3.5.7 Study on Existing Water Supply System

(1) Whole Distribution System

1) Water Sources and Distribution Volume

Capacities of each WTP and water sources located in Tashkent City are shown in Table 3.5.39.

Table3.5.39 Capacity of WTP

Name	Capacity (cu.m/day)	Maximum Capacity (cu.m/day)	Water Sources
Boz-su	235,600	275,000	Boz-su Canal
Kadirya	1,375,000	1,831,000	Boz-su Canal
Kibray	455,200	478,000	Groundwater
Sergeri	40,000	40,000	Groundwater
Bektemir	25,000	25,000	Groundwater
Kara-Su	52,000	25,000	Groundwater
South	113,200	127,000	Groundwater
Total	2,296,000	2,801,000	

The water source of Boz-su and Kadriya WTP is located in Boz-su canal, downstream of the irrigation canal issued from Charvak Dam Lake and each intake water right of 3.19cu.m/sec (=275,616 cu.m/day) and 21.2cu.m/sec (1,831,680cu.m/day) was accepted.

Therefore, intake water volumes in Boz-su WTP and Kadirya WTP are possible to increase up to 1.17 times as much as facility capacity (275,616/235.600=1.17) and 1.33 times as much as facility capacity (1,831,680/1,375,000=1.33), respectively.

In summer season, intake water volume is virtually in line of full water intake right. Furthermore, the storage amount of Charvak Dam Lake is very huge with 2 billion cu.m. However, the water right from the lake is already settled with objectives for irrigation and electric power generation, etc.

River water being utilized as a source for water supply discharges to the Aral Sea. In order to have converted river water for irrigation and water supply with large quantity, water loss increased for transpiration and infiltration against underground. As a result, the surface area of the Aral Sea rapidly has shrinkaged by decrease of inflow water from river. Though the Aral Sea originally had had a little bit high salinity, the salinity became higher.

The increase of salinity in the lake water and utilization of pesticide for cotton cultivation has caused serious environmental problems in the periphery areas.

These conditions constrain the water right to expand and intake volumes of groundwater to largely increase.

Maximum capacity of WTP in the city was calculated considering the survey result of water supply volume and the water right and it was estimated about 2.8 million cu.m/day as shown in Table 3.5.39.

Figure D.3.5.5 is shown measured water distribution volume of Kadirya, Boz-su, Kibray and South WTP.

As a result, it is difficult to adopt values more than the water volume as mentioned the above as supply amount in Tashkent City.

2) Maximum Water Consumption Volume

Maximum daily water distribution volume per capita in Tashkent is Approximately 1,270L/cap/day because Population is 2.2million and maximum water distribution volume is about 2.8 million cu.m/day(=2.8lion/2.2million).

Furthermore, maximum daily water consumption of individual is estimated as average 650 liter/capita/day from the results of water consumption survey in detached houses and apartments.

Water consumption of large consumer as factories, stores, and semi-governmental corporation was about 500L/capita/day (distribution volume of Large consumer is Approximately 1.1 million cu.m/day on August). Therefore the leakage of transmission and distribution pipelines is calculated of 10 %.

These calculated results are summarized in Table 3.5.40.

Table 3.5.40 Water Consumption per Capita

Item	Volume L/cap/day	Rate(1) %	Rate(2) %
Maximum water distribution volume	1270	100.0	
Water leakage volume	120	9.4	
Maximum water consumption	1150	90.6	100.0
Individual water consumption	650	51.2	56.5
Large water consumption	500	39.4	43.5

3) Pipe-line Network and Location of Plants

Pipe-line networks of Tashkent City are designated as confidential information. Therefore, the details cannot be known. However, the outline of the entire pipeline networks can be supposed from the Figure3.5.11a Kadirya WTP and Kibray WTP located in the outside of the city play important roles from viewpoints of both the supply and the distribution amounts.

Kadirya WTP outlet and Boz-su WTP have the elevations of about 540 m and of about 480 m, respectively. On the other hand, Sergeri WTP locates at comparative low land south of the city. Kadirya and Boz-su WTPs locate at higher elevation sites with relative height of 60 m to 140 m than that of the urban areas of the city. These dispositions have advantage to be possible to be naturally distributed by gravity.

In addition, Kadirya WTP conveys treated water of 1,830,000 cu.m/day, full amount of water right to the city areas at the peak time of water consumption in summer season. This amount corresponds to 65 % (= 1,830,000/2,814,000) of total supply amount against the city.

Furthermore, Kadirya WTP also conveys treated water to Kibray WTP by gravity. Kibray WTP transmits treated water of about 840,000 cu.m/day to the city areas by pumped distribution system, which sums up treated amount of Kibray WTP and transmission amount from Kadirya WTP to Kibray WTP.

Kibray WTP is also located along the Chirchk River at higher elevation than that of Tashkent City but in lower elevation than that of Kadriya WTP and its location has advantage to naturally convey treated water by gravity.

Boz-su WTP has thirdly larger scale among the city's WTPs and its elevation is fairly high in the city areas as mentioned the above.

Though these facilities are rationally disposed, almost no distribution areas are virtually conveyed by gravity. Therefore, supply water is boosted by 92 booster pump stations.

These pump stations consume about 25 % of the total electricity consumption of Vodokanal and are operated and managed by 550 operators. Pump operations of these stations give the largest weight among those in the entire facilities in a viewpoint of operation and maintenance.

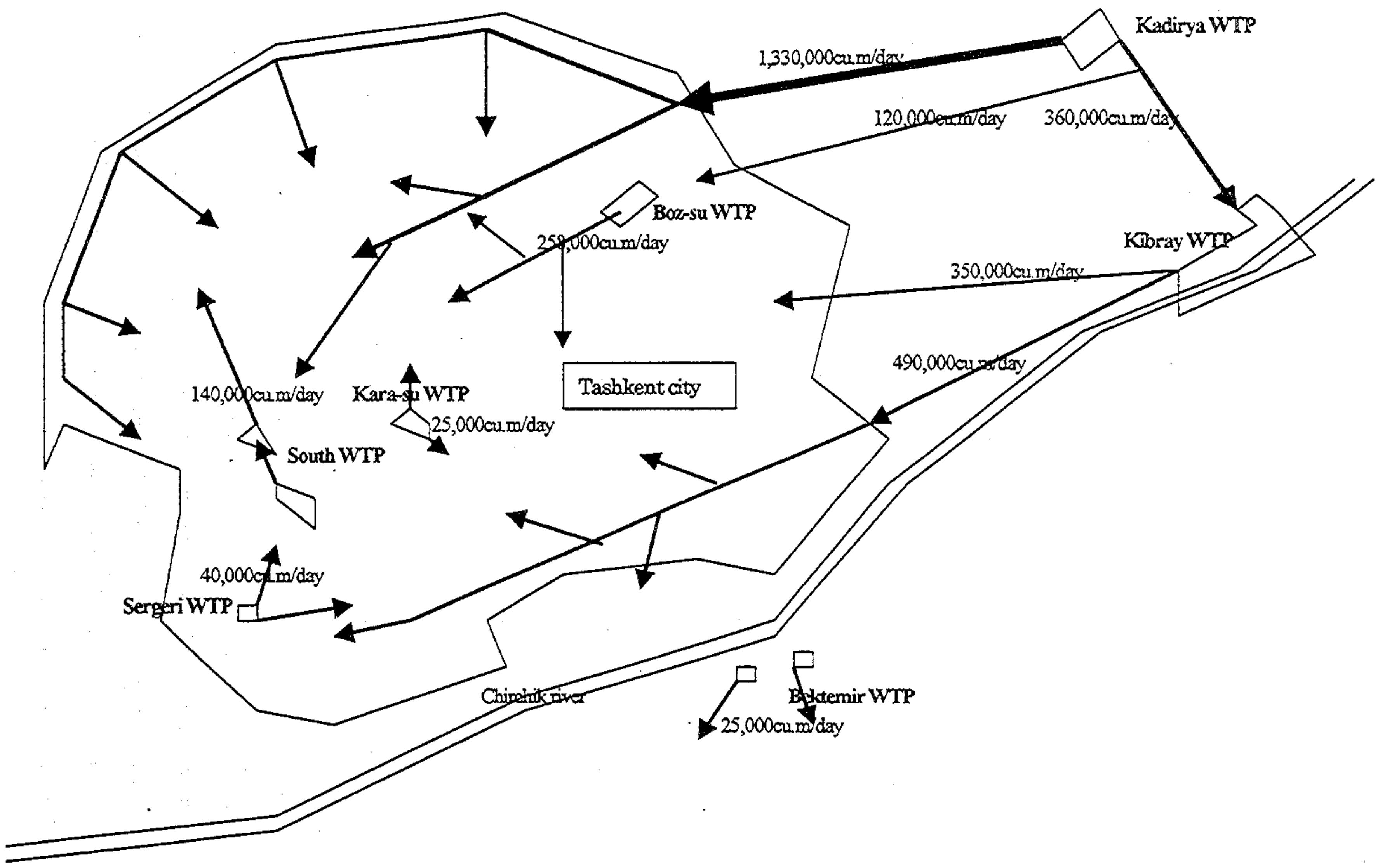


Figure 3.5.11a Water Supply System in Tashkent City

These facts are laid out as shown in Figure3.5.11b City water supply system generally boosts service reservoirs located at high elevation by pumps and distributes supply water by gravity. In Tashkent City, the system mostly conveys supply water by pumped distribution system. The layout map presents that detention time of reservoirs is very short with 1.7 hours.

In Tashkent City, booster pumps in the early stage after completing the water supply system were mostly not necessary. However, supply amount with the lapse of time has increased. It caused increase of the head loss in distribution pipelines and supply pressure reversely decreased. When the authority had alternating plans between the improvement of pipeline networks and construction of booster pump stations as a countermeasure to solve a low pressure problem in distribution pipes, they adopted to construct booster pump stations due to the low investment cost.

However, operation of the booster pumps can be judged uneconomically, evaluated budget balance in a long period between small investment cost and the large expenditures for electricity, personnel, and repair.

(2) Plants and These Facilities

1) Water Treatment Plants (WTP)

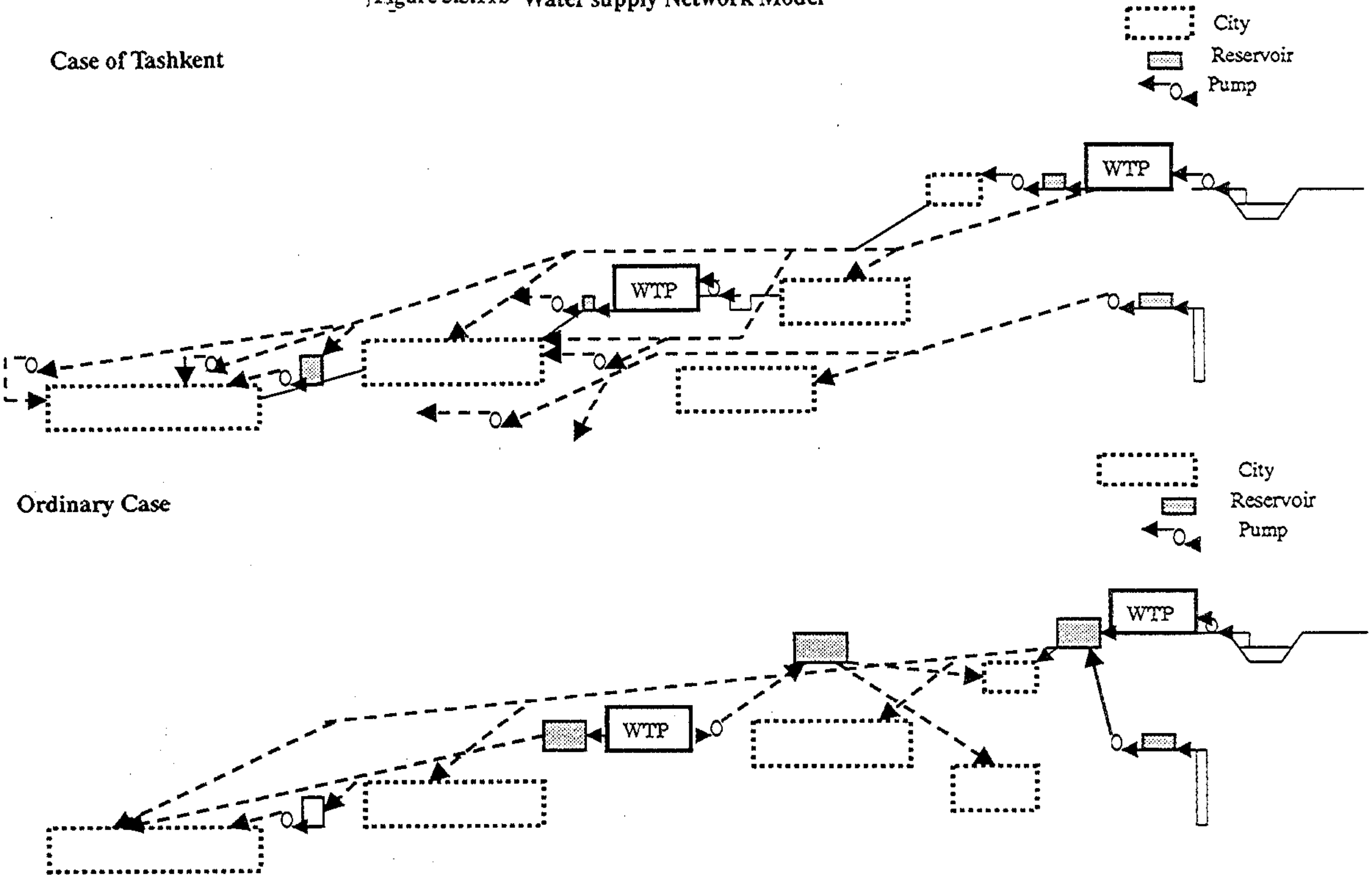
i) Kadirya WTP

a) Characteristic

Characteristics of Kadriya WTP are described below.

- Kadirya WTP completed in 1996 is the largest facility among the city systems. After completion, the system has repeatedly expanded to cope with the increase of water demand. At present, the plant has a huge treated capacity of 1,375,000 cu.m/day.
- Water source is lake water of Charvak Dam leading to Boz-su canal that has a vast storage but water right for water supply constrains to 1,830,000 cu.m/day.
- Kadirya WTP has a very simple treatment system as shown in Figure3.5.11c

Figure 3.5.11b Water supply Network Model



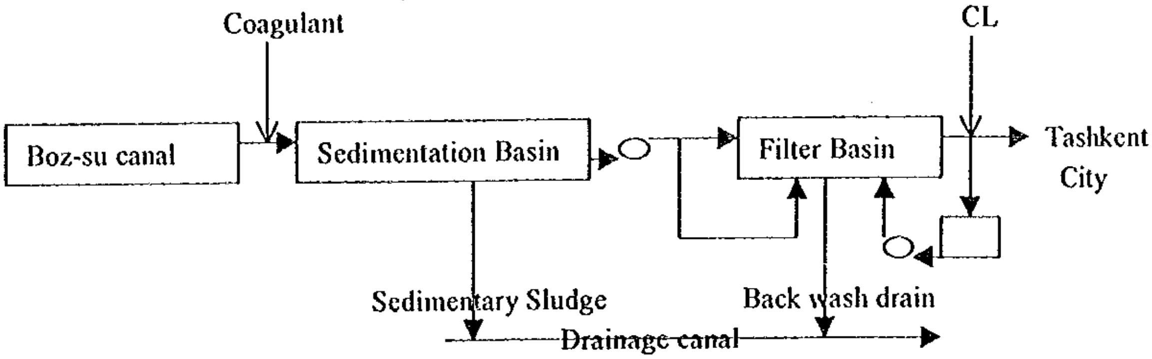


Figure 3.5.11c Flow Chart of Kadirya WTP

- Sedimentation basin has topographic structures which make use of old or artificial digging canals with a storage capacity of total 1.5 million cu.m. Sedimentation sludge is discharged to a drain canal by micro pump boat. Settled water is conveyed to the filter by the intake pump. The intake pumps are set in two lines as systems with intake pump capacity of about 1.6 million cu.m/day, namely the basin owns actual capacity of 200 % or more compared with facility capacity.
- Coagulant, aluminium sulfate is used for the system. The turbidity of raw water is comparative low. The coagulant is not injected to the basin if raw water keeps the drinking standard, 1.5 mg/litter.

As a common sense of Japanese water supply technology、rapid sand filtration method with filtration speed of 300 m/day such as this WTP is deemed not to be able to remove the turbidity if coagulant is not injected. However, water quality with less turbidity than 1.5 mg/litter in filtrated water in Uzbekistan can be got if the inflow turbidity in sedimentation basin is about 15 mg/litter.

Since water quality of raw water is good except for spring season, the system can be operated without the addition of coagulant during the numbers of days more than 70 % through a year.

- Washing of filter basin sand is conducted by using raw water when turbidity of raw water is low. Polluted water for washing is discharged to the drain canal.
- Chlorination is conducted by chlorine injection so as to come to a standard value ranging from 0.3 mg/litter to 0.5 mg/litter in residual chlorine concentration.

The average injection ratio is low with 0.7 mg/litter. This presents that raw water is not polluted.

- Treated water is basically and directly conveyed from the WTP to the city areas. Detention time of the reservoir is only 0.5 hour.

b) Problem

Facilities function and management problems are described below.

- Water supply system is in good maintenance condition but are generally deteriorated due to old facilities installed at the establish time.
- Automatic circuits of electric equipment are mostly out of order and are operated by manual. In addition, measurement equipment such as flow meters is also broken down.
- Detention time of the reservoir is 0.5 hour.

ii) Boz-su WTP

a) Characteristic

Characteristics of Boz-su WTP are described below.

- Boz-su WTP constructed in 1930 is the oldest facility among the city systems. The WTP has a treated facility capacity of 235,600 cu.m/day and intakes lake water of Chavak Dam through the Boz-su canal. The canal water is also used as a source of Kadriya WTP.
- Treated system is almost the same as that of Kadriya WTP as shown in the flow sheet of Figure 3.5.12.

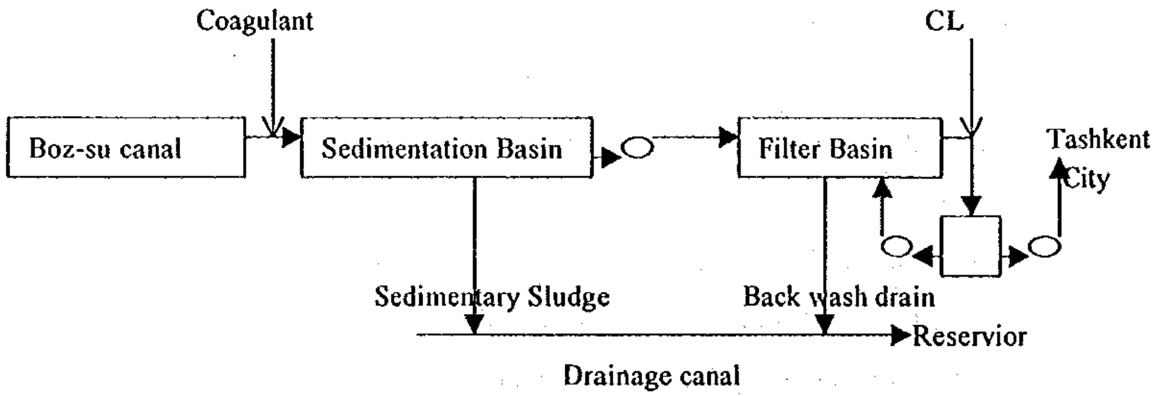


Figure 3.5.12 Flow Chart of Boz-su WTP

- Sedimentation basin has a topographic structure which makes use of artificial old canal with the stream. The sedimentation capacity is a total of 90,000 cu.m. Settled water is conveyed to the filter basin by the intake pump. Sedimentation sludge is discharged to the drain canal.

- Aluminium sulfate is used as a coagulant. However, the chemical is not injected if raw water keeps less turbidity standard value than 1.5 mg/litter due to the low turbidity of raw water.

  Since water quality of raw water is good except for spring season, the system can be operated without the addition of coagulant during the numbers of days more than 70 % through a year.
- Polluted water for washing is discharged to the drain canal.
- Chlorination is conducted by chlorine injection so as to come to standard value ranging from 0.3 mg/litter to 0.5 mg/litter in residual chlorine concentration. The average injection ratio is low with 0.7 mg/litter. This presents that raw water has not polluted.
- Treated water flows in the reservoir and is boosted by pumps. Detention time of the reservoir is 3.0 hours.

b) Problem

Facilities function and management problems are described below.

- Water supply system is in good maintenance condition but are generally deteriorated due to old facilities.
- Automatic circuits of electric equipment are mostly out of order and are operated by manual. In addition, measurement equipment such as flow meters is also broken down.
- Storage capacity of the reservoir is large and also has the function of drainage basin and its detention time is very small with 3.0 hours.

iii) Kibray WTP

a) Characteristic

Characteristics of Kibray WTP are described below.

- Kibray WTP is the largest groundwater treatment plant among the city systems. Facility treated capacity is 455,200 cu.m/day. Intake wells of 95 units are distributed in both sides of the Chirchik River.

- Well pumps of two types, submersible pumps and pumps on the ground are used.
- The WTP receives treated water of 270,000 to 360,000 cu.m/day from Kadirya WTP.
- The WTP has two pump stations. One transmits treated water from Kadirya WTP to the city areas with addition of pressure and the other conveys groundwater from Kibray WTP to the same areas.
- Detention time of the reservoir is only 0.5 hours and the reservoir functions only as a pump pit.

b) Problem

Facilities function and management problems are described below.

- Water supply system is in good maintenance condition but are generally deteriorated due to old facilities.
- Automatic circuits of electric equipment are mostly out of order and are operated by manual. Especially, a modernized graphic panel is installed in the control room but is not function.
- The reservoir also has the function as a distribution basin but its detention time is only 0.5 hours. In addition, a booster pump may be operated in dangerous no load condition due to manual operation.

iv) South WTP

a) Characteristic

Characteristics of South WTP are described below.

- South WTP is groundwater treatment plant. Planned facility treated capacity is 113,200 cu.m/day but actual maximum capacity is more than 140,000 cu.m/day.
- The WTP are divided into two sites. Secondary site is used as a wellfield. A part of well facilities directly convey groundwater to the Sergeri area.
- Well pumps of two types, submersible pumps and pumps on the ground are used.
- Pump stations have some pumps with high water head of 100 m which are used to convey groundwater to the Chiranzar area.
- Detention time of the reservoir is 2.0 hours and a water level meter only in this reservoir except for the other city systems is functioned

b) Problem

Facilities function and management problems are described below.

- Water supply system is in good maintenance condition but are generally deteriorated due to old facilities.
- Automatic circuits of electric equipment are mostly out of order and are operated by manual.
- The reservoir has the function as a distribution basin but its detention time is short with only 2.0 hours.

v) Sergeri, Kara-Su and Bektemir WTP

a) Characteristic

Sergeri, Kara-Su, and Bektemir WTPs located southwest of the city area function groundwater treatment plants and their characteristics are described below.

- Sergeri WTP has a treated capacity of 40,000 cu.m/day and the number of intake wells are not so many with 8 units. Therefore, pumping rate per a well is large. Detention time of the reservoir is 2.4 hours. The WTP controls water quality of Sergeri, Kara-Su, and Bektemir WTPs
- Kara-Su WTP has a planned facility treated capacity of 52,000 cu.m/day but actual capacity is about a half. There are 4 wells in the WTP area and other 8 wells in the outside of the WTP area. In addition, groundwater directly pressures from these wells to the distribution networks. Each well has a injection pump of chlorine solution.
- Bektemir WTP has a planned facility treated capacity of 25,000 cu.m/day and is divided into two sites. Each site has the reservior of detention time 2.6 hours, booster pumps, and several wells in the inside and the outside areas of the WTP.

b) Problem

Facilities function and management problems are described below.

- Water supply system is in good maintenance condition but are generally deteriorated due to old facilities.
- Automatic circuits of electric equipment are mostly out of order and are operated by manual.

・Kara-Su WTP is difficult to control operation because every wells directly convey groundwater to distribution-lines. Furthermore, appropriate chlorine injection control in each well is difficult to be conducted.

2) Pump Stations

i) Characteristic

Number of pump stations in Tashkent City are summed up 92 sites and are distributed in the whole city ares. The capacity of most pumps is small with less than 1,000 cu.m/hour. Pumps with special capacity of 3,000 cu.m/day is installed in 5 stations, with that of each one station of 7,000 cu.m/day and 30,000 cu.m/day.

Furthermore, most pump stations directly suck supply water from distribution pipelines and after that, it pressure supply water into distribution pipelines by pumps.

Only three pump stations of Mirzo-Ulugbek (30,000cu.m/hr) 、 CVRU(Chiranzar) (7,200cu.m/hr) Sergeri(3,000cu.m/hr) have the reservoirs and pumps of about 50 m water head.

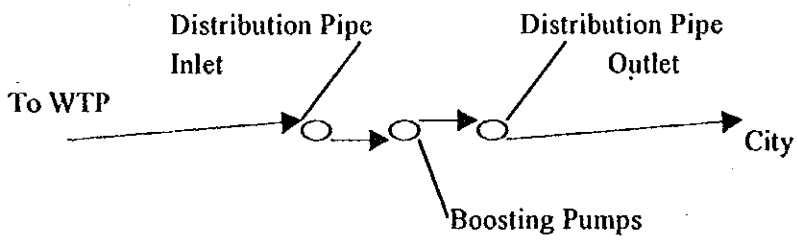


Figure 3.5.13 Schematic Diagram of General Pump Station System

ii) Problem

Facilities function and management problems are described below.

・Pump stations are not planned and installed based on the mid-term and long-term master plan and are constructed at random as a countermeasure for low pressure in distrubition pipelines.

・As an alternative plan of construction of pump stations, an expansion of distribution pipelines is planned. However, comparison of advantage shall not be conducted in long-term viewpoint. If distribution pipelines are appropriately disposed, pressure pump stations shall not be necessary.

- Since most pump stations have no reservoirs, the water supply system cannot control fluctuation of discharge. In this case, pump cavitation and negative pressure in distribution pipelines easily happen.
- small scale of pump stations are distributed in the city area and they are operated by manual. Therefore, 500 operators or more are necessary to manage the pump stations.
- Ratio of broken down pumps naturally increase due to long-term operation of many pumps.
- As a result of operation of many pumps, electrical expenditure increases.

(3) Water Supply Pipe-line Network

1) Pipe-line Network

i) Characteristic

Detail Plan of pipe line network in Tashkent City was not available due to political reason. Rough net-work plan is presented in Figure D.3.5.6 Total length of pipe-line in Tashkent City is approx. 3,650km and length by diameters and material are shown in Table D.3.5.2.

As shown in the table, 65 % of pipes were installed more than 20 years before while 34 % of them installed more than 30 years before. 31% of them were implemented 20 to 30 years before. Moreover, 67% are occupied by steel pipe with empiric life of 18 years and this makes problem serious.

In Japan steel pipe's durable years is 25 years and these pipes have outer and inner lining but in Tashkent and Chirchik City steel pipes don't have inner lining.

In this case it is proper that steel pipes durable years shall be set forth less than 20 years. Such steel pipe is used for portable water supply, it can be pipes easily rusted by high dissolved oxyzen and residual chlorine. Annual thickness reduction by corrosion will be 0.1 to 0.2mm.

In this condition, partial corrosion easily takes occurs due to potential electric difference. These corrosion can makes holes in pipes with thickness of 6 to 7 mm within 10 years.

Cast iron pipes is relatively hard to corrode and pipes are thick, but water leakage is frequently occurred in Tashkent. This is because of the applied connection method," faucet joint" that drive fiber into joint and block by lead. Therefore steel pipe is mostly adopted for new installation.

In Japan, ductile iron pipes and vinyl chloride pipes are used for water distribution, and few leakage is occurred due to rubber ring connection.

Table3.5.41 shows pipe length and accessories list by each district and decrepitude is accelerated not only in pipe-lines but also in these accessories. Many valves are not operational by corrosion of gears and Vodokanal is replacing them. Also it is dangerous because a lots of valve pits within the city don't have manhole covers.

Table 3.5.41 Pipe-line Accessories List

District	Length	Pits	Fire hydrants	Air Valves	Valves
Mirzo-Ulugbek	368,476	3,987	1,346	427	4,106
Shayhantour	425,312	3,387	1,192	780	3,283
Sobir Rahimov	336,230	2,840	1,164	418	2,791
Akmal Ikramov	385,314	3,438	1,652	222	2,992
Mirobod	219,193	1,904	657	388	1,857
Hamza	443,517	2,793	1,217	243	3,196
Unus Obod	528,341	4,140	1,424	787	4,411
Yakkasaray	205,964	1,713	568	262	1,628
Sergeri	278,556	2,283	853	127	2,447
Bektemir	22,932	137	25	-	138
Chilanzar	320,844	2,954	1,307	303	2,844
Total	3,534,679	29,576	11,405	3,957	29,693

ii) Problem

Problems of pipe-line network are described below.

- The intensive leakage of pipelines that cause to cut off water supply frequently occur (4,000 to 5,000 times per year).
- There are many old pipes and majority of pipe material is steel with low durability. Inner lining is not installed.
- " Faucet Joint" which causes leakage relatively easily, is adopted for connection of cast iron pipe.
- Decrepitude is accelerated not only in pipe-lines but also in valves and accessories. Many valves are non functioning.
- Many valve pits have no manhole cover and it's dangerous.

2) Pipe-line Network and PSs

i) Relation with Pipe-line and PSs

Pipe-line network and PS are in mutual relationship.

Booster PS is needed to mitigate low water pressure caused by insufficient flow capacity of pipe-lines.

Ordinary diameter and route(grade, length) of distribution pipe-line is decided for gravity flow so that booster PS is not necessary. In some cases, construction of booster PS is economical than enlargement or replacement of pipes.

However, construction of many small PS increases O&M, electricity and repair cost, therefore reexamination of pipe diameter and route enlargement or replacement of pipe-lines might be economical in long term span.

As aforementioned, real daily consumption of residents in Tashkent shall be nearly same as Japan, by enligtening residents to avoid wasting water and by installation of water meters, water consumption will be decreased sharply.

Reexamination of pipeline network and location of PS should be conducted in consideration of these reduction effects.

ii) Problem

Problem of pipe-line network and PSs are described below.

- Generally, enlargement or replace large pipes are economical as long team countermeasure for shortage of flow capacity of pipe-line but booster PSs were constructed.
- Water supply system is expanding only to cope with ceaselessly increasing water demand without any measures to reduce water consumption, such water leakage prevention.

(4) Water Volume and Quality Control and O&M

1) Water Volume Control

Flow balance of whole Tashkent City is shown in Figure D.3.5.7.

As shown in the figure, trunk flows are started from Kadirya WTP to city and relative large flows are also started form Kibray and Boz-su WTP. In general, water is flowing from east to west.

Pressure balance of distribution pipe-line in the city is shown in Figure D.3.5.8, many low pressure zones can be seen. Although distribution volume of Tashkent City changes by seasons to some degree, daily and hourly distribution volume is almost constant. This is because there is

huge volume of water leakage in housings and buildings of consumer. Excess distribution volume will rise the water pressure and leakage volume, free from system damage.
However, when distribution volume is too small, water pressure will be decreased and negative pressure might occur at the suction of booster PS. This means that excessive volume shall be always distributed to prevent the system damage.

i) Surface Water WTP

In Tashkent, operating number of pumps controls distribution volume. Seasonal pump operation pattern is already scheduled by type and number of pumps. Kadirya and Boz-su WTPs are important facilities which supply 70% of total water demand.

a) Kadirya WTP

Since Kadirya WTP supplies water to city by gravity, there's no measure to confirm whether the distribution volume is adequate or not. Then, based on the seasonal basic distribution volume, volume control is performed by monitoring pressures in major distribution points, including Vodacanal office, and adjusts pressure by regulating distribution volume from the plant.

b) Boz-su WTP

Boz-su WTP supplies water by pumping and thus distribution pressure can be an index to determine whether the distribution volume is adequate or not. Distribution pressure is controlled by distribution PS and booster PS in the city.

ii) Groundwater WTP

Excluding Kibray WTP, Groundwater WTPs supply relatively small amount of water only to the surrounding areas. Therefore, these WTPs control groundwater and distribution pump by scheduled seasonal operational pattern. Including the distribution volume from Kadirya WTP, Kibray WTP supplies 800,000 cu.m/day of water to whole southern part of the city. It is important facility but its distribution operation is almost constant throughout a year.

iii) Distribution Network

In distribution network, no volume control is attempted basically. Though there are some large scaled booster PS, such as Mirzo-Ulugbek PS, they don't have any volume control function due to their limited reservoir capacity. They only pumped water conveyed from WTPs.

2) Water Quality Control

i) Drinking Water Quality Standard

WHO Guideline for drinking water quality are shown in Table 3.5.4 (1)~(3). This guideline is very severe for the indices that harmful for human body while, it is generous for the indices non-toxic but represents comfort. Recently, many indices were added after the confirmation of existence and toxicity of organic compounds.

Table 3.5.42 shows water quality analysis indices measured by both Tashkent and Chirchik Vodacanal on surface and ground water, respectively.

In these tables, standards of Uzbekistan, WHO, Japan are also indicated. Although there are no remarkable differences between each standard, adopted indices are different.

Uzbekistan standard doesn't include organic chloride compounds and agricultural chemicals. Considering the Aral Sea's contamination by agricultural chemical, it might be serious problem in future environmental preservation. However, since Tashkent and Chirchik City are located in most upstream of the river basin, there will be no influence by this contamination.

On general indices and metal, Uzbekistan standard seems appropriate compared with international standard.

Present problems are as follows :

a) There are no standards for organic chloride compounds and agricultural chemicals, which have become international problems.

b) Since these compounds needs microanalysis, analysis is difficult and analysis equipment is also highly advanced. They can't be analyzed by existing equipment in Tashkent.

ii) Surface Water WTP

As surface water WTP, there are Kadirya WTP and Boz-su WTP. Both of them adopted sedimentation + rapid filter method and rapid filter has two-story structure with capacity of 300 m/sq.m/day.

Table 3.5.42 Analyzing Item in Tashkent and Chirchik

No.	Item	Unit	Criteria			Analyzing Item			
			Uzbekistan	WHO	Japan	Tashkent		Chirchik	
						Surface	Graound	Surface	Graound
1	Temperature					○	○	○	○
2	Colour		20	(15)	5	○	○	○	○
3	Taste		2	--	Normal	○	○	○	○
4	Odour		2	--	(3)	○	○	○	○
5	Turbidity	mg/L	1.5	(5)	2,(0.1)	○	○	○	○
6	pH		6 to 9		5.8-8.5	○	○	○	○
7	Chlorine rest	mg/L	0.3-0.5	<5	<1,>0.2	○	○	○	○
8	Aluminium rest	mg/L	0.5	(0.2)	(0.2)	○	○	△	
9	Ammonia	mg/L	Non	(1.5)	Non	○	○	○	○
10	Hardness	mol/L	7		300*1	○	○	○	○
11	Alkalinity	mg/L				○	○	○	○
12	Nitrite	mg/L	45	50	Total	○	○	○	○
13	Nitrate	mg/L			0.05*2	○	○	○	○
14	Chloride	mg/L	350	250	200	○	○	○	○
15	Sulfate	mg/L	500	(250)		○	○	○	○
16	Fluoride	mg/L	1.5	1.5	0.8	○	○	○	○
17	Iron	mg/L	0.02	(0.3)	0.3	○	○	○	○
18	Solid total dissolved	mg/L	1000	(1000)	500	○	○	○	○
19	Colonies quantity		<100	Coliform	Coliform	○	○	○	○
20	Coli- index				<100	○	○	○	○
21	Copper	mg/L	1	2	1	○	○	○	○
22	Molibdenium	mg/L	0.25	0.07	0.07		○	○	○
23	Polyphosphates	mg/L	3.5			○	○	○	
24	Orthophosphates	mg/L					○		
25	Zinc	mg/L	5	(3)	1	○	○	○	○
26	Lead	mg/L	0.03	0.01	0.05	○	○	○	○
27	Arsenic	mg/L	0.05	0.01	0.01	○	○	○	○
28	Manganesum	mg/L	0.1	0.5	0.05	○	○	○	○
29	Phenol	mg/L			0.005		○		
30	Chrome	mg/L		0.05	0.05	○	○		
31	BOD	mg/L				△		○	
32	Oxigen Ability	mg/L			10(3)			○	○
33	Oxigen dissolved	mg/L				△		○	
34	Transparacy	mg/L				○			
35	Calcium	mg/L						○	○
36	Magnesium	mg/L						○	○
37	Chlorine Demand	mg/L						○	○
38	Radiation			α, β		○	○		

○: Analizing *1: mg/L
△: Exisiting Item but No analizin; *2: Nitrite-nitrogen
WHO:( )Needful for drink
Japan:( )Disirable value

In sedimentation + rapid filter method, set up of coagulant dosage rate is the important point. In Uzbekistan, minimum dosage rate enables standard turbidity of filtered effluent, less than 1.5 mg/L, is adopted. So about half of the year, when turbidity of raw water is low, coagulant dosage is not performed.

Economical operation needs set up of these minimum dosage rates according to the raw water quality, water quality analysis shall be done precisely and strictly.

If coagulant is not used, diameter of turbid materials will be several μ mm and such turbidity can not be removed by existing filter materials with diameter of 2.3～3 mm (upper layer) and 0.6～2 mm (lower layer).

But actually raw water turbidity of 10 mg/L is reduced to 1.5 mg/L in Kadirya WTP and Bozsu WTP. In Uzbekistan, back-washing rate is 20 m/hr. It's very low compared with Japanese case and in such rate filter materials will not be suspended. It is supposed that this low back-washing rate have created filters with high capture capacity.

Since this system needs such a delicate adjustment, coagulation and filtration process is controlled by chemical dosage rate based on most efficient indices, turbidity of filtered effluent analyzed on every 1 to 3 hours. As to chlorine, residual chlorine is also measured frequently to comply with appropriate concentration.

Water quality analysis was conducted on treated water from Kadirya WTP which was sampled in city. Samples were sent to the laboratory of Kadirya WTP and Japanese laboratory. The results are shown in Table 3.5.43 and Japanese one is furnished with public certification.

As to water quality there are few problem but as to turbidity analyzed in Japan, it exceeds the standard. This might be happened by difference between analysis methods in Japan and in Uzbekistan or by changes in water quality during the transportation to Japan.

While pH is high, Langelier's index is negative. This means that the water is corrosive and seemed to be affected by free carbonic acid.

Problems in surface WTP are as follows :

a) Ordinary, rapid filter is operated without coagulant dosage even though the turbidity removal efficiency is reduced. So, plant operation shall be conducted with close monitoring to turbidity of filtered water, to comply with the standard, 1.5 mg/L.

Table 3.5.43 Analyzed Result of Distribution Water in Kadirya WTP

No.	Item	Unit	Uzbekistan criteria	By Kadirya WTP	Japanese criteria	By Japanese laboratory
1	Temperature			16.5		
2	Colour		20	0	5	2
3	Taste			0	Normal	Normal
4	Odour			0	Normal	Normal
5	Turbidity	mg/L	1.5	0.8	2	2.7
6	pH		6 to 9	8	5.8-8.5	7.7
7	Chlorine rest	mg/L	0.3-0.5	0.34	0.2<,<1	<0.1
8	Aluminium rest	mg/L	0.5		0.2	0.03
9	Ammonia	mg/L	Non	0		
10	Hardness	mg/L	7	1.96		
11	Hardness(as CaCo3)	mg/L			300	94
12	Alkalinity	mg/L		1.45		
13	Nitrite	mg/L	45	0		
14	Nitrate	mg/L		1.99		
15	Chloride	mg/L		3.24		
16	Chrorine ion	mg/L			200	1
17	Sulfate	mg/L	500	6.9		
18	Fluoride	mg/L	1.5	0.14		
19	Iron	mg/L	0.02	0.12	0.3	<0.03
20	Solid total dissolved	mg/L	1000	112	500	108
21	Colonies quantity		<100			
22	Coli- index			2		
23	Coliform count				Non	Non
24	Total colonies	Number/mL		2	100	14
25	Copper	mg/L	1	0.075	1	<0.1
26	Molibdenium	mg/L	0.25	0		
27	Polyphosphates	mg/L	3.5	0.01		
28	Orthophosphates	mg/L				
29	Zinc	mg/L	5	0	1	<0.1
30	Lead	mg/L	0.03	0		
31	Arsenic	mg/L	0.05	0		
32	Manganesum	mg/L	0.1	0	0.05	<0.005
33	Phenol	mg/L			0.2	<0.05
34	Chrome	mg/L				
35	Magnium	mg/L				
36	Calcium	mg/L				
37	Free carbon dioxide	mg/L			20	7.5
38	Sodium	mg/L			200	1.6
39	BOD	mg/L				
40	Anion surface active agent	mg/L			0.2	<0.02
41	Oxigen dissolved	mg/L				
42	Potassium permaganate	mg/L			10	1.5
43	Oxidity	mg/L				
44	Langerlier's index	mg/L			>-1	-0.3

b) Analysis results will be reflected on coagulant dosage rate but since retention time of sedimentation tank is long, it will take time until coagulant effect appears.

c) The same person who conducted water quality analysis will order the change in operation. This means "water quality controller" is also acting as "operation supervisor". Thus, there will be no "mutual monitoring effects".

d) The existence or concentration of agricultural chemicals and organic chloride compounds shall be examined.

iii) Groundwater WTP

As to groundwater, quality can be controlled by a) chlorine dosage rate and b) prevention of over-pumping. However, since there will be no possibility of saline water intrusion in Tashkent, case b) can be omitted and thus, only case a) shall be controlled strictly.

In most WTPs, residual chlorine is monitored by every hour to reflect on chlorine dosage operation, so it can be said that pumped groundwater quality is properly controlled. As to water quality indices, there are no problems. Nevertheless, the followings can be pointed out :

a) Existence or concentration of organic chlorine compounds shall be examined.

b) In case of Kara-Su WTP, solid chlorine is dissolved and injected into wells. In such cases, standards are needed to maintain proper dosage amount.

iv) Distribution Network

In Tashkent city, there are many quantitative problems, rather than qualitative ones, in distribution network. Problems are caused by corrosion and leakage in steel pipes which has no inner lining. Problems are as follows:

a) As shown in Table 3.5.43, treated water of Kadirya WTP meet the Uzbekistan water quality standard. However, steel pipe is rusted therefore distributed water becomes rusty color.

b) Injected chlorine is consumed by rust for the sake of non inner lining not used for disinfection. Sanitary safety is endangered and epidemic danger is risen.

c) Above-mentioned effects is accelerated by water supply interruption caused by low water pressure and leakage repair works.

3) O&M

i) Staff of Tashkent Water Supply System

Table 3.5.44 shows the comparison of number of staff engaged in water supply management in Tashkent and Japanese large-scale cities having the population exceeding one million (source : "Large-scale City Management Guidelines" Yokohama City Water Works Bureau). As shown in the table, Tashkent has three times of staff per population, two times per distribution volume compared with Japanese cities.

Table3.5.44 Comparison of Number of Staff in Japanese Large-scale Cities with Tashkent

No.	Item		Yoko-hama	Sapporo	Sendai	Toukyo	Kawasaki	Nagoya	Kyoto	Average	Tashkent
1	Population ×1000		3,660	1,840	1,283	11,303	1,316	2,313	1,598	3,330	2,200
2	Distribution Volume cu.m/d ×1000		1,781	785	506	6,960	1,026	1,424	1,050	1,933	2,296
3	Staff	Total	2,553	872	555	5,561	971	1,788	1,059	1,908	
4		Intake	107	0	5	178	24	36	37	55	
5		WTP	302	125	132	797	129	220	183	270	
6		Distribu-tion	450	114	91	1,389	195	566	127	419	
7		Control and repairTotal	859	239	228	2,364	348	822	347	744	1,695
		1/7	4,261	7,699	5,627	4,781	3,782	2,814	4,605	4,796	1,298
		2/7	2,073	3,285	2,219	2,944	2,948	1,732	3,026	2,604	1,355

ii) WTP

Within limited budget, O&M activities are conducted. Especially machinery, such as pumps, is well maintained. However, many electrical instruments, such as automatic pump operator, flow measure, water level indicator, which deemed indispensable for WTP's operation, are left non-functioning. Thus, plant operation is managed by manual that needs more staff. Since they are not automated, many staff is necessary even during nighttime.

Existing problems are as follows:

a) Automation is not introduced even initial level operation, such as auto ON-OFF pump operation by electrode. So, there's high possibility that operator's decision mistake might cause accident. Large number of operation supervisor is needed therefore.

b) There's tendency that malfunction in electric instruments are left non-functioning.

c) It's hard to operate the plants to cope with hourly demand fluctuation.

iii) PS

There are over 600 staffs operating PSs, including Sergeri PS. Since none of them are automated, one mechanic and one electrician must be allocated in day/night shifts to even the smallest PS and this makes number of staff large.

Problems are as follows :

a) Unmanned operation is impossible since pump operation is not automated.

b) Although machinery is already deteriorated, there maintenance is not well as WTPs. Most of them are left not repaired.

c) As to electric instruments, many of them are left non-functioning.

iv) Pipeline Network

Maintenance of pipe-line is annually conducted every winter and spring. They check the length of 120 km together with valves, repair and replace the pipes if needed, repair the leakage portion mainly based on claims from hot water company.

However, pipe repair and reinstallation budget in 1999 was only 10,000,000 sum, which must be said underestimated for Tashkent Vodokanal having pipe-line with total length of over 3,600 km.

Existence of many booster PSs means the hydraulic inappropriateness of pipe-line, after all.

Problems are as follows :

a) No sufficient budget for repair, investigation and replacement of deteriorated pipe.

b) Superannuated pipes that passed over 50 years from their installation needs systematic survey and replacement. Even though partially carried out, it's not enough.

c) Review of overall pipeline allocation and preparation of reallocation plan is needed.

3.5.8 Progress and Improvement for Water Supply System

(1) Reduction of Water Consumption

1) Prevention of Leakage

i) In-house leakage

Water consumption shall be reduced to deduct in-house leakage both in Tashkent and Chirchik. As aforementioned, actual water consumption in ordinary household is 350 L/cap/day at daily maximum but meter reading is over 600 L/cap/day. This is caused by in-house leakage mainly from toilet.

Through campaign is needed to raise the residents' awareness and to let them know that "you will lose your money if you don't lessen your in-house leakage". Although water meter installation will be the most effective and reliable countermeasure, it will take time. Emergency measure shall also be prepared.

ii) Office Leakage (Large Consumer)

In school and governmental offices must have large volume of leakage. Large percentage of enterprises, paying higher water tariff, are not equipped with water meters and leakage is also deemed large. Leakage prevention measures shall be taken immediately.

iii) Road Leakage (Pipeline)

Leakage from roads is still occupies large percentage of total leakage volume. Introduction of leakage detector is needed for effective detection of leakage points and repair works. Replacement plan shall be prepared, for instance ; all steel pipes passed 50 years after their installation must be replaced.

2) Ban of waste

This problem will naturally be solved if water meter reading is carried out certainly. Inclined tariff system can be adopted for high income levels. Campaign fro, viewpoint of water resources preservation is also important.

(2) Plants and these Location

1) WTP

There are no inappropriateness in composition and structure of the plants. Allocation of plants, including the largest Kibray WTP, proper and they are is convenient location and elevation for water supply. However, some improvement is necessary for the followings, I) capacity expansion of reservoir, ii) acceleration of automation and iii) grasp of distribution volume, chemical dosage, storage volume and so on. Each items will be explained below:

i) Capacity Expansion of Reservoir

At present, small capacity and non-automation of reservoirs doesn't make any inconvenience in Tashkent city, since supplied volume from WTPs is almost constant. However, if large hourly water demand fluctuation appears resulting from countermeasures described in clause (1), the existing facilities can't cope with it.

Assuming that hourly demand fluctuation corresponds to total daily average demand, appropriate capacity of reservoir can be calculated as 8 to 12 hours' retention time, according to the Japanese facility design guideline. Considering the present retention time of 1.58 hours, it is recommended that tentative retention time shall be set as 4 hours and then 6 to 8 hours, gradually.

Figure D.3.5.12 shows the deference between daily average demand and hourly fluctuated demand and its accumulation in case of daily average demand of 1,000 cu.m/hr and hourly maximum demand of 2,000 cu.m/hr.

As shown in the figure, if hourly maximum demand is appropriately 2 times of daily average demand, reservoir can supply water constantly with retention time of 6 hours receiving water from WTP, constantly daily average demand. If retention time is 4 hours, supply volume from WTP shall be increased to 1.1 times of daily average demand.

Excluding Kadirya WTP, treated water is pumped from every WTP to reservoirs. Basically, these reservoirs shall be considered as "pump pit" and their capacity calculated by retention time (0.5 hour each) shall be omitted from total reservoir capacity.

Based on above concept, necessary reservoir capacity was calculated in Table 3.5.45 (1) and capacities to be expanded were also calculated by retention time of 4, 6 and 8 hours. They are indicated in Table 3.5.45 (2).

Allocation plan was prepared for the retention time of 4 hours. Proposed site was selected within the site of Kadiya, Boz-su and Kibray WTP, since there's no need to rearrange the existing structures. They are shown in Figure D.5.5.13.

Table 3.5.45 (1) Effective Volume of Reservoir

Name	Capacity Cu.m/day	Reservoir volume cu.m	1/2hr Cu.m	Effective volume cu.m
Boz-su	236,600	29,900	5,000	24,900
Kadirya	1,375,000	30,000	30,000	0
Kibray	455,200	10,000	9,500	500
Sergeri	40,000	4,000	900	3,100
Bektemir	25,000	2,750	550	2,200
Kara-Su	52,000	0	1,100	
South	113,200	10,000	2,400	7,600
Mirz Uzbek	(30,000)	25,000	650	24,350
Chiranzar	(7,200)	25,000	150	24,850
Sergeri	(3,000)	12,000	70	11,930
WTP	2,261,000			99,430
				↓
				100,000

Table 3.5.45 (2) Needed constructing reservoir volume

Detention time (hours)	Needed volume	Needed constructing volume
4	300,000	200,000
6	400,000	300,000

ii) Acceleration of Automation

As aforementioned, expansion of reservoir capacity and automatic pump operation is indispensable to cope with fluctuated distribution volume. In concrete, automatic pump ON-OFF operation according to the water level is needed for surface WTP, shown in Figure3.5.14. Although this automation is simple as system, in case of self-priming pump requires large initial power, some electrical devices might be needed to lower this. In case of groundwater WTP, automation will be as shown in Figure 3.5.15.

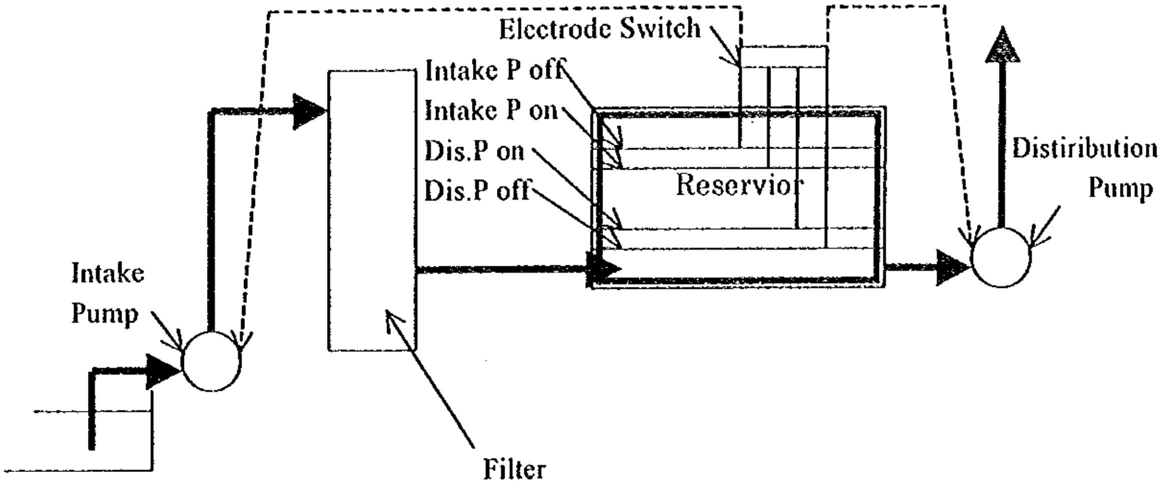


Figure 3.5.14 Automatic Operation of Pumps in Surface Water WTP

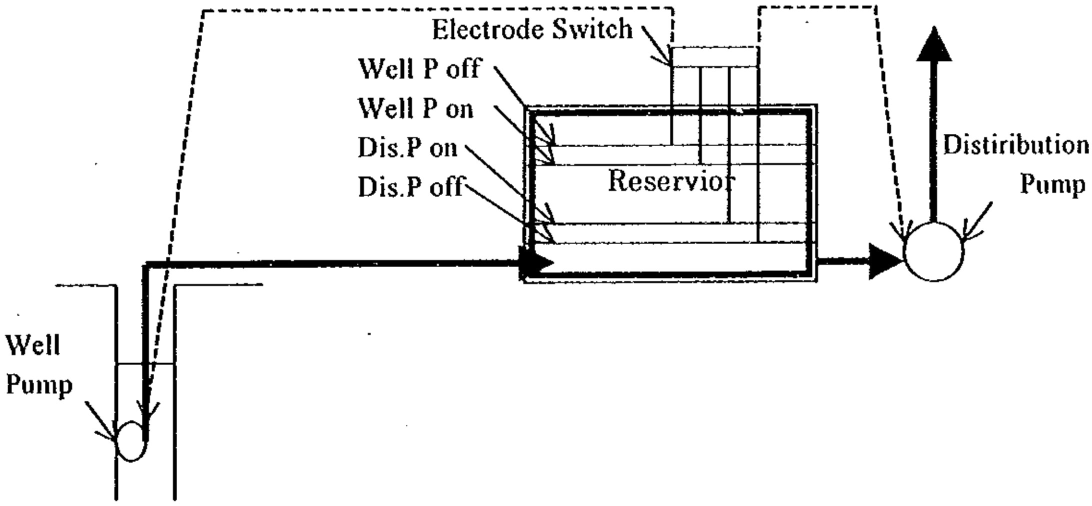


Figure 3.5.15 Automatic Operation of Pumps in Groundwater WTP

iii) Grasp of Information for Control

a) Distribution Volume

As water flow meters were already installed in major distribution trunks, electric instruments shall be rearranged for precise measurement. Recorder and integrating meter shall also be installed.

b) Chemical Dosage

As to coagulant, flow meter with eye measurement is needed at least. In case of Boz-su WTP with gravity system, weir type flow meter is applicable while, direct reading type flow meter can be adopted in WTPs with pumped system, such as Kadirya, to allow punctual monitoring of dosage rate.

c) Storage Volume

Water level indicator shall be installed in important reservoir. Mechanical type is applicable also but electrical type is preferable because water level can be monitored in control room. Since there are plural chemical storage tanks in Boz-su and Kadirya WTPs, indicator that shows some signal when tank is empty shall be installed in each tank.

d) Water Pressure in the City

The water pressure in the city is needed for operation of WTP because distribution volume of each distribution pipes shall be decided by this information.

Therefore pressure in major points in the city shall be measured and informed to WTP this measured value hourly at least.

2) Distribution System

The most needed examination for the existing distribution system is to review the present system to study the possibility of gravity water supply and necessity of PS, assuming that water demand in households and offices will be decreased resulting from countermeasures described later. In long-term span, pipeline network which makes booster PS unnecessary shall be designed and formulated.

Variable elements are as follows :

i) Population and per capita water consumption

ii) In house, office and road leakage

As results, per capita water consumption will decrease and hourly fluctuation will be come larger (See Figure D.3.5.12) .

At present system, apartment house has no elevated tank and water is directly supplied by pumping. This caused high water pressure and made number of booster PS large.

Although booster PS for apartment is still constructed, economical examination shall be carried out to determine which is efficient ; elevated tank or Booster PS.

PS with reservoir shall be automated by electrode switch and booster PS shall be automated by pressure switch installed on incoming and outgoing pipelines. However, since pressure switch is unstable, it shall be operated carefully.

3) Pipeline Network

AS aforementioned, pipe-line shall be reviewed by future distribution volume. Considering the pipe material, some of the existing pipes shall be replaced immediately. So, long term replacement plan shall be prepared and implemented.

Table D.3.5.5 shows replacement plan according to the age of pipeline. Although in Uzbekistan, it is said that durable year of steel pipe is 18 years and of cast iron pipe is 42 years, adopted durable year in the table was 30 years for steel pipe and 50 years for cast iron pipe. By this assumption, annual replacement pipe length is less than 100 km, well balanced.

(3) Proposed Improvement for O&M

1) Plants

i) WTP

As a whole, number of maintenance staffs in WTPs are large, facilities are all manual operated and repair works are also carried out by themselves, it can't be said "excessive" indiscriminately. Further, since labor cost is low and it corresponds only 10 % of total O & M cost, it is not a big burden as of now. Aside from the above-mentioned issue, there are the following items to be solved ;

a) Not only machinery, but also electric instruments, such as automation circuit and flow meter, shall properly be maintained for daily use.

b) Present coagulation operation too much stuck to economical efficiency and the turbidity of treated water is always close to the effluent standard. Coagulant injection is needed to assure better effluent quality.

c) As to the maintenance of equipment, the basic method is "repair if they are broken". Preventive maintenance, which replaces worn out parts in daily maintenance work to prevent future break down, is preferable.

ii) Distribution System

As to PSs in distribution system, issues are almost the same as above. The followings are the points to be improved ;

a) Due to the shortage of budget, malfunctioning stand-by units are apt to be left as they are.

These stand-by units shall be immediately repaired to secure stable operation.

b) Electric instruments, such as automation circuits and flow meter, shall be appropriately maintained for daily use.

c) As to the maintenance of equipment, the basic method is "repair if they are broken". Preventive maintenance, which replaces worn out parts in daily maintenance work to prevent future break down, is preferable.

2) Water Supply Pipe-line Network

i) Distribution Pipe-line

Pipe-line is inspected annually by 120 km per year. When leakage is located, repair work is conducted immediately. However, as leakage detector is not equipped, road excavation volume is apt to be large.

The followings are the points to be improved ;

a) Leakage detector shall be introduced for more efficient repair work.

b) Preparation and implementation of leakage detection plan is needed.

c) Replacement plan based on the results of leakage detection plan shall be established.

ii) Water Consumer

Prevention of in-house, office leakage and ban of waste is the largest theme of Tashkent city Vodokanal.

In concrete, the following improvement is needed ;

a) Conference for emergency countermeasure against in-house leakage

b) Actual leakage status survey in apartment and detached houses

c) Water usage survey in large scale consuming houses

d) Water usage survey in houses where water meter reading is extremely small.

e) Improvement in water supply appurtenance in housing and water conservation campaign

f) Prepare countermeasures for water supply appurtenance (soft and hard aspects)

g) Standardization of water meter installation (with structure allows convenient and reliable meter reading)

h) Acceleration of water meter installation

3.6 Summary of Water Supply Services in Tashkent City Vodokanal

3.6.1 Major Issues

With respect to the current issues regarding the situation of Tashkent City Vodokanal mentioned so far in Chapter 3, the future scenarios anticipated can be summarized as shown in Figures 3.6.1. Also, these current issues can be tackled at both the central and local government level.

(1) Management Problems

1) High Volume of Water Consumption by the Population

The current water consumption in Tashkent as a whole, including consumption by industries, exceeds 1000 liters per capita per day. In particular, the results of the study showed that the general public consumes 661 liters per day. This figure far exceeds the level of the daily worldwide standard, which is 200 to 250 liters. A leading cause for this is the water leakage (waste of water) in residential premises including toilets. To tackle this problem, a plan is now underway to install meters in all households. However this plan has not worked out effectively as it puts an enormous load on the users. This burden also applies to the users in individual houses and meters have not been installed in most of apartment buildings.

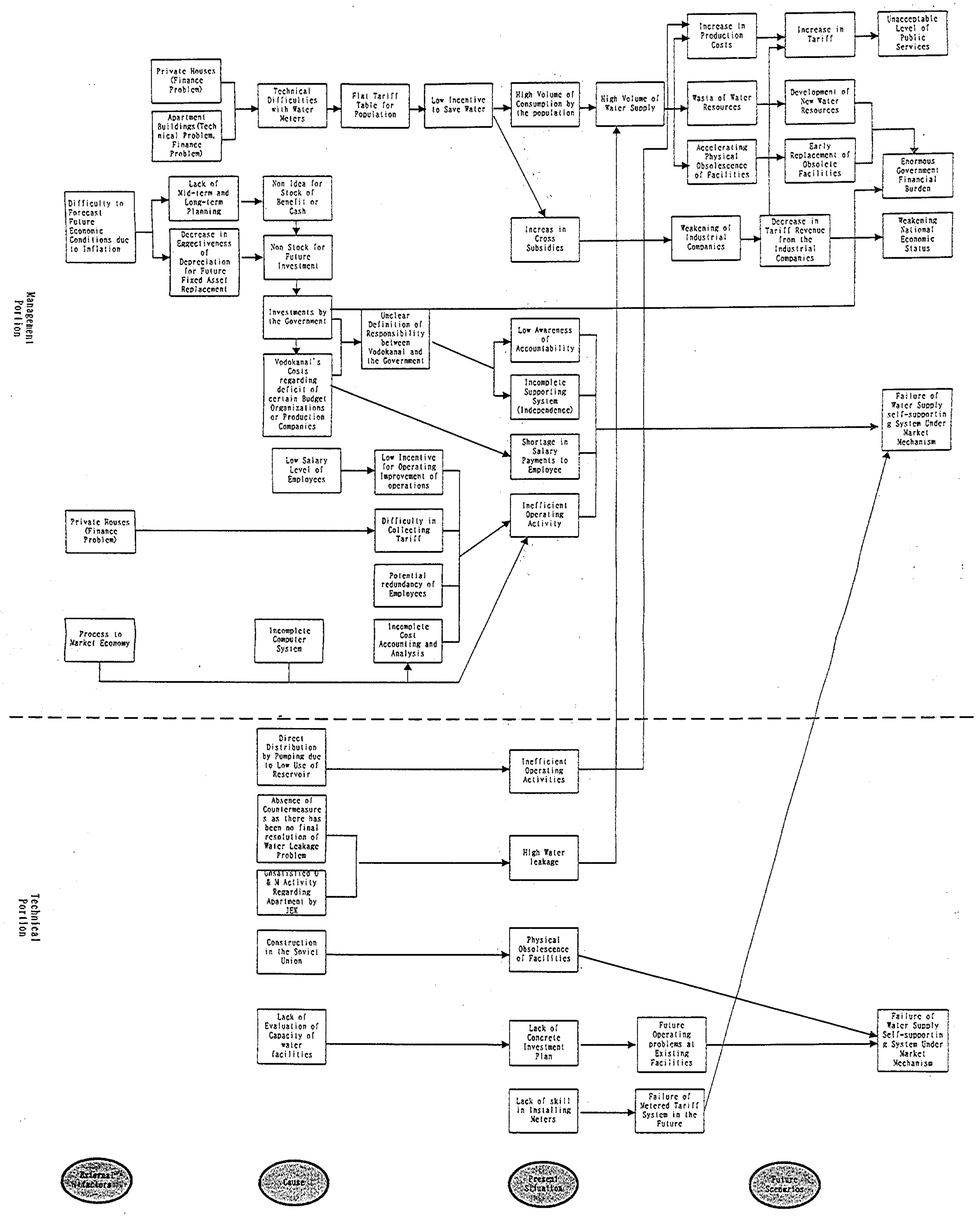


Figure 3.6.1 Issues of Water Supply Services – Tashkent

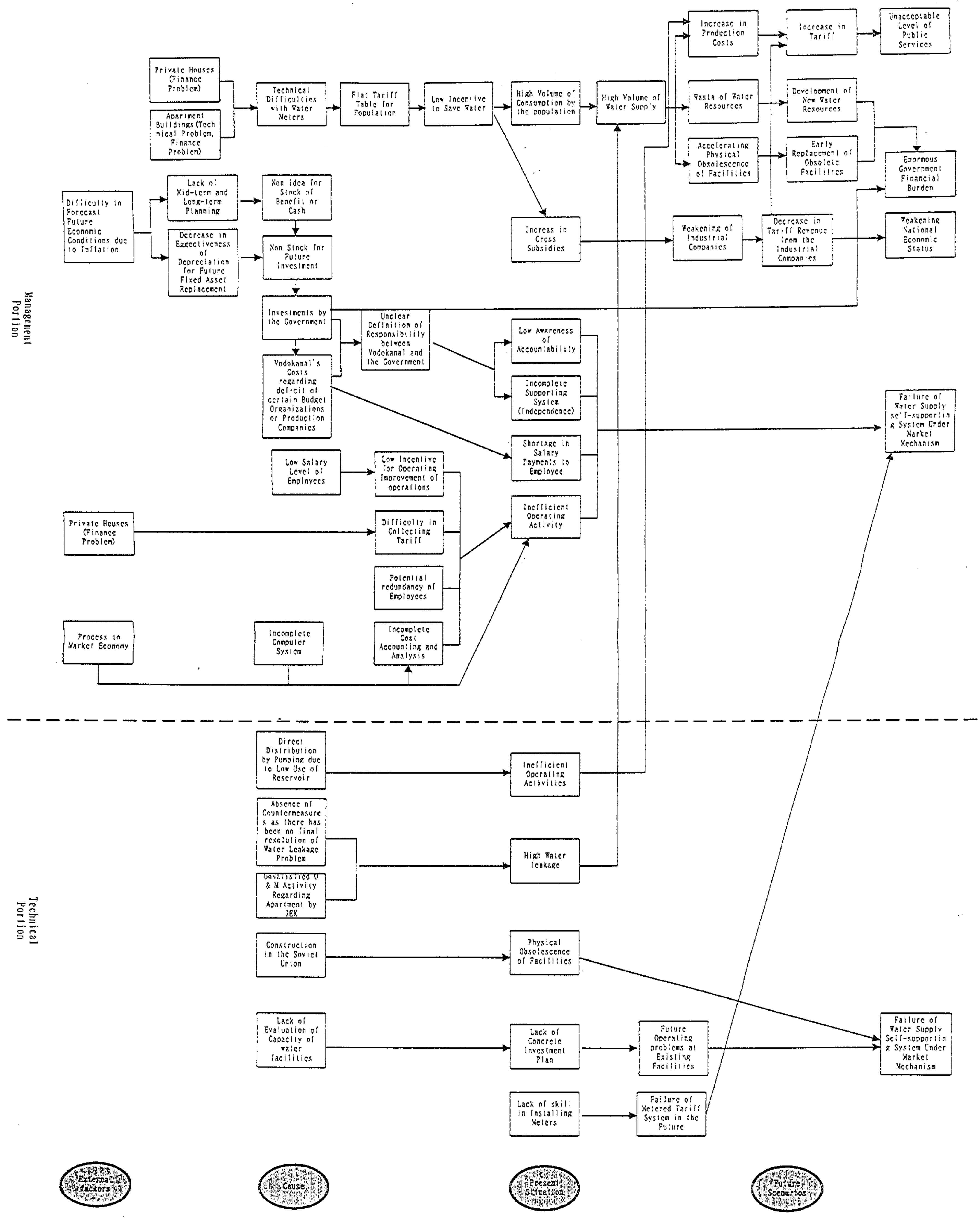


Figure 3.6.1 Issues of Water Supply Services – Tashkent

Table 3.6.1 Progress in the Installation of Meters in Tashkent during 1999

	Target	Accomplished	Collection of cost installation
Number of households with installed meters	18,000	7,000	1,500

Cost of installation of meters and cost burden

The type of meter installed for the population is a standard size with a diameter of 20 mm and a likely cost of 18,000 Sum per meter. The local government believes that all users have to bear the total cost. However, given that the average income per month in the general public is 18,000 Sum, the nominal income is 13,000 Sum, and the survey results indicate approximately 16,000 Sum, in Tashkent, this puts a enormous financial burden on the population. Because of this, the central government is willing to allow the population to pay by installments over a year in order to collect the cost. Nonetheless, a large number of population still can not afford the cost, and this will lead to a poor record of installation costs collection. The income level of the population living in apartments is even lower than that of the population who live in private houses. This means that their ability to afford the cost of the installation of the meters is less and, thus this issue is more serious for the residents of apartment buildings.

2) Cross Subsidy

Unless meters are installed, there is no way to collect water consumption tariffs other than by imposing a fixed cost on the population. Needless supply costs are also being generated because there is a low level of awareness of the need for water conservation in the population.

Also, this issue has created a situation involving cross subsidy for water supply costs between the population and the corporations as the fixed costs charged to the population have been deliberately set at a lower level as a governmental policy. Therefore, a shift of the cost to the corporations has resulted as they are charged usage-based rates.

Although the central government has enumerated targets to resolve this cross-subsidy issue, the gap has tended to widen as a result of the fact that most meters have not yet been installed.

3) Incomplete Self-Supporting System

Vodokanal has been preparing for the implementation of a self-supporting system within the existing system. The local government is planning to divide up the current Vodokanal into 11 Rayon Vodokanals and regards them as income units in order to step up progress toward achieving self-supporting system. However, Vodokanal still has to rely on the local government because of the reasons outlined below, to operate within market economy:

- New investments from the government budget (reserving deficit funds)
- No function to operate on a self-financing basis
- No mid- or long-term
- Presence of unpaid receivables by budget organizations
- Problems with continuing water supply services to companies with outstanding overdue payments
- Problem of bearing the expense for a social safety net.

4) Shortage of Cash for Salary Payments

The reasons mentioned below are the causes for the deterioration in Vodokanal's cash flows, which have caused a shortage of cash for salary payments and late payments to suppliers.

- Presence of unpaid receivables by budget organization
- Problem in continuing water supply services to the companies with outstanding overdue payments

5) Low Consciousness of Accountability

The public enterprises which operate public utilities such as water works, have a certain accountability for the fact that the local government as the owner and the public as the recipients have delegated them to operate the business. In so-called developed countries including Japan where the water works business operates under a market economy, disclosure of information is an important issue in response to such accountability. In the case of Vodokanal, it also discloses information through reports prepared at the regular meetings and at the time of revising the utility tariffs, as well as by preparation of profit and loss statements and balance sheets. However, these are not adequate measures because of the following factors:

- A Vodokanal newsletter to introduce water works services has not yet been prepared.

- An annual report with particular emphasis on the financial condition has not yet been issues.
- No Cash flow statements

As outlined above, certain improvements in disclosing information on Vodokanal are needed not only to fulfill accountability as a public enterprise but also to enable it to operate on a self-financing basis when investments in plant and machinery are required.

6) Inefficient Operating Activities

Vodokanal is making an effort to operate under many constraints, such as collecting tariffs while many meters yet to be installed, using deteriorating facilities built in the time of the former Soviet Union, as well as operating its business as efficiently as possible within a limited budget.

For the collection of tariffs, the use of automatic deductions from bank accounts, would essentially mean reduced collection costs and a stable income. However, unless more individuals (in the population) open bank accounts, there is a limit to the usefulness of implementing such banking services.

In addition, Vodokanal has been introducing a computer system in order to operate more efficiently. In spite of the limited number of computers and the manual operations still used in calculating, summing up and preparing the documents, it is expected to improve efficiency significantly. Delays in the introduction of the computer system became yet another obstacle in introducing management accounting for budget-actual variance analysis, etc. and thus using a standard cost system to control costs. Although Vodokanal is aware of the need for budge-actual variance analysis as part of a standard cost system, it has not adopted this because the introduction of its computer system has lagged behind and because it is difficult to set standard costs given the background of a high rate of inflation in Uzbekistan.

Apart from the issues of management accounting, Uzbekistan is now in the process of moving towards market economy, and has not used standard components generally installed in water works companies and other manufacturing industries in so-called developed countries. In addition, its manufacturing techniques have not be standardized and manuals outlining these techniques have not yet been prepared. Moreover, it has not adopted certain management methods such as quality control procedures and not experienced the effective use of such methods. These factors could enable them to improve efficiency.

Deteriorating facilities and a delay automating operations have led to a reliance on manual operations and that is why they have more employees than in Japan, for example. At this point, there is a great scope for improving the efficiency of operations, assuming that the number of workers at operating sites can be reduced.

On the other hand, considered the level of the wages paid for such a large number of employees, the total expenditure for employees' salaries is certainly not high by any means compared to level of income in Tashkent. It seems there are a problems in terms of securing excellent human resources and in providing incentives for the workers.

(2) Technical Problems

1) Economically inefficient water supply system

Although the present water works facilities were built during the time of the Soviet Union, the water supply is basically distributed by direct pump pressure. Generally, there is a gap between the volume of consumption during the day and at night, and thus the water works facilities are operated on a smaller scale at night. Reservoirs are build on higher ground and use natural gravity to deliver the water supply. According to the current survey, however, no clear disparity in water conservation between the day and night volume was found especially in Tashkent, and this means that there is either some level of use at night or considerable leakage or waste of water in the daytime, although the flow rate has not been measured each year and conclusions cannot be drawn as a result of the current measurement. However, considering the change in the original water consumption required during the daytime, the present system water supply by direct pump pressure consumes a large volume of electricity and operates in such an inefficient way that the maximum power of the operations required has increased.

2) High rate of leakage

As mentioned in 1) "High Volume of Population Consumption" under (1) "Management Problems," the extremely high percentage of leakage or waste of water in Tashkent shown as a result of the current survey is due to leakage inside various facilities, e.g. leakage from water pipes and waste of water from water tanks, etc. Although JEK should be in charge of maintaining and repairing any leaks inside the apartment houses, the results indicated that there have been problems with their ability to maintain these and repair the leaks.

3) Aging Facilities

Many of the current facilities were build in the time of the Soviet Union and have either already exceeded their period of durability or will exceed this within the next 10 years. Although Vodokanal is trying hard to maintain and repair these facilities, the estimated costs are less than the actual costs for the upkeep and renovation. Furthermore, maintenance costs for these facilities are expected to increase in exponentially in the future.

4) Concrete measures for future investments

There is no reliable data on the period of technical durability remaining for the aging facilities which are currently in use. Without such information no concrete measures for investment can be drafted to meet the actual situation.

5) Technical agenda for the installation of meters

In the current survey, a meter was installed at each household surveyed and the water consumption was measured for these as pilot cases. Ten to twenty percent of the meters were out of order within two months of their installation. This is an extremely usual phenomenon, but the cause is not readily apparent and should be investigated. Also, it is necessary that the meter installation proceed only after selecting the most reliable type of meter and after standardizing the procedures for installation based on these results.

3.6.2 Analysis and Simulation of Future Scenarios for Water Supply Services

The points below are a summary of future issues which TASHKENT CITY VODOKANAL will face if it keeps on ignoring the current issues discussed so far.

(1) Management Problems

1) High Volume of Water Consumption by the Population

The increasing volume of water consumption as well as the problems of water leakage and water wastage by the population, in addition to the projected growth of the population will in the end require further development of the water resources in future. In addition increasing the water supply to cope with this increase in water consumption will hasten the deterioration of the already old facilities, thus increasing future maintenance costs requiring, and earlier replacement of these sites. At present, these costs have not been estimated and the government could face an enormous financial burden.

Any increase in water supply will cause a rise in overall manufacturing costs. If these expenses were to be financed by water utility tariffs as is now being considered to remedy the current situation, the water tariffs would have to be increased far higher than necessary and would possibly far exceed the level deemed fair by the public.

2) Cross Subsidy

It is regarded that the presence of cross subsidy can be rationalized to a certain extent by comparing the level of wages in the population with the ability of corporation to afford water tariffs given the present economic conditions in Uzbekistan. However, any unreasonable shift of the cost burden to the corporations will weaken the competitiveness of these industries in the global economy and, in the end, to a decline is the economic power of Uzbekistan. Furthermore, if the water works business relies primarily on income from corporations this could be an element in impeding the stability of the financial operations of Vodokanal. If the cross subsidy system continues and is unreasonably burdensome, this will involve an even heavier burden for the corporations and could initiate a vicious circle.

3) Incomplete Self-Supporting System

If the situation remains the same, the low level of the self-supporting system today indicates that it will not be able to be implemented in the water works business in the market economy in the future. In short, Vodokanal may tend to rely on the government to raise capital and to assume the responsibility for management and, in this way, will not be a self-supporting corporation.

4) Shortage of cash for salary payments

If unstable conditions, under which the payment of salary to the employees is sometimes delays, Vodokanal will not be able to maintain its credibility outside investors and face difficulties in implementing a self-supporting system.

5) Low Awareness of Accountability

In order to achieve its aim of establishing a self-supporting system in the future, Vodokanal must agree to a substantial disclosure of information with a particular emphasis on its financial condition in order to gain credibility in the eyes of outside investors. At this point, information disclosure is not adequate and it is difficult to operate on a self-financing basis under current conditions. In implementing substantial disclosure of information , Vodokanal would make its own management status clear and encourage self-help efforts to improve its own management. Apart from the issue of disclosure of its financial condition, issuing newsletters could be also an important way of disclosing information and the population's understanding of the water works business. If the current conditions remain the same, Vodokanal will lose an opportunity to communicate with the population. This is not desirable in terms of improving the level of the public's awareness of the need for water conservation.

6) Inefficient Operating Activities

The current level of inefficient operating activities shows that it will be difficult for Vodokanal to operate on a self-supporting basis in a future market economy. Thus, it seems that some type of subsidiary by the government will be needed.

(2) Technical Problems

1) Economically inefficient water supply system

If leakage from facilities inside houses is reduced after usage-based rates are introduced, this would create a change in the amount of water consumed during the day and at night. On the other hand, as the current water facilities are manually operated , the capacity of the reservoirs is too small to adjust the volume. Also, if the current way of distributing by direct pump pressure is continued, the facilities must be maintained at the maximum level of operation power and this would produce idle costs. These costs will eventually rebound in the form of water tariffs.

2) High rate of leakage

Ignoring the high rate of leakage could lead to a rise in water supply and production costs. New water resources development will likely be required because of rise in the demand for water supply and the waste of water resources. Useless operations of water facilities will lead to further deterioration and a steep rise in maintenance costs.

3) Aging facilities

Ignoring aging, deteriorating facilities without sufficient repairs and maintenance would involve a steep rise in maintenance costs in the future and is likely to impede a stable supply of water.

4) **Concrete measures for future investments**

There is no statistical data on the remaining period of technical durability of the aging facilities in current use. This means that stable water supply services in the future cannot be guaranteed and it is likely that no capital allowance will be provided for investments.

5) **Technical agenda for the installation of meters**

If the meter installation plan proceeds without solving the technical problems encounter in installing the meters, the conditions of meters will deteriorate soon after and the collection of tariffs based on a usage-based rate will be overdue. Other new meters will then have to be installed. This would interrupt the stability of water works services and would also imply that the investment in installing the meters has been wasted.

3.6.3 Approach for Progress and Improvement of Water Supply Services in Tashkent City

The following approaches has been taken to determine measures to deal with issues outlined above.

(1) Final goal

Vodokanal should realize that the water service business is a delicate balance between a public services operated to promote public welfare and an economic venture to be run under efficient management and sound operations in a market economy in Uzbekistan. The former, the public nature of the operations, means that Vodokanal operates the water works business to supply water under certain pressure and of an acceptable, safe quality for the users and that the water tariffs for this service should be fair and appropriate. The latter, the viewpoint economic nature of the operation, means that Vodokanal operates a business operation on a self-supporting basis in preparation for privatization.

However, based on the current circumstances in Uzbekistan, it will be difficult to achieve this final goal in one stage. Therefore, the following stages would seem to be appropriate as this process unfolds:

- The first stage (From the year 2000 to the year 2005

  Requirements for a self-supporting system

- The second stage (From the year 2006 to the year 2010)

  Establishment of the business operation on a self-supporting basis and preparation for privatization.

- The third stage (After the year 2011)

Operating a self-supporting system and examination of privatization

3.7. Overview of Tashkent City Vodokanal

3.7.1 Outline of Water Supply Services and Facilities

An outline of water supply services is presented in Table 3.7.1.

Table 3.7.1 Outline of Water Supply Works and Facilities

Item		Units	Value	Remarks
Service Area		sq.km	340	
Population Served		People	2,260,000	estimated
Rate of Service Coverage		%	98.55	
Number of Service Connections		Number	568,768	
Total Length of Pipes		Km	3,652	January, 1999
Total Production Capacity		cu.m/day	2,296,000	Nominal
Total Annual Water Supply Volume		10^3cu.m	899,706	Aug.'98-Jul.'99
Maximum Daily Water Supply Volume		cu.m/day	2,830,000	
Average Daily Water Supply Volume		cu.m/day	2,465,000	Aug.'98-Jul.'99
Water Supply Volume per Capita	Maximum	L/cap./d	1,252	
	Minimum	L/cap./d	1,091	
Staff Numbers of Water Supply Service		People	3,341	
Water Pressure in the City		Kgf/cm^2	1.0 to 2.5	
Water Sources		Boz-su Canal and Groundwater		
WTPs		Surface Water WTP:2, Groundwater WTP:5		

It is estimated that 2,260 thousand people were served with water supply in 1991, which population was determined by that the total population of the city; 2,160,000 in 1996 multiplied by the annual population growth rate; 2%. 2,160 thousand × (1.02)3 × 0.9855 = 2,260 thousand.

The major character of water supply services of Tashkent is that the volume of water supply per capita is extremely large and the average annual volume is 1,091 L/capita/day.

3.7.2 Financial Conditions and Cost Analysis

Vodokanal has been increasing the rate of water tariff almost every year up to the present because of an increase in costs due to inflation. Thus, the annual profit and loss has been positive. However, as presented in Table 3.7.2, the proportion of depletion and repair costs are fairly small, compared with those of Japan. On the other hand, the proportion of power costs is taken up largely.

In spite of a change in the currency and inflation occurred due to its independence in 1991 from the former Soviet Union, Vodokanal's assets were not properly re-assessed. As a result, the valuation of fixed assets, that is a basis of depletion costs, on balance sheet became lower than actual valuation, and thus the depletion costs were earmarked low. As for repair costs, Vodokanal has been trying to maintain the degrading facilities and equipment on the lowest costs, but it is estimated that Vodokanal will need greater investment on these facilities and equipment in future. As the technical parts stated about power costs, the type of original operation system has been consuming large volume of electricity and thus the percentage of power costs became high.

Vodokanal's investment costs on water supply facilities and equipment have been covered by the local government and Vodokanal did not need to raise funds. As the result, Vodokanal is clear out of debt, i.e. borrowing and the investment costs covered by the local government have been earmarked as capital stock or capital reserve. This way of settlement lacks the concept of capital accumulation and reservation. This means, in other words, Vodokanal has no financial plans with clear future visions.

Table 3.7.2 Compositions of Costs

Costs	Unit	Uzbekistan		Japan
		Tashkent	Chirchik	Tokyo
Rate of labour	%	10	4	16.7
Rate of Depreciation	%	10	3	18.9
Rate of Electiricity	%	48	72	2.9
Rate of Materials	%	6	5	0.6
Rate of Repairs	%	4	2	21.4
Rate of Orders made to third parities	%	0	0	6.7

3.7.3. Tariff Policy and Charge Collection

The current status of revenue from collection of charge is analyzed as follows:

Vodokanal increased tariff of corporate users in August, 1998 and of general public in February, 1999 respectively. Thus, unit cost of revenue is lower than the one in the current tariff table. Also, as installation of water meters has not proceeded, the actual volume of water consumption can not be measured and had to be estimated by calculation. This means that Vodokanal cannot grasp the actual volume of water intake. As presented in Table 3.7.3, the sales unit of general public is less than the unit cost, and the sales unit of production industry and other users far exceeded than those of the unit costs. The Study Team defines this status as cross subsidies for the general public. The rate of tariff disparity among the users in the ROU is 4.5 and is fairly high compared to that of international standard, which is around 2%.

As mentioned before, tariff of the general users is not calculated by metered rate, but by fixed rate system which pay water bills no matter how much volume of water is consumed. Therefore, this system does not generate an incentive of conserving water and does not lead them to take any positive actions even if water leakage was found inside an apartment blocks.

Table 3.7.3 Revenue from Collection of Water Charge- Tashkent Vodokanal

	Annual volume Of water consumption	Revenue (1,000 thousands in Sum	Sales unit (sum/m^3)	Unit cost (sum/ m^3)
General users	289	210	0.7	2.1
Public organizations corporations i.e., restaurants	341	1,482	4.3	2.1
Production industry	58	373	6.4	2.1
Subtotal	687	2,065	3.0	2.1
	212	0		
Total	899	2,065		

Unit cost was determined as:

Annual costs on water works services/volume of accounted water

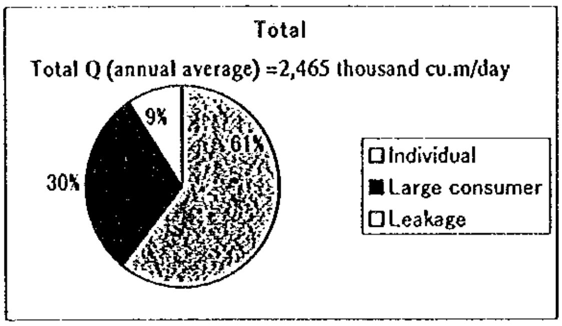
=1,447 million sum/687 million m3 = 2.1 sum/ m3

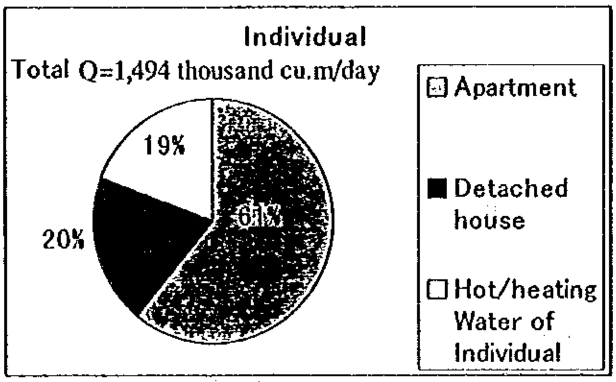
3.7.4 Analysis of Water Supply and Consumption

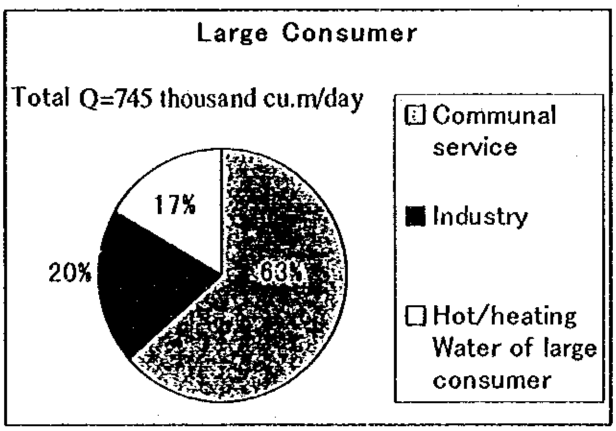
The element of water supply and consumption is analyzed in chapter 5.3, however the overview is described below and the status of the whole water supply works should be presented in this section.

The composition of water consumption is segregated into three categories; individual, large consumer and leakage of pipeline as presented in Figure 3.7.1. The compositions of water supply volume by individual and large consumers are also shown.

Figure 3.7.1 Composition of Volume of Water Consumption

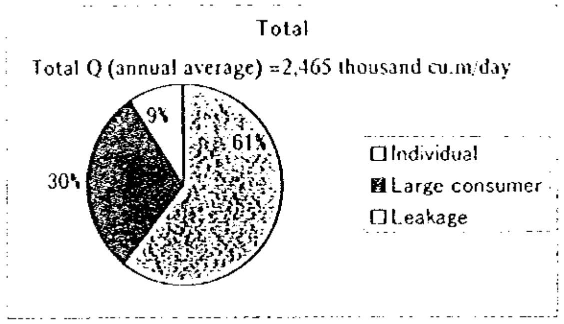


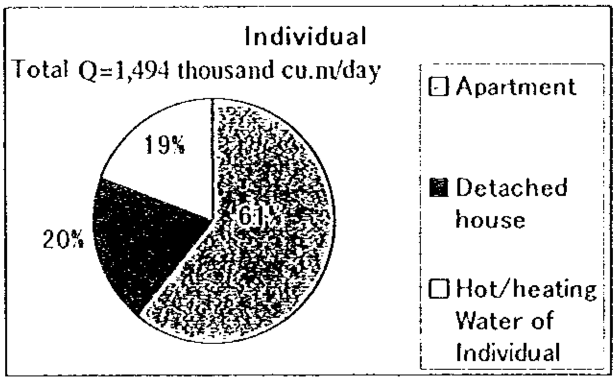


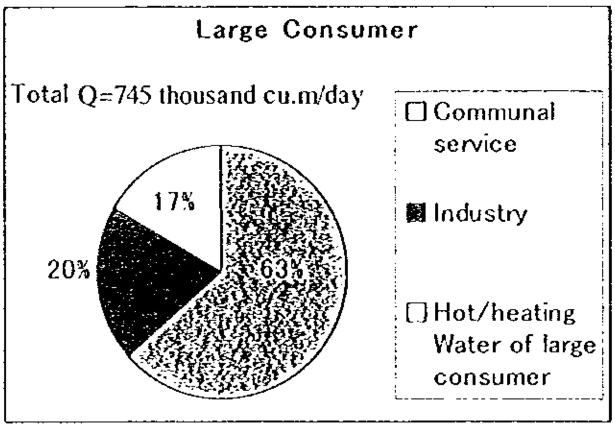


As presented in the figure, 9% of the total volume of water supply is consumed by leaking pipelines, 61 % by individual, and 30% by large consumer. It also presents that water supply is largely consumed as hot

Figure 3.7.1 Composition of Volume of Water Consumption



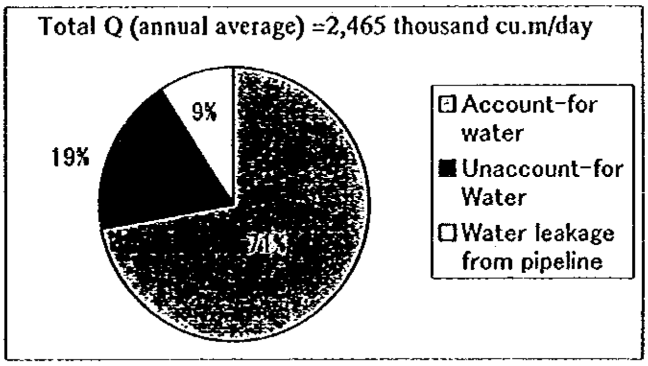




As presented in the figure, 9% of the total volume of water supply is consumed by leaking pipelines, 61 % by individual, and 30% by large consumer. It also presents that water supply is largely consumed as hot water and for heating.

Basically, most of the large consumers (the distribution volume of hot and heating water distributed by supply factories is calculated in large consumption) is charged based on meter-rate system, however, individuals living in apartment blocks and detached houses are not charged based on mater-rate system but fixed charge rate of 330 liter per capita a day. (total distribution volume = 0.33 cu.m/capita/day x 2,260,000 population served = 745,800 cu.m/day.) Therefore the difference between the actual volume and fixed volume of water consumption by individuals is defined as unaccount-for water volume. The rate of this unaccount- and account-for water volume by individuals, and also water volume consumed by water leakage are shown in Figure 3.7.2.

Figure 3.7.2 Account-for and Unaccount-for Water



It is assumed that the volume of water consumption due to water leakage include the leakage from water equipment and pipes in housings and buildings, and pipeline laid under roads. Regarded the level of excessive volume of water consumed by consumers in Japan as a volume of wasting water, the volume of actual water demand is determined by deducting the volume of water leakage and wasting water from the total the volume of whole water supply.

Based on this point of view, the composition of the actual volume of water demand, water leakage and wasting water is presented in Figure 3.7.3. The figure presents that 61% of the current volume of water

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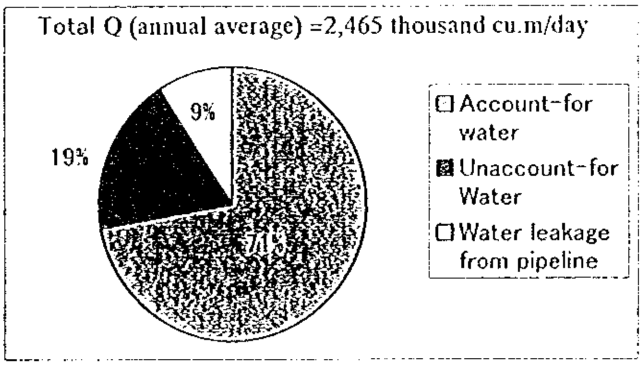
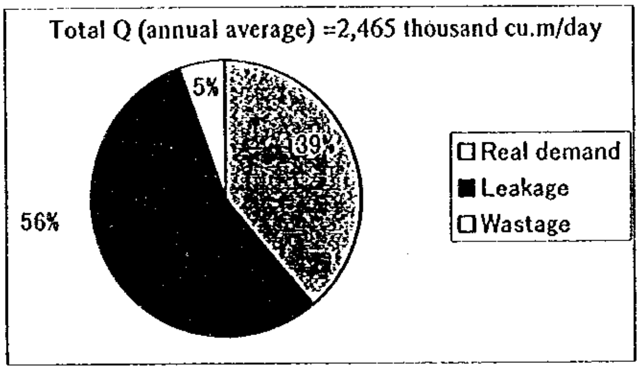


It is assumed that the volume of water consumption due to water leakage include the leakage from water equipment and pipes in housings and buildings, and pipeline laid under roads. Regarded the level of excessive volume of water consumed by consumers in Japan as a volume of wasting water, the volume of actual water demand is determined by deducting the volume of water leakage and wasting water from the total the volume of whole water supply.

Based on this point of view, the composition of the actual volume of water demand, water leakage and wasting water is presented in Figure 3.7.3. The figure presents that 61% of the current volume of water supply can be reduced in the future.

Figure 3.7.3 Actual Volume of Water in Demand



3.7.5. Facilities of Water Supply Service, and its Operation and Maintenance

The location of WTPs and other facilities of Tashkent Vodokanal is presented in Figure 3.1.

The capacity of WTPs shown in the figure is 2,326,000 cu.m/d and this rate falls below the annual average of water supply volume, that is 2,465,000 cu.m/d. Thus, it is clear that the facilities have been operating beyond these capacities.

Many of these facilities are aging and replacement of these facilities tends to stagnate because of lack of funds. The annual budget prepared for repair and improvement of Tashkent Vodokanal is approximately 50 million sum which is less than 1/10 of the costs actually needed.

The degrading condition of water distribution pipes network is especially serious and nearly 4,500 cases of interruptions caused by intensive water leakage, were annually recorded.

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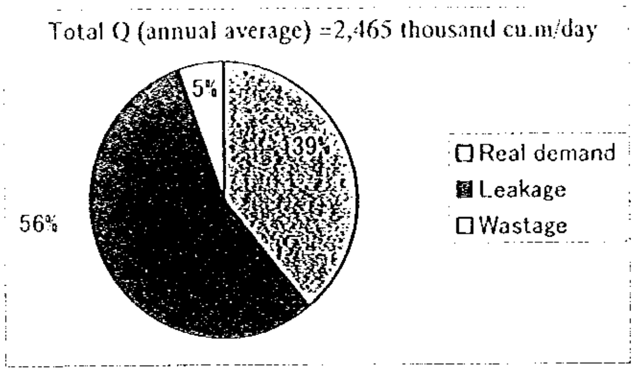

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The degrading condition of water distribution pipes network is especially serious and nearly 4,500 cases of interruptions caused by intensive water leakage, were annually recorded.

3.7.6. Issues

Vodokanal is facing many issues to be solved as mentioned in 3.6 and especially following issues should be focused for managerial improvement.

1) General users are not encouraged to conserve water as a meter installation program at general users' sites have not been proceeded and tariff system of the general users employs fixed rate. Also, there is a large disparity of charges between general users and corporate users.

2) As the above point, precious water resources have been largely wasted and this generates waste of expenses on water treatment and supplying.

3) As the tariff policy is lagged as above, charge to offset the costs can not be reserved. The financial foundation is vulnerable and the essential facilities are not prepared.

In the ROU, a further transition to a market economy is expected to take place and it is assumed that Tashkent City as a capital will develop as the center in future. Therefore, it will create greater changes such as a population movement into the city and various conditions i.e. price of commodities. Concerned these points above, ignoring the issues pointed out will hinder the operation of water supply services to a large extent.

In conclusion, ignoring the issues pointed above will bring about financial and technical situations as follows:

1) Collapse of the budget balance and the financial failure

a. Overdue payments and outstanding by corporation due to a steep rise in water tariff

b. Lowering rate of collecting operational costs of water supply services

c. Shortening Vodokanal's funds, lowering ability to pay off the debts, and unable to pay the employees' salaries

d. Conceding to operate a self-supporting system under the market economy

2) Worsening the quality of water supply services due to the lagged preparation of improving facilities

a. Frequent cut off in water supply

b. An increase in running costs due to inefficient operation system

c. Fear of worsening water quality due to the lagged preparation of improving facilities and equipment

d. Conceding or worsening the concept of public nature in water supply services

3) Increasing demand for development of new water resources

a. A need of developing already marginal water resources and the development costs

b. No integration with environment aspects

Vodokanal would face the above three crisis such as financial failure, a collapse of service, and a collapse of water resources, and needs to deal adequately with those issues.

CHAPTER 4

PRESENT STATUS OF WATER SUPPLY SERVICES IN CHIRCHIK CITY

Chapter 4 Present Status of Water Supply Services in Chirchik City

4.1 Organizational Management

4.1.1 Vodokanals in Tashkent Province

As described in 1.4.2, there are 15 districts (rayons) in Tashkent Province. According to the official data, there are 5 big cities, and towns and villages located somewhere in these 15 districts. The province is currently being provided with drinking water by the regional Vodokanals as follows:

Table 4.1.1 Regions and Vodokanals in Tashkent Province

Regions and Cities	Vodokanal
≪Districts≫	
Akkurgansky	Akkurgansky
Ahangaransky	Ahangaransky
Bekabadsky	Bekabadsky *)
Bostanlyksky	Gazalkinsky
Bukinsky	Bukinsky
Zangiatinsky	Zangiatinsky
Kibrajsky	Kibrajsky
Kuyichirchiksky	Kuyichirchiksky
Parkentsky	Yukorichirchiksky ***)
Pskentsky	Pskentsky
Tashkentsky	Kelesky
Urtachirchiksky	Tojtepinsky
Tchinazsky	Tchinazsky
Yukorichirchiksky	Yukorichirchiksky ***)
Yangiyulsky	Yangiyulsky **)
Five Big Cities	
Almalyk	Almalyksky
Angren	Angrensky
Bekabad	Bekabadsky *)
Chirchik	Chirchiksky
Yangiyul	Yangiyulsky **)

(Source: Vodokanal of Tashkent Province)

Five big cities in the province have their own Vodokanals and 11 of the 15 districts have their own Vodokanals as well. Of the remaining 4 districts, 2 districts have established 1 joint Vodokanal. Two other districts do not maintain their own Vodokanal; instead they receive their water supply from the adjacent cities. As noted before, Zangiat, Kibraj and Kele Vodokanal has been buying potable water from Tashkent. Table 4.1.2 below is a summary of all 17 Vodokanals in the Province, prepared for a comparison of their scale and efficiency.

Table 4.1.2 Comaprison of Vodokanals in Tashkent Province

(Data prepaared at September 1999)

No.	Vodokanal		Service Area	No. of Employee			Water Sales ('000m^3)		Monthly Av. Sales ('000Sum)	Capacity ('000m^3/day)		No. of Plant		No. of Customer	
				Water Supply	Sewerage	Total	Year	Month Ave.		Water Supply	Sewerage	Water Supply	Sewerage	Resident	Others
1	Akkurgan	S	Akkurgan District Akkurgan city Alimkent town	59	0	59	1,270	105.8	1,200.5	8.5	0.0	0	0	2,500	62
2	Ahangaran	M	Akhangaran District Akhangaran city	180	14	194	6,460	538.3	10,980.0	61.5	0.0	0	0	9,571	150
3	Bekabad	M	Bekabad District Bekabad city Zafar r/u	133	72	205	6,864	572.0	9,731.0	43.7	60.0	0	1	18,000	100
4	Gazalkent	M	Bostanlyk District Gazalkent city	125	35	160	3,000	250.0	6,405.6	39.3	0.0	0	0	10,000	82
5	Buka	S	Buka District Buka city			0	0	0.0	0.0	6.7	0.0	0	0	0	0
6	Zangiat	S	Zangiata District	20	8	28	1,211	100.9	1,329.4	7.2	0.0	0	0	1,440	13
7	Kibraj	S	Kbraj District Kibraj r/u	59	5	64	1,772	147.7	2,573.0	30.7	0.0	0	0	3,041	62
8	Kuyichirchik	M	Kujchirchik District	94	10	104	1,291	107.6	0.0	6.2	0.0	0	0	0	0
9	Pskent	S	Pskent District Pskent city	44	0	44	1,145	95.4	976.8	8.3	0.0	0	0	3,250	31
10	Kele	S	Tashkent District Keles city	32	7	39	1,515	126.3	1,746.0	20.7	0.0	0	0	2,930	27
11	Tojtepa	S	Urtachirchik District Tojtepa city Tuyabuguz city			0	0	0.0	842.2	11.3	0.0	0	0	3,722	38
12	Chinaz	S	Chinaz District Chinaz city Almazar city Pakhta	50	0	50	1,270	105.8	1,028.8	14.2	0.0	0	0	2,800	41
13	Yukorichirchik	S	Yukorichirchik District Paarkat District	94	10	104	1,291	107.6	1,934.4	24.7	0.0	0	0	6,500	95
14	Yangiyul	M	Yangiyulj District Yangiyulj city	113	115	228	8,098	674.8	10,433.0	66.5	76.0	0	1	14,243	181
15	Almalyk	B	Almalyk city	322	78	400	15,097	1,258.1	30,683.0	168.7	110.0	0	1	23,800	180
16	Angren	B	Angren city	312	78	390	16,040	1,336.7	36,008.8	139.3	100.0	1	1	29,840	187
17	Chirchik	B	Chirchik city	256	225	481	29,885	2,490.4	35,119.9	193.0	115.0	1	1	35,026	402
	Total			1,893	657	2,550	96,209	8,017.4	150,992.4	850.5	461.0	2	5	166,663	1,651

Source: Tashkent Province Vodokanal

The results of the comparison are as follows:

(1) There is a wide range of difference in the scale of the 17 Vodokanals. For example, Chirchik (481) has 17 times in the number of employees as Zangiatin (28); and Chirchik (29,885 thousand m3/year) consumes 26 times the volume of water as Pskent (1,145 thousand m3/year).

(2) The 17 Vodokanals in the Province are roughly divided into three groups based on their scale as indicated below:

Small: 9 Vodokanals	(Akkurgan, Buka, Zangiata, Kibraj, Pskent, Keles, Tojtepa, Chinaz, Yukorichirchik)
Medium-sized: 5 Vodokanals	(Ahangaran, Bekabad, Gazalkent, Kuyichirchik, Yangiyul)
Large: 3 Vodokanals	(Almalyk, Angren, Chirchik)

(3) Chirichik Vodokanal is the largest organization in all respects, excluding the average monthly income.

(4) It should be noted that the average monthly income of Chirichik Vodokanal is lower than that of Angren. Angren Vodokanal looks to be efficiently managed because it has the fewest employees and the lowest volume of water sales, and capacity among the three large Vodokanals (Almalyk, Angren and Chirchik), whereas it has the highest average monthly income.

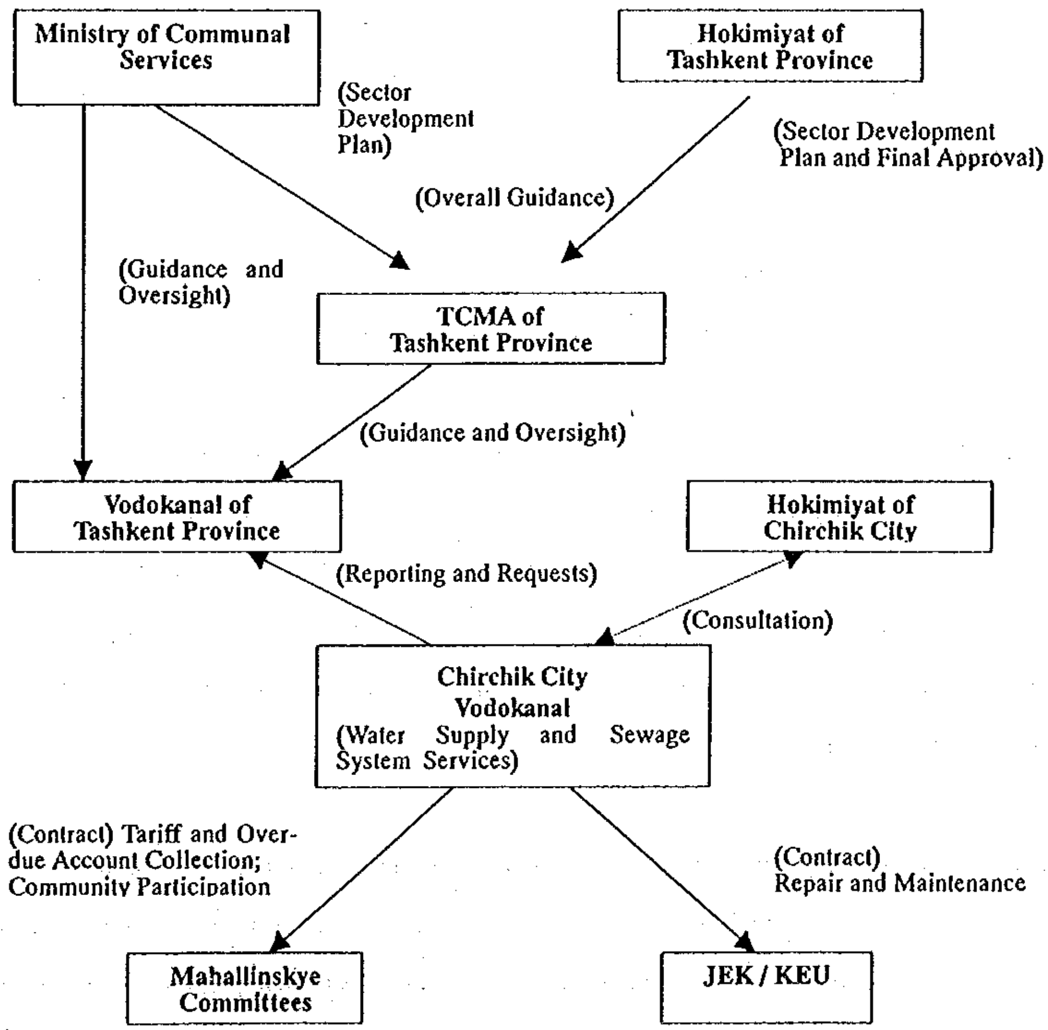
The JICA Team discussed this issue with Tashkent Province Vodokanal and Chirchik City Vodokanal. JICA raised the possibility of consolidating the present small Vodokanals and establishing inter-district or inter-rayon water utilities in order to gain the benefits of economy of scale and enhanced efficiency. No such cases were reported, nor did they show much interest in such a reorganization.

4.1.2 Chirchik City Vodokanal

Chirchik City Vodokanal was founded in the early 1950s based on the water supply units required by the largest of the industrial plants located in Chirchik, mainly Elektrohimprom. It is currently operating under a charter registered by the Hokim of Chirchik on April 3, 1998.

According to the Charter, Chirchik City Vodokanal is a separate legal entity subordinated to another state-owned legal entity, Trust Vodokanal of Tashkent Province ("Vodokanal of Tashkent Province" hereinafter). The current place of Chirchik City Vodokanal amongst other institutions and their relationship is briefly illustrated in the figure below:

Figure 4.1.1 Administrative Structure of the Water Sector of Chirchik City



As it follows from the above figure, Chirchik City Vodokanal, as a state-owned enterprise, reports to the Vodokanal of Tashkent Province, which in turn has a dual subordination to the Ministry of Communal Services and to the Hokim of Tashkent Province (via the TCMA of Tashkent Province). In 1993, the present structure replaced the old structure which assumed the subordination of Vodokanal of Tashkent Province to Uzvodokanal and further to the Ministry. In the process of decentralization and restructuring, all Uzvodokanal's functions were transferred to the TCMA.

Chirchik City Vodokanal is independent in making its own operating decisions, but these must be strictly within the budgets preapproved by the Vodokanal of Tashkent Province. No significant financing or investment decisions can be made by Chirchik City Vodokanal without the approval of the Provincial Vodokanal and/or the TCMA.

Currently Chirchik City Vodokanal has 431 employees. Its organizational chart is presented in Figure 4.2.1. Except for every Tuesday, there are no fixed regular meetings. They do not hold a special meeting for the approval of their yearly operating results. No auditing has been is introduced.

Since a significant number of Chirchik City Vodokanal's customers are entities of social importance for the entire city of Chirchik (such as schools, hospitals, kindergartens, other communal services enterprises, etc.) many day-to-day issues require a kind of approval or decision of the Hokim of Chirchik City. For example, it is the Hokim of Chirchik who often make the final decision on the priority of certain maintenance or installation work to be done, about the location with the territory of the city, as to who might help Chirchik City Vodokanal collect fees from the city's budgetary organizations, and to approve Chirchik City Vodokanal's decision to cut off water supply by to socially important entities, and so on. However, the Hokimiyat of Chirchik does not provide any financing to Chirchik City Vodokanal.

The process followed for the preparation and approval of the yearly business is outlined as follows:
The initial plan, also called "Prognoz," for the next year is prepared by the Planning and Economic Dept. of the Vodokanal in October or November. Once this has been approved by the Chief Engineer

and the Director of the Vodokanal, the Prognoz plan is sent to the Provincial Vodokanal before December 1st, who consolidate plan with those sent by other Vodokanals in Tashkent Province in order to draft a provincial plan. The provincial Vodokanal submits the provincial plan to the Provincial TCMA, who, after their approval, submit the plan to the Ministry of Communal Services.

The preparation of a large-scale investment plan follows the same process up to the Provincial TCMA every year. The Provincial TCMA submits this plan to the Ministry of Macroeconomics and Statistics instead of to the Ministry of Communal Services, and the Ministry of Macroeconomics and Statistics who makes the decisions about the actual allocation of cash. Chirchik City Hokimiyat then requests a realization of the plan from the Provincial TCMA.

There is no medium and/or long-term development plan that they should consider during the preparation of their business planning.

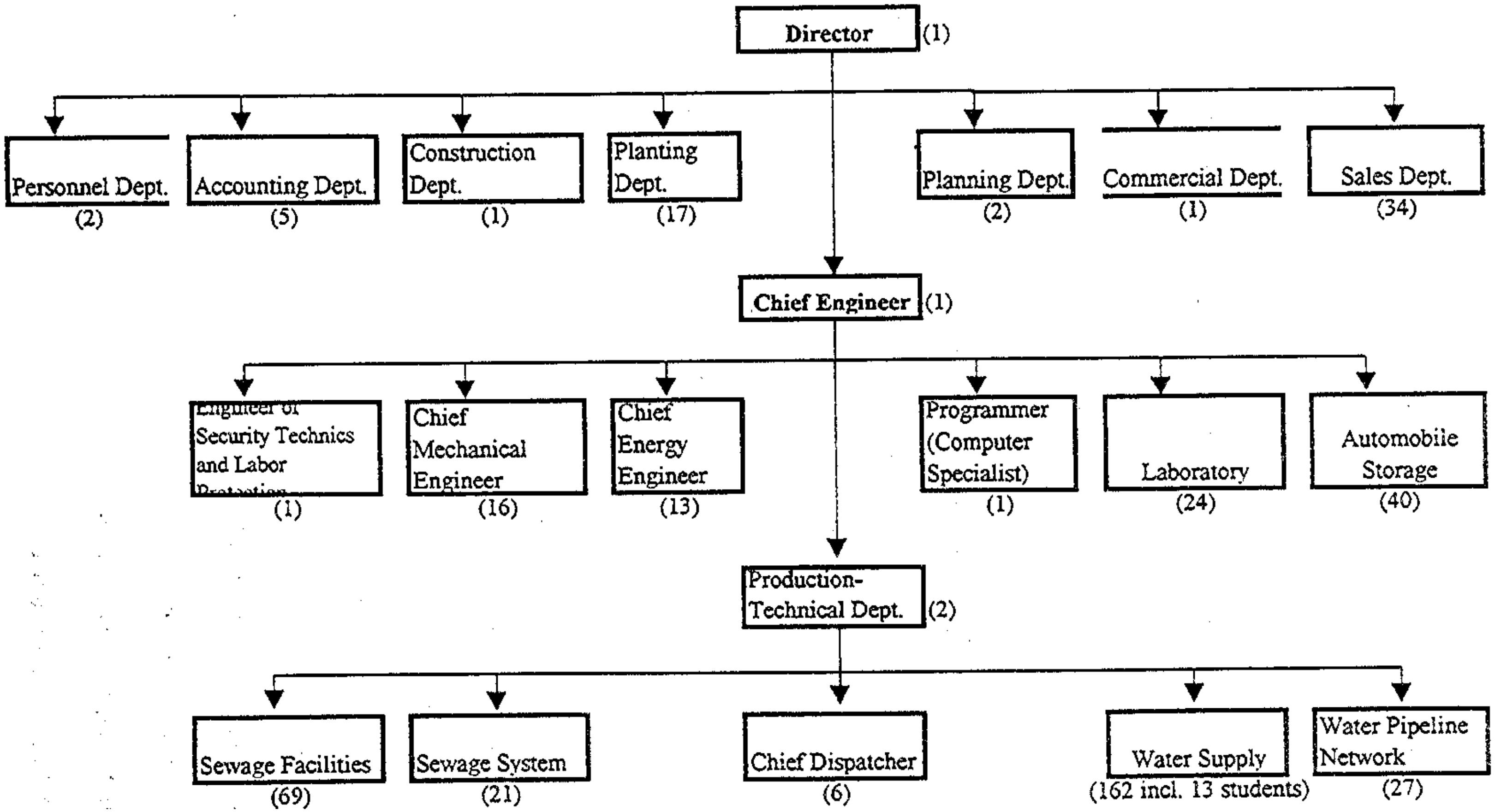
4.2 Managerial and Financial Status

4.2.1 Structure of Chirchik City Vodokanal

Fig 4.2.1 presents the current organizational chart of Chirchik City Vodokanal.

The Chirchil City Vodokanal has prepared the financial statements itself since its restructuring in 1997. Before 1997, the Chirchil City Vodokanal had been a portion of the Tashkent Province Vodokanal. The Chirchil City Vodokanal has borne the administration costs, which amount to 3% of the total revenue of the Chirchil City Vodokanal for Tashkent Province. A further restructuring of Chirchil City Vodokanal will depend on the privatization program and could be made by the year 2000.

Fig 4.2.1 **Organization Chart of Chirchik City Vodokanal** (As of July 6, 1999)



(Number): Number of Employee

(Source: Chirchik City Vodokanal)

4.2.2 Managerial Status

(1) Check on Business Operating Status

The Vodokanals of Tashkent Province hold a monthly meeting. This meeting is attended by the President of each Vodokanal, including Chirchik City Vodokanal. The main purpose of this meeting is to discuss management strategy for the next month. At the latest meeting in August 1999, it was decided to rely on a bank loan to avoid further delay in the payment of employee's salaries by Chirchik Vodokanal, due to the delay by a chemical company. This is the first time for such a bank loan in paying its utility bills for any Vodokanal in Tashkent province. Chirchik Vodoknal says that this decision was unavoidable. The government may not question this decision closely because this problem was not the fault of Chirchil City Vodokanal.

The following items (2)-(13) are similar to corresponding cases at Tashkent Vodokanal. Therefore, for details, please refer to Chapter 3.2.

(2) Property rights

(3) Accountability

(4) Investment plans

(5) Cash flows

(6) Concept of a Planned Economy

(7) Production plan

(8) Personnel management

(9) Employee promotion

(10) Salary

(11) Pension plan

(12) Employee training program

(13) Professional union

4.2.3 Financial Status

Table 4.2.1 presents the income statements of Chirchil City Vodokanal for the years ended December. 31, 1997 and 1998.

Table 4.2.1 Chirchil City Vodokanal of Statement's Income (Unit : Thousands of Sum)

		12/31/98		12/31/97	
Sales		350,047	%	251,225	%
VAT	Note 1	(47,785)		(32,551)	
Net sales	Note 2	302,262	100	218,674	100
Cost	Note 3	(190,889)	63	(163,966)	75
Gross Margin	**Note 4**	**111,373**	**37**	**54,708**	**25**
Administrative expenses		(14,594)		(8,655)	
Other operation income		2,642		5,868	
Other operation expenditure	Note 5	(61,663)		(31,322)	
Income Before Income Tax		37,758		20,599	
Income tax	Note 5	(34,797)		(18,691)	
Other Tax		-		-	
Net income (loss)	**Note 6**	**2,961**	**1**	**1,908**	**1**

(1) Sales

A breakdown of sales for the year ended December 31, 1998 is shown in Table 4.2.2.

Table 4.2.2 Chirchik Vodokanal Sales

	unit	Dec. 31, 1998		%
(WATER-Supply)				
Water treated by plants	Thou. m^3	22,189		
Other(fr subsoil)		16,579		
Water supply total	Thou. m^3	38,768		
Water distribution - total	"	31,062		100
(population)	"	22,337		72
(Budget Organizations)	"	4,685		15
(Others.)	"	4,040		13
Water Supply Income	**Thou. sum**	**186,419**	5	**100**
(population)	"	31,365		17
(Budget Organizations)	"	68,502		37
(Others.)	"	86,552		46
(SEWER)				
Total sewage	Thous. m	43,559		100
(population)	"	20,198		46
(Budget Organizations)	"	4,647		11
(Others.)	"	14,412		33
(GasPU)		4,302		10
Sewerage Treatment Income	**Thous. sum**	**146,617**	4	**100**
(population)	"	28,515		19
(Budget Organizations)	"	18,388		13
(Others.)	"	82,710		56
(GasPU)		17,004		12
Others		17,013		
TOTAL INCOME		**350,047**	10	
		P/L		

Chirchik City Vodokanal's revenue is derived from sales of water supply services and sewage treatment services, which is similar to that of Tashkent Vodokanal. The sales of water supply services amounted to 186 thousand sum, which represents 53% of the total sales of 350 thousand sum. The cost of water supply services was 121 thousand sum or 65% of the water supply sales. On the other hand, the cost of sewage treatment services was 61 thousand sum and this amount represents 41% of the total sewage treatment sales.

Comparing these figures with Tashkent Vodokanal's, Chirchik City Vodokanal relies on sales of sewerage more than Tashkent Vodokanal does. This difference may be caused by the difference in the tariff table structure between Chirchik City Vodokanal and Tashkent Vodokanal.

The source of Chirchik City's water supply is as follows: 16.6 thousand m3 is underground water and 22.2 thousand m3 is surface water. Chirchik City has abundant underground water resources.

The Chirchik City's water supply sales consist of metered and non-metered sales. Regarding non-metered sales, the water distribution volume in Table 4.2 includes some assumptions similar to those made for Tashkent Vodokanal. Therefore the water distribution presented is not the actual quantity, and this means there is no accurate actual rate for the water sales.

(2) Cross Subsidies

Water users are classified as follows:

Population

Communal Enterprises

Industry, Transportation, Construction

There is a cross subsidy system between the population and the other users, similar to that of Tashkent Vodokanal; however, the cross subsidy of Chirchik City Vodokanal is larger.

Communal Enterprises include budget organizations and commercial enterprises. As shown in Table 4.2.2, water sales to the population represent only 17% even though their percentage of the water supply volume is 72%. On the other hand, the proportion of water sales to others is 46% even though their percentage of the water supply volume is 13%. "Others" means industrial companies whose water consumption volume may be high. The reason why the Chirchil City Vodokanal relies on such companies is that Chirchik is an industrial city. Chirchik City Vodokanal has delayed paying employee salaries similar to Tashkent Vodokanal. Even though Tashkent Vodokanal might increase the tariff to solve any such financial problem, Chirchik City Vodokanal has resorted to a bank loan to de so, as mentioned above.

(3) Income Recognition

Same as Tashkent Vodokanal

(4) Method of Measuring Water supply sales

Same as Tashkent Vodokanal

The present status of the meter installation program is shown in Table 4.2.3.

Table 4.2.3 Status of Water Meters

	Total	With meters	Percentage
Enterprises			
-Budget organization -Others	397	80%	80%
Population			
Householders	9,000	30	0.3%
Apartments	26,423	1	0%

(5) Method of Tariff Collection

The method of collection is outlined in Chapter 3.3.1 under "tariff collection."

(6) Tariff Status of Collection

The balance of accounts receivable as of December. 31, 1998 was 20,351 thousand sum (Note C) and sales amounted to 350,047 thousand sum. The turnover period for tariff collection is approximately 0.7 months and this may not be so financially different from the global average. Table 4.2.4 presents the status of tariff collection in the first half of 1999. As shown in Table 4.2.4, collection from the budget organizations is not good. On the other hand, collection from the population and others looks good because the percentage of accounts collected collection proportion exceeds 100%.

Table 4.2.4 Status of Tariff Collection

Users	Billing (Thousands of Sum)	Collection (Thousands of Sum)	Coverage (%)
Population	31,365	33,269	106
Budget Organization	68,502	42,127	61
Others.	86,552	100,468	116
Total	186,419	175,866	94

1) Status of collection from budget organizations

The sales department prepares a summary of delinquent account receivables (those still were not collected over 90 days from the billing date). Almost all delinquent account receivables are from the budget organizations. Table 4.2.5 shows a summary of delinquent account receivables for budget organizations. Offsetting an account receivable account an account payable for budget organizations is the main method of settlement of the receivables. From budget organizations, however, the Chirchik City Vodokanal generally does not have accounts payable from budget organization as does the national education department of the city or the medical association, etc. As a result of our interviews, we noted that the possibility of collecting account receivables from such budget organization seems to be low.

Table 4.2.5 Summary of Delinquent Account Receivables from Budget Organization

Name of organization	Bal (thousands of sum)
GORONO (City National Educ. Dept)	6,574
Gorzdrav (City territorial Medical Assoc.)	4,997
"Electro-chemical Industry" association	4,196
Municipal enterprise. for Heating & Power	2,375
Uzbek Complex of Refractory Materials	2,230
GAS. VODOKANAL	967
Others	2,286
TOTAL:	**23,625**

2) The status of collection from the population and others

The reasons why collection from the population and from others exceeds 100% is as follows;

i) The amount of collection includes the amount collected from accounts receivable of previous years.

ii) Almost all the population pays in advance. Householders pay 1 year in advance and the population living in apartments pay 3 months in advance.

3) Difficulty in collection

Chirchik City Vodokanal collects tariffs from the population by visiting their homes and talking with them face to face. Collection activities are time-consuming for Chirchik City Vodokanal's employees because they collect not only on weekdays but also on weekends. Chirchil City Vodokanal formerly had JEK collect the tariff.

However, JEK is an organization which supports public services including collecting the tariffs not only for water supply but also for gas, electricity, etc., and there were some related problems, if the population was unsatisfied with certain other public services, they did not pay any tariff including the charges for water supply services. Therefore Chirchik City Vodokanal gave up collecting tariffs through JEK, and Vodokanal now collects these itself. However, Chirchik City Vodokanal has another problem in that it is difficult to impose a penalty on households in the population by stopping their water supply because JEK mainly controls the water valves.

(7) Production Unit Costs

Table 4.2.6 presents a breakdown of costs

Table 4.2.6 Breakdown of Costs

item	Water supply	%	Sum/m3	Sewage	%	Total	%
Materials	6,230	5	0.20	5,532	9	11,762	6
Power	87,647	72	2.82	23,299	38	110,946	61
Main production salary	5,192	4	0.17	3,328	5	8,520	5
Social Insurance	2,077	2	0.07	1,331	2	3,408	2
Capital repair	2,697	2	0.09	11,498	19	14,195	8
Amortization	4,237	3	0.14	1,605	3	5,842	3
Others	13,555	11	0.44	14,288	23	27,843	15
Sub- total	121,635	100	3.92	60,881	100	182,516	100
(expense for the period)						8,373	
Total						190,889	

Table 4.2.7 presents the cost breakdown between the Chirchik City Vodokanal and other countries.

Production cost per unit is 3.92 Sum/ m3, as calculated (121,635 thousand Sum/ 31,062 thousand m3) from Table 4.2.6. The principal variable costs consist only of the cost of materials and electric power, and the variable production cost per unit is 3.0 Sum/ m3.

The cost component of Chirchik City Vodokanal is similar to that of Tashkent Vodokanal. As a result of comparing the cost components, we noted that the expenses incurred by Chirchil City Vodokanal for electrical power are extremely high, but that personnel expenses, depreciation, and cost of repairs are lower than the comparable expenses in other countries. Analysis of expenses for power, depreciation and repair is presented later. The rate of personnel expense is lower, on the other hand; however, the population served by each employee of Chirchik Vodokanal is lower as well. This means that the productivity of the employees is not high, but that Chirchik City Vodokanal succeeds in keeping personnel expenses at a relatively low level. On the other hand, generally speaking, the low salary level may, in general, discourage employee motivation. The rate of the expense of power is significantly higher, as the unit cost for Chirchik City Vodokanal is double that of Tashkent Vodokanal. The difference in unit cost between Chirchik City Vodokanal and Tashkent Vodokanal is mainly due to the difference in the unit power cost. Table 4.2.8 presents an outline of the power expense of Chirchik City Vodokanal.

Table 4.2.7 Comparison of Capacity and Breakdown of Costs among Chirchik and Other Countries

Location			Japan (97)		Developing countries
	Chirchik	Tashkent	Tokyo	Nagano	
GDP per capita (US$)	510				2,861
Population served (Thousands of personnel)	145	2,110	11,103	565	5,827
Rate of service pervasion (%)			98.5	32.0	81
Total annual water supply volume (mil m3)	31		1,689	21	
Maximum daily water supply volume (thousand m3)			5,413	70	
Average daily water supply volume (thousand m3)					935
Water tariff collection method (%) (B/K transfer) (Not B/K transfer) (Using collector staff)			 76.6 23.4 -	 89.5 10.5 -	
Number of employees	433	4,490	5,540	58	3,138
Rate of accounted for/paid water tariff (%)			89.2	84.8	65
Turnover of accounts receivable (months)	0.7	2.2			3.7
Population served by each employee	334	490	2,176	3,477	1,856
Average tariff (per m3)					US$ 0.348
Production unit cost (per m3)	3.92 sum	2.11 sum	210 yen (US$ 1.98)	162yen (US$ 1.53)	US$ 0.172
Personnel expenses (%)	4	10	16.7	16.6	
Depreciation	3	10	18.9	25.9	
Power expenses	72	48	2.9	5.5	
Materials (%)	5	6	0.6	0.5	
Repairs (%)	2	4	21.4	11.8	
Outsourcing expenses (%)	0	0	6.7	2.1	

Table 4.2.8 Outline of Power Expenses

	Usage	Reactive	Capacity	Total
Tariff (Sum/KWh)	2.8875	0.207	486.1	
Volume (Thous.Kwh))	32,260	15,600	41	
Amount (Thous.Sum)	93,151	3,229	19,930	116,310

(8) Taxes (Note 5)

The tax structure is the same as that of Tashkent Vodokanal.

(9) Net Income (Note 6)

Considerations for the appropriation of net income is the same as those for Tashkent Vodokanal.

Table 4.2.9 shows the balance sheets of Chirchil City Vodokanal.

Table 4.2.9 Chirchik City Vodokanal Balance Sheets

(Unit : Thousands of Sum)

		12/31/97	12/31/98
ASSETS			
Fixed assets:			
Acquisition costs	Note a	82,991	88,573
Accumulated depreciation	Note b	(27,169)	(33,113)
Net book value		55,822	55,460
Total of Fixed Assets		55,822	55,460
Current assets:			
Inventories		19,250	12,450
Money resources		2,910	1,936
Debtors:			
*settlements with buyers and users	Note c	17,002	20,351
*settlements with budget		252	1,349
*settlements with subsidiary enterprises		6,754	11,567
Others		114	
Total of Current Assets		46,282	47,653
TOTAL assets		102,104	103,113
Capital			
Charter capital	Note d	48,119	48,119
Additional capital	Note d	23,198	26,159
Reserve capital		8,629	
Total of Capital		79,946	74,278
Liabilities			
*suppliers	Note e	4,732	3,512
*budget indebtedness	Note f	3,470	6,322
Accounts payable - payroll	Note f	5,531	10,442
Accounts payable - social insurance		3,707	5,549
Accounts payable - non-budget payments		223	384
*other payables		4,494	2,626
Total of Liabilities		22,157	28,835
Capital and Liabilities		102,103	103,113

(10) Fixed assets (Note a)

How the fixed assets are booked is the same as the method followed by Tashkent Vodokanal.

(11) Increase in Amount of Investments

The Chirchil City Vodokanal is planning an expansion of its sewage network, but there is not enough budget from the government to implement this plan.

(12) Construction

Dealings with local construction companies are the same as those of Tashkent Vodokanal.

(13) Inflation Accounting

Inflation accounting is applied in the same way at both Chirchik and Tashkent Vodokanal.

(14) Depreciation

Depreciation is accounted for by the same method that followed by Tashkent Vodokanal and depreciation expense is small, considering the need for replacement in the future.

Table 4.2.10 Summary of Fixed Assets (Units : Thousands of Sum)

Items	Balance
CANALIZATION NETWORKS	23,343
OPEN WATER COLLECTORs	16,362
WATER TREATMENT PLANT 1 BASIN	10,478
WATER SUPPLY NETWORKS	9,601
WATER SUPPLY BUILDING	6,952
GARAGE	6,774
2 BASINS	4,890
WATER SUPPLY EQUIPMENT	3,533
FIRE FIGHT. EQUIPMENT	2,276
MANAGEMENT	1,374
WAREHOUSE	1,205
ELECTRICAL EQUIPMENT	671
RECREATION ZONE	404
LABORATORY	278
Other	431
TOTAL FOR THE ENTERPRISE	88,573

Table 4.2.11 Depreciation rate

Items	Rate (%)
Buildings, Construction	5
Cars	20
Trucks	15
Equipment, Office Furniture	15
Computers	20

Table 4.2.12 Breakdown Of Fixed Assets (Units : Sum)

0010 Water Supply Equipment					
Card No.	Item	Rate %	Commission date	Quantity	Balance cost as of the beginning of the month
1782	Single-beam travelling crane	15	01.1980	1	31,666
2709	Electric engine AIR 31520	8	06.1995	1	160,000
2750	Electric engine 110	8	04.1996	1	123,180
2751	Electric engine 630 kW	8	02.1997	1	400,000
2902	Pump ETSV-10-160-35	15	11.1998	1	150,000
Others					2,668,574
	Sub-total				
	TOTAL				3,533,420

0013 Water Treatment Plant, 1 Basin		
Card No.	Item	Balance Cost
1279	Reinforced concrete aerotanks	845,397
1304	Concrete aerotanks	1,013,133
2894	Gas signaling device MERAN	558,000
2898	Mechanical rake	974,000
Others		7,087,620
	TOTAL	10,478,150

0019 Open Water Collector					
Card No.	Name	Rate	Commission date	Quantity	Balance cost as of the Beginning of the month
1980	Building of main facilities	15	12.1991	1	1,796,320
2048	Reagent block building	5	12.1990	1	1,716,803
2128	Filtering plant building	5	12.1990	1	1,014,633
2241	Build. of industry pump station	5	12.1990	1	269,226
2324	Chlorinating room	5	12.1990	1	405,553
2400	Auxiliary rooms	5	12.1990	1	462,550
2796	Asynchronous electric engine 500 kW	8	07.1996	1	552,000
2845	electric pump D-2500M62	15	12.1996	1	120,000
Others					10,025,020
	TOTAL				16,362,105

(15) **Physical Control over Fixed Assets**

The manner of the physical control of fixed assets is similar to Tashkent Vodokanal's, but it is not as strict as Tashkent Vodokanal. Chirchik City Vodokanal is gradually implementing EDP system .

(16) **Capital (Note d)**

The same as Tashkent Vodokanal

(17) **Accounts Payable (Note e)**

The same as Tashkent Vodokanal

(18) **Accounts Payable to Employees (Note f)**

The same as Tashkent Vodokanal

(19) **Cash Flows**

The same as Tashkent Vodokanal

(20) **Investment Plan**

The mid- and long-term plans of Chirchik City Vodokanal are drafted by Tashkent State Vodokanal, and Chirchik City Vodokanal has requested development of its sewage system rather its than water supply system. However, the remaining durability of most facilities might be less than 10 years, and it is estimated that repair and maintenance costs will increase gradually.

4.2.4 Communication with Users

The present situation and problems with the public relations activities for educating users' awarenedss of water conservation and user participation management style in Chirchik City Vodokanal are basically the same as those of Tashkent City Vodokanal (refer to 3.2.4).

4.3 Tariffs

4.3.1 Current Water Tariffs and Tariff Policy

(1) Current Tariff Table

Table 4.3.1 is the current tariff table as of August 31, 1999.

Table 4.3.1 Present Tariff Table

	Users	Water Supply	Sewage
Norma (Fixed rate)	Population	72 Sum/m3 $=3.0$ Sum/ $m^3 \times 0.4$ $m^3 \times 30$ days $+3.0$ Sum/ $m^3 \times 0.4$ $m^3 \times 30$ days	
Metered rate	Population	3.0 Sum/	3.0 Sum/ m^3
	Budget Organizations	23.40 Sum/ m^3	5.25 Sum/ m^3
	Self-accounting Communal Organizations	23.40 Sum/ m^3	5.25 Sum/ m^3
	Production, Transportation, and Construction	23.40 Sum/ m^3	5.25 Sum/ m^3

Value Added Tax (VAT). A VAT rate of 20% is charged on the amounts presented above.

(2) Current Tariff Policy

The current tariff policy is the same as that of Tashkent Vodokanal.

The present factors used in calculating the tariff table are as follows:

① Estimating the total unit cost based on the production plan

② Forecasting the necessary revenues as the total unit costs; plus an appropriate margin;

③ The tariff for the general population is determined politically by the government of Chirchik City and the revenue to be generated from the population is estimated at this tariff times the forecasted volume of consumption;

④ Revenues from budget organizations, self-accounting communal organizations, production, transportation, and construction, etc. are calculated by forecasting the necessary revenues (②) and subtracting this amount from the revenues to be generated from the population (③); and

⑤ The tariff for budget organizations, self-accounting communal organizations, production, transportation, and construction, etc. is calculated by dividing the projected revenue (④) by the forecasted volume of consumption.

The tariff table is usually revised semiannually due to the high rate of inflation in Uzbekistan and depending on whether or not there is any shortage in Vodokanal's cash flows. In other districts, the Vodokanal's usually forecast revenues and costs for one year.

The tariff for the general population is determined politically and is currently 3.0 Sum/m3. However, the calculation of the production unit cost is based on the revenue statement as of December 31, 1998, which came to 3.91 Sum/m3 and, thus, the tariff for the population cannot fully cover the unit cost. There is presently a differential of approximately 7.8 times between the utility fees charged to users in the general population and those charged to other users. This, in effect, amounts to a "cross subsidy" for the population.

The government of Tashkent Province has developed a plan for its water supply which is based on the plan of Tashkent City. The plan of Tashkent Province is outlined in the following:

① To end the cross subsidy to users in the population (whose costs are currently the borne by other users) by the year 2002 under orders of the mayor of Tashkent;

② To install meters for all users by the year 2004;

③ To charge the cost of installation of these meters back to the users; and

④ To continue funding new investments from the government's budget.

(3) Desirable Water Tariff Policy for a Self-Supporting System under a Market Economy

Please refer to 3.3.1 (3).

(4) Points to Be Improved in the Current Water Tariff Policy of Chirchik Vodokanal

As a result of comparing the current water tariff policy of Chirchik Vodokanal with that for self-supporting system in a market economy, we noted certain points to be improved, which are the same as those identified for Tashkent Vodokanal. These are outlined as follows.

1) High Volume of Consumption by the Population

The current water consumption in Chirchik on the whole, including the consumption of industries, exceeds 1000 liters per capita per day. The results of the study showed that, in particular, the general public consumes 548 liters a day. This figure far exceeds the level of the worldwide standard, which is 200 to 250 liters. A leading cause of this is the water leakage (wastage of water) from toilets in residential premises. To tackle this issue, a plan is now underway to install meters in all households. However, this plan has not worked out effectively as it puts an enormous financial burden on the users as shown in Figure 4.3.3 below. This burden also applies to the users in individual (private) houses. Meters have not been installed in most apartment buildings.

2) Installation Costs for Meters and Cost Burden

The type of meter installed for the population is a standard size with a diameter of 20mm and a likely cost of 18,000 Sum per meter. The local government has determined that all users have to bear this cost. However, considering that the population's average income per month is less than 13,000 Soum nominally, and the survey results shows approximately 10,000 sum in Chirchik, this puts a enormous burden on the population. A large number of the population still can not afford this cost, and this leads to a poor record of installation cost collection. The income level of the apartment residents is lower than that of the residents living in individual houses. This means that the difficulty in bearing the installation cost for the general public is more serious among apartment residents.

3) Cross Subsidies

Unless meters are installed, there is no way of collecting water tariffs other than by imposing a fixed cost on the population. Furthermore, needless supply costs are being generated because there is a low level of awareness of the need for water conservation among the people.

This issue has created a cross subsidy system for water supply costs between the population and corporations as the fixed cost charged to the population has been deliberately set at a low level as governmental policy. The shift of the cost burden to corporations has resulted in their billing charged a usage-based rate.

Although the central government has announced targets to resolve this cross subsidy, the gap tends to be widening as most meters have not yet been installed.

4) Differences in the Area Covered by Water Tariffs

New investments are funded from the city or state budget and Tashkent Vodokanal and Chirchik Vodokanal are not required to fund new investments. Accordingly, the basic concept of the water tariff for Tashkent Vodokanal and Chirchik Vodokanal is to cover operating costs and not to cover new investments. Table 4.3.2 presents the differences in the areas covered by water tariffs.

The differences in the areas covered by water tariffs are outlined in detail in 3.3.1 (4) and so please refer there.

Table 4.3.2 Differences in the Areas Covered by Water Tariffs

Types of cost	Tashkent Vodokanal and Chirchik Vodokanal	Basic Concept	Japan
Operating costd	O	O	O
Cost of meters	×	O	O
Capital costs	×	O	O

5) Philosophy for Revised Tariff Table

We believe a the tariff policy should be established for a long term and we prepared the long-term plan presented later in Chapters 7.4 and 8.4. On the other hand, we also considered a revised short-term tariff table (effective for 2 to 3 years) based on the following factors, which is same as the case of Tashkent Vodokanal, and is outlined as follows:

i) Applicable to users with and without meters.

ii) Consideration for low-income families

iii) Incentives for promoting conservation of water

iv) Percentage of water tariff to the total cost of living

v) Elimination of cross-subsidies

vi) Applicable for the next 2 to 3 years

vii) Comparison of costs used in preparation of the proposed table with actual costs anticipated in the future as a measurement of management efficiency

viii) Maintaining the current schedule for the installation of water meters

To review the philosophy and approaches in further detail, please refer to 3.3.1(5).

(6) Global Average

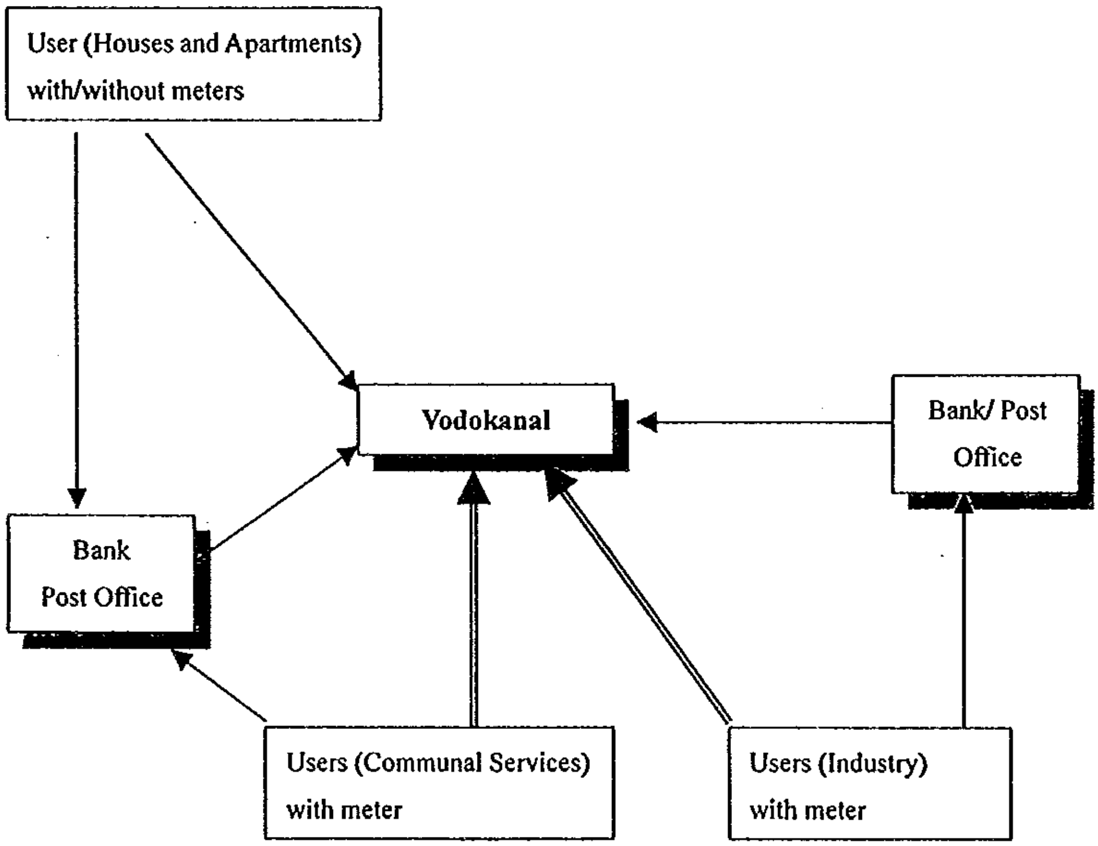
We examined global average for the water supply business with reference to our proposal for the revised tariff table. For details of these global average, please refer to 3.3.1 (6).

4.3.2 Tariff Collection System

(1) Outline of Present Tariff Collection System

The present tariff collection system in Chirchik City classified by categories is roughly illustrated in Fig. 4.3.1:

Fig. 4.3.1 Present Tariff Collection System



Note 1: ——→ is payment.

Note 2: ⟹ is offset.

Note 3: VOD is the Vodokanal.

(2) Installation of Water Meters

At present, tariffs based on meter readings are applied to about 0.3 percent of the individual houses, 0.1 percent of the apartments, 100 percent of the communal service sector and 100 percent of the industries, in terms of number of users, respectively. As a metered rate tariff for the population was enforced only effective 1999, the effect of the system cannot be sufficiently determined. Unlike in Tashkent, Chirchik Vodocanal has conducted both meter readings and tariff collection themselves. Because of their low level of computerization, the tariff calculation has mostly been computed manually.

(3) Collection Procedures

Bills are not sent by mail, but are delivered directly to the residents in detached houses. Regarding communal service sector and industries, consumption statements or meter reading forms are first handed to users, and bills are not issued in principle.

(4) Role of JEK

All tariff collection is conducted by Chirchik Vodocanal and the repairs and maintenance of the water equipment inside the apartment buildings is entrusted to JEK. As technical compensation, a commission of 25 percent of the total tariff collection is paid to JEK.

Payments from users are accepted at post offices (27 percent), habitant banks (20 percent), Uzjilsotsbank (7 percent), and by the collectors of the Vodokanal (46 percent) in terms of amount of collection. The payments are recorded in the customer ledger and the deletion of payment is made.

(5) Collectability

As shown in Figure 4.3.5, payments may be in cash or by the offsetting. Offsetting is made for customers in the communal service sector and industry categories.

In 1998, the collection ratio is 106 percent for residents (including the transfer amount), and 61 percent for communal service sector and 116 percent for industries (including the transfer amount).

The present collection system is summarized in Table 4.3.3.

Table 4.3.3 Summary of Tariff Collection System

User's categiry		number of users	meter reading	collection or contract	payment/billing method	payment place or settlement	commission	period of payment	repair and maintenance (inner house)
House	with meter	26	VOD, with user, quarterly (inspection)	VOD	refer to (2) Flows of Payment/Billing Method	banks, post offices, VOD direct	4% as Bank	monthly, quarterly yearly	user
	without meter	9,312	-	VOD	same as above	same as above	same as above	same as above	user
Apartment	with meter	43	VOD, with user, quarterly (inspection)	VOD	same as above	same as above	(4% as Bank) (25% to JEK)	same as above	JEK
	without meter	36,371(about 650	-	VOD	same as above	same as above	same as above	same as above	JEK
Communal	with meter	184	VOD, with user, monthly (inspection)	VOD	same as above	banks, VOD (offset)	4% as Bank	monthly	user (almost all) VOD
	without meter	0	-	-	same as above	-	-	-	-
Industry	with meter	403	VOD, with user, monthly (inspection)	VOD	same as above	banks VOD (offset)	4% as Bank	monthly	user (almost all) VOD
	without meter	0	-	-	same as above	-	-	-	-

Note1: VOD is Vodokanal.

(6) Function of Controller

Each controller is responsible for a particular district. The number of controller is 16 for apartments and 11 for enterprises and residential houses.

The controllers handle all the services – reading the water meters, billing, collection of tariffs, and control of outstanding bills - for their own users.

Job rotations seldom happened except when it is necessary. One controller offers all services to the same users for a long period.

(7) Cycle for Meter Reading and Billing

The cycle for each procedure is shown in Table 4.3.4. Basically the fruquency of payment depends on that of the billing and any change in tariffs. The users charged under the "norm" system can pay monthly, quarterly, biannually or annually, as they like.

Table 4.3.4 The Cycle

	Enterprises	Houses		Apartments
		Norm	Non-Norm	
Reading water meters	Every month	N/A	Once a quarter	N/A
Billing	Every month	Once per year Once per quarter Once per month	Once per quarter	Once per year Once per quarter Once per month

(3) Issues and Problems

As a result of our questionnaire survey 14 percent of the population (the individual users) want to pay the water tariff by means of automatic transfer from banks. This shows that users are looking for a convenient place to pay.

Issues and problems with the tariff collection system classified by category are summarized as follows.

1) Houses with Meters

i) Because the meters often break down, the trust of the users in the metered rate system is declining. Therefore, the inspector first confirms whether or not the meters working correctly. Of it is broken, the fixed rate tariff is applied. Because the metered rate tariff only started this year, the system is not operates yet smoothly.

ii) Because of the location of meters inside the houses or the cases of broken meters, the inspectors check/read the meter value with attendance of users. When the user is not available, the inspector must visit consequently once again.

iii) As the meter sometimes is installed in a restroom in the house, meter reading is not smoothly done.

iv) Information by metered rate system is not sufficient for users.

2) House without Meter

i) The tariff calculation for fixed rate system, based on the family number, facility contents and others, is rather complicated.

ii) There is no way to measure the consumption volume of users. Water conservation consciousness of users has not been matured.

iii) Because there is not a meter, there is no way to know a leak of water in a house.

3) Common Comments on House

i) There are some payment periods by which it is difficult for smooth tariff collection to be done. Therefore the setting of arrears becomes illegible.

4) Apartment with Meter

i) Same as 1) i

ii) In spite of the largest number of users, there are comparatively few numbers of meter installations.

5) Apartment without Meter

i) Same as 2) ii

ii) Same as 2) iii

6) Common Comments on Apartment

i) Same as 3) i

ii) The commission of repair and maintenance to JEK is 25 percent of the collection amount and it consequently aggravates water supply services management.

7) Communal Service Sector/Industry with Meter

i) Same as 1) i

ii) Same as 1) ii

iii) Same as 1) iii

iv) The water tariff payment is apt to delay because of the lack of subsidy from the government or the management slump. Because of large users in arrears, the influence given to the Vodokanal is serious.

v) This category is the lowest tariff collection rate (61 percent) compared with another categories.

4.3.3 Water Tariff Setting Process

The process of setting the water tariffs in Chirchik City is summarized in Table 3-3-8 in Section 3.3.3. When compared with the process and system in Japan, the following issues have been identified as future improvements.

(1) The Planning and Economic Department is solely responsible for the preparation of the draft tariff revision proposal. This is exactly the same as the system in Yokohama City, but the consultation process is fragmented. The department needs to consult the other departments for the required data and information, and to obtain their opinions. This would be a time-consuming and ineffective process. Data sharing on a day-to-day operating basis and easy and efficient data retrieval would improve the efficiency of the relevant operations of the Planning and Economic Department. For this purpose, the effective use of computers and data storage and retrieval systems are recommended.

(2) As noted in 3.3.3 regarding the tariff setting process in Tashkent City, plans to promoto rationalization and efficiency in Chirchik City Vodokanal's waterworks management, both technical and organizational, should be given due consideration.

4.3.4 Tariffs of Other Communal Services

For the same reasons as noted in the case of Tashkent City, all tariff changes decided from 1991 to the current rates in Tashkent Province were collected from the TCMA of Tashkent Province, as attached in DATA 4-3-401. Based on this data, the JICA Study Team developed a table and a figure showing the tariffs for communal services at the end of each year from 1994 to 1999 (July).

The following developments can be seen from Table 4.3.5 and Figure 4.3.2.

(1) Hot water, wasted water and gas tariffs have soared: hot water 214 times, wastewater 219 times and gas 629 times. According to the officers in charge, the recent sharp increases in gas and electricity costs explains everything about the sharp tariff hikes for these services.

(2) Cold water supply, and electricity tariffs have increased moderately: cold water supply 151 times, electricity 100 times.

(3) Natural gas and dwelling area tariffs have remained steady. Natural gas has increased 8 times and dwelling are, 24 times.

Table 4.3.5 Tariff Changes for Communal Services in Tashkent Province

from 1994 till 1999 (as of 16 July 1999)

Communal Services / Year (end)	heating @m²	hot water @person	cold water @person	waste water @person	gas @person	natural gas @kg	electricity @kw	dwelling spaces @m2
1994	0.04	0.42	0.16	0.16	0.04	0.18	0.20	0.24
1995	0.86	8.40	1.30	1.05	0.68	4.00	3.00	2.35
1996	1.00	18.00	6.48	8.42	4.19	1.50	6.00	3.44
1997	2.00	50.00	8.10	10.53	12.57	1.50	10.00	4.79
1998	4.50	90.00	18.22	26.32	25.16	1.50	20.00	5.97
1999(July)	4.50	90.00	24.30	35.10	25.16	1.50	20.00	5.97

Figure 4.3.2 Tariff Changes in Tashkent Province