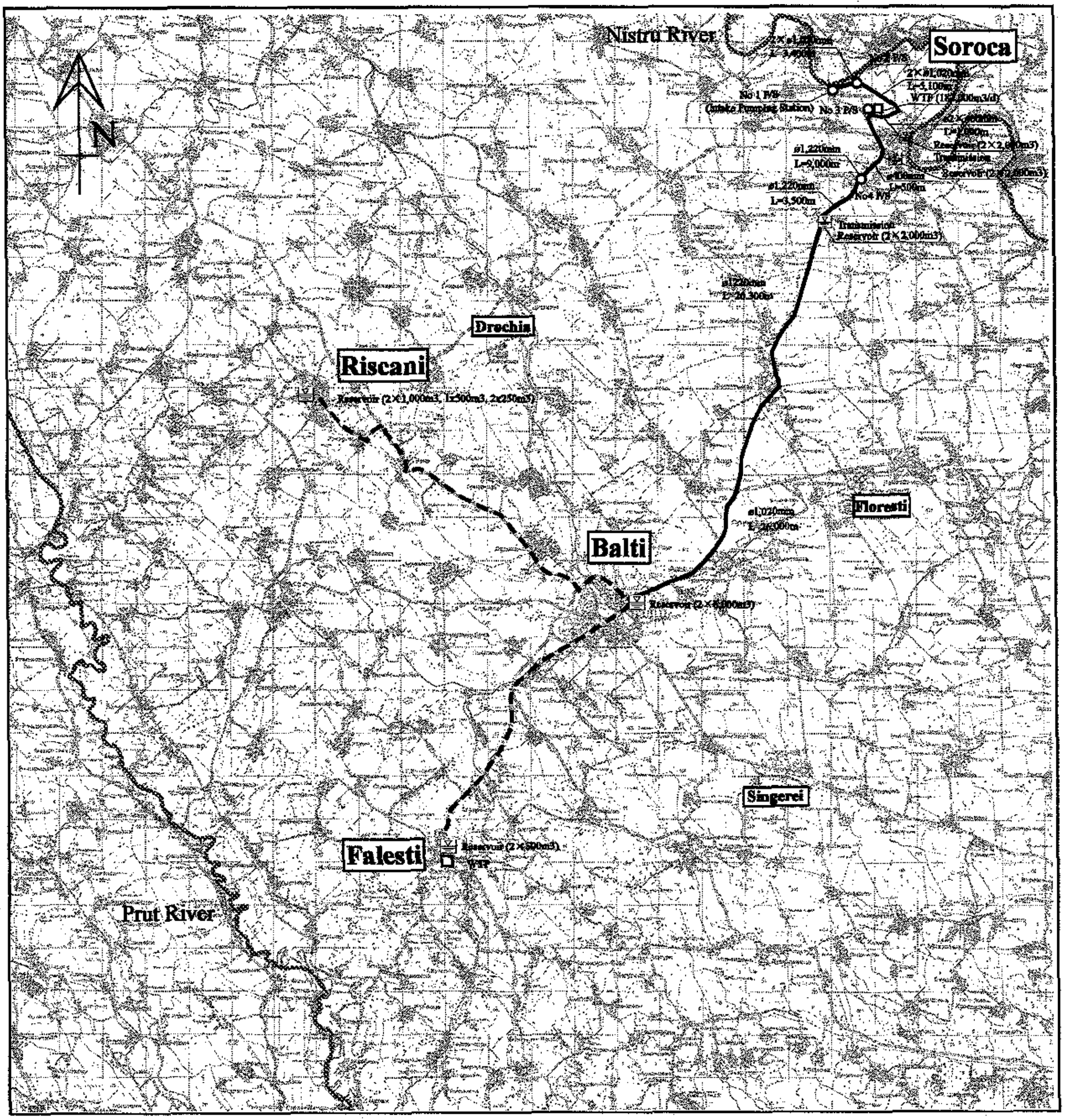


LEGEND

○	Pumping Station
□	Water treatment Plant
	Reservoir
—	Pipeline (existing)
- - -	Pipeline (new)

Figure.4.1.1 Plan of Alternative 1

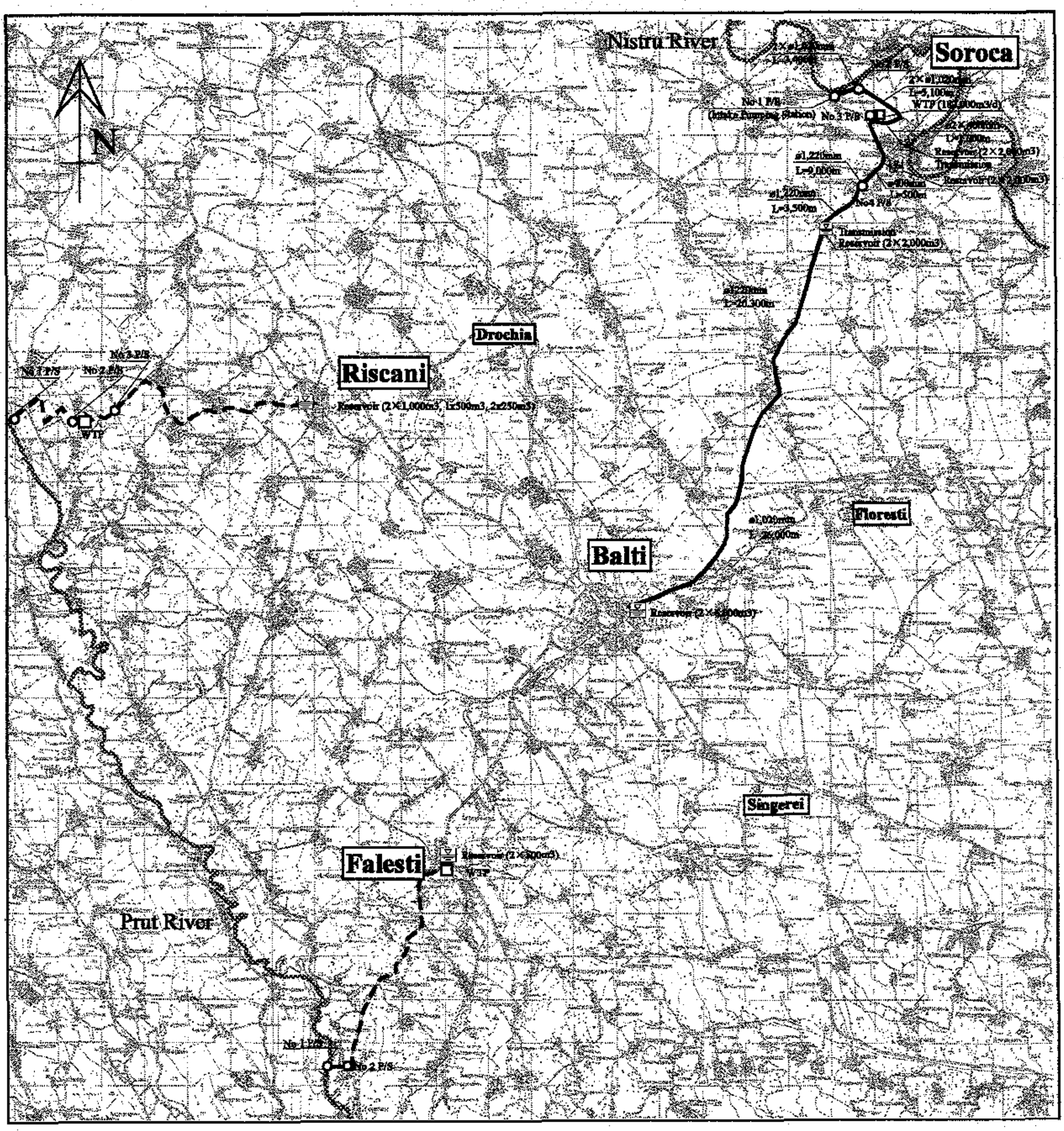


Figure.4.1.2 Plan of Alternative 2

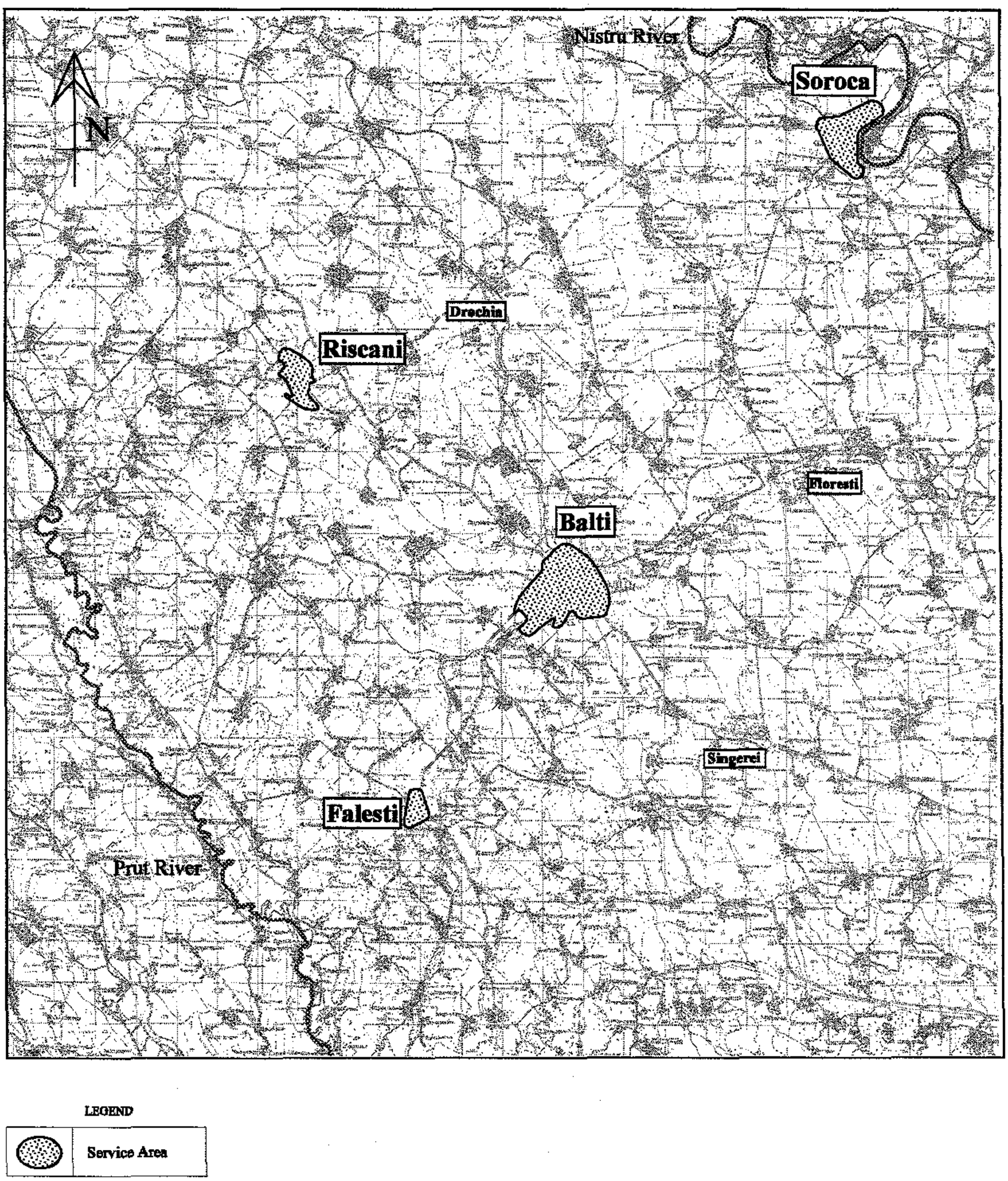


Figure.4.1.3 Plan of Alternative 3

4.2 Determination of an Optimum Facility Development Plan

4.2.1 Facility Development Plan in the Alternatives

(1) Alternative 1

1) Pumping Stations

There are four existing pumping stations in the Soroca-Balti water supply system. In these pumping stations, three pumps of the same type, two for operation and one for standby, are installed although the capacity and lift are different. These pumps were designed to meet the water demand of 182,000 m^3/d, while the water demand in the target year of 2015 is 94,000 m^3/d. The original design capacity is almost two times the water demand and the pumps are approaching to their economic lives.

Therefore, the pumps shall be replaced with new ones of proper sizes with motors suitable for new demand. The head loss, which is a very important factor to decide the pump type, will be decided by the following Hazen-Williams equation.

$$H = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L;$$

Where: H = Total Head (m)

C = Coefficient of Flow (110)

D = Diameter of Pipe (m)

Q = Water Demand (m^3/s)

L = Pipe Length (m)

The daily maximum water demand, the pipe diameter and the pipe length for each section are shown below.

Section	Daily Maximum Water Demand (m^3/d)	Pipe Diameter (mm)	Pipe Length (m)
PS-1 - PS-2	93,500	2 x 1,020	3,400
PS-2 - WTP	93,500	2 x 1,020	5,100
WTP - PS-4	84,700	1,220	9,000
PS-4 - TR-2	78,600	1,220	3,500
TR-2 - Branch to Floresti	71,000	1,220	20,300
Branch to Floresti - Balti Reservoir	65,500	1,020	26,000

Note: PS: pumping station, WTP: water treatment station, TR: Transmission Reservoir

The results of the total head required for each section are shown in Table 4.2.1. Based on these results, specifications of pumps suitable for the new demand have been determined as follows:

Pumping Station	Pump Specification	Number of Pump*
PS-1	32.7 m^3/m x 56m x 450 kW	3
PS-2	32.7 m^3/m x 96m x 750 kW	3
PS-3	29.4 m^3/m x 71m x 500 kW	3
PS-4	27.3 m^3/m x 73m x 500 kW	3

* Including one standby each

The air blowers for cooling at PS-1 will be replaced and the interlocking system will be installed at PS-2.

2) Water Treatment Plant

All the mechanical and electrical facilities were installed during 1980 to1983. The economic lives of these facilities appear to expire soon as stated in chapter 2. Some of them are still functioning. However, deteriorated and functionless facilities must be replaced to keep the smooth operation for the water treatment plant. The following table shows the facilities and equipment in the water treatment plant, of which replacement is recommended.

Name of Facilities and Equipment	Specification	Quantity
Coagulation equipment with pump	ϕ100 mm - 0.6 m^3/m x 5.5kW	3
Coagulation equipment with pump	ϕ125 mm - 0.8 m^3/m x 11kW	3
Chlorine gas injection equipment with pump		2
Butterfly valve with motor	ϕ400	12
Sluice valve with motor	ϕ250	12
Sludge pump at the retaining pond	ϕ200 mm - 2.3 m^3/m x 11kW	2
Pump for returning water from the retaining pond to the contact chamber	ϕ300 mm - 4.3 m^3/m x 22kW	2
Pipe for sludge conveyance	ϕ300 mm	200 m
Pipe for returning water	ϕ400 mm	300 m
Discharge pipe from sludge drying beds to Nistru River	ϕ500 mm	2000 m
Sludge drying beds	6,000 m^2	1
Elevated tank for backwashing	800 m^3	1
Instrumentation		1
Boiler		1
Heating system		1

3) Expansion of Pipeline to Falesti and Riscani

The distances from Balti to Falesti and from Balti to Riscani are 32 km and 35 km, respectively. The suitable diameter of the pipe is also determined by the Hazen-Williams equation. The diameter of both pipes is recommended to be 400 mm. The result of computation is shown in the Table 4.2.1, and the hydraulic profiles of both pipelines are shown in Figure 4.2.1.

4) Construction of Reservoirs

In Moldova, the recommended total capacity of distribution reservoirs is for 24 hours storage because of unstable supply of electricity. The capacities of new reservoirs for four cities/towns have been determined by the difference between the water demand in each city/town and the existing reservoir capacity. The following table shows the required capacity of the new reservoirs:

City/Town	Existing Reservoirs Capacity (m^3)	Uncompleted Reservoir Capacity (m^3)	Daily Maximum Water Demand in 2015 (m^3)	Required Capacity of New Reservoir in 2015 (m^3)
Soroca	8,000	-	12,200	4,200
Balti	12,000	32,000 (20,000 + 2 x 6,000)	45,000	-
Falesti	1,000	-	5,200	4,200
Riscani	3,000	-	4,400	1,400

In Balti, there are the reservoirs of which construction has been suspended. Completion of construction of these reservoirs is necessary to meet the water demand in 2015.

(2) Alternative 2

1) New Falesti Water Supply System

A new water supply system for Falesti, the water source of which is Prut River, can be developed to meet the water demand in 2015 of 7,100 m^3/d instead of expanding the Soroca-Balti pipeline.

The size of pumps of the pumping stations has been determined by the same method as for the Soroca-Balti water supply system, using the Hazen-Williams equation. A new plan, profile and hydraulic profile are shown in Figure 4.2.3. The water treatment method to be applied is the same as that of the uncompleted one in Falesti. The plan of water treatment plant for the new Falesti water supply system is shown in Figure 4.2.4.

The new water supply system will be composed of the following facilities:

- Water Intake (PS-I with the capacity of 7,100 m^3/d)
- Water Treatment Plant (with the capacity of 7,100 m^3/d)
- PS-II (with the capacity of 6,900 m^3/d)
- Transmission Main
- Reservoir (with the capacity of 4,200 m^3)

The pump size in each pumping station obtained from pipe loss computation (see Table 4.2.1) is shown below.

Pumping Station	Specification of Pump	Number of Pump*
PS-I	2.5 m^3/m x 131.6 m x 90 kW	3
PS-II	2.4 m^3/m x 62.2 m x 45 kW	3

* Including one standby each

The most suitable pipe diameter and the length of transmission main are as follows:

- ϕ 400 mm L = 15,600 m
- ϕ 450 mm L = 16,400 m

Total L = 32,000 m

The required capacity of the reservoir in 2015 is the same as that in Alternative 1, i.e. 4,200 m^3.

2) New Riscani Water Supply System

A new water supply system, the water source of which is Prut River, can be developed to meet the water demand in 2015 of 7,500 m^3/d.

The size of the pumps at the pumping station has been determined by the same method as for the Soroca-Balti water supply system, using the Hazen-Williams equation. A new plan, profile and hydraulic profile are shown in Figure 4.2.3. The water treatment method to be applied is the same as that of the uncompleted one in Riscani. The plan of water treatment plant for the new Riscani water supply system is shown in Figure 4.2.4.

The new water supply system will be composed of the following facilities:

- Water Intake (PS-I with the capacity of 7,500 m^3/d)
- Water Treatment Plant (with the capacity of 7,500 m^3/d)

- PS-II (with the capacity of 7,200 m^3/d)
- PS-III (with the capacity of 7,200 m^3/d)
- Transmission Main
- Reservoir (with the capacity of 1,400 m^3)

The size of pumps at each pumping station obtained from pipe loss computation (see Table 4.2.1) is shown in below.

Pumping Station	Specification of Pump	Number of Pump*
PS-I	2.6 m^3/m x 103 m x 75 kW	3
PS-II	2.5 m^3/m x 107 m x 75 kW	3
PS-III	2.5 m^3/m x 65 m x 45 kW	3

* Including one standby each

The suitable pipe diameter and the length of transmission main are as follows:

- ϕ 400 mm L = 30,180 m
- ϕ 250 mm L = 3,900 m

Total L = 34,080 m

The required capacity of the reservoir is the same as that in Alternative 1, i.e. 1,400 m^3.

3) Rehabilitation of the Soroca-Balti Water Supply System

In this case, the water demand in the Soroca-Balti water supply system is different from that in Alternative 1. The new specifications of pumps for each pumping stations are determined based on the water demand using the Hazen-Williams equation. The water demand, the pipe diameter and the pipe length for each section are shown below:

Each Part	Water Demand (m^3/d)	Pipe Diameter (mm)	Pipe Length (m)
PS-1 - PS-2	80,700	2 x 1,020	3,400
PS-2 - WTP	80,700	2 x 1,020	5,100
WTP - PS-4	66,200	1,220	9,000
PS-4 - TR-2	58,600	1,220	3,500

The specifications of pumps suitable for the new demand are shown below.

Pumping Station	Pump Specification	Number of Pump*
PS-1	28.0 m^3/m x 54m x 400 kW	3
PS-2	28.0 m^3/m x 93m x 650 kW	3
PS-3	23.0 m^3/m x 68m x 400 kW	3
PS-4	20.3 m^3/m x 71m x 400 kW	3

* Including one standby each

(3) Alternative 3

1) The Actual Situation of Wells in the Four Cities/Towns and Additional Wells Required

The actual situation of wells in the four cities/towns is summarized in the following table:

The unit discharge of the existing wells (m^3/d/well) in each city/town is assumed to be of the same, and the number of new wells required has been determined by dividing the water demand by the unit discharge per well.

Item		Soroca	Balti	Falesti	Riscani
Water Demand (m^3/d)		12,200	45,000 (75,000)	5,200 (8,700)	4,400 (7,300)
Existing Condition	No of Existing Deep and Shallow Wells	10	58	15	5
	Depth of Deep and Shallow Wells (m)	50	60-280	180	150
	Average Depth of Deep and Shallow Wells (m)	50	170	180	150
	Total Amount of Discharge from the existing Wells (m^3/d)	3,500	27,000	1,350	1,500
	Unit Discharge from the Existing wells (m^3/d)	350	466	90	300
Required Wells Condition	Required No of Wells to meet the Water Demand in 2015	12,200/350 =35	75,000/466 =161	8,700/90 =97	7,400/300 =25
	Required No of Wells to be constructed	35-10 = 25	161 - 58 = 103	97 - 15 = 82	25 - 5 =20
	Total Length of constructed Wells (m)	25 x 50 = 1,250	103 x 170 =17,510	82 x 180 =14,760	20 x 150 = 3,000

2) Fluorides Removal Plant

In the city of Balti and towns of Falesti and Riscani, groundwater treatment facility must be provided to remove fluorides.

The reverse osmosis method is considered to be the most appropriate way of removing the fluorides because of the low initial and operation/maintenance costs. The flow chart and a plan of fluoride removal facility are shown in Figures 4.2.5 and 4.2.6, respectively.

In case of application of the RO method, it must be considered that 40% of raw water will be lost in the process. Therefore, the required amount of raw water in these three city/towns increases as shown below.

Name of City	Water Demand in 2015 (m^3/d)	Required Amount of Raw Water (m^3/d)
Balti	45,000	75,000
Falesti	5,200	8,700
Riscani	4,400	7,400

4.2.2 Preliminary Cost Estimates for the Development Alternatives

(1) Basis of Cost Estimate

The unit costs prevailing in Moldova, based on the data in similar works in Moldova in early 2000, are used as the basis of the cost estimate under the following conditions.

- Exchange rate of 12.8 Lei to one US $ (as of August 2001) is used.
- Physical contingencies and engineering costs are not included.

1) Pipe Works

The costs for pipelines are based on the "all in" prices, which were calculated from estimation of the material, plant and labor costs. These include pipes and fittings. Pipe material is assumed to be ductile iron. "All in" pipeline costs are shown below.

Nominal diameter of Pipe (mm)	"All in" Price (US$/m)
250	65
300	85
400	105
450	115
500	150

2) Treatment Plant

The treatment plant cost is based on the "Improvement of Water Supply and Sewerage System Planning for the Priority Regions of Moldova, June 2000" (Ref. 1).

Cost of full treatment $2{,}900 \times [Qm^3/d]^{0.822}$ US$

Cost of fluorides removal facility $6{,}800 \times [Qm^3/d]^{0.822}$ US$

3) Borehole Cost

Borehole cost is based on Refrence 1.

Borehole cost	2,100 + 45 x [depth (m)]	US$
Borehole pump cost	1100 + 10 x [kW]	US$

4) Pumping Station Cost

The pumping station cost is based on Reference 1. The cost functions were developed for two cases: one case for the capacity of more than 50,000 m^3/d and the other case for the capacity of less than 10,000 m^3/d.

Pumping station cost (more than 50,000 m^3/d)	18,000 + 0.25 x $[Qm^3/d]$ x $[Kw]^{0.55}$	US$
Pumping station cost (less than 10,000 m^3)	18,000+ 4 x $[Qm^3/d]$ x $[Kw]^{0.55}$	US$

5) Reservoir Cost

Reservoir cost is based on reference 1.

Reservoir cost	1,200 x $[\text{Capacity } (m^3)]^{0.687}$	US$
Suspended Reservoirs cost	600 x $[\text{Capacity } (m^3)]^{0.687}$	US$

The construction cost of three alternatives will be calculated based on the above cost.

(2) Construction Cost for Each Alternative

The construction costs for three Alternatives are shown in the Tables 4.2.2, 4.2.3 and 4.2.4, respectively.

4.2.3 Selection of the Optimum Development Alternative

Three development alternatives have been studied as presented above. Out of these, the most suitable one will be selected as the master plan, taking into consideration of stability of water source, easiness of construction, construction and maintenance costs, and construction period. The following table shows the comparison of these aspects of the three Alternatives.

Unit; US$

Item		Alternative 1	Alternative 2	Alternative 3
Construction Cost		17,800,000	26,000,000	67,000,000
		◎	○	△
Operation and Maintenance Cost per Year		1,900,000	2,100,000	4,800,000
		◎	○	△
Reliability of Water Source		Nistru River	Nistru River Prut River	Ground Water
		◎	○	△
Easiness of Construction		◎	△	○
Construction Period		○	△	○
Overall Evaluation		◎	○	△

Note: ◎; excellent ○; good △; not good

Above table clearly shows that Alternative 1 is superior to the other 2 Alternatives. Therefore, Alternative 1 is proposed as the facility development master plan.

Table 4.2.1 Pipe Loss Computation

Name	C	D	Q	L	V	H1	H2 (Actual Head)	H3	H4 (Total Head)
Soroca-Balti(1)	110	1	1.09	3400	1.39	7.11	46	3	56.11
Soroca-Balti(2)	110	1	1.09	5100	1.39	10.67	81.5	3	95.17
Soroca-Balti(3)	110	1.2	0.98	9000	0.87	6.37	60.5	3	69.87
Soroca-Balti(4)	110	1.2	0.91	3500	0.80	2.16	67	3	72.16
Soroca-Balti(5) Gravity	110	1.2	0.82	20300	0.73	10.32			10.32
Soroca-Balti(6) Gravity	110	1	0.76	26000	0.97	27.92			27.92
Total									38.24
							303-38.0		265.00
Riscani(1)-From Balti	110	0.5	0.07	35000	0.36	13.33	-54.5	3	-38.17
Riscani(2)-From Balti	110	0.4	0.07	35000	0.56	39.53	-54.5	3	-11.97
Riscani(3)-From Balti	110	0.6	0.07	35000	0.25	5.49	-54.5	3	-46.01
Riscani(4)-From Balti	110	0.35	0.07	35000	0.73	75.74	-54.5	3	24.24
Riscani (1)-From Prut	110	0.4	0.09	5460	0.72	9.82	87.8	5	102.62
Riscani (2)-From Prut	110	0.45	0.09	5460	0.57	5.53	87.8	5	98.33
Riscani (3)-From Prut	110	0.5	0.09	5460	0.46	3.31	87.8	5	96.11
Riscani (4)-From Prut	110	0.35	0.09	5460	0.94	18.81	87.8	5	111.61
Riscani(2) Gravity	110	0.4	0.09	3900	0.72	7.01	-80	3	-69.99
Riscani(2) Gravity	110	0.35	0.09	3900	0.94	13.43	-80	3	-66.57
Riscani(2) Gravity	110	0.3	0.09	3900	1.27	28.46	-80	3	-51.54
Riscani(2) Gravity	110	0.25	0.09	3900	1.83	69.16	-80	3	-10.84
Riscani(2) P/S (2)	110	0.4	0.09	4000	0.72	7.19	96.5	3	106.69
Riscani(2) P/S (2)	110	0.45	0.09	4000	0.57	4.05	96.5	3	100.55
Riscani(2) P/S (2)	110	0.5	0.09	4000	0.46	2.43	96.5	3	98.93
Riscani(2) P/S (2)	110	0.35	0.09	4000	0.94	13.78	96.5	3	110.28
Riscani(2) P/S (2)	110	0.3	0.09	4000	1.27	29.19	96.5	3	125.69
Riscani(3) P/S (3)	110	0.4	0.09	9420	0.72	16.94	43.5	5	65.44
Riscani(3) P/S (3)	110	0.45	0.09	9420	0.57	9.54	43.5	5	58.04
Riscani(3) P/S (3)	110	0.5	0.09	9420	0.46	5.71	43.5	5	54.21
Riscani(3) P/S (3)	110	0.35	0.09	9420	0.94	32.45	43.5	5	80.95
Riscani(3) P/S (3)	110	0.3	0.09	9420	1.27	68.75	43.5	5	117.25
Riscani(3) Gravity	110	0.4	0.09	11300	0.72	20.32	-39	3	-15.68
Riscani(3) Gravity	110	0.45	0.09	11300	0.57	11.45	-39	3	-24.55
Riscani(3) Gravity	110	0.5	0.09	11300	0.46	6.85	-39	3	-29.15
Riscani(3) Gravity	110	0.35	0.09	11300	0.94	38.93	-39	3	2.93
Riscani(3) Gravity	110	0.3	0.09	11300	1.27	82.47	-39	3	46.47
Falesti(1)-From Balti	110	0.4	0.08	32000	0.64	46.27	-60	3	-10.73
Falesti(1)-From Balti	110	0.5	0.08	32000	0.41	15.61	-60	3	-41.39
Falesti(1)-From Balti	110	0.45	0.08	32000	0.50	26.07	-60	3	-30.93
Falesti(1)-From Balti	110	0.35	0.08	32000	0.83	88.65	-60	3	31.65
Falesti(1)-From Prut	110	0.4	0.09	3700	0.72	6.65	120	5	131.65
Falesti(1)-From Prut	110	0.35	0.09	3700	0.94	12.75	120	5	137.75
Falesti(1)-From Prut	110	0.5	0.09	3700	0.46	2.24	120	5	127.24
Falesti(2) P/S (2)	110	0.35	0.08	11900	0.83	32.97	42	3	77.97
Falesti(2) P/S (2)	110	0.4	0.08	11900	0.64	17.21	42	3	62.21
Falesti(3) Gravity	110	0.3	0.08	16400	1.13	96.25	16	3	-77.25
Falesti(3) Gravity	110	0.4	0.08	16400	0.64	23.71	16	3	-4.71
Falesti(3) Gravity	110	0.45	0.08	16400	0.50	13.36	16	3	5.64
Falesti(3) Gravity	110	0.5	0.08	16400	0.41	8.00	16	3	11.00

Note; Only coloured rows are to be adopted

Table 4.2.2 Construction Cost of Alternative 1

Unit:US$

		Methods	Quantity	Unit Price	Cost	Remark
Rehabilitation of Soroca-Balti Water Supply System						
	No1 Pump station	Screen cleaning machine	2	80,000	160,000	
		Pumps 32.7m^3/min x 56m x 450kw	3		695,000	
	No2 Pump station	Pumps 32.7m^3/min x 96m x 750kw	3		914,000	
	No3 Pump stasion	Pumps 29.41m^3/min x 71m x 500kw	3		664,000	
	No4 Pump stasion	Pumps 27.3m^3/min x 73m x 500kw	3		617,000	
	Rehabilitation of Soroca-Balti transmission main	ϕ 1200mm,1000mm	Lump		2,400,000	
	Total				5,450,000	
	Distribution reservoirs in Soroca	Reinforced concrete	4,200m^3		370,000	
	Completion of suspended construction of distribution reservoirs in Balti	Reinforced concrete	20,000m^3		541,000	
		Reinforced concrete	12,000m^3		381,000	
	Total				1,292,000	
	Pipeline to Falesti	Ductile cast-iron pipe ϕ 400	32,000	105	3,360,000	
	Distribution reservoirs in Falesti	Reinforced concrete	4,200m^3		370,000	
	Pipeline to Riscani	Ductile cast-iron pipe ϕ 400	35,000	105	3,675,000	
	Distribution reservoirs in Riscani	Reinforced concrete	1,400m^3		174,000	
	Total				7,579,000	
	Improvement of water treatment plant					
	Coagulation equipment with pump	ϕ 100mm 0.6m^3/min x 5.5kw	3	20,000	60,000	
	Coagulation equipment with pump	ϕ 125mm 0.8m^3/min x 11kw	3	35,000	105,000	
	Chlorine gas injection equipment with pump		2	16,000	32,000	
	Butterfly valve with motor	ϕ 400mm	12	20,000	240,000	
	Sluice valve with motor	ϕ 250mm	12	16,000	192,000	
	Sludge pump at the retaining	ϕ 200mm 2.3m^3/min x 11kw	2	24,000	48,000	
	Pump for returning water from the retaining pond to the contact chamber	ϕ 300mm 4.3m^3/min x 22kw	2	28,000	56,000	
	Pipe for sludge conveyance	ϕ 300mm (m)	200	85	17,000	
	Pipe for returning water	ϕ 400mm (m)	300	105	31,500	
	Discharge pipe from sludge drying beds to Nistru River	ϕ 400mm (m)	2,000	105	210,000	
	Sludge drying beds	6,000m^2	1	500,000	500,000	
	Elevated tank for backwashing	800m^3	1	650,000	650,000	
	Automatic control system		1	650,000	650,000	
	Boiler		1	80,000	80,000	
	Heating system		1	160,000	160,000	
	Reform of building and others		1	400,000	400,000	
	Total				3,431,500	.=3,430,000
	Grand total				17,800,000	

Table 4.2.3 Construction Cost of Alternative 2

Unit;US$

	Name	Methods	Quantity	Unit Price	Cost	Remark
Falesti Water Supply System						
	No1 Pump station	Pumps 2.5m³/min x 132m x 90kw	3		355,000	
	No2 Pump station	Pumps 2.4m³/min x 62m x 45kw	3		248,000	
	Water treatment plant	Q=7,100m3/day	Lump		4,247,000	
	Distribution reservoirs	Reinforced concrete	4,200m³		370,000	
	Transmission main	φ450	16,400	115	1,886,000	.=1,885,000
		φ400	15,600	105	1,638,000	.=1,635,000
	Total				8,740,000	
Riscani Water Supply System						
	No1 Pump station	Pumps 2.6m³/min x 103m x 75kw	3		340,000	
	No2 Pump station	Pumps 2.5m³/min x 107m x 75kw	3		340,000	
	No3 Pump stasion	Pumps 2.5m³/min x 65m x 45kw	3		261,000	
	Water treatment plant	Q=7,500m3/day	Lump		4,440,000	
	Distribution reservoirs	Reinforced concrete	1,400m³		174,000	
	Transmission main	φ400	30,180	105	3,168,900	.=3,170,000
		φ250	3,900	65	253,500	.=255,000
	Total				8,980,000	
Rehabilitation of Soroca-Balti Water Supply System						
	No1 Pump station	Screen cleaning machine	2	80,000	160,000	
		Pumps 28.0m³/min x 54m x 400kw	3		562,000	
	No2 Pump station	Pumps 28.0m³/min x 93m x 650kw	3		729,000	
	No3 Pump stasion	Pumps 25.1m³/min x 68m x 400kw	3		506,000	
	No4 Pump stasion	Pumps 23.0m³/min x 71m x 400kw	3		465,000	
	Improvement of water treatment plant	Q=80,700m³/day	Lump		3,430,000	
	Distribution reservoirs in Soroca	Reinforced concrete	4,200m³		370,000	
	Completion of suspended construction of distribution reservoirs in Balti	Reinforced concrete	20,000m³		540,000	
		Reinforced concrete	12,000m³		380,000	
	Rehabilitation of Soroca-Balti transmission main	φ 1200m/m,1000mm	Lump		1,110,000	
	Total				8,252,000	
	Grand total				26,000,000	

Table 4.2.4 Construction Cost of Alternative 3

Unit;US$

	Name	Methods	Depth	Quantity	Unit Price	Cost
Soroca Water Supply System	Deep well constraction	Borehole	50m	25	4,300	107,500
		Submerged pumps 0.24m^3/min x 70m x 11kW		25	1,200	30,000
	Pipe laying	Collection pipe ϕ250	Pipe Length (m)	12,000	60	720,000
	Distribution reservoirs	Reinforced concrete		4200		370,000
	Total					1,227,500 ≒1,200,000
Balti Water Supply System	Deep well constraction	Borehole	170m	103	9,700	999,100
		Submerged pumps 0.4m^3/min x 180m x 55kW		103	1,500	154,500
	Pipe laying	Collection pipe ϕ350	Pipe Length (m)	15,000	99	1,485,000
	Completion of suspended construction of distribution reservoirs in Balti	Reinforced concrete		20,000m^3		540,000
		Reinforced concrete		12,000m^3		380,000
	Fluorides removal treatment facility	Q=45,400m^3/day	Lump			45,400,000
	Total					48,958,600 ≒49,000,000
Falesti Water Supply System	Deep well constraction	Borehole	180m	82	10,200	836,400
		Submerged pumps 0.07m^3/min x 200m x 11kW		82	1,200	98,400
	Pipe laying	Collection pipe ϕ150	Pipe Length (m)	20,000	27	540,000
	Distribution reservoirs	Reinforced concrete		4,200m^3		370,000
	Fluorides removal treatment facility	Q=5,200m^3/day	Lump			7,700,000
	Total					9,544,800 ≒9,500,000
Riscani Water Supply System	Deep well constraction	Borehole	150m	20	8,850	177,000
		Submerged pumps 0.21m^3/min x 160m x 15kW		20	1,200	24,000
	Pipe laying	Collection pipe ϕ200	Pipe Length (m)	10,000	39	390,000
	Distribution reservoirs	Reinforced concrete		1,400m^3		174,000
	Fluorides removal treatment facility	Q=4,400m^3/day	Lump			6,700,000
	Total					7,465,000 ≒7,500,000
	Grand total					67,200,000 ≒67,000,000

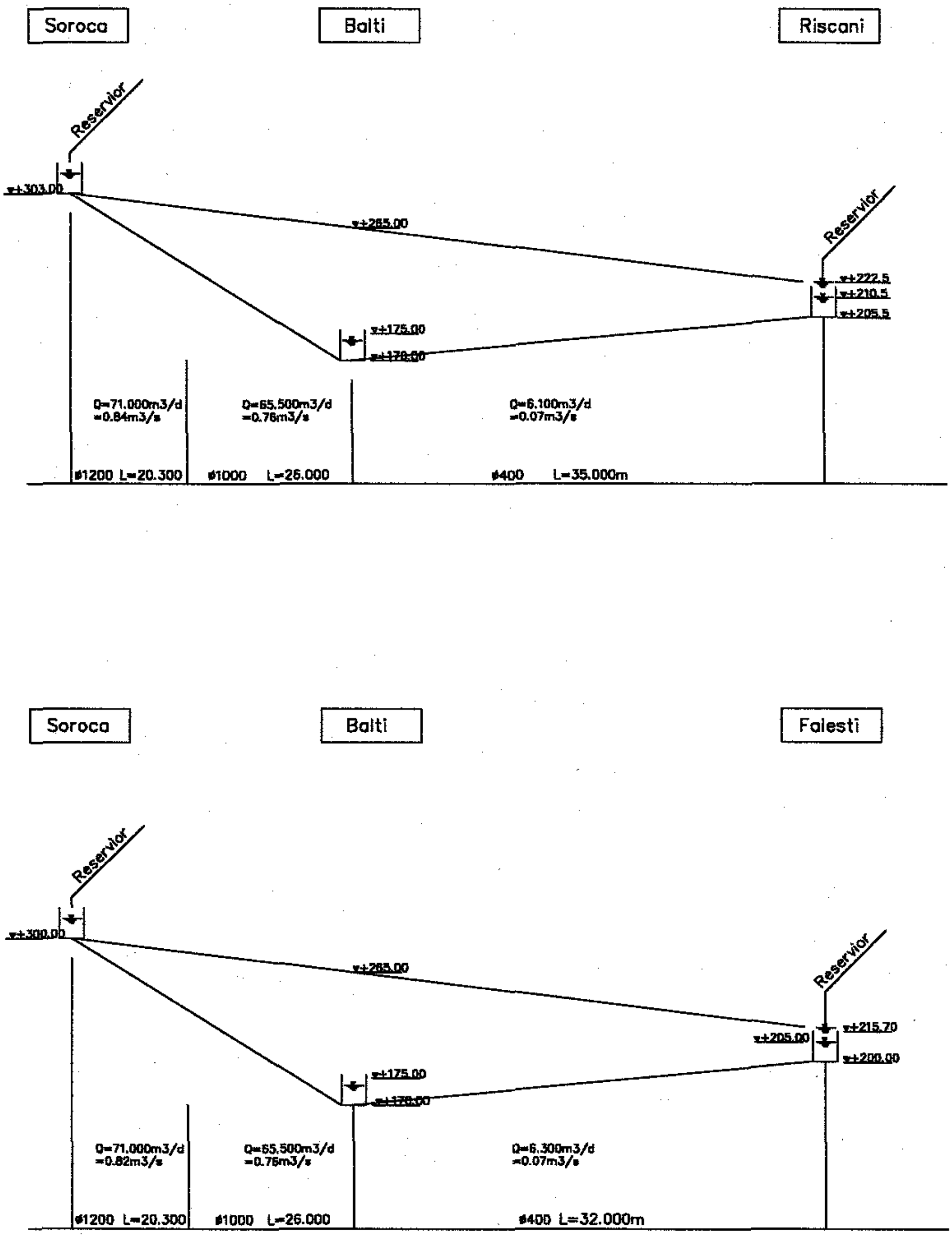


Figure 4.2.1 Hydraulic Profile of Expansion of Transmission Main

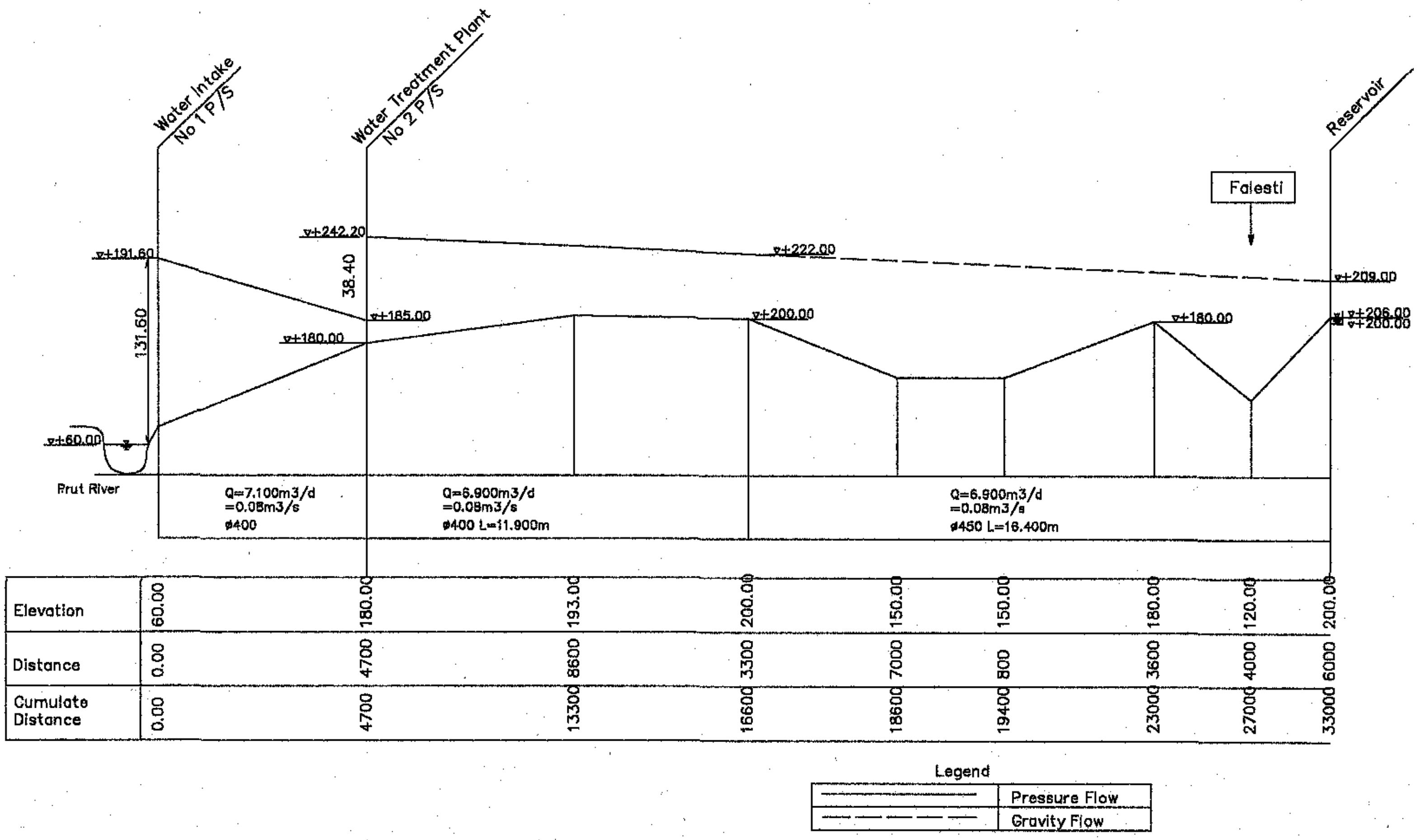
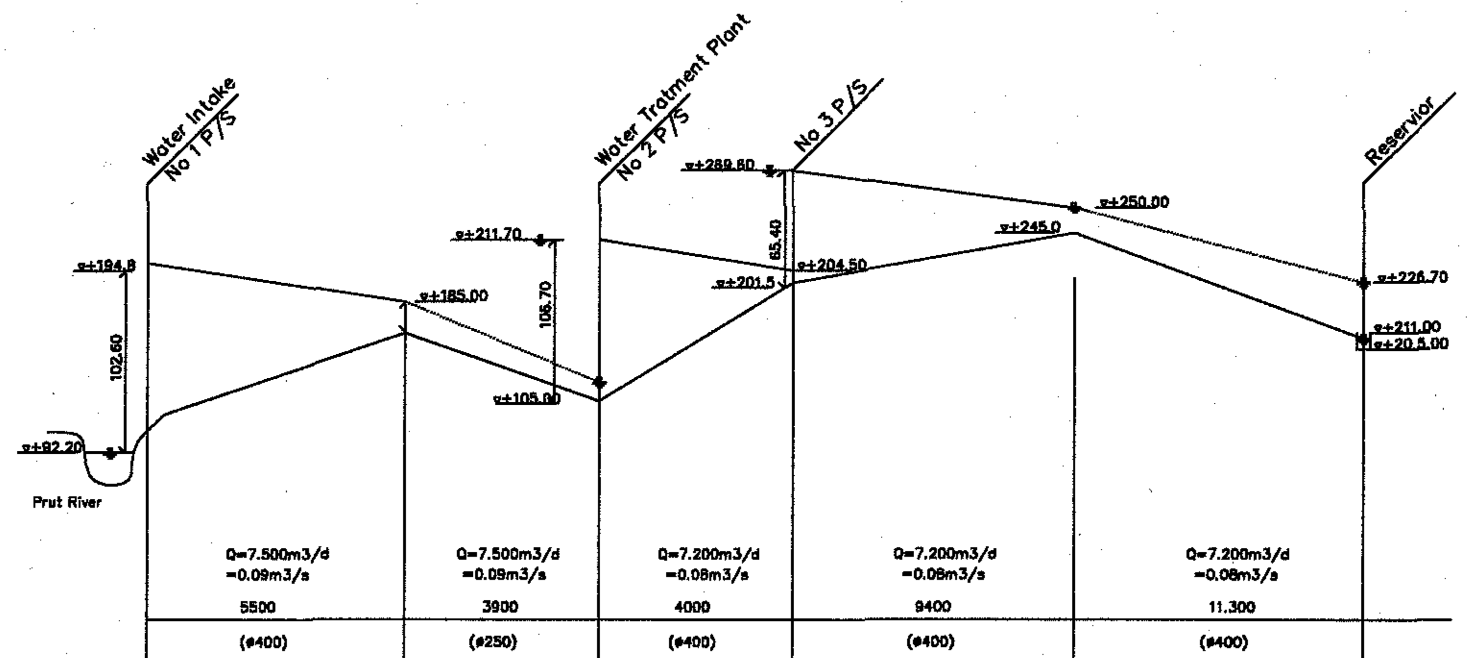


Figure 4.2.2 Profile and Hydraulic Profile of New Falesti Water Supply System



Elevation	92.20	180.00	105.00	201.50	245.00	205.50
Distance	0.00	5.500	3900	4.000	9400	11.300
Cumulate Distance	0.00	5.500	9400	13400	22.800	34.100

Figure 4.2.3 Profile and Hydraulic Profile of New Riscani Water Supply System

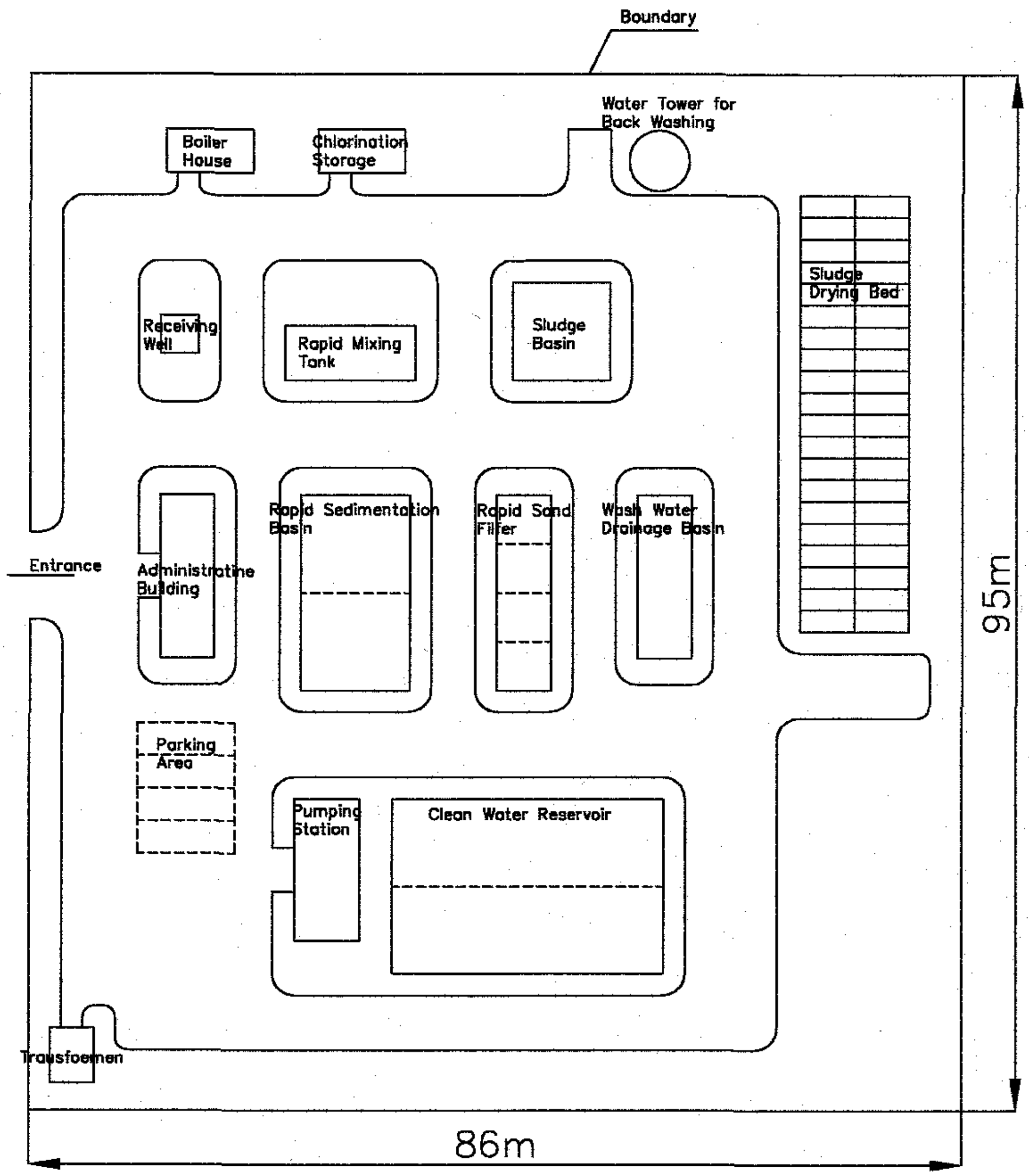


Figure 4.2.4 Plan of Water Treatment Plant for Falesti and Riscani New Water Supply System

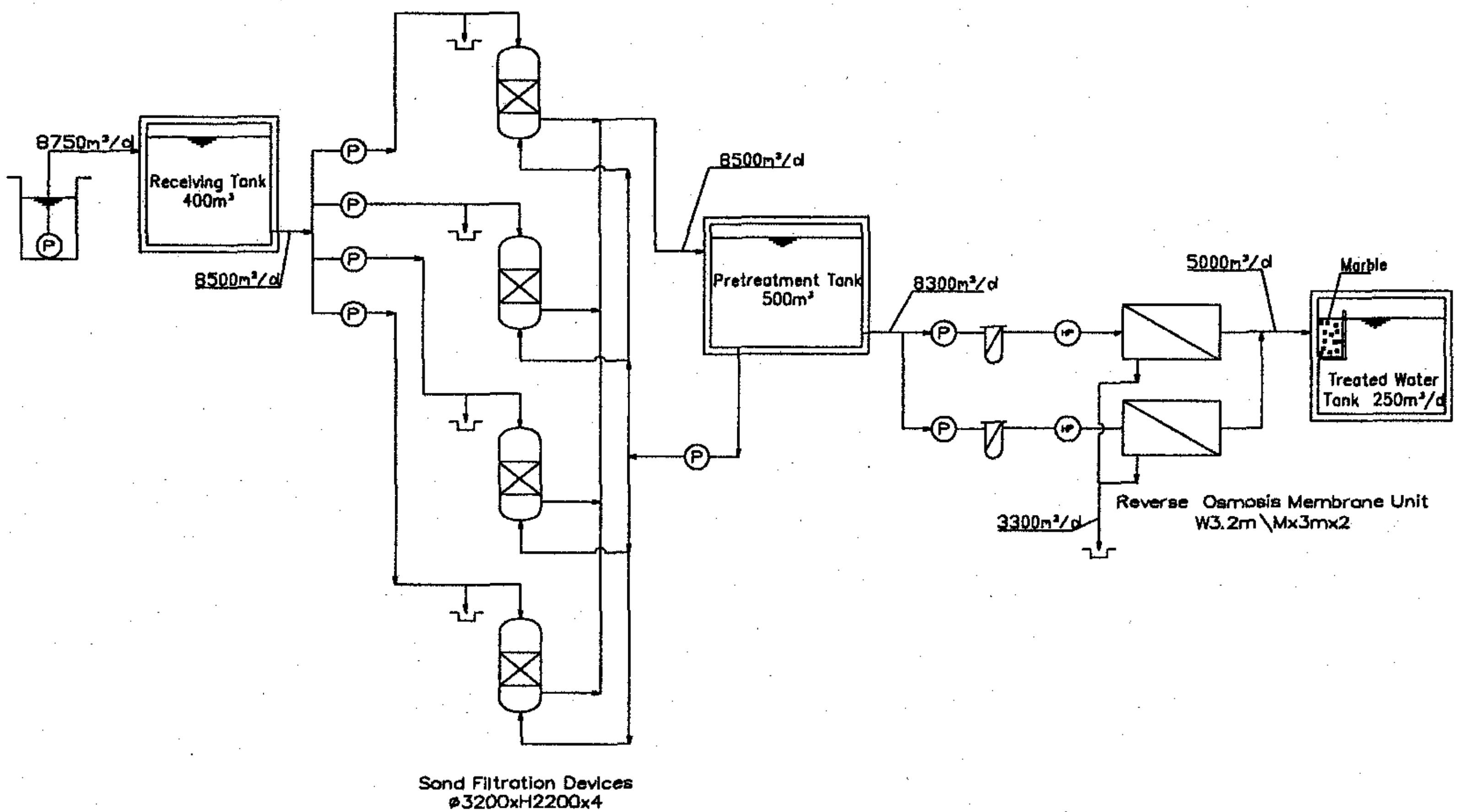


Figure 4.2.5 Diagram of Fluoride Removal Facility (Q = 5.000 m³)

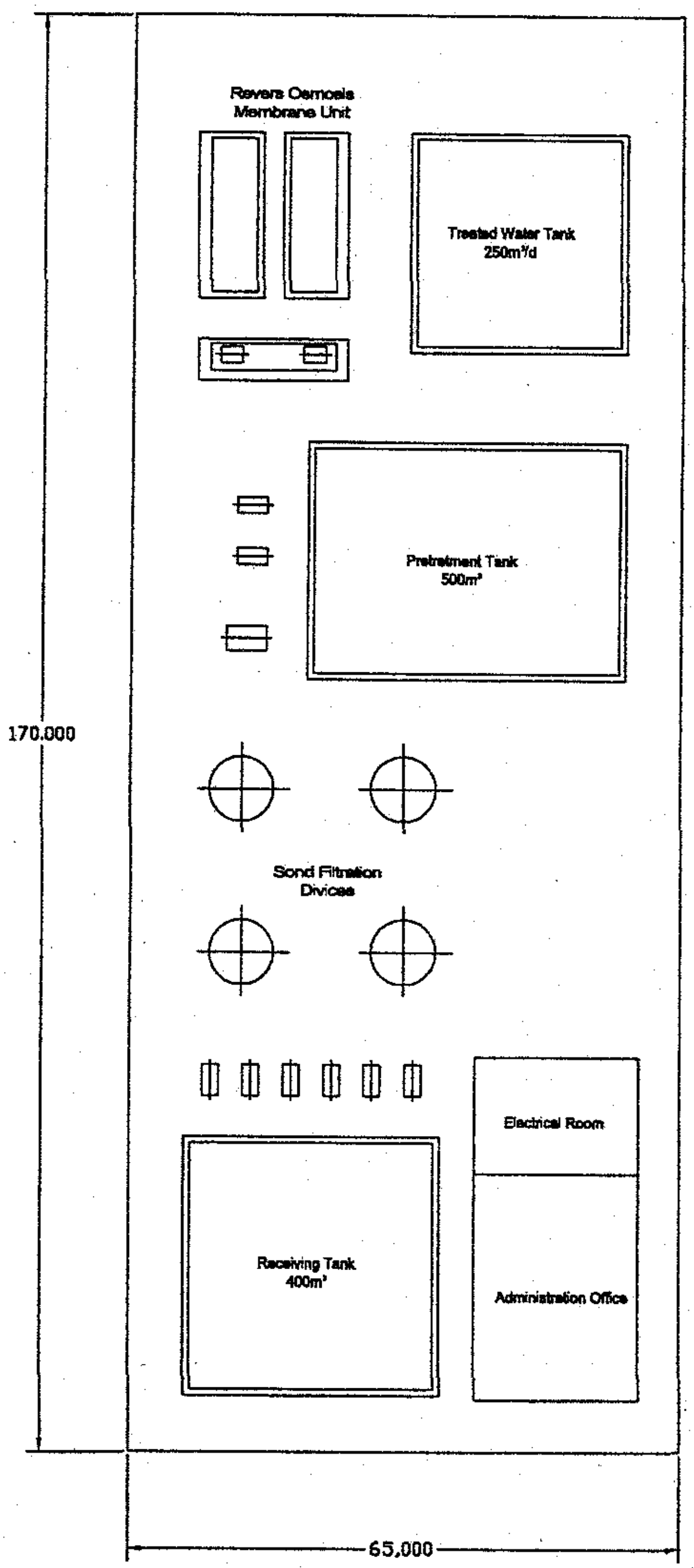


Figure 4.2.6 Plan of Fluoride Removal Facility

4.3 Plan for Institutional Development and Operational and Maintenance Systems Improvement

Based on the foregoing observation and analysis of the institutional issues in the water supply sector in Moldova, it is recommended that the institutional development should be undertaken in the following manner:

4.3.1 Institutional Framework

In general there must be an administrative structure in the water supply sector at the national level and the local level. Licenses for the establishment or alteration of water supply utilities should be given by a ministry of the government for major ones, and by counties for minor ones. In such licensing operation, the ministry should check the eligibility of such water utilities in terms of requirements to supply safe water to the public reliably at reasonable cost.

It is therefore proposed for the Government of Moldova to establish a functional administrative structure in the water supply sector. When granting a license to a new or an existing water supply utility to be altered, the licensing ministry or its authorized agency should examine all the requirements for the applicant of license to possess. They shall include 1) definition of the service area, 2) outline of facilities, 3) construction cost estimate of facilities and its source of financing, 4) population served and the base for quantity of water to be served, 5) outline of projected revenue, expenditure and their balance, 6) water rate, allocation of the cost of connection and other conditions of service connection.

The application for the above license should also be attached with an implementation plan for the proposed scheme, which shall include the following:

1) Daily maximum demand and daily average demand
2) Type of water source(s) and the location(s) of water intake
3) Yield of the source per day and the result of water quality analysis
4) Location, size and structure of facilities for water transmission, treatment and distribution
5) Method of water treatment
6) Maximum and minimum pressure in the distribution mains
7) Planned commencement and completion dates of construction
8) Method of financing the proposed scheme
9) Proposed water rate(s) and financial projections

Apele Moldovei should also oversee the operation of water utilities in terms of (1) the installation of a technical administrator, (2) the protection of water sources, (3) the quality of water supplied, (4) the use of water service products of proper technical standards by their customers, (5) the appropriateness of water rate, (6) technically appropriate and financially sound operation, (7) annual reports of operation to be presented to Apele Moldovei. As for water quality testing, Apele Moldovei should promote the system of water testing to be performed by large utilities or public service agencies, which possess a suitable laboratory, on behalf of small water utilities.

Apele Moldovei should encourage the water utilities in a region to merge to form a unified or regional water utility so as to realize economic and user-friendly operation wherever such merging is technically viable and if too large a capital cost can be avoided.

4.3.2 Organization of the Water Supply Utilities

There can be various forms of organization and types of business for a water supply utility. Typical forms of organization are the following:

1. Publicly owned utility
2. Public corporation
3. Privately owned joint-stock company

The publicly owned utility is not a joint-stock company, but all its assets are owned by a municipality (county, city, town or village), and its employees are public officials. The managing director of the utility reports to the head of the community (county governor, city mayor, etc.). Its advantage is the financial stability as it can expect subsidies when its operation results in red. Its disadvantage is the limited freedom in decision-making and personnel management, e.g., for raising the water rate, or instating its executives. It is also possible that managers and their staff in such status tend to lack incentives to improve their performance.

The public corporation is an independent organization owned by a consortium of investors including municipalities, other enterprises and banks. The managing director of the corporation does not report to any head of municipality but to the board of directors, and, if exists, to the general assembly of shareholders. The public corporation in general possesses broader liberty than the publicly owned utility since it can instate the directors and principal staff by itself, and can revise the water tariff by itself.

A joint-stock company is the typical form of a privately owned water utility. The shareholders can be banks, other enterprises, or individuals. It can revise water tariff as it wishes in the framework of the market economy although certain general regulation on the level of water tariff might be imposed by the government in some cases.

4.3.3 Proposed Institutional Framework

For the water supply sector and water utilities under the Study, the following steps are proposed to take place:

(1) At the National Level

1) The government should establish a structure of water supply sector administration at the national level. At present there is no specific department in the MECTD, which is supposed to be responsible for the national level administration of the water supply sector. Although Apele Moldovei is authorized to grant a license to a new water utility, it has no right to enact laws and ordinances related to the administration of the sector.

   The Study Team has learned that the government has a plan to create a department in the MECTD, which must assume, inter alia, the administration of the water supply and sewerage sector at the national level. Such reorganization of the government is highly desirable, so shall quickly be realized.

2) The government should also provide the rule for the application of license for a new or altered water supply utility including the method of application and requirements for the applicant.

3) The government should promote the development of water supply in light of public health and the productivity of the society to be realized by the provision of affluent and safe drinking water. As a government's policy, it should mount such a campaign as to promote people's awareness of the importance and benefits of safe drinking water and their need to pay the cost of water service as water tariff.

4) The present legislative provisions for the water supply sector in Moldova are inadequate. Although there are three laws directly related to water supply (See Section 2.6.1), none of them clearly set forth the requirements for the application for a license to found a new water utility or alter the existing one. Given this, it is proposed for the government to enhance the legislative provisions related to water supply as follows:

i) Unification and enhancement of water supply-related laws into one;

The Water Act and the Law on Potable Water shall be unified. The unified water law should set forth, among other things, (1) procedure of application and granting of a license for a new or altered water supply, (2) conditions for the eligibility to make such an application, (3) authority and responsibilities of the administrator of the water supply utility, (4) safety assurance of the tap water, etc.

ii) Provision of laws, in addition to the above unified water supply law, closely related to the administration and operation of water supplies including, but not necessarily limited to, the following:

1. Public Utilities Law
2. Local governments law
3. Local finance law
4. Local government officials law
5. Labor union law
6. Labor standards law
7. Labor safety and sanitation law
8. Building code law, etc.

(2) At the County Level

When considering the organizational structure and manpower of the Ministry and Apel Moldovei, it is unthinkable for them to have sufficient resources to handle all the matter related to the administration of all the water utilities across the country. Thus it must be reasonable for each county government to establish an administrative unit in its organizational structure for small-to-medium water supplies in their jurisdiction.

(3) Apa Canal Soroca - Balti

1) Rationalization and enhancement of the present institutional framework are needed as follows:

ACSB, which has nominally become a joint-stock company, does not come directly under the administration of a government ministry. There must be a national level institutional framework to include the wholesale water supplies, which used to be state enterprises.

The organizational structure of ACSB, which is at present not only complex but also has poorly defined command lines, should be restructured in accordance with rational classification of activities.

ACSB should provide well-defined job descriptions for principal staff members and the main trades of engineering staff.

The current practice of setting wholesale water rate lower than the actual cost should be discontinued. No commercial enterprise can be financially viable under such a policy. Therefore, a rule should be established for ACSB to be entitled to set the wholesale water rate at financially viable level. Such a rule shall be authorized by a law or ministerial decree.

2) Based on the principle of preventive maintenance, maintenance practices should be reorganized as follows:

A comprehensive facility maintenance plan should be provided taking into consideration the following main factors:

1. Quantitative capacity of the system
2. Qualitative performance of the system
3. The age of equipment and structures and their remaining economic lives
4. Maneuverability of the mechanical, electrical and instrumentation systems – automation, remote sensing and control, monitoring system, spare (stand-by) systems, etc.
5. Operating, maintenance and personnel costs
6. Record and prospect of the nature and frequency of mechanical and electrical failures and replacement of equipment and spare parts

Rational maintenance will result in the important decision whether or not each equipment and structure be repaired or replaced, and eventually whether or not the whole system be renewed in a specific time schedule.

Manuals for inspection of equipment should be provided for each equipment and structure, of which method and frequency (interval: daily, weekly, monthly and yearly) shall be specific depending on the age and the nature of the respective equipment and the structures.

In addition to the provision of maintenance manuals, the evaluation of integrity, reliability and maintenance cost of equipment and concrete structures should be carried out, which shall bring about the provision of a facility replacement plan.

A computerized facility maintenance system shall be introduced to carry out the following functions although too high-tech a system is not to be built from the beginning:

1. Description of the existing facilities and equipment,
2. Provision of a GIS (geographical information system) for visual illustration of facilities and equipment,
3. Recording of changes made to the facilities,
4. Charting of schedules of maintenance jobs,
5. Issuance of warnings in the cases of overdue maintenance schedules,
6. Provision of inventories of equipment and its spare parts.

3) Privatization of ACSB

Immediate privatization of ACSB appears to be difficult since no individuals and enterprises will wish to invest in such a water supply utility and own it since its institutional strength and financial profitability are too low. Therefore, the following phased approach may be recommended:

<u>Phase 1. Establishment of firm foundation as a publicly owned enterprise</u>

- The ownership of ACSB, which is at present unclear, should be settled down by the Counties of Soroca and Balti and other interested parties. Then ACSB should make efforts to become institutionally and financially strong and profitable as much as possible. Although ACSB has a statute for itself to be a joint-stock company, no stocks have been floated; the general assembly of stockholders have never been held; and therefore it is still actually a publicly owned enterprise.

<u>Phase 2. Transformation to a public corporation</u>

- A public corporation is to be formed as a joint-venture with other investors such as banks and other enterprises. By that time, ACSB should have been demonstrating sufficient institutional strength and financial profitability.

<u>Phase 3. Foundation of a privately owned company</u>

- A genuine joint-stock company is to be founded; and shares are to be issued. To this end, inter alia, the following measures should be executed:

  a. The statute of the company shall be provided based on the market economy principles;
  b. The authority and rights of the general assembly and the board of directors should be stated in the statue; and they should actually be formed;

c. The company should possess untamed right to instate its executive officers by itself;

d. The organization shall be restructured to functionalize the operation; and

e. The company should possess the right to set the water tariff at such level as its financial position be maintained sound and firm.

There seems to be a long way for the present ACSB to reach the point where it can genuinely form a privately owned joint-stock company. It must overcome a number of obstacles.

4) The proposed institutional framework for ACSB is to be the following:

a. Form of Organization:

The form of the organization shall remain a Joint-stock company with all the stocks to be owned by Soroca and Balti Cities (or Soroca and Balti Counties). Floatation of stocks, however, can only be considered after the rationalization of the tariff policy of Moldova, and the near realization of profitability of ACSB's operation.

b. Establishment of the board of directors:

The directors shall represent the company itself, the cities (counties) of Soroca and Balti, and financing agencies, if any.

c. Revision of the statute:

The present statute of ACSB is too lengthy and complex. The statute of a joint-stock company shall only set forth (1) the purpose of the company, (2) its address, (3) the total number of stocks, face value per stock, restrictions in the transfer of stocks, etc., (4) the general assembly of stockholders, (5) the installable numbers of directors and auditors, their term, board of directors, and (6) dividends. All other items would only be included if not covered by the commercial law or the joint-stock company law and other related laws.

d. Restructuring of the organization:

The organization should be restructured with Director, Chief Engineer and the divisions of (1) General Affairs, (2) Accounting, (3) Customer, (4) Construction, and (5) Production. The Chief Engineer shall supervise all the divisions. The lawyer shall be appended directly to Chief Engineer as the Special unit.

General Affairs Division shall consist of General Affairs Section, Personnel Section, Planning Section and Labor Safety Engineer. Accounting Division shall be composed of Accounting Section, and Logistic Section. Customer Division shall consist of Business Section and Customer Services Section. Construction Division shall be composed of Engineering Section and Design Section. Production Division shall contain Water Transmission Section, Water Treatment Section, Laboratory, and Maintenance Section. The functions of the boiler house, garage, and shifts-men shall come under the command of the Water Treatment Section manager. General Affairs Division shall also assume the function of human resources development, especially for technical staff. Such human resources development activities can be carried out by either an in-house, regional or national level institution.

Despite the comprehensiveness of organizational structure as proposed above, actual installation of respective divisions and sections must depend on the availability of competent personnel to head the respective unit and to work under them. The structure can gradually be expanded. The proposed organization structure is charted in Figure 4.3.1.

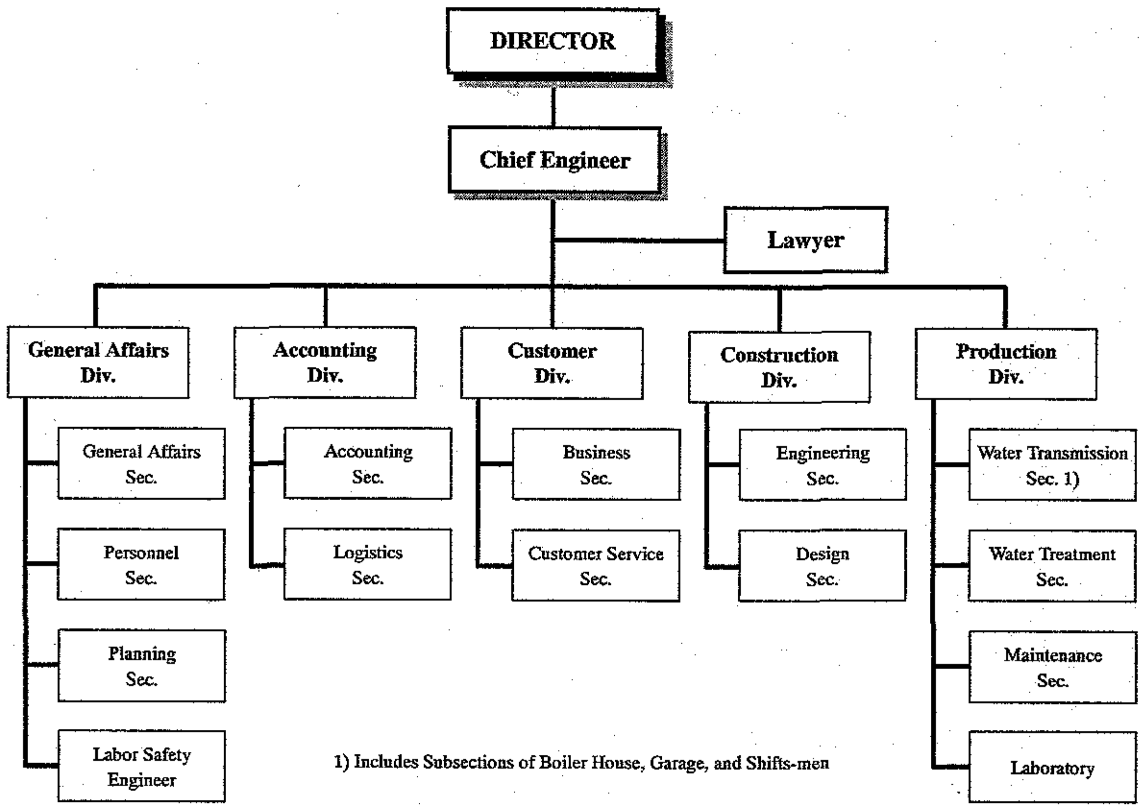


Figure 4.3.1 Proposed Organization Structure of Apa Canal Soroca-Balti

As for the staff size, although the considerable part of work force is redundant and so should be reduced to a rational level, such reduction may not be easy to implement immediately under the present social condition. Therefore, major restructuring thereof may have to be postponed for the time being. Such reduction in the staff size should be made in the near future.

(4) Apa Canal Balti

Like for ACSB, rationalization and restructuring of the organization of Apa Canal Balti (ACB) are required.

1) Form of organization:

The form of the organization shall remain a publicly-owned water utility, instead of a joint-stock company, in consideration of the rather primitive present stage of the introduction of the institutional and accounting systems which shall be in conformity with the principles of the market economy. Its alteration to a joint-stock company can only be successful after a full experience with the above forms of institution and accounting including the establishment of rational tariff structure.

2) Restructuring of the organization:

The organization should be restructured so as to have Director, Chief Engineer and, under him, the divisions of (1) General Affairs, (2) Accounting, (3) Customer, (4) Water Supply, and (5) Sewerage. The lawyer shall be appended directly to Chief Engineer as the Special unit.

The General Affairs Division shall consist of General Affairs Section, Personnel Section, Planning Section and other sections such as Guards Section and Civil Protection Section. Accounting Division shall be composed of Accounting Section, Logistic Section and Computer Section. Customer Division shall consist of Business Section, Customer Services Section and Metering Section. Customers Section shall be staffed with considerably more personnel than for ACSB due to the much larger number of customers. Water Supply Division shall be composed of Engineering Section, Construction Section, Distribution Section, Water Treatment Section and Laboratory Section. Sewerage Division shall be composed of Construction Section, Sewers Section, Pumping Stations Section, Wastewater Treatment Section, and Mechanical and Electrical Section. Each Construction Section in the above two Divisions shall also undertake repair work. The proposed organizational structure is charted in Figure 4.3.2.

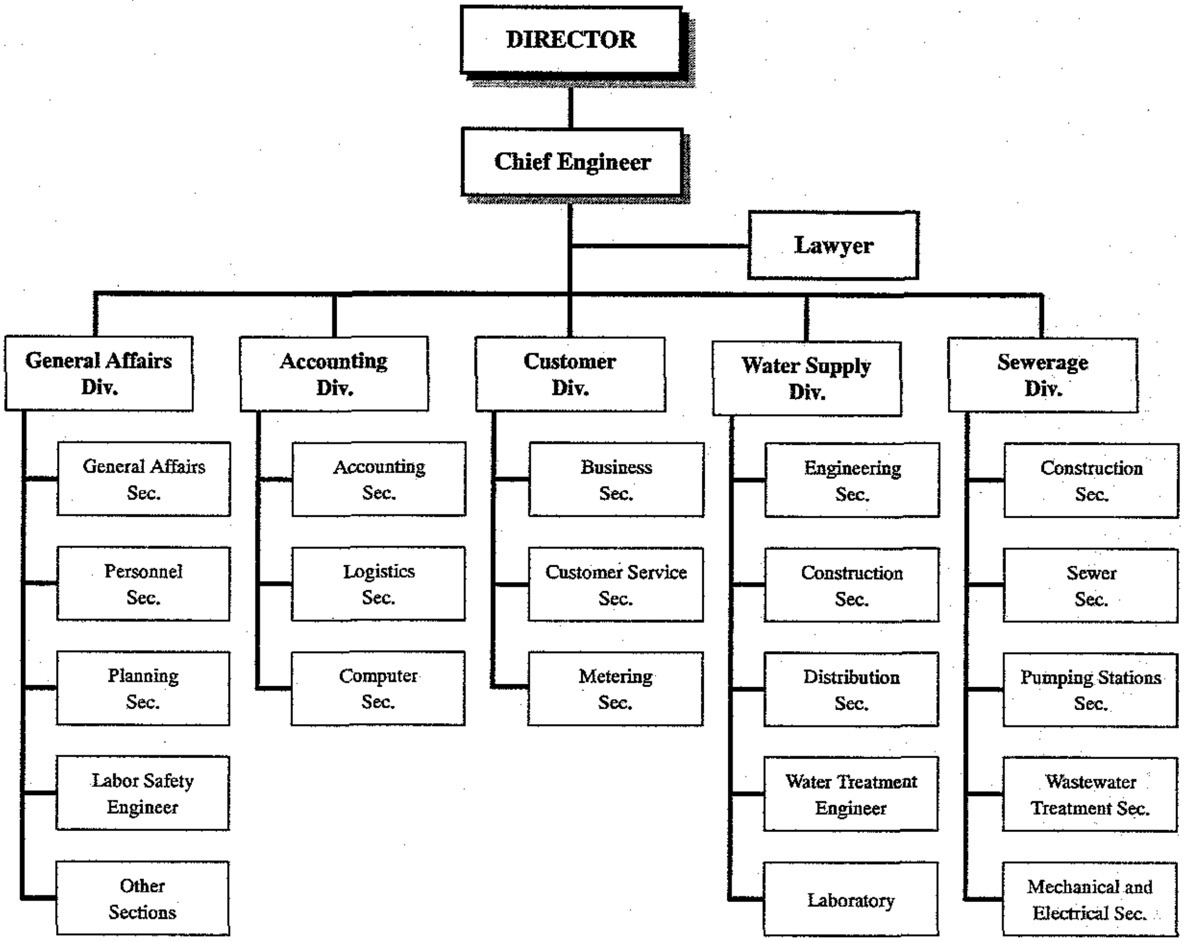


Figure 4.3.2 Proposed Organization Structure of Apa Canal Balti

As to the maintenance practices, the same consideration as to ACSB shall apply to ACB.

In respect to the maintenance of water mains, the following measures shall be exercised:

- Preparation of plans (maps) of water mains in various scales as required.
- Preparation of the inventory of water mains by size, pipe material, and age.
- Survey of distribution pressure and the preparation of a water pressure contour map.
- Detection of pipe breaks (leaking points).
- Repair of mains.
- Evaluation of the condition of the mains for their economic lives and the costs of repair or replacement. The cost comparison between the repeated repairs and the replacement should be made.
- Preparation of a replacement schedule for the mains.

Metering is the very base of physical and financial operations of a water supply utility. The present effort of ACB should be expanded. The following will be the necessary steps for improved metering:

1. Installation of water meters on all the customers

   - Meters should be installed by ACB at customer's cost. However, such a cost shall be collected from the customers to be piggybacked on water bills in monthly installments. Uniform standards should be used for the selection of meters and their installation.

   - In the case of apartment houses, due to the particular design of the building, it is often difficult to measure the flow to an apartment with one single meter. Installation of more than one meters is impracticable for meter reading and inspection. In such a case, the method of installing a block meter on the main service pipe for the building and sharing the total consumption by households in the building by appropriate means may be allowed for the time being.

2. Inspection of meters

   The accuracy and the integrity of meters should be inspected by both (1) identification of too little or too large consumption compared with the previous readings, and (2) regular physical inspection of meters at a prescribed interval.

3. The establishment of the system of meter repair and replacement

   Any meters, whenever found showing under-registration or at the end of the preset life time, should be tested for the integrity and accuracy, and, if needed, repaired or replaced. Apa Canal Balti can run a meter repair shop by itself. However, the testing and repair of meters are conducted by meter manufacturers on a contract basis as commonly practiced elsewhere.

To enhance customer services and also improve tariff collection rate, ACB should employ an advanced system of customer database. The database shall contain important information on every customer, irrespective of customer category, such as the following:

1) Code of Branch Office (of ACB)
2) No. of the customer
3) Code of the customer category
4) Name of the customer
5) Customer's address

6) Telephone No.
7) Size or sizes (diameter) of connection
8) Latest meter reading (or estimate of consumption)
9) Penultimate meter reading
10) Quantity consumed in the current period
11) Current billed charge, and record of bills in arrear
12) Date of service commencement
13) Date of service termination
14) Code of tariff-exemption, if any
15) Bank account holder name, account No., bank name, and branch name payable of tariff for the above customer
16) Name of the tariff collector (intermediary) who collect charges on behalf of the water utility.
17) Address and telephone No. of tariff collector
18) Bank account holder name, account No., bank name, and branch name payable of tariff for the above tariff collector

Based on the above information stored in the database, the Customer Division shall issue meter reading slips and tariff collection bills separately. The meter reading slip should include the following items of information:

1) Code of Branch Office
2) Customer No.
3) Code of the customer category
4) Name of the customer
5) Customer's address and telephone No.
6) Meter reading for the period (or estimate of consumption) (to be filled out by the meter reader)
7) Latest meter reading
8) Quantity consumed in the current period (to be filled out by the meter reader)
9) Meter reader's name

The billing slip for each customer to be brought by the bill collector shall bear the following:

1) Code of Branch Office
2) Customer No.
3) Code of the customer category

4) Name of the customer
5) Customer's address and telephone No.
6) Meter reading for the period (or estimate of consumption)
7) Latest meter reading
8) Quantity consumed in the current period
9) Charge for the current period
10) Outstanding (unpaid) charges
11) Money received by the collector for this time.
12) Outstanding charges after the above payment
13) Bill collector's name

The Customer Division should, without delay, update the customer database in accordance with the reports of the meter readers and the bill collectors.

To promote customer's willingness-to-pay, consumer education should be implemented by every Apa Canal including ACB. They have to understand their right to receive high-quality service as well as their obligation to pay the cost of such services.

(5) Apa Canal Soroca

The same recommendations as for Apa Canal Balti shall apply to Apa Canal Soroca except for the form of organization. As to the organization, basically the same but somewhat reduced structure shall apply to Apa Canal Soroca.

(6) Apa Canal Falesti and Apa Canal Riscani

Although the same recommendations as for Apa Canal Balti shall apply to Apa Canal Falesti and Apa Canal Riscani, guidance and technical and institutional assistance by the government may be required to realize the required improvements in its institution and operational practices. As to the organization, the similar structure shall apply to Apa Canal Falesti and Apa Canal Riscani since they need to achieve basically the same functions.

4.4 Financial Management Plan

4.4.1 National Economy

In order to establish the financial management plan within the frame of the master plan targeting the year of 2015, we have to forecast the economic situation of the country. Until the year of 2008, we adopt the forecast done by the World Bank. For the year from 2009 to 2015 we extrapolate the World Bank forecast (Table 4.4.1 and Figure 4.4.1). In this forecast, the recovery of country's economy is remarkable. In 2005, the real GDP per capita growth increases up to 5.00%. World Bank establishes this forecast in 1999 as the part of "the Country Assistance Strategy." But, the stabilization of the inflation and foreign exchange rate are significant in 2001. Therefore the more quick recovery of the economy might be expected. Because of the recent stagnation of American economy and the fear of international terrorism, we take conservative attitude and adopt 1999 forecast.

According to our forecast, nominal GDP per capita will be 17,313 lei (2015). We will be able to present the healthy financial plan of water supply under this level of GDP per capita. In addition, the economic growth will exceed 5% in US dollar denomination because we envisage the improvement of foreign exchange rate. This situation contributes the improvement of financial situation of the water supply also.

Especially, in the transitional economy, it must be highly appreciated for this country to have achieved the control of financial deficit and the stabilization of foreign exchange rate. These two factors are the fundamentals for the healthy growth and development of the national economy. Most transitional economies and developing countries are unable to achieve these two targets. But as the result of this performance, the shortage of government income causes the water tariff arrears in budget organizations. The issue of improving government revenue is beyond of the scope in this master plan. Any economy is unable to run without sufficient tax revenue for government activities. As the portion of water revenue from the budget organizations is substantial to Apa Canals, the tax collection system has to be improved.

4.4.2 Roles of the Central Government

Therefore first issue that the central government must do is the timely allocation of water cost to all budget organizations. If this is not achieved, the healthy financial management of water supply activities is absolutely impossible. The government must recognize this point firstly.

The second task for the government is the improvement of water tariff system. Under the current tariff system every Apa Canal shows income deficit. Even all water bills are collected, Apa Canal is unable to pay all the costs. Therefore Apa Canal accumulates financial deficit and trade liabilities and taxes. Because the current and future financial situation of the government does not allow financial assistance' the financial assistance from the government for operational deficit is impossible and not desirable also. Every Apa Canal has to meet all the cost with its own tariff revenue. Next issue on the tariff system is to eliminate the cross-subsidy from business enterprise to population (domestic uses). The policy that the most water cost must be supported by business enterprises is unable to sustain. The water demand by business activities has decreased remarkably recently and will not recover forever. Economic condition of the country has been changed completely after the independence. For the correction and improvement of water tariff systems, the decisive action of the central government is required. If the problems are given to local governments and Apa Canals, they are not able to solve the issues.

The third and final critical task of the central government in achieving this master plan is to coordinate ACSB and retail Apa Canals, especially, ACB, the largest customer of ACSB. The low tariff system and low water bill collection of ACB are the cause of financial trouble of ACSB. Without financial improvement of ACB, the financial stability of ACSB is not achieved. ACB must understand this point.

If the water supply in this mater plan must be realized, the freehand of retail Apa Canals should not be allowed. All financial liabilities of ACSB are to be considered also financial liabilities of retail Apa Canals. Retail Apa Canals must accept all water cost of ACSB. This is the critical point for the success of ACSB operation. In pure market economy, both parities enjoy freehand and market price determines transaction but this principle is unable to be applied to this case. ACSB is acting like an agent actually. Assignment of electricity bill to retail Apa Canals according to water demand might be a partial solution.

Above-mentioned three actions by the central government are the prerequisite of this master plan. Without appropriate government actions, the financial management of water supply activities will not be stabilized. On the contrary, if these conditions are cleared, then the most financial obstacles are diminished.

4.4.3 Financial Rehabilitation of Water Supply Utilities

We divide the master plan in three stages in terms of financial rehabilitation. The Phase I covers from 2003 to 2006. In the Phase I, the main issues are to realize new tariff structure covering all the costs and to eliminate cross-subsidy from business enterprises to population and bill collection from the budget organizations. Regarding the short-term trade liabilities and taxes (including social security tax), the long-term payment plan must be developed and approved by creditors. While interest rate is decreased as the inflation is stabilized, some portion of interest or penalties are expected to be waived. Phase I is urgent rehabilitation period. Every effort has to be done to realize financial surplus in each fiscal year. With the urgent rehabilitation plan proposed in this master plan, the saving of electricity cost is expected. As for the cost of this urgent rehabilitation plan, it is difficult to finance internally in Phase I and resources from outside is expected.

Even with substantial efforts made in Phase I, it will not be possible that all three targets are achieved completely in Phase I. The correction of tariff structure will require step-by-step improvements. In Phase II (2007-2010), we expect the finish of tariff system correction and the elimination of water bill arrears. Corporate accounting system has to be improved and cost control system should be introduced. By paying salary and wages timely with cash, the moral of employees will be improved significantly. In this period, real GDP increase will allow substantial increase of tariff comparing to former level. Financial surplus in operation should be firmly established in Phase II.

The effort in Phase III (2011-2015) will concentrate the payment of accumulated liabilities. As financial surplus established by Phase II, the surplus from operation can be used for the payment of accumulated liabilities. The constant financial surplus allows the long-term borrowing or the issuance of bonds. Then Apa Canals are able to swap the accumulated trade liabilities and taxes with long-term stable financing and eliminate these short-term liabilities as early as possible.

The fundamental principle to be observed is financial sustainability with water tariff. The task of the central government is mainly three points mentioned already. Especially, as the local governments have insufficient interest in financial sustainability of Apa Canals and try to keep low tariff structure, the central government has to take decisive actions.

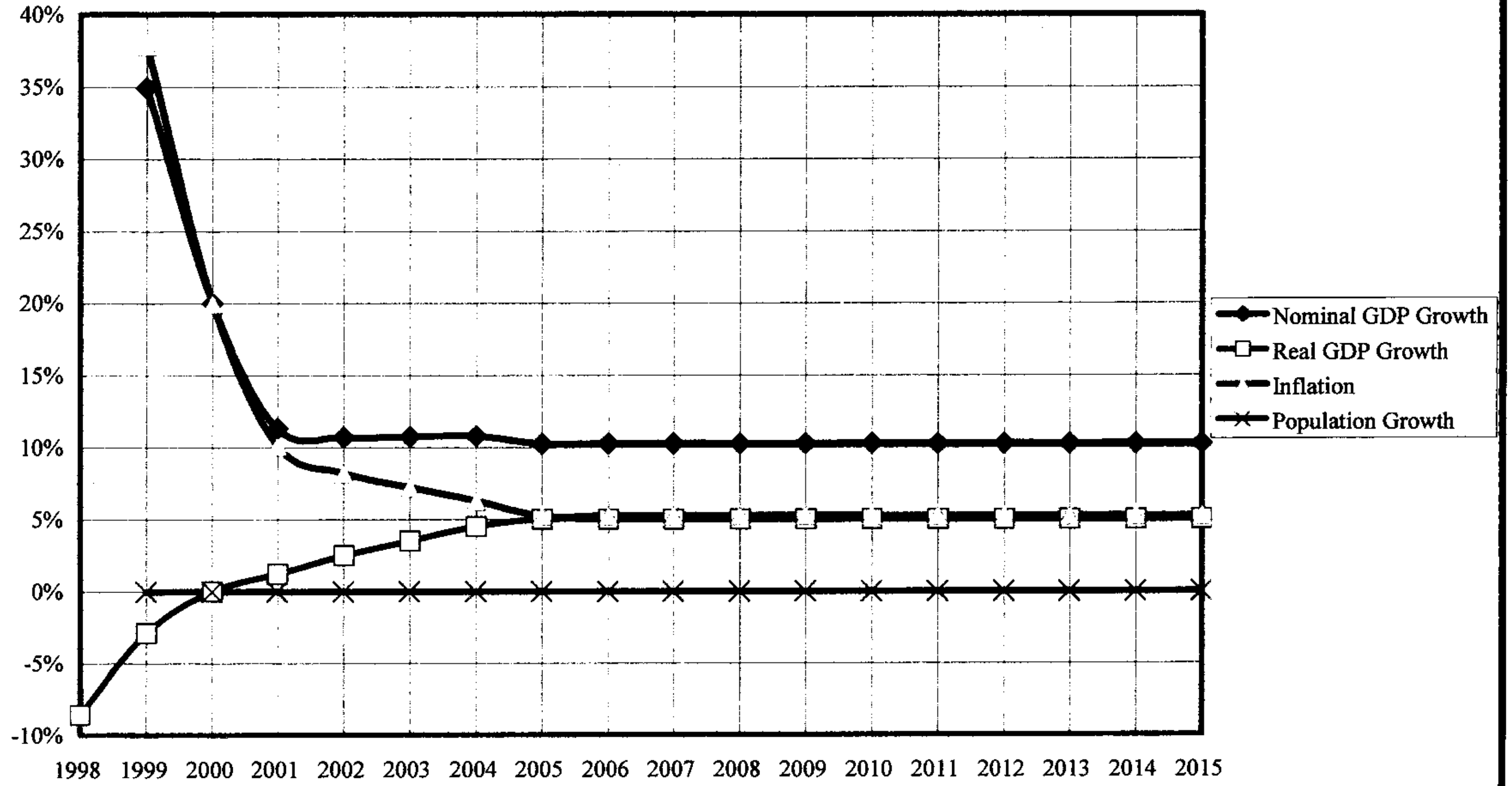
While the scope of financial plan is the one of ACSB, the financial stability of ACSB is completely dependent on the financial policy and performance of retail ApaCanals, especially Apa Canal Balti (ACB). Therefore we will examine the financial management of retail Apa Canals as necessary.

Table 4.4.1 Macroeconomic Forecast in Moldova

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nominal GDP Growth		34.95%	20.01%	11.31%	10.71%	10.73%	10.78%	10.24%	10.25%	10.26%	10.25%	10.24%	10.26%	10.24%	10.26%	10.25%	10.26%	10.24%
Real GDP Growth	-8.60%	-2.90%	0.00%	1.20%	2.50%	3.50%	4.50%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Inflation		37.85%	20.01%	10.11%	8.21%	7.23%	6.28%	5.24%	5.25%	5.26%	5.25%	5.24%	5.26%	5.24%	5.26%	5.25%	5.26%	5.24%
Population Growth		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
GDP per capita (lei)	2,418	3,263	3,916	4,359	4,826	5,344	5,920	6,526	7,195	7,933	8,746	9,642	10,631	11,720	12,922	14,246	15,707	17,316

Source: World Bank, "Country Assistance Strategy", April 1999 for 1998-2008. Consultants own estimate for 2009-2015

Figure 4.4.1 Macroeconomic Forecast



4.5 Initial Environmental Examination

4.5.1 Introduction

Generally, the IEE (Initial Environmental Examination) study is carried out as one of important components of a development master plan, in which due consideration should be given to any negative impacts on natural, physical, ecological and socio-economic environments.

IEE is not legally required for development projects in the Republic of Moldova, and the necessity of EIA (Environmental Impact Assessment) is determined by type and scale of development projects. Although the conduct of the IEE is not required in Moldova, it will provide useful basis to conduct EIA in the next stage, i.e. a feasibility study.

Generally speaking, a construction of new water supply facilities and new operation works are certain to cause some impacts on the environment. Most of the impacts are considered to be positive, but some might be negative, and monitoring and special mitigation measures may be required.

Components of construction of new facilities and new operations included in the Master Plan are summarized below.

Construction of new facilities:

- Transmission pipeline from Balti to Riscani (L= 35 km)
- Transmission pipeline from Balti to Falesti (L= 32 km)
- Distribution reservoirs in Saroca (V=5,000m^3)
- Distribution reservoirs in Falesti (V=4,200 m^3)
- Distribution reservoirs in Riscani (V=1,400 m^3)
- Drying bed for sludge treatment

New operation works:

- Treatment works (sludge treatment)
- Transmission works (from Balti to Riscani, and from Balti to Falesti)

Expected potential environmental impacts associated with the above-described new facilities construction and new operation works were examined in the manner provided by the "Environmental Guidelines for Infrastructure Projects - Vol. IX. Water Supply," that has been prepared by JICA The full content of the IEE study is given in the Supporting Report. The following are the conclusions of the IEE study.

4.5.2 Expected Potential Environmental Impacts

Expected potential environmental impacts associated with the above-described new facilities construction and new operation works were categorized using an impact matrix table as shown in Table 4.5.1. Conclusions of the Initial Environmental Examination are as follows:

1. EIA is necessary as the project may have some impacts to the existing environment.

2. EIA is required by the Moldavan regulations for the water supply systems with capacities exceeding 10,000 m^3/day.

3. Specific items for EIA of more importance are: 8) construction wastes, 15) fauna and flora, 18) air pollution, 19) water pollution, and 21) noise and vibration.

4. EIA items of 2) economic activities and 3) traffic are important as well.

5. EIA items of 1) resettlement, 5) cultural site, 10) topography and geology, and 17) landscape depend on selection of precise sites for new construction, but full-scale assessment will not be required.

6. EIA items of 6) water rights and 7) public health conditions should be preliminarily clarified with national environmental and health authorities before the final decision on EIA is made.

7. EIA items of 12) groundwater and 20) soil contamination will depend on technical options to be proposed.

Table 4.5.1 Result of Initial Environmental Examination (Potential Environmental Impacts)

		Items	Construction			Operation		Remarks
			Transmission pipe line	Reservoir tank	Drying bed	Transmission pipe line	Drying bed	
Social Environmental Factors	1	Resettlement		C				Land acquisition may cause resettlement. The exact sites for new reservoir tanks in Falesti and Riscani are unknown yet and should be clarified during final selection of the construction sites.
	2	Economic Activities	B	C				Temporal losses of agricultural yields or negative effects to the road protection corridor (trees and vegetation) are expected for the construction areas of the transmission pipelines. The scale and extent of the impacts should be clarified.
	3	Traffic and Public Facilities	B	B	C			Construction vehicles and machinery potentially may affect traffic at the local roads.
	4	Division of Communities						Not expected at this stage.
	5	Historical or cultural site	C	C				The exact project sites for new reservoir tanks and transmission pipeline are unknown yet. Location of archeological sites should be clarified at the architecture departments and Academy of Science.
	6	Water Rights and Rights of Common				C		Not expected at this stage as there are no new water intakes are proposed. However, the impacts should be clarified in the fishing rights and the river water management.
	7	Public Health Condition				C		Not expected at this stage. The capacities and technical conditions of the wastewater treatment facilities should be evaluated.
	8	Waste	B	B	B		B	Impacts which are relevant to the construction period temporal and small-scale. Operation of new sludge drying bed may cause long-term impacts of dried sludge if not managed properly.
	9	Risk of disaster						Not expected at this stage.
Natural Environmental Factors	10	Topography and Geology		C				The exact sites for new reservoir tanks in Falesti and Riscani are unknown yet and should be clarified during final selection of the construction sites.
	11	Soil Erosion						Not expected at this stage.
	12	Groundwater		C				Not expected at this stage, but possible pollution caused by drainage water leaches should be clarified during designing of sludge drying bed.
	13	Hydrological Situation						Not expected at this stage.
	14	Coastal Zone						Not expected at this stage.
	15	Fauna and Flora	B	C				Potentially expected for the construction sites and areas for transmission pipelines and reservoir tanks. The impacts are temporal and small-scale.
	16	Meteorology						Not expected at this stage.
	17	Landscape		C				The exact sites for new reservoir tanks in Falesti and Riscani are unknown yet and should be clarified during final selection of the construction sites.
Pollution Factors	18	Air Pollution	B	B	B			Expected impacts are small-scale and for short period during construction phase.
	19	Water Pollution					B	Expected for discharge of supernatant liquor from the drying bed.
	20	Soil Contamination			C			Not expected at this stage, but possible pollution should be clarified during designing of sludge drying bed.
	21	Noise and Vibration	B	B	B			Expected impacts are small-scale and for short period during construction phase.
	22	Land Subsidence						Not expected at this stage.
	23	Offensive Odor						Not expected at this stage.

Note: A: Serious negative impact is expected.
B: Some negative impact is expected.
C: Extent of impact is unknown and examination is needed.

4.6 Preliminary Project Cost for the Master Plan

4.6.1 Conditions

The following conditions are applied to estimate the preliminary project cost.

1. Cost of rehabilitation of the Soroca-Balti transmission main includes the transmission devices such as air-relief valves, valves for drainage and replacement of damaged pipe.
2. Cost of pumping station includes electrical equipments, i.e., power transformers, control transformers, distribution panels and cables, and rehabilitation of the buildings.
3. Engineering cost is assumed to be 8% of the construction cost.
4. Physical contingency is assumed to be 10% of the construction cost.
5. VAT and import duty taxes are not included.
6. Land acquisition cost is not included.

4.6.2 Initial Investment Cost

(1) Rehabilitation and Construction Cost

The direct construction cost has been estimated in section 4.2.2. The total project cost is shown below.

Unit: US$

Work Item		Cost
Direct Construction Cost	Rehabilitation of Pumping Station and Transmission Main	5,450,000
	Improvement of Water Treatment Plant	3,430,000
	Construction of new reservoirs and suspended reservoirs	1,290,000
	Expansion of Transmission Main to Falesti and Riscani and Construction of Reservoirs	7,580,000
Total		17,750,000≒17,800,000
Engineering Cost (8%)		1,420,000
Physical Contingency (10%)		1,780,000
Grand Total		21,000,000

(2) Cost of Distribution Pipe Replacement and Extension for the 4 Cities/Towns

Replacement of the existing distribution pipes is required to improve the water leakage from the distribution pipes in all of the 4 cities/towns. In Falesti and Riscani, extension of distribution pipe is also required for the served population to reach 95% by the target year 2015.

Cost of pipe replacement and extension for the 4 cities/towns is estimated as shown below (see the Supporting Report for details).

Item		Cost
Balti	Cost of Distribution Pipe Replacement	7,299,000
	Cost of Distribution Pipe Extension	0
	Total	7,299,000
Soroca	Cost of Distribution Pipe Replacement	887,800
	Cost of Distribution Pipe Extension	0
	Total	887,800
Riscani	Cost of Distribution Pipe Replacement	72,600
	Cost of Distribution Pipe Extension	505,700
	Total	578,300
Falesti	Cost of Distribution Pipe Replacement	118,300
	Cost of Distribution Pipe Extension	395,200
	Total	516,500
Grand Total		9,278,600

4.6.3 Operation and Maintenance Cost

Annual operation and maintenance (O/M) cost for the Soroca-Balti Water Treatment Plant will be estimated by referring the O/M cost of Chisinau Water Treatment Plant as indicated below.

The breakdown of the monthly O/M cost of Chisinau WTP is as follows,

• Chemical	Aluminum Sulfate;	1,500kg/day x 30 days x 0.17 US$	= 7,600 US$/mon
	Chlorine;	700kg/day x 30 days x 0.3 US$	= 6,300 US$/mon
• Electricity		11,000 kW/day x 30 days x 0.65/12.8	= 16,800 US$/mon
• Personnel and Repairing			= 43,500 US$/mon
		Total	= 74,200 US$/mon
			(950,000 Lei/mon)

The monthly average volume of treated water in Chisinau WTP is equivalent to 150,000 m^3/day. Therefore, monthly/yearly O/M cost for the unit volume of treated water is estimated as follows,

Chemicals	(7,600 + 6,300)/150,000	= 0.09 US$/mon/($m^3$/d)
		= 1.08 US$/y/($m^3$/d)
Electricity	16,800/150,000	= 0.11 US$/mon/($m^3$/d)
		= 1.32 US$/y/($m^3$/d)
	11,000 x 30/150,000	= 2.2 kW/mon/(m^3/d)
		= 26.4 kW/y/(m^3/d)

Personnel and Repairing 43,500/150,000 = 0.29 US$/mon/(m^3/d)

= 3.48 US$/y/(m^3/d)

The O/M cost for pumping station is estimated based on the monthly motor output, personnel and repairing cost for pumps. Monthly motor outputs for 4 pumping stations are summarized in the following table,

Pumping Station	Monthly Motor Outputs	Remarks
PS-1	450 kW x 2 x 24hr x 30 days x 0.7 = 454,000 kW/mon	Q = 94,000m^3/d
PS-2	750 kW x 2 x 24hr x 30 days x 0.7 = 756,000 kW/mon	Q = 94,000m^3/d
PS-3	500 kW x 2 x 24hr x 30 days x 0.7 =504,000 kW/mon	Q = 84,600m^3/d
PS-4	500 kW x 2 x 24hr x 30 days x 0.7 =504,000 kW/mon	Q = 78,500m^3/d
Total	= 2,218,000 kW/mon = 26,616,000 kW/y	Average Q = 90,000m^3/d

Monthly/Yearly motor output per unit volume of lifted water by pump is as follows:

2,218,000 kW/mon ÷ 90,000 m^3 = 25 kW/mon/(m^3/d) = 300 kW/y/(m^3/d)

Annual cost of electricity per unit treated/lifted water for WTP and pumping station is as follows, where unit price of electricity is assumed 0.56 Lei/kW:

26.4 kW/y/(m^3/d) + 300 kW/y/(m^3/d) = 326.4 kW/y/(m^3/d)

326.4 x 0.56 = 183 Lei/y/(m^3/d) = 14.0 US$/y/(m^3/d)

Annual personnel and repairing cost for pumps is estimated by assuming 5% of the construction cost in reference to the O/M costs in similar projects. The annual personnel and repairing cost is as follows:

Construction cost for 4pumping stations: 3,140,000 US$

Annual personnel and repairing cost: 3,140,000 x 0.05 = 157,000 US$/y

Planned supplying water from 2005 to 2015 for 4 cities/towns is shown the following table based on the water demand given in Chapter 3.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Supplying Water (m^3/d)	49,417	51,099	52,781	54,463	56,145	57,825	59,596	61,365	63,134	64,903	66,672

The annual O/M cost estimated is summarized in Table 4.6.1.

Table 4.6.1 Annual Operation and Maintenance Cost for Apa-Canal Soroca-Balti

Unit; US$

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Supplied Water (m^3/d)	52,781	54,463	56,145	57,827	59,596	61,365	63,134	64,903	66,672
Supplied Water (m^3/y)	19,265,065	19,878,995	20,492,925	21,106,855	21,752,540	22,398,225	23,043,910	23,689,595	24,335,280
Accounted-for water (m^3/d)	43,984	45,386	46,788	48,189	49,663	51,138	52,612	54,086	55,560
Accounted-for water (m^3/y)	16,054,221	16,565,829	17,077,438	17,589,046	18,127,117	18,665,188	19,203,258	19,741,329	20,279,400
Electricity	739,000	762,000	786,000	810,000	834,000	859,000	884,000	909,000	933,000
Chemical for WTP	59,000	61,000	62,000	64,000	66,000	68,000	70,000	72,000	74,000
Personnel and Repairing for WTP	184,000	190,000	195,000	201,000	207,000	214,000	220,000	226,000	232,000
O/M cost for Pumping Station	157,000	157,000	157,000	157,000	157,000	157,000	157,000	157,000	157,000
Total (Annual Operation and Maintenance Cost)	1,139,000	1,170,000	1,200,000	1,232,000	1,264,000	1,298,000	1,331,000	1,364,000	1,396,000

[Note] 1. Excahnge Rate 1US$ = Lei 12.8 = Yen 125.0
2. Life spans for facilities and equipment are as follows:
1) Civil and building works: 40 years
2) Mechanical and electrical equipment: 20 years

4.7 Implementation Schedule for the Master Plan

On the basis of the study results, the following implementation schedule is tentatively proposed as a basis of economic and financial analyses to be followed.

Item		02	03	04	05	06	07	08	09	10	11	12	13	14	15
FS, Design and Tendering		■	■												
Rehabilitation and Construction				■	■	■									
Operation and Maintenance							■	■	■	■	■	■	■	■	■
Expansion and Replacement of Distribution Pipeline	Balti			■	■	■	■	■	■	■	■				
	Soroca				■	■	■	■	■						
	Riscani			■	■	■	■	■	■	■	■	■	■	■	
	Falesti			■	■	■	■	■	■	■	■	■	■	■	
Financial Rehabilitation	Phase 1		■	■	■	■									
	Phase 2						■	■	■						
	Phase 3									■	■	■	■	■	■
Institutional Development			■	■	■	■	■	■	■	■	■	■	■	■	■

4.8 Economic and Financial Analyses of the Master Plan

4.8.1 Economic Analysis

As for economic effects from the implementation of the Master Plan, we can think of the increase of local residents' welfare by the improvement of water supply (especially for the residents in high-rise apartments without wells, labor saving for women and young residents engaging in water carrying), the positive effects for individual health by the improvement of water quality.

Among these possible positive effects, we have quantified the labor saving of water carrying. The economic internal rate of return (EIRR) at 14.50% has been obtained (see the Supporting Report for details). The estimation is based on the average disposable income in the Study Area.

4.8.2 Financial Analysis

(1) Method of Financial Analysis

The financial analysis has been done for three categories, the first is for ACSD, the second is for Apa Canals in four cities/towns, and the last is for consolidated financial analysis for ACSB and the municipal Apa Canals. The price used in financial analysis is 2001 price. The physical life of investment is 40 years for civil engineering facilities and 20 years for machinery and electrical equipment. In both cases, salvage value is assumed to be 10 percent. The project life for financial analysis is 40 years.

(2) Financial Analysis for ACSB

We established four cases for the financial analysis of ACSB as follows:

1) Main Line (Soroca + Balti)
2) Main Line + Riscani
3) Main Line + Falesti
4) Main Line + Riscani + Falesti

We will call Case (1) as M, Case (2) as M+R, Case (3) as M+F, Case (4) as M+R+F for simplicity.

As for the availability of external financial assistance, we have assumed three cases, i.e., zero percent, fifty percent and seventy percent. Remaining portion is assumed to be financed with borrowing. The O&M cost and the general administration expenses will be borne by the organization. The general and administration expenses are based on the data of 1999 and expected to increase proportionally with O&M cost. The wholesale price of water to be paid by the municipal Apa Canals is set to 1.62 lei/m^3 in 2002. This is the price being planned by ACSB against current 1.43 lei/m^3 and expected to be realized within a few years. It is assumed that the price will increase in proportion to inflation rate and real GDP growth rate towards the future (see Supporting Report). The rate of collection of water tariff from the municipal Apa Canals is assumed to be 100 percent.

The result of financial analysis is shown in the following table. The detailed results of the FIRR and NPV estimation are shown in the Supporting Report. It is clear in this summary table that the case M has the best FIRR, and the additional investment in water supply to ACR and ACF reduces FIRR.

Case	FIRR			NPV at 7 % (US$ 1,000)		
	①	②	③	①	②	③
M	2.70%	8.10%	13.24%	(4,254)	672	2,642
M+R	1.29%	5.97%	10.18%	(7,635)	(843)	1,874
M+F	1.36%	6.07%	10.38%	(7,458)	(754)	1,927
M+R+F	-	3.46%	7.10%	(13,627)	(3,839)	76

Note ① : 100 % of initial investment is covered by loan.
② : 50 % of initial investment is covered by loan.
③ : 30% of initial investment is covered by loan.

The WITHOUT case for ACSB is that water supply from ACSB is suspended.

(3) Financial Analysis of Retail Apa Canals

Definition of WITH and WITHOUT cases and fundamental assumptions are as follow:

1) In case of distribution network, the repair works are included in both cases; therefore, they are excluded in the analysis. Only the investment for extension is considered.

2) The cost of replacement of pumps for groundwater extraction and related electricity is considered in WHTHOUT case only.

3) Average tariffs assumed are 4.5 lei/m^3 in Balti and 4.0 lei/m^3 in the other three Apa canals. These are the levels that the retail Apa Canals are currently trying to achieve. The tariff and the O&M cost are assumed to increase in proportion to the per capita GDP growth.

4) The tariff collection rate in both cases is assumed to be 80 percent except in Balti where it is assumed to be 85 percent.

The results of financial analysis are shown in the Supporting Report. The analysis is performed for the difference between WITH and WITHOUT. The NPVs at 7% are positive in all four cities. It represents substantial financial benefits to these Apa Canals. Especially, ACR and ACF have higher financial benefit than in ACB because ACR and ACF have tremendous benefit from new water supply from ACSB.

(4) Consolidated Financial Analysis of ACSB and Retail Apa Canals

The summary table of FIRR and NPV is shown below. The detailed estimation processes are shown in the Supporting Report. The best FIRR is shown in Case M, and the water supply to ACR and/or ACF will reduce FIRR. The same can be said for NPV in the case of 100 % loan. However, inclusion of ACR or ACF or both results in NPV higher than that of Case M when the external financial assistance is increased.

Case	FIRR			NPV at 7 % (US$ 1,000)		
	①	②	③	①	②	③
M	9.34%	19.30%	32.89%	2,618	7,543	9,513
M+R	7.84%	15.83%	25.70%	1,365	8,157	10,873
M+F	7.88%	16.10%	26.53%	1,376	8,079	10,760
M+R+F	5.79%	12.31%	19.66%	(2,753)	7,079	11,011

Note ①: 100% of initial investment is covered by loan.
②: 50% of initial investment is covered by loan.
③: 30% of initial investment is covered by loan.

In comparison to non-consolidated financial analysis, the FIRR and NPV are improved remarkably. But the results depend significantly on wholesale water tariff, retail tariffs and tariff collection rates.

CHAPTER 5 EVALUATION OF THE MASTER PLAN

5.1 Economic Aspect

In the region where water supply is not adequate, the economic effect of the improvement of water supply is significant. As for industrial promotion and tourism attraction, the improvement of water supply is prerequisite. But since other conditions are not satisfied yet, the investment in water supply only is not able to bring about economic effects of these sectors.

5.2 Financial Aspect

As the financial performance of both ACSB and retail Apa Canals are affected by wholesale tariff of water supply, the whole perspective of the financial picture of the Master Plan is clearer in the consolidated analysis than in non-consolidated ones.

If we consider FIRR only, the best is the case M, but we can find higher NPV in ACR and ACF (especially if we consider per capita NPV etc.). Therefore we recommend the inclusion of the extension of the ACSB facility to ACR and ACF in the Master Plan considering the welfare of the residents.

Currently, we assume 1.62 lei/m^3 as wholesale water tariff from ACSB. But when considering water supply cost, the wholesale price to ACS should be the lowest and the wholesale tariff to ACR and ACF should be higher. On the contrary, if we consider the financial benefit to retail Apa Canals, ACS, ACR and ACF will be able to accept higher wholesale tariff. In Balti, however, the financial benefit of wholesale water from ACSB is substantially lower than other Apa Canals.

This financial evaluation is based on the assumption that cost recovery tariff is approved and satisfactory level of tariff collection is realized. If this assumption is not realized, any financial planning, analysis and evaluation will be nothing but works on the desk.

5.3 Institutional Aspect

The institutional framework proposed in Section 4.3 possesses economic merits and technical rationality, which will maximize the benefits of the water utilities as well as the residents together with other measures proposed under the Study.

The institutional framework at the national level proposed under the study will lead to functional administration of the water supply sector since it aims at formulating (1) an administrative structure with the specific ministry (MECTD) and the authorized agency (Apele Moldovei) in charge of the water supply sector; (2) a system of application and granting of a license for a new or altered water supply utility; and (3) a monitoring system for the performance of water utilities in terms of the service level.

At the local level, although the existing form of the water utility, namely, Joint-stock company, of ACSB is recognized under the Study, the perfection of the organization by floatation of stocks is not recommended. No economic benefits can be expected from such an operation for the time being. The creation of the proposed board of directors, on the other hand, will be the base of functional managementof the water utility. It also benefits not only the utility but also its ultimate beneficiaries, i.e., the residents in that it can acquire experience in democratic and market-economy-like management of a water utility so as to realize reasonable but profit-making tariff as well as good services to customers.

The proposed organizational structure for the water utilities under the Study has characteristics of comprehensive and functional lines of command. Despite the comprehensiveness of the proposed organizational structure, rather gradual reform and expansion of the existing structure of ACSB is recommended. Premature reorganization and expansion of the structure can only lead to inefficiency and costly operation. As to technical benefits, it is recommended for General Affairs Division to resume the function of human resources development, especially for technical staff by either an in-house, regional or national level institution. These recommendations shall apply also to Apa Canals of Soroca, Balti, Falesti and Riscani.

The proposed maintenance system, as based on the preventive maintenance principle, will provide timely and efficient maintenance work with comprehensive manuals and the subsystem of computerized inventory control including the GIS device. Such a system will result in technically sound as well as cost-saving maintenance practices.

The legislative framework proposed under the study will secure the provisions of laws and regulations which will give the legislative base for the MECTD, Apele Moldovei and water utilities for their administrative and operational activities.

5.4 Technical Aspect

Technical soundness of the proposed facility development master plan is examined from the following view points:

- Appropriateness of the capacity of the water supply system
- Sufficiency in the quality of the water
- Cost effectiveness of the facility development
- Easiness and safety of the operation
- Protection of the environment

(1) Water Supply Capacity

The facility development plan has been prepared based on the deliberate projection of the water demand in the Study Area up to the year 2015. It is expected that the projected water demand is appropriate; not too large and not too small. Capacity of each facility has been determined based on the projected water demand, e.g., the capacities of the intake and transmission pumps will be reduced by a half of the existing ones. Appropriate size of the water supply system will ensure cost-efficient operation, while maintaining supply of sufficient amount of the water.

(2) Quality of Water

In the towns of Falesti and Riscani, the present water supply is entirely dependent on the groundwater of which water quality is not satisfactory for drinking purpose. The situations were the same in the cities of Balti and Soroca until August 2001 when the Soroca-Balti water supply system resumed the operation after one year of suspension.

It has been planned that the Soroca-Balti pipeline will be extended to Falesti and Riscani, and the existing water treatment plant of the Soroca-Balti water supply system will be extensively improved. The renovated treatment plant will be operated smoothly to produce the high-quality water satisfying all items of the drinking water quality standards.

(3) Cost Effective Development

The facility development master plan has been prepared based on the comparative studies of several alternatives applicable to the cities/towns in the Study Area (Balti, Soroca, Falesti, and Riscani). The proposed plan is proved to be most economical among the alternative schemes of the development. The existing facilities of the Soroca-Balti water supply system will be utilized to the maximum extent, and the uncompleted distribution reservoirs in Balti will be completed, thereby contributing to cost saving.

(4) Easiness and Safety of the Operation

The facility development plan includes various components which aim to improve easiness and safety of the operation. These include the interlocking system in the pumping station (No. 2) and the automatic control system in the treatment plant.

(5) Protection of the Environment

In the water treatment plant, the sludge drying beds will be newly introduced. This facility treats the sludge from filter backwash drainage basin and the sludge produced in the flocculation and sedimentation chamber, while they are presently discharged to a nearby natural pond without treatment. Introduction of this facility will contribute to the protection of the water environment.

5.5 Social and Environmental Aspects

(1) Social Aspect

Implementation of the proposed master plan will greatly increase the availability of drinking water that is a basic human need. Supply of sufficient quantity and quality of water, which will be available for 24 hours, will enhance the convenience in daily life, and therefore positively affect the economic activities of the people.

As regards gender and poverty issues, the following can be expected.

- 24-hour supply of quality water will considerably reduce the labour of people particularly of women for obtaining water. Even in the cities of Balti and Soroca where the population served with water supply exceeds 95%, majority of people use community shallow wells additionally because of frequent stoppage of the water supply. The situation is much worse in Falesti and Riscani where the service rates are significantly lower. The result of the sociological survey indicated that even the households connected to the water supply have to bring water from wells 2 - 4 times/day through the distance of 70 - 230 meters. The frequency of bringing water from wells increases to 4 - 7 times/day for the households not connected to water supply. Such labour of the households will be greatly reduced.

- Improvement of quality of supply water will reduce people's cost of obtaining drinking water. At present, a variety of bottled drinking water are sold because the quality of the present supply water and well water are in general unsafe for drinking. The cost of bottled water is an economic burden particularly for the people of low income. When the water suitable for drinking becomes available from the water supply, it will significantly benefit the low-income people.

As such, the master plan can be evaluated very positively in the social point of view.

(2) Environmental Aspect

No serious negative environmental impacts are expected by the implementation of the master plan.

However, consideration should be given to the operation stage and the construction stage for the new facilities in order to eliminate or minimize any negative impacts to social and natural environments. Items that need to be considered in the feasibility study stage are listed below. Among these, the handling of dried sludge and supernatant water from the sludge drying bed is most important, since any impact arising from the operation of the drying bed is not temporal one.

Social Environmental Factors

1) Temporal losses of agricultural yields and/or negative effects to road protection corridor (trees and vegetation) may occur by construction works of the water transmission pipelines from Balti to Falesti and Riscani. The same may be possible by construction of distribution reservoirs.

2) Construction vehicles and machinery for construction of the pipelines and reservoirs may affect traffics of local roads.

3) Operation of the new sludge drying bed may cause long-term impacts if the dried sludge is not properly managed.

Natural Environmental Factors

1) There may be temporal and small-scale negative effects to fauna and flora during the construction of the pipelines and reservoirs.

Pollution Factors

1) There may be short-period, small-scale pollution of the air during the construction of the pipelines, reservoirs, and sludge drying bed.

2) Discharge of supernatant from the sludge drying bed may cause pollution of receiving water during its operation.

3) Short-period, small-scale noise and vibration by construction machinery and vehicles are expected during the construction stage.