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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Ministry of Macroeconomics and Statistics
Ministry of Communal Services
City of Tashkent

THE REPUBLIC OF UZBEKISTAN

6

The Study Report for Improvement of Management and Tariff Policy in Water Supply Services in the Republic of Uzbekistan

FINAL REPORT

SUPPORTING REPORT

MARCH 2000

Showa Ota & Co.
Nippon Jogesuido Sekkei Co., Ltd.

JAPAN INTERNATIONAL COOPERATION AGENCY

THE MINISTRY OF MACROECONOMIC AND STATISTICS
THE MINISTRY OF COMMUNAL SERVICES
THE REPUBLIC OF UZBEKISTAN

THE STUDY

FOR

IMPROVEMENT OF MANAGEMENT AND TARIFF

POLICY

IN

WATER SUPPLY SERVICES

IN

THE REPUBLIC OF UZBEKISTAN

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SUPPORTING REPORT

S.2.3 Other Influential Aspects

S.2.3.1 Present Situation of Computerization in the Country

Table S.2.3.1 Information and Computing Services in Asia & Pacific region

(Unit: million US Dollar)

	Production	Growth Rate (%)	Domestic Market Sales	Growth Rate (%)
Japan	65,669	6.80	65,617	-2.80
Australia	4,138	12.60	4,335	-1.30
Korea, Republic of	4,024	-6.50	4,381	-14.60
Taiwan	2,063	8.60	2,455	13.20
New Zealand	284	-66.50	967	24.30
Malaysia	200	-2.40	865	42.30
Singapore	590	-62.30	1,100	15.30
India	2,803	53.90	950	-9.20
Thailand	250	16.80	521	10.60

Asian-Oceanian Computing Industry Organization (ASSOCIO), 1998

Table S.2.3.2 Trade of Automatic Data Processing Equipment

Uzbekistan (Unit : Thousand US$)

Import		Export	
US	5,572	Germany	64
UK	5,167		
Germany	4,624		
France	1,652		
Netherlands	997		
Others	970		
TOTAL	18,982	TOTAL	64

Kazakhstan

Import		Export	
UK	4,093	Netherlands	50
France	3,859	UK	35
US	2,278		
Germany	1,824		
Ireland	619		
Others	1,647		
TOTAL	14,320	TOTAL	85

Kyrgyz

Import		Export	
Finland	341	Germany	37
US	263		
Germany	239		
UK	134		
Denmark	37		
Netherlands	42		
TOTAL	1,056	TOTAL	37

Tajikistan

Import		Export	
Japan	384	US	194
TOTAL	384	TOTAL	194

Turkmenistan

Import		Export	
Germany	208	Italy	48
Israel	188		
US	124		
Belgium	34		
France	32		
TOTAL	587	TOTAL	48

"1996 Supplement to World Trade Annual", the United Nations, 1997

Table S.2.3.3 Number of Employees by Sector

(Unit: Thousand)

	1994	1993	1992	1991	1990
Total	8,150.3	8,259.0	8,271.4	8,322.8	7,940.8
Industry	1,067.1	1,222.1	1,202.1	1,213.1	1,201.4
Agriculture, Forestry, Fishery	3,607.2	3,681.1	3,656.4	3,554.9	3,120.2
Construction	519.5	556.5	588.9	679.6	710.0
Transport & Communication	342.1	336.0	356.4	369.0	401.5
Commerce	565.2	521.3	476.3	511.5	458.6
Information & Computing	2.8	6.2	7.6	12.0	13.5
Other manufacturing	178.1	124.3	133.9	129.3	130.3
Health	485.9	467.0	488.5	486.2	468.0
Education	1,038.0	989.0	982.1	950.0	997.8
Science	41.9	64.7	77.2	100.7	103.4
Finance & Insurance	34.3	28.5	25.0	24.9	23.3
Government	83.9	90.3	113.2	126.0	118.9

"The study report of development assistance for Central Asia Region", p. 65, International Development Center, 1996, Tokyo

Table S.2.3.4 Employees Ratio by Type of Companies

(Unit : %)

	State Enterprises		Private Enterprises		Joint Venture with Foreign Investors	
	1996	1991	1996	1991	1996	1991
Uzbekistan	36.0	96.7	52.0	0.0	12.0	3.3
Kazakhstan	83.0	93.1	12.8	1.1	4.2	5.8
Kyrgyz	71.4	92.3	14.3	7.7	14.3	0.0
Tajikistan	n.a.	90.6	n.a.	6.3	n.a.	3.1
Turkmenistan	100.0	86.4	0.0	13.6	0.0	0.0

Source: "CIS Statistical Yearbook '97", 1998

S.3.3 Tariff

S. 3.3.2 Tariff Collection System

(1) Flow of Payments/Billing Method

The present flows of payments/billing method are described below.

1) Houses with Meters

The functions of "Controller" is to read meter, to calculate charges to issue bills, to collect tariff, to collect delinquent tariff bills. "Controllers" fill in the meter reading sheets in the presence of the users, and give a part of the meter reading form to each user as a bill. The users pay either to a "controller", at a bank or at a post office. Payments remitted at banks and post offices are then transferred to the Vodokanal's account.

2) Houses without Meters

Controllers issue a bill to each user, and the users pay either to a collector, at a bank or at a post office. In rare cases, users come directly to a bank, fill a bill themselves, and then pay the tariff. Collections by visiting users are conducted approximately four times a year. Payments remitted at banks and post offices are then transferred to the Vodokanal's account.

3) Apartments with Meters

"Controllers" or JEK staff fill in the meter reading sheets in the presence of the users, and issue a bill to each user. The users pay the tariff either directly to JEK or at a bank. Payments remitted to JEK are the transferred to the Vodokanal's account.

4) Apartments without Meters

Bills are kept by the users and are mainly paid to JEK, of are sometimes paid at a bank. Sometimes the users themselves fill in the water tariff forms. Payments remitted to JEK are then transferred to the Vodokanal's account.

5) Communal Services Sector Enterprises with Meter/Industry with Meter

"Controllers" fill in the meter reading sheets in the presence of the users, and give copies of these to the users. At the Vodokanal, the accounting staff make four copies of the bills. Two copies are handed to the tax collection bureau, while the others are handed to the banks. At the tax collection bureau, settlements can be made by offsets based on the bills. When there is no user bank account, the users complete the bills at the Vodokanal which pays the tariff to the banks.

6) Communal Enterprises without Meters/Industries without Meters

"Collectors" determine the volume of consumption which is computed according to pipe diameter, pressure, scale of building and other, and issue the user a copy of the information. In the Vodokanal, the accounting complete the bills and make four copies. Two copies are handed to the tax collection bureau, and the others are handed to the banks. At the tax collection bureau, settlements can be made by offsets based on the bills. When there is no user bank account, the users complete the bills at the Vodokanal which pays the tariff to the banks.

Tables S.3.3.1 Issues and Problems Tables S.7.3.1 Countermeasures and Proposed solutions

Tashkent City			
User's category		Issues/Problems	Countermeasures/Proposed solutions
House	1)with meter	<1>Meters are easy to break; <2>Meter reading is conducted with user, resulted in passing many times if user is absent; <3>Meters are attached in a house, where is difficult for meter reading; <4>Notification of metered system is not operated sufficiently.	<1>Adoption of improved meters such as plastic-material/water-proof meters; <2>Abolition of attendance of user by locating a meter easy to read; <3>Make up the meter settlement criteria; <4>Introduction of Meter reading logger/Handy terminal; And, make training program of meter reading.
	2)without meter	<1>Tariff tables calculated by instrument etc., are complex; <2>There is no consumption control of users; <3>It is impossible to find out inner/outer house leakage because of no meters.	<1>Simplification of tariff table caluculated by number of instrument/family; <2>Early sifting to metered system by means of certain plannings; <3>Same as above.
	3)common	<1>There are some payment periods resulted in complexity; <2>This category is the lowest collection ratio (64%) compared to another categories.	<1>Clarify/Unification of payment priods; <2>Adoptionn of discount rate system at early payment.
Apartment	4)with meter	<1>Meters are easy to break; <2>Meters are at present few compared to another categories; <3>Administrators of meters are VOD and JEK, resulted in difficulty of maintenance.	<1>Adoption of improved meters such as plastic-material/water-proof meters; <2>Early sifting to metered system by means of certain plannings; <3>Clarify/Unification of management responsibility between JEK.
	5)without meter	<1>There is no consumption control of users; <2>It is impossible to find out inner/outer house leakage because of no meters.	<1>Early sifting to metered system by means of certain plannings; <2>Same as above.
	6)common	<1>Users are not informed water charge, resulted in lack of water canservation; <2>There are some payment piriods resulted in complexty; <3>Commition to JEK is expensive (54%).	<1>Information of water charges to users; <2>Clarify/Unification of payment priods; <3>Arangement of commition fee to JEK considering various commition companies.
Communal Service Sector	7)with meter	<1>Meters are easy to break; <2>Meter reading is conducted with user, resulted in passing many times if user is absent; <3>Meters are attached in a house, where is difficult for meter reading; <4>Meters are attached deep location resulted in difficulty of meter reading.	<1>Adoption of improved meters such as plastic-material/water-proof meters; <2>Abolition of attendance of user by locating a meter easy to read; <3>Make up the meter settlement criteria; <4>Same as above.
	8)without meter	<1>Caluculation of ACT is rather complex; <2>There is no consumption control of users; <3>It is impossible to find out inner/outer house leakage because of no meters.	<1>Simplification of tariff table caluculated by instrument; <2>Early sifting to metered system by means of certain plannings; <3>Same as above.
	9)common	<1>Deleyed payment of water charge because of deficit of subsidy or business depression; <2>In future, frequency of meter reading will be high according to meter installation plan.	<1>Adequate establishment of collection level on offset (recovery for delayed payment of saraly); <2>Change from every manthly meter reading at intervals of two/three months.
Industry	with meter	(same as Communal category)	(same as Communal category)
	without meter	(same as Communal category)	(same as Communal category)
	common	(same as Communal category)	(same as Communal category)

S.4.3 Tariff

S.4.3.2 Tariff Collection System

(1) Flows of Payment/Billing Method

Present flows of payment/billing method classified by each case are described below.

1) Houses with meters

"Controllers" fill in the meter reading sheets in the presence of the users, and issue a bill to each user. The users pay either to a "controller," at a bank or at a post office. The banks and post offices then transfer the remittances to Chirchik Vodokanal's account.

2) Houses without meters

"Controllers" issue a bill to each user, and the users pay to a collector, at a bank or at a post office. In rare cases, the users come directly to a bank, fill a bill themselves and then pay the charge. Collection by visiting the users are conducted about four times a year. The banks and post offices then transfer the remittances to Chirchik Vodokanal's account.

3) Apartments with meters

"Controllers" readers fill in the meter reading sheets in the presence of the users, and issue a bill to each user. The users pay either to a "controller," at a bank or at a post office. The banks and post offices then transfer the remittances to Chirchik Vodokanal's account.

4) Apartments without meters

Bills are kept by the users and are paid either to a controller, at a bank or at a post office. The users themselves sometimes fill in the in water tariff form. The banks and post offices then transfer the remittances to Chirchik Vodokanal's account

5) **Communal services with meters/Industries with meters**

"Controllers" fill in the meter reading sheets (act) in the presence of the users, and give a copy of the AKT to users. In the Vodokanal, the accounting staff fill in the bills and make four copies. Two copies are handed to the tax collection bureau, while the others are handed to the banks. At the tax collection bureau, offsets are settled based on the bills. When there is no user's bank deposit, the users fill in the bills at the Vodokanal and pay the charge to other banks.

Table S.4.3.1 Issues and Problems

Table S.8.3.1 Countermeasures and Proposed Solutions

Chirchik City			
Users category		Issues/Problems	Countermeasures/Proposed solutions
Houses	1)with meters	<1>Meters are easily broken. <2>Meter reading is conducted in the presence of users, resulting in wasted time if the user is absent. <3>Meters are attached inside the houses, and are difficult to read. <4>Notification of the introduction of the metered system	<1>Adoption of improved meters such as plastic/waterproof meters. <2>Discontinue the requirement for the user to be present for the meter reading by installing meters in accessible locations. <3>Prepare meter installation criteria. <4>Introduction of meter reading loggers/handy terminals. Conduct training programs for meter reading.
	2)without meters	<1>Tariff tables calculated by instrument etc., are complex. <2>There is no consumption control for users. <3>It is impossible to detect leaks inside /outside the houses without meters.	<1>Simplify tariff table calculated by instrument. <2>Early shifting to metered system by means of planning. <3>Same as above.
	3)common	<1>Payment periods are long, resulting in complexity.	<1>Clarify/unify the payment priods.
Apartment Building	4)with meters	<1>Meters are easily broken. <2>Few meters at present have been installed compared to the other categories.	<1>Adoption of improved meters such as plastic/waterproof meters. <2>Early shifting to metered system.
	5)without meters	<1>There is no consumption control for users. <2>It is impossible to detect leaks inside or outside the houses without meters.	<1>Early shifting to metered system. <2>Same as above.
	6)common	<1>Payment periods are long, resulting in complexity. <2>Commission for repairs paid to JEK is high (25%).	<1>Clarify/Unify the payment priods. <2>Arrangement of commission to JEK cosidering various comission companies.
Communal	7)with meters	<1>Meters are easily broken <2>Meter reading is conducted in the presence of the users, resulting in wasted time if the user is absent. <3>Meters are attached inside houses, where it is difficult forthem to be read. <4>Delayed payment of water charges because of a deficit in subsidies or a recession. <5>This category has the lowest collection ratio (61%) of all categories.	<1>Adoption of improved meters such as material/waterproof meters. <2>Discontinue the requirement for the user to be present for the meter reading by locating the meter in a lo <3>Establish meter settlement criteria. <4>Adequate establishment of collection level for offsets (recovery for delayed payment of saraly). <5>Adoption of discount system early payment.
Industry	with meters	(same as Communal category)	(same as Communal category)

S.5.2 Analyzing Water Consumption in Tashkent City

(1) Water consumption in Tashkent City

Average water consumption in Japan is 391 liter/capita/day in 1995 as shown in Table S.5.2.1 Maximum supply amount/capita/day is 482 liter and 1.23 times as much as average supply amount/capita/day. Of that amount, domestic supply amount occupies 71.1 % and daily maximum supply amount/capita/day comes to 343 liter as shown in the below table (source: Water Supply Statistics, 1995 in Japan).

TableS.5.2.1 Water Consumption in Japan

Item Population	Distribution Volume /person/day		Home Consumption Rate(%)
	Average	Maximum	
All	391	482	71.1
Home	278	343	
<1million		492	
100,000 to 250,000		464	

Water consumption between Japan and Tashkent City is examined as follows:

A breakdown of domestic water consumption in large cities with populations more than 1million is indicated in Table S.5.2.2 (refer to Design Criteria for Waterworks Facilities in Japan). The breakdown indicates average values of the ratio of each component.

Table S.5.2.2 Water Consumption in Homes

Classification	City	Kitchen	Laundry	Bath	Washing hands	Toilet	Sweeping	Others	Total
Rate (%)	Tokyo	26	24	21	5	21	3	-	
	Kawasaki	18	32	20	12	13	1	4	
	Yokohama	16	24	28	5	23	--	4	
	Hiroshima	22	20	28	4	13	4	9	
	Fukuoka	28	29	27	--	11	--	5	
	Average	22	26	25	5	16	3	3	100
Volume (L/p.day)	Japan	76	89	85	17	56	10	10	344
	Tashkent Cold Water	38	89	42	20	56	12	40	297
	Hot Water	38		42					80
	Base	×0.5	×1.0	×0.5	×1.2	×1.0	×1.2	+30	300

If maximum domestic supply amount is supposed as 70 % of daily maximum supply amount in the large cities with population more than 1 million in 1995 in Japan.

The domestic supply amount shall be 344 liter/capita/day.

The breakdown of average domestic water consumption in Japan is calculated by multiply the domestic supply amount and average ratio.

In Tashkent City, the following conditions are different from those in Japan.

1) The citizens generally have a conception that supplied water is free of charge with waste tendency. In addition, they have another one that water supply mostly has rusty water for a while at the opening time of water faucets and supply water is necessary to continuously discharge from the faucets.

2) Detached houses generally have the yard with an area of about 100 sq.m. where citizens cultivate orchard and vegetables. In addition, many families sprinkle water on the streets in front of their houses during summer season.

   Most families have no bathtubs and use shower. Therefore, water consumption for bathing is a little because many houses are connected to hot water supply.

3) Washing machines are owned by families of 80 % or more and washing times is short compared with that in Japan.

Considering the above conditions, water consumption for domestic use in Tashkent City was estimated as 1.2 times as much as that of Japan for washing hand, and sweeping; 1.0 times for laundry and toilet; 0.5 times for bath (shower) and Kitchen, with consideration of hot water use.

Sprinkling with water for the yard in detached houses was estimated to conduct for average 1 hour by 20 liter/min. Considering the watering, water consumption/capita/day for domestic use was estimated for averaged four persons' family as follows:

(10 liter/min. × 60 min./day) / five persons = 120 liter/capita/day

However, population ratio of dwellers between apartments and detached houses was estimated as 3 to 1, the water consumption/capita/day for whole city areas was calculated as 30 (120/(3+1)=30)liter/capita/day by dividing the consumption of a detached house (300 liter/capita/day) into 4 persons.

As for sewer system, percent of population served in Tashkent City is considered about 85 % and both apartments and detached houses have connection pipes to the sewer system.

As a result of the above calculation, daily maximum supply amount becomes 300 liter/capita/day and it is the same level as that of Japan.

Furthermore, daily average supply amount is estimated as (1/1.25) times as much as daily maximum supply amount. - Since watering except for summer season is considered to largely decrease, the ratio between the daily average supply amount and the daily maximum supply amount in Tashkent City will be smaller than (1/1.23) times in Japan.

Daily average supply amount in Tashkent City is calculated from the daily maximum supply amount of 300 liter/capita/day as follows.

300 liter/capita/day(daily maximum supply amount)×1/1.25 = 240 liter/capita/day (daily average supply amount)

Based on the above consideration, daily maximum water consumption of inhabitants in apartments is calculated as follows.

300 liter/capita/day – 30 liter = 270 liter/capita/day

Daily maximum water consumption of dwellers in detached houses is estimated as below.

300 liter/capita/day –30 liter + 120 liter/capita/day = 390 liter/capita/day

As a result of water supply survey in summer season, the water consumption/capita/ day of apartments and detached houses became large values with ranging from 600 liter to 700 liter. This large values are derived from the following reasons:

1) Apartments generally have leakage of 50 % or more against supplied water due to non-function of ball taps in toilets.

2) Estimated water consumption of detached houses will be a reasonable value considering the above conditions.

However, average water consumption in the supply areas with water meters was not so large except for users with extremely much water consumption.

The average water consumption in the supply areas with water meters is comparatively a little by the following reasons: (1) sewerage system is not connected to houses, (2) The areas generally have no drain system and roads in front of houses are not improved by pavement.

Therefore, we suppose that daily average water consumption is 240 liter/capita/ day, and daily maximum water consumption is 300 liter/capita/day in Tashkent City.

(2)Estimation of daily water consumption

1) Detached house

In the consideration as mentioned the above, estimated water consumption for detached houses is evaluated as follows: the month of August carrying out the survey corresponds to maximum demand period. Both water consumption values of 1,000 liter/capita/day and less than 150 liter/capita/day for detached houses at the survey areas are omitted from as extraordinary values as shown in Table S.5.2.3.

Considering the above conditions, the average supply amount is calculated as 322 liter/capita/day.

Since these houses have no connection to sewerage system, flushing water for toilets at least increases and the water consumption reversely decrease due to the difficulty of drain for no installation of drainage system.

As indicated in Table S.5.2.2, flushing water for toilets becomes 56 liter/day. This amount shall become 378 liter/capita/day by 322 liter/capita/day plus 56 liter/day.

In addition, the water supply survey has been conducted for a week. Therefore, the tendency of water consumption within a week was examined. Table S.5.2.4 indicates only measured values as routine works from the remains, excluding from extraordinary data as mentioned the above.

In the 17 data, the ratio between the difference of daily measured values and the weekly average value is calculated. In this calculation, daily water consumption from Friday (rest day in Islam religion) to Saturday is much. Daily maximum consumption is observed from Saturday to Sunday and is 1.42 times as much as average consumption.

In the case that sewerage system is connected to the toilets, daily maximum water consumption becomes 536 liter/capita/day by multiplying 378 liter/capita/day by 1.42.

Table S.5.2.3 Water Consumption of Detached House

No.	House No	Address	Dwellers Number	Total Area(x100sq.m)			Presence			Wayer Consumtion		
				Total	House	Garden	Car	Pool/ Fountain	Animal and hens	Cu.m/d	Cu.m/d.person	
											All	Omit too few and many
1	37	Adolat str.	5	6	2	1.5	+	-	-	2.00	0.400	0.400
2	128	Adolat str.	6	6	2	3	-	-	-	1.86	0.310	0.310
3	20	Adolat str.	4	6	1.5	1	+	-	cow:1	1.00	0.250	0.250
4	11	Adolat str.	3	6	2	-	+	-	-	1.83	0.611	0.611
5	19(129)	Adolat str.	1	6	1.5	2	+	-	-	0.71	0.714	0.714
6	2	Adolat str.	5	6	2.5	1.5	+	-	sheeps:6	1.57	0.314	0.314
7	4(54)	Adolat str.	6	6	2	1.5	-	-	-	1.14	0.190	0.190
8	7	Adolat str.	4	6	2	3	-	-	sheeps:2	1.17	0.292	0.292
9	8	Adolat str.	5	6	2	3	-	-	cow:1	1.50	0.300	0.300
10	9(38)	Adolat str.	8	6	2	2	-	-	-	1.14	0.143	
11	12	Adolat str.	5	6	1.6	1.5	+	-	-	29.86	**5.971**	
12	13	Adolat str.	4	6	2	1.5	-	-	-	1.57	0.393	0.393
13	16	Adolat str.	5	6	2	1	+	-	cow,horse	1.43	0.286	0.286
14	18	Adolat str.	5	6	1	4	-	-	hens:10	1.14	0.229	0.229
15	34	Adolat str.	5	6	2	2	-	-	-	0.57	0.114	
16	3	Adolat str.	5	6	2	3	-	-	hens:10	0.83	0.167	0.167
17	21	Adolat str.	6	6	2	3	+	-	-	0.17	**0.028**	
18	16	Adolat str.	4	6	1	1.5	-	-	hens:100	2.57	0.643	0.643
19	20	Adolat str.	6	6	2	2.5	-	-	cow:1	9.00	**1.500**	
20	1	Feruza str	4	6	2	3	-	-	cow:1	15.00	**3.750**	
21	2	Feruza str	1	6	3	3	-	900 cu.m	hens:34	7.00	**7.000**	
22	23	Adolat str.	4	6	2	2	+	-	-	0.86	0.214	0.214
23	10	Feruza str	6	6	2	-	+	-	cows:2	1.86	0.310	0.310
34	11	Feruza str	9	6	2.5	2.5	+	-	-	1.86	0.206	0.206
25	17	Adolat str.	2	6	2	3	-	-	cows:2	0.14	0.071	
26	8	Adolat str.	3	6.5	2	3	-	300 cu.m	-	1.00	0.333	0.333
27	21	Adolat str.	3	6	2	3	+	-	-	1.14	0.381	0.381
28	2	Adolat str.	5	6	1	2	+	-	hens:20	0.71	0.143	
29	73	Adolat str.	7	6	2	2	-	-	-	1.00	0.143	
30	79	Adolat str.	3	6	0.8	3	+	-	-	1.14	0.381	0.381
31	16	Adolat str.	6	6	2	3	+	-	-	1.14	0.190	0.190
32	126	Adolat str.	5	6	2	3	+	-	-	0.29	0.057	
33	7	Adolat str.	6	6	2	3	-	-	-	1.86	0.310	0.310
34	9	Adolat str.	7	6	2	1.5	+	-	-	1.00	0.143	
35	18	Adolat str.	5	6	2	3	+	-	cows:2	1.00	0.200	0.200
36	12	Adolat str.	5	6	2	2	+	-	-	1.29	0.257	0.257
37	2	Adolat str.	4	6	2	3	+	-	hens:10	1.57	0.393	0.393
38	9	Feruza str	7	6	2	2	+	-	-	1.29	0.184	0.184
39	6	Adolat str.	4	6	2	2	-	-	-	0.57	0.143	
40	4	Feruza str	5	6	2	2	+	-	-	2.00	0.400	0.400
41	6	Feruza str	5	6	1.6	2	+	-	-	0.43	0.086	
42	8	Feruza str	13	6	2.5	2.5	-	-	cows,bull	0.71	0.055	
43	20	Adolat str.	6	6	2	1	+	-	hens:10	1.50	0.250	0.250
44	21	Adolat str.	5	6	2	3	+	-	sheep,cow	1.14	0.229	0.229
45	2	Adolat str.	5	6	1	2	+	-	hens:20	0.71	0.143	
46	73	Adolat str.	7	6	2	2	-	-	-	1.00	0.143	
47	79	Adolat str.	3	6	3	3	+	-	-	1.40	0.467	0.467
48	16	Adolat str.	6	6	2	3	+	-	-	1.14	0.190	0.190
Average			5.1	6.0	1.9	2.3					**0.617**	**0.322**

Table S.5.2.4 Daily Change of Water Consumption

No.	House No.	Aug./7(Sat.)		Aug./8(Sun.)		Aug./9(Mon.)		Aug./10(Tue.)		Aug./11(Wed)		Aug./12(Thu.)		Aug./13(Fri.)		Aug./14(Sat.)		Usage Volume	Usage days	Average Use
		Time	Q	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	cu.m		cu.m/d
1	129	14:00	94	14:00	95	14:00	95	14:00	96	14:00	97	14:00	99		99		99	5	7	0.71
2	4	11:35	47		48		49		49.7		50		54		54		55	8	7	1.14
3	7	11:40	36	11:40	37	11:40	38		39		40		41		43			7	6	1.17
4	8	11:50	78	21:00	84	20:00	84	20:00	85	20:00	85	20:00	87	20:00	87			9	6	1.50
5	3	12:00	93	13:00	94	13:00	95	13:00	96	13:00	97	13:00	98		98			5	6	0.83
6	16	9:52	109	9:52	111.5	9:52	114	9:52	116	9:52	119	9:52	123	9:52	127	10:20	127	18	7	2.57
7	10	10:20	100	10:30	102	10:30	104	10:30	106	10:30	109	10:30	111	10:30	112	9:40	113	13	7	1.86
8	11	10:40	67	11:00	70	12:00	72	15:00	73	12:00	75	11:00	78	12:00	79	9:30	80	13	7	1.86
9	8	10:00	133		134		135		136		137		138		139	9:25	140	7	7	1.00
10	21	12:40	30	13:00	33		36		35		36		37		38		38	8	7	1.14
11	79	12:00	31	12:00	33	12:00	35	12:00	37		38		38		39	9:20	39	8	7	1.14
12	16	12:05	109	12:00	110	12:00	111	12:00	112	12:00	113	12:00	114	12:00	116	9:15	117	8	7	1.14
13	7	12:00	112		115		117		115		120		122		123	9:15	125	13	7	1.86
14	18	12:00	80	12:00	80	12:00	82	12:00	82	12:00	84	12:00	85	12:00	86	9:00	87	7	7	1.00
15	12	13:20	76	13:20	80	14:00	81	14:00	82	14:00	83	13:00	84	13:30	85	9:00	85	9	7	1.29
16	21	12:00	30	13:00	33		36		35		35		36		37		38	8	7	1.14
17	16	12:05	9	12:00	10	12:00	11	12:00	12	12:00	13	12:00	14	12:00	16	9:15	17	8	7	1.14
Total			1234		1270		1295		1307		1331		1359		1378		1409	(×17/14)		
Difference					35.5		25.5		11.7		24.3		28		19		30.6			24.9
Rate(times)					**1.42**		**1.02**		**0.47**		**0.97**		**1.12**		**0.76**		**1.23**			

If the sewerage system is prevailing and the drain system is completed in the future, the water demand excluding for flushing water of toilet shall increase. Therefore, the daily maximum water consumption of a detached house, 620 liter/capita/day shall be the suitable value.

2) Apartment Buildings

The average water consumption for dwellers living in 4 to 9 floors of 12 apartments was 617 liter/capita/day as shown in Table S.5.2.5.

TableS.5.2.5 Water Consumption of Apartments

Apart No.	Adress	Stories	Dwel-ling flat	Dweller	Average			Water consumption	
					Flat area sq.m	Dweller	Area/ person	Total cu.m/day	cu.m/ person
4	Sergeri	5	40	188	100	4.7	21.3	140.5	0.747
5	-2	4	56	179	73	3.2	22.9	101.7	0.568
6		5	70	223	72	3.2	22.7	108.3	0.486
21		5	70	193	75	2.8	27.1	156.8	0.813
23		5	40	184	100	4.6	21.7	98.0	0.533
66		5	89	242	60	2.7	21.9	168.3	0.696
67		5	80	241	66	3.0	21.9	128.5	0.533
2	Dustlik	9	71	296	95	4.2	22.8	149.7	0.506
13	-2	9	72	302	88	4.2	21.0	148.3	0.491
24		9	71	296	95	4.2	22.8	161.7	0.546
26		9	71	270	92	3.8	24.2	243.3	0.901
30		9	36	150	90	4.2	21.6	99.5	0.663
Total			766	2764				1704.7	
Average			51.1	184.3	67.1	3.0	18.1	142.1	0.617

However, survey results in 24 hours measurement in the No.23 apartment of Sergeri-2 area and No. 30 apartment of Dustlik-2 area indicate as follows. The discharges are 126.6 cu.m/day and 121.9 cu.m/day, respectively and hourly fluctuation as shown in Figure S.5.2.1 is small and the original discharge during the nighttime shall be small but actual discharge is large.

The discharge is more than 1.2 times as much as the values as shown in Table S.5.2.5. However, discharges measured in the period from Saturday to Sunday on September and August 14 to 15 are large as indicated in Table S.5.2.6.

Compared with measured temperature from September 8 to 14 as shown in Table S.5.2.5, the large discharge may be caused by high temperature during the middle of August.

Figurue S.5.2.1 Water Consumption of Apartment

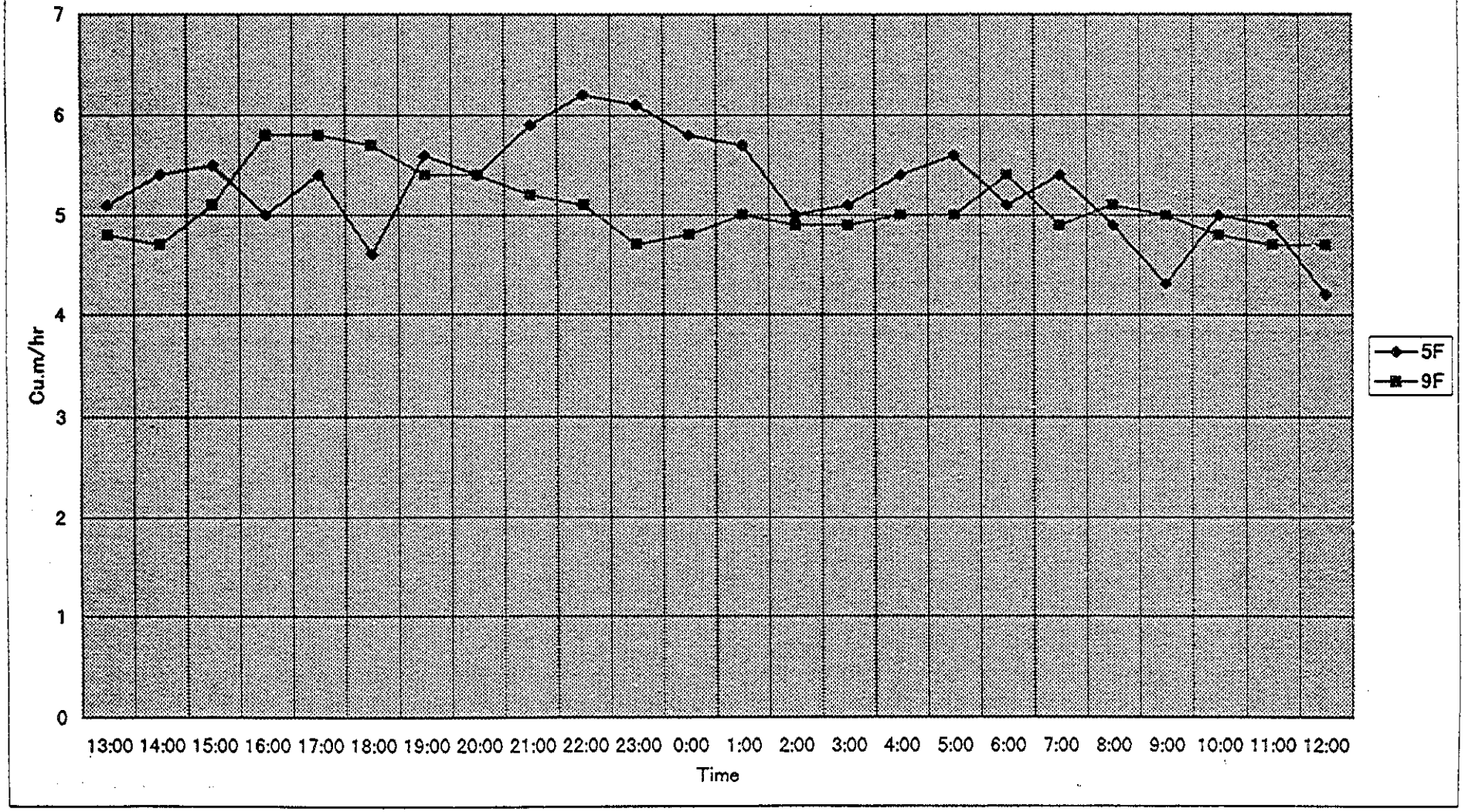


Table S.5.2.6 Water Measured Record

No.	Apart No	Sep./8(Wed.)		Sep./9(Thu.)		Sep./10(Fri.)		Sep./11(Sta.)		Sep./12(Sun.)		Sep./13(Mon.)		Aug./14		Usage Volume	Usage days	Average Usage
		Time	Q	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	Time	Q cu.m	cu.m		cu.m/d
1	4	16:45	127	17:20	259	17:00	396	18:30	542	18:40	694	17:10	834	17:08	970	843	6	140.50
2	5	16:52	211	17:30	313	17:00	397	17:10	507	17:10	614	17:25	716	17:00	821	610	6	101.67
3	6	16:42	45	18:30	151	17:15	223	17:35	348	14:34	458	17:50	571	18:00	695	650	6	108.33
4	21	18:00	380	17:25	532	17:00	691	17:25	853	16:55	1,006	17:10	1,176	17:00	1,321	941	6	156.83
5	23		210	17:00	220	17:00	310	17:15	410	17:10	510	17:00	610	17:20	710	490	5	98.00
6	66	17:00	621	17:30	798	17:00	935	17:00	1,092	17:00	1,249	17:15	1,443	17:20	1,631	1,010	6	168.33
7	67	17:10	360	17:30	439	17:00	539	17:30	704	17:00	881	17:15	1,003	17:25	1,131	771	6	128.50
8	2	15:55	100	16:34	243		384	15:20	524	18:45	687	19:00	840	17:15	998	898	6	149.67
9	13	16:00	1,029	17:25	1,161		1,312	18:55	1,462	18:40	1,617	18:57	1,768	17:50	1,919	890	6	148.33
10	24	15:15	238	16:49	401		544	19:50	686	19:05	875	19:40	1,042	17:35	1,208	970	6	161.67
11	26	15:20	639	16:42	885		1,110	14:46	1,334	19:02	1,616	19:40	1,859	17:30	2,099	1,460	6	243.33
12	30	15:38	1,040	17:05	1,137		1,228	15:02	1,318	19:17	1,431	19:50	1,536	17:40	1,637	597	6	99.50
Total			5,000		6,539		8,069		9,780		11,638		13,398		15,140			
Difference					1,539		1,530		1,711		1,858		1,760		1,742			1,690
Rate(times)					0.91		0.91		1.01		1.10		1.04		1.03			1.00

In the No.13 and No.30 apartments with 5 stories as shown in Figure S.5.2.1, actual water consumption is supposed. Then, provided to have peak water consumption at the time of peak discharge, actual water consumption at the time of the peak discharge is estimated as 70 % of the discharge.

Daily water consumption pattern was determined by supposing 10 % of the actual water consumption estimated in the midnight and appropriate consumption in other times. These patterns in apartment No.23 with 5 stories and apartment No.30 with 9 stories are shown in Figure S.5.2.2, and Figure S.5.2.3, respectively.

Since the average of the estimated water consumption in these figures corresponds to about 48 % of actual discharge, the actual water consumption excluding for leakage water was designed as 40 % to 50 % of actual measured discharges.

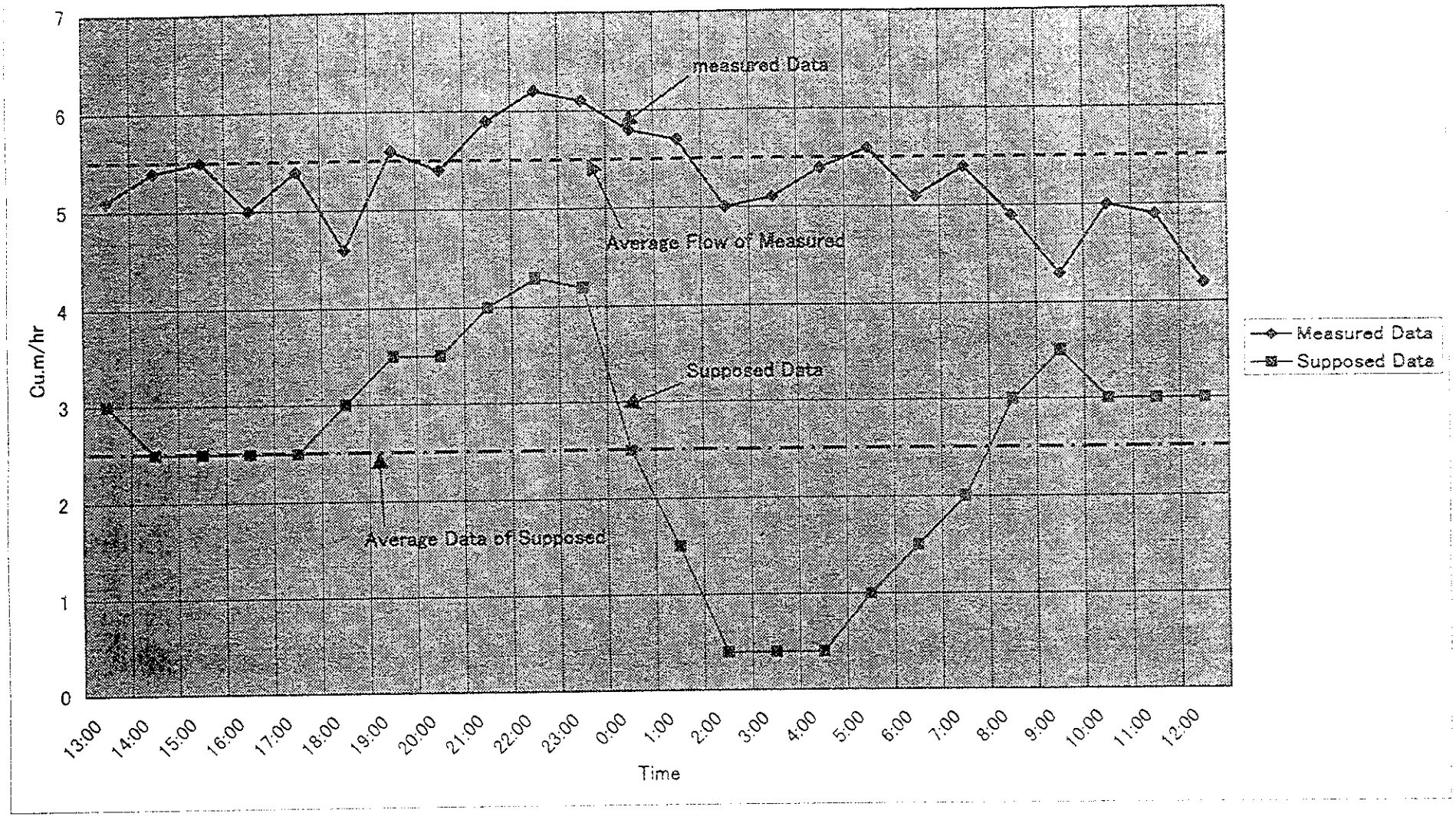
Furthermore, discharge values measured by flow meters belong to the data in the hottest period of the summer season and in the period from Saturday to Sunday, when large water consumption is expected. Therefore, those data are dealt as daily maximum supply amount.

Considering the above conditions, daily maximum supply amount comes to 275 liter/capita/day as a minimum value and 406 liter/capita/day in a maximum value as shown in Table S.5.2.7 therefore, the average supply amount, 320 liter/capita/day estimated in the preceding phrases shall be within a good range.

Table S.5.2.7 Maximum Daily Water Consumption of Apartment

Apartment No.	Stories	Occupants	Flow data cu.m/day				
			Sep.8 to 14		Aug.14 to 15		
			Total	/person	Total	/person	40 to 50%
23	5	184	98.0	0.533	126.6	0.688	0.275 to 0.344
30	9	150	99.5	0.663	121.9	0.813	0.325 to 0.406

Figure S.5.2.2 Water Consumption of 5 Stories Apartment



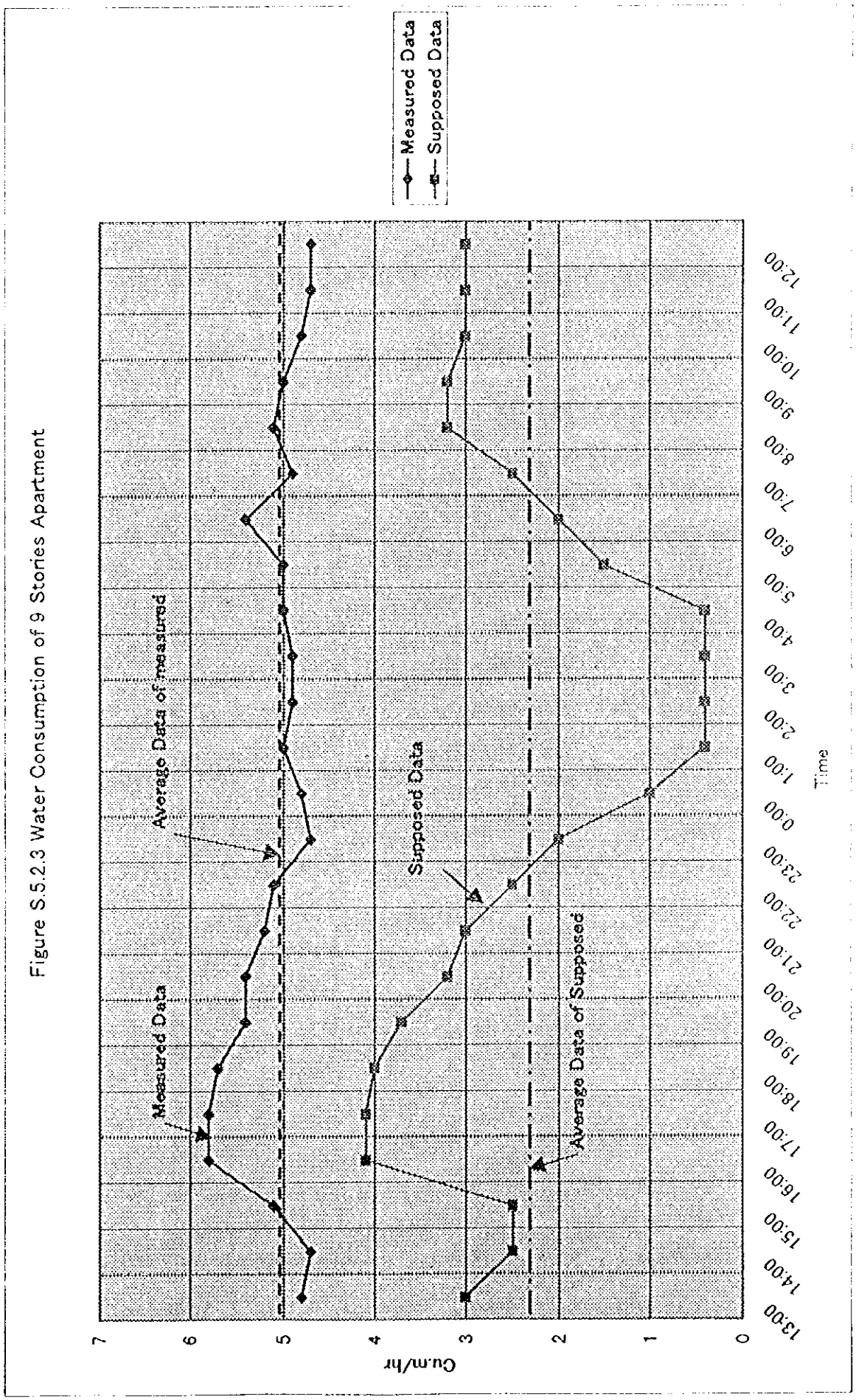


Figure S.5.2.3 Water Consumption of 9 Stories Apartment

S 5.3 Conduct of Water Leakage Detection

(1) Sergeri 8 Apartment 24: No. 1, No. 4 Detection

- **Preliminary Survey**

A reconnaissance survey was conducted on July 17 accompanied by senior staff menbers of Vodokanal Mr. Ordukhanov, the Director of Production Management and Mr. Azizov, the Chief Engineer, and others.

The Study Team conducted preliminary acoustic detection but this method failed because of high level of traffic noise during the daytime.

- **No. 1 Detection**

The leakage detection survey at the location as shown in Figure S.5.3.1 was conducted from 9:00 pm on July 19 in the presence of Mr. Ordukhanov and Mr. Azizov. Three 300m-long pipelines with diameters of 300 mm, 400 mm, 600 mm are buried at a depth of 3 m at this location.

There was heavy traffic (both vehicles and pedestrians) at the start of the survey. There was no significant difference from the conditions in the daytime. Furthermore, since many eateries (food stalls) which occupy part of the streets at night, the traffic was often more congested than in the daytime.

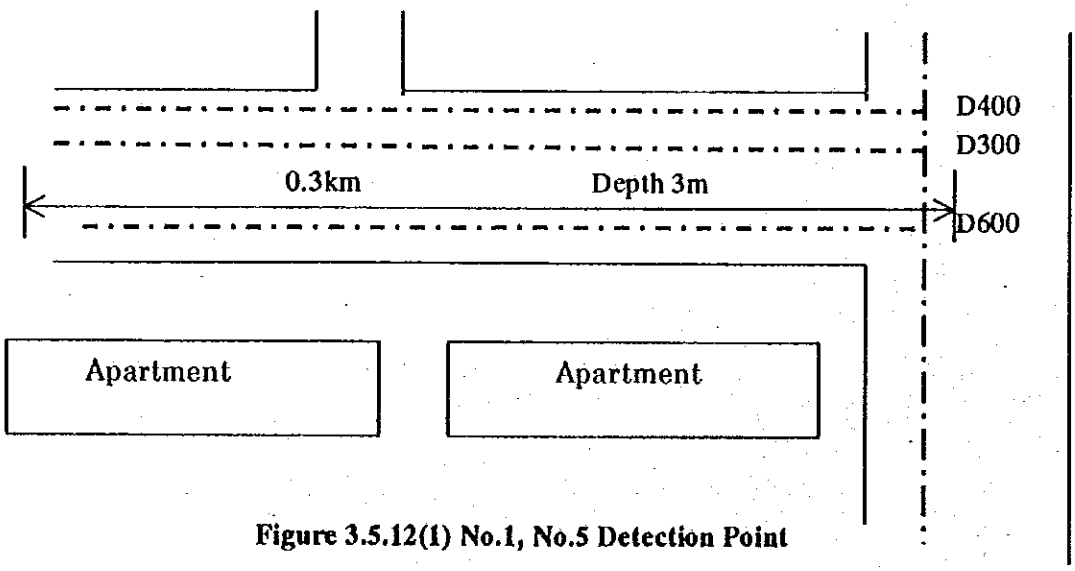


Figure 3.5.12(1) No.1, No.5 Detection Point

As a result of the acoustic leakage sound detection survey, sounds similar to water leakage were detected in some places. Irrigation pumps used to pump up the groundwater were operating

near the leakage points and the conduit pipes to these pumps are installed close to the ground level are also distributed parallel to all the water supply pipes.

A detailed survey revealed that these pump sounds prevented the leak sounds from propagating through the ground. Therefore, this lead the team to conclude that the survey would not be able to be performed without interruption of the pumps operations.

The total survey distances were within 0.9 km.

Considering the above conditions, the survey schedule with a one-hour interruption of pump operations was planned for another day.

- **No.4 Detection**

The survey was carried out when the pumps ceased operations from 2:40 to 3:40 on July 31. As a result, similar leakage sounds originated from the hot water pipelines and did not come from the water supply pipes. In addition, two perspective leakage sound points were found. However, the causes were not obvious.

The leakage was presumed to come from the hot water pipelines.

(2) Sergeri N2 Apartment: No.2 Detection

In the presence of Mr. Ordukhanov and Mr. Azizov as observers, the leakage sound detective survey in Sergeri N2 apartment was conducted from 11:00 p.m. on July 19 to find out the reason why the culvert connecting the hot water pipelines was filled with leaked water from the distribution pipes in an apartment building.

However, the detection survey revealed that no leakage sounds. When the cover of the manhole was opened, the inundation phenomenon disappeared. Furthermore, leakage of water supply pipes was found not to have occurred, and the operator himself made a hole to inspect the hot water pipelines.

At this survey point, adjacent to the pumping station and the electric power plant, it was very difficult to detect leakage sounds.

The detection survey distance was about 0.2 km.

(3) Amir Temur Street Aquapark: No. 3 Detection, No. 5 Detection

- No. 3 Detection

In the presence of Mr. Ordukhanov and Mr. Azizov as observers, a leakage sound detection survey in the locations shown in Figure S.5.3.2 was conducted from 00:00 a.m. on July 19. At midnight, there was still busy traffic in the street. To conduct the survey safely, traffic control was enforced.

This survey point encountered problem of electrical wave jamming caused by existing radio and television broadcasting antenna. However, after 1:00 a.m, the wave jamming was decreased traffic noise lessen.

First a pipeline with a length of about 300 m, from which water leakage was anticipated, was surveyed. However, no obvious leakage could be pinpointed because of noise interference from the traffic.

Secondly, a manhole on the hot water pipeline was filled with hot water to a height of 0.5 m when it was opened. This might have been caused by the leakage of hot water from the hot water pipeline.

However, the team was told that previous survey had confirmed water leakage at this point. In addition, a decrease in the traffic noise and the wave jamming, together with change in the length of the pipeline to be surveyed (from 300 m to 500 m) made it easy to detect the leakage sounds. As a result, two leakage points were detected.

To reconfjrm water leakage at the detected leakage sounds, two detected points were selected and marked on the road. After making holes it the road, it was planned to insert a leakage sound detection bar in the holes.

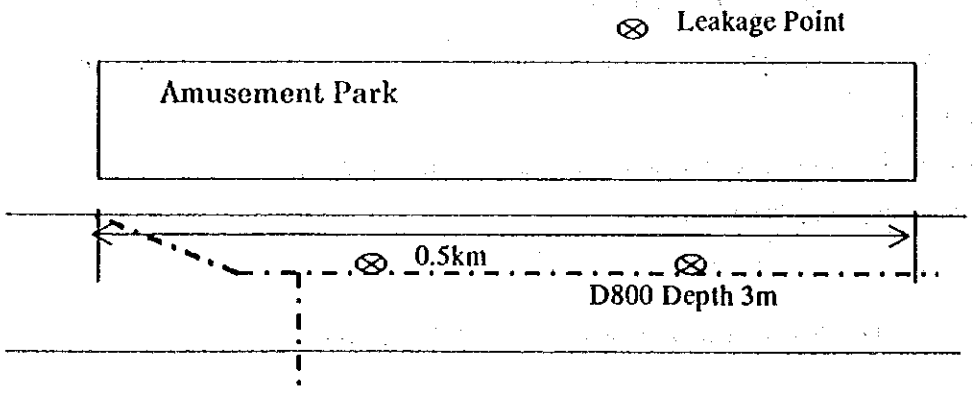


Figure S.5.3.2 No.3, No.5 Detection Point

- **No.5 Detection**

In the presence of Mr. Ordukhanov as an observer, a reconfirmation of the leakage points detected in the previous survey was conducted from 0:00 a.m. on July 31.

After re-detection of acoustic leakage sound, the marked points in the previous survey were used and the Vodocanal staffs tried to make holes with an iron bar. However, the first point could not be confirmed due to shallow driving depth of 50 cm to 60 cm in the ground.

At the second point, the iron bar could be driven to the depth of only 1.5 m. Though thickness of soil formation is 3.0 m, the detected sound was believed to come from water leakage. This was the reason why groundwater level was very low but the leak sound detection bar got wet. In addition, Mr. Nitta conducting the water leakage survey judged that the first point had a louder sound than the second point and therefore, the former point would surely have water leakage.

(4) Mannon Vigur Str, Behzod Ave: No.6, 8 Detection

- **No.6 Detection**

In the points as shown in Figure S.5.3.3, the acoustic detection method and the correlational detection method were carried out at an the inundation point at a house and at a manhole for telephone lines twice, from 11:00 a.m. and 2:00 p.m.on August 5.

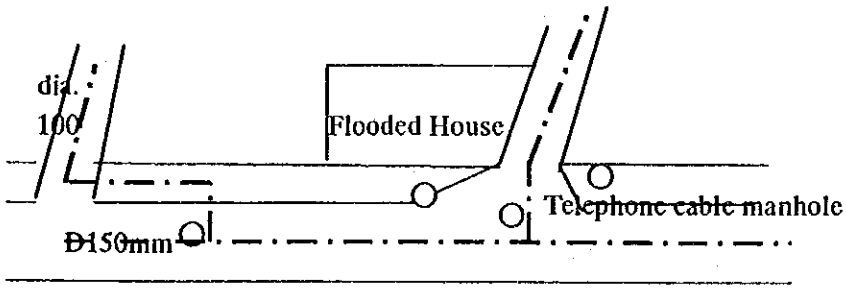


Figure S.5.3.3 No.6 Detection Point

After that, the team tried to confirm water leakage by pumping out the water flooding the manhole. However, no water leakage (excluding for the water discharge from the manhole) was detected.

In the pipeline with diameter 100 mm, the sound of water being discharged was detected. The team tried to close the valve but this was impossible due to rust.

Next, the main pipeline with a diameter of 150 mm was surveyed. The sound of leaks were believed to come from the joint of two type pipes with a diameter 150 mm and diameter a 100 mm. As a result, the occurrence of water leakage may be doubtful. During the daytime, traffic noise was high and the leakage survey could not be conducted. Therefore, it was proposed to conduct the survey at the nighttime. The length of the pipeline to be survey for detection was about 500 m.

- **No.8 Detection**

An acoustic detection survey was conducted from 11:00 p.m. on August 5. As a result, no clear water leakage sound was detected. However, a doubtful small sound detection point was identified after the insertion of a leak sound detection bar. However, the soil at this point was dry and no water leakage was detected.

The water leakage to the manhole had already stopped by this time.

(5) Muhano Ave. N186 elementary school:No.7 detection

An acoustic detection survey was carried out at the point shown in Figure S.5.3.4 from 15:00 p.m. on August 5. The ground level of the pipelines surveyed in the school area is several meters higher than that of the road. Thus, the manhole with a valve which is located in the area of school often has been observed with water flowing down to the lower level.

As a result of the survey, no water leakage was detected. But sewer leakage may be occuring because dirty water was observed in the manhole. The detection distance was about 500m.

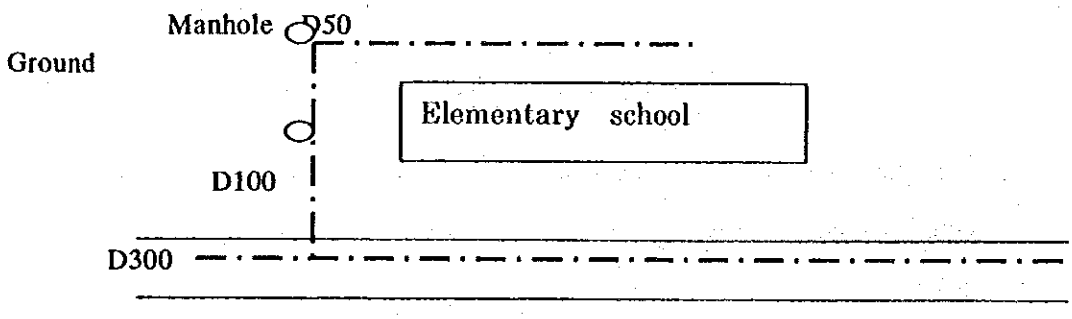


Figure S.5.3.4 No.7 Detection Point

(6) **Biruni Str.: No.9 Detection**

The acoustic detection survey was carried out at the points shown in Figure S.5.3.5 from 0:30 a.m. on August 6. Leakage occurred in a subway tunnel into which water flowed. However, the water leakage points had not been found for the past year. In this survey, one of three doubtful points was surveyed. The manhole cover near valve with most the largest sound was opened. As a result, water leakage from the packing of the seal on the valve was detected.

These water leakage points have been surveyed since a year ago. However, the leakage points could not be detected. The leakage discharge was about 10 liter/minute. According to the inspector who acted as an observer, the leakage discharge is low compared with the leak observed in the tunnel. Furthermore, the leaking valve was not identified at the previous survey.

For the other two points, the length of the leakage sound detection bar was shorter for the survey of these points and no water leakage could be found.

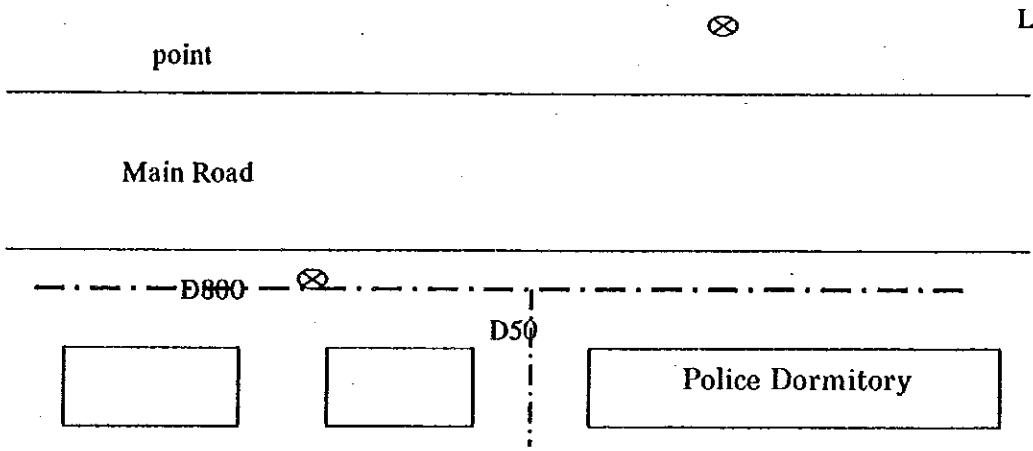


Figure S.5.3.5 No.9 Detection Point

(7) **Kibray Distribution Pipes:No.10 Detection**

The acoustic detection survey was carried out at the points shown in Figure S.5.3.6 from 4:00 p.m. on August 10 to 12 for the three distribution pipelines running from Kibray WTP to Tashkent downtown. Water leakage in one point near the Kibray WTP was doubtful. However, no leakage was detected.

Three water leakage points on the Musao Muhamedov collective farm (on the way to Tashkent from the Kibray WTP) were detected. The leaks were easily found due to presence of the water on the surface of the ground.

As a result of the survey, no hidden leakage was found.

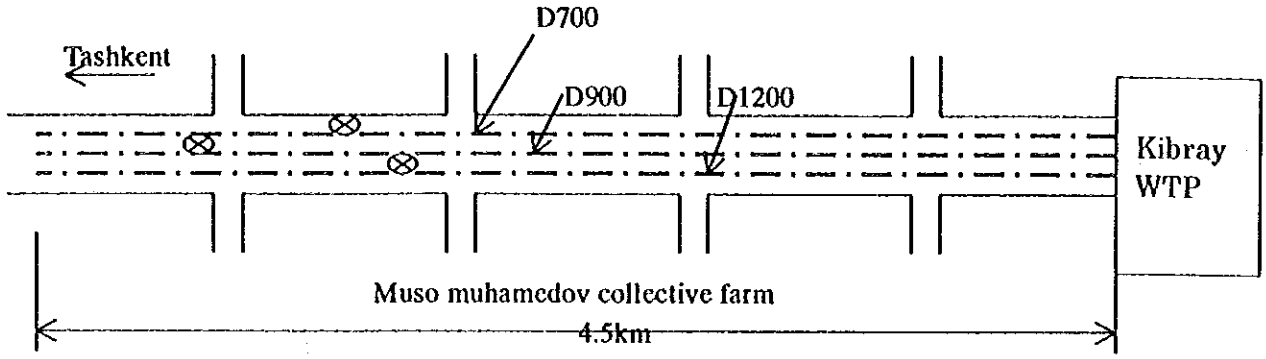


Figure S.5.3.6 No.10 Detection Point

(8) Lisunova District.1block. Apartement BuildingNo.115: No.11 Detection

The acoustic leakage sound detection survey was conducted at the point as shown in Figure S.5.3.7 from 11:00 a.m. on August 28. The manhole for the telephone line was in full of water due to the leakage. However, the point is located on the opposite site of Bazar and no available sonic detection survey was conducted due to the traffic noise.

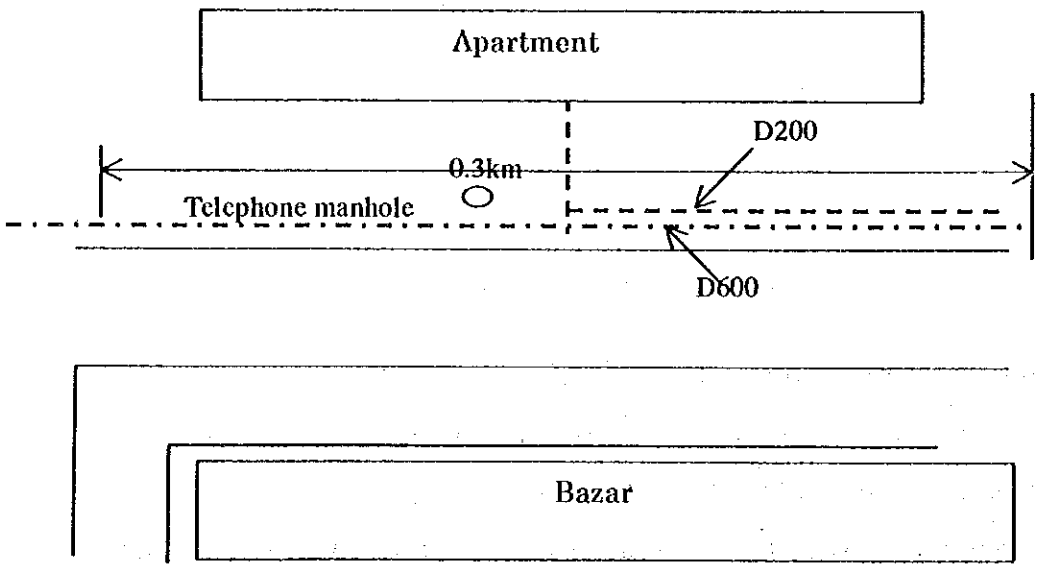


Figure S.5.3.7 No.11 Detection Point

(9) **Birlshgan Street. House 17: No.12 Detection**

- **No.12 Detection**

The acoustic leakage sound detection survey was carried out at the point shown in Figure S.5.3.8 from 3:00 p.m. on August 28. This area was assumed to be a water leakage point due to a depression in the road. However, conducting water leakage survey was impossible due to the traffic noise here as well as at the No. 11 detection point. Therefore, a correlational detection method was conducted for the detection of the water leakage. However, leakage sound could not be clearly detected.

Considering the restricted conditions for leakage detection survey during the daytime, in particular, the difficulty caused by the noise of traffic, the surveys were generally carried out during the night, after that.

- **No.21 Detection**

An acoustic leakage sound detection survey was conducted from 3:00 a.m. on August 10. Detection at the point of depression on the road was possible and water leakage was certain to have occurred in that point. The detection distance was 0.5 km.

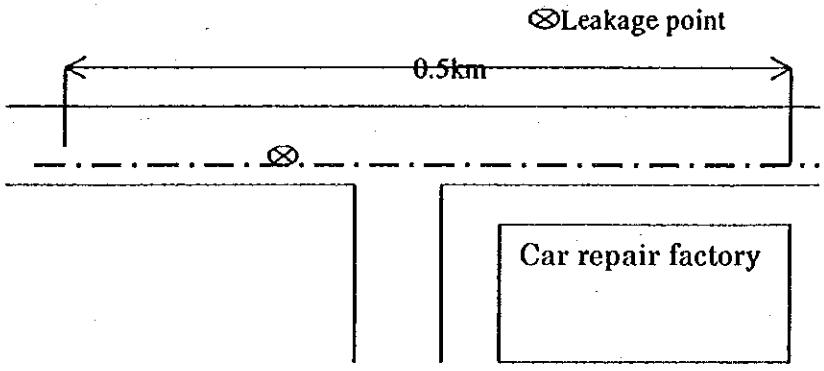


Figure S.5.3.8 No.12 and 21 Detection Point

(10) **Hamza Umarov Street. Apartment Building No.4: No.13, 15 detection**

- **No.13 Detection**

The acoustic leakage sound detection survey was carried out at the points shown in Figure S.5.3.9 from a.m.0:00 a.m. on August 2nd when the survey was conducted at the preliminary stage of the preject.

This point has been the subject of many repair request the Hot Water Supply Authority for a long time. The detection survey was carried out on Umarov Street over a length of 2.5 km.

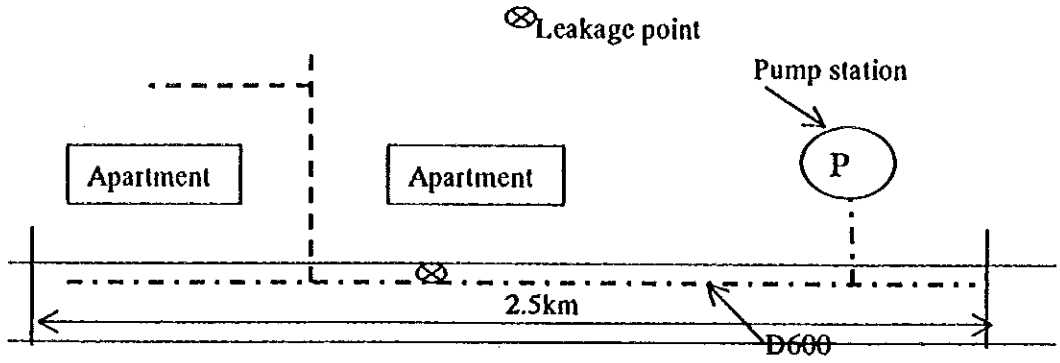


Figure S.5.3.9 No.13 and 15 Detection Point

As a survey result, one water leakage point was found. However, the buried depth of the pipeline was 3.0 m or more and the leak sound detection bar could not reach to that point due to a short length of the bar. Therefore, the water leakage was not sure to occur.

- **No.15 Detection**

The pavement and road bed were broken up from 3:00 a.m. on September 2 and a welded leakage sound detection bar with a length of 3.5 m was inserted in the pit. The water leakage at that point was clearly confirmed by the direct contact of the detection bar with the pipeline.

(11) Intersection of Yakkasaroy Street and Salomatina Street: No.14 Detection

The acoustic leakage sound detection survey was conducted from a.m. 4:00 on September 2nd along the water supply pipelines at the housing areas shown in Figure S.5.3.10. This point has been identified for repair by the local citizens because the hot water supply culvert sometimes contains leaked water.

As a result of the survey, the leakage point was revealed and as well leaking water was discovered after insertion of the leakage detection bar.

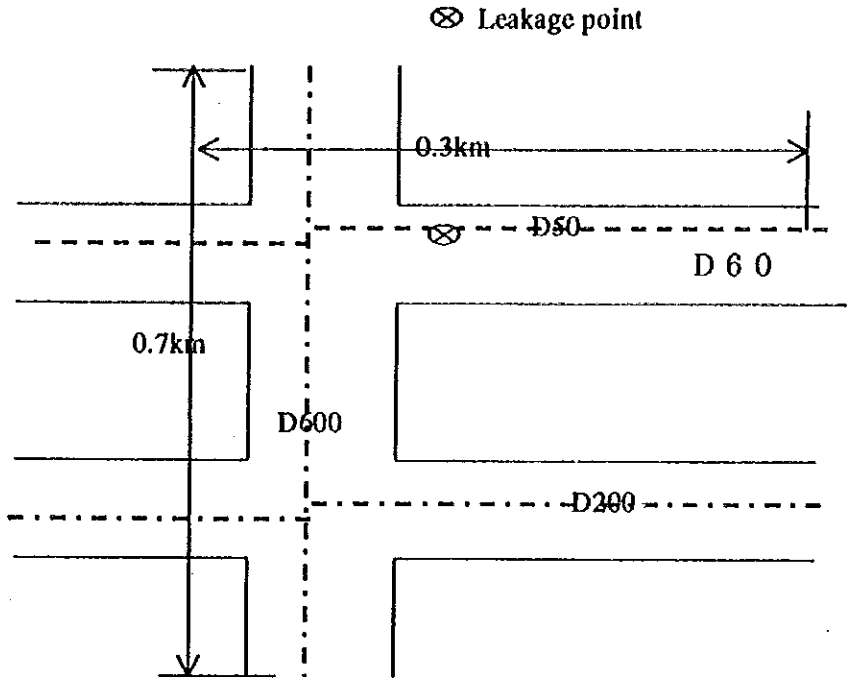


Figure S.5.3.10 No. 14 Detection Point

(12) Almazar District. Almazar Street. 15/3: No.16 Detection

The acoustic leakage sound detection survey was conducted from 0:00 a.m. on September 7 at the point shown in Figure S.5.3.11.

As a result, water leakage was found at the junction of the water supply pipe and the hot water pipe.

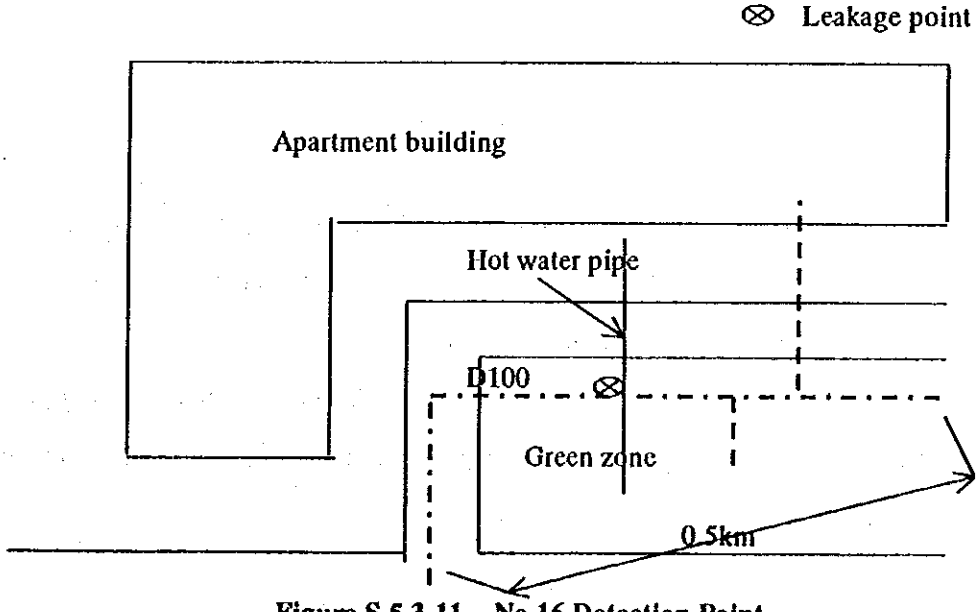


Figure S.5.3.11 No.16 Detection Point

Water leakage at this point had already been detected by the leakage detection bar. The detection distance was about 0.5 km.

(13) Chilanzar District. 8-Block. Apartment No.2A: No.17 Detection

The acoustic leakage sound detection survey was conducted from 2:00 a.m. on September 7 at the point shown in Figure S.5.3.12.

The surveyed pipeline is installed in a park facing to the road on the opposite side of the apartment building area and the local citizens have requested that the situation be improved due to the discharge of leaked water into the hot water supply culvert. Recently, one point was repaired but a new survey was required due to the reoccurrence of water leakage.

As a result, the water leakage point was directly observed and was also detected by the leakage detection bar.

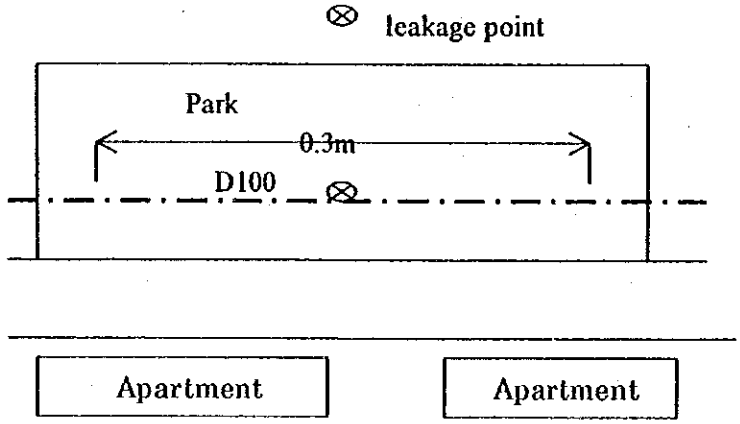


Figure S.5.3.12 No.17 Detection Point

(14) Chilanzar District 17 Block. 2 - Qatortol Str. Music School: No18 Detection

The acoustic leakage sound detection survey was conducted from 4:00 a.m. on September 7 in the yard of Music school shown in Figure S.5.3.13.

In this case, the leakage was detected because water flooded the manhole for the fire hydrant.

As a result, the water leakage point was directly observed and it was also detected by the leakage detection bar.

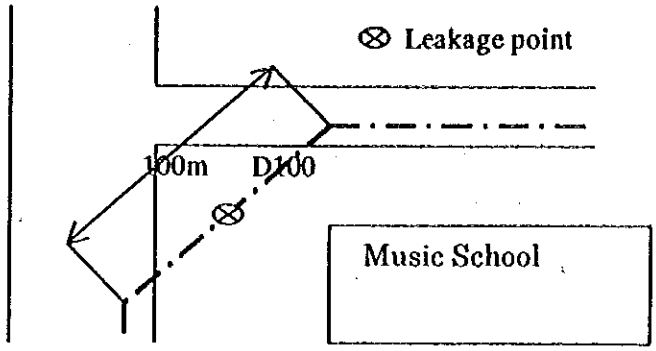


Figure S.5.3.13 No.18 Detection Point

(15) Center 17/18. Gafur Gulom Street Apartement Building No.45: No.19 Detection

In a water supply pipe with a sleeve pipe, water leakage was surveyed by the acoustic leakage sound detection method from 0:00 a.m. on September 9. The sleeve pipe was installed to cross over Gafur Gulom Street. In the green belts on both sides of the road and in the central portion of the road, manholes are installed.

Since one of these manholes was submerged, the water leakage was easily found.

No water leakage was supposed to occur (and none was believed to have occurred) in the sleeve pipe. Therefore, this point was not found for the past year.

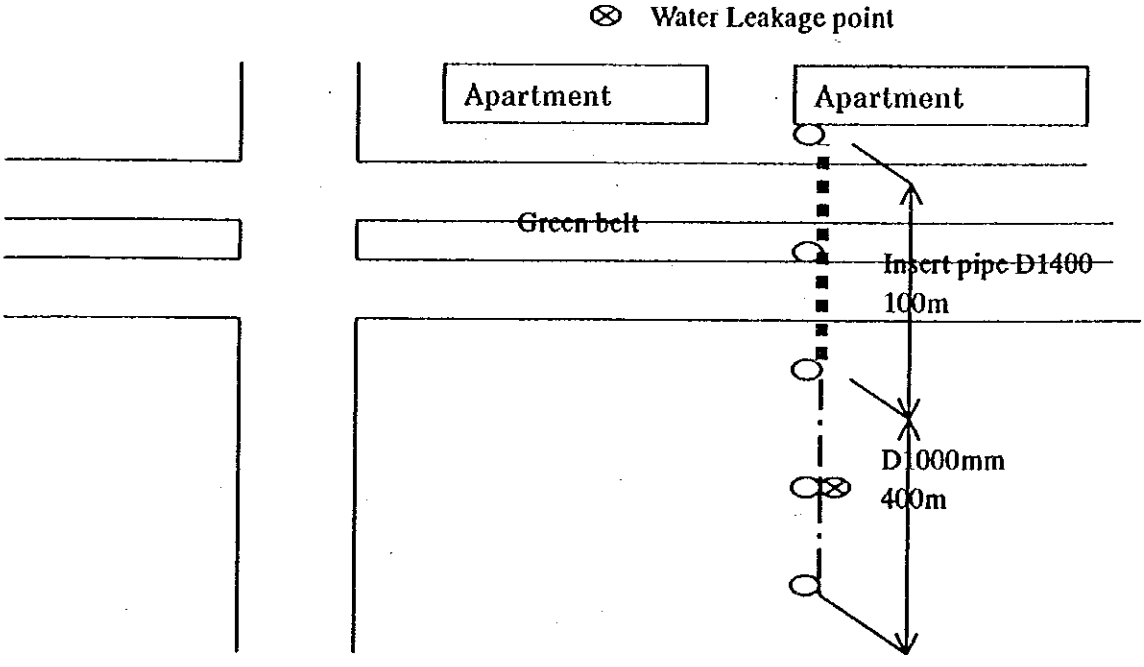


Figure S.5.3.14 No.19 Detection Point

As a result, no water leakage sound could be detected at the point of the sleeve pipe. The length of the sleeve pipe surveyed was extended lower as shown in the drawing in Figure S.5.3.14. The survey led to a water leakage point at the manhole.

The water in the manhole was pumped out and it was found that leaking water was coming from a joint in the cast iron pipes.

S 6.2 Analyzing Water Consumption in Chirchik City

Average water consumption in Japan is 391 liter/capita/day in 1995 as shown in Table S.6.2.1. Maximum supply amount/capita/day is 464 liter and 1.23 times of average supply amount/capita/day for the population of 100,000 to 250,000, (Population of Chirchk City is approx. 146,000) Of that amount, domestic supply amount occupies 71.1 % and daily maximum supply amount/capita/day comes to 343 liter as shown in the table(source: Water Supply Statistics in Japan, 1995).

Water consumption in city with population of over 1 million is 492which corresponds to 1.06 times(492/464) of that in city with population of 100,000 to 250,000.

Table S.6.2.1 Water Consumption in Japan

Item Population	Distribution Volume /person/day		Home Consumption Rate(%)
	Average	Maximum	
All	391	482	71.1
Home	278	343	
<1million		492	
100,000 to 250,000		464	

Water consumption between Japanese citys and Chirchik City is examined as follows:

A breakdown of domestic water consumption in large cities with populations more than 1million is indicated in Table S.6.2.2 (refer to Design Criteria for Waterworks Facilities in Japan). The breakdown indicates average ratio of each component.

Table S.6.2.2 Water Consumption in Homes

Classification	City	Kitchen	Laundry	Bath	Washing hands	Toilet	Sweeping	Others	Total
Rate (%)	Tokyo	26	24	21	5	21	3	-	
	Kawasaki	18	32	20	12	13	1	4	
	Yokohama	16	24	28	5	23	--	4	
	Hiroshima	22	20	28	4	13	4	9	
	Fukuoka	28	29	27	--	11	--	5	
	Average	22	26	25	5	16	3	3	100
Volume (L/p.day)	Japan>1million	76	89	85	17	56	10	10	344
	Japan>100,000 to 250,000 :1/1.06	72	84	80	16	53	9	9	323
	Chirchik	43	84	40	19	53	11	49	299
	Base	×0.5	×1.0	×0.5	×1.2	×1.0	×1.2	+40	

·If maximum domestic supply amount is supposed as 70 % of daily maximum supply amount in the Japanese large cities with population more than 1 million, the domestic supply amount shall be 344 liter/capita/day.

The breakdown of average domestic water consumption in Japan is calculated by multiply the domestic supply amount and average ratio.

In Chirchik City, the following conditions are different from those in Japan.

①The citizens generally have a conception that supplied water is free of charge and they also have wasting tendency. In addition, rusty water comes out from faucet is discharged until it comes clear. they have another one that water supply mostly has rusty water for a while at the opening time of water faucets and supply water is necessary to continuously discharge from the faucets.

②Detached houses generally have yard with an area of about 100 sq.m. where citizens cultivate orchard and vegetables. Many families sprinkle water on the streets in front of their houses during summer season.

Most families have no bathtubs and use shower. Therefore, water consumption for bathing is a little because many houses are connected to hot water supply.

③80% of families own washing machines more and washing times is shorter compared with that in Japan.

Considering the above conditions, water consumption for domestic use in Chirchik City was estimated as 1.2 times of Japan for washing hand, and sweeping; 1.0 times for laundry and toilet; 0.5 times for bath (shower) and Kitchen with consideration of hot water use.

Sprinkling time and water amount for the yard in detached houses was estimated as 1 hour and 10 liter/min by average. Considering the watering, water consumption/capita/day for domestic use was estimated for averaged four persons' family as follows:

(10 liter/min. × 60 min./day) / 3.7 persons = 160 liter/capita/day

However, population ratio of dwellers between apartments and detached houses was estimated as 3 to 1, the water consumption/capita/day for whole city areas was calculated as 40 liter/capita/day by dividing the consumption of a detached house (160 liter/capita/day) into 4 persons.

As for sewer system, percent of population served in Chirchik City is considered about 80 % and all of the apartments and a few of the detached houses have connection pipes to the sewer system.

As a result of the above calculation, daily maximum supply amount becomes 299→300 liter/capita/day and it is the same level as that of Japan.

Furthermore, daily average supply amount is estimated as (1/1.25) times of daily maximum supply amount. Since watering except for summer season is considered to be largely decreased, the ratio between the daily average supply amount and the daily maximum supply amount in Chirchik City will be smaller than (1/1.23) times in Japan.

Daily average supply amount in Chirchik City is calculated from the daily maximum supply amount of 330 liter/capita/day as follows.

300 liter/capita/day(daily maximum supply amount)×1/1.25 =240liter /capita/day (daily average supply amount)

Based on the above consideration, daily maximum water consumption of inhabitants in apartments is calculated as follows.

300 liter/capita/day – 40 liter = 260 liter/capita/day

Daily maximum water consumption of dwellers in detached houses is estimated as below.

300 liter/capita/day –40 liter + 160 liter/capita/day = 420 liter/capita/day

As a result of water supply survey in summer season, the water consumption/capita/ day of apartments and detached houses became large 636 to 664 liter. This mas derived from the following reasons:

i) Apartments generally have leakage of 50 % or more against supplied water due to non-function of ball taps in toilets.

ii) Estimated water consumption of detached houses will be a reasonable value considering the above conditions.

Therefore, it is supposed that daily average water consumption is 240 liter/capita/day, and daily maximum water consumption is 300 liter/capita/day in Chirchik City.

S.7.3 Tariff Collection

Water tariff collection system should be formed in harmonization of the execution bodies and users. Countermeasures and proposed solutions of tariff collection categorized by users in Tashkent City are explained as follows.

S.7.3.1 Explanation of Table S.7.3.1

(1) House with Meter

1) Quality of meters should be improved, such as meters with plastic impeller and waterproof meters. All meters should be pass performance examination. Proper inspection and maintenance systems for meters should also be established.

2) Meter reading needs to be carried out efficiently and smoothly. For this purpose, attendance of users at the time of meter reading should be abolished to avoid delay of meter reading.

3) A meter installation criteria, including structure of meter box, location and depth of meters for easy meter readings, should be prepared. Besides, proper methods and standard should be prepared for removal and replacement of defective meters or meters damaged by freezing.

4) Owing to efficient meter readings and delivery of notification to users, the handy terminal/logger should be introduced for meter reading works. This equipment, using electronic information, can enter information for water tariff receipt of last time and new meter reading value. At the same time of meter reading, meter readers should carry out other works such as confirmation of the meter performance and dealing with simple complaints from users. To do these things smoothly, a proper training should be provided for meter readers.

(2) House without Meter

1) The present tariff table, which is computed complicatedly by installment and others, needs to revise to simple one such as only by the number of family or water taps.

2) Metered rate system should be expanded as early as possible on the basis of the executable plan. As for the proposal of the meter establishment plan, refer to another chapter.

3) Same as above.

(3) House in Common

1) Payment periods need to be clearly specified so that a penalty regulation can be enforced for the case of nonpayment.

2) With the establishment of the definite payment period, it is recommended to introduce a discount rate system for the users who make early payment for improvement of users' service. Such system would work to improve the payment.

(4) Apartment with Meter

1) Same as (1) 1)

2) Same as (2) 2)

3) A management responsibility of JEK should be reconsidered once again. It is desirable that the meter is managed only by the Vodokanal. This management includes meter readings, repairs of troubled meters and replacement of defective meters.

(5) Apartment without Meter

1) With the basis of the executable plan, early conversion into the metered rate system is required. To improve tariff collection, meters must be installed at all units. At first, installation of the bulk meters is also needed. The residents of the first and second floors use water for watering the garden which is a common part of the apartments. Such consumption should not be charged to individual but should be accounted as common charge of all residents. As for the proposal of the meter establishment plan, refer to the another chapter.

2) Same as above.

(6) Apartment in Common

1) To improve user's water conservation consciousness, it is needed to inform users about the consumed volume and the price. For smooth implementation of this works, it is proposed to use a handy terminal/logger which is described the consumed volume and others.

2) Same as (3) 1)

3) Considering various commission companies, the collection commission fee should be reduced to the order of several percent. A repair cost should also be paid by users directly to the trader according to the contents of repair.

(7) Communal/Industry with Meter

1) Same as (1) 1)

2) Same as (1) 2)

3) Same as (1) 3)

4) Same as above.

(8) Communal/Industry without Meter

1) First of all, the tariff should be simplified, using only family number or tap number. The metered rate system should then be introduced as a definite system for future.

2) Same as (2) 2)

3) Same as above.

(9) Communal/Industry in Common

1) Because of big consumption users, the Vodokanal may accept serious influences on the water supply management. Therefore, to uplift water conservation consciousness to users and enforce suitable water tariff, are needed. Also, it is needed to make cash income in suitable degree in order that salary for staffs is paid without delay. For this reason, the offset settlement, which is now accounted at about 72 percent of tariff, should be avoided to the proper standard in some cases.

2) Because the Vodokanal is expected to increase the number of meters, interval of meter readings may have to be changed from every month to two/three months.

S.7.3.2 Example of Meter Installation

Examples of actual meter installation in Japan as shown below may be a good reference.

(1) Meter Management

As the readings of meters are the basis of calculating water tariff, sufficient attention shall be paid to the management of meters. Under the Japanese Measurement Law, meters with metallic impeller

and those with plastic impeller are checked for their accuracy, every six and eight years, respectively.

One city of Japan (population served is approximately 3,100,000) in which the waterworks' meters are of plastic impeller type, about 100,000 meters are replaced annually. The replacement work is carried out by contract. About 9,000 irregular cases are found unfitting for the contract; stop cocks are missing or faulty; and meters' in-flow and out-flow pipes are corroded. The waterworks, taking those cases over from contractor, make repair and meter-replacement works to normalize them. Removed meters are repaired by changing faulty parts, tested and reused.

Apart from the irregularity, about 4,000 cases are problems of reading, caused by construction of structure on meter boxes or blocking spaces on meter boxes. Since 1948, the waterworks has relocated a number of meter boxes, or replaced them with the remote reading type.

(2) Selection of Meter

The source of income for waterworks is water tariff which is charged on meter's reading. In selecting the type of meters, meters' characteristics shall be considered and an appropriate type shall be selected. Even for appropriate type of meters, if it is undersized for consumption and instantaneous flow, malfunctions including failure of measurement may occur. If it is oversized on the contrary, the measurement may become inaccurate because of too-low flow. Selection of meters' size, therefore, needs careful considerations.

Of various types of meters, the waterworks use four types as shown in Table S.7.3.2: straight-line inferential, dual-pipe inferential, vertical axial (Woltman) flow and horizontal axial flow (Woltman), considering accuracy, performance, durability, economy and aspects of maintenance. All of them are wet type.

The size of meters is selected based on the planned maximum day demand, except the cases where it is directly connected or instantaneous large flow is applied with a 25 mm and below meter. Table S.7.3.2 is a guideline of selection.

Table S.7.3.2 Selection of Type and Size of Meter

Size (mm)	Type	Max. Day Demand (m^3/d)	Regulated Max. Hour Flow (m^3/h)	Range of Suitable Demand (m^3/h)
13	Straight line, inferential	6.0	1.0	
20	Dual-pipe, inferential	12.0	1.5	
25	Dual-pipe, inferential	15.0	2.0	
40	Vertical, axial flow	48.0	8.0	
50	-	120.0	25.0	
75	-	240.0	40.0	1.00
100	-	360.0	60.0	1.60
150	-	720.0	120.0	4.020
200	Horizontal, axial flow	1,500.0	250.0	4060
250	-	2,100.0	350.0	6080
300	-	2,700.0	450.0	90100

In selecting the size of meters for 25 mm and below and meters directly connected to distribution pipes, the number of water taps simultaneously used is limited as shown in Table S.7.3.3.

Table S.7.3.3 Meter Size and Simultaneously Used Taps' Number

Meter Size	Number of 13 mm taps
13 mm	1-4
20 mm	5-13
25 mm	14

For a water tap larger than 13 mm, it is converted to an equivalent number of 13 mm size taps, considering the discharge. The number to be converted is listed in Table S.7.3.4.

Table S.7.3.4 Conversion of Large Tap to 13 mm Size Tap

Taps	Equivalent Number of 13 mm Size Tap
13 mm tap	1
20 mm tap	5.5
25 mm tap	11
Toilet flush valve	16

(3) Setting Meter

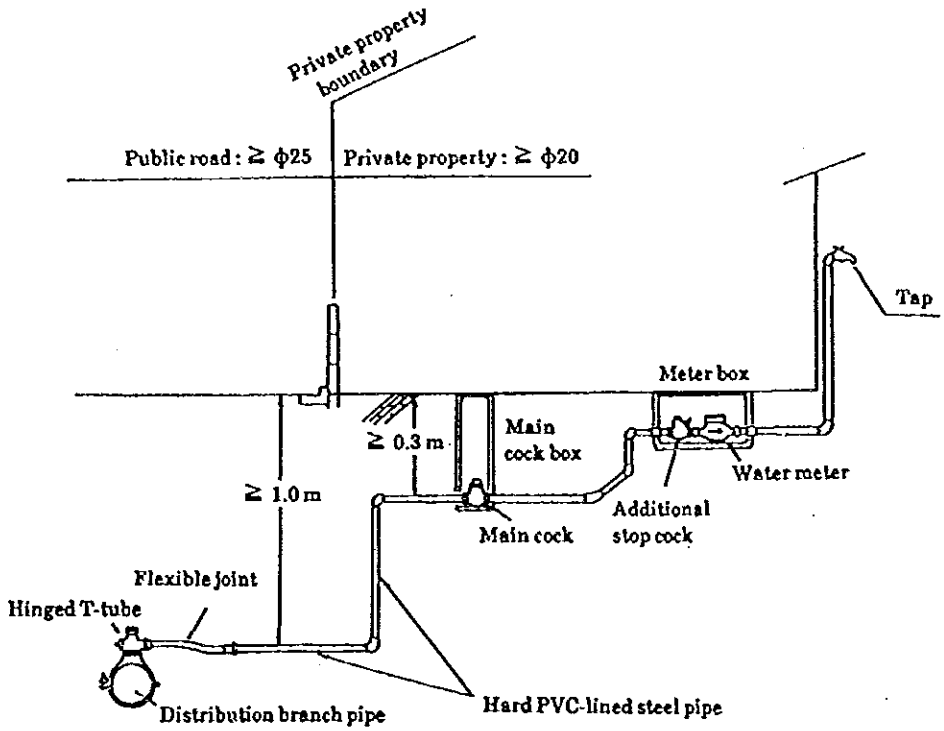
The location of a meter is very important as it affects the works for meter reading and meter-replacement after completion of the ruled service period. The waterworks specifies the following matters regarding the location of meter and method of installation work:

- setting at the side of the private property from the boundary of public roads and private properties;
- setting meter horizontally and lower than water taps in elevation;
- setting at a location convenient for reading and replacement;
- setting at a clean and dry location where dirt or wastewater does not soil the meter;
- setting in accordance with the flow direction mark so that water will not flow to the opposite direction.

But finding a location satisfying all of the above conditions is not practically easy, as land space is fully utilized in urban areas.

According to above mentioned, the meter settlement example is illustrated in Fig S.7.3.1.

Fig S.7.3.1 Meter Settlement



Along with the above-mentioned proposal, a flow of tariff collection proposed is shown in Fig S.7.3.2.

(Figure 7.3.2 Flow of Proposed Solution on Tariff Collection)

Explanation of Fig S.7.3.2, which is described the flow of proposed solution on the water tariff collection, is as follows.

S.7.3.3 Explanation of Fig S.7.3.2

(1) Users

Water tariffs are paid by users of service installations, therefore management of water tariffs begins with the management of users. In this case, all service installations have their own codes (referred to as "tap numbers"), by which users are accurately monitored, using cards, magnetic tape or electronic information. As a rule, one card (referred to as "meter reading form") is used for each installation. A tap number, address, meter number, name of user, user number, date of commencement of use, actual meter readings and quantity used for metered month, etc., are recorded on respective user's card. Each card is renewed every three years, and is preserved for six years after renewal. The data on the card are transmitted to the computer center, which proposed in another chapter, at the time of each meter reading and are used as basic data for water rate control.

(2) Relations of Meter Reading

Water tariffs are calculated on the basis of the quantity of water used as measured by the meter. For the rational calculation of water tariffs, the reading date is strictly observed. In this case, meters are read and water tariffs are billed each month. In the case of users of more than 2,000 cubic meters of water a month, the meter is read and water tariffs are billed every month.

Meter reading is conducted by the Vodokanal for the purpose of calculating water tariffs. In order to inform users of water consumption and water tariffs prior to collection, forms showing actual meter readings and water tariffs are delivered to users at the time of inspection. In this method, instrument such as electric loggers/terminal to facilitate meter reading is used. Furthermore, at this time a meter reader should deal with complaints from users, and check the meter for defects or other improvement. After meter reading, a meter reader should report to his superior in view of meter management.

As for the meter maintenance, it is important that meters have to satisfy certain standard and quality, be done appropriate maintenance individually for having good condition, and be obtained the reliance on users. So it is required to make not only a manual of meter reading but also a standard of meter maintenance.

As regards meter reading of each month, there is a problem relating to measurement of the water consumption. In this case, it is assumed that the same water consumption was used in each of the two months involved. In the event that the consumed quantity is unknown due to breakage of the meter or leakage of water from the service installation, the consumed quantity is fixed on the basis of the quantity used by the same user in the corresponding period of the preceding year.

Users are responsible for leakage of water caused by breakage in their installation. The consumed quantity is calculated by deducting the quantity of leaked water estimated according to the difficulty in finding the leakage and the length of time from the discovery of leakage.
Besides, the meter readers should be trained through a proper training program since they act as the contracting point for the Vodokanal directly with users.

(3) Water tariff decisions

When the consumed quantity is determined, the water tariff is calculated by use of specific formula and a water tariff table. The new tariff table is proposed in another chapter thus the water tariff is calculated using this one. Calculating water tariffs on the basis of these complicated systems and corrective measures, is extremely painstaking work, and calculation of water tariffs to users is done by a computer system. The computer system is mentioned in another chapter.

Unpaid water bills are computed in this process, but are deleted upon payment by users. When changes are required for any reason after calculation, they should be listed by a corrective note. The latest lists of water bills should be prepared in the form of microfilm or others and distributed to each branch office. Bills are sent by mailing (step by step).

(4) Collection

The water tariffs must be collected immediately after billing. There are two main methods of collection. Users pay their water bills at financial institutions or they pay their charges automatically from their accounts at financial institutions such as banks on a fixed day.(In some city of Japan, as of 1997, about 79.9 percent of water tariffs were paid by automatic transferring system of banks and 20.1 percent by users in person).

However, the latter method, which is an automatic transferring system, is proposed at the second stage of the tariff collection system. At second stage, it is supposed that more convenient payable places of water tariff for users such as drugstore or other shops would be adopted. The cash paid to financial institutions is transferred to the Vodokanal's account by the related banks within five days. The collected water tariffs must be categorized by fiscal year and method of collection, and be deleted from the list of unpaid bills. A computer system should be used for account transfer and bills, classifying collected water tariffs and deleting them from the list of unpaid bills.

(5) Measures for Unpaid Water Bills

It is desired that all water tariffs including special water bills be paid within a specified period. In fact, however, there are cases where customers fail to pay their bills on time for various reasons. The management of water bills, which begins with management of user's registration/record, ends with measures to be taken against unpaid water bills.

Measures to deal with unpaid bills include reduction of unpaid bills and the collection of unpaid bills. In order to avert rises in unpaid bills, it is necessary to obtain user's trust on the meter reading process and on the determination of water tariffs. The most effective method is to ask users to use the automatic transfer (proposed at second stage) of charges from their bank accounts. (In some city of Japan, the rate of unpaid water bills with bank transfers is about 1 percent, while that with direct payment at banks is about 14 percent)

Methods of collection include: urging users to pay by reminder as the first step, and collecting water tariffs by calling on users as the second step. If these are not successful, water supply should be finally suspended.

Besides in this country, it is very important to deal with the trading-off, which can not gain the cash and results in non-collection. Treatment of non-collection charge should be clearly divided into cash and equivalent goods. It is required that the equivalent water tariff needs strict evaluation of its worth, and should set the level of trading-off.

Regarding users, it is important to make atmosphere for reducing unpaid water tariffs. For this purpose, effective measures should be taken such as delivery of notes, timely warning and re-collection.