,512	4,195
1999	5,721		5,721	4,707		4,707	4,891		9,016	13,907	1,706		2,529	4,234
2000	6,019		6,019	4,168		4,168	5,222		9,619	14,841	1,729		2,546	4,275
2001	6,922	139	7,061	6,663	316	6,979	5,381		9,824	15,205	2,276		5,023	7,299
2002	7,163	139	7,302	6,859	316	7,175	5,540		10,029	15,569	2,311		5,091	7,402
2003	7,206	139	7,345	7,056	316	7,372	5,547		9,924	15,471	2,352		5,162	7,513
2004	7,206	139	7,345	7,253	316	7,569	5,521		9,758	15,279	2,390		5,230	7,619
2005	7,206	139	7,345	7,449	316	7,765	5,497		9,592	15,089	2,427		5,297	7,724
2006	15,360	139	15,499	7,676	316	7,992	6,185	130	13,125	19,440	2,466	108	5,363	7,937
2007	16,228	139	16,367	7,900	394	8,294	6,361	130	13,429	19,920	2,505	108	5,429	8,041
2008	16,389	487	16,876	8,125	394	8,519	6,531	302	13,729	20,562	2,542	199	5,492	8,233
2009	16,904	487	17,391	8,326	394	8,720	6,705	302	14,028	21,035	2,575	199	5,533	8,307
2010	17,418	487	17,905	8,326	394	8,720	6,882	302	14,327	21,510	2,544	199	5,361	8,104

Note ·Basic cost : consisting of Electricity, wages, chemicals, social insurance, repair fund, fuel & gas, and other operating costs, excluding depreciation.

·Addition : T-N & T-U : After the completion of the high priority project and the successive remaining of the construction schedule, 0.5 percent of the relevant invested cost, mainly of the pumping stations and W.T.P is added to O&M cost as additional repairs from 2001 and 2007 year respectively.

KKP & KZ: 1)After the completion of the W.T.P rehabilitation at Nakus and Urgench, 0.5 percent of the relevant asset value is added to O&M cost from 2006 year.

2)Replacement of water meters shall be started from 2008 year, ten years after installation on average.

·Electricity: T-N: Cost of increased electricity volume is included in the basic cost from 2000,2001 and 2006 year respectively.

TABLE.6.6 PROJECTION OF OPERATION AND MAINTENANCE COST (Case of 100% subsidies to the construction cost)

(Assumed Basic OM cost in 1998 is calculated from 1996 OM cost-unescalated-)

Unit : 1,000 Dollars

entity / year	T-N			T-U			KKP				KZ			
	Basic Cost	Addition	Total	Basic Cost	Addition	Total	Basic Cost	Addition	Water Purchase	Total	Basic Cost	Addition	Water Purchase	Total
1998	5,423		5,423	4,707		4,707	4,560		6,478	11,037	1,683		2,501	4,184
1999	5,721		5,721	4,707		4,707	4,891		6,942	11,833	1,706		2,518	4,224
2000	6,019		6,019	4,707		4,707	5,222		7,407	12,629	1,729		2,535	4,264
2001	6,922	139	7,061	6,663	316	6,979	5,381		7,565	12,946	2,276		5,003	7,279
2002	7,163	139	7,302	6,859	316	7,175	5,540		7,723	13,263	2,311		5,070	7,381
2003	7,206	139	7,345	7,056	316	7,372	5,547		7,642	13,188	2,352		5,141	7,492
2004	7,206	139	7,345	7,253	316	7,569	5,521		7,514	13,035	2,390		5,208	7,598
2005	7,206	139	7,345	7,449	316	7,765	5,497		7,386	12,883	2,427		5,276	7,703
2006	11,651	139	11,790	7,676	316	7,992	6,185		10,107	16,292	2,466		5,341	7,807
2007	12,045	139	12,184	7,646	316	7,962	6,361		10,341	16,703	2,505		5,406	7,911
2008	12,431	139	12,570	8,125	316	8,441	6,531	173	10,571	17,275	2,543	91	5,469	8,102
2009	12,821	139	12,960	8,326	316	8,642	6,705	173	10,802	17,680	2,575	91	5,510	8,176
2010	13,211	139	13,350	8,326	316	8,642	6,882	173	11,032	18,086	2,545	91	5,339	7,974

Note ·Basic cost: consisting of Electricity, wages, chemicals, social insurance, repair fund, fuel & gas, and other operating costs, excluding depreciation.

·Addition : T-N & T-U : After the completion of the high priority project (1998~2000),0.5 percent of the relevant invested asset value such as Kaparas intake station, other pumping station and "W.T.P" except transmission pipe-line·distribution network is annually added to O & M cost as repairs from2001 year.

KKP & KZ: Water meters will be replaced after ten (10) years from the installation on average.

6.2.6 Comparison of Financial Feasibility Analysis by Project

As discussed in Section 6.2.2 (1) and (2), the analysis was made in two (2) different method according to the following three (3) projects.

Case 1 Phase I of the Basic Plan : 1998~2000 Year total cost : US$ 607.1 million
Case 2 Rescheduled Project (total) : 1998~2010 Year total cost : US$ 602.7 million
Case 3 Rescheduled Project (FPP) : 1998~2002 Year total cost : US$ 277.8 million

Case 1 Phase-1 of the Basic Plan (Preliminary Evaluation - Pre F/S)
Based on the assumed water tariff as per Section 9.3 of Part I, financial analysis was made by the method of Section 6.2.2 (1) which is an orthodox approach by firstly securing the viability of Vodokanals under 7.5% discount rate then proceeding to check the viability of DOMIWPs (T-N and T-U) by respective FIRR.

Case 1-1 Case of 0% Subsidies :
As for Group A, T-N's annual balance of account is constantly in the deficit and not available to calculate FIRR.

As for Group B, T-U's aggregated annual balance is also deficit in a huge amount. Consequently there is no possibility of obtaining FIRR.

In conclusion, no financial feasibility exist in this case due to too much shortage of revenue under the assumed tariff.

Case 1-2 Case of 90% Subsidies to the Construction Cost.

Obtained Ave. Tariffs are as follows under the assumed conditions.

(Ratio to the Current Ave. Tariff)

- KKP US$ 0.158 - - - - - - - -0.158/0.130 = 1.22
- KZ US$ 0.134 - - - - - - - -0.134/0.083 = 1.61

These are tariffs appear to be in practical range for enforcement. However, T-N's annual balance of account is constantly in the deficit again, and no availability of FIRR. With the bigger percentage of subsidies, T-U produces annual surplus of balance except the first two years, and consequently, T-U's FIRR exceeds 47 %.

Nevertheless, this does not mean total viability as positive unless the viability of Group-A can not be gained by raising up the water tariff of KKP separately.

Thus, there is " No financial feasibility " in this case too.

Case 1-3 Case of 100% subsidies to the construction cost.

Calculation was made on the assumption that KKP and KZ remain financially balanced during the project life with no discount rate, and it proved that the basic tendency was not improved and almost the same as in case of (1)-2. T-U's annual balance is constantly "surplus", while T-N produces constant deficit during the project life.

As a conclusion, there is no possibility of Financial Feasibility in these 3 alternatives of Case I "phase-1 of the Basic Plan".

In addition to the above, it must be also understood that phase I has total investment of US$ 607.1 million in only three years, and if the fund of subsidies of 90~100% were required to be raised from the international financing market, such a huge money can hardly be supplied from any kind of financing institution for this kind of project because there exist respective credit line by each financing Agency at much lower level.

Case 2 Rescheduled Project (FPP+SPP : Total)

Method of analysis is as per Section 6.2.2 (2), and the Vodokanal's ave. tariffs are obtained by reverse operation from the selling price by which secure the financial viability of DOMIWP first under the given discount rate.

The summary of the above calculation is shown in Table 6.7 and Table 6.8. Group-wise tariff in these table was calculated by using the assumed tariff of Group I, first of all, and then proceeding calculation to Group 2 and 3 by assuming the equal level of tariff in each Vodokanal.

Case 2-1 Case of 0% subsidies

For both group-A and group-B, ave. tariffs of Vodokanals in the different combination are above 3 times more on average than the current ave. tariff. Selling prices of DOMIWP come out as 16 times more (in case T-N) and 13 times more (in case T-U) than the current Ave. price. Without such a drastic increase of water tariff, this case will not be "Workable" or "Practical" either.

Case 2-2 Case of 50% subsidies

It is essential and recommendable to keep the range of 10~15% of discount rate and FIRR for the stable management of funds.

According to this criterion, case No. 11~12, and case No. 17~18 can be selected as a shaded portion in Table 6.7, 6.8. Ave. tariffs of KKP and KZ in this case stand between 2.0~2.2 times the current ave. tariff. This case will give useful suggestions for possible alternatives by manipulation of the subsidies.

Case 2-3 Case of 100% subsidies

This is traditional style of Uzbekistan up to now. In this case, the construction cost is off-set by subsidies, and it is minimum requirement for the entity to reserve the revenue by water selling for covering the O&M cost at minimum.

Thus, stable operation and maintenance are continuously assured without any further subsidies on self-sufficient basis.

As for Vodokanals' ave. tariff, KKP has US$ 0.180 (1.4 times the Current Ave. tariff) and KZ has US$ 0.089 (1.075 times as well) as shown No. 19 of Table 6.7 and 6.8. This is quite practical level of tariffs if the GOU choose this alternative.

Case 3 Rescheduled Project (FPP only)

Due to the smaller amount of the total construction investment as 46% of the R/P total (FPP+SPP), obtained Ave. tariffs were reduced still more as shown in Table 6.9 and 6.10.

As already discussed in the above cases, there are recommendable range of discount rate and FIRR. Situations are more improved in this case, and those cases of analysis are plotted as a shaded portion in the tables.

Accordingly, more practical level of Ave. tariff were obtained and summarized as per Table 6.11.

Case (2)
Group-A

Table 6.7 Comparison Table of Ave.Tariffs of Vodokanal

Rescheduled Project(Total)

No.	Tuyamuyun (T-N) Construction Cost US$257,011×10³					Vodokanal (KKP) Construction Cost US$117,430×10³											
	Discount Rate	Subsidies %	Water Selling Price		multiple of the Current Ave.Price	F.I.R.R	Subsidies %	Water Parchasing Price	Ave.Tariff		multiple of the Current Ave.Tariff	Grp 1		Grp 2		Grp 3	
			US$	sum	0.853sum/m³				US$	sum	5.198sum/m³	US$	sum	US$	sum	US$	sum
1	5.0	0	0.280	11.200	13.130	5.0	0	0.280	0.326	13.040	2.509	0.0525	2.10	0.540	21.62	0.540	21.62
2	〃	0	0.280	11.200	13.130	10.0	0	0.280	0.339	13.560	2.609	0.0525	2.10	0.562	22.49	0.562	22.49
3	〃	0	0.280	11.200	13.130	15.0	0	0.280	0.347	13.880	2.670	0.0525	2.10	0.577	23.07	0.577	23.07
4	〃	50	0.213	8.520	9.988	5.0	50	0.213	0.250	10.000	1.924	0.0525	2.10	0.405	16.18	0.405	16.18
5	〃	50	0.213	8.520	9.988	10.0	50	0.213	0.255	10.200	1.962	0.0525	2.10	0.413	16.53	0.413	16.53
6	〃	50	0.213	8.520	9.988	15.0	50	0.213	0.258	10.320	1.985	0.0525	2.10	0.418	16.73	0.418	16.73
7	10.0	0	0.344	13.760	16.131	5.0	0	0.344	0.376	15.040	2.893	0.0525	2.10	0.629	25.16	0.629	25.16
8	〃	0	0.344	13.760	16.131	10.0	0	0.344	0.387	15.480	2.978	0.0525	2.10	0.649	25.96	0.649	25.96
9	〃	0	0.344	13.760	16.131	15.0	0	0.344	0.394	15.760	3.032	0.0525	2.10	0.662	26.48	0.662	26.48
10	〃	50	0.242	9.680	11.348	5.0	50	0.242	0.272	10.880	2.093	0.0525	2.10	0.444	17.77	0.444	17.77
11	〃	50	0.242	9.680	11.348	10.0	50	0.242	0.277	11.080	2.132	0.0525	2.10	0.452	18.08	0.452	18.08
12	〃	50	0.242	9.680	11.348	15.0	50	0.242	0.279	11.160	2.147	0.0525	2.10	0.457	18.27	0.457	18.27
13	15.0	0	0.403	16.120	18.898	5.0	0	0.403	0.422	16.880	3.247	0.0525	2.10	0.711	28.43	0.711	28.43
14	〃	0	0.403	16.120	18.898	10.0	0	0.403	0.432	17.280	3.324	0.0525	2.10	0.729	29.17	0.729	29.17
15	〃	0	0.403	16.120	18.898	15.0	0	0.403	0.439	17.560	3.378	0.0525	2.10	0.741	29.64	0.741	29.64
16	〃	50	0.268	10.720	12.567	5.0	50	0.268	0.293	11.720	2.255	0.0525	2.10	0.481	19.24	0.481	19.24
17	〃	50	0.268	10.720	12.567	10.0	50	0.268	0.297	11.880	2.285	0.0525	2.10	0.488	19.52	0.488	19.52
18	〃	50	0.268	10.720	12.567	15.0	50	0.268	0.299	11.960	2.301	0.0525	2.10	0.492	19.68	0.492	19.68
19		100	0.152	6.069	7.115	0.0	100	0.152	0.181	7.232	1.391	0.0525	2.10	0.281	11.25	0.281	11.25

Recommendable combination of Discount Rate, FIRR and subsidies.

Case (2)
Group-B

Table 6.8 Comparison Table of Ave.Tariffs of Vodokanal

Rescheduled Projuect(Total)

No.	Tuyamuyun (T-U) Construction Cost US$144,562×10³					Vodokanal (KZ) Construction Cost US$ 83,687×10³										
	Discount Rate	Subsidies %	Water Selling Price		multiple of the Current Price	F.I.R.R	Subsidies %	Water Parchasing Price	Ave.Tariff		multiple of the Current Tariff	Grp 1		Grp 2		Grp 3	
			US$	sum	0.550sum/m³				US$	sum	3.313sum/m³	US$	sum	US$	sum	US$	sum
1	5.0	0	0.133	5.320	9.673	5.0	0	0.133	0.189	7.560	2.282	0.0368	1.47	0.258	10.31	0.258	10.31
2	〃	0	0.133	5.320	9.673	10.0	0	0.133	0.201	8.040	2.427	0.0368	1.47	0.284	11.38	0.284	11.38
3	〃	0	0.133	5.320	9.673	15.0	0	0.133	0.209	8.360	2.523	0.0368	1.47	0.296	11.84	0.296	11.84
4	〃	50	0.100	4.000	7.273	5.0	50	0.100	0.138	5.520	1.666	0.0368	1.47	0.189	7.58	0.189	7.58
5	〃	50	0.100	4.000	7.273	10.0	50	0.100	0.144	5.760	1.739	0.0368	1.47	0.198	7.91	0.198	7.91
6	〃	50	0.100	4.000	7.273	15.0	50	0.100	0.147	5.880	1.775	0.0368	1.47	0.202	8.10	0.202	8.10
7	10.0	0	0.194	7.760	14.109	5.0	0	0.194	0.242	9.680	2.922	0.0368	1.47	0.345	13.81	0.345	13.81
8	〃	0	0.194	7.760	14.109	10.0	0	0.194	0.253	10.120	3.055	0.0368	1.47	0.362	14.50	0.362	14.50
9	〃	0	0.194	7.760	14.109	15.0	0	0.194	0.260	10.400	3.139	0.0368	1.47	0.373	14.90	0.373	14.90
10	〃	50	0.130	5.200	9.455	5.0	50	0.130	0.165	6.600	1.992	0.0368	1.47	0.237	9.49	0.237	9.49
11	〃	50	0.130	5.200	9.455	10.0	50	0.130	0.170	6.800	2.053	0.0368	1.47	0.237	9.47	0.237	9.47
12	〃	50	0.130	5.200	9.455	15.0	50	0.130	0.172	6.880	2.077	0.0368	1.47	0.241	9.63	0.241	9.63
13	15.0	0	0.217	8.680	15.782	5.0	0	0.217	0.262	10.480	3.163	0.0368	1.47	0.376	15.06	0.376	15.06
14	〃	0	0.217	8.680	15.782	10.0	0	0.217	0.273	10.920	3.296	0.0368	1.47	0.393	15.72	0.393	15.72
15	〃	0	0.217	8.680	15.782	15.0	0	0.217	0.280	11.200	3.381	0.0368	1.47	0.402	16.10	0.402	16.10
16	〃	50	0.142	5.680	10.327	5.0	50	0.142	0.175	7.000	2.113	0.0368	1.47	0.245	9.80	0.245	9.80
17	〃	50	0.142	5.680	10.327	10.0	50	0.142	0.180	7.200	2.173	0.0368	1.47	0.252	10.09	0.252	10.09
18	〃	50	0.142	5.680	10.327	15.0	50	0.142	0.182	7.280	2.197	0.0368	1.47	0.256	10.23	0.256	10.23
19		100	0.066	2.659	4.835	0.0	100	0.066	0.089	3.560	1.075	0.0368	1.47	0.115	4.59	0.115	4.59

Recommendable combination of Discount Rate, FIRR and subsidies.

P/S

Case (3)
Group-A

Table 6.9 Comparison Table of Ave.Tariffs of Vodokanal

Rescheduled Projuect(FPP)

No.	Tuyamuyun (T-N) Construction Cost US$ 89,706 ×10³					Vodokanal (KKP) Construction Cost US$ 35,205 ×10³											
	Discount Rate	Subsidies %	Water Selling Price /m³		multiple of the Current Price	F.I.R.R	Subsidies %	Water Parchasing Price	Ave.Tariff /m³		multiple of the Current Tariff	Grp 1		Grp 2		Grp 3	
			US$	sum	0.853sum/m³				US$	sum	5.198sum/m³	US$	sum	US$	sum	US$	sum
1	5.0	0	0.177	7.080	8.300	5.0	0	0.177	0.215	8.600	1.654	0.0525	2.10	0.342	13.69	0.342	13.69
2	〃	0	0.177	7.080	8.300	10.0	0	0.177	0.222	8.880	1.708	0.0525	2.10	0.354	14.16	0.354	14.16
3	〃	0	0.177	7.080	8.300	15.0	0	0.177	0.228	9.120	1.755	0.0525	2.10	0.366	14.64	0.366	14.64
4	〃	50	0.146	5.840	6.846	5.0	50	0.146	0.182	7.280	1.401	0.0525	2.10	0.284	11.35	0.284	11.35
5	〃	50	0.146	5.840	6.846	10.0	50	0.146	0.185	7.400	1.424	0.0525	2.10	0.288	11.52	0.288	11.52
6	〃	50	0.146	5.840	6.846	15.0	50	0.146	0.187	7.480	1.439	0.0525	2.10	0.293	11.70	0.293	11.70
7	10.0	0	0.216	8.640	10.129	5.0	0	0.216	0.245	9.800	1.885	0.0525	2.10	0.396	15.85	0.396	15.85
8	〃	0	0.216	8.640	10.129	10.0	0	0.216	0.251	10.040	1.932	0.0525	2.10	0.407	16.28	0.407	16.28
9	〃	0	0.216	8.640	10.129	15.0	0	0.216	0.258	10.320	1.985	0.0525	2.10	0.418	16.73	0.418	16.73
10	〃	50	0.166	6.640	7.784	5.0	50	0.166	0.197	7.880	1.516	0.0525	2.10	0.310	12.41	0.310	12.41
11	〃	50	0.166	6.640	7.784	10.0	50	0.166	0.199	7.960	1.531	0.0525	2.10	0.314	12.56	0.314	12.56
12	〃	50	0.166	6.640	7.784	15.0	50	0.166	0.202	8.080	1.554	0.0525	2.10	0.318	12.72	0.318	12.72
13	15.0	0	0.260	10.400	12.192	5.0	0	0.260	0.280	11.200	2.155	0.0525	2.10	0.458	18.31	0.458	18.31
14	〃	0	0.260	10.400	12.192	10.0	0	0.260	0.285	11.400	2.193	0.0525	2.10	0.467	18.70	0.467	18.70
15	〃	0	0.260	10.400	12.192	15.0	0	0.260	0.291	11.640	2.239	0.0525	2.10	0.478	19.10	0.478	19.10
16	〃	50	0.187	7.480	8.769	5.0	50	0.187	0.214	8.560	1.647	0.0525	2.10	0.340	13.61	0.340	13.61
17	〃	50	0.187	7.480	8.769	10.0	50	0.187	0.216	8.640	1.662	0.0525	2.10	0.344	13.74	0.344	13.74
18	〃	50	0.187	7.480	8.769	15.0	50	0.187	0.218	8.720	1.678	0.0525	2.10	0.347	13.89	0.347	13.89
19	〃	100	0.117	4.673	5.479	〃	100	0.117	0.142	5.680	1.093	0.0525	2.10	0.211	8.44	0.211	8.44
20	〃	100	0.118	4.720	5.533	〃	100	0.118	0.144	5.760	1.108	0.0525	2.10	0.216	8.64	0.216	8.64

Recommendable combination of Discount Rate, FIRR and subsidies.

〃 Neither discount rate nor FIRR is considered in this case.

Remarks: No.20 is the data derived from the sensitive analysis in order to attain the stable fund management in actual operation.

Case (3)
Group-B

Table 6.10 Comparison Table of Ave.Tariffs of Vodokanal

Rescheduled Projuect(FPP)

No.	Tuyamuyun (T-U) Construction Cost US$129,058 ×10³					Vodokanal (KZ) Construction Cost US$ 23,870 ×10³											
	Discount Rate	Subsidies %	Water Selling Price		multiple of the Current Price	F.I.R.R	Subsidies %	Water Parchasing Price	Ave.Tariff		multiple of the Current Tariff	Grp 1		Grp 2		Grp 3	
			US$	sum	0.550sum/m³				US$	sum	3.313sum/m³	US$	sum	US$	sum	US$	sum
1	5.0	0	0.133	5.320	9.673	5.0	0	0.133	0.160	6.400	1.932	0.0368	1.47	0.223	8.92	0.223	8.92
2	〃	0	0.133	5.320	9.673	10.0	0	0.133	0.166	6.640	2.004	0.0368	1.47	0.231	9.25	0.231	9.25
3	〃	0	0.133	5.320	9.673	15.0	0	0.133	0.171	6.840	2.065	0.0368	1.47	0.239	9.56	0.239	9.56
4	〃	50	0.106	4.240	7.709	5.0	50	0.106	0.123	4.920	1.485	0.0368	1.47	0.167	6.69	0.167	6.69
5	〃	50	0.106	4.240	7.709	10.0	50	0.106	0.126	5.040	1.521	0.0368	1.47	0.171	6.82	0.171	6.82
6	〃	50	0.106	4.240	7.709	15.0	50	0.106	0.128	5.120	1.545	0.0368	1.47	0.173	6.94	0.173	6.94
7	10.0	0	0.172	6.880	12.509	5.0	0	0.172	0.194	7.760	2.342	0.0368	1.47	0.273	10.94	0.273	10.94
8	〃	0	0.172	6.880	12.509	10.0	0	0.172	0.199	7.960	2.403	0.0368	1.47	0.281	11.23	0.281	11.23
9	〃	0	0.172	6.880	12.509	15.0	0	0.172	0.203	8.120	2.451	0.0368	1.47	0.288	11.50	0.288	11.50
10	〃	50	0.119	4.760	8.655	5.0	50	0.119	0.140	5.600	1.690	0.0368	1.47	0.193	7.71	0.193	7.71
11	〃	50	0.119	4.760	8.655	10.0	50	0.119	0.142	5.680	1.714	0.0368	1.47	0.196	7.82	0.196	7.82
12	〃	50	0.119	4.760	8.655	15.0	50	0.119	0.144	5.760	1.739	0.0368	1.47	0.198	7.92	0.198	7.92
13	15.0	0	0.213	8.520	15.491	5.0	0	0.213	0.230	9.200	2.777	0.0368	1.47	0.327	13.09	0.327	13.09
14	〃	0	0.213	8.520	15.491	10.0	0	0.213	0.234	9.360	2.825	0.0368	1.47	0.334	13.35	0.334	13.35
15	〃	0	0.213	8.520	15.491	15.0	0	0.213	0.238	9.520	2.874	0.0368	1.47	0.339	13.57	0.339	13.57
16	〃	50	0.140	5.600	10.182	5.0	50	0.140	0.158	6.320	1.908	0.0368	1.47	0.220	8.80	0.220	8.80
17	〃	50	0.140	5.600	10.182	10.0	50	0.140	0.160	6.400	1.932	0.0368	1.47	0.222	8.89	0.222	8.89
18	〃	50	0.140	5.600	10.182	15.0	50	0.140	0.161	6.440	1.944	0.0368	1.47	0.224	8.96	0.224	8.96
19	*	100	0.067	2.680	4.873	*	100	0.067	0.089	3.560	1.075	0.0368	1.47	0.1154	4.62	0.1154	4.62
20	*	100	0.067	2.680	4.873	*	100	0.067	0.090	3.600	1.087	0.0368	1.47	0.1172	4.69	0.1172	4.69

Recommendable combination of Discount Rate, FIRR and subsidies.

* Neither discount rate nor FIRR is considered in this case.

Remarks: No.20 is the data derived from the sensitive analysis in order to attain the stable fund management in actual operation.

Table 6.11 Ave. Tariff of Practical Level

Group	Const. Cost mil. US$	Subsidies %	Discount Rate/FIRR	Vodokanal Ave. Tariff/m³	Ratio to Current Ave. Price	
					Tariff to Consumers	Water Purchase
A (T-N)	89,71	50	10-15%	Approx. US$ 0.200	1.54 times	7.78 times
(KKP)	35,21	50	10-15%	Approx. US$ 0.217	1.67 times	7.78 times
A (T-N)	**89,71**	**100**				
(KKP)	**35,21**	**100**	*	**Approx. US$ 0.142**	**1.093 times**	**5.48 times (US$ 0.117)**
B (T-U)	129,06	50	10-15%	Approx. US$ 0.143	1.73 times	8.66 times
(KZ)	23,87	50	10-15%	Approx. US$ 0.160	1.93 times	10.18 times
B (T-U)	**129,06**	**100**				
(KZ)	**23,87**	**100**	*	**Approx. US$ 0.089**	**1.075 times**	**4.87 times (US$ 0.067)**

* Neither discount rate nor FIRR is applied in this case.

In this case, T-U has biggest investment (46.5%) of all, but due to increased electricity charge of T-N, total cost of T-N during project life is much higher than T-U. Consequently ave. tariff of KKP should be still higher than that of KZ, because this ave. tariff should cover such O&M cost.

These Ave. tariffs are possible lowest level available under the assumed condition and especially part of the bold letter of Table 6.11 will be most of use and realistic alternative in all.

Through the Table 6.7 ~ 6.10 and Table 6.11, it will be summarized as follows,

1) Level of Ave. Tariff to the consumers depends on the amount of the investment cost (i.e.: construction cost) and the amount of water purchase from DOMIWPs to be covered by water revenue of Vodokanals.
2) Consequently the Ave. tariffs depend on the size of the subsidies to the construction cost.
3) The lowest available Ave. tariff was obtained in the case of 100% subsidies to the FPP plan, wherein at least the O&M cost should be covered by water revenue.
4) In every case of the analysis, water tariff of Group 1 shall be recommended to adopt the assumed tariff equivalent to the 2% of the household income.
   Namely,
   KKP 2.10 sum/m³

KZ 1.47 sum/m³

5) Water tariff of Group 2 and 3 shall be manipulated from at least current tariff upward even in case of 100% subsidies.

6) As one practicable example, the following Ave. Tariffs were obtained with the group-wise tariff of the above criterion under 100% subsidies.

		Ave. Tariff/m³	Ratio /current Ave.	Tariff (Sum/m³)		
				Grp 1	Grp 2	Grp 3
Grp-A	T-N / KKP	US$ 0.150 (6.00 Sum)	1.154 times	2.10	9.64	9.64
Grp-B	T-U / KZ	US$ 0.099 (3.96 Sum)	1.195 times	1.47	6.38	7.90

These Ave. tariffs produce the additional water revenues, covering certain portion of the construction cost of each group as follows;

		Added Rev.	% of Const. Cost.
Grp-A	T-N / KKP	22,140 10^3 x US$	Aprox. 18%
Grp-B	T-U / KZ	22,773 10^3 x US$	Aprox. 15%

7) Considering all these data, it became quite evident that the financial support of the GOU is absolutely necessary as a form of subsidies to the construction cost enabling Vodokanals to obtain sustainable level of Ave. tariffs for the stable management of the project.

6.2.7 Forecast and Analysis of Financial Statement

In this section, further financial analysis of the selected case of Rescheduled Project (FPP) was done as a forecast on the following financial statements based on the assumptions as blow.

	Case No. 19	Case No.20 (Refer Table 6.9, 6.10)
a) Income statement	(Table 6.12)	[Table 6.12 (R)]
b) Cash Flow Statement	(Table 6.13)	[Table 6.13 (R)]
c) Balance Sheet	(Table 6.14)	[Table 6.14 (R)]

(1) Assumptions for the projections

1. Selected Case for the analysis :

In order to simplify the case, case No. 19 of Table 6.9 and 6.10 was selected which is most realistic alternative with 100% subsidies from the GOU. However due to much

fluctuation in the balance of account between the first 3 years and the following years on T-N side as well as T-U side, the **Sensitive Analysis** was made to rectify such a unstable situation.

Consequently, there arose slight adjustment in the selling price of Tuyamuyun as well as in the Ave. Tariff of Vodokanal which is shown in No.20 columns of Table 6.9 and 6.10.

The related financial statements were reported in this chapter as in Table 6.12, 6.13, 6.14 as a part of No.19 and Table 6.12(R), 6.13(R), 6.14(R) as of No.20 in the separate Supporting Report. These data will give good lessons for the actual enforcement.

2. Loan Schedule :
Due to the 100% subsidies, no other additional loan is expected for this analysis. Hence, no factor of interest will occur. (Repayment of the loan connected with subsidies is out of the consideration herein).

3. Subsidies :
This item is treated as a part of Equity (Government Grant) and not as a kind of Revenues.

4. Depreciation : Consisting of two portions.
   1) Annual depreciation amount fixed for existing facilities.
   2) Annual 2.5% of the fixed assets value of the new facilities, assuming 40 years durable period on an average.

5. Account receivable : Equivalent to 2 months' amount of Water Sales

6. Account Payable : Equivalent to 2 months' amount of direct O&M cost.

7. Revenue fund : No reserve fund is assumed.

6.2.8 Fund Procurement

The financial feasibility analysis and the projected cash flow statements were made with respect to the Rescheduled Project based on certain reasoned assumptions and conditions. The results indicate that even when the GOU obtain funds from financial sources in the international market for the whole investment cost for the total period

(1998~2010) including local component at the interest of 7.5% p.a., the financial situation will not be sound if the fund management should be done by individual enterprise with its own revenue sources, and thus the project will not be feasible under the assumed conditions unless water tariffs be raised up to the level to cover manageable revenue.

Therefore, in order to promote this project, the GOU must endeavor to find fund sources with more favorable financial conditions in the global fund market and/or in the domestic market with which the GOU supply sufficient money as subsidies.

The following are potential fund sources in the international market for the capital investment of this kind of the project. Their funding conditions vary from source to source.

(a) General Loans from international lending agencies

General conditions of loan :

Interest rate	: 6~11% included commission fee
Average repayment period	: 10-30 years including 2-7 years grace period

(b) Soft Loan from a foreign country

Loan with soft lending conditions :

Interest rate	: Approx. 2.7%
Repayment period	: 30 years including 10 years grace period

Besides the above foreign lending system, there is grant aid system from some countries to those classified as the Less Developed Countries (LDC) and the Least Less Developed Countries (LLDC) according to the GNP per capita. Grant aid, however, is available only for small or medium scale projects mainly for the Basic Human Need (BHN) assistance and/or in the field of technical cooperation.

Therefore, it will be rather difficult to obtain grant aid for the whole portion of this kind of gigantic project with massive investment.

Even in the case of general/soft loans, there are limitations to the amount of loan as a credit line and therefore it would not be possible to obtain funds from a single agency to finance the high investment in this project. Under these circumstances, it would be desirable that in addition to seeking funds from the above-mentioned external funding agencies and from the domestic sources, also special measures be taken for extra budgetary support from the GOU and/or local government.

6.3 Economic Feasibility Analysis

6.3.1 Introduction

The objective of the project is to uplift the social welfare of the community. Therefore, an evaluation of the effectiveness of the project, in terms of socio-economic factors not considered in the financial analysis, is made in this economic analysis.

It may not be possible to evaluate all the cost and benefits of a project because some of them are not quantifiable or the technical methods to evaluate them quantitatively are not available. It is for this reason that only quantifiable benefits and costs will be included in the analysis. Comparison between the costs and benefits shall allow an assessment of the economic feasibility of the project.

6.3.2 Method of Analysis

The economic costs and benefits, measurable in monetary terms(direct benefits), of the project are treated under the cash flow analysis and the discount cash flow method is used for the cost benefit analysis. The project feasibility in terms of the national economy is them determined based on the calculated Economic Internal Rate of Return(EIRR) and net present value of the project.

The project is considered economically feasible if the EIRR is higher than the opportunity cost of capital, or the rate of return that can be obtained from the best alternative use of the available capital. For public investment programs the opportunity cost of capital considered in general is from about 12% to 15%. In case of water supply projects, however, such a rate of return will not easily come to this range, being even lower than it.

6.3.3 General Assumptions for the Analysis

For the projection of the economic benefit and economic cost, the following assumptions are set up:

1) Project Evaluation Period:

The evaluation period for the project is 30 years.(up to the year 2027) from the time of the commencement of the construction.

2)Case of the Project to be Analyzed:

Following two projects are selected for this economic analysis.

- Case 2 : Rescheduled Project (Total : FPP and SPP)
- Case 3 : Rescheduled Project (FPP only)

3)Project cost and Benefit:

-All cost and benefits are evaluated at 1996 constant prices in US Dollars VS Uzbekistan Sums.

-Price escalation is not taken into consideration.

-All taxes and duties are excluded in this evaluation.

-Economic benefit and economic cost are calculated based on the "with and without project principle.'

a)Economic Costs of the Project:

The direct cost of the project should be transformed into economic cost by removing an excess portion. For this purpose, construction costs and O&M costs are considered as "quantifiable cost" in this analysis. As for the calculation of O&M cost on the basis of "with and without project principle', the relevant volume of AFW is equivalent to the current volume of norm consumption which includes the leakage and unaccounted-for water(UFW).

b)Economic Benefits of the Project

For the EIRR calculation only the benefit from increased water supply is counted as "quantifiable benefit'.

Accounted-for water (AFW) to be applied in this analysis is not based on the AFW by the current norm-consumption which was used in the financial analysis, but based on the AFW by the assumed design base of the project which exclude the leakage and unaccounted-for water.

c)Cost Water Purchase of KKP and KZ and revenue from water

Sales of T-N and T-U to Vodokanals are to be offset in the same flow of transaction due to a equal amount, and these factors are excluded in this analysis from the view point of national economy.

d)Economic benefits from Agro. Vodokanal and others on T-N and T-U side are not considered and excluded. Naturally, the construction cost itself is adjusted accordingly only for the urban area as per following section 6.3.4 2).

6.3.4 Economic Cost of Project - Table 6.15, 6.15(R) and Table 6.16, 6.16(R)

1)The estimated construction cost is to be converted to the economic cost by using the factor of shadow pricing to the local cost components which are once expressed in

US Dollars by the bank rate (40 sum = 1 US $).

2)Since the construction costs of T-N and T-U include the supply scope of both "Urban" and "Rural" areas, these costs were reduced proportionally to the assumed percentage of the volume of AFW (Urban) in 2010 year as a countable economic cost of the net "Urban" area.

$$\text{Coefficient : T-N : } \frac{\text{Urban } 258.7}{\text{Total } 311.5} \left(10^3 \times m^3 \quad \text{AFW / day} \right) = 0.830$$

$$\text{T-U : } \frac{\text{Urban } 220.9}{\text{Total } 359.8} \left(10^3 \times m^3 \quad \text{AFW / day} \right) = 0.614$$

(As of 2010 year)

6.3.5 Economic Benefits of the Project - Table 6.17 and 6.17(R)

1)Beneficial Value of Water

a)Economic Value of net supply volume

Economic benefit in this analysis should be counted by the incremental volume of water as per 6.3.3 3). In this regard, the current water tariff under the norm consumption should also be transformed into the economic water value which is to be paid against the actual volume of delivery eliminating the assumed leakage and the unaccounted-for water (UFW).

Therefor, the economic water value is obtained as follows;

Economic Water Value:

$$\text{KKP : } \frac{\text{Current Ave. Tariff (US\$ 0.130)}}{1 - 0.3 \text{ (assumed leakage + UFW)}} = \text{US\$ } 0.1857 / m^3$$

$$\text{KZ : } \frac{\text{Current Ave. Tariff (US\$ 0.083)}}{1 - 0.3 \text{ (assumed leakage + UFW)}} = \text{US\$ } 0.1186 / m^3$$

b)Water Value of Consumer's Satisfaction

Considering the consumer's satisfaction (Willingness-to-pay) after the completion of Kaparas intake station, water value can be increased accordingly as for the respective consumer group as follows;

Regarding group 1, Ave. water value by the consumers' satisfaction in the study area is 4.52 sum/m^3 according to the consumers' survey in June, 1996, and this value can be used as an economic water value or willingness-to-pay.

Regarding group 2 and 3, since these groups are even willing to equip themselves

with own water producing facilities instead of making the supply agreement with Vodokanal, their concept for water value is considered as almost same level of such producing cost.

This value is assumed as an affordability of the consumers of Group 2 and 3. In this respect, water price of Urgench transgas(one of the private water producing companies)as 10.55 sum/m^3 in June, 1996 is good reference for the corresponding water value, and this value is also to be used as a consumers' satisfaction.

Therefore, average water benefit can be increased after the completion of Kaparas intake station as follows;

$$\text{KKP}: \frac{\text{Revised Ave. Water Value (US\$ 0.191)}}{\text{1 - 0.3 (assumed leakage + UFW)}} = \text{US\$ 0.273 /m}^3$$

From the year 2001 to 2027

$$\text{KZ}: \frac{\text{Revised Ave. Water Value (US\$ 0.180)}}{\text{1 - 0.3 (assumed leakage + UFW)}} = \text{US\$ 0.257 /m}^3$$

From the year 2001 to 2027

It must be taken note that the level of water quality of Urgench transgas is not yet as good as that of Vodokanal, being of high total hardness and mineralization element.

2)Other Estimated Economic Benefits

Implementation of the project will provide the following direct and indirect benefits;

Direct benefits ;

- Increase in the area and population to be served
- Continuous supply of piped water

Indirect benefits ;

- Improvement of health conditions
- Increase in consumer satisfaction (As willingness-to-pay)
- Increase of employment opportunities - Increase in land values
- Increase in income in some productive sectors

Of the quantifiable benefits to be considered in the economic feasibility analysis are the aforesaid beneficial value of water (consumer's satisfaction) and land values, increase in income in some productive sectors.

a)Land Values

In Uzbekistan, however, privatization of land property is still in the initial stage and the land has not been habitually dealt as an object of business transactions. As a result, data are lacking for the calculation of quantifiable benefit of land values in this economic analysis.

b)Increase in income in some productive sectors.

Among the usage of water from Vodokanals majority of the water volume is used for non productive sectors including domestic use and communal services(i.e. 85% of KKP and 80% of KZ). As for the water for Agro-Vodokanal, over 10% of Khorezm Vodokanal (KZ) is provided to rural areas as a domestic use. Sufficient date was not available during the study either of industry or of agriculture.

Therefore, these quantifiable benefits could not be aggregated in this economic analysis. Some other unquantifiable benefits will also be produced from the implementation of the project. Thus the estimated economic benefits as a whole will be much more than the benefits included in this analysis which are only a part of real socio-economic benefits.

6.3.6 Economic Internal Rate of Return (EIRR) - Table 6.18 and 6.18(R)

EIRR is obtained based on quantifiable economic cost and economic benefit of the project with the general assumptions of section 6.3.3.

In this report, the total rescheduled project including FPP(First Priority Project) and SPP(Second Priority Project), and furthermore separately the rescheduled project of FPP only ware selected for the calculation of EIRR and duly analyzed as per Table 6.18 and 6.18(R).
As result,

Case 2 : IRR 1.4 %
(FPP + SPP Total)
Case 3 : IRR 8.4 %
(FPP Total)

Sensitivity Analysis was made for case 2, by adding the assumed water value by 50% of Group 2 and 3 in section 6.3.5 1)-b necessary for upgrading water quality as good quality as of Kaparas water resources or by applying water softening technology if possible.

As a consequence,

Case 2 : IRR 7.8 % (Sensitivity Analysis)

Although it is hardly possible to get financial viability as already discussed in section 6.2, and therefore, necessity of subsidies to the constructions cost has been emphasized, and considering that this project yields such unquantifiable socio-economic benefits as explained herein, it can be assessed that the economic feasibility of the project will be positive.

6.4 Summary and Conclusion

Considering the results of Financial and Economic feasibility analysis as a whole as discussed in section 6.2 and 6.3, it will be possible to sum up the conclusion as follows;

1) Taking all cogitable socio-economic benefits, quantifiable and unquantifiable, into account, and considering the reasonable EIRR values obtained for the whole Rescheduled Project (case 2) and especially FPP (case 3), this project is considered economically feasible form the view point of total benefits to Uzbekistan.

2) As for financial feasibility, considering the limitation to the tariff affordability of the consumers, it is inevitable for the GOU to provide the necessary support as a form of subsidies to the construction cost which enables to keep the balanced management of funds on the part of the water enterprises.

Table 6.12 PROJECTED INCOME STATEMENT (KKP)

UNIT:US$*$10^3$

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Supply (m^3*10^3)	85,994	92,272	98,514	101,507	104,500	104,500	104,500	104,500	104,500	104,500	104,500	104,500	104,500	104,500	104,500
Accounted for Water (m^3*10^3)	77,417	83,038	88,659	91,360	94,061	94,061	94,061	94,061	94,061	94,061	94,061	94,061	94,061	94,061	94,061
Ave. Tariff ($/$m^3$)	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142
Water Sales	10,997	11,796	12,594	12,978	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362
Other Revenues															
Subsidies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Metering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Revenues-	10,997	11,796	12,594	12,978	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362	13,362
Operational & Maintenance Cost															
Water Purchase	6,499	6,965	7,432	7,590	7,748	7,748	7,748	7,748	7,748	7,748	7,748	7,748	7,748	7,748	7,748
Electricity	1,198	1,285	1,372	1,414	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456
Wages	569	610	652	671	691	691	691	691	691	691	691	691	691	691	691
Chemicals	252	270	288	297	306	306	306	306	306	306	306	306	306	306	306
Repair Fund	718	770	822	847	872	872	872	872	872	872	1,044	1,044	1,044	1,044	1,044
Social Ins.	228	245	262	270	277	277	277	277	277	277	277	277	277	277	277
Fuel & Gus	182	195	208	215	221	221	221	221	221	221	221	221	221	221	221
Others	1,413	1,516	1,618	1,667	1,718	1,718	1,718	1,718	1,718	1,718	1,718	1,718	1,718	1,718	1,718
-Total Costs-	11,059	11,856	12,654	12,971	13,289	13,289	13,289	13,289	13,289	13,289	13,461	13,461	13,461	13,461	13,461
Income Before Depreciation	-62	-60	-60	7	73	73	73	73	73	73	-99	-99	-99	-99	-99
Depreciation	149	149	149	149	149	1,029	1,029	1,029	1,029	1,029	1,029	1,029	1,029	1,029	1,029
Income Before Interest	-211	-209	-209	-142	-76	-956	-956	-956	-956	-956	-1,128	-1,128	-1,128	-1,128	-1,128
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	-211	-209	-209	-142	-76	-956	-956	-956	-956	-956	-1,128	-1,128	-1,128	-1,128	-1,128
Aggregated Net Income	-211	-420	-629	-771	-847	-1,803	-2,759	-3,715	-4,671	-5,627	-6,755	-7,883	-9,011	-10,139	-11,267

Note: 100% subsidies are considered.

Rescheduled Project
Case No.19

Table 6.13 PROJECTED CASH FLOW STATEMENT (KKP)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sources of Funds															
Income Before Depreciation	-62	-60	-60	7	73	73	73	73	73	73	-99	-99	-99	-99	-99
Foreign Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subsidies	7,041	7,041	7,041	7,041	7,041	0	0	0	0	0	0	0	0	0	0
-Total Sources of Funds-	6,979	6,981	6,981	7,048	7,114	73	73	73	73	73	-99	-99	-99	-99	-99
Applications of Funds															
Investment in Project	7,041	7,041	7,041	7,041	7,041	0	0	0	0	0	0	0	0	0	0
Capitalized Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Investment]	7,041	7,041	7,041	7,041	7,041	0	0	0	0	0	0	0	0	0	0
Interest(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Operational Interest>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Principal Repayment>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Debt Services]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Working Capital Increase	-11	1	0	12	11	0	0	0	0	0	-29	0	0	0	0
Cash & Other Current Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Receivable	1,832	1,966	2,099	2,163	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227
Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Payable	1,843	1,976	2,109	2,161	2,214	2,214	2,214	2,214	2,214	2,214	2,243	2,243	2,243	2,243	2,243
Customers Deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Applications of funds-	7,030	7,042	7,041	7,053	7,052	0	0	0	0	0	-29	0	0	0	0
Cash Surplus	-51	-61	-60	-5	62	73	73	73	73	73	-70	-99	-99	-99	-99
Cumulative Cash Surplus	-51	-112	-172	-177	-115	-42	31	104	177	250	180	81	-18	-117	-216
Cash Flow	-51	-61	-60	-5	62	73	73	73	73	73	-70	-99	-99	-99	-99

Note: 100% subsidies are considered.

Table 6.14 PROJECTED BALANCE SHEET (KKP)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fixed Asset	7,041	14,082	21,123	28,164	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205
Depreciation	149	298	447	596	745	1,774	2,803	3,832	4,861	5,890	6,919	7,948	8,977	10,006	11,035
Net Fixed Asset	6,892	13,784	20,676	27,568	34,460	33,431	32,402	31,373	30,344	29,315	28,286	27,257	26,228	25,199	24,170
Current Asset	1,781	1,854	1,927	1,986	2,112	2,185	2,258	2,331	2,404	2,477	2,407	2,308	2,209	2,110	2,011
-Total Assets-	8,673	15,638	22,603	29,554	36,572	35,616	34,660	33,704	32,748	31,792	30,693	29,565	28,437	27,309	26,181
Capital Equity															
Government Grant	7,041	14,082	21,123	28,164	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205	35,205
Operational Surplus	-211	-420	-629	-771	-847	-1,803	-2,759	-3,715	-4,671	-5,627	-6,755	-7,883	-9,011	-10,139	-11,267
-Total Equity-	6,830	13,662	20,494	27,393	34,358	33,402	32,446	31,490	30,534	29,578	28,450	27,322	26,194	25,066	23,938
Long Term Debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current Liabilities	1,843	1,976	2,109	2,161	2,214	2,214	2,214	2,214	2,214	2,214	2,243	2,243	2,243	2,243	2,243
-Total Equity and Liabilities-	8,673	15,638	22,603	29,554	36,572	35,616	34,660	33,704	32,748	31,792	30,693	29,565	28,437	27,309	26,181

Note: 100% subsidies are considered.

Table 6.12 PROJECTED INCOME STATEMENT (T-N _)

UNIT:US$*10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Supply (m^3*10^3)	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050	62,050
Accounted for Water (m^3*10^3)	51,794	54,641	57,488	59,568	61,649	61,649	61,649	61,649	61,649	61,649	61,649	61,649	61,649	61,649	61,649
Ave. Tariff ($/$m^3$)	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117
Water Sales	6,071	6,405	6,739	6,983	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226
Other Revenues															
Subsidies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Metering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Revenues-	6,071	6,405	6,739	6,983	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226	7,226
Operational & Maintenance Cost															
Water Purchase	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity	3,060	3,228	3,396	4,694	4,858	4,858	4,858	4,858	4,858	4,858	4,858	4,858	4,858	4,858	4,858
Wages	650	686	721	748	774	774	774	774	774	774	774	774	774	774	774
Chemicals	590	623	655	189	196	196	196	196	196	196	196	196	196	196	196
Repair Fund	218	229	241	389	398	398	398	398	398	398	398	398	398	398	398
Social Ins.	260	275	289	299	310	310	310	310	310	310	310	310	310	310	310
Fuel & Gus	290	306	322	334	345	345	345	345	345	345	345	345	345	345	345
Others	355	374	395	408	421	421	421	421	421	421	421	421	421	421	421
-Total Costs-	5,423	5,721	6,019	7,061	7,302	7,302	7,302	7,302	7,302	7,302	7,302	7,302	7,302	7,302	7,302
Income Before Depreciation	648	684	720	-78	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76
Depreciation	351	351	351	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594
Income Before Interest	297	333	369	-2,672	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	297	333	369	-2,672	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670	-2,670
Aggregated Net Income	297	630	999	-1,673	-4,343	-7,013	-9,683	-12,353	-15,023	-17,693	-20,363	-23,033	-25,703	-28,373	-31,043

Note: 100% subsidies are considered.

Table 6.13 PROJECTED CASH FLOW STATEMENT (T-N)

UNIT:US $*10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sources of Funds															
Income Before Depreciation	648	684	720	-78	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76
Foreign Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subsidies	45,034	26,184	18,488												
-Total Sources of Funds-	45,682	26,868	19,208	-78	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76
Applications of Funds															
Investment in Project	45,034	26,184	18,488	0	0	0	0	0	0	0	0	0	0	0	0
Capitalized Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Investment]	45,034	26,184	18,488	0	0	0	0	0	0	0	0	0	0	0	0
Interest(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Operational Interest>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Principal Repayment>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Debt Services]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Working Capital Increase	108	6	6	-133	0	0	0	0	0	0	0	0	0	0	0
Cash & Other Current Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Receivable	1,011	1,067	1,123	1,163	1,204	1,204	1,204	1,204	1,204	1,204	1,204	1,204	1,204	1,204	1,204
Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Payable	903	953	1,003	1,176	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217
Customers Deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Applications of funds-	45,142	26,190	18,494	-133	0	0	0	0	0	0	0	0	0	0	0
Cash Surplus	540	678	714	55	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76
Cumulative Cash Surplus	540	1,218	1,932	1,987	1,911	1,835	1,759	1,683	1,607	1,531	1,455	1,379	1,303	1,227	1,151
Cash Flow	540	678	714	55	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76

Note: 100% subsidies are considered.

Table 6.14 PROJECTED BALANCE SHEET (T-N)

UNIT:US$*10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fixed Asset	45,034	71,218	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706
Depreciation	351	702	1,053	3,647	6,241	8,835	11,429	14,023	16,617	19,211	21,805	24,399	26,993	29,587	32,181
Net Fixed Asset	44,683	70,516	88,653	86,059	83,465	80,871	78,277	75,683	73,089	70,495	67,901	65,307	62,713	60,119	57,525
Current Asset	1,551	2,285	3,055	3,150	3,115	3,039	2,963	2,887	2,811	2,735	2,659	2,583	2,507	2,431	2,355
-Total Assets-	46,234	72,801	91,708	89,209	86,580	83,910	81,240	78,570	75,900	73,230	70,560	67,890	65,220	62,550	59,880
Capital Equity															
Government Grant	45,034	71,218	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706	89,706
Operational Surplus	297	630	999	-1,673	-4,343	-7,013	-9,683	-12,353	-15,023	-17,693	-20,363	-23,033	-25,703	-28,373	-31,043
-Total Equity-	45,331	71,848	90,705	88,033	85,363	82,693	80,023	77,353	74,683	72,013	69,343	66,673	64,003	61,333	58,663
Long Term Debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current Liabilities	903	953	1,003	1,176	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217	1,217
-Total Equity and Liabilities-	46,234	72,801	91,708	89,209	86,580	83,910	81,240	78,570	75,900	73,230	70,560	67,890	65,220	62,550	59,880

Note: 100% subsidies are considered.

Table 6.12 PROJECTED INCOME STATEMENT (K Z)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Supply (m^3*10^3)	61,138	61,393	61,649	89,863	91,360	91,360	91,360	91,360	91,360	91,360	91,360	91,360	91,360	91,360	91,360
Accounted for Water (m^3*10^3)	59,897	60,700	61,539	80,994	82,235	82,235	82,235	82,235	82,235	82,235	82,235	82,235	82,235	82,235	82,235
Ave. Tariff ($/$m^3$)	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
Water Sales	5,332	5,403	5,478	7,210	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320
Other Revenues															
Subsidies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Metering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Revenues-	5,332	5,403	5,478	7,210	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320
Operational & Maintenance Cost															
Water Purchase	2,518	2,535	2,552	5,037	5,105	5,105	5,105	5,105	5,105	5,105	5,105	5,105	5,105	5,105	5,105
Electricity	720	730	740	974	989	989	989	989	989	989	989	989	989	989	989
Wages	264	267	271	356	362	362	362	362	362	362	362	362	362	362	362
Chemicals	109	111	112	148	150	150	150	150	150	150	150	150	150	150	150
Repair Fund	228	231	234	308	312	312	312	312	312	312	402	402	402	402	402
Social Ins.	106	108	109	144	146	146	146	146	146	146	146	146	146	146	146
Fuel & Gus	76	77	78	103	105	105	105	105	105	105	105	105	105	105	105
Others	180	182	186	242	246	246	246	246	246	246	247	247	247	247	247
-Total Costs-	4,201	4,241	4,282	7,312	7,415	7,415	7,415	7,415	7,415	7,415	7,506	7,506	7,506	7,506	7,506
Income Before Depreciation	1,131	1,162	1,196	-102	-95	-95	-95	-95	-95	-95	-186	-186	-186	-186	-186
Depreciation	152	152	152	152	152	749	749	749	749	749	749	749	749	749	749
Income Before Interest	979	1,010	1,044	-254	-247	-844	-844	-844	-844	-844	-935	-935	-935	-935	-935
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	979	1,010	1,044	-254	-247	-844	-844	-844	-844	-844	-935	-935	-935	-935	-935
Aggregated Net Income	979	1,989	3,033	2,779	2,532	1,688	844	0	-844	-1,688	-2,623	-3,558	-4,493	-5,428	-6,363

Note: 100% subsidies are considered.

Table 6.13 PROJECTED CASH FLOW STATEMENT (K Z)

UNIT:US$*10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sources of Funds															
Income Before Depreciation	1,131	1,162	1,196	-102	-95	-95	-95	-95	-95	-95	-186	-186	-186	-186	-186
Foreign Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subsidies	4,774	4,774	4,774	4,774	4,774	0	0	0	0	0	0	0	0	0	0
-Total Sources of Funds-	5,905	5,936	5,970	4,672	4,679	-95	-95	-95	-95	-95	-186	-186	-186	-186	-186
Applications of Funds															
Investment in Project	4,774	4,774	4,774	4,774	4,774	0	0	0	0	0	0	0	0	0	0
Capitalized Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Investment]	4,774	4,774	4,774	4,774	4,774	0	0	0	0	0	0	0	0	0	0
Interest(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Operational Interest>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Principal Repayment>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Debt Services]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Working Capital Increase	188	6	6	-217	2	0	0	0	0	0	-16	0	0	0	0
Cash & Other Current Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Receivable	888	900	913	1,201	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220	1,220
Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Payable	700	706	713	1,218	1,235	1,235	1,235	1,235	1,235	1,235	1,251	1,251	1,251	1,251	1,251
Customers Deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Applications of funds-	4,962	4,780	4,780	4,557	4,776	0	0	0	0	0	-16	0	0	0	0
Cash Surplus	943	1,156	1,190	115	-97	-95	-95	-95	-95	-95	-170	-186	-186	-186	-186
Cumulative Cash Surplus	943	2,099	3,289	3,404	3,307	3,212	3,117	3,022	2,927	2,832	2,662	2,476	2,290	2,104	1,918
Cash Flow	943	1,156	1,190	115	-97	-95	-95	-95	-95	-95	-170	-186	-186	-186	-186

Note: 100% subsidies are considered.

Table 6.14 PROJECTED BALANCE SHEET (K Z)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fixed Asset	4,774	9,548	14,322	19,096	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870
Depreciation	152	304	456	608	760	1,509	2,258	3,007	3,756	4,505	5,254	6,003	6,752	7,501	8,250
Net Fixed Asset	4,622	9,244	13,866	18,488	23,110	22,361	21,612	20,863	20,114	19,365	18,616	17,867	17,118	16,369	15,620
Current Asset	1,831	2,999	4,202	4,605	4,527	4,432	4,337	4,242	4,147	4,052	3,882	3,696	3,510	3,324	3,138
-Total Assets-	6,453	12,243	18,068	23,093	27,637	26,793	25,949	25,105	24,261	23,417	22,498	21,563	20,628	19,693	18,758
Capital Equity															
Government Grant	4,774	9,548	14,322	19,096	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870	23,870
Operational Surplus	979	1,989	3,033	2,779	2,532	1,688	844	0	-844	-1,688	-2,623	-3,558	-4,493	-5,428	-6,363
-Total Equity-	5,753	11,537	17,355	21,875	26,402	25,558	24,714	23,870	23,026	22,182	21,247	20,312	19,377	18,442	17,507
Long Term Debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current Liabilities	700	706	713	1,218	1,235	1,235	1,235	1,235	1,235	1,235	1,251	1,251	1,251	1,251	1,251
-Total Equity and Liabilities-	6,453	12,243	18,068	23,093	27,637	26,793	25,949	25,105	24,261	23,417	22,498	21,563	20,628	19,693	18,758

Note: 100% subsidies are considered.

Rescheduled Project
Case No .19

Table 6.12 PROJECTED INCOME STATEMENT (T-U)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Supply (m^3*10^3)	65,700	65,700	65,700	131,400	131,400	131,400	131,400	131,400	131,400	131,400	131,400	131,400	131,400	131,400	131,400
Accounted for Water (m^3*10^3)	65,737	65,737	65,737	105,084	108,186	108,186	108,186	108,186	108,186	108,186	108,186	108,186	108,186	108,186	108,186
Ave. Tariff ($/$m^3$)	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067
Water Sales	4,382	4,382	4,382	7,005	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212
Other Revenues															
Subsidies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Metering	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Revenues-	4,382	4,382	4,382	7,005	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212	7,212
Operational & Maintenance Cost															
Water Purchase	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity	2,641	2,641	2,641	4,222	4,346	4,346	4,346	4,346	4,346	4,346	4,346	4,346	4,346	4,346	4,346
Wages	455	455	455	728	749	749	749	749	749	749	749	749	749	749	749
Chemicals	749	749	209	334	343	343	343	343	343	343	343	343	343	343	343
Repair Fund	181	181	181	605	614	614	614	614	614	614	614	614	614	614	614
Social Ins.	182	182	182	292	300	300	300	300	300	300	300	300	300	300	300
Fuel & Gus	294	294	294	470	484	484	484	484	484	484	484	484	484	484	484
Others	205	205	745	328	339	339	339	339	339	339	339	339	339	339	339
-Total Costs-	4,707	4,707	4,707	6,979	7,175	7,175	7,175	7,175	7,175	7,175	7,175	7,175	7,175	7,175	7,175
Income Before Depreciation	-325	-325	-325	26	37	37	37	37	37	37	37	37	37	37	37
Depreciation	213	213	213	213	213	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439
Income Before Interest	-538	-538	-538	-187	-176	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	-538	-538	-538	-187	-176	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402	-3,402
Aggregated Net Income	-538	-1,076	-1,614	-1,801	-1,977	-5,379	-8,781	-12,183	-15,585	-18,987	-22,389	-25,791	-29,193	-32,595	-35,997

Note: 100% subsidies are considered.

Table 6.13 PROJECTED CASH FLOW STATEMENT (T-U)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sources of Funds															
Income Before Depreciation	-325	-325	-325	26	37	37	37	37	37	37	37	37	37	37	37
Foreign Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subsidies	29,003	61,957	24,909	8,068	5,121										
-Total Sources of Funds-	28,678	61,632	24,584	8,094	5,158	37	37	37	37	37	37	37	37	37	37
Applications of Funds															
Investment in Project	29,003	61,957	24,909	8,068	5,121	0	0	0	0	0	0	0	0	0	0
Capitalized Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Investment]	29,003	61,957	24,909	8,068	5,121	0	0	0	0	0	0	0	0	0	0
Interest(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Operational Interest>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal(Soft Loan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<Total Principal Repayment>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[Total Debt Services]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Working Capital Increase	-54	0	0	58	3	0	0	0	0	0	0	0	0	0	0
Cash & Other Current Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Receivable	730	730	730	1,167	1,202	1,202	1,202	1,202	1,202	1,202	1,202	1,202	1,202	1,202	1,202
Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Payable	784	784	784	1,163	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195
Customers Deposit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Total Applications of funds-	28,949	61,957	24,909	8,126	5,124	0	0	0	0	0	0	0	0	0	0
Cash Surplus	-271	-325	-325	-32	34	37	37	37	37	37	37	37	37	37	37
Cumulative Cash Surplus	-271	-596	-921	-953	-919	-882	-845	-808	-771	-734	-697	-660	-623	-586	-549
Cash Flow	-271	-325	-325	-32	34	37	37	37	37	37	37	37	37	37	37

Note: 100% subsidies are considered.

Table 6.14 PROJECTED BALANCE SHEET (T-U)

UNIT:US $ *10^3

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fixed Asset	29,003	90,960	115,869	123,937	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058
Depreciation	213	426	639	852	1,065	4,504	7,943	11,382	14,821	18,260	21,699	25,138	28,577	32,016	35,455
Net Fixed Asset	28,790	90,534	115,230	123,085	127,993	124,554	121,115	117,676	114,237	110,798	107,359	103,920	100,481	97,042	93,603
Current Asset	459	134	-191	214	283	320	357	394	431	468	505	542	579	616	653
-Total Assets-	29,249	90,668	115,039	123,299	128,276	124,874	121,472	118,070	114,668	111,266	107,864	104,462	101,060	97,658	94,256
Capital Equity															
Government Grant	29,003	90,960	115,869	123,937	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058	129,058
Operational Surplus	-538	-1,076	-1,614	-1,801	-1,977	-5,379	-8,781	-12,183	-15,585	-18,987	-22,389	-25,791	-29,193	-32,595	-35,997
-Total Equity-	28,465	89,884	114,255	122,136	127,081	123,679	120,277	116,875	113,473	110,071	106,669	103,267	99,865	96,463	93,061
Long Term Debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current Liabilities	784	784	784	1,163	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195
-Total Equity and Liabilities-	29,249	90,668	115,039	123,299	128,276	124,874	121,472	118,070	114,668	111,266	107,864	104,462	101,060	97,658	94,256

Note: 100% subsidies are considered.

Table 6.15 Economic Construction Cost

(UNIT: 10^3X(US$)

	T-N				T-U					KKP			KZ				
	① Construction Cost			② Net ※ Investment for VK/KKP	③ Construction Cost			④Net ※ Investment for VK/KZ	⑤Total	⑥ Construction Cost			⑦ Construction Cost			⑧ Total	⑨Total Economic Construction cost
	Local X0.8(S.E.P)	Foreign	Total	···①X0.830	Local X0.8(S.E.P)	Foreign	Total	③X0.614	②+④	Local X0.8(S.E.P)	Foreign	Total	Local X0.8(S.E.P)	Foreign	Total		⑤+⑧
1998	16,806	24,026	40,832	33,891	11,914	14,111	26,025	15,979	49,870	3,136	3,121	6,257	2,162	2,072	4,234	10,491	60,361
1999	2,906	22,551	25,457	21,130	7,127	53,048	60,175	36,948	58,077	3,136	3,121	6,257	2,162	2,072	4,234	10,491	68,568
2000	2,262	15,661	17,923	14,876	2,658	21,586	24,244	14,886	29,762	3,136	3,121	6,257	2,162	2,072	4,234	10,491	40,252
2001	0	0	0	0	617	7,297	7,914	4,859	4,859	3,136	3,121	6,257	2,162	2,072	4,234	10,491	15,350
2002	0	0	0	0	486	4,513	4,999	3,070	3,070	3,136	3,121	6,257	2,162	2,072	4,234	10,491	13,560
2003	12,610	24,669	37,279	30,942	0	0	0	0	30,942	4,142	16,199	20,341	3,146	16,844	19,990	40,331	71,273
2004	7,366	57,490	64,856	53,830	0	0	0	0	53,830	3,812	10,686	14,498	2,354	3,252	5,606	20,104	73,935
2005	5,838	49,114	54,952	45,610	1,598	9,745	11,343	6,964	52,575	3,253	6,153	9,406	2,316	6,097	8,413	17,819	70,394
2006	477	3,168	3,645	3,025	477	3,166	3,643	2,237	5,262	3,136	3,121	6,257	2,162	2,072	4,234	10,491	15,752
2007										3,136	3,121	6,257	2,162	2,072	4,234	10,491	10,491
2008										3,136	3,121	6,257	2,162	2,072	4,234	10,491	10,491
2009										3,136	3,121	6,257	2,162	2,072	4,234	10,491	10,491
2010										3,136	3,095	6,231	2,162	2,072	4,234	10,465	10,465
Total	48,266	196,679	244,945	203,304	24,877	113,466	138,343	84,942	288,246	42,566	64,222	106,788	29,433	46,913	76,346	183,134	471,381

※Note: Investment cost only for the "urban"area (Vodokanals) calculated by the assumed proportional volume of AFW in 2010 year.

Table 6.16. Economic Cost (O & M)

(UNIT: 103X(US$)

	DQM/WP											Vodokanal											
	T-N					T-U					I	KKP					KZ					II	I+II
	A)with project		B)without project		A)-B)	C)with project		D)without project		C)-D)	Sub Total	A)with project		B)without project		A)-B)	C)with project		D)without project		C)-D)	Sub Total	Total Incremental cost
	AFW	O&M Cost	AFW	O&M Cost	X 10³ uss	AFW	O&M Cost	AFW	O&M Cost	X 10³ uss		AFW	O&M Cost	AFW	O&M Cost	X 10³ uss	AFW	O&M Cost	AFW	O&M Cost	X 10³ uss		
1998	41,610	4,357	41,610	4,357	0	34,016	2,436	33,288	2,383	52	52	77,380	4,558	77,380	4,558	0	59,824	1,681	59,824	1,681	0	0	52
1999	44,749	4,685	44,749	4,685	0	34,227	2,451	33,288	2,383	68	68	83,038	4,891	83,038	4,891	0	60,663	1,705	60,663	1,705	0	0	68
2000	47,852	5,010	47,852	5,010	0	34,456	2,185	33,288	2,383	-199	-199	88,659	5,222	88,659	5,222	0	61,466	1,727	61,466	1,727	0	0	-199
2001	48,764	5,805	48,764	5,106	700	68,000	4,627	33,288	2,383	2,244	2,944	91,360	5,381	91,360	5,381	0	60,864	2,273	60,663	1,705	568	568	3,512
2002	49,640	5,907	49,640	5,197	710	68,912	4,685	33,288	2,383	2,302	3,011	94,061	5,540	94,061	5,540	0	62,235	2,311	59,933	1,684	627	627	3,638
2003	48,947	5,826	48,947	5,125	702	69,661	4,745	33,288	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	63,622	2,350	59,203	1,664	686	686	3,750
2004	47,961	5,712	48,947	5,125	587	70,810	4,806	33,288	2,383	2,422	3,009	93,732	5,521	93,732	5,521	0	64,936	2,387	58,546	1,645	742	742	3,751
2005	46,976	5,597	48,947	5,125	473	71,723	4,863	33,288	2,383	2,480	2,953	93,331	5,497	93,331	5,497	0	66,286	2,425	57,889	1,627	798	798	3,751
2006	77,855	12,066	48,947	5,125	6,941	72,599	4,919	33,288	2,383	2,536	9,477	105,011	6,315	92,783	5,465	850	67,673	2,572	57,066	1,604	967	1,817	11,294
2007	79,680	12,694	48,947	5,125	7,569	73,475	5,052	33,288	2,383	2,669	10,238	107,947	6,489	92,272	5,435	1,054	69,060	2,611	56,356	1,584	1,027	2,081	12,318
2008	81,432	12,962	48,947	5,125	7,837	74,351	5,108	33,288	2,383	2,724	10,562	110,887	6,833	91,834	5,409	1,424	90,411	2,739	55,626	1,563	1,176	2,600	13,162
2009	83,220	13,236	48,947	5,125	8,111	74,898	5,142	33,288	2,383	2,759	10,870	113,844	7,007	91,396	5,383	1,624	91,542	2,771	54,933	1,544	1,227	2,851	13,722
2010	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2011	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2012	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2013	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2014	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2015	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2016	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2017	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2018	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2019	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2020	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2021	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2022	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2023	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2024	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2025	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2026	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
2027	84,972	13,504	48,947	5,125	8,380	72,562	4,994	33,288	2,383	2,611	10,991	116,800	7,182	90,995	5,360	1,822	90,447	2,740	54,276	1,525	1,215	3,037	14,027
Total	2,226,179	336,907	1,456,277	152,472	184,455	2,053,454	140,915	998,640	71,503	69,412	253,878	3,255,837	198,068	2,721,915	160,321	37,747	2,586,646	76,871	1,679,146	47,184	29,687	67,434	321,311

Table 6.17 Economic Benefit

(UNIT:10³XUS$)

Case 1	KKP					KZ					Total
	A)with project		B)without project		A)-B) Incremental water revenue	C)with project		D)without project		C)-D) Incremental water revenue	
	AFW	Revenue	AFW	Revenue		AFW	Revenue	AFW	Revenue		
1998	55,699	10,343	54,166	10,059	285	47,158	5,593	45,479	5,394	199	484
1999	61,466	11,414	54,166	10,059	1,356	49,531	5,874	46,173	5,476	398	1,754
2000	66,503	12,350	54,166	10,059	2,291	51,210	13,161	46,793	5,550	7,611	9,902
2001	69,460	18,962	54,166	10,059	8,904	68,292	17,551	46,173	5,476	12,075	20,979
2002	72,453	19,780	54,166	10,059	9,721	70,336	18,076	45,552	5,402	12,674	22,395
2003	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2004	72,416	19,770	54,166	10,059	9,711	74,570	19,164	44,457	5,273	13,892	23,603
2005	73,000	19,929	54,166	10,059	9,870	76,723	19,718	43,946	5,212	14,506	24,376
2006	85,082	23,227	54,166	10,059	13,169	78,913	20,281	43,289	5,134	15,147	28,315
2007	88,249	24,174	54,166	10,059	14,115	81,140	20,853	42,669	5,060	15,792	29,908
2008	92,053	25,130	54,166	10,059	15,072	83,366	21,425	42,085	4,991	16,434	31,506
2009	95,630	26,107	54,166	10,059	16,048	87,819	22,569	41,574	4,931	17,639	33,687
2010	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2011	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2012	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2013	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2014	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2015	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2016	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2017	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2018	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2019	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2020	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2021	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2022	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2023	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2024	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2025	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2026	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
2027	99,280	27,103	54,166	10,059	17,045	87,162	22,401	41,026	4,866	17,535	34,580
Total	2,690,853	718,569	1,624,980	301,759	416,810	2,410,424	606,097	1,271,660	150,819	455,278	872,088

Economic Analysis (R/P Total)

Table 6.18 EIRR CALCLATION(Case 2)

(UNIT:US$1,001)

	①Economic Construction Cost		②Economic Cost (incremental)		③Total Economic cost	④ Economic Benefit		⑤ Total Eco.Benefit	⑥ Bene.- Cost	EIRR 1.41%	Present Value
	DOMIWP	Vodokanal									
	T-N + T-U	KKP + KZ	T-N + T-U	KKP + KZ	① + ②	KKP	KZ				
1998	49,870	10,491	52	0	60,413	285	199	484	-59,929	0.986	-59,096
1999	58,077	10,491	68	0	68,636	1,356	398	1,754	-66,882	0.972	-65,034
2000	29,762	10,491	-199	0	40,054	2,291	7,611	9,902	-30,151	0.959	-28,911
2001	4,859	10,491	2,944	568	18,861	8,904	12,075	20,979	2,117	0.946	2,002
2002	3,070	10,491	3,011	627	17,198	9,721	12,674	22,395	5,196	0.932	4,845
2003	30,942	40,331	3,064	686	75,023	9,462	13,283	22,745	-52,278	0.919	-48,064
2004	53,830	20,104	3,009	742	77,685	9,711	13,892	23,603	-54,083	0.907	-49,032
2005	52,575	17,819	2,953	798	74,144	9,870	14,506	24,376	-49,768	0.894	-44,493
2006	5,262	10,491	9,477	1,817	27,047	13,169	15,147	28,315	1,269	0.882	1,118
2007		10,491	10,238	2,081	22,809	14,115	15,792	29,908	7,099	0.869	6,171
2008		10,491	10,562	2,600	23,652	15,072	16,434	31,506	7,853	0.857	6,732
2009		10,491	10,870	2,851	24,212	16,048	17,639	33,687	9,475	0.845	8,009
2010		10,465	10,991	3,037	24,492	17,045	17,535	34,580	10,088	0.834	8,409
2011			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.822	16,893
2012			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.811	16,658
2013			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.799	16,426
2014			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.788	16,198
2015			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.777	15,973
2016			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.766	15,750
2017			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.756	15,531
2018			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.745	15,315
2019			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.735	15,102
2020			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.725	14,892
2021			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.715	14,685
2022			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.705	14,481
2023			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.695	14,280
2024			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.685	14,081
2025			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.676	13,885
2026			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.666	13,692
2027			10,991	3,037	14,027	17,045	17,535	34,580	20,552	0.657	13,502
Total	288,247	183,134	253,878	67,434	792,692	416,810	455,278	872,088	79,396		0

Table 6.15(R) Economic Construction Cost(case 3)

(UNIT: 10³XUS$)

	T - N				T - U				⑤Total	KKP			KZ			⑧ Total	⑨Total
	① Construction Cost			② Net ※ Investment for VK/KKP	③ Construction Cost			④Net ※ Investment for VK/KZ		⑥ Construction Cost			⑦ Construction Cost				Economic Construction cost
	Local × 0.8(S.E.P)	Foreign	Total	①X0.830	Local × 0.8(S.E.P)	Foreign	Total	③X0.614	②+④	Local × 0.8(S.E.P)	Foreign	Total	Local × 0.8(S.E.P)	Foreign	Total		⑤+⑧
1998	16,806	24,026	40,832	33,891	11,914	14,111	26,025	15,979	49,870	3,136	3,121	6,257	2,162	2,072	4,234	10,491	60,361
1999	2,906	22,551	25,457	21,130	7,127	53,048	60,175	36,948	58,077	3,136	3,121	6,257	2,162	2,072	4,234	10,491	68,568
2000	2,262	15,661	17,923	14,876	2,658	21,586	24,244	14,886	29,762	3,136	3,121	6,257	2,162	2,072	4,234	10,491	40,252
2001	0	0	0	0	617	7,297	7,914	4,859	4,859	3,136	3,121	6,257	2,162	2,072	4,234	10,491	15,350
2002	0	0	0	0	486	4,513	4,999	3,070	3,070	3,136	3,121	6,257	2,162	2,072	4,234	10,491	13,560
2003																	
2004																	
2005																	
2006																	
2007																	
2008																	
2009																	
2010																	
Total	21,974	62,238	84,212	69,896	22,802	100,555	123,357	75,741	145,638	15,680	15,605	31,285	10,808	10,360	21,168	52,453	198,091

※Note: Investment cost only for the "urban"area (Vodokanals) calculated by the assumed proportional volume of AFW in 2010 year.

Table 6.16(B) Economic Cost (O & M)(Case3)

(UNIT: 10⁶XUS$)

	DOMWP											Vodokanal										
	T-N					T-U					I	KKP					KZ					II	I+II
	A)with project		B)without project		A)-B)	C)with project		D)without project		C)-D)	Sub Total	A)with project		B)without project		A)-B)	C)with project		D)without project		C)-D)	Sub Total	Total
	AFW	O&M Cost	AFW	O&M Cost	X 10⁶ US$	AFW	O&M Cost	AFW	O&M Cost	X 10⁶ US$		AFW	O&M Cost	AFW	O&M Cost	X 10⁶ US$	AFW	O&M Cost	AFW	O&M Cost	X 10⁶ US$		Incremental cost
1998	41,610	4,357	41,610	4,357	0	34,018	2,436	33,266	2,383	52	52	77,380	4,556	77,380	4,558	0	59,824	1,681	59,824	1,681	0	0	52
1999	44,749	4,685	44,749	4,685	0	34,237	2,451	33,266	2,383	68	68	83,038	4,891	83,038	4,891	0	60,663	1,705	60,663	1,705	0	0	68
2000	47,852	5,010	47,852	5,010	0	34,456	2,185	33,266	2,383	-199	-199	88,659	5,222	88,659	5,222	0	61,466	1,727	61,466	1,727	0	0	-199
2001	48,764	5,805	48,764	5,106	700	68,000	4,627	33,266	2,383	2,244	2,944	91,360	5,381	91,360	5,381	0	80,884	2,273	60,663	1,705	568	568	3,512
2002	49,640	5,907	49,640	5,197	710	68,912	4,685	33,266	2,383	2,302	3,011	94,061	5,540	94,061	5,540	0	82,235	2,311	59,933	1,684	627	627	3,638
2003	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2004	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2005	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2006	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2007	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2008	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2009	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2010	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2011	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2012	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2013	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2014	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2015	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2016	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2017	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2018	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2019	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2020	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2021	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2022	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2023	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2024	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2025	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2026	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
2027	48,947	5,826	48,947	5,125	702	69,861	4,745	33,266	2,383	2,362	3,064	94,170	5,547	94,170	5,547	0	83,622	2,350	59,203	1,664	686	686	3,750
Total	1,456,277	171,422	1,456,277	152,472	18,950	1,986,148	135,020	998,640	71,503	63,518	82,468	2,788,746	164,257	2,788,746	164,257	0	2,435,609	68,441	1,782,624	50,092	18,349	18,349	100,816

Table6.17(R) Economic Benefit(Case3)

(UNIT:10^3XUS$)

Case 1	KKP					KZ					Total
	A)with project		B)without project		A)-B) Incremental water revenue	C)with project		D)without project		C)-D) Incremental water revenue	
	AFW	Revenue	AFW	Revenue		AFW	Revenue	AFW	Revenue		
1998	55,699	10,343	54,166	10,059	285	47,158	5,593	45,479	5,394	199	484
1999	61,466	11,414	54,166	10,059	1,356	49,531	5,874	46,173	5,476	398	1,754
2000	66,503	12,350	54,166	10,059	2,291	51,210	13,161	46,793	5,550	7,611	9,902
2001	69,460	18,962	54,166	10,059	8,904	68,292	17,551	46,173	5,476	12,075	20,979
2002	72,453	19,780	54,166	10,059	9,721	70,336	18,076	45,552	5,402	12,674	22,395
2003	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2004	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2005	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2006	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2007	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2008	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2009	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2010	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2011	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2012	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2013	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2014	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2015	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2016	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2017	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2018	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2019	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2020	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2021	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2022	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2023	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2024	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2025	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2026	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
2027	71,504	19,520	54,166	10,059	9,462	72,453	18,620	45,005	5,338	13,283	22,745
Total	2,113,166	560,861	1,624,980	301,759	259,102	2,097,838	525,763	1,355,282	160,736	365,026	624,128

Table6.18(R) EIRR CALCLATION(Case 3)

(UNIT: 10³XUS$)

	①Economic Construction Cost		②Economic O&M Cost (Incremental)		③Total Economic cost	④ Economic Benefit		⑤ Total Eco.Benefit	⑥ Bene.- Cost	EIRR 8.41%	Present Value
	DOMIWP	Vodokanal									
	T-N + T-U	KKP + KZ	T-N + T-U	KKP + KZ	① + ②	KKP	KZ				
1998	49,870	10,491	52	0	60,413	285	199	484	-59,929	0.922	-55,282
1999	58,077	10,491	68	0	68,636	1,356	398	1,754	-66,882	0.851	-56,911
2000	29,762	10,491	-199	0	40,054	2,291	7,611	9,902	-30,151	0.785	-23,667
2001	4,859	10,491	2,944	568	18,861	8,904	12,075	20,979	2,117	0.724	1,533
2002	3,070	10,491	3,011	627	17,198	9,721	12,674	22,395	5,196	0.668	3,471
2003			3,064	686	3,750	9,462	13,283	22,745	18,995	0.616	11,703
2004			3,064	686	3,750	9,462	13,283	22,745	18,995	0.568	10,796
2005			3,064	686	3,750	9,462	13,283	22,745	18,995	0.524	9,958
2006			3,064	686	3,750	9,462	13,283	22,745	18,995	0.484	9,186
2007			3,064	686	3,750	9,462	13,283	22,745	18,995	0.446	8,474
2008			3,064	686	3,750	9,462	13,283	22,745	18,995	0.412	7,817
2009			3,064	686	3,750	9,462	13,283	22,745	18,995	0.380	7,211
2010			3,064	686	3,750	9,462	13,283	22,745	18,995	0.350	6,651
2011			3,064	686	3,750	9,462	13,283	22,745	18,995	0.323	6,136
2012			3,064	686	3,750	9,462	13,283	22,745	18,995	0.298	5,660
2013			3,064	686	3,750	9,462	13,283	22,745	18,995	0.275	5,221
2014			3,064	686	3,750	9,462	13,283	22,745	18,995	0.254	4,816
2015			3,064	686	3,750	9,462	13,283	22,745	18,995	0.234	4,443
2016			3,064	686	3,750	9,462	13,283	22,745	18,995	0.216	4,098
2017			3,064	686	3,750	9,462	13,283	22,745	18,995	0.199	3,780
2018			3,064	686	3,750	9,462	13,283	22,745	18,995	0.184	3,487
2019			3,064	686	3,750	9,462	13,283	22,745	18,995	0.169	3,217
2020			3,064	686	3,750	9,462	13,283	22,745	18,995	0.156	2,967
2021			3,064	686	3,750	9,462	13,283	22,745	18,995	0.144	2,737
2022			3,064	686	3,750	9,462	13,283	22,745	18,995	0.133	2,525
2023			3,064	686	3,750	9,462	13,283	22,745	18,995	0.123	2,329
2024			3,064	686	3,750	9,462	13,283	22,745	18,995	0.113	2,148
2025			3,064	686	3,750	9,462	13,283	22,745	18,995	0.104	1,982
2026			3,064	686	3,750	9,462	13,283	22,745	18,995	0.096	1,828
2027			3,064	686	3,750	9,462	13,283	22,745	18,995	0.089	1,686
Total	145,638	52,453	82,468	18,349	298,907	259,102	365,026	624,128	325,221		0

CHAPTER 7

ENVIRONMENTAL IMPACT ASSESSMENT

CHAPTER 7 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Results of Initial Environmental Examination (IEE)

As a results of the IEE of the Basic Plan report (Part I), the following environmental elements during whole project activities cannot be ignored and Environmental Impact Assessment (EIA) is needed.

1) Noise and vibration
2) Landscape
3) Archaeological treasures

On the other hand, from the view point of the project activities, the following specific activities may have an impact on the environment in the study area and EIA is needed.

1) Operation of the Kaparas reservoir
2) Operation of the expanded water treatment plant
3) Increase in sewage waste water as the water supply system develops

In addition, the following specific activities are to be considered:

1) Rehabilitation and replacement of existing facilities, and increase of solid waste.
2) Construction of pipelines that hinders traffic.

7.2 Examinations of Selected Environmental Elements and Activities

(1) Selected Environmental Elements

1) Noise and vibration

During the construction work of the whole project, the noise from machines such as air compressor and concrete blender will be 70-75 dB, which might not cause serious problems if the works is done during day time. In the operation phase of the project, noise levels will be negligible since machines operation generating noise are installed in buildings. Also the degree of the impact of vibration is similar to that of the noise. The neighboring areas are basically uninhabited. Accordingly, the possible impacts will not be serious and no additional restrictions are needed on the work.

2) Landscape

Once a plant, building or artificial structure has been constructed in a natural environment, the landscape changes. Major buildings in this project are intake pumping station, water treatment plants and pipelines. In general, impacts of these structures will be negligible since the first two structures are not very large and the last one is installed under ground.

3) Archaeological treasures

In the study area, there are many archaeological sites as in Khiva city. Although major archaeological treasures have not been identified at the construction sites, there is a possibility of discovery of archaeological treasures underground during the construction. When digging, care will be required especially.

(2) Selected major activities

1) Operation of Kaparas reservoir

Kaparas reservoir has already been completed as the drinking water source but not been put into operation since the intake pumping station and raw water main have been not completed. Instead, the reservoir is being used for irrigation and other purposes. After the reservoir is used as a drinking water source water will be drawn from the Amudarya river in summer season. This operation might have the following effects.

i) Generation of offensive odor and pollution of water in the reservoir

If river water containing nutrients, especially nitrogen and phosphorus compounds flows into and is then stored for some period in a reservoir under conditions such as high temperature, long hours of sunlight, etc., algae and microorganism may be generated in the stored water and dead algae decompose and accumulate at the bottom. Eventually the water is polluted by the accumulation, give off offensive odors and turn stale. Besides, some kinds of algae generate a substance with offensive odor during propagation. This mechanism is called eutrophication with basic characteristic as below. As a result of the eutrophication, the water become inappropriate for drinking and the environment in and around the reservoir deteriorates.

- Basic characteristics of eutrophication

  Nitrogen(N) >0.15 mg/l, phosphorus(P) >0.02 mg/l

  10 < Ratio of N to P (N/P ratio) >25

  If conditions for eutrophication are met properly, it occurs rapidly within one week or within a few weeks.

In the Kaparas reservoir, the detention time for the stored water is much longer- about nine months from September to May and concentrations of some nutrients are high enough for eutrophication to occur as shown in Table 7.1, according to the results of water quality analysis by the JICA Study Team.

Table 7.1 Chemical Conditions of Kaparas Reservoir in 1995

	unit	June	July	August
PO_4 ($P\text{-}PO_4$)		(0.023)	(0.0023)	(0.0046)
NH_4 ($N\text{-}NH_4$)	mg/l	0.67 (0.52)	0.99 (0.77)	0 (0)
NO_2 ($N\text{-}NO_2$)	mg/l	0.004 (0.001)	0.016 (0.005)	0 (0)
NO_3 ($N\text{-}NO_3$)	mg/l	0.25 (0.056)	2.45 (0.55)	0 (0)
Total-N	mg/l	(0.577)	(1.325)	(0)
N/P ratio		25	576	-

Source: water quality analysis by the JICA Study Team

Judging from the water quality in June, there is a possibility eutrophication to occur. However, the water quality in July and August is good and eutrophication does not occur.

To check the possibility of occurrence of eutrophication, further studies have been conducted with the SANIIRI using their standards.

Water eutrophication level, along with its bio-bacteriological indicators is a characteristic of the water quality. There are four grades of biological water quality:

1. Oligosaprobe - uncontaminated;
2. β-mesosaprobe - slightly contaminated;
3. α- mesosaprobe - moderately contaminated;
4. Polysaprobe - highly contaminated.

Depending on the content of organic and biological substances, there are three eutrophication levels:

Table 7 2 Eutrophication Level

(unit : mg/l)

Level	Level	$N\text{-}NH_4^+$	$N\text{-}NO_3^-$	$P\text{-}PO_3^-$	O-PO	BOD_5	COD
I	Oligotrophic	0.1	0.2	0.03	3	1.5	10
II	Mesotrophic	0.8	0.3	0.07	8	5.0	30
III	Euthrophic	3.0	0.4	0.15	12	8.0	70

Source : SANIIRI

In order to determine the eutrophication level in the Kaparas reservoir, the average value for the reservoir is given below with respect to the content of biological and organic substances detected in water of this reservoir during spring-summer (S-S) and autumn-winter (A-W) periods of 1990-93.

Table 7.3 Content of Biological and Organic Substances in water of Kaparas Reservoir (average during 1990 - 1993)

(unit : mg/l)

	$N\text{-}NH_4$		$N\text{-}NO_3$		$P\text{-}PO_4$		BOD_5		COD	
	S-S	A-W	S-S	A-W	S-S	A-W	S-S	A-W	S-S	A-W
Concentration	0.08	0.05	0.35	0.30	0.02	0.01	1.46	1.33	20.6	19.1
Eutrophication level	I	I	II	II	I	I	I	I	II	II

Note: spring-summer (S-S),autumn-winter (A-W)

As seen from the results above, the Kaparas reservoir water is mainly oligotrophic, and indicators by the nitrogen of nitrates and COD show mesotrophic, i.e. water of the Kaparas reservoir is not rich with nutrients and contains easily oxidized organic substances, although the concentration of hard oxidized substances is relatively excessive. Consequently, there is no possibility of eutrophication to occur in this reservoir.

In addition, it has been confirmed through the site survey of the Kaparas reservoir by the JICA Study Team that eutrophication has not occurred at all until July 1996 although water is stored in the reservoir. However, monitoring of the water quality of the river and the reservoir should be continued in case that the quality of the water change in future or suddenly.

ii) Impact on river and ground water

After the reservoir starts operating, water will be drawn from the Amudarya river in the summer season. Consequently, the main stream flow of the Amudarya river will decrease in the summer season. However, the drawn water volume (238 million m^3/year), annual volume required for domestic and drinking water in 2010 planned in Chapter 8, is a quite small compared to the discharge rate of the Amudarya river as shown in Table 7. 4, therefore change in the environment can be neglected.

Table 7.4 Monthly Minimum Probabilistic Discharge Rates

(unit : mil. m^3)

Probability Year (Return Period)	Jun.	Jul.	Aug.
2	5,215	6,742	5,360
5	3,408	4,795	3,914
10	2,727	4,015	3,320
20	2,271	3,466	2,898

Note : Monthly Minimum Probabilistic Discharge Rates are calculated from Table 5/17

iii) Impact on other water use

To draw water from the Amu Darya river, water level of the Ruslovoye reservoir needs to be raised up to an appropriate level. This may affect irrigation system of the downstream. According to Chapter 5, in average flow year, water level can be raise up to water level of 123 m, equivalent to an effective volume of 260 million m^3. This volume meets the water demand in 2010. However, in drought year such as 1986, it is considered to be difficult to raise the water level to the required level. In such years, irrigation system as well as water supply system is affected by scarce water unless Kaparas reservoir is used. Consequently, it is necessary for the organizations related with the water use of the Amu Darya river as shown in Chapter 3 to coordinate and manage rational distribution of the water.

iv) Impact on the dam

Silting on the reservoir bed may reduce the storage volume. However, this was the problem has already occurred by the past operation of the Tuyamuyun Hydro-Unit and that does not newly occur by operation of the Kaparas reservoir. This problem should be considered by the related organization. Considering the silting on the Kaparas reservoir, effect of the volume of the accumulated silts in the Kaparas reservoir is minimum since silt water of the Ruslovoye reservoir is settled down before entering the reservoir.

v) Water right

Kaparas reservoir will be used as a water source only for domestic and drinking water for realizing this project, The following resolutions have been issued by the Cabinet of Ministers of the ROU related to utilization of this reservoir.

1) No. 200 of April 15, 1986
2) No. 275 of August 4, 1990

These resolutions state that the ROU has decided to use the Kaparas reservoir as the main source of domestic and drinking water supply for the inhabitants of the Karakalpakstan and Khorezm.

Furthermore, a meeting on this matter has been held on July 18, 1996, with the participation of the related organizations. At this meeting, the water right of the Kaparas reservoir was confirmed for domestic and drinking use. In addition, consultations on the utilization of the Kaparas reservoir have been held and monitoring and forecast of water quality of the Amudarya river and the Kaparas reservoir have been recommended. However, if there are questions on water rights, they should be discussed immediately to avoid disputes in future.

2) Operation of water treatment plants

Major adverse effects of a water treatment plant are contamination of soil and water because of sludge disposed from a treatment plant. The existing plants dispose the sludge by discharging it to a vast arid area around the plants, which functions as a natural dried bed in the conventional sludge treatment system. This disposal method is basically appropriate in this area. However, if harmful substances such as metals and agricultural chemicals are included in the sludge, it should be treated carefully.

Table 7.5-(a) and 7.5-(b) shows concentration of heavy metals and agricultural chemicals in the sludge of water treatment plants and in the sediments accumulated at the bottom of river and canal bed (the river sediments) analyzed by the GosSIAK. Many heavy metals and agricultural chemicals were detected in the sludge. The components of the sludge is almost similar to those in the river sediments with Fe, which is not harmful substance forming a major part. Compared to the total amount of the river sediment, sludge is very small volume and its environmental impact is minimal. However, sludge should be treated carefully if it contains more or less heavy metals and agro-chemicals. The following measures are necessary for its disposal.

a) Dehydrate and reduce the volume
b) Dispose to the appropriate locations reserved for disposal of harmful materials
c) Keep good sanitary conditions that do not scatter in the air and do not leach underground

Also it should be considered that sludge can be used for the following purposes if contents and conditions of sludge are met for the purposes.

a) for construction (banking, backfill, etc.)
b) for agriculture (reclamation and compost)
c) for construction materials (aggregate, cement and concrete brick form)

Table 7.5-(a) Components of Metals in the Water Treatment Sludge and River/Canal Bottom Sediments (as of April 1996)

(unit : mg/kg-total dried solid weight)

	Sampling Point	Cu	Zn	Mn	Fe	Pb	Cd	Se	Ni	Cr
1	T-U WTP	23.4	43.8	453	22,815	2.13	0.25	0.22	24.3	20.7
2	T-N WTP(Feb.)	25.3	47.0	461	24,870	0.43	0.44	0.16	8.1	22.5
3	UrgenchTrangas WTP	3.9	8.5	75	5,055	1.63	0.08	0.05	22.7	15.3
1	Kaparas Reservoir	9.3	27.4	231	13,230	0.3	0.18	0.07	20.3	15.6
2	Shavat Canal	16.9	39.6	435	20,280	0.76	0.14	0.06	3.4	19.3
3	Takhiatash	24.4	54.9	400	21,390	0.9	0.45	0.11	20.6	22.8
4	Kizketken Canal	20.9	40.9	457	24,450	0.92	0.26	0.07	36.3	20.1
5	Kipchak, Amudarya river	14.1	36.3	394	19,020	2.76	0.14	0.05	10.3	17.8
6	Kungrad, intake	25.4	46.4	475	21,885	2.37	0.17	0.1	21.4	17.4
7	Muynak Canal	25.7	47.9	471	22,920	1.11	0.14	0.16	32.6	18.9

Source : GosSIAK

Table 7.5-(b) Components of Agricultural Chemicals in the Water Treatment Sludge and River/Canal Bottom Sediments as of April 1996

(unit : mg/kg dried solid weight)

	Sampling Pt.	α-BHC	γ-BHC	DDE	DDT
1	T-U WTP	0.011	0.022	0.048	1.648
2	T-N WTP	0.002	0.001	0.006	0.059
3	UrgenchTrangas WTP	0.001	0.001	0.004	0.046
1	Kaparas Reservoir	0.004	0.032	0.015	0.518
2	Shavat Canal	0.005	0.011	0.007	0.067
3	Takhiatash	0.001	0.001	0.003	0.032
4	Kizketken Canal	0.002	0.001	0.008	0.30
5	Kipchak, Amudarya.	0.001	0.001	0.002	0.043
6	Kungrad, intake	0.002	0.075	0.080	2.040
7	Muynak Canal	0.002	0.002	0.018	0.770

Source : GosSIAK

3) Increase in sewerage water as the water supply system develops

According to the demand estimation, the daily average water demand was about 513 thousand m^3/day in the Study Area in 1995. After the implementation of this project, the demand will increase to 730 thousand m^3/day for both regions in 2010. Accordingly, the volume of sewage will increase proportionally with the water supply. If the sewerage system could not meet this sewage increase, the living environment and the natural environment such as rivers, lakes and ground water may deteriorate. The development of sewerage system in addition to development of water supply system is equally necessary to prevent the living and natural environment in the Study Area from deterioration.

The MPU have a development plan for the sewerage system up to 2010 for the Study Area, Karakalpakstan and Khorezm. According to the plan, the sewerage treatment volume which was 278 thousand. m^3/day in 1995 will increase to 582 thousand m^3/day and 1,563 thousand m^3/day in 2000 and 2010 respectively. Although this plan should be implemented to prevent the environment from deterioration due to sewerage increase, the planning capacity of sewerage is necessary to be revised based on the water supply capacity of this report. According to preliminary estimation, the planned daily average capacity of sewerage of 380 thousand m^3/day is necessary for 2010. Here, the calculation conditions are; leakage ratio: 20 %, gardening water ratio: 20 %, and coverage rate of water supply : 80 %.)

(3) Other minor activities

1) Rehabilitation and replacement of existing facilities

This activity will generate solid waste such as the wrecks of machines and concrete. Although the quantity of this solid waste is small, the place or the method of disposal of the wrecks should be planned in advance.

2) Construction of pipelines

This activity will obstruct traffic. However, most of the transmission and distribution pipelines are located under the ground. During the construction, traffic regulation or in some case a temporary by-pass may be required.

7.3 Conclusion

In this EIA, the following activities are mainly discussed.

1) Operation of Kaparas reservoir considering eutrophication
2) Operation of water treatment plant considering the disposal of the sludge
3) Increase in sewage water due to the development of the water supply system

As a result of the examination, it is conducted that the operation of Kaparas reservoir have eutrophic impact and water level can be raise up to water level equivalent to an effective water volume that meets the water demand in 2010 in average flow year. However, it is necessary for the organizations related with the water use of the Amu Darya river to coordinate and manage rational distribution of the water. The effect of the accumulated silt on the Kaparas reservoir is minimum. The utilization of the Kaparas reservoir as the main source of domestic and drinking water supply for the inhabitants of the Karakalpakstan and Khorezm has been decided by the Resolutions.

Although the other two activities have some impact on the environment, the impact can be mitigated if the necessary measures are taken, namely, appropriate disposal of the sludge and development of sewerage system.