NO.

THE STUDY ON RESTRUCTURING OF WATER SUPPLY SYSTEM OF TASHKENT CITY IN THE REPUBLIC OF UZBEKISTAN

FINAL REPORT

VOLUME 1

SUMMARY REPORT

MARCH 2006

Japan International Cooperation Agency
Global Environment Department

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JAPAN INTERNATIONAL COOPERATION AGENCY

TASHKENT CITY MUNICIPALITY
THE REGIONAL COMMUNAL SERVICE ASSOCIATIONS (TKEO)
TASHKENT VODOKANAL (SUVSOZ)
THE REPUBLIC OF UZBEKISTAN

THE STUDY ON RESTRUCTURING OF WATER SUPPLY SYSTEM OF TASHKENT CITY IN THE REPUBLIC OF UZBEKISTAN

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ERNST & YOUNG SHINNIHON

NJS CONSULTANTS CO., LTD.

VOLUMES of FINAL REPORT

"THE STUDY ON RESTRUCTURING OF WATER SUPPLY SYSTEM OF TASHKENT CITY IN THE REPUBLIC OF UZBEKISTAN"

Volume 1 SUMMARY REPORT

Volume 2 MAIN REPORT

Volume 3 SUPPORTING REPORT

Volume 4 DATA REPORT

PREFACE

In response to a request from the Government of the Republic of Uzbekistan, the Government of Japan decided to conduct the Study on a comprehensive rehabilitation and maintenance program for the facilities, as well as implement financial, organizational and institutional improvement plans including a review of the tariff system in Tashkent city and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Akihiro NAKAGOME of Ernst of Young ShinNihon and composed of staff member of Ernst of Young ShinNihon and NJS Consultants, Co., Ltd. to Uzbekistan, four times between August 2003 and March 2006. In addition, JICA set up an advisory committee headed by Mr. Yoshiki OMURA, Japan International Cooperation Agency, between February 2003 and March 2006, which examined the Study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Republic of Uzbekistan, and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Uzbekistan for their close cooperation extended to the team.

March, 2006

Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

March 2006

Mr. Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the final report for "*The Study on Restructuring of Water Supply System of Tashkent City in the Republic of Uzbekistan*".

The Study aims to achieve the effective water supply services in Tashkent City, and the Study Team formulated a Long-Term Development Plan of the water supply services featuring water supply facilities, tariff system and management, conducted a Feasibility Study (F/S) on the priority projects, and shared the expertise with counterpart during the course of the Study and pilot projects.

The water supply services in Tashkent City have confronted a number of difficult issues such as high non-revenue water rate and obsolete water treatment plants. To encounter these issues, the Long-Team Development Plan developed by the Study Team set a goal to achieve three targets stable water supply, self-financial management, and efficient management organization in 2015. Some of the recommendations made by the Study Team have already been incorporated into the policy of Tashkent Vodokanal (SUVSOZ).

We wish to take this opportunity to express the sincere gratitude to the officials of your Agency, the Steering Committee, the Ministry of Foreign Affairs, the Ministry of Health, Labor and Welfare, and Japan Bank for International Cooperation for their kind support and advice. We also would like to show the appreciation to the officials of Tashkent City Municipality, the Regional Communal Service Associations (TKEO), and Tashkent Vodokanal, JICA Uzbekistan Office, and the Embassy of Japan in Uzbekistan for their kind cooperation and assistance throughout the field survey. Finally, We hope that the recommendations of the Study Team will contribute to further improvement of water supply system in Tashkent.

Very truly yours,

Akihiro Nakagome
Team Leader
Study Team for the Study on Reconstructing of Water Supply System of Tashkent City in the Republic of Uzbekistan.

EXECUTIVE SUMMARY

1. Background

Water consumption per capita in Tashkent city, Republic of Uzbekistan has reached an enormously high level compared to that of other countries. There are many reasons why the situation persists, but among the more pressing reasons is the tariff structure for water supply services. Firstly, the flat rate tariff system (so called "Norms") is determined according to family size; and secondly, the tariff level is too low to recover the cost. These two factors have encouraged wasteful use of water resulting in a very weak awareness of conserving this precious resource. To ensure a sustainable water supply service, there is an urgent need to transform from the "Norm" tariff system to the metered tariff system, as well as to restructure institutions and organizations of this service, and to make urgent investments in water supply facilities that have become deteriorated. Therefore, it is imperative to plan and implement a comprehensive rehabilitation and maintenance program for the facilities, as well as implement financial, organizational and institutional improvement plans including a review of the tariff system.

The objectives of the study are as follows:

(1) To formulate a Long-Term Development Plan (LTDP)[1] for the water supply system towards 2015 for the improvement of water supply facilities, inclusive of a tariff system and organizational structure;

(2) To conduct Feasibility Study (F/S) on projects prioritized in the LTDP to evaluate their appropriateness and effectiveness. Action plans will be formulated for organizational, institutional and management improvement; and

(3) To share expertise and provide technology transfers in planning methods and skills for facility rehabilitation and management improvement with counterpart (C/P) during the course of the Study.

2. The Long-Term Development Plan

2.1 Current Issues

Most of the water supply facilities in Tashkent city were constructed before 1980 and proper investments for their maintenance and replacement have not been made. The deteriorated water supply facilities cause frequent breakdowns and the generation of non-revenue water (NRW) in water supply service in the city. Subsequently, the financial burden of the service has been large in recent years. Therefore, unless the deteriorated facilities are replaced, frequency and cost of repairs will increase, and further repairs will become very difficult to carry out. In the long run, it will become impossible to meet the water demand. The operational stability of the water supply facilities will mean a reliable and adequate supply of

[1] When the scope of work of this project was agreed between TKEO and JICA in 2003, the LTDP was called "master plan".

water to all the consumers. The need, therefore, of carrying out repair and rehabilitation of the facilities, including the replacement of some, is urgent. For this purpose, a necessary budget needs to be secured. In order to secure the budget, the long-term development plan (LTDP) focusing on the financial and management view points including strengthening the organization, have to be formulated, as well as the replacement and improvement plans for facilities.

2.2 Formulation of the Long-Term Development Plan

In order to provide long-term solutions to the various problems facing Vodokanal, the LTDP has been formulated in the target year of 2015. Three targets: (i) stable water supply through suitable rehabilitation and operation for facilities, (ii) self-financial management, and (iii) efficient management organization, are set. The following eight elements are examined in this study.

(1) Water Demand Projections

Population growth rate was assumed to be almost flat in the future, according to the Statistics Department of the city council. Water demand projection was also assumed that non-revenue water (NRW) and wastage would be decreased as a result of the implementation of the NRW reduction program. The projection results are shown in Figure 1.

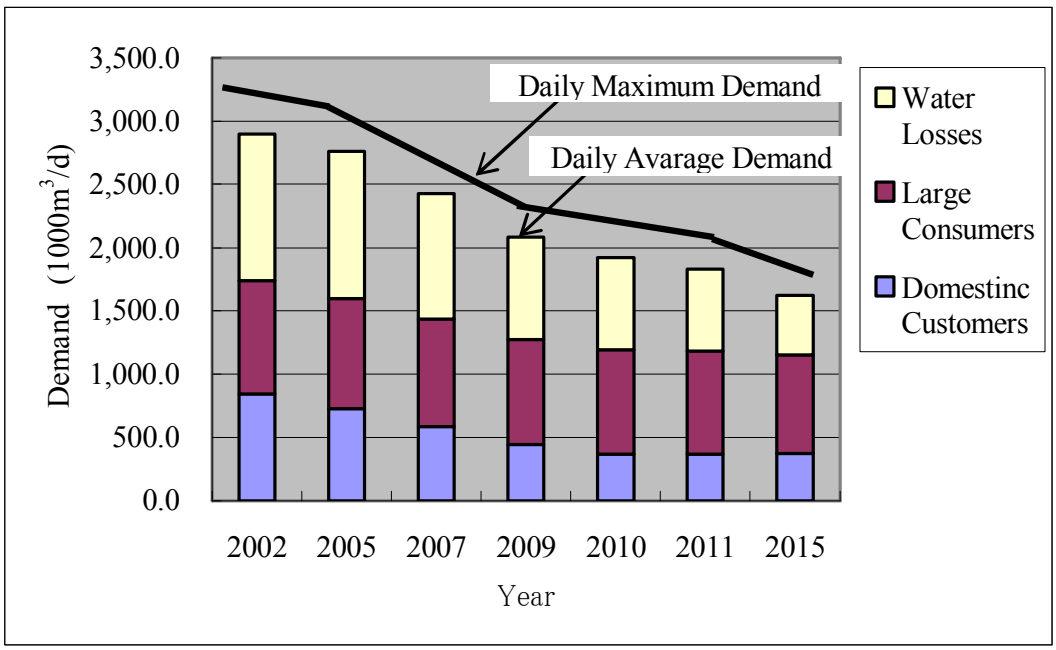


Figure 1 Water Demand Projections

(2) Reduction of NRW and Wastage (NRW Reduction Program)

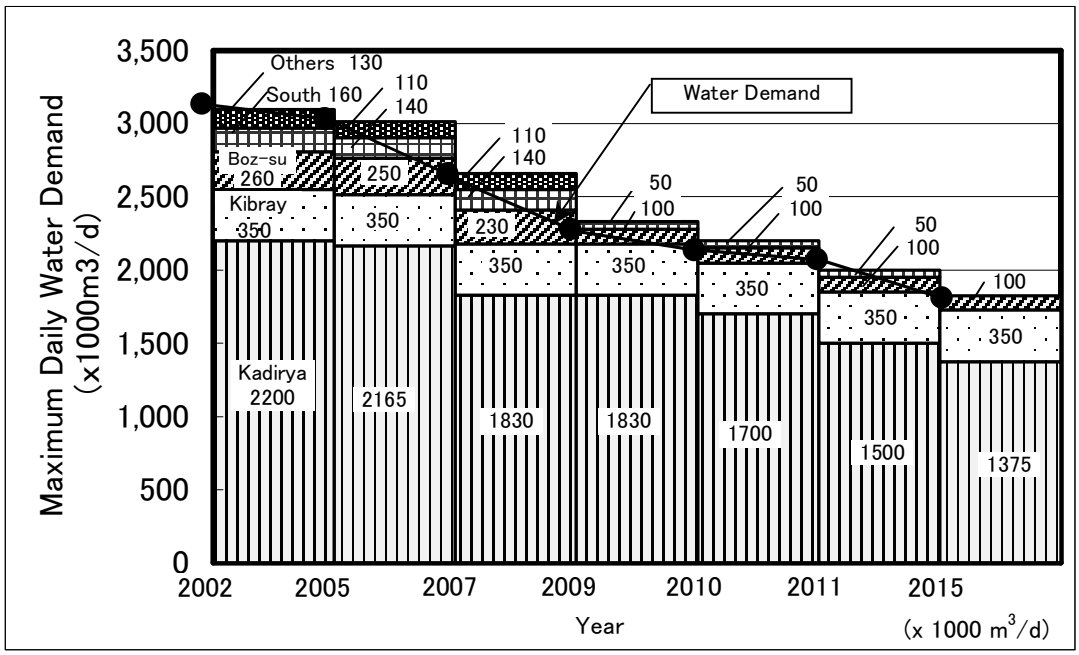
In order to reduce non-revenue water (NRW) and wastage, a NRW Reduction Program is formulated. The components are (i) promotion of meter installation, (ii) replacement of deteriorated pipelines, and (iii) strengthening of management.

(3) Replacement for Deteriorated Facilities and Improvement of Inefficient Distribution Systems

There is a need to draw up a plan to replace deteriorated facilities as well as to make the existing distribution system operate more efficiently. To do this, retained water treatment plants (WTPs) that meet decreasing water demand in the future need to be identified. Improvement plans for the facilities of the selected WTPs incorporated with the overall distribution systems, should be formulated as shown below.

1) Selection of Necessary WTPs in the Future

Kadirya WTP, the largest out of eight WTPs in the city, needs to be operated continuously. The relation between the projected maximum daily water supply and the required capacity of Kadirya and other WTPs is shown in Figure 2. Although Kadirya WTP is currently overloaded, the amount of water it treats will gradually decrease based on the reduced water demand, and it will be operated at a design capacity of 1,375,000 m^3/d in the target year. The shortage of capacity of 450,000 m^3/d will be produced by Kibray and Boz-su WTPs in the figure.



Total Capacity	3,100	3,015	2,660	2,330	2,200	2,000	1,825
Water Demand	3,100	3,015	2,656	2,289	2,130	2,060	1,820

Figure 2 Transition of water demand and required capacity of WTPs

2) Establishment of Water Distribution by Gravity Flow

In establishing an efficient distribution system, making full use of topographic features of the area should be investigated to introduce the gravity flow system as much as practical. The proposed improvement plan for the water distribution system includes the replacement of deteriorated pipes, the pipe augmentation for securing proper water pressure, improvement of booster pump stations (PSs), and the introduction of the pressure and flow control system. Among other things, the study focused on the improvement of booster PSs since there is a

possibility that many existing PSs will be abandoned upon the introduction of the water distribution by gravity flow.

3) Management Organization for the Implementation of the LTDP

Implementing the LTDP will require the reformation of the management organization as follows:

(i) Establishment of a Unit for the Promotion of the LTDP

In order to implement the contents of the LTDP, it will be necessary to constantly evaluate its progress. If any problems arise, proper actions must be taken and these should be reflected in the subsequent parts of the LTDP. Therefore, a department that will carry out such a function, namely the Unit for the Promotion of the LTDP, will be established under the General Director of Vodokanal.

(ii) Relocation of Employees under Restructuring WTPs and PSs

With the restructuring of the WTPs and PSs, it is estimated that some employees working at WTPs and PSs may no longer be required. However, the relocation of those employees will be possible due to adjustments caused by attrition. They will be also relocated to construction projects implemented under the LTDP, to meter reading and maintenance positions, as well as to departments that will be newly established.

(4) Improvement of the Financial Situation

A program to improve the financial situation of Vodokanal will be formulated. This improvement program will enable Vodokanal to achieve a stable financial status, allowing it to procure and repay the investment funds required for the LTDP, without putting too much burden on the domestic consumers. In this regard, as the LTDP sets the year 2015 as the target year for the minimum necessary improvements of facilities. The plans must be revised periodically as external factors change.

(5) Improvement Plan for the Tariff System

In order to achieve a self-financed system, reform of the tariff system is inevitable. Above all, an early transition to the metered tariff system is necessary, thus the promotion and eventual completion of meter installation should be carried out. The future tariff levels in relation to the repayment will be examined in Section 2.3 (2). Even though the increase of tariff is relatively low at 3.0% per year, it will be much higher than the current level, thus the domestic consumers must be consulted to get their understanding and support of the plan. It is very important for Vodokanal to first set a plan for tariff, and then set an appropriate financial plan. There are two considerations in the implementation of a new tariff plan: (i) items to be reformed independent of the transition to the metered system (e.g. reforms for the methods of tariff revision and reform of the tariff collection systems) and (ii) items to be taken into account in the transition to the metered system (e.g. introducing the new tariff system etc.).

(6) Improvements in Management and Organization

The executive management has to correctly understand the problems, set the necessary targets for solving those problems and make improvements as necessary, and formulate the strategies that are required to attain such targets. The LTDP will bring about such a process. The contents are divided into three categories as follows:

1) Strengthening of Management

Vodokanal managers must examine and correctly understand the content of the LTDP. The top management of Vodokanal must be knowledgeable of the LTDP. This awareness is a critical component to being able to disseminate accurate information to related governmental institutions and gain their support to reach the eventual accomplishment of the targets set in the LTDP. It will also mean having all key institutions supporting necessary legal reforms. The top management and managers must be able to explain the contents of the LTDP to all its employees because their understanding of the vision for Vodokanal will mean gaining their cooperation in implementing planned and necessary changes.

2) Reform of Personnel Management

Firstly, employee training should not only be limited to technical training but should also include those aimed at strengthening information collection and analysis of management and finance. Secondly, in order to motivate employees and revitalize the whole organization, a performance-based wage system can be introduced. The current wage structure is basically low in relation to the cost of living and wages cannot be increased because of budget as well as legal limitations. Thus, a performance-based evaluation system, which can provide special allowances to individual employees, may be introduced.

3) Organizational Reform

The Unit for the Promotion of the LTDP is expected to play the core role in the implementation of LTDP. The role of the Unit involves not only promoting the renewal and rehabilitation of the facilities, but also promoting management and organizational reform as a whole. Therefore, it is important to allocate staff with not only technical knowledge, but also management and organizational restructuring knowledge, including the water tariff systems, into the Unit. Particularly, it is expected to play a triggering role in reforming the management and the organization's structure and culture.

(7) Information Development and Sharing

Improvement of management requires that accurate information must always be shared among the executive management, heads of sections, and their staff, and be effectively utilized. For instance, information obtained at the work sites is generally very valuable for management and administration. However, a "top-down" decision-making process inherited from the previous regime is still strongly in place. In addition, even if information is transmitted from the work sites to the middle management, the information flow sometimes stops there. Thus, as an alternative measure to solve such problems, introducing a "bottom-up" decision-making process would be effective. Therefore, internal regular meetings, based on each problem (or theme) should be organized, with the result of the meetings shared among employees. In

addition, information development should be established in order to share the information.

(8) Promotion of Customer Participation

In order to reduce water wastage and NRW under the norm tariff system, public information brochures (experimentally prepared in this Study), as well as the preparation of a short video to be broadcasted on TV are necessary. These activities will be promoted by the Public Relations (PR) division, which is expected to be established. Due to the special requirements of such a job, officers in the PR division should be recruited from the outside.

2.3 Project Costs, Financial Plan and Evaluation in the LTDP

(1) Project Costs

The costs of the LTDP are calculated in Table 1 and 2.

Table 1 List of Physical Components of the LTDP with Construction Costs

Physical Componnets	Cost (1,000 USD)
Kadirya WTP replacement and improvement	24,530
Kibray WTP replacement and improvement	8,255
Pipeline replacement	45,462
Booster PS improvement	11,639
Pipeline network improvement	13,071
Total direct costs	102,957
Indirect costs	55,197
Total costs	158,154

Table 2 List of Management Components of the LTDP with Costs

Items	Cost (1,000 USD)
Program to promote the installation of water meters	17,275
Developing the IT infrastructure	1,400
Improve employee training	600
Introduction of external auditing	50
Total costs	19,325

(2) Financing Plan

To implement the entire LTDP, a considerable amount of investment funds will be necessary. Even if water tariffs are increased, it is impossible to secure the necessary funds for the recommended plan by Vodokanal alone within a tight time frame before implementing the LTDP, and thus, borrowings or a government subsidy will be essential. A simulation was carried out in order to obtain a tariff level which would not face fund shortages in the future. Repayment schedules are established changing the borrowing conditions of the investment funds. The results are summarized in Table 3, which assumes that the period of the annual tariff rate increases 3.0% per year, will start from the year 2006. As the result of this simulation, if funds are borrowed at interest rates of 1.3% or 5.0% per year, it is estimated that tariff increases would be needed until the year of 2017 for interest 1.3% or 2025 for 5.0%, respectively, and cumulative tariff increases of 1.4 or 1.8 folds, respectively in comparison with the current level. 1.8 folds increase in tariffs is indeed big, but the tariff increase rate is 3.0% per year. However, in the case of a 10.0% interest rate, the tariff increase rates, which can avoid cash shortages, are shown in Table 4.

Table 3 The Relation between Interest Rates and the Period of Tariff Increases

Interest Rates	The Period of Tariff Increases	Annual Tariff Increase Rates	Cumulative Tariff Increases
1.3 %	2006-2017	3.0% per year	1.4 folds in 2017
5.0%	2006-2025	3.0% per year	1.8 folds in 2025
10.0%	Unable to repay with the annual tariff increase rate of 3.0% per year		

Table 4 Tariff Increase Simulation for 10% Interest Rate

Interest Rate	Annual Tariff Increase				Results
	2006 - 2010	2011 – 2020	2021 – 2022	2023 - 2040	
10.0%	5.0%	5.0%	3.0% Cumulative increase: 2.2 folds	0%	Cash surplus of USD 77 million by 2040

(3) Evaluation of the LTDP

The technical evaluation in the LTDP reveals that NRW from the pipeline and the number of WTPs and booster PSs will be drastically decreased, then the number of staff operating these facilities and electricity consumption are also expected to decrease sharply. Accordingly, the effect of LTDP is very positive. With regard to the evaluation of socio-economic and financial viewpoints, the financial situation will stabilize in the long-run by implementing the LTDP based on a given tariff increase. If the LTDP is not implemented, the financial status beyond the year 2011 will worsen due to an increase of running and repair costs, in spite of adopting a similar level of tariff increase, as the LTDP suggests. It can be concluded that implementing the LTDP is justified also from a financial point of view.

3. Feasibility Study

3.1 Selection of the F/S Project Components

Based on the Study for LTDP, the F/S Project Components were selected as shown in Table 5, through the examination of prioritized projects. The main target of the F/S is set at the establishment of the water distribution system by gravity flow, excluding simple rehabilitation, which requires special technical and administrative skills. Accordingly it facilitates the F/S to maximize the effectiveness of technology transfers. The target year of the components for F/S (hereinafter referred to as F/S project) is set at 2011, considering its scale and the duration of construction works.

Table 5 Selected F/S Projects for Physical Improvement

Name	Facility	Replacement/ Repair/Reconstruction	Direct cost (1,000USD)
Kibray WTP	Distribution PS	Construction (capacity 1000m^3/hr)	269
	Distribution pipes	Improvement to change for gravity system	1,755
Distribution facilities	Pipeline network	Reinforcement of pipeline 16.8km	10,554
		Pressure/flow regulation Valve, 22units	2,090
		Refurbishing Booster PSs	9,398
		Monitoring stations	427
Total direct cost			24,993

3.2 Preliminary Design for Improvement of Distribution Network

(1) Water Distribution by Gravity Flow from Kibray WTP

The major contents of the improvement in the WTP are: reinstallation of distribution pipes with a diameter of 1,400mm x length 1.5km to supply water by gravity from the existing reservoir, and the construction of a new distribution pump station with a capacity of 1,000m^3/hr to distribute to the surrounding area.

(2) Improvement of Distribution Networks for Entire Service Area

At present, in some distribution pipes, there is a lack of flow capacity and it causes low water pressure downstream. In order to increase the flow capacity and raise water pressure in the city, the reinforcement of pipes with a length of 16.8km is planned. Since the hourly flow will fluctuate more in the future and subsequently the pressure will also fluctuate, an automatic pressure/flow control will be required. The points where the pressure/flow control is to be installed are 19 points and these are the points where a substantial decrease in water pressure is required based on hydraulic calculations. In addition, three flow regulation valves will be installed.

(3) Improvement of Booster PSs

Based on the detailed survey of booster PSs in the Hamza, Mirabad, Sergeli and Bectemir Districts and their supply areas in the Kibray distribution area, improvement plans for PSs are assumed for two cases of a residual pressure of 26m or more and under 26m respectively. Based on the examination, three categories of a rehabilitation plan were formulated for booster PSs; “Monitoring (only a monitoring system will be installed)”, “Improvement” (pumps with an automatic operation system will be replaced and a monitoring system will be installed), and “Abandonment”. Ratios of three categories within a range of design capacity are calculated in addition to current and future required capacities and electricity consumptions. The data gathered at the PSs will be transmitted to the monitoring station at the Vodokanal Head Office.

Furthermore, the water pressure of each PS in the entire distribution area was judged if water pressure is 26m or more and under 26m, and the ratio of each pressure condition was calculated. Table 6 summarizes the results of the improvement methods of the above three categories by the capacity, of which the ratio examined in the survey in the Kibray area was adopted to the above ratio of pressure condition in entire distribution area. As shown in the table, the number of PSs that will continue to operate is 73 and this is 54% of the total number of the existing PSs. However, the capacity and the electricity consumption of PSs will be reduced to 23% and 31% in 2011, and 19% and 25% in 2015 compared to current value, respectively.

Table 6 Number of PSs by Category under the Rehabilitation Plans

Category/Capacity(m^3/hr)	Large*2	3000	1000	800-600	500-300	200-100	Under100	Total
Monitoring	2	4	6					12
Improvement			25	5	3	3	9	45
Later Improvement*1			8	2	2	2	2	16
Abandonment		1	4	4	2	3	31	45
Later Abandonment*1			1	3	2	2	9	17
Total	2	5	44	14	9	10	51	135

*1: To be conducted between 2012 and 2015
*2: Mirzo-Ulugbek and Chilanzar PS

(4) Operation and Maintenance

The number of staff necessary for facilities and electricity/chemical consumption will be drastically reduced after implementation of the above booster PSs rehabilitation plan and the EBRD Projects as shown in Table 7.

Table 7 Operation Cost for Electricity, Chemical and Labor

Items	Consumption/Number			Cost (1000 USD/year)		Unit price
	2002	2011	Unit	2002	2011	
Electricity	274.6	119.5	GWh/y	8,238.0	3,585	30 USD/1000kWh
Coagulant	2582	5429	ton/year	278.3	585.2	107.8 USD/t
Liquid Chlorine	662.6	386.4	ton/year	106.5	61.8	160 USD/t
Hypochlorite	9.7	0	ton/year	9.7	0	1,000 USD/t
Sub-total				8,632.0	4,232.0	
Operators	1,695	847	Persons	1,017.0	508.0	600 USD/person/y
Total				9,649.0	4,740.0	

3.3 Project Costs and Implementation Plan in F/S Project

Total construction costs including indirect costs are calculated in Table 8. Replacement of the decrepit pipes, 420 km in length, is required to introduce the 'water distribution by gravity flow' studied in this F/S. The pipe replacement is included in the 'highest priority project', consisting of F/S project and the replacement of pipelines, and thus included in the total construction costs.

Table 8 Total Construction Costs

Items		Cost (1000 USD)			Total
		2007-2008	2009-2011	2012-2014	
Project components targeted in F/S	Kibray WTP Replacement/ Improvement		2,024		2,024
	Booster PSs Improvement		9,398		9,398
	Pipeline Network Improvement		13,071		13,071
	Sub-total		24,493		
Pipeline Replacement (420km)		12,989	12,989	19,484	45,462
Total direct cost		12,989	37,482	19,484	69,955
Import Tax		514	1,957	772	3,243
VAT		2,495	7,105	3,744	13,344
Other indirect cost		3,214	10,736	6,375	20,325
Total indirect cost		6,223	19,798	10,891	36.912
Grand Total by Period		76,492		30,375	106,867

3.4 Project Evaluation

(1) Financial Evaluation

In this section, a financial evaluation was conducted for the 'highest priority project'.

1) Results of financial simulations

Table 9 presents the results of the financial simulation, showing changes in the borrowing rate of interest, and taking into consideration the affordability of domestic customers by employing a slow tariff increase scenario.

Table 9 Simulation Results of Slow Tariff Increase, by Interest Rate

Interest Rates	Tariff increase until			
	2016 Cumulative increase: 1.4 folds	2025 Cumulative increase: 1.8 folds	2030 Cumulative increase: 2.1 folds	2040 Cumulative increase: 2.8 folds
1.3%	No cash shortage during 2005 to 2040 Cash surplus of USD 7 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 130 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 185 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 239 million by 2040
5.0%	Cash shortage*	No cash shortage during 2005 to 2040 Cash surplus of USD 68 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 123 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 177 million by 2040
10.0%	Cash shortage	Cash shortage	Cash shortage	Cash shortage

Note: Tariff increase rate (per year) during 2006-2040: 3%

* If tariff increases until 2016, cash shortage will occur after this period (see Volume 3, S 11-1-3)

2) Concluding results in the financial simulations

Table 10 Feasibility and Minimum Financial Requirements

Borrowing Interest Rates	Feasibility of the F/S Project and the pipeline replacement	Minimum Required Financial Measures
1.3 %	Feasible	Tariff increase by 3% per annum
5.0 %	Feasible	Tariff increase by 3% per annum
10.0 %	Not Feasible	Tariff increase of more than 3%per annum or government's subsidy

In order to keep the annual tariff increase rate less than 3.0%, it is necessary to borrow at an interest rate 1.3 % to 5.0%. If the interest rate exceeds 10.0%, the highest priority project is not feasible and a more severe tariff increase or a larger amount of government subsidy will be necessary. When Vodokanal examines the actual funding plan, the following issues are required to be addressed:

- It is unlikely that Vodokanal will be able to secure funds at such an unrealistically low interest rate of 1.3%;

- It will be necessary to consider the possibility of an Uzbekistan internal fund, if Vodokanal could borrow the funds from international financial institutions or foreign governments. In general, international financial institutions do not finance the full amount

of a project and require the borrowing country to finance a part of the necessary investment amount. The internal funds will be mostly used for civil engineering works and installation of machineries, which will be conducted by Vodokanal's affiliated companies.

(2) Socio-Economic Evaluation

A stable supply of water is one of the Basic Human Needs (BHN). The F/S project and the pipeline replacement are essential for people living in Tashkent. The economic benefits provided by this project after its implementation can be summarized into the following:

- Public health benefits
- Improvements in living conditions

(3) Technical and Environmental Evaluation

This study is mainly composed of activities that would lead to the formulation of an efficient distribution system. The study was carried out maintaining conformity with the technical conditions prevalent in Uzbekistan. With all these taken into consideration, the project is assessed to be appropriate. With regard to the environment, some mitigation methods, such as preparation of a detour road, and prevention of generating noise and dust, need to be carried out in the construction work, the installation of pipe reinforcement and pipe replacement.

4. Conclusions and Recommendations

4.1 Conclusions

In order to achieve a stable water supply, the following objectives for the proposed project will be addressed as below:

(1) In 2002, NRW in Tashkent city amounted to 1,400,000 m^3/d (per day), and the ratio of NRW in the total production of water of 2,900,000 m^3/d (per day), which totals approximately 48 percent. In order to reduce NRW, there are needs to be an implementation of an NRW Reduction Program including the promotion of water meter installation, replacement of deteriorated pipes and the strengthening of management. Based on the program, water demand projection is carried out by employing a flat population growth rate. Necessary WTPs are chosen in order to cope with the projected water demand, which are planned to be replaced and improved. In addition, water distribution network is examined and planned to be improved.

(2) By implementing the LTDP, in the target year of 2015, operation staff and electric consumption will decrease to 63% in comparison with 2002.

(3) 158 million USD of the construction costs will be required to rehabilitate and improve the facilities in the LTDP.

(4) A large amount of investment funds will be required. Financial simulation was undertaken with regard to the required financial resources for the rehabilitation of the facilities and its repayment scheme. The analysis indicates that if funds are available at an interest rate of below 5% per year, Vodokanal will not have to rely on government subsidy, and so consumers will not be excessively burdened by excessive water tariffs. However, if the interest rate is above 5% per year, it will be a tremendous financial burden for consumers, especially as tariff increases will be sharp (see Table 3 and 4). But to avoid such a situation, a government subsidy might be necessary to reduce the burden for the consumers.

(5) In order to improve the strength of the Vodokonal management system, this study proposes: (i) improvement in the tariff structure, which takes into the consideration each stage of transition to a metered system, (ii) management and organizational improvement program, which emphasizes the measurement of an effective resolutions to problems within this area, making it more sustainable unto itself, (iii) information sharing program, which target the sharing of management information, and (iv) co-operation program with domestic customers.

(6) The F/S project was formulated on the basis of improving the water distribution system, which is expected to save energy in parallel with the implementation of the plan to reduce NRW and to rehabilitate the deteriorated facilities. The implementation of the F/S project and pipe replacement will reduce electricity by 57%, and the number of employees by 50% in 2011. The financial resources and repayment in the F/S project and pipe replacement is the same as referred in (4).

4.2 Recommendations

In order to improve Tashikent's water supply operations in the future, the LTDP proposed in this study should be carried out and ultimately realized. Vodokanal will play a core role in the actual implementation process. Thus, the following recommendations are proposed for Vodokanal and the government.

(1) Recommendations to Vodokanal

1) It is important to precisely understand the current business situation for the improvement of water supply management in the future as below:

- To understand consumer's propensity to contribute to NRW, such as illegal connections by investigating improper usage;
- To establish facilities (almost all existing facilities are dilapidated) that would be able to provide accurate data on the amount of water at the intake and sent to the WTPs, the amount of water actually being distributed through the system and the water pressure during distribution;
- To utilize data information, collected and analyzed by computers including the

quality of water analysis and so on.

2) In the proposed LTDP, the plan to reduce NRW must be given priority in implementation;

3) As for the issues that the F/S will not be able to cover, Vodokanal will study and assess these issues;

4) The importance of daily operation and maintenance activities must be recognized, so a certain portion of the budget must be allocated to maintenance operations;

.

5) In implementing the LTDP, the necessary funds would be 158 million USD for the facility plan and 19 million USD for the management plan. Vodokanal should understand the significance of the plan, have accountability to the government, and seek their cooperation in order to procure the necessary funds;

6) In implementing the LTDP, setting up of the range and subject matter for the training programs, as well as developing the capacity of the trainers are necessary; and

7) It is vital to get the support of the people and increased interaction with the consumers through PR activities because the new programs to be implemented will require tariff increases in the future.

(2) Recommendations to the Government

1) The government should consider its role in assisting this program in regards to issues of salaries for employees and the implementation of the tariff structure, which will make Vodokanal's water supply more stable.

2) As the water supply is closely related to other public services and is important to the daily life of the population as a whole, it is necessary to ensure the consistency of the LTDP with the plans and programs of the other public services, and that the Government should cooperate in disclosing and providing information on the project.

3) The government is strongly advised to reform its legal system by introducing international accounting standards.

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Glossary

Terms	Description
Counterpart (C/P)	Tashkent city, TKEO, Vodokanal
GOST	Quality standard of the former Soviet Union
Government	Tashkent city Hokimiyat, the GOU and/or other governmental authorities
GUPT SUVSOZ	The official name of Vodokanal
Hokim	The city mayor
Hokimiyat	The city administration of Tashkent
Norm	The flat rate
SNIP	Design criteria of the former Soviet Union
Study Team	Study team sent by JICA
Subsozkurilish	New subsidiary for construction separated from Vodokanal
Tashteplocentral	Water heating company
Tashteploenergo	Hot water supply company
TKEO	The regional communal service associations
Ulgurgisuvsavdo	New sales subsidiary separated from Vodokanal
Uzbek-Zenner	A joint venture company which was established with investment by Hokimiyat and Zenner, a German instrument manufacturer
Vodokanal	Water supply company (Tashkent city)
Water CAD	The name of hydraulic analysis software

List of Abbreviations

Abbreviations	Formal form
C/P	Counterpart
EBRD	The European Bank for Reconstruction and Development
EDR	Equalizing Discount Rate
F/S	Feasibility Study
GDP	Gross Domestic Product
IT	Information Technology
JICA	Japan International Cooperation Agency
LIBOR	London Interbank Offered Rate
LTDP	Long-Term Development Plan
M/P	Master Plan
NRW	Non-Revenue Water
OJT	On-the-Job Training
O & M	Operation and Maintenance
PC	Personal Computer
PDCA	Plan, Do, Check, Act
PR	Public Relations
PS	Pump Station
S/W	Scope of Work
USD	United States Dollar
VAT	Value Added Tax
WTP	Water Treatment Plant

Units of Measurement

Abbreviations	Formal form
GWh/y	Giga-watt-hours per year
kWh/d	kilo-watt-hours per day
kWh/m^3	kilo-watt-hours per cubic meters
kWh/y	kilo-watt-hours per year
L/cap./d (Lpcd)	liters per capita per day
m/hr	meters per hour
mil.	million
Mg/L	milligrams per liter
m^3/d	cubic meters per day
m^3/hr	cubic meters per hour
t/d	tons per day
t/y	tons per year

Exchange Rate applied in this report[*]

USD 1 = UZS 1,000 in 2003 (During the formulation of LTDP in 2003)

USD 1 = UZS 1,090 in 2004 (During the investigation of F/S in 2004)

[*] Please note that for majority of this report, 2003 exchange rate is used. Exception to this can be found in Chapter IV, where the 2004 exchange rate is used. As a reference, the exchange rates for USD to JPY are shown as follows: in 2003 (USD 1 = JPY 106) and in 2004 (USD 1 = JPY 103).

The Republic of Uzbekistan

Chirchik River Basin and Tashikent City

Chapter I Introduction

FINAL REPORT

Chapter I Introduction

Water consumption per capita in Tashkent city, Republic of Uzbekistan (hereinafter referred to as "ROU") has reached an enormously high level compared to that of other countries. There are many reasons why the situation persists, but among the more pressing reasons is the tariff structure for water supply services. Firstly, the system of tariff is determined according to family size (so called "Norms"); and secondly, the tariff for water supply services is too low to recover the cost. These two factors have encouraged wasteful use of water resulting in a very weak awareness of conserving this precious resource. In accordance with the policy that water supply services should be more self-sustainable, adopted when Uzbekistan became independent, there is an urgent need to transform from the "Norm" tariff system to the metered tariff system, as well as to restructure institutions and organizations of this service. Another consequence is inadequate funds to repair water supply facilities that have become deteriorated, or to make urgent investments in new facilities. To ensure a sustainable water supply service, therefore, it is imperative to plan and implement a comprehensive rehabilitation and maintenance program for the facilities, as well as implement financial, organizational and institutional improvement plans including a review of the tariff system.

Under these circumstances, "The Study for Improvement of Management and Tariff Policy in Water Supply Services" was conducted by Japan International Cooperation Agency (hereinafter referred to as "JICA") in 1999-2000, in response to the request from the Government of Uzbekistan (hereinafter referred to as "GOU"). In this Study, the tariff structure and collection systems were assessed in terms of compliance with the market economy and the management improvement plan for Vodokanal, a public water supply service company.[1]

[1] The legal status of Vodokanal, its obligations and scope of its responsibilities are set in its charter. Although Vodokanal is under the authority of TKEO (Tashkent Regional Communal Service Association), it is basically a monopoly, being fully owned and controlled by the *Hokimiyat* (the city administration of Tashkent). In addition, while its name was officially changed to "Suvsoz" (Uzbek) in

Based on recommendations borne out of the above-mentioned study, the GOU requested Japan conduct a study to formulate a long-term development plan (LTDP)[2] for the renewal and rehabilitation of the existing water supply facilities, and improvement of organizations, institutions and management for sustainable water supply services. Also, GOU requested the conduct of a feasibility study (F/S) for the projects prioritized in the LTDP and the sharing of expertise with the GOU counterpart. In response to this request, JICA dispatched a preliminary study team in February 2003, which verified the need to implement the study. Thus, the scope of work (S/W) was agreed by TKEO and JICA, and a decision was made to carry out this study.

The objectives of the study are as follows:

(1) To formulate a Water Supply System LTDP towards 2015 for the improvement of water supply facilities inclusive of a tariff system and organizational structure;

(2) To conduct F/S on projects prioritized in the LTDP to evaluate their appropriateness and effectiveness. Action plans will be formulated for organizational, institutional and management improvement; and

(3) To share expertise and provide technology transfers in planning methods and skills for facility rehabilitation and management improvement with counterpart (C/P) during the course of the Study.

The Study Area mainly covers Tashkent city, the capital of the ROU. The areas in the suburbs of the city where water sources and water treatment plants (WTPs) exist are also included as part of the study area. The scope of the study is summarized in Table I.1.1.

the year 2000, it will still be referred to throughout this report as "Vodokanal" (Russian) for which it is commonly known.

[2] When the scope of work of this project was agreed between TKEO and JICA in 2003, the LTDP was called "master plan (M/P)".

Table I.1.1 Scope of Study

Subject	Item	Description
Long-Term Development Plan	Survey	-Data collection, organization and analysis -Water supply facilities and operation status -Consumer survey, demand survey, employee survey -Organization, institutions and management surveys and questionnaires
	Survey, Training and Awareness Program	-Pilot projects, participatory analysis workshop
	Study/Planning	-Wastage of water resources, -Management improvement in Vodokanal, -Facilities replacement and rehabilitation
	Evaluation	-Finance, socioeconomic, technical, environmental and general aspects
Project Prioritization	Study	-Identification of technical components -Action plan for management improvement, employee training plan
Feasibility Study	Supplemental Study	-Water quality
	Feasibility Study	-Facilities replacement and rehabilitation -Organization, institutions and management
	Evaluation	-Finance, socioeconomic, technical, environmental and general aspects
Workshop for Technology Transfer	Contents	-Organization, institutions, management -Facilities replacement and rehabilitation

The contents of this report are as follows: Chapter II will explain the current conditions as well as the issues of the water supply system in Tashkent city, followed by the formulation of the long-term development plan (LTDP). Prioritized project components derived from the LTDP and the subsequent selection of F/S project components are explained in Chapter III. Selected F/S components are described in Chapter IV, complete with the project costs, schedule and evaluations. Finally, conclusions and recommendations will be explained in Chapter V.

Chapter II Long-Term Development Plan of Tashkent City Water Supply System

Chapter II Long-Term Development Plan of Tashkent City Water Supply System

II.1. Current Conditions

II.1.1 Natural Conditions

(1) Topography, Geology and Meteorology

Tashkent city is located in the eastern part of Uzbekistan, only 10 km from the border of Kazakhstan. The city, having an area of around 340 km^2 is configured as a circle with a diameter of approximately 20 km. The elevations are as follows: eastern area, 500 m; western and southern areas, 400 m; and the city center, 440-450 m. The city is built on a complex alluvial cone formed by mud and sand discharged from the Chirchik River that flows through the southern part of the city. There is abundant groundwater in the alluvial sand and gravel layer along the river and the city utilizes this as its one of the main water sources. Several faults that cross the city are considered as active because they cut through the Quaternary layers.

The climate of the city is classified as a Steppe zone. The average annual temperature of the city between 1980 and 2002 was 14.6℃; whereas the monthly average varied between 1.9℃ in the winter and 27.8℃ in the summer. The annual precipitation in the same period was 430 mm, and the monthly average precipitation varied from 1.2 mm in August to 69.1 mm in March.

(2) Water Sources

The two principal water sources for the water supply system of the city are surface water and groundwater from the Chirchik Valley. The surface water source is the Boz-su canal, an intake canal taken from the Chirchik River, from which 2,300,000 m^3/d (in 2002) of raw water is withdrawn. The Chirchik River itself is discharged from the Charvak Dam, with a storage capacity of 2 billion m^3, and together with the Syrdaria River, represents the major water source of Uzbekistan. An average of approximately 600,000 m^3/d of

groundwater is taken by six WTPs as their water source.

II.1.2 Socio-Economic Conditions

(1) Population

According to official statistics, the population in Tashkent city as of 2002 was 2.14 million, which is equivalent to eight percent of the total population of the country. The population growth has been relatively stable over the last few years. According to the forecasts of the Statistics Department of Tashkent city, the population will remain constant until 2015.

Tashkent city is divided into 11 administrative districts, so-called "*Rayons*". Vodokanal provides services to the 11 districts of Tashkent city and the surrounding areas of the city, including Kibray, Kadirya and Ata. According to Vodokanal, their domestic consumers accounted for 98.5% of the total population of the city in 2002, plus 64,000 people in the surrounding areas.

(2) Economy

Uzbekistan's economy at the time of its independence in 1991 had been heavily reliant on the production of cotton, gold, and natural gas. The standard of living was one of the lowest among all countries in the former Soviet Union. Under such circumstances, the government introduced an import substitution industrialization (ISI) strategy, which was based upon exchange and trade control policies. This strategy envisions the transformation of the country's industrial structure, from an agriculture and natural resources-based economy to a modern industrial economy that emphasizes food and energy self-sufficiency.

However, this strategy resulted in the withdrawal of foreign capital from the country. Consequently, the gross domestic product (GDP) growth rate of the country has remained at 4% for the past several years (in the industrial sector, it increased from 2.9% in 2001 to

3.4% in 2002[3]). The per capita GDP in Uzbekistan is less than 400 USD[4], so Uzbekistan is categorized as a low-income country. According to the official statistics of the GOU, the yearly inflation rate was relatively high at 10.3%, which was measured by the consumer price index in 2003.

In Tashkent city, the two major sectors are food and machinery. According to the Statistics Department of Tashkent city, output of consumer goods production in Tashkent city increased by approximately 20% in 2002, while the average monthly salary in the city was approximately 44,000 soums. Of the total household expenditures, on average around 50% is spent on food, while 19% is spent on public service fees. Table II.1.1 indicates recent trends of tariffs in the public utility charges in Tashkent city.

Table II.1.1 Trends in Tariffs for Domestic Customers

	Water		Hot water		Gas		Electricity		Collection of garbage		Bus / Subway	
	Soum/ cu.m.	Change (times)	Soum/ capita	Change (times)	Soum/ capita	Change (times)	Soum/ kWh	Change (times)	Soum/ capita	Change (times)	Soum/ times	Change (times)
Jan.00	1.81	1.00	200	1.00	30	1.00	3.50	1.00	50	1.00	25	1.00
Jan.01	6.75	3.73	200	1.00	30	1.00	4.70	1.34	100	2.00	40	1.60
Jan.02	8.90	4.92	400	2.00	42	1.40	6.50	1.86	100	2.00	50	2.00
Jan.03	16.00	8.84	961	4.81	42	1.40	10.30	2.94	250	5.00	n/a	n/a
Oct.03	22.00	12.15	1100	5.50	105	3.50	15.50	4.43	250	5.00	150	6.00

Sources: TKEO, Vodokanal and Uzbekistan newspapers (Bus/Subway)

II.1.3 Existing Water Supply Services

(1) Outline of Services

Table II.1.2 provides an overview of water supply services in Tashkent city in 2002.

[3] Source: *Uzbekistan at a Glance*, World Bank 2002 and 2003

[4] Source: *Uzbekistan at a Glance*, World Bank 2002 and 2003. Part of indicators is from reports by ADB

Table II.1.2 Overview of Water Supply Services in Tashkent City (2002)

Item		Unit	Value	Remarks
Water Supply Area		km^2	340	
Served Population		1,000 people	2,107	
Coverage of Water Supply		%	98.5	
Number of Water Supply Connections		number	582,783	
Total length of Pipelines		km	3,494	
Daily Production Capacity		$1,000m^3/d$	2,296	
Annual Production		$1,000m^3$	754,300	
Daily Production*1	Max	$1,000m^3/d$	2,313	3,100 (estimated by the study team in 2003)
		L/cap./d	1,098	1,471 (estimated by the study team in 2003)
	Average	$1,000m^3/d$	2,067	2,900 (estimated by the study team in 2003)
		L/cap./d	981	1,376 (estimated by the study team in 2003)
Ratio of NRW*2		%	48.0	
Numbers of Staff of Vodokanal		People	5,014	
Water Pressure		m	From 10 to 25	
Water Sources		Boz-su canal and groundwater		
WTP		2 surface WTPs, 6 groundwater WTPs		

Sources : Vodokanal

*1: The figures in the "Value" column was reported to Tashkent city *Hokimiyat* by Vodokanal, whereas comments in the "Remarks" column were made by the Study Team based on the measurement during 2003.

*2: Non-Revenue Water (NRW) is the rate of the quantity of non-chargeable against water supplied.

(2) Water Supply Facilities

1) Outline of Water Treatment Plants (WTPs)

Tashkent city is served by three large-scale WTPs (Kadirya, Kibray and Boz-su) in the highland area and five small-scale WTPs (South, Sergeli, Kara-su, Kuiluk and Bectemir) dispersed in the lowland areas of the city, as shown in Figure II.1.1. Among these WTPs, Kadirya and Boz-su WTPs take surface water from the Boz-su Canal, while the rest take groundwater from the deep wells.

Kadirya is the largest WTP, producing 72% of the total amount of water required by the city. The construction year, design plant capacity, actual production amount and elevation of the WTPs are shown in Table II.1.3.

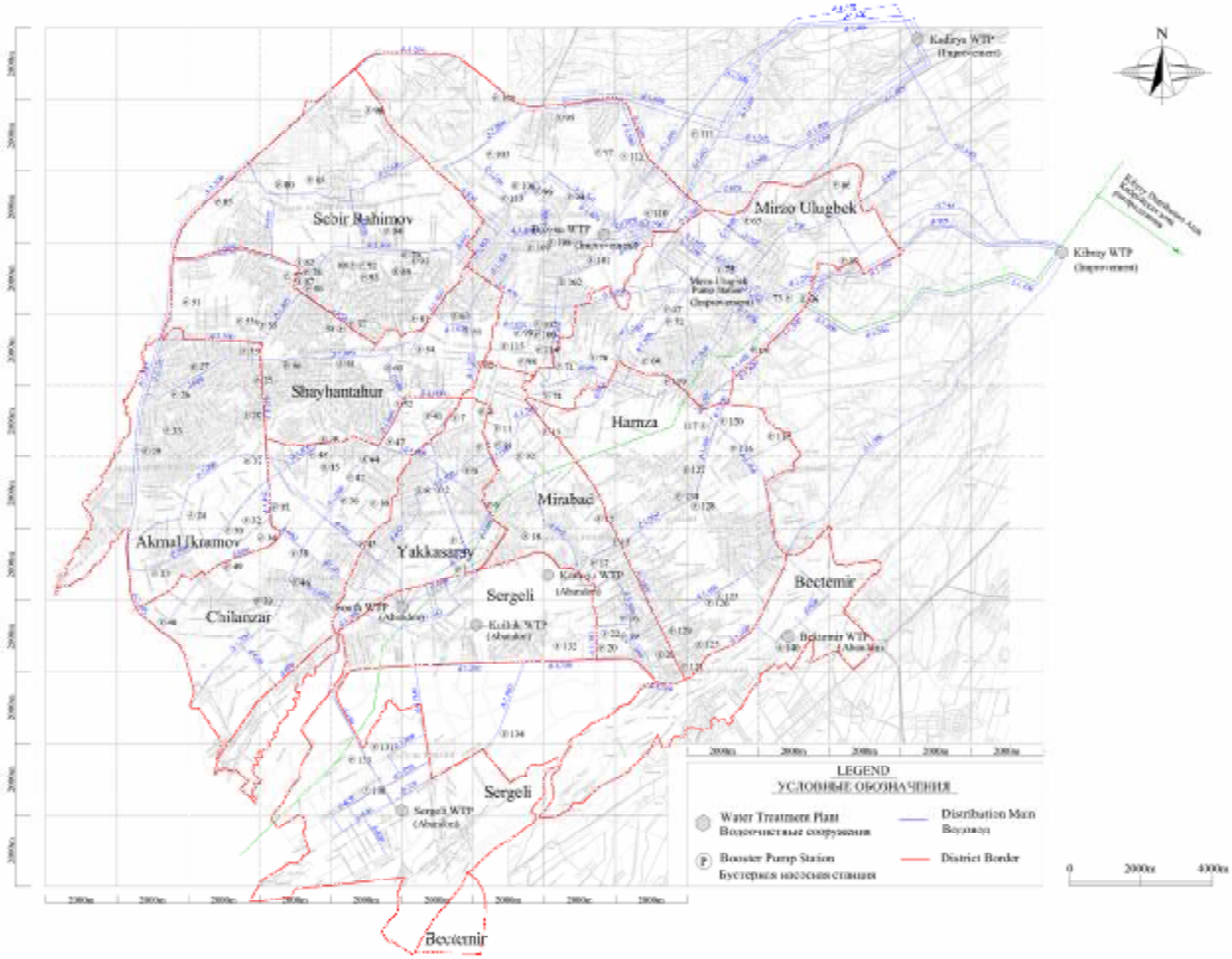


Figure II.1.1 Layout of Water Supply Facilities in the City

Table II.1.3 Overview of Water Treatment Plants

Water Source	WTP	Construction Year	Design Plant Capacity (1,000m^3/day)	Actual Distribution Amount		Elevation of WTP (m)
				(1,000m^3/day)	Rate (%)	
Surface Water	Kadirya	1969	1,375	2,100	71.6	540
	Boz-su	1931	236	250	8.5	485
Groundwater	Kibray	1955	455	350	11.9	500
	South	1961	143	150	5.1	420
	Sergeli	1966	40	23	0.8	400
	Kara-su	1960	52	25	0.9	420
	Kuiluk	1962	20	20	0.7	420
	Bectemir	1966	20	14	0.5	400
Total			2,341	2,932	100	-

Source: Vodokanal

Outline of WTPs in the city is as follows:

i) Kadirya WTP

Kadirya WTP is the latest among the WTPs in the city, having been augmented until the 1980s. In the use of surface water from the Boz-su Canal, raw water is treated by a combination of chemical sedimentation and rapid sand filtration processes. The condition of these facilities is superior to any other WTPs in the city, having the lowest operation cost per cubic meter among the WTPs of Vodokanal, providing gravity flow to the service area (except for the surrounding areas with higher elevations). However, some facilities, such as the intake pump stations (PSs), require urgent rehabilitation.

The amount of current water production at the Kadirya WTP (2,250,000-1,800,000 m^3/d) exceeds the design capacity of 1,375,000 m^3/d. Under this condition, the two intake PSs are currently being operated simultaneously, although one of them was designed as a stand-by station. Furthermore, the actual filtration rate exceeds the SNIP standard (which is the design standard of former Soviet Union, and is still used as the national standard for former member states). The filtration speed is designed to be 8.7 m/hr (the standard for water supply facilities is regulated as 'SNIP 2.04.02-84' and the filtration rate for double layer is regulated to be 12 m/hr), but the actual rate is reported at 14m/hr. Accordingly both the intake and filtration processes are obliged to operate under overloading conditions. The sedimentation basin is large enough to accommodate sediment.

ii) Kibray WTP

The water source of Kibray WTP is groundwater that was a main WTP of the city before the operation of Kadirya WTP. Most of the facilities at Kibray WTP, including wells, buildings, pumps and electrical facilities, have deteriorated with age. Thus, urgent rehabilitation or replacement of such facilities is recommended within next five years, based on the results of a functional diagnosis of the facilities.

Presently, a total of 95 deep wells that are meant to be used by Kibray WTP, located on both the right (26 wells) and the left (49 wells) banks of the Chirchik River, which flows through the WTP site. The wells located at the right bank take the groundwater from the Chirchik Valley aquifer, and those located at the left bank take the river-bed water of the Chirchik River. The yield of the wells on the right bank is comparatively stable, with approximately 150,000 m^3/d, even when the river flow is small.

Approximately 20 out of 49 well pumps on the left bank have not been in operation, while the others have been breaking down frequently due to a lack of maintenance. As a result of unfavorable conditions in 2004, the wells' operating ratio hovered to around 40%. Records in 2004 reveal that the total yield of the left bank wells was 150,000-190,000 m^3/d, while the total yield of this WTP was 300,000-340,000 m^3/d.

iii) Boz-su WTP

Boz-su WTP, which is the oldest WTP in Vodokanal and located downstream of Kadirya WTP in Tashkent city, utilizes raw water from the Boz-su Canal. The treatment process is the same as in Kadriya WTP. Some of original structures, such as the civil structures of the rapid filters, are still in use, but are considerably dilapidated. Almost all of the facilities – pumps and electrical facilities, civil and building structures – require renewal and rehabilitation. Although the intake water of Boz-su WTP has higher turbidity than that of Kadirya WTP, sufficient water treatment is practiced, resulting in the delivery of good quality water to the city central area. This WTP is located in a higher area in the city, but pumps are still required to enable the water supply to reach the surrounding areas.

iv) Other WTPs

South, Segreli, Kara-su, Kuiluk and Bectemir WTPs, located in the southern part of the city, were constructed in low elevation areas. All of them are groundwater treatment plants, and mainly distribute the disinfected water to the surrounding areas. The pumped

water at South, Sergeli and Bectemir WTPs is stored in reservoirs and then supplied to the city. Kara-su and Kuiluk WTPs is directly distributed by the well pumps.

As shown in Table II.1.3, age and serious deterioration of these WTPs have caused frequent breakdowns of well and distribution pumps.

2) Water Distribution Facilities

Table II.1.4 lists the pipelines operated by Vodokanal by diameter, materials and age. The total length of pipelines is approximately 3,500 km, with diameters ranging from 19 mm to 1,800 mm. There are 134 PSs distributed around the city's service area. Table II.1.5 also lists booster PSs by capacity range.

Table II.1.4 Overview of Pipelines in the City (unit: km)

Diameter (mm)	Total			Less than 20Years*1			20 – 40years*1		Over 40 years*1*2	
	Steel	Cast Iron	Others	Steel	Cast Iron	Others	Steel	Cast Iron	Steel	Cast Iron
19-100	739.2	270.8	1.2	226.1	32.0	1.2	379.1	165.5	134.0	73.3
125-200	497.3	436.6	0.0	248.5	45.8	0.0	218.7	285.4	30.1	105.4
250-400	543.2	313	1.9	276.2	36.8	1.9	243.7	183.6	23.3	92.6
500-900	206.6	110.8	9.1	85.6	2.1	9.1	113.7	71.0	7.3	37.7
1000-1800	358.9	0.7	5.0	87.9	0.0	5.0	271	0.7	0.0	0.0
Sub-total	2,345.2	1,131.9	17.2	924.3	116.7	17.2	1,226.2	706.2	194.7	309
Total	3,494.3			1,058.2			1,932.4		503.7	

Source: Vodokanal
*1: Years past after installation
*2: Pipes over 40 years should be the targets for replacement by Vodokanal (in this case, the objective for the replacement of pipelines accounts for 503.7/3494.3x100=14.4% in the total amount)

Table II.1.5 Overview of Booster Pump Stations

Capacity: m^3/hr, (Average)	Number	Pump Number	Average Pump Head: m	Location
30,000	1	8	51	Mirzo-Ulugbek
7,200	1	9	90	Chilanzar
3,000	5	6-8	53	Sergeli & Others
1,000	43	3-7	49	Entire city area
800	3	2-4	50	Entire city area
600	11	2-10	45	Entire city area
500-300	9	2-5	43	Entire city area
200-100	10	2-5	35	Entire city area
Under 100	51	1-5	38	Entire city area
Total	134			

Source: Vodokanal

3) Operation and maintenance

The manpower structure of Vodokanal, as of the end of 2003, is shown in Table II.1.6. The total number of 1,695 staff members is assigned for operations of water supply facilities, and of this number 1,010 are shift operators, (with four staff members operating in each shift).

Table II.1.6 Number of Staff for Facilities Operation as of December 2003

(Unit: persons)

Division		Shift Operator	Others	Total
Water supply facilities	WTP	425	476	901
	PS	585	209	794
	Total	1,010 (41)	685 (161)	1,695 (202)
Others		0	2,716 (959)	2,716 (959)
Total		1,010 (41)	3,401 (1,120)	4,411 (1,161)

Source: Vodokanal
( ): number of engineers
Contents of "Others" are staff for sewerage system, head office and *Rayon Vodokanals*

The number of shift operators for Booster PSs is quite large, because all pump machines are operated manually and constant observation of these pumps is required. Note that the pumps do not have water level switches in the case of either low water levels in the pump well or high boosting pressure.

Electricity and chemical consumption/costs are shown in Table II.1.7. It is evident that Kadirya WTP is the most cost-efficient facility compared to the other WTPs.

Table II.1.7 Electricity and Chemical Consumption and Costs (in 2002)

WTP Name	Chemical			Electricity		Total Cost (1,000USD)	Water Distribution (million m^3)	Unit Cost (soum= USD /1,000m^3)
	Name	Consumption (ton)	Cost (1,000USD)	Consumption (GWh)	Cost (1,000USD)			
Kadirya	$Al_2(SO_4)_3$	1533	165.3	80.29	634.3	883.3	766.5	1.2
	Liquid Cl	523.3	83.7					
Boz-su	$Al_2(SO_4)_3$	1,048.7	113	25.14	198.6	323.4	124.8	2.6
	Liquid Cl	73.6	11.8					
Kibray	Liquid Cl	46.9	7.5	54.56	431.0	438.5	129	3.4
South	Liquid Cl	15.6	2.5	18.18	148.4	150.9	52	2.9
Others	Liquid Cl	3.43	0.5	7.04	55.6	65.8	34.5	1.9
	Hypochlorite	9.7	9.7					

Source: Vodokanal

(3) Quality of Raw and Treated Water

The quality standard for drinking water in Uzbekistan is contained in the enactment, Quality Standard (UzDSt 950:2000). The standards for quality and frequency of analysis of the raw/treated /supply water are regulated in this enactment. The quality standard is shown in Table II.1.8 (1).

Surface water from the Boz-su Canal is intake water for Kadirya and Boz-su WTPs. Its quality is usually good except for the spring season, when thawed water from winter snow enters the water system, creating extremely high turbidity of raw water. The operators of WTPs manage to cope with this situation by using the inefficient dosing facilities.

As Boz-su WTP is located downstream of Kadirya WTP along the Boz-su Canal, sludge from the sedimentation basins and water from washing the filters of the Kadirya WTP without any treatment is discharged, causing high turbidity of the raw water of Boz-su WTP. With a sufficient amount of coagulant injected into the raw water, high transparency treated water can be produced at Boz-su WTP.

However, the coagulant is injected only when the turbidity of raw water exceeds 15 degrees at Kadirya WTP, in order to reduce the operation costs, yet the transparency of the treated water is still deficient. Although the values of the treated water quality meet the Quality Standard for drinking water mentioned above, the transparency of treated water is apparently inferior compared to that of Boz-su and other groundwater WTPs. The inferior transparency is one of reasons of so many complaints by the consumers, according to the questionnaire survey carried out by the previous JICA study.

Except for the wells on the left bank of the Chirchik River at Kibray WTP, the hardness in groundwater taken from the other wells in the city is unusually high and the value in some WTPs exceeds the standard. At Kibray WTP, the nitrate concentration of water yielded from some wells River at the right bank exceeds the standard. The transparency of each groundwater source is quite high, and there appears to be no problems with color and odor. The yield from these wells meets the standard when mixed with the raw water taken from various other water sources before it is supplied to the city. The quality of raw water for major WTPs is shown in Table II.1.8 (2).

Table II.1.8(1) Quality Standard for Drinking Water

Indices or components	Unit	Standard	Analysis method
1. Microbiological indices			
1.1 Total bacteria number	microbe quantity in 1ml. of water	not more than 100	GOST 18963-73, ISO 8360/1-2-88
1.2 Number of coliform group	quantity in 1000 ml. of water	not more than 3	GOST 18963-73, ISO 9308/1-2-90
1.3 Number of fresh fecal coliform	quantity in 300 ml. of water	Not detected	GOST 18963-73, SO 9308/1-2-90
1.4 Kolifags	BOE quantity in 200 ml. of water	Not detected	Methodical instructions, approved by Ministry of Health of Republic of Uzbek.
2. Parasitological indices			
2.1 Pathogenic bacteria	Cyst quantity in 25 l. of water	Not detected	Methodical instructions, approved by Ministry of Health of Republic of Uzbek.
2.2 Heminth ovums	Ovum and larvae quantity in 25 l. of water	Not detected	-Ditto-
3. Toxicological indices			
a) Inorganic components			
3.1 Aluminum (Al)	mg/L	0.2 (0.5)*4	GOST 18165-89
3.2 Beryllium (Be)	Ditto	0.0002	GOST 18294-81
3.3 Boron (B)	Ditto	0.5	ISO 9390-90
3.4 Cadmium (Cd)	Ditto	0.001	ISO 5961-85
3.5 Molybdenum (Mo)	Ditto	0.25	GOST 18308-72
3.6 Arsenic (As)	Ditto	0.05	GOST 4152-81
3.7 Nickel (Ni)	Ditto	0.1	ISO 8288-86
3.8 Nitrates (NO_3)*1	Ditto	45	GOST 18826-73
3.9 Nitrites (NO_2)	Ditto	3	GOST 4192-82
3.10 Mercury (Hg)	Ditto	0.0005	ISO 5666/3-84
3.11 Lead (Pb)	Ditto	0.03	GOST 18293-72
3.12 Selenium (Se)	Ditto	0.01	GOST 19413-89
3.13 Strontium (Sr)	Ditto	7	GOST 23950-88
3.14 Fluoride (F)	Ditto	0.7	GOST 4386-89
3.15 Chromium (Cr^{+6})	Ditto	0.05	ISO 9174-90
b) Organic components			
3.16 Benzol	mg/L	10	Meth. instr. appr. by Min. of Health of Rep.of Uzb.
3.17 Benzapilene	Ditto	0.01	-ditto-
3.18 Polyacrylamide	Ditto	2	GOST 19355-85
3.19 Pesticides 6)	Ditto		Meth. instr. appr. by Min. of Health of Rep.of Uzb.
4. Others			
4.1 Taste	degree	2	GOST 3351-74
4.2 Odor	Ditto	2	-Ditto-
4.3 Turbidity*2	mg/L	1.5/2.0/*5	-Ditto-
4.4 Color	degree	20/25/*6	-Ditto-
4.5 pH value	pH	6-9	measured by pH-meter
4.6 Total dissolved solid	mg/L	1000/1500/*7	GOST 18164-72
4.7 Iron (Fe)	mg/L	0.3/1.0/*7	GOST 4011-72
4.8 General hardness*3	Ca+Mg eqv/L	7/10/*7	GOST 4151-72
4.9 Manganese (Mn)	mg/L	0.1	GOST 4974-72
4.10 Copper (Cu)	Ditto	1	GOST 4388-72
4.11 Phosphate (PO_4)	Ditto	3.5	GOST 18309-72
4.12 Sulfate (SO_4)	Ditto	400/500*7	GOST 4389-72
4.13 Chloride (Cl)	Ditto	250/350*7	GOST 4245-72
4.14 Zinc (Zn)	Ditto	3	GOST 18293-72
4.15 SPAV (PAV)	Ditto	0.5	ISO 7875/1-2-84
4.16 Phenol	Ditto	0.001/0.1*8	ISO 6439-90
4.17 Mineral oil	Ditto	0.1	Meth. instr. appr. by Min. of Health of Rep.of Uzb.
5. Radioactive pollution indices			
5.1 Total alpha-radioactivity*9	Bq/L	0.1	ISO 9696-92
5.2 Total beta-radioactivity*9	Bq/L	1	ISO 9697-92

*1: Analyzed as NO_3^-, 45mg/L of the standard value is almost equivalent to the Japanese standard value of 10 mg/L for $N\text{-}NO_3$

*2: This value is analyzed in comparison with the water standard liquid of GOST, and is approximately 50% lower than the value analyzed by Japanese method when the value is low

*3: The Uzbekistan standard of Ca + Mg equivalent with a value 7 as above, is equivalent to 294-350mg/L in $CaCO_3$ conversion (Japanese standard is 300mg/L)

*4: When high colored water is treated by coagulant

*5: When water is effectively disinfected

*6: When high color is treated and disinfected under the control of trihalomethane

*7: With only disinfection

*8: When water is not chlorinated

*9: Recommended by WHO Guideline (2^{nd} edition) , average intensity of α and β radiation

Table II.1.8 (2) Raw Water Quality

Raw Water	Name of WTP	Item		
		Turbidity (mg/L)	Total Hardness (Ca+Mg eqv/L)*	Nitrate (mg/L)
Surface Water	Kadirya	3-9200 (23)	1.5-1.7 (1.6)	0-0.01 (0.002)
	Boz-su	9-1370 (28)	1.8-3.3 (2.5)	0-0.004 (0.002)
Groundwater	Kibray	0	5.8-6.4 (5.9)	20-57 (37)
	South	0	6-10 (7.0)	15-36 (25)
GOST Standard		1.5	7	45

Note: ( ): Average
*: The Uzbekistan standard of Ca + Mg equivalent with a value 7 as above, is equivalent to 294-350mg/L in $CaCO_3$ conversion (Japanese standard is 300mg/L)
Source: Vodokanal

(4) Organizational Structure

1) Tashkent City *Hokimiyat*

The city administration of Tashkent ("*Hokimiyat"*) is the highest administrative authority in the city. The city mayor (*"Hokim"*) is appointed by the President of ROU and his appointment is approved by the Legislative Assembly *("Sovet Narodnyh Deputatov* ") of Tashkent city. The *Hokimiyat* of Tashkent city, being the founder of Vodokanal and the owner of the assets of the water supply and sewerage systems, has the responsibility for providing water supply services to the city. The First Deputy of the *Hokim* of Tashkent city supervises the work of Vodokanal and TKEO.

2) TKEO (The Regional Communal Service Associations)

The Tashkent city TKEO was established under the Tashkent city *Hokimiyat* by virtue of a statute aimed at supporting and maintaining communal services (e.g. water supply, sewerage, and heating, etc.) in the city. Thus, Vodokanal is virtually administered by TKEO.

To provide consistent public services, TKEO undertakes administration and maintenance work of all public utilities, as well as repair and maintenance of old apartment buildings for its citizens. TKEO and Tashkent city *Hokimiya*t are different legal entities, and the financial resources of TKEO come from commissions derived from the communal sector under its control, as well the funds from the city budget.

However, TKEO, whose current General Director is one of the Deputy *Hokims*, is virtually subordinated to Tashkent city *Hokimiyat*.

3) Vodokanal

Although Vodokanal is legally an independent entity, major important decisions, such as the formulation of long-term investment plans, are subject to the *Hokimiya*. It is the First Deputy of the *Hokim* that supervises the work of Vodokanal.

Vodokanal is currently undertaking a major organizational reform, which includes spinning-off of some departments into separate companies. During 2003, the following restructuring took place in Vodokanal:

- The establishment of a new sales subsidiary (Ulgurgisuvsavdo);
- The reorganization of the Vodokanal sales department;
- The establishment of a construction subsidiary (Suvsozkurilish).

Ulgurgisuvsavdo, formerly the sales division of Vodokanal that dealt mainly with industrial clients, was established as a new subsidiary in July 2003. This company, which has 946 employees, is 100% owned by Vodokanal, and is not a stock company. Ulgurgisuvsavdo purchases water from Vodokanal at 22 soum/m³ and sells this at 39.66 soum/m³ to its clients. The sales profits are planned to be used for the rehabilitation and improvement of pumps.

Suvsozkurilish, formerly the construction division of Vodokanal, was established in June 2003 as a new subsidiary. It is fully owned by Vodokanal and is manned by 100 employees. The orders for this subsidiary, however, are taken only from Vodokanal. From July to September 2003, net profits of this company were very low, because of initial costs incurred in setting up the new company. The restructuring of Vodokanal through the establishment of the two subsidiaries impacted on the reduction of the number of employees, as indicated in Table II.1.9.

Table II.1.9 Number of Employees (Unit: persons)

Classification	As of 12.31.2002	As of 12.31.2003
Vodokanal	5,014	3,649
Two new subsidiaries	0	1,046
Total	5,014	4,695

Source: Based on the interviews with the Department of Planning of Vodokanal

The organizational chart of Vodokanal is shown in Figure II.1.2.

(5) Tariff system

Approximately 16% of the total domestic consumers in Tashkent city are currently under the metered tariff system, while the rest are under the flat tariff (called "Norm") system. On the other hand, 80% of large consumers have been metered, which cover close to 95% water consumption of the category. The Norm rate depends on domestic consumers' lifestyle (e.g. with/without sewage, with/without hot water supply etc.). The tariffs were revised on the 1st July 2003 (see Table II.1.10.).

Table II.1.10 Tariff as of July 1, 2003

Division	Consumers		Water Supply	Sewer Services
Norm (Flat rate)	Domestic		22 soum/m^3 x a* (liters/day per capita) x 365 days / 12months x the number of persons/1,000 + 10.5 soum/m^3 x b* (liters/day per capita) x 365 days / 12months x the number of persons / 1,000	
Metered rate	Domestic		22 soum/m^3	10.5 soum/m^3
	Industry	From Vodokanal to Subsidiary (Ulgurgisuvsavdo)	22 soum/m^3	10.5 soum/m^3
		From Subsidiary to Industry	39.66 soum/m^3	14.07 soum/m^3
	Communal Services		22 soum/m^3	10.5 soum/m^3

- a* and b* are coefficient of consumption of water (ranging from 50 to 330 liters /day) and sewage water (ranging from 0 to 429 liters/day), respectively, which depends on the domestic consumer's lifestyle. (Refer to S 2-3-7-2 and S 2-3-7-3 in Volume 3 Supporting Report).
- Value Added Tax (VAT) rate of 20% is added on the amounts from users other than domestic consumers.
- Ulgurgisuvsavdo (a new subsidiary of Vodokanal) purchases water from Vodokanal at 22 soum/m^3 and sells it to clients at 39.66 soum/m^3.

Sources: Vodokanal

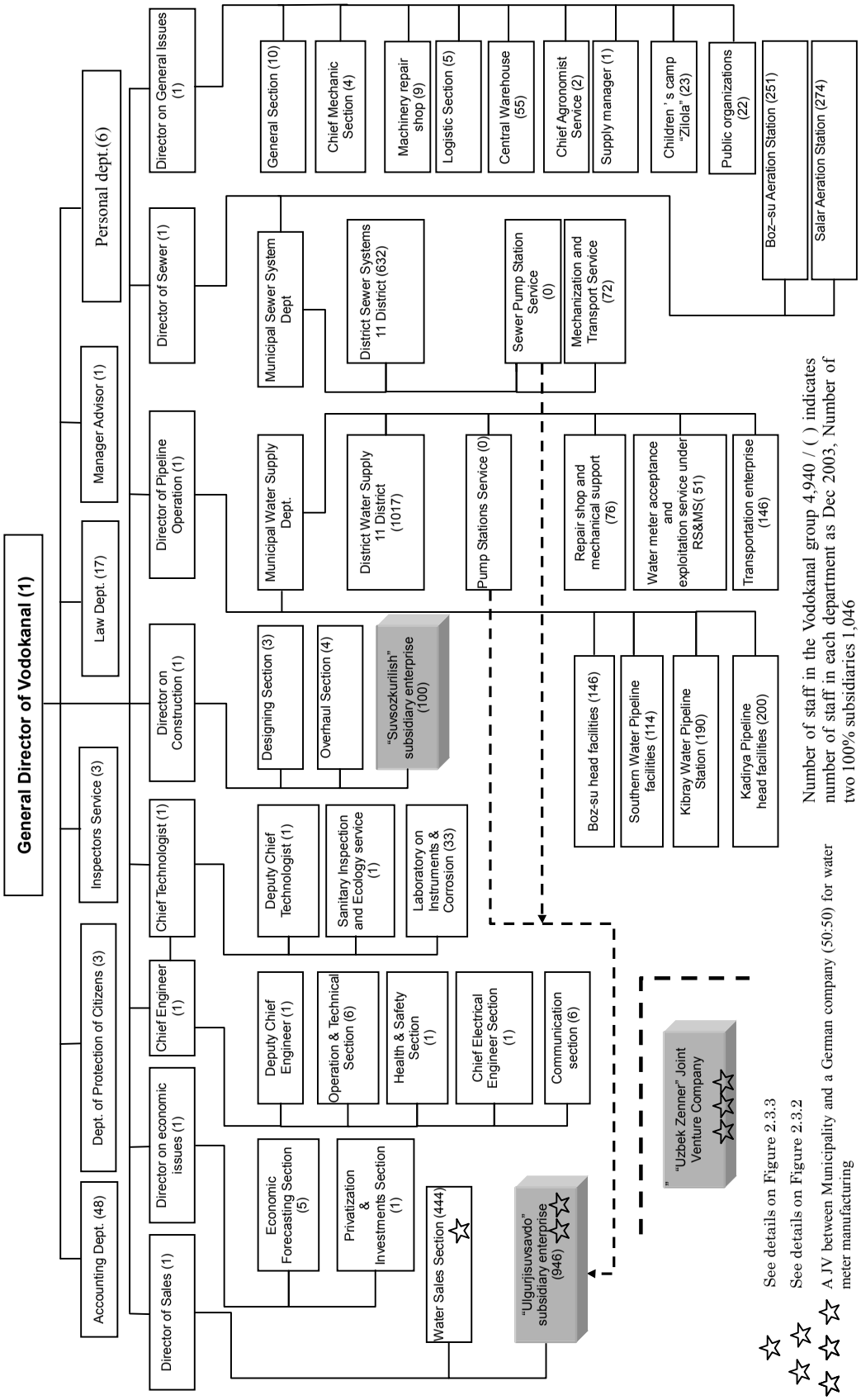


Figure II.1.2 Organizational Chart of "Vodokanal" as of December 2003

Table II.1.10 Tariff as of July 1, 2003

Division	Consumers		Water Supply	Sewer Services
Norm (Flat rate)	Domestic		22 soum/m^3 x a* (liters/day per capita) x 365 days / 12months x the number of persons/1,000 + 10.5 soum/m^3 x b* (liters/day per capita) x 365 days / 12months x the number of persons / 1,000	
Metered rate	Domestic		22 soum/m^3	10.5 soum/m^3
	Industry	From Vodokanal to Subsidiary (Ulgurgisuvsavdo)	22 soum/m^3	10.5 soum/m^3
	Industry	From Subsidiary to Industry	39.66 soum/m^3	14.07 soum/m^3
	Communal Services		22 soum/m^3	10.5 soum/m^3

- a* and b* are coefficient of consumption of water (ranging from 50 to 330 liters /day) and sewage water (ranging from 0 to 429 liters/day), respectively, which depends on the domestic consumer's lifestyle. (Refer to S 2-3-7-2 and S 2-3-7-3 in Volume 3 Supporting Report).
- Value Added Tax (VAT) rate of 20% is added on the amounts from users other than domestic consumers.
- Ulgurgisuvsavdo (a new subsidiary of Vodokanal) purchases water from Vodokanal at 22 soum/m³ and sells it to clients at 39.66 soum/m³.

Sources: Vodokanal

1) Tariff Revision Method

Vodokanal may revise the tariffs based on its calculation of the expected operation costs plus a profit margin of up to 10%. Tariff revisions are decided upon by the Central Finance Department of the *Hokimiyat* of Tashkent city after obtaining approvals from a number of other *Hokimiyat*'s departments, such as tariff revision and anti-monopoly departments.

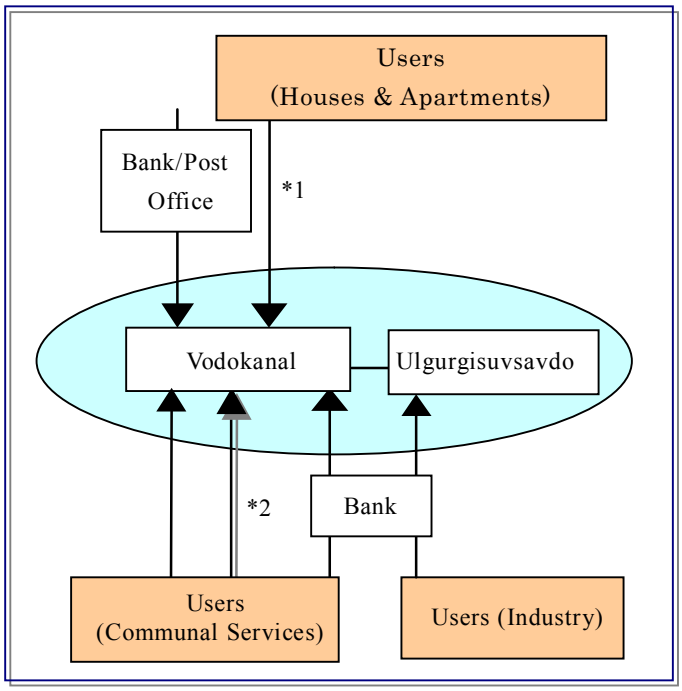
2) Tariffs Level

Apartment residents in Tashkent city make up 67% of the population. Their average water consumption under the current Norm system is 330 Lpcd. For a household of four family members, the tariffs would amount to 871 soum per month (22 soum/m^3 x 330 L x 30 days x 4 persons). According to the Statistics Department of Tashkent city, the average income for a family of four members in 2002 was 81,803 soum/month. Water tariff, therefore, accounted for a mere 1.1% of the average income of a family of four members, and if sewage tariff was included, it accounted for 1.6%. Based on a World Bank document, there is still some room to increase the tariffs if the tariff level of up to

3% of average income can be tolerated.[5]

3) Payment Collection System

An outline of the present Vodokanal payment collection system is illustrated in Figure II.1.3. Water bills can be paid at banks, post offices and at Vodokanal. However, individual customers and small business owners who have a bank account are still limited, thus bills are often preferred to be paid directly at Vodokanal, or in the case of detached houses, directly to the inspectors (meter readers). When the Study was conducted in 2003, 35% of consumers living in apartments paid at banks or post offices, while 65% paid at Vodokanal or to the inspectors.



Note:
*1 50-70% of detached house users pay their bills to the inspectors
*2 is offset

Figure II.1.3 Present Payment Collection System

On the other hand, in the case of consumers living in detached houses, the percentages were 3% and 97%, respectively. According to Vodokanal, the percentage of consumers living in detached houses who pay directly to the inspectors is estimated to be in the range of 50% to 70%. Lacking precise data, Vodokanal is not able to clearly differentiate between consumers who pay at Vodokanal's counter or directly to the inspectors. It must also be noted that inspectors can only read the meters when somebody is at home, because meters are installed inside houses as a precaution against theft. This fact is common not only for water meters, but for electricity and gas meters as well.

[5] *Information and Modeling Issues in Designing Water and Sanitation Subsidy Scheme*. May 2000, The World Bank

(6) Financial status

Vodokanal's accounting and financial systems are still manually operated, because it lags behind in office automation, including the use of computers. Thus, the present financial assessment is based on the limited information available. Although Vodokanal's accounts are periodically verified by the authorities, it is made primarily from the point-of-view of tax compliance and justification of the tariffs.

1) Financial Statements

Income statements, sales breakdown, and balance sheets of Vodokanal are shown as below.

Table II.1.11 Income Statements of Vodokanal, 1998, 2000 and 2003 (unaudited)

(Unit: millions of soum)

	2003 (6 months)		2002		1998	
Sales	10,742		21,918		3,429	
Less: VAT	(1,358)		(2,774)		(514)	
Net sales	**9,384**		**19,144**		**2,915**	
Cost of sales	(6,704)		(12,538)		(2,142)	
Gross margin	**2,680**	29%	**6,606**	35%	**773**	27%
Sales, general & administration expenses	(723)		(1,289)		(65)	
Other operating income (expenses)	(689)		(2,723)		(289)	
Operating income	**1,268**	14%	**2,594**	14%	**419**	14%
Other financial income (expenses)	(6)		(1,971)		0	
Income before tax	**1,262**	13%	**623**	3%	**419**	14%
Taxes	(378)		(622)		(205)	
Net income	**884**	9%	**1**	0%	**214**	7%

Source: Statutory Financial Statements of Vodokanal

Table II.1.12 Sales Breakdown in the Period of January-June 2003

	Water mill.m^3	Sewerage mill.m^3	Water mill. soum (excl. VAT)	Sewerage mill. soum (excl. VAT)	Total mill. soum (excl. VAT)
Industries	22.7	35.6	901.8	501.0	1,402.8
Communal services	130.5	39.5	4,853.2	543.6	5,396.8
Domestic / apartments	75.5	91.1	1,205.8	729.2	1,935.0
Domestic / det. houses	29.9	16.8	481.1	134.1	615.2
Other	-	-	-	-	33.9
Total	258.6	183.0	7,441.9	1,907.9	9,383.7

Source: Accounting data of Vodokanal

Table II.1.13 Balance Sheets of Vodokanal, 1998, 2002 and 2003 (unaudited)

(Unit: millions of soum)

	June 30, 2003	Dec. 31, 2002	Dec. 31, 1998
Assets			
Fixed assets:			
Acquisition cost	33,561	33,095	4,946
Less: accumulated depreciation	(14,638)	(13,227)	(1,137)
Net book value	18,923	19,868	3,809
Other long-term assets	628	277	45
Total fixed assets	19,551	20,145	3,854
Current assets:			
Debtors	11,039	8,244	794
Other current assets	1,210	1,209	295
Total current assets	12,249	9,453	1,089
Total Assets	31,800	29,598	4,943
Equity & Liabilities			
Equity:			
Charter capital	112	112	99
Reserve capital	23,816	23,499	4,654
Retained earnings	2,063	1,179	0
Total equity	25,991	24,790	4,753
Liabilities:			
Settlements with budget	1,706	975	0
Other liabilities	4,103	3,833	190
Total Liabilities	5,809	4,808	190
Total Equity & Liabilities	31,800	29,598	4,943

Source: Statutory Financial Statements of Vodokanal

2) Financial Indicators

In this Study, the following key financial indicators were used for analysis:

- Average Tariff for Water and Sewerage (USD/m^3);
- Operating Ratio: Total annual operating costs / Total operating revenues;
- Labor Costs vs. Operating Costs: Labor costs / Total operating costs (%);
- Depreciation vs. Water Charges: Depreciation / Total operating revenues (%);
- Debt Service Coverage Ratio: Total annual debt service / Total operating revenues (%);
- Return on Equity: Net income / Equity (%);
- Collection Period: (Year-end accounts receivable / Total operating revenues) x 12 (months);
- Current Ratio: Current assets / Current liabilities;
- Quick Ratio: Cash / Current liabilities; and

- Fixed Assets Component Ratio: Fixed assets / Total assets (%).

Table II.1.14 shows a comparison of the key financial indicators for Vodokanal to those of other water supply companies.

Table II.1.14 Comparison of Key Financial Indicators

Indicators	**Tashkent**[1]	Astana[2]	Phnom Penh[3]	Manila[5]
GDP per capita (USD)	**400**	1,400	300[4]	975
Average tariff (USD/m^3)	**0.03**	0.27	0.24	0.1~0.29
Operating ratio	**0.86**	1.21	0.68	0.79
Collection period (months)	**5.2**	7.0	0.76	2.5
Current ratio	**2.0**	2.9	2.3	2.1
Quick ratio	**0.01**	0.09	n.a.	1.4
Labor costs vs. operating costs (%)	**24**	30	25	20
Debt service coverage (%)	**0.9**	0.2	70	n/a
Return on equity (%)	**0.001**	0.27	2	20
Fixed assets component ratio (%)	**68**	80	88	71
Depreciation vs. water charges (%)	**13**	14	38	13
Served Population (Thousand)	**2,107**	490	824	4,700

Notes:
[1] Tashkent, 2002. Source: Financial Statements of Vodokanal. Labor costs vs. operating costs (%) was estimated by the Team based on the data provided partially by Vodokanal
[2] Capital city of Kazakhstan 2002. Source: JICA studies.
[3] 2003 audited financial statements of PPWSA (Phnom Penh Water Supply Authority)
[4] Cambodian Government Statistics Data
[5] Capital of the Philippines. 2002, Manila Water Company Inc website (www.manilawater.com)

The following results can be derived from the comparison of the above indicators. First, the average tariff in Tashkent city of 0.03 USD/m^3 may initially seem to be very low. But even after considering GDP per capita, the average tariff in Tashkent city is still low in comparison with Astana, the capital of neighboring Kazakhstan.

Second, the Quick Ratio, a measure of how quickly a company's assets can be turned into cash, remained at a low level of approximately 0.01 and the company had, in fact, taken short-term bank loans from time to time to solve its liquidity problems. A low Quick Ratio means that the risk of experiencing a cash shortage is very high. This is actually evident as Vodokanal has increased its short-term borrowing. Also, the current collection period is 5.2 months instead of less than two months, which should be the case, if based on the dates of Vodokanal sales and the dates of payment of customers. The reasons for such a long collection period are explained under “3) Debtors and Cash

Collection" below.

Other than the above, there are some points that need to be considered in regard to comparing the financial indicators. The "Fixed asset component ratio" and "Depreciation vs. water charges" are not so high. However, as it will be explained under "4) Costs" below, the cause is the undervaluation of the depreciation costs. When corrected, the above mentioned indicators will increase.

In addition, the debt service coverage ratio is also low, because the current facilities represent the public investments made during the Soviet period, and thus outside loans were not necessary. However, if the current government has no plans to subsidize Vodokanal, then it will have to procure funds from outside. Under such conditions, this indicator will worsen drastically.

3) Debtors and Cash Collection

The accounts receivable balance in Vodokanal has continued to grow by approximately 8,000 million soum over the last 1.5 year and has reached 11,039 million soum as of June 30, 2003. This balance represents collection period of more than six months, which is quite long. A breakdown of debtors classified by major customer group is provided in Table II.1.15.

Table II.1.15 Debtors Breakdown

(Unit: millions of soum)

	June 30, 2003	Dec. 31, 2002	Dec. 31, 2001
Trade debtors:			
Industries	1,087	1,066	474
Communal services	7,811	5,179	1,943
Domestic / apartments	1,373	1,169	238
Domestic / detached houses	129	427	244
Total per management accounts	10,400	7,841	2,899
Other debtors	61	137	346
Difference	*578*	*266*	*(89)*
Total per financial statements	11,039	8,244	3,156

Source: Accounting data of Vodokanal

A list of the biggest debtors and their aging analysis prepared by Vodokanal are

provided in Table II.1.16. The biggest trade debtor, whose debt is more than half of the total trade receivables, is Tashteplocentral, the heating and hot water monopoly producer in the city. Tashteplocentral and its sole wholesaler, Tashteploenergo, are currently in a difficult financial situation and their activity heavily depends on subsidies from the city budget.

Table II.1.16 Major Debtors (Unit: millions of soum)

	June 30, 2003	December 31, 2002			
		Total	Less than 90 days	Less than 1 year	Over 1 year
Industries:					
TAPOiCh*	890	936	161	644	130
GAO TTZ**	-	91	91	-	-
Communal services:					
Tashteplocentral	5,994	4,012	1,667	2,305	40
TashTETS	419	137	137	-	-
MPU Tashsuvokavataminot	412	331	73	258	-
Ratio of major debtors in the total debts	*70%*	*67%*	*26%*	*39%*	*2%*

Note: * Aircraft manufacturer; ** Tractor manufacturer
Source: Accounting data of Vodokanal

Recoverability of the above debts, as well as all other debts depends primarily on the macroeconomic situation of the country. For instance, the reason why Tashteplocentral has become a bad debtor is because a considerable number of domestic consumers are not able to pay the bills for hot water. Thus, in order to collect debts from this company, the income of domestic consumers needs to increase so that they can pay for hot water, or they will just keep on relying on subsidies from the government. With regard to TAPOiCh, although it is currently producing aircraft parts, it has been experiencing a decrease in new orders. Thus, in order to collect debts from this company, the orders need to go up, if not the company will be forced to sell part of its assets. As can be seen, the collection of bad debts depends significantly on the economic condition of the country, and it can not be solved by the management efforts of Vodokanal alone.

4) Costs

A breakdown of costs of Vodokanal is provided in Table II.1. 17.

Table II.1.17 Water Supply Costs Structure, 1998, 2000, 2002 and 2003

	2003 (January-June)		2002		2000		1988	
	soum/m^3	%	soum/m^3	%	soum/m^3	%	soum/m^3	%
Materials	0.98	4.1%	0.51	1.9%	0.41	6.6%	0.13	5.1%
Electricity	6.24	25.6%	4.42	16.0%	1.84	29.5%	1.01	39.7%
Prod. Salaries	2.16	8.9%	2.09	7.6%	0.44	7.0%	0.22	8.6%
Social charges	0.78	3.2%	0.83	3.0%	0.18	2.9%	0.08	3.3%
Capital repairs	0.26	1.1%	0.76	2.8%	0.43	6.9%	0.08	3.2%
Depreciation	2.98	12.3%	2.78	10.0%	0.51	8.2%	0.22	8.6%
Transportation	0.82	3.4%	0.81	2.9%	0.31	5.0%	0.13	5.1%
In-house expenses	1.10	4.5%	1.15	4.1%	0.27	4.3%	0.08	3.0%
SG&A costs	4.05	16.7%	5.33	19.3%	1.33	21.3%	0.45	18.1%
Other costs	4.93	20.2%	8.95	32.4%	0.52	8.3%	0.13	5.3%
Total costs	24.30	100.0%	27.63	100.0%	6.24	100.0%	2.53	100.0%

Source: Accounting data of Vodokanal, SG&A costs: Selling, General and Administrative costs

Caution should be taken in interpreting the above cost structure of Vodokanal, not only because of inflation, which complicates historical comparisons, but also because depreciation charges are not sufficient for proper rehabilitation of facilities, and because the company is likely to cut down on repair and maintenance costs.

It should be pointed out that the acquisition cost of Vodokanal's fixed assets (31,561 million soum or 32 million USD at the current exchange rate) is far below the replacement cost of those assets. The replacement cost of WTPs and other facilities operated by Vodokanal could be roughly estimated to be about 300 million USD, at least. This amount is equivalent to ten times the booked acquisition cost of the current fixed assets, 32 million USD. If the current acquisition cost of the fixed assets is re-evaluated at the replacement cost, depreciation costs will increase by ten-fold from the current 2.98 soum/m^3 to 29.8 soum/m^3 based on Table II.1.17. If we consider water tariffs corresponding to depreciation expenses after revaluation of the fixed assets as a reserve of funds for future replacement investments, there is an understatement of 27 soum/m^3 in depreciation expense.

It can be concluded from here that under the current tariff revision method, which is based on current costs, it is obvious that the current water tariff level does not meet the required level.

(7) Management Style

The management style of Vodokanal is still in the process of transformation as the country moves away from the central planning economy towards the market economy. Vodokanal, being a state unitary enterprise owned by the *Hokimiyat*, is legally independent and, according to its Charter, should be a self-sufficient enterprise. However, Vodokanal is strongly influenced by the *Hokimiyat*.

On the other hand, with the government's plans not to subsidize Vodokanal, necessary funds will have to be procured by Vodokanal itself. However, as explained under "(5) Tariff System", the costs that can be collected from the tariff are sufficient only as short-term operating costs. In addition, tariff changes are not approved in a timely manner, and in most cases, these are approved only after a fund shortage has occurred.

As can be seen from just one example of the tariff changes, management decisions are based on national legislation and determined by the *Hokimiyat*. The management style of Vodokanal itself appears to be biased towards solving the current issues, often leaving the long-term planning and major investment decisions outside of the current agenda. However, the management style of Vodokanal is now undergoing rapid change, together with the on-going reforms in its organization, which are described under section (4) "Organization". In this connection, there is an urgent need to update and modernize the skills in the present water supply management systems, planning strategies, financial and commercial management and investment decision.

(8) Current Status of Privatization

A significant legal base with regard to privatization has been provided in the ROU. Vodokanal, regulated by these decrees, also stands to be privatized. The scheme of privatization has been issued; however, the process has not yet been clarified. The content and scheme of the privatization as currently understood by Vodokanal are explained below.

1) Ownership of the new company

GOU (through *Hokimiyat*) will hold the majority ownership of 51%, 10% will be offered to the employees, and the remaining 39% can be bought by either foreign or domestic private investors. There is a possibility that the share held by the *Hokimiyat* can be reduced in the future.

2) Decision making at the new company

All major management issues of the new company, once it is transformed into a shareholding company, will be decided at shareholders' meetings.

3) Commencement of Privatization

During the project period, should there be any loans from foreign financial institutions, the privatization process should be delayed. This is according to the official announcement of the First Deputy Prime Minister.

4) Final Decision for Privatization

Decisions for privatization are made by the State Property Committee and approved by the Cabinet of Ministers, assuming of course that Vodokanal will give its consent.

II.1.4. Relevant Sector Projects and Studies

In this section, on-going projects of *Hokimiyat*, the previous JICA Study and the EBRD project, will be explained.

(1) On-going projects of *Hokimiyat*

Hokimiyat has planned or announced the following projects and studies that will be fully considered in this Study:

- Installation of water meters for all domestic customers by the year 2009; and
- Promotion of privatization of Vodokanal.

(2) Relevant Sector Projects and Studies

1) The Previous JICA Study (*"The Improvement of Management and Tariff Policy in Water Supply Services in the ROU"*)

From June 1999 to March 2000, a JICA development study entitled, *"The Improvement of Management and Tariff Policy in Water Supply Services in the ROU"* was conducted. Table II.1.18 indicates the main recommendations of the Previous JICA Study on tariffs and management, as well as Vodokanal's respective countermeasures.

Table II.1.18 Recommendation by previous JICA Study Team and Actions Taken by Vodokanal

Division	Recommendation	Actions taken by Vodokanal
Tariff	An early transition from the Norm Tariff System to the Metered Tariff System	Vodokanal and TKEO's have made efforts to realize this; however, the target schedule by 2004 failed due to lack of budget
	Meter installation costs should be included in water charges, or a long-term loan system should be introduced for domestic consumers	Vodokanal accepted the former plan and installed meters for a while, however, with the July 2003 tariff revision, the meter cost is no longer included in the water charge. Therefore, a long-term loan from Vodokanal, enabling domestic consumers to purchase a water meter is currently being considered as the recommendation suggests.
	Water meters should be installed outside the houses.	Installation of outdoor water meters in a steel control box was made for 30 detached houses as a pilot project in summer, 2003. Technical as well as financial aspects of this method are currently being examined.
	Excessive cross subsidies between domestic consumers and businesses should be eliminated.	It has almost been eliminated since the tariff revision of March 2000.
Management	Autonomy and decision-making powers of Vodokanal should be increased in order for Vodokanal to become financially independent.	There have been little institutional reforms as yet, in terms of strengthening autonomy and decision-making powers of Vodokanal, organizational changes within Vodokanal are under way within the current institutional framework.
	To achieve financial independence of Vodokanal, water tariffs should be formulated, based on appropriate financial planning including future investment in their facilities. The Team indicated the flowchart, which was estimated after three years and also proposed a sample of desirable water tariffs.	Although several water charge increases have been made, the charge only covers operational costs. Thus, the current situation is still far from the desired targets.
	Vodokanal should enhance public awareness of water supply service for domestic consumers.	Some improvements have been made in this regard: a TV series co-sponsored by National Television and a short TV spot ad are being aired.

Due to the enormity of fund requirements, significant improvements related to facilities are not yet visible. Also, since the previous study focused mainly on the tariff system and management reforms, it did not formulate any detailed plans for facility improvement.

2) EBRD Project

The most relevant project is the Tashkent Water Supply Improvement Programme of EBRD (the EBRD Project). The purpose of the EBRD project is to invest on the facilities in Tashkent city water supply services which require urgent rehabilitation and improvement. The total project cost is estimated at 14.5 million USD, of which up to 10.0 million USD is supposed to be financed by EBRD, and the rest by ROU.

However, since the latter part comprises mostly civil engineering work, it is planned that an affiliated company of Vodokanal will do the job. The borrower will be the Tashkent city *Hokimiyat*, who will re-lend the loan to Vodokanal.

As of February 2005, the loan agreement had been signed between EBRD and the *Hokiymia* under the following conditions: a repayment period of 15 years with a three-year grace period, with an interest rate of LIBOR (London Interbank Offered Rate) plus 1% (in section II.3.5.(1), fund procurements are estimated at 3.5% of interests rate with 15 years repayment and a three year grace period). The contents of the project are implementing the items as indicated in Table II.1.19. The target year of completion is 2008. The EBRD project is supposed to contribute to stable supply of water by improving and rehabilitating the facilities which need urgent action. The main items of the EBRD project are: partial improvements through urgent replacement of deteriorated facilities at Kadirya, Boz-su and Kibray WTPs; partial improvement of the PS and construction of a new PS for low-pressure level areas.

Table II.1.19 Contents of the EBRD Project

Place	Items	Contents
Kadirya WTP	Replacement of No.1 and No.2 Intake PS	15 units of pumps with valves, transformers and control panels
	Filter improvement/ replacement	Replacement of 50% of valves, introduction of automatic filter washing
	Laboratory equipment	Replacement of all equipment
Boz-su WTP	Replacement of intake and distribution PS	Pumps with valves, transformers and control panels
	Replacement of filters	New construction of rapid filters with capacity of 100,000 m^3/d
Kibray WTP	Replacement of well pump	63 units of pumps
Lisunova PS	New construction	Capacity of 1,000m^3/hr
Oktyabrskiy Pipe	Purchase and setting up of equipment; overflow-pipe construction	Reinforcement of pipes D1000 and D1200 Total length=2km

II.2. Current Issues and Formulation of the Long-Term Development Plan

The final objective of the LTDP is to achieve a stable water supply business in Tashkent by 2015. In order to meet this goal the following must be undertaken, 1) the rehabilitation and improvement of the facilities to ensure stable water supply; 2) securing the necessary funds to make the rehabilitation and improvement happen; and 3) having efficient management to ensure that funds are appropriated in accordance with the objectives. In the following section, the current problems that may hinder the achievement of the above mentioned goals will be studied.

II.2.1 Issues on the Facilities to Secure a Stable Water Supply

There are issues related to the facilities that must be resolved in order to secure through a stable supply of water for the city in the future.

(1) Deteriorated WTPs

The results of the functional diagnosis of WTPs reveal that the majority of facilities of WTPs are seriously deteriorated. Many of the problems besetting the WTPs are described

and summarized below. In order to represent the level of deterioration within the facilities, the diagnostic results of Kadirya and Kibray WTPs are shown as examples in Table II.2.1.

1) The mechanical and electrical facilities of old WTPs, such as Kibray and Boz-su, are seriously deteriorated as well as the civil and architectural constructions. Even the intake pumps of Kadirya WTP, which is the newest WTP in the city, break down once to twice yearly. It produces 2,100,000 m^3/d, far exceeding the WTP's design capacity of 1,375,000 m^3/d. This continued operation is obviously overloading the WTP, thereby increasing the frequency of washing the rapid filters and affecting the stability of water quality of treated water as well as hastening the deterioration of the facilities.

2) The intake capacity of Kibray WTP is on the decline due to frequent breakdowns of the pumps and the gradual deterioration of the wells. The reason is that the pumps do not have safety lock devices to prevent dry operation, and a rapid and increased drop of the groundwater levels in the wells frequently takes place. The reasons for the drop in groundwater level are: i) the pump capacity exceeds the actual safe yield of wells, and ii) mutual interference of the wells has shorter intervals (100-200m) than that of hydraulically required intervals (300-700m).

3) Other than above, there are five small groundwater WTPs in the city, and the intake capacities of the majority of the wells have been decreasing. Well pumps also frequently break down.

Table II.2.1 Summary of Survey Results for Kadirya and Kibray WTP

Diagnosis		Kadirya WTP	Kibray WTP
Commissioning Year	Structures and facilities	No.1 intake and old filter 1969, No.2 intake and new filter 1985	Structures:1955. No.1 PS:1962, No.2 PS 1969, Wells 1955-1990
Function Diagnosis	Design capacity	1,375,000 m^3/d	455,200m^3/d
	Intake capacity	2,250,000 m^3/d	470,000m^3/d
	Distribution capacity	By gravity: 2,250,000m^3/d, by pumps: 121,000m^3/d	750,000m^3/d (including water from Kadirya WTP)
	Actual distribution amount	1,800,000-2,250,000m^3/d	750,000m^3/d (including water from Kadirya WTP)
	Sedimentation	No.1-1,000,000m^3 (RT=18hr), No.2-500,000 m^3 (RT-12.5hr), Insufficient flocculation facilities	N/A
	Filter	6,720 m^2, 320-335m/d (exceeding SNIP standard)	N/A
	Dosing	Not specific problem	N/A
	Disinfection	Not specific problem (14kg/hrx16units)	Not specific problem (7.5kg/hr x 6units)
	Service Reservoirs	30,000m^3(RT=0.3hr)	10,000m^3 (RT=0.5hr)
Deterioration Diagnosis	Wells	N/A	Progressing capacity reduction, Many well pumps are left in out of order condition at left bank
	Sedimentation basins	No serious deteriorations, attached equipment is needed to replace or repair	N/A
	Other civil structures		Deteriorations is progressing, replacement or refurbishing are necessary
	Buildings	Fittings and steel product are needed to replace and repair	Deteriorations is progressing, Fittings and steel product are needed to replace
	Intake pump facilities	Needed to replace for pumps and accessories urgently	N/A
	Filters	Some pipes and auto-valves are needed to replace	N/A
	Distribution pump facilities	Needed to replace for pumps and pipes urgently	Needed to replace for pump facilities urgently
	Washing pump facilities	Needed to repair for some parts	N/A
	Coagulant dosing facilities	Needed to replace urgently	N/A
	Disinfection facilities	Needed to replace urgently	Needed to replace urgently
	Electric receiving facilities	Needed to replace within 10 years	Needed to replace within 10 years
	Electric facilities	Needed to replace urgently	Needed to replace urgently
	Pipes and valves	Due to lack of painting maintenance, the deterioration was accelerated	Due to lack of painting maintenance, the deterioration was accelerated
	Laboratory	Old Equipment, no new type electron measure devices which can analyze more rapidly and precisely	Old Equipment, no new type electron measure device which can analyze more rapidly and precisely

RT: Retention Time

(2) Inefficient and Deteriorated Water Distribution Facilities

Issues for water distribution facilities are summarized as follows:

1) Kadirya and Kibray WTPs are located at higher elevation levels than the distribution areas, and as such are ideal for using the gravity flow. However, the excessive water flow in the pipelines increases friction loss, thus reducing water pressure in many areas of the pipeline network. The pressure is excessive in the areas where there is a big difference in elevation with the WTPs, and pressure decreases when the valves are partially closed. It extends the areas that experience low water pressure, usually at the downstream part of the pipelines, necessitating the operation of 134 booster PSs in the city. Many of these booster PSs can be abandoned if NRW can be reduced, and proper pressure regulation measures installed. Since these PSs have no automatic control system and the discharge capacities of pumps are higher than its actual required capacities, electricity is being wasted.

2) The hourly fluctuation of distribution flow will become larger when the NRW is reduced in the future, and therefore the capacities of the existing reservoirs are too small. Since the automatic ON/OFF operation for existing distribution pumps cannot be carried out in response to water level or pressure, operators must observe and regulate the operation of the pumps. Manual operation of the pumps is sufficient if flows do not fluctuate. However, if flows fluctuate, then a pump automatic control system must be introduced to respond to changes on the water level of the pump wells, or on boosting pressure.

3) Vodokanal identified 420 km of pipelines for urgent replacement. The annual frequency of leakages is around 10 times/km (60% of the annual number of leakage accidents of 8000 times took place in these pipelines. In Japan, when the frequency of leakage accidents is more than two times a year, the pipeline in that interval should be replaced.).

4) Pumps and electric facilities for 24 Booster PSs, which were diagnosed within 80 PSs,

have deteriorated and frequently break down.

(3) Issues for Operation and Maintenance

Issues pertaining to O&M are as follows:

1) A large number of operation staff is necessary, since many booster pumps have to be operated manually;
2) An appropriate maintenance and repair could not be carried out because of budget shortages; and
3) The current training programs and operation manuals are inadequate.

II.2.2 Problems on Securing the Necessary Funds

Funds should be secured to ensure the stability of water supply services. These funds will be utilized for the operation of facilities and rehabilitating and improving deteriorated facilities as mentioned in Section II.2.1.

In procuring these funds, it is imperative that necessary investment and operating capital be estimated correctly, and that full cost recovery must be guaranteed through tariff collection. However, Vodokanal has failed to estimate the required costs thus far, which has resulted in the failure to obtain income from tariff collection. In addition, the large amount of NRW worsens the already acute shortage of funds, since this translates into lost income. On the other hand, the government has not handled the problems on fund procurement and tariff reform correctly, and is trying to pass on these issues to Vodokanal.

(1) Non-Revenue Water (NRW)

This study revealed the extent of NRW and wastage in Tashkent city. The NRW is water lost through leakages due to deteriorated pipelines, as well as illegal connections. Water consumption over the flat tariff (Norm) is also counted as NRW. In addition, much of the water consumed within the flat tariff limit is often wasted, since there is very low

awareness on water conservation measures. The water supply volume in Tashkent city in 2002 (estimated as 2,900,000 m^3/d) can be categorized as indicated in Table II.2.2 and II.2.3.

Table II.2.2 Water Demand Breakdown

Category	Ratio	Sub-Category	Reason	Revenue Water (○) NRW (X)	NRW ratio	Remarks
Consumption by Customers	60%	Necessary consumption for every day living	-	○	0%	
		Potential reduction if water is saved Unnecessary consumption (Wastage)	Low incentives for saving water, due to the flat tariff system, "Norm"	Up to "Norm" Volume:○, More than "Norm" volume: X	8%	Includes consumption due to watering of gardens
Loss from the Distribution System	40%	Leakage from the distribution system	Deteriorated Pipes	X	25%	
		Improper usage such as illegal connections	Under investigation by Vodokanal	X	15%	Irrigation in the nearby green areas is frequently observed.
Total	100%				48%	

Source: Study Team estimates

As shown in Table II.2.3, the percentage of both NRW and wastage from the total amount of water distributed is 48.2% and 14.4% respectively. Therefore, leakage from distribution pipelines and wastage can be greatly reduced if pipelines are rehabilitated, and if awareness on the benefits of water conservation is enhanced. Particularly, leakage from distribution pipelines is caused mainly by the deterioration of pipelines. The existing water demand, with the potential of reduction, is putting a lot of pressure on the future finances of Vodokanal, as well as on its consumers.

Table II.2.3 Composition of Water Distribution

Division	Name	No.	Value 1,000m^3/d	Rate %	Formula	Note
Total water supplied to the City		①	2,900	100.0		Estimated by the Team
Actual consumption by consumers		②	1,739	60.0		Domestic: Population x estimated per capita consumption*1 Large: Charged consumption*2
Components of water demand	Domestic consumers	③	365	12.6		Population x daily per capita water consumption with meter*3
	Large consumers	④	717	24.7		Current consumption*2 x0.8
	Real demand	⑤	1,082	37.3	③+④	Consumers' actual demand for water
	Wastage by consumers	⑥	418	14.4	⑦−⑤	Charged consumption
	Revenue water	⑦	1,500	51.7	⑤+⑥	According to Vodokanal's record
	NRW from housing	⑧	239	8.2	②−⑦	Difference between charged water consumption and actual consumption
	NRW from pipes (losses)	⑨	1,161	40.0	①−②	Including leakage from pipes and improper usage, such as illegal connections
	NRW	⑩	1,400	48.3	①−⑦	
	Total		2,900	100.0		

Actual water supply: Water supplied to domestic and large consumers. Domestic consumers with meters: maximum daily per capita water consumption surveyed by the Study Team x population. Domestic consumers without meters: estimated maximum daily per capita water consumption x population. Large consumers: revenue water is adapted because connections are metered.

Actual consumption: Water consumption by domestic and large consumers. Domestic consumers: estimated daily per capita consumption, assuming that all domestic consumers have meters. Large consumers: 80% of the amount of charged water.

Water demand: including water loss

*1: Domestic consumers/Apartment/with meter: 150Lpcd x 128,000 people = 19,000m^3/d
Domestic consumers/Apartment/without meter: 500Lpcd x 1,263,000 people = 631,000m^3/d
Domestic consumers/Detached house /with meter: 200Lpcd x 259,000 people = 52,000m^3/d
Domestic consumers/Detached house/without meter: 270Lpcd x 521,000 people
=141,000 m^3/d

*2 Large consumers: 896x1,000 m^3/d

*3 Domestic consumer/Apartment: 150Lpcd x 1,391,000 people = 209,000m^3/d
Domestic consumer/Detached house: 200Lpcd x 780,000 people = 156,000m^3/d

(2) Financial Issues

1) Absence of a long-term financial plan

The changes in the currency unit of Uzbekistan, and past hyperinflation have decreased the current book value of the fixed assets of Vodokanal. This means that if these were to be repurchased, their actual price would be more than their book value. Because tariffs have been set to recover only the costs corresponding to the current book values of the

existing assets, the necessary funds for facility replacement/improvement have not been secured, implying that long-term investment plans have not been formulated in the past. It has not changed significantly since the Soviet era until the present day.

2) Shortage of short-term operating capital

Vodokanal has never been in the red, at least in terms of the reported income statements. However, it has often suffered from a capital shortage. This is proven by the fact that even now, delays in the payment of wages still occurs. The reasons behind this are the existence of a large amount of bad debts from national and public enterprises. Also, debt collection from governmental bodies tends to be delayed due to budget shortfalls on their side, and that electricity costs were higher than the estimates, all contributing to Vodokanal's capital shortage. Obviously, the issue on accumulated bad debts involves other governmental bodies. Therefore, in order to solve this problem, Vodokanal needs the government's cooperation.

(3) Issues on the Tariff System

1) Limits in raising tariff levels

To ease capital shortage problems, it is necessary to reduce NRW and expenditure. However, there is a limit to the amount of funds that can be obtained through these measures. It can be said that the current tariff does not cover the necessary costs, such as the improvement of the facilities, which maintain a stable water supply. Thus, it will be necessary to increase the tariff to the appropriate level. The above-mentioned World Bank study noted that a tariff level of up to 3% of average income can be tolerated[6]. Therefore, the average household can still absorb doubled or tripled water tariffs, as water expenses account for only 1.1% of the current average household income. However, since communal fees, such as electricity, gas, hot water, etc. already account for 18.7% of a household's income, an increase in water tariffs should not be made when the people's standard of living is adversely affected. Since an increase in water

[6] The World Bank, *Information and Modeling Issues in Designing Water and Sanitation Subsidy Scheme*, May 2000.

tariffs to fund facility investments cannot be avoided for water supply services to continue, it may therefore be necessary to consider getting subsidies to mitigate the burden on the domestic consumers.

2) Transition to a Metered System

To achieve the self-financed management of the water supply operations, NRW and wastage must be reduced. This can be realized by full transition from the current norm system to a metered system. However, there is a considerable delay in the installation of meters. In 1999, full meter installation was targeted by 2004, but when 2004 came, the target year was rescheduled to 2009. Currently, around 84% of domestic consumers are still under the Norm System and the reduction of NRW and wastage is not progressing as planned. In addition, even if the transition to a Metered System is complete, new problems may arise as follows:

i) Problems on meter reading

Currently, to avoid theft, the meters are installed indoors, making the presence of the homeowner necessary for the inspectors to read the meters. It is anticipated that more inspectors will have to be hired in the transition to a metered system.

ii) Decrease in income from tariff collection

As meters are installed, domestic consumers will become more aware of the importance of saving water, resulting in a decrease in consumption and the attendant decrease in income from tariff collection (Right now, in apartments, average water consumption under the norm system is 330 Lpcd, and this is expected to decrease to 150 Lpcd with the installation of meters).

3) Problems regarding tariff collection

The following problems may surface with the tariff collection:

i) Payment collection

Consumers pay their water bills directly to the banks or the post offices, or bills are collected by the Vodokanal's inspectors. The current payment collection method using banks although not widespread, will still continue. But as the metered system progresses, the use of inspectors will also increase. Using inspectors to collect payment will cost more, as well as increase the risk of corruption. Vodokanal must consider more efficient collection methods, and put in place corruption prevention measures when using inspectors as payment collectors.

ii) Manual operations

Meter reading, billing and collection are manually done, making the process quite inefficient. Miscalculations and mistakes in recording are highly probable. It would be best to computerize the billing process.

II.2.3 Problems in Attaining Efficient Management

Attaining current and future water supply stability for Vodokanal does not depend on solving its facility and financial problems alone. One of the more important aspects is strengthening top management's vision and improving employee awareness. Management must lead the entire organization toward change, and encourage the employees to embrace quality and excellence at all times. This will enable all the levels of management to make the right decisions, and the employees to work more efficiently. In addition, accurate information, based on appropriate management decisions should be developed.

(1) Problems with Organizational Culture and Employee Training

1) Attitude towards solving problems

Top management is responsible for understanding the current situation of the business and identifying the problems they are facing in order to achieve an effective water supply service. After identifying the problems, they need to set the targets and formulate the strategies to achieve the targets. Top management also needs to enhance

the comprehension of their employees in order to carry out the strategies. However, Vodokanal rarely understood the magnitude of the current problems and the counter measures needed in the long-term perspective.

2) Employee awareness

Information sharing between top management and employees play an important role in solving identified problems. Particularly, opinions from the employees are important in proposing and executing the strategies. Although there is a periodic meeting in Vodokanal, there is a need to institutionalize or systematize the manner by which employees can be encouraged to voluntarily participate and speak out. This can be done through empowerment meetings or conference meetings where the method of management decision-making is participatory (bottom-up) rather than autocratic (top-down). Furthermore, the contribution of the employee is not reflected in his/her performance evaluation, and such employee is rewarded based on the nature of the input and its contribution to the efficient operations of Vodokanal. Therefore, it can be said that the employee awareness to understand and solve identified problems is not high in Vodokanal.

3) Employee training

In order to enhance the organizational capacity, not only awareness but also individual capacity should be empowered. Expanding knowledge and upgrading skills should not only be on the technical or engineering aspects, but also on general management, finance and accounting, and human resources. However, training is limited to newly hired employees in Vodokanal. Therefore it can be said that their training programs are not sufficient.

(2) Information Management

For the top management and the persons in charge to correctly understand and analyze the current problems, it is necessary to have accurate information and that such information is shared with all the persons involved. However, the reliability even for basic information is

questionable, such as the status of current facilities' operation and financial information, including supporting data necessary for analysis. In addition, information gathering and analysis is still done manually, limiting the collection of accurate data.

(3) Relationship with Domestic Consumers

The relationship with domestic customers is very important in providing stable and continuous service in the aspect of water supply as a public service.

Water supply is a public service and maintaining of good relationship with the customers, especially the domestic consumers, is extremely important. However, public relations activities have been insufficient so far, since there is no integrated program to inform and educate the public of vital information on the operations of Vodokanal. It is necessary for Vodokanal to improve PR, such as increasing the customer's understanding of water conservation and management through such means as providing information and displaying facilities.

The above-mentioned problems that Vodokanal is facing in the process of achieving a stable water supply operation are summarized in Table II.2.4.

Table II.2.4 Summary of the Issues in Securing a Stable Water Supply

Issues in securing a stable water supply	Current Problems	
Facilities to secure a stable water supply	Rehabilitation of facilities	-Frequent accidents due to deteriorated facilities -Overstaffed facilities and large energy expenses due to inefficient system's organization - No fund reserves for facility rehabilitation
Securing necessary funds	Reduction of large NRW	-There are large water losses from distribution lines mainly due to pipeline deterioration -There is large water wastage by the consumers because of the delay of meter installation -Operation of facilities for NRW needs high water treatment and conveyance costs -An important opportunity to gain income is lost
	Improvement of financial status	-Shortage of long-term investment funds -Shortage of short-term operating capital -Government policy: no financial support
	Reform for tariff system and management	-Due to capital shortage problems, revising the tariff table is necessary, but raising tariff levels is limited -Problems arising in the transition to the Metered System: 1) in efficient meter reading method and 2) decrease in income from tariff collection -Problems regarding tariff collection: 1) inconvenient tariff collection system due to limited use of bank account by customers.
Efficient management	Organizational culture and employee training	-Deteriorated facilities etc. lack of understanding current problems -Top-down decision making structure -Inefficient and insufficient employee training
	Information management	-Information required for management is not correctly gathered, analyzed and transmitted due to delays in information management
	Relationship with domestic consumers	-Information disclosure for domestic consumers and promotional and PR activities are not sufficient

II.2.4 The Need for the Long-Term Development Plan

As described in Section II.2.2, there are significant water losses from the existing distribution pipelines and wastage by the consumers. Water demand in Tashkent city has been on a downward trend for the past few years as a result of progress in the installation of water meters. However, since the water leakage ratio is anticipated to increase if deteriorated pipelines and equipment are not regularly replaced, the rate of the increase by leakage will eventually exceed the rate decreased by the meter installation. This is expected to cause serious breakdowns of intake and distribution pumps (i.e., breakdowns by shaft wear, burn-out of electric motors and erosion of pump impellers), thus significantly decreasing water supply capacity.

Unless the deteriorated facilities are replaced, frequency and cost for repairs will increase and further repair would become very difficult to carry out. In the long run, it will become impossible to supply the demand for water.

The operational stability of the water supply facilities will mean a reliable and adequate supply of water to all the consumers. The need, therefore, of carrying out repair and rehabilitation of the facilities, to include replacement of some, is urgent.

Towards this end, short-term measures will be insufficient. The more prudent action is the preparation of long-term plans that will provide longer lasting solutions. Firstly, the extent of deterioration of the pipelines and facilities indicates that these cannot be repaired, rehabilitated, or even replaced in the short-term. This brings us to the second point. Significant investments will be required to replace or rehabilitate the facilities. Even if subsidies will be granted, these will not be sufficient to cover the replacement and repair requirements. A long-term fund procurement or financial plan will also necessary, taking into consideration repayment schemes through tariff collection. The Soviet-style of management is still alive in Vodokanal, and it is therefore necessary to include changes in management as part of the long-term plan, because any change cannot be efficiently achieved overnight.

II.3 Long-Term Development Plan

II.3.1 Formulation of the Long-Term Development Plan

In order to provide long-term solutions to the various problems facing Vodokanal mentioned in sections from II.2.1 to II.2.3, the Long-Term Development Plan (LTDP) has been formulated as described below. Three targets were set to help resolve each of the problems within the target year of 2015.

(1) Stable Water Supply

The first target is to attain maximum system efficiency. To achieve this, water supply

must be stable in order to provide a reliable and adequate water supply to the service area. This would mean the construction of new facilities to replace the deteriorated ones, plus the rehabilitation/improvement of the distribution system.

(2) Self-financial management

The second target is to achieve financial independence. To do so, a long-term financial procurement plan must be formulated in order to cover for shortfalls adequately.

(3) Efficient management organization

The third target is to realize an efficient management organization. It is not enough to have plans for facilities improvement and fund procurement. What is important is that these plans are put into action, or are implemented by a strong management organization. Since the current organization is in a period of transition, further improvements are required to achieve better organization and management.

To achieve these three goals, the following plan was formulated, also related to problems currently faced by Vodokanal.

1) Reduction of NRW (including wastage)
2) Replacement and rehabilitation of deteriorated facilities and improvement of inefficient distribution system
3) Reform of financial status
4) Reform of the tariff system
5) Reform of organization and management
6) Information development and sharing
7) Promote cooperation with the activities targeting the domestic consumers

Figure Ⅱ.3.1 shows the flow chart for formulation of LTDP

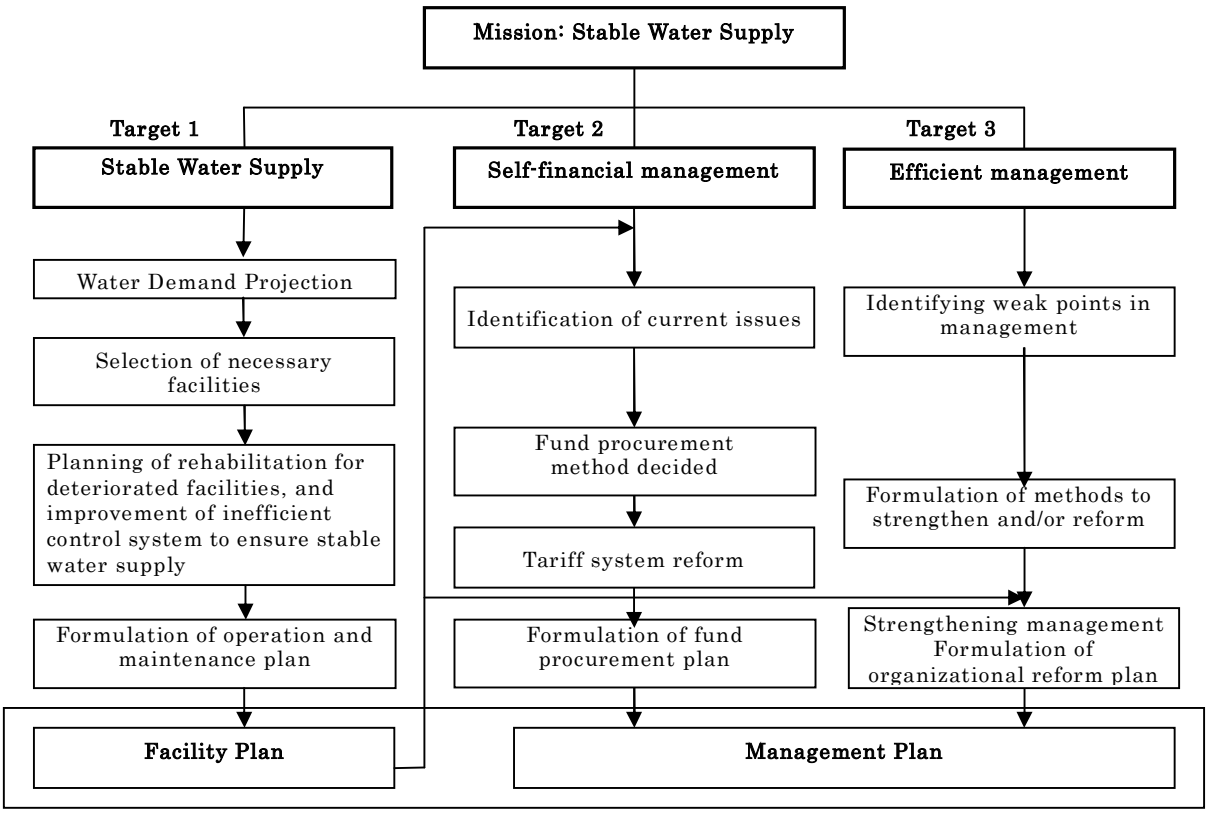


Figure II.3.1 Formulation of Long-Term Development Plan

II.3.2 Planning Fundamentals for Water Supply Systems

This section deals with the water demand projection which is a premise for the formulation of the LTDP.

(1) Population Projections

The service area of Vodokanal covers Tashkent city and the nearby areas of Kadirya, Kibray and Ata districts. According to the population projection of the Statistics Department of the city, the current population of 2,107,000 will slightly grow to 2,110,000 by 2015. These data have been used in the following analysis. In addition, Vodokanal expects that the present service coverage of Vodokanal, which is 98.5% of its area of jurisdiction in Tashkent city, will also be maintained in the future. Meanwhile the rest of domestic users will still utilize wells as the source of water, causing no threat to either the quality or quantity of water. Thus, the same coverage ratio will be used in the analysis.

Table II.3.1 Service Population Projections (Unit: 1,000)

Division	Area	2002	2005	2010	2015
Apartments	City*	1,376.8	1,375.5	1,377.4	1,378.6
	Vicinity	14.0	14.0	14.0	14.0
	Total	1,390.8	1,389.5	1,391.4	1,392.6
Detached Houses	City	730.2	730.7	730.7	731.4
	Vicinity	49.8	57.6	73.6	93.9
	Total	780.0	788.3	804.3	825.3
Total	City	2,107.0	2,106.2	2,108.1	2,110.0
	Vicinity	63.8	71.6	87.6	107.9
	Total	2,170.8	2,177.8	2,195.7	2,217.9

Note: The present service coverage ratio in the City of 98.5% will be maintained.
*: Projected by the Statistic Department of the City

It is also assumed that the service areas of nearby towns will continue to be supplied with water. Table II.3.1 shows the projection of the service population in the city and its surrounding areas. In the projection for the surrounding areas, based on the data provided by Vodokanal, a five percent annual growth rate from 2000 to 2010 will be adopted for detached houses where there is rapid development. On the other hand, it is assumed that the current service population will be maintained for apartments (constant population of 14,000) because no further development projects are expected in the future.

(2) Water Demand Projection

Water demand projection, on the basis of estimated population growth, assumed that NRW and wastage would be decreased as a result of the implementation of the NRW reduction program. This is firstly, because the replacement of the pipelines will reduce leakages (which is proposed in this study), and secondly, it is expected that water saving will begin to take effect as a result of the transition to the metered tariff system, which has already been announced as a government policy.

1) Assumptions for the water demand projection

i) Domestic Customers (apartments and detached houses)

Water demand by apartments and detached houses was estimated based on the status of meter installation in the future. The range of current water consumption for

metered clients for both apartments and detached houses are 135-510 (ave.150) Lpcd and 180-270 (ave.200) Lpcd, respectively. This projection is based on the demand that Vodokanal will complete meter installation by 2009. On the other hand, per capita consumption for domestic customers is assumed to be constant, even after meters have been installed.

ii) Large Consumers

Large consumers can be classified into budgetary organizations (such as governmental offices, public facilities, water heating plants, schools, and public hospitals), large and small-scale industries and commercial entities. For these large consumers, the following assumptions were made to project demand by the target year:

- Drastic reduction in water demand cannot be expected since 80% of the consumers already have water meters, which account for 95% of their water charges;
- Demand for budgetary organization offices shall be considerably reduced with the provision of repair work for water service equipment, such as flush valves for toilets;
- In large and small industrial water demand, the consumption rate has been on a downward trend due to a stagnant economy since 1998. However, the estimated per capita demand in 2015 was set at a 10% increase in that of 2002, according to the estimated economic development in the future, which assumes that Uzbekistan's industries have grown at around 3% from 2001 to 2002, and by 2015 the country would be growing at the same water demand as in 1998; and
- A reduction of hot water supply for domestic consumers is expected in the future. This is based on the fact that the transition to a metered tariff system and the introduction of other measures under consideration for the hot water supply operations will eventually result in the decrease in hot water demand.

iii) Water losses in the water distribution system

In 2002, about 40% of water was lost in the distribution system. However, a reduction

of water losses is expected in the future due to pipes replacement and the implementation of several countermeasures. By the year 2015, the water losses ratio will have been reduced to 29% (See Table II.3.2).

Table II.3.2 Daily Average Water Demand Projection by Target Year

Division	Item/Year		2002	2005	2007	2009	2010	2011	2015
Population (x1000)	Apartment		1,390.8	1,389.5	1,390.5	1,391.4	1,391.4	1,391.6	1,392.6
	Detached house		780.0	788.3	794.5	800.7	804.3	808.5	825.3
	Total		2,170.8	2,177.8	2,185.0	2,192.1	2,195.7	2,200.2	2,217.9
Projection of water demand ($1000m^3$/day)	Domestic customers	Apartment	650.6	548.9	415.3	281.7	208.7	208.8	208.9
		Detached house	192.5	179.7	170.1	160.5	160.9	161.7	165.1
		Total	843.1	728.6	585.4	442.2	369.6	370.5	374
	Large consumers		896.0	851.1	842.1	833.1	824.1	815.1	779.2
	Water loss		1,161	1,161	987	805	726	646	472
	Total		2,900	2,741	2,415	2,080	1,920	1,832	1,625
Per capita demand (Lpcd)	Domestic customers		388	335	268	202	168	168	169
	Large consumption		413	391	385	380	375	370	351
	Water losses		535	533	452	367	331	294	213
	Total		1,336	1,259	1,105	949	874	832	733
Water loss ratio (%)			40.0	42.3	40.9	38.7	37.9	35.3	29.1
Control for water reduction	Promote installation of meter								
	Pipe replacement								
	Strengthening of management								

2) Results of water demand projection

Table II.3.2 and Figure II.3.2 show the estimated water demand by the target year. Water demand is anticipated to decrease sharply as a result of water meter installation, the replacement of deteriorated pipelines, and through strengthening of management. In other words, the water supply of 2,900,000 m^3/day in 2002 could almost be halved in 2015 (1,625,000 m^3/day), which is adopted as the basis for the design of the facilities.

Contribution to the reduction of water wastage through meter installation is especially notable for domestic consumers, whose current metered ratio is low. In contrast, the reduction in water demand for large consumers is not large since the majority of these consumers have already been metered.

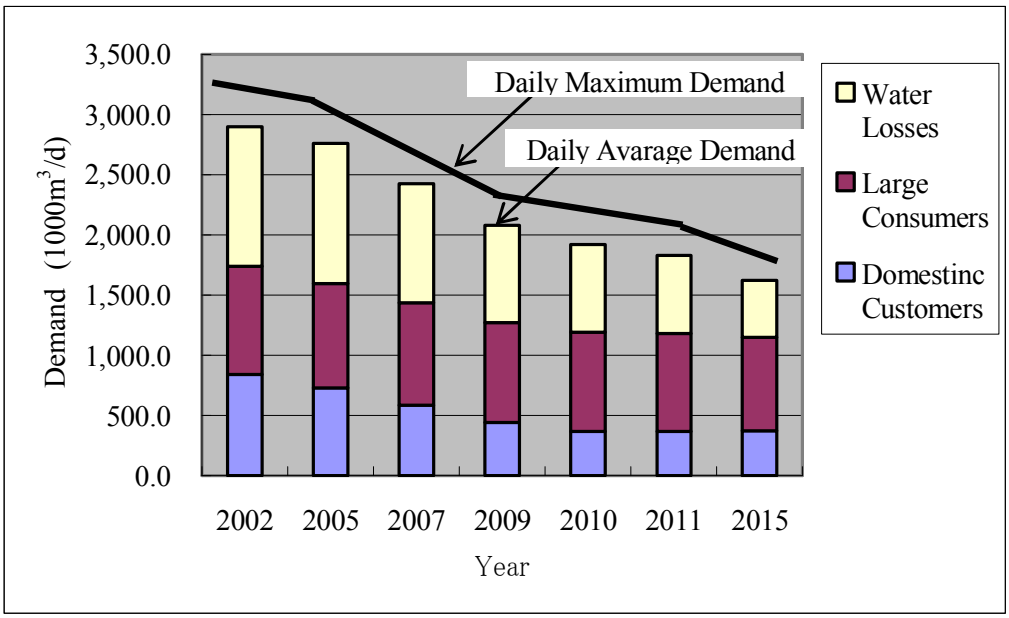


Figure II. 3.2 Water Demand Projections

The current daily factor (Maximum daily water distribution amount/average daily) in Tashkent city is around 1.07 and the assumed value in target year 2015 is 1.12. The current hourly factor (Maximum hourly flow/maximum daily flow) is at 1.03, and it is assumed at 1.12 for the target year.

II.3.3 Reduction of NRW and Wastage (NRW Reduction Program)

In order to reduce NRW and wastage, a NRW Reduction Program is formulated. The components are (1) promotion of meter installation, (2) replacement of deteriorated pipelines, and (3) strengthening of management.

(1) Promotion of Meter Installation

It is clear from the records obtained that when the Metered System was introduced, water wastage by domestic customers was reduced. Therefore, the completion of meter installation is the most important component of the NRW Reduction Program.

In 2003, the Government's target was to achieve 100% meter installation by 2009. This

target has been postponed for the last five years since the previous JICA study conducted in 1999, and a meter installation program was set up. Therefore, it is highly recommended that the latest schedule be followed strictly. The main reason why the installation of water meters did not proceed as scheduled was because the meters had to be paid by each of the domestic customers outright but they cannot afford these. To make it easier and more affordable for the domestic customers, Vodokanal implemented a recommendation by the previous JICA Study, which suggested the cost of the meter and its installation be included in the water tariff.

However, Vodokanal experienced an increase in electrical and operational costs, not to mention the difficulty in collecting the meter installation cost together with the water charges. Thus, there was a return to the previous manner of installing meters. A discussion held between the Study Team and Vodokanal produced a number of countermeasures, such as introducing a long-term loan system in order to share the burden of the installation cost, and the use of bulk meters in order to avoid individual installation of meters in the case of apartments. The details are indicated in the Main Report.

However, according to Vodokanal, although these countermeasures are theoretically sound, the social reality will make implementation difficult. A meter installation pilot study was then made for 25 detached houses. Each water meter was enclosed in a steel box by the roadside, and connected to the house, making reading and inspection of meters easier. However, the cost of the materials and equipment for this water meter installation method came up to thrice the usual. As of this time, the final water meter installation method has not been decided on.

For meter installation to be completed, it is important to solve technical and financial problems, and to provide incentives to promote the transition from the Norm System to a Metered System. Specifically the following plan is to be implemented:

1) Installation of meters by 2009

- Evaluating both the technical and financial aspects of the pilot project regarding installation of water meters, including problems with regard thereto in detached

houses conducted by Vodokanal and considering whether it should be adopted or not;

- Carrying out a technical investigation on meter installation methods for apartment buildings, with emphasis on installation costs and technical issues with the installation, while looking into the possibility of using bulk meters;
- Evaluating the report on the results of the technical investigation for meter installation methods in apartment buildings, submitted by Vodokanal's subcontractors;
- Determining water meter installation methods based on above conditions;
- Considering external loans including temporary loans from the government, in order to raise funds for installing water meters;
- Planning the exact installation schedule up to 2009; and
- Designating a responsible person in order to follow the schedule as planned.

2) Revision of the Norm Tariff System

- With regard to determining water charges according to the Norm Tariff System, the standard consumption volume of water will be increased based on the updated actual usage figures (e.g. the current Norm consumption amount will be changed from 330 L/cap/d to 580 L/cap/d.); and
- If authorities disagree with the proposed revision of the Norm Tariff System, introducing the Bulk Metered Tariff System will be considered.

Each of the methods explained will have to be re-examined, and the most suitable one selected. This is necessary so as to calculate the amount of funds required for procurement, as well as what laws or processes need to be revised and/or implemented. Thus, the following action needs to be taken.

Vodokanal should submit the proposed changes to the authorities based on consistent and credible data. In turn, the authorities should promptly discuss the proposed changes and do their best to adopt it to the maximum possible extent. It should be stressed that revision of the tariff system must be carried out simultaneously with the progress in

meters' installation.

(2) Well-Planned Replacement of Pipelines

A total length of 420 km of pipeline has been selected by Vodokanal for replacement. These leaky pipes, of which 73% are small diameter pipes, less than 200mm, are distributed throughout the city, as shown in Table II.3.3

Table II.3.3 Selected Pipes for Replacement

District name	Length (m)	Selected Sites
Mirzo Ulugbek	67,265	46
Sabir Rahimov	28,242	4
Akmal Ikramov	52,700	94
Hamza	34,317	39
Yunusabad	30,162	24
Sergeli	51,520	39
Bektemir	8,420	54
Chilanzar	33,248	67
Shayhantahur	47,996	65
Yakkasaray	31,066	63
Mirabad	35,145	33
Total	420,081	528

Source: Selected by Vodokanal

Most of the selected sites will require many and relatively small workloads in extending pipelines. Consequently, both the difficulty and the progress of the construction works will be determined by traffics. According to Vodokanal, due to complicated construction works for replacement, the length of pipes to be replaced would be limited to 60 km per annum. Since the losses in distribution lines were estimated at 725,000 m^3/d by the Study Team, it is extremely important that replacement works start as soon as possible.

(3) Measures for Strengthening Inspection

NRW may include losses other than leakage, such as illegal connections. However, Vodokanal does not have concrete data with regard to this issue. Thus, it needs to strengthen inspections and take strict measures when illegal use of water is discovered to prevent the recurrence of such offenses.

II.3.4 Replacement for Deteriorated Facilities and Improvement of Inefficient Distribution System

There is a need to draw up a plan to replace deteriorated facilities as well as to make the existing distribution system operate more efficiently. To do this, retained WTPs that meet decreasing water demand in future, as shown in Table II.3.2 must be identified. Improvement plans for the facilities of the selected WTPs incorporated with the overall distribution systems, should be formulated as shown below.

(1) Selection of Necessary WTPs (Superiority of Kadirya WTP)

The design flow for water supply in the city is shown in Table II.3.4 and WTPs are identified based on this projection.

Table II.3.4 Design Flow for Water Demand

(x1000m^3/d)

Year	2002	2005	2007	2009	2010	2011	2015
Daily average	2,900	2,741	2,414	2,081	1,919	1,831	1,625
Daily maximum	3,100	3,015	2,656	2,289	2,130	2,051	1,820

Kadirya WTP, the largest one out of eight WTPs in the city, needs to be operated continuously, as it distributes as much as 72% of the total water demand. Its operation will be indispensable at coping with the future water demand, having built-in advantages such its relatively new facilities, and its low operation costs.

The relations between the projected maximum daily water supply and the required capacities of Kadirya and other WTPs are shown in Table II 3.5. Although Kadirya WTP is currently overloaded, the amount of treated water will gradually decrease based on the reduced water demand, because the required production volume cannot decrease immediately. It will be operated at design capacity of 1,375,000 m^3/d in the target year. Therefore, the shortage in the total water demand of the city shall be provided by other WTPs. As Table II.3.5 indicates, 445,000 m^3/d of treated water out of 1,820,000 m^3/d (in the total demand) will be supplied by other WTPs. Accordingly, the capacity of other WTPs has been designed at 450,000 m^3/d.

Table II.3.5 Water Demand and Required Production of WTPs

(x 1,000 m^3/d)

Year		2002	2005	2007	2009	2010	2011	2015
Projected Maximum Daily Water Demand		3,100	3,015	2,656	2,289	2,130	2,051	1,820
Required Capacity	Kadirya	2,200	2,165	1,830*1	1,830	1,700*1	1,500	1,375*2
	Others	900	850	826	459	430	551	445
Total Production		3,100	3,015	2,656	2,289	2,130	2.051	1,820

*1: Maximum filtration rate meeting the SNIP Standard (12m/hr)

*2: Design capacity of the WTP

(2) Selection of Other WTPs to Meet Future Demand

In order to meet the future water demand in 2015, the WTP(s) that will supply 450,000 m^3/d must be selected. The proposed selection criteria of WTPs which will continue to be operated and maintained into the future are: (a) elevation to enable treated water to be distributed by gravity, (b) low rehabilitation costs, and (c) low O&M costs. In this regard, Kibray WTP meets above-mentioned conditions (a) and (b), and Boz-su WTP meets (b) and (c). However, the operation cost for Kibray WTP is currently high, from the point of view of condition (c), but there is a possibility of reducing O&M cost, such as electricity and labor costs, by improving well pump and distribution system efficiencies.

1) Kibray WTP

The evaluation results for the groundwater source for the Kibray WTP show that the aquifer's potential is sufficient to secure the volume of 350,000 m^3/d only if the operation of the wells is improved; i.e., the capacities of the well pumps are properly selected, and the pumps are replaced with new pumps that have automatic operation functions. The EBRD Project includes the replacement of well pumps in the Kibray WTP, with capacities that match the wells' yield capacity, allowing automatic operation in accordance with the water levels in the wells. Thus, Kibray WTP will be able to continuously secure the capacity of 350,000 m^3/d by implementing this Project. In addition, by replacing well pumps with those of suitable capacity, breakdowns will be prevented and the consumption of electricity will be sharply reduced.

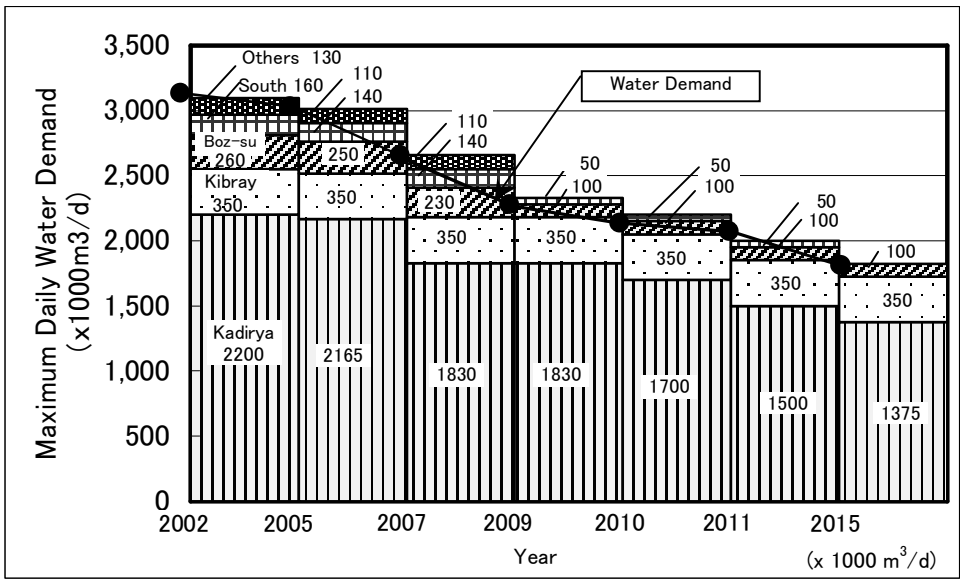
2) Boz-su WTP

The intake and distribution pumps with accessory facilities, including some rapid

filters, need urgent replacement at Boz-su WTP. Consequently, a new rapid filter with the capacity of 100,000 m^3/d will be constructed as part of the EBRD Project to replace the old filters. The project includes replacement of intake and distribution pumps with accessory facilities. Therefore, Boz-su WTP can continuously produce a minimum of 100,000 m^3/d of treated water in the future.

As mentioned-above, the total capacity of Kibray and Boz-su WTPs can be maintained at 450,000 m^3/d, which is the required capacity. Accordingly, Tashkent city will be ultimately served with drinking water from three WTPs namely, Kadirya, Kibray and Boz-su by the target year of 2015.

For the short or medium term, however, since the projected water demand will gradually decrease from the current demand, it is not advisable to close the existing WTPs unless the combined capacities of these three WTPs can meet the total water demand in the city as shown in Figure II 3.3.



Total Capacity	3,100	3,015	2,660	2,330	2,200	2,000	1,825
Water Demand	3,100	3,015	2,656	2,289	2,130	2,060	1,820

Figure II.3.3 Transition of Capacity of WTPs

(3) Establishment of a Gravity Type Water Distribution System

1) Improvement of water distribution system

In establishing an efficient distribution system, the economy of making full use of topographic features of the area should be investigated. Thus, distributing treated water by gravity is a very viable option. A hydraulic analysis for the target year shows that when proper pressure regulation with pressure regulating valves is carried out, 90 percent of the city areas can be kept 26m or more of water head, which is enough pressure to distribute to 5-story (low-story) buildings without booster PSs in the target year. However, because some areas remain below 26m of water pressure in the city, a few booster PSs for low-story buildings will be required for continuous operation.

The proposed improvement plan for the water distribution system includes the replacement of deteriorated pipes, pipe augmentation for securing proper water pressure, improvement of booster PSs, and the introduction of the pressure and flow control system. Among other things, the study focused on the improvement of booster PSs since there is a possibility that many existing PSs will be abandoned upon the introduction of the gravity flow. Through the surveys of existing PSs, it was found that booster PSs could be classified into three types depending on the number of floors of the buildings they were distributing to:

Type 1: Those distributing to low-story (not more than 5 -story) buildings

Type 2: Those distributing to high story (6-9 -story) buildings

Type 3: Those distributing to both low- and high-story buildings simultaneously

When the gravity flow will be introduced, a water pressure of 26m or more can be secured in most distribution areas, meaning that most PSs of Type 1 can be abandoned. Type 2 and Type 3 cannot be abandoned because the buildings require water pressure of 42m (in the case of 9-story buildings). However, surveys revealed that all existing PSs have excessive capacity compared to the actual water demand in their distribution areas. Hence, the replacement plan for existing pumps must be consistent with actual water demand and should also take into consideration the introduction of an automatic control and monitoring system to enable unmanned control. There is a possibility that other Type 3 PS can be abandoned in supply areas where the there are a few high-story

buildings (6 to 9 -story) and if pump units are installed in these buildings. As a result, about a half of existing PSs can be abandoned, and the total discharge capacity and electricity consumption of PSs can be reduced by 20% and 25 %, respectively. In this case, installation and operation for these pump units is a responsibility of Vodokanal.

Table II.3.6 shows the contents of replacement/improvement works of distribution pipes and improvement of booster PSs needed for establishing the efficient water distribution network in Tashkent city.

Table II.3.6 Replacement/improvement for Water Distribution System

Item	Replacement	Improvement	Abandonment
Pipeline Network	-Pipeline 420 km	-Installation of automatic pressure/flow regulation valves, -Reinforcement of pipes to rise pressure in the city -Introduction of pressure/flow monitoring system	
Distribution PSs	-Boz-su PS	-Changing to the gravity distribution system and to construct a new small PS in Kibray WTP	-Existing PS in Kibray WTP
Booster PSs		-Continuous improvement of existing booster PSs together with introduction of automatic control and monitoring system	-Existing unnecessary PSs

2) Cost comparison between the existing and the proposed system

Comparison between the existing system and the proposed gravity distribution system is shown in Table II 3.7. Pipeline replacement is not included in this comparison because the costs for each system are the same. In case of the existing system, as 24 PSs were identified to be urgently replaced, these replacement costs are calculated until 2015 and those for other PSs are calculated after 2015 because replacement will still be necessary in the future.

Table II.3.7 Comparison between Existing and Proposed Gravity Distribution Systems

Category		Items	Unit	Existing Pump System	Proposed Gravity System	Note
PS Construction Improvement	Construction /Replacement Cost	-2015	1,000USD	15,000	37,435	
		2015-2035	1,000USD	21,000	7,400	
		Total	1,000USD	36,000	44,835	
Operation	Annual consumption	Electricity	MWh	90	20	30USD/MWh
		Staff	Person	794	356	600 USD/y/p
	Annual Cost	Electricity	1,000USD/y	2,670	600	
		Personnel	1,000USD/y	476	213	
		Total	1,000USD/y	3,146	813	

A cost comparison between the both cases was carried out and the present value was calculated using the 10% discount rate. The result of the calculations showed that the PVs (present values) for the two alternative cash flows until 2035 result in 41 million USD for the gravity system and 47 million USD for the existing system. Therefore, the PV of the total costs for the proposed system is less than that for the existing system.

The proposed system is disadvantageous from the investment aspect because construction costs are higher, and these need to be invested in the near future; however, since the cost of operations is much lower, the PV of the total cost for the proposed system becomes lower. Therefore, the proposed gravity system is advantageous from the viewpoint of the costs.

(4) Construction Plan and O&M Plan

1) Proposed water supply system for the year 2015

The concrete construction plan for the target year of LTDP in 2015 is as follows:

- 420 km of deteriorated distribution pipelines will be replaced;
- Major facilities in Kadirya WTP will be replaced/improved (most of the rehabilitation in the facilities will be implemented by the EBRD Project);
- The replacement of intake/distribution pump facilities and rapid filters with capacity of 100,000 m^3/d at Boz-su WTP will be implemented by the EBRD Project;
- Small volume service reservoirs in Kadirya and Kibray WTP will be expanded to cope with flow fluctuation (two hours retention time will be secured to the daily maximum distribution amount)
- The distribution system at Kibray WTP will be changed from “by pump” to “ by gravity";
- The existing pumps at booster PSs will be replaced to new pumps with suitable capacity and automatic operation functions will be added to make more efficient;
- The distribution pipeline will be reinforced to secure an appropriate water pressure;
- Automatic pressure/flow regulation facilities, which will control water

pressure/flow will be introduced; and

- Monitoring system for the distribution network and booster PSs will be introduced to ensure proper system operation.

2) Major Works

Proposed major works are shown in Table II.3.8.

Table II.3.8 Rehabilitation and Augmentation of Facilities

Name	Facility	Replacement	Improvement	Reinforcement
Kadirya WTP	No.1 and No.2 intake P/S	Pumps/pipes/electric facilities,	Introduction of automatic control for pumps	
	Sedimentation basin		Flocculation facilities	
	Coagulant facilities		Tanks, Injection pumps	
	Rapid sand filters	Valves and pipes	Automatic-washing control facilities	
	Disinfection facilities	Chlorinators		
	Reservoir			45,000m^3x2units with pipes
	Distribution P/S	Distribution pump		
	Power receiving facilities	Transformer and panels		
	Administration building			Control/monitoring room
	Monitoring facilities	Flow meters	Level meters, central-monitoring	
	Laboratory equipment	Analysis equipment		
Kibray WTP	Well facilities	Well pumps	Automatic control	
	Transmission pipes		For gravity distribution	
	Disinfection facilities	Chlorinators		
	Power receiving facilities	Transformers and panels		
	Reservoir			V=20,000m^3
	Distribution P/S		Distribution system for surrounding area	
	Monitoring facilities	Flow meters	Water level indicators	
Deteriorated Pipeline	VP D150 mm and less	285.2km		
	Ductile Iron pipe D200-600	120.4km		
	Steel pipe D700-D1600	14.5km		
Pipeline network	Pressure/flow regulation		D1600-600 22 units	
	Reinforcement of pipes			Pipes D1400-500mm, 16.8km
	Monitoring Stations		Main: Head office and Sub: Karasu office	
Booster P/S	Replacement of pumps/ introduction of automatic control and monitoring function		61 PSs Pump replacement and introduction of automatic control and monitoring	
	Introduction of monitoring facilities (for over 1,000m^3/hr)		12PSs Monitoring facilities	
	Pump units (with control panel/stand-by, for high story buildings)		134 unit Automatic pump units	

The works are divided into three categories, namely replacement; improvement; and reinforcement as shown in the table. As a result of these works, the existing water supply systems as shown in Figure II.1.1 will be changed to those as described below:

- Eight WTPs will be reduced to three;
- 134 booster PSs will be reduced to about a half;
- Twenty-two of the pressure/flow regulation facilities for distribution pipelines will be installed in the distribution network;
- 420 km of deteriorated pipes will be replaced; and
- 16.8 km of reinforcement pipes will be installed.

3) Operation and Maintenance

The water supply facilities will be improved by 2015 as mentioned in the previous sections, and together with this will be the improvement in operation and maintenance, as follows:

i) Reduction of number of operation staff and O&M costs

The number of O&M staff will be reduced in line with the reduction of the number of existing facilities, and the planned improvement of the system. Manpower will also be reduced for the WTPs which will continue to be operated because of automation. For example, the rapid filters will be automatically washed at Kadirya and Boz-su WTPs, while the well pumps at Kibray WTP will also be automatically operated. Because of the automatic operation for many PSs, there will be fewer or even no need for shift operators, reducing the number of employees, who conduct monitoring work in Vodokanal.

The electricity consumption per cubic meter of Kibray WTP will be reduced (from 0.42 to 0.20 kWh/m^3), as a result of the increase in intake pump efficiency and the use of gravity flow for water distribution. The consumption of electricity of booster PSs will also decrease as these are improved.

Tables II.3.9, II.3.10 and II.3.11 show the proposed number of operation staff, power (electricity) consumption, and chemical consumption compared to that in 2002.

Table II.3.9 Staff Assignment for the Proposed Water Supply System

Category		Division	Shift Operator	Operation	Machine/Electric/Repair	Laboratory	Total	Changed Point
WTPs to be operated continuously		Present	199	192	90	32	513	Introduction of Auto-operation
		Proposed	130	150	86	35	401	
Abandoned WTPs		Present	226	85	53	24	388	Abandonment of plants
		Proposed	0	0	0	0	0	
Booster PSs	Existing	Present	585	173	36	0	794	Introduction of Automatic/ monitoring function
	Proposed PS	PSs	56	44	20	0	120	
		Patrol	40	60	10	0	110	
		Total	96	104	30	0	230	
Present Total		Engineer	41	127	14	20	202	Mainly by abandonment of facilities, automatic operation, and monitoring
		Worker	969	323	165	36	1,493	
		Total	1,010	450	179	56	1,695	
Proposed Total		Engineer	40	100	40	20	200	
		Worker	186	154	76	15	431	
		Total	226	254	116	35	631	
Reduction Number		Total	784	196	63	21	1,064	

Table II.3.10 Power Consumption and Costs

Category	Name	Unit consumption		Water*1 production		Consumption		Cost*2	
		kWh/m^3		1,000m^3/d		GWh/y		1,000USD/y	
		2002	2015	2002	2015	2002	2015	2002	2015
WTPs to be operated continuously	Kadirya	0.105	0.110	2,100.0	1,224	80.3	49.1	2,409	1,475
	Kibray	0.423	0.200	353.5	312	54.6	22.8	1,638	683
	Boz-su	0.276	0.296	249.9	89	25.2	9.6	756	287
	Sub-total	0.162	0.138	2,703.4	1,625	160.1	82.0	4,803	2,445
Booster PSs	Existing	-	-	-	-	88.8	-	-	-
	Dis. in WTPs	-	-	-	-	11.0	-	-	-
	Sub-total	-	-	0	0	99.8	20.0	2,994	599
Others		0.205	0	196.6	0	14.7	0	441	0
Total		0.259	0.171	2,900	1,625	274.6	101.5	8,238	3,044

Note: *1: Amount of treated water being distributed by each WTP, as shown by the ratio of capacity.
*2: Unit electricity price is at 8 soum/kWh in 2002, and this went up to 30 soum/kWh in December 2004.This price is used to come up with accurate calculations.

ii) Improvement of Operation and Maintenance

Operators at Kadirya and Kibray WTPs will be able to cope with the flow fluctuations by the introduction of automatic control system for pumps and the expansion of the service reservoirs.

Table II.3.11 Chemicals Consumption and Cost

WTP Name	Chemical	Unit Consumption		Water Production		Consumption		Cost	
		mg/L		1,000m^3/d		t/year	t/year	1,000USD/y	
		2002	2015	2002	2015	2002	2015	2002	2015
Kadirya	Coagulant	2.0	10.0*	2,100	1,224	1,533.0	4,467.6	165.3	481.6
	Liquid Chlorine	0.7	0.7			523.3	312.7	83.7	50.0
Kibray	Liquid Chlorine	0.4	0.4	353	312	46.9	45.6	7.5	7.3
Boz-su	Coagulant	11.5	11.0	250	89	1,048.7	357.3	113.0	38.5
	Liquid Chlorine	0.8	0.8			73.6	26.0	11.8	4.2
Others	Liquid Chlorine	0.3	-	197	-	18.8	-	3.0	0
	Hypochlorite	0.1	-		-	9.7	-	9.7	0
Total	-	-	-	2,900	1,625	-	-	394.0	581.6

* Coagulant injection ratio at Kadirya WTP will be increased in target year

Since the flow rate, pressure, and the water level of reservoirs can be monitored at the Vodokanal's head office and in each WTP, operators can access the precise and timely information. The monitoring system will enable operators to better cope with abnormal incidents and operate with precise flow rate and pressure. Thus a marked improvement of water service standards for consumers is expected.

Training programs for O&M staff will be organized and conducted, while operations manuals will be prepared. The training programs and manuals will be based on and will conform to the improvements that were introduced for the water supply systems' facilities.

(5) Future Plans for Surrounding Areas (see S.5.4.7 in Volume 3 Supporting Report)

As part of the city's expansion, Vodokanal has been requested to extend its water supply to the surrounding areas as planned by Tashkent city *Hokimiyat*. Accordingly, the Study Team was asked to assist in drafting these plans. However, the plans for surrounding areas were not included into the original scope of this study. In addition, the city plans and the

areas were not clear. Thus, the study was limited to examining the outlines, and mainly the calculation of the necessary quantity of water supply.

(6) Management Organization for the Implementation of the LTDP

In order to implement the LTDP, the following management organization is required:

1) Establishment of a Unit for the Promotion of the LTDP

In order to implement the contents of the LTDP, it will be necessary to constantly evaluate its progress. If any problems arise, proper actions must be taken and these should be reflected in the subsequent parts of the LTDP. Therefore, a department that will carry out such function, namely the Unit for the Promotion of the LTDP, will be established under the General Director of Vodokanal.

2) Actions to be taken for the restructuring of WTPs and PSs (From 2007 to 2014)

i) Relocation plan for the excess staff as a result of the restructuring of WTPs and PSs.

With the restructuring of the WTPs and PSs, it is estimated that the services of around 1,060 employees working at WTPs and PSs may no longer be required. Although this will lessen payroll costs, it will represent a serious problem for those who will be reduced. Therefore, Vodokanal should prepare any of the following – a relocation plan, or retirement plan, and/or a benefit plan for those who will be affected. Table II.3.12 shows the proposed relocation plan for the redundant employees. Based on the table, the relocation of those employees will be possible due to adjustments caused by attrition. They will be relocated to construction projects implemented under the LTDP, to meter reading and maintenance positions, as well as to departments that will be newly established.

Table II.3.12 Employee Relocation Plan for Redundant Employees

No	Items	Reasons of decrease/increase	2003	~2005	~2010	~2015	Total
1	Number of excess employees due to restructuring of facilities	Restructuring of facilities			-850	-210	**-1,060**
2	Attrition	Retirement			200	200	**400**
3	Number of employees required for the implementation of the LTDP	Pipe replacement			40		**40**
4	Number of employees required for the transition to a metered system	Meter reading and maintenance		100	400		**500**
5	Number of employees that will be transferred	Transfer to newly established affiliated companies				120	**120**
	Total	1-5		100	-210	110	**0**

Note: Besides the employment opportunities indicated in the table, it is estimated that new employment opportunity will be created from the transition to the Metered System. For example, personnel for repairing indoor water leakages will be required.

In any case, urging current employees to acquire new skills and increasing their awareness of relocation is a necessity. Vodokanal should take the following actions:

- Revise retirement policies and regulations, and apply them as formulated.
- Implement training programs for the acquisition of new technical knowledge and skills that are necessary for relocation, and
- Provide counseling services to employees who will be relocated.

ii) Plan for the reutilization of WTPs and PSs

As facilities are abandoned, handling of such facilities will become an issue. Needless to say that finding ways for their most effective use would be the ideal scenario; however, the disposal of Vodokanal's assets can only be made with the government's approval. Therefore, an easy sell-off of these facilities to developers is not an option, even if such measures have a potential to contribute to the development of the country's economy. The following options for the utilization of these facilities can be expected, assuming that the government approves of their disposal:

- Sell-off to a private sector developer or a company (including costs for ground leveling); and
- Utilization by the government (construction of public facilities).

II.3.5 Improvement of the Financial Situation

A program to improve the financial situation of Vodokanal will be formulated. This improvement program will enable Vodokanal to achieve a stable financial status, allowing it to procure and repay the investment funds required for the LTDP, without putting too much burden on the domestic consumer's shoulders. In this regard, as the LTDP sets the year 2015 as the target year for the minimum necessary improvements of facilities, the plans must be revised periodically as external factors change.

(1) Measures to Acquire Funds

To implement the LTDP, a considerable amount of investment funds will be necessary. While there are many sources of funds, it is most likely that funds will be procured from a combination of the following options.

1) Self-financing through Vodokanal's management efforts

Self-financing will rely on self-support efforts raise funds through cost-cutting measures and improvement of tariff collection. However, the amount that could be obtained from these efforts is limited.

2) Borrowing from outside

Borrowing from international aid agencies/international financial institutions can be considered. However, due to the high country risk, a precondition to this type of borrowing requires securing the transparency of Vodokanal's financial status or getting a guarantee from the government.

3) Subsidy from the Government

The ideal water supply management is one that would be able to cover all expenses with the income from tariff collection. However, there are only few cases in the world where the ideal situation is attained, for in most cases, the government provides the investment funds for big projects. For Vodokanal, it seems unlikely that government

subsidies will be forthcoming in the future.

4) Privatization

Vodokanal's privatization policy has already been announced by the government. There are many other privatization methods other than the government's proposal, thus it does seem that privatization provides a better window of opportunity in acquiring needed funds. However, it is obscure that the government assumes what kinds of investors are appropriate for privatization.

5) Grant aid from international cooperation agencies

Grant aid from international cooperation agencies can be one of the options. However, several political issues in the country are decreasing the possibility of grant aid from international cooperation agencies, and even if grant aid is permitted, the amount would also be very limited.

(2) Formulation of a Fund Procurement Plan

As mentioned above, there are various options to procure financial resources for the LTDP. However, the main goal of this project is to achieve a self-financed management, which is scheme supported by the government. Therefore, the LTDP should be initially planned without any government support, hence the role of the government will be considered in the last phase of the plan. Furthermore, sufficient care has been taken so that, if tariffs have to be increased, this would be done according to the affordability level of domestic consumers.

1) Financial improvements through self-support efforts

The following financial resources may be attained by the year 2015 by improving Vodokanal's financial status as shown below:

i) NRW Reduction Program

Reduction of NRW will result in the reduction of operating costs. The NRW

Reduction Program is composed of the promotion and completion of water meter installation, the well-planned replacement of pipelines and the strengthening of management. While it is necessary to prepare a significant investment amount for the replacement of pipelines, the others can be done without such large investments.

ii) Collection of bad debts

The largest bad debts are those from Tashteplocentral and TAPOiCh Aircraft Production Company. Because these are state-owned companies, this issue cannot be solved by Vodokanal alone. A strong government commitment is required to introduce organizational reforms for these companies. Once this is solved, the collection of these debts could be considered as potential funding resources.

The total expected financial resources, which are available until the year 2015 through improvements in Vodokanal's management, are summarized as below. Through meter installation, water demand will be less than the norm amount, which will correspondingly reduce income. However, the analysis has been carried out under the assumption that income can be secured by increasing tariff rates.

Through a self-financed management, about 5 million USD in funds can be expected (see Table II.3.13). Reduction of NRW requires organizational restructuring. For instance, one option suggests providing incentives for finding illegal connections such as a result-oriented based allowance for the officers in Vodokanal. Another option suggests concluding a management contract with an outside consultant on a result-oriented basis, so that the fees paid to consultants are directly linked to the achievement of the NRW reduction targets. Such methods could yield higher results.

Table II.3.13 Expected Cost Saving Sources (2005-2015)

No.	Item	Finance resources to be created until the year 2015
a)	NRW Reduction Program -Promotion of meters installation	USD 1,682,000
b)	NRW Reduction Program -Strengthening the management	USD 3,411,000
Total		USD 5,093,000

Note: Estimation does not include rate of inflation

2) Additional funds to be procured

The required funds for the LTDP amounts to approximately 158 million USD. The amount of funding through Vodokanal's management efforts is equivalent to only 3% of this amount. Therefore, the remaining 153 million USD must be procured separately.

3) Consideration of the tariff increase rate

According to the simple assumption that 153 million USD has to be recovered in 30 years, approximately 5 million USD per year would be needed. Since the current annual revenue from tariff collection (excluding revenue from sewage services) is approximately 15 million USD, then the actual minimum water tariff level has to be increased 1.3 times in real terms.

4) Consideration of the validity of the tariff increase rate

As mentioned in Section II.2.2, it seems to be rather difficult to raise tariffs at present, because the service expenses, including communal services, are already a burden for the domestic consumers. However, if we assume that the domestic consumers' income will increase as the country's economy grows, a tariff increase equivalent to the expected real GDP growth rate would be permitted. Uzbekistan's real economic growth rate for the past several years has been 4%, hence the real GDP growth rate would be estimated at 4%. Subsequently, tariff increase rate will be set at 3%, which is relatively lower than the expected real GDP growth rate.

5) Consideration of a proper funding plan

A simulation was carried out in order to obtain a tariff level which would not face fund shortages in the future. Repayment schedules are established changing the borrowing conditions of the investment funds. The results are summarized in Table II.3.14, which assumes the period of tariff increases with the annual tariff increase rates of 3% per year from the year 2006. As the result of this simulation, if funds need to be borrowed at interest rates of 1.3% or 5% per year, it is estimated that tariff increases until the year

of 2017 or 2025, respectively, and cumulative tariff increases of 1.4 or 1.8 folds, respectively in comparison with the current level would be needed. A 1.8 fold increase in tariffs is indeed big, but the tariff increase rate is less than 4% per year. However, in the case of a 10% interest rate, the tariff increase rates which can avoid cash shortages are shown in Table II.3.15.

Table II.3.14 The Relation between Interest Rates and the Period of Tariff Increases

Interest Rates	The Period of Tariff Increases	Annual Tariff Increase Rates	Cumulative Tariff Increases
1.3 %	2006-2017	3.0% per year	1.4 folds
5.0%	2006-2025	3.0% per year	1.8 folds
10.0%	Unable to repay with the annual tariff increase rate of 3.0% per year		

Table II.3.15 Tariff Increase Simulation for 10% Interest Rate

Interest Rate	Annual Tariff Increase				Results
	2006 - 2010	2011 – 2020	2021 – 2022	2023 - 2040	
10.0%	5.0%	5.0%	3.0% Cumulative increase: 2.2 folds	0%	Cash surplus of USD 77 million by 2040

As shown in Table II.3.15, in the case of a 10% interest rate, the maximum required annual tariff increase rate will be 5%. Therefore, if Vodokanal can borrow funds from outside at a 1.3 - 5% interest rate, tariffs can be set at a reasonable level as mentioned before. In case of a 10% interest rate, tariffs will have to be increased at a rate of 5% from the beginning, and ultimately reach a level which would be 2.2 times the current tariff. Although Tables II.3.14 and II.3.15 assume that all funds are borrowed from outside, if governmental subsidies are available, these tariffs increase rates can be lowered as presented in Table II.3.16.

Table II.3.16 Cash Shortages under the Slow Tariff Increase Scenario

Interest Rate	Annual Tariff increase				Results
	2006 - 2010	2011 - 2015	2016 - 2025	2026 - 2029	
10.0%	3.0%	3.0%	3.0%	3% by 2029 Cumulative increase 2.0 folds	Cash surplus of USD 40 million by 2040
Cash shortage for the period (Cumulative)	0	USD 9 million (USD 9 million)	USD 55 million (USD 65 million)	USD 30 million (USD 95 million)	-

(3) Results

As it can be seen from Table II.3.14, if Vodokanal borrows with the interest rate of 1.3% to 5%, it can procure funds for investments without relying on any subsidy from the government and without putting excessive burden on the domestic consumers. However, it is not certain that Vodokanal can borrow funds under such favorable terms. If borrowing terms are worse, as shown in Table II.3.15, loan repayment requirements could increase the burden on domestic consumers. In order to prevent such situation, it is necessary to consider methods that lessen the burden on domestic consumers such as subsidies from the government.

On the other hand, if Vodokanal borrows funds from international financial institutions or foreign governments, it will be necessary to take into consideration how much Uzbekistan will bear using internal funds, because international financial institutions do not finance the full amount of projects and oblige the borrower to carry a certain share (co-finance) of the investment amount within the country. With regard to loan repayment requirements, they are generally used for public engineering works and machinery installation costs in the above-mentioned EBRD projects. Thus, in this case, Vodokanal will be required to directly provide labor costs or the government will be required to prepare the necessary budgets.

II.3.6 Improvement Plan for the Tariff System

In order to achieve a self-financed system, reform of the tariff system is inevitable. Above all, an early transition to the metered tariff system is necessary, thus the promotion and eventual completion of meter installation should be carried out as referred to in Section II.3.3.(1). The future tariff levels in relation to the repayment were examined in Section II.3.5. Even though the increase of tariff is relatively low at 3.0% per year, it will be much higher than the current level, thus the domestic consumers must be consulted to get their understanding and support of the plan. It is very important for Vodokanal to first set a plan for tariff, and then set an appropriate financial plan. There are two considerations in the implementation of a new tariff plan: (1) items to be reformed independent of the transition to the metered system and (2) items to be taken into account in the transition to the metered system. Since the

implementation of the metered system will be completed by 2009, the introduction of the new tariff system referred in (2) 1), will be employed after the year of 2007, after metering would have gained ground. Option (1), however, can be introduced immediately.

(1) Items to be Reformed Independent from the Transition to the Metered System

1) Reforms for the methods of tariff revision

As mentioned in Section II.1.3, until now, tariff revisions have been conducted in order to recover the costs reported in the income statements. It has also been pointed out that the reporting of the costs themselves was insufficient. However, such costs-based method can be adopted in the long-term plan. Thus in the short- and medium-term plans, tariff revisions must be based on the expected amount of cash flow. A short- and medium-term tariff revision will be needed after formulating a proper funding plan as mentioned in Section II.3.5. If tariffs are not revised according to this process, problems caused by short-term fund shortages, such as delayed wage payments, will never be resolved.

2) Reform of the tariff collection systems

i) IT utilization for tariff billing and collection systems

Improvement of the existing billing and tariff collection systems is a priority task for Vodokanal and its newly established subsidiary. One of the reform methods is digitalization of the tariff collection system. However, it is not easy to introduce the digitalized system from a financial point of view. Therefore, we will propose a method which can utilize existing computers to enhance efficiency.

The digitalization of information on tariff collection at banks and post offices is one of the examples for utilizing existing computers. In spite of the existence of digitalized data at banks and post offices, data are provided to Vodokanal on paper, so Vodokanal is currently inputting data into its computer system. Thus, sharing the same data between Vodokanal and the banks, as well as post offices, can surely enhance efficiency. In such case, it is necessary for Vodokanal to sign a contract with the banks and post offices. There are some possibilities to increase efficiency without additional investment, such as

purchasing equipment, to augment existing computers that do not work efficiently in terms of this plan. These additional computers need to be purchased after evaluating such investment effects.

This project should aim to introduce an automatic debit transfer system so funds could be transferred from consumers' personal bank account to Vodokanal in the future. However, the use of bank accounts is still not common in Uzbekistan, making the introduction of an automatic debit transfer system seems to be difficult.

ii) Prevention of corruption in tariff collection

Tariff collection is carried out either through the user paying at banks or direct tariff collection by inspectors (meter readers). Water meter readers' tariff collection often involves potential corrupt practices as addressed in Section II.2.2 (3). In order to avoid such potential problem, strengthening the internal organizational structure will have to be addressed. Periodic rotation of water meter readers can be instituted, as well as having other water meter readers double check the other readers' work. Imposing heavy penalties could be effective at preventing future corruption.

(2) Items to be taken into Account in the Transition to a Metered System

1) Introducing the new tariff system

When meter installation in apartments progresses, water charges will decrease because of the reduction in the billed water volume from 330 Lpcd under the Norm System, to an average of 150 Lpcd of metered volume. There will still be a probability that some wealthy people will still waste water in spite of introducing the metered tariff system. Therefore, the introduction of i) a two-tier tariff system and ii) a progressive tariff system can be considered, but this will need a revision of the law on the tariff system.

i) Transition to the "two-tier tariff system"

A two-tier tariff system is a system in which the fixed costs, that is, personnel cost, depreciation cost, capital repair, etc. (which, when based on data from 2002, are estimated

to be about 10 billion soum) are charged through the basic rate, while the variable costs, that is, electricity, chemicals etc. are charged according to the metered amount. The two-tier tariff system enables Vodokanal to collect the tariffs according to actual cost structures. For instance, under the metered system, if the consumption of water is zero, the tariff will be zero and thus it will not be able to collect the fixed costs. The two-tier system, however, prevents uncollected fixed costs.

Although Vodokanal is aware of the benefits of the two-tier tariff system, it is not about to introduce it because the basic rate might be recognized as a norm, and domestic consumers who intend to use the new metered system will strongly object to it. It is therefore necessary for Vodokanal to win the consumers' understanding and then propose such a tariff system to the government supported by a thorough explanation of the reasons behind this system.

ii) Progressive tariff system

Under the metered tariff system, water is charged by using a constant rate according to the volume of water consumed. It is clear that such system does create awareness in saving water among domestic consumers. To further enhance this awareness, it is better to introduce a system in which the tariff rate increases progressively after water consumption goes beyond a certain volume.

Table II.3.17 indicates an example of a new tariff system consisting of two-tier and progressive tariff systems for individual consumers on the 1st July 2003. The new tariff system will be introduced after 2007 to support the transition to the metered system. Therefore, rates of tariffs collected under a basic tariff system or a progressive system will be decided by that time.

Table II.3.17 Example of a Tariff Table under a New Tariff System

Basic tariff (soum/month)	Tariffs under the Metered System (soum/ m^3)					
	0-10m^3	11-20 m^3	21-30 m^3	31-40 m^3	41-50 m^3	51 m^3 and over
250	0	28	31	38	44	50

Note: Fractions will be rounded off the closest to figure

2) Repairing indoor-water fixtures and development of spare parts

Some of the main reasons for water wastage under the Norm Tariff System are leakages from the water taps and flush toilet valves. For the fixtures, high quality spare parts are currently not available in the country. Thus, Vodokanal (or TKEO) will have to subcontract a company to develop those spare parts and distribute the use of such parts to ensure reliable fixtures.

3) Integrating the billing and payment collection with those of other public services

With the transition to the metered system, the number of water meter readers will increase, which will result to increased costs for Vodokanal. It would be necessary to look for new avenues where costs can be further reduced. For instance, services such as meter reading, billing and payment collection can be spun off into a separate company and be integrated with the billing and payment collection of other public services such as electricity and gas. By introducing such measures, an increase in the number of meter readers can be prevented. According to TKEO, there is a current plan to establish an inspection division within or outside the government. However, with this reform, feedback from consumers might not be able to reach Vodokanal, which could decrease the quality of services to consumers. Therefore, it is important to expand the Customer's Service and Public Relations (PR) divisions.

II.3.7 Improvements in Management and Organization

As mentioned in Section II.2.3, the top management has to correctly understand the problems, set the necessary targets for solving those problems and make improvements as necessary, and formulate the strategies that are required to attain such targets. The LTDP will bring about such a process. The content is explained in the following section, which is divided into (1) Strengthening of management, (2) Reform of personnel management and (3) Organization reform.

(1) Strengthening of Management

1) Strengthening management under the LTDP

Vodokanal managers must examine and correctly understand the content of the LTDP. The top management of Vodokanal must be knowledgeable of the LTDP. This awareness is a critical component to being able to disseminate accurate information to related governmental institutions and gain their support to and eventual accomplishment of the targets set in the LTDP. It will also mean having all key institutions support necessary legal reforms. The top management and managers must be able to explain the contents of the LTDP to all its employees because their understanding of the vision for Vodokanal will mean gaining their cooperation at implementing planned and necessary changes.

2) Management based on the PDCA Cycle

In order to secure a self-sustainable management, it is necessary to standardize the management process and implement such processes as routine. However, as can be seen with the delay of the meters installation plan, Vodokanal's management have failed to evaluate their business plans for certain targets and devise measures to deal with such problems. Therefore, in order to achieve efficient management, employing the PDCA (Plan, Do, Check, and Act) Cycle method is highly recommended. When individual workers understand and employ such cycle in the future, potential problems, which were previously unknown, will be identified and early measures could be formulated to deal with the problems. Thus, such cycle will facilitate and strengthen the management organization.

Plan

Planning means: (i) set a target; (ii) correctly appraise the current status or situation; (iii) identify and correctly separate the factors that could become obstacles for the achievement of a goal; (iv) formulate (and plan) countermeasures to the existing problems.

Do

Proper resources (human, materials, money and information) should be allocated according

to the formulated plan.

Check

Compare and evaluate progress against set plans. Identify problems by checking whether it is necessary to take actions other than those planned and analyze those problems.

Act

Based on the results of the "Check" step, decisions on whether to revise previous plans or to maintain them should be made. Move to the next process once it has been judged appropriate to proceed with the plan.

3) Reforming the organization's environment

As shown in Section II.2.3, the "top-down" decision making process should be changed and the organization's environment needs to be improved. In order to reform the organization's environment, changes in Vodokanal employees' and management's attitude in regard to the following points are necessary. Most of these points are correlated with other reform plans.

① Carryout everyday tasks while putting oneself in the customer's place
② Fully recognize water supply services as public utility services
③ Fully evaluate the capacity and personal characters of employees
④ Prize information sharing within the company and within each organization
⑤ Work as a team towards common goals

With regard to the above, the following measures can be undertaken. ① In order to put oneself in the customer's place, a Customer's Service division, as well as a PR division as shown in Figure II.4.3 will be established. ② To fully recognize water supply services as public utility services, uniforms could be introduced in order to increase employees' sense of belonging to the organization. ③ To fully evaluate the capacity and personal characters of employees, reforms on personnel management, introduction of a suggestions system and improvements in employees' education can be implemented. ④ To increase information sharing, the way that periodical meetings are held should be improved as well as ensuring a

thorough dissemination of information. Finally, in order to ⑤ work as a team towards common goals, as mentioned in 1) above, it is necessary that the top management of Vodokanal inform all employees on the goals of the LTDP so that Vodokanal can work together as one.

(2) Reforming Personnel Management

1) Introduction of performance-based evaluation system

In order to motivate employees and revitalize the whole organization, a performance-based wage system can be introduced. The current wage structure is basically low in relation to the cost of living. However, wages cannot be increased because of budget limitations. Thus, a performance-based evaluation system, which can provide special allowances to individual employees, maybe introduced. For instance, NRW reduction is important for Vodokanal, which when undertaken can provide additional funds, a part of which can be utilized to finance the proposed employee performance-based incentive pay. However, any performance-based system should be carefully introduced, because it might stir feelings of unfairness among the employees. It would be necessary to introduce a fair and clear evaluation system, based on quantities standards, such as the rate of reduction of NRW. In the long term, current seniority-based evaluation system should be replaced with a performance-based system.

2) Employee training

Employee training should not only be limited to technical training but should also include training aimed at strengthening information collection, analysis and utilization of management and finance. Training will be outsourced to external consultants or supported by training programs offered by aid agencies (e.g. JICA, Uzbekistan Japan Center). Recognizing the importance of on-going training and education, formation of trainers within Vodokanal will also be an important part of these programs. External consultants will basically be paid in proportion to their output. To determine the target indicators, the result of training must be organizational sustainability, and one of the best methods is to employ On-the-Job Training (OJT) at Vodokanal. The contents of the programs are in response to

Vodokanal's requests, as shown below.

i) Technical training:

The current technology was introduced during the 1970s Soviet era. Therefore, proposed training will mainly focus on acquisition of water supply technology, thereby getting basic knowledge of existing system and proposed system in LTDP and these O&M.

ii) Management training:

It is necessary for Vodokanal to acquire finance and accounting knowledge and skills in order to formulate long-term financial planning, as proposed in the LTDP, including managerial accounting, needed to make the right investment decisions and enhance the efficiency of management. The training methodology could be through seminar-workshops and use of case studies, such as customer services in Japan. These methods would expose the employees to real organizational situations and can help change the working attitude of the employees in Vodokanal.

(3) Organizational Reform

1) Strength of private sector participation

Although Vodokanal's privatization has already been approved by the government, its exact schedule has not been decided yet as mentioned in Section II.1.3 (8). Under the privatization stipulated by the government, *Hokimiyat's* participation in Vodokanal will decrease from 100% to 51% while the remaining will be owned either by the private sector or the employees. On the other hand, even if such privatization does not take place, other alternative forms to introduce private sector participation into water supply operations can be considered. Under Vodokanal's current conditions, service contract and management contract are two alternative methods to bring in the participation of the private sector.

Since Vodokanal is already considering to spin-off several departments into separate companies, judging from past performance, these newly formed companies could be the candidates for outsourcing. However, competitive bidding systems must have to be put in

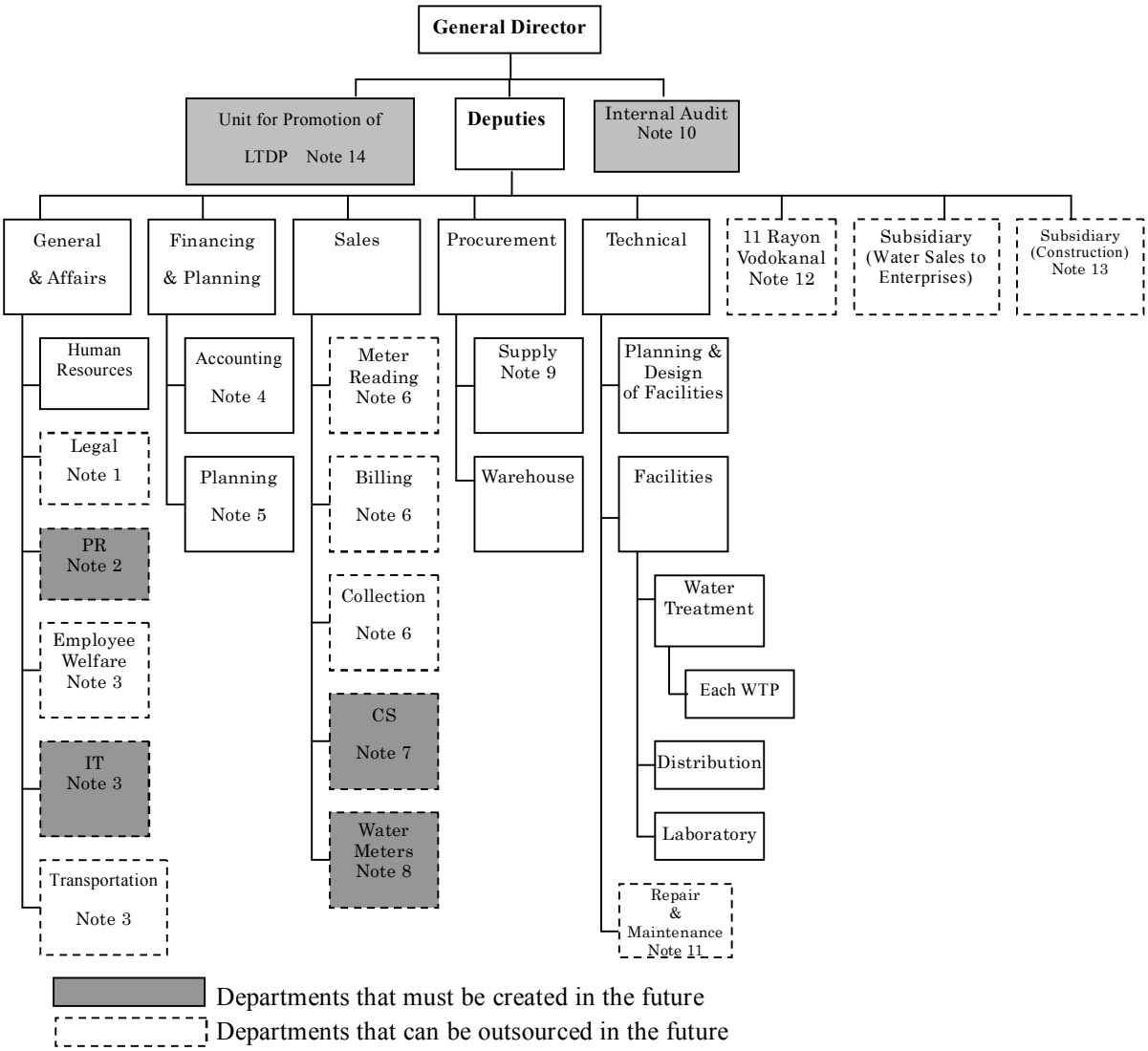
place when selecting outsource partners. However, if outsource partners are fixed due to no appropriate competitors, Vodokanal will be required to administrate them effectively and not to maintain inappropriate high level of outsourcing costs, by reforming their management , such as reducing costs without decreasing the quality of their services and setting their targets.

2) Organizational reform

The organizational reform plan is indicated in Figure II.3.4. The policies of this plan are as follows.

i) The active promotion of private sector participation through outsourcing making management more effective. Divisions within Vodokanal will be spun-off, becoming potential companies for outsourcing. Meter reading and issuance and collection of bills can be done jointly with other public services such as electricity and gas. This way, outsourcing costs can be kept down.
ii) Based on their importance in the future, some new divisions, such as a Unit for the Promotion of the LTDP, Information Technology and Public Relations (PR) divisions were created.
iii) Under the current organization, there are communication barriers between divisions so it can hardly be said that information is shared. Thus, divisions that are functionally related were merged and administration responsibilities were clarified. In order to control management information and secure its reliability, the establishment of Internal Audit division was proposed for strengthening internal control in the organization.

The Unit for the Promotion of the LTDP is expected to play the core role in the implementation of LTDP. The role of the Unit involves not only promoting renewal and rehabilitation of facilities, which is referred in Section II.3.4 (6), but also promoting management and organizational reform as a whole. Therefore, it is important to allocate staff with not only technical knowledge, but also management and organizational restructuring knowledge, including water tariff systems, into the Unit. Especially, it is expected to play a triggering role in reforming the management and the organization's structure and culture.



Note1: Privatization issues will be managed here, among other tasks. The division could be spun off or outsourced in the future.
Note2: The PR division will cover not only water saving promotion but also discloses the operating and financial status of Vodokanal. Similarly, this division will manage outgoing information from Vodokanal to users. Most functions of this division could be spun off or outsourced in the future.
Note3: The functions of Employee Welfare and Transportation should be outsourced in the near future. An IT division should be established; however, most of its functions could be spun off or outsourced in the future.
Note4: The Accounting division will temporarily include a treasury function. If the significance of the treasury function increases, it should be separated as a Treasury division from the Accounting division.
Note5: The Planning division will also include a function of forecasting.
Note6: These divisions should be spun off or outsourced in consideration of the financial performance of each category (domestic customers, communal service).
Note7: The Customer Service (CS) division will receive all complains from users regarding water supply services. Thus, it will manage incoming information from users to Vodokanal. This division should also be spun off or outsourced.
Note8: Management for not only installation but also maintenance of water meters is a significant issue for Vodokanal. The Water Meters division will be responsible for these functions.
Note9: The Supply division will be necessary in the near future.
Note10: Current Internal Audit Division should be strengthened.
Note11: Repair & maintenance function should be spun off or outsourced in the near future.
Note12: Rayon Vodokanals will actually be spun off or outsourced.
Note13: The service area of this company should be expanded.
Note14: The Unit will be established in order to promote the implementation of LTDP.

Figure II.3.4 Proposed Organizational Chart of Vodokanal

Table II.3.18 and II.3.19 indicate potential changes of personnel due to the restructuring of facilities and organizational reforms, including personnel cuts, which are shown in Figure II.3.4. As a consequence, the total number of employees in Vodokanal will decrease by one-third, from 3,649 to 2,589 people, whereas, employees in the spun-off companies will increase from 1,046 to 1,706 people. By the year of 2015, total employees in water supply operations will reach 4,295 people (= 2,589 +1,706 people). The important point of this organizational reform is that personnel will be cut in departments that are overstaffed, and that new departments will require new employees. Looking at the change in the total number of employees for the water supply operations as a whole, headcount will decrease only by attrition. The facilities' staff will be significantly cut, but with the introduction of the metered system and the implementation of the projects, new hiring will become necessary. Therefore the total number of employees will not differ significantly.

Table II.3.18 Proposed Personnel Changes at Vodokanal

No.	Org.	Items	Reasons for Decrease/Increase	2003	~2005	~2010	~2015	Total
1	Vodokanal	Natural Attrition	Retirement			-200	-200	-400
2		New hiring	Inspection and maintenance		100	400		500
3		Transfer to subsidiaries	Implementing the facilities' LTDP			-80	-80	-160
4			Spin-off of sales departments			-400	-600	-1,000
Number of Vodokanal's employees at year-end			= Number of employees at previous year-end+1+2+3+4	3,649	3,749	3,469	2,589	-1060

Table II.3.19 Proposed Personnel Changes at Spun-off Companies

No.	Org.	Items	Reasons for Decrease/Increase	2003	~2005	~2010	~2015	Total
1	Subsidiary	Transferred from Vodokanal	Implementing the facilities' LTDP			80	80	160
2			Spin-off of sales departments			400	600	1000
3		Transfer to other bill collection operations	Conduct bill collection operations jointly with other public services such as gas and electricity				-500	-500
Number of subsidiary's employees year-end			= Number of employees at previous year-end+1+2+3	1,046	1,046	1,526	1,706	660

II.3.8 Information Development and Sharing

In order to improve management, accurate information must always be shared among the top management, heads of sections, and their staff, and be effectively utilized.

(1) Strengthening the Reliability of Management Information and Information Sharing

1) Developing management information

Vodokanal does not have essential information on water supply management, hence information lacks reliability. It is important to establish a comprehensive information network and also to determine which department should be responsible for such network.

In addition, a system through which the reliability and consistency of the data obtained can be verified by managers as well as by the Internal Audit Division should be established. It is necessary that the Internal Audit Division be established directly under the General Director. The following roles of the Internal Audit Division are expected as below:

- To collect and verify management information, such as the amount of water provided and sold, and to point out flaws if it is necessary;
- Investigating the causes for NRW and verifying the result of the analysis;
- To audit financial information and also to advise and make some improvements if evidences are not sufficient;
- To investigate the mutual inspective procedure in exchanging data between the departments and to propose improvements if it is necessary; and
- To investigate assets and the situation of stocks and to propose improvements if it is necessary.

2) Information Sharing

Information obtained at the work sites is generally very valuable for management and administration. However, a “top-down” decision-making process inherited from the previous regime is still strongly in place. In addition, even if information is transmitted from the work sites to the middle management, the information flow sometimes stops there. Thus, as an alternative measure to solve such problems, introducing a “bottom-up” decision-making process, which is referred in Section II.3.7 (1), would be effective. Therefore, internal periodic meetings, based on each problem (or theme) should be organized, with the result of the meetings shared among employees.

(2) Strengthening Reliability of the Financial Information

1) Improving Accounting Standards and other measures

Judging from the current financial statements of Vodokanal, it can hardly be said that depreciation expenses, allowance for rehabilitation and allowance for bad debt are reported correctly.

In order to secure future investment funds, it is necessary to estimate appropriate costs. To do so, the introduction of International Accounting Standards or other accounting standards that meet similar criteria is highly recommended in order to shift to a stable financial status. By introducing these standards, some costs, which are not currently accounted, will be recognized. However, it should be noted that a reform in Uzbekistan's legal system takes place.

2) Introduction of external auditing

External auditing shall be introduced to fulfill accountability. Since external auditing is conducted by a fair third party, the verification results are objective, and with this, Vodokanal can achieve accountability. However, external auditing is limited to the verification of financial information, and it is not conducted constantly as in the case of internal auditing.

(3) Utilization of Information Technology

IT cannot be ignored in the development and sharing of information. However, its utilization in Vodokanal is still very limited. Subsequently, installation of personal computers must be completed immediately, particularly that in each *Rayon* Vodokanal. Parallel to this, the work process should be reviewed, especially the data re-entry process which is supposed to be completed with the use of the new computers.

Moreover, data transfer from banks is currently manually done; hence it is necessary to conclude a new agreement on electronic data exchange as well as new service contracts with banks. After the completion of the above-mentioned IT utilization, the development of a LAN

network within Vodokanal's main office, and the development of networks between each *Rayon* Vodokanal should be considered. In order to conduct the above activities and promote the use of IT, a new IT Division must be established.

II.3.9 Promotion of Customer Participation

In order to reduce water wastage and NRW under the Norm Tariff System, public information brochures (experimentally prepared in this Study), as well as preparation of a short video to be broadcasted on TV are necessary. These activities will be promoted by the Public Relations (PR) division, which is expected to be established under "Organizational Reform". Due to the special requirements of such job, officers in the PR division should be recruited from the outside.

II.3.10 Overview of Issues and Improvement Plan

For an overview of various issues in this project, the above-mentioned issues and their improvement plans are summarized in Table II.3.20.

Table II.3.20 Issues and Improvement Plans

Objective	Current problems	Improvement Plan	Details	Desired actions from the government	Organizational Reform
Stable water supply	─ Frequency of accidents are high due to deteriorated facilities. Operation and maintenance costs are also high due to the inefficient structure of the system ─ Lack of funds for renewal of facilities	Renewal of deteriorated facilities and improvement of inefficient distribution systems	─ Implementing the renewal of deteriorated facilities and improvement of inefficient water distribution system ─ Implementation of the plan after verifying its appropriateness through technical and financial evaluations. (Progress will be monitored constantly throughout the PDCA Cycle ─ Formulation of a fund procurement plan for the implementation of the facilities investment plan		─ Establishment of a task force for the promotion of the facilities improvement plan
Financial independence	─ Large water leakages from deteriorated pipes ─ Lack of water saving awareness due to the delay in meter installation ─ Operation and maintenance costs for NRW, which are not necessary	Reduction of NRW	─ Renewal of pipes ─ Implementing the plan for the transition to a metered system ─ Implementing the NRW reduction plan（promotion of meter installation, renewal of distribution pipes, strengthen control of stolen water）		─ Establishment of a team to strengthen control of illegal connections
	─ Lack of a long-term financial plan ─ Insufficient short-term working capital ─ Due to government policies, no subsidies can be expected from now on	Improvement of financial status	─ Formulation of a long-term financial plan based on a tariff level that takes into consideration of domestic consumers' affordability and the amount of funds that need to be collected ─ Collection of accumulated bad debts from governmental agencies and reduction of NRW ─ Considering fund procurements from third parties	─ Joint effort with the government is required for solving the collection of accumulated bad debt ─ the government's guarantee is necessary for borrowing	
	─ On one hand, there is a need to reform tariff table in order to secure long-term investment funds, on the other hand, tariffs cannot be raised easily ─ Following problems might arise as the transition to a metered system progresses: 1） Improvement in the water reading method 2） Temporary decrease of income from bill collection due to water saving by consumers ─ Problems on bill collection: 1） Due to the lack of use of a bank account, automatic transfer is difficult 2） Bill collection process is mainly conducted manually	Improvement of tariff system	─ Early transition to a metered tariff system ─ The tariff table needs to be revised once cost reduction has been implemented and domestic consumer's affordability as well as required funds for the renewal of facilities has been fully taken into consideration ─ Outside meter installation ─ A tariff structure reform is necessary in response to the reduction of income from bill collection as the result of the transition to a metered system ─ Improvement of bill collection operations by collecting bills jointly with other public services ─ Implementation of bill collection based on IT	─ Governmental approval is necessary for the introduction of a new tariff table as well as a new tariff system	
Efficient management organization	─ Problems on the organization's environment such as: 1） Measures for deteriorated facilities and other issues that require periodical review are insufficient 2) An environment in which the voice from job-site is not reflected in management due to the top-to-bottom decision making process, 3） Insufficient employee training system	Improvement of management and organization	─ Management has to give a thorough explanation of the LTDP to the government ─ Review of transition to a more performance based wage system in order to give incentives to employees. ─ Invigoration of the organization and promotion of more efficient operations through participation of private sector and spin over of some departments ─ Introduction of employee training system by outsourcing to outside consultants and aid agencies	─ Governmental approval and support is necessary for the LTDP as well as the procurement of funds ─ Governmental approval is necessary for the introduction of a performance-based wage system	─ Spin off specific departments ─ Outsourcing of specific departments
	─ Necessary management information does not flow correctly due to delays in development and sharing of information	Development and sharing of information	─ Strengthening internal control (checking the consistency and credibility of data produced from different departments). It will cover the contents of all operational activities in Vodokanal, including non-financial activities. However, it should be noted that it will not be considered objective for the outside. ─ Introduction of International Accounting Standards and external auditing in order to strengthen the reliability of financial information and to secure transparency. External auditing will only cover financial information but will be considered objective for the outside. ─ Strengthen utilization of IT	─ Governmental approval is necessary for the introduction of International Accounting Standards and external auditing	─ Establishment of an Internal Audit Department directly under control of the general director in order to strengthen internal control ─ Establishment of an IT Department
	─ Insufficient public relations regarding water supply operation, as well as promotion of water saving awareness	Promotion of cooperation from domestic consumers	─ Preparing brochures and a short video on TV in order to promote water saving and reduction of NRW under the Norm system		─ Establishment of PR Division

II.3.11 Components of the LTDP with Respective Project Costs

(1) Physical Components

The physical components list of LTDP with their respective construction costs is shown in Table II.3.21. It is divided into two phases:

- Phase1 – the detailed design for the pipeline replacement can be executed in the short term because its contents were already decided by Vodokanal and a detailed data of the pipeline was already prepared. Therefore, the installation work can commence even before the improvement of the other facilities in the first two years. During this period, detailed design for the improvement of WTPs and the distribution system will be conducted, followed by the improvement of the distribution system, which will start directly by the completion of detailed design, and
- Phase2 – the rest of the pipe replacement and LTDP projects will be implemented by the target year.

(2) Operation and Maintenance Costs

O&M costs for the facilities are shown in Table II.3.22. They are based on the new electricity price with steep price increases in December 2004 in order to represent the future trend and chemical consumption costs in 2003. Repair costs are not included.

(3) Management Components

Table II.3.23 indicates estimated costs for the purchase of equipments, the installation of meters, establishment of effective IT environment, employee training, and introduction of external auditing under the management improvement plans in the LTDP.

Table II.3.21 List of Physical Components of the LTDP with Construction Costs

Name	Facility	Value	Cost (1,000USD)			Remarks
			Phase1		Phase2	
			2007-2008	2009-2011	2012-2014	
Kadriya WTP Replacement and Improvement	No.1 Intake PS Rep.	1	(9,331)			By EBRD Project
	No.2 Intake PS Rep.	1	(9,961)			
	Sedimentation Imp.	1			1,400	
	Coagulant Facilities Imp.	1			1,446	
	Rapid sand filters Rep.	1	(1,198)			By EBRD Project
	Rapid sand filters Imp.		(1,226)			By EBRD Project
	Disinfection Facilities Rep.	1			535	
	Reservoir V=45,000m^3	1			7,650	
	Reinforcement V=45,000m^3	1			6,900	
	Distribution PS Rep.	1			910	
	Power Receiver Rep.	1			3,714	
	Administration Building Rep./Imp.	1			420	
	Monitoring facilities Rep./Imp.	1	(160)		1,555	By Vodokanal budget
	Lab. Equipment Rep.	1	(200)			By EBRD Project
	Sub-total			0	24,530	
Kibray WTP Replacement and Improvement	Rep. of well pumps (63units)	1	(3,500)			By EBRD Project
	Pipe rearrangement	1		1,755	530	
	Disinfection Facilities	1			445	
	Power Receiver	1			2,516	
	Reservoir V=20,000m^3	1			2,400	
	Distribution PS (1000m^3/hr)	1		269		
	Monitoring facilities	1	(50)		340	By Vodokanal budget
	Sub-total	1		2,024	6,231	
Pipeline Replacement	D1200-100mm	120km	12,989			Upper area
	D1200-100mm	120km		12,989		Middle area
	D1200-100mm	180km			19,484	Low area
	Sub-total	420km	12,989	12,989	19,484	Total 45,462
Booster PS Improvement	Mirzo-Ulugbek	1		1,440		
	Other PSs	1		7,958	2,241	
	Sub-total			9,398	2,241	
Pipeline Network Improvement	Reinforcement of Pipes	16.8km		10,554		
	Pressure Regulation Valves	22units		2,090		
	Monitoring facilities	1		427		
	Sub-total			13,071	0	
A) Total direct cost			12,989	37,482	52,486	Total 102,957
B) Total imported material cost			6,431	24,459	23,447	
1) Land acquisition Cost		---	0	0	0	
2) Administration cost		1	260	750	1,050	A) x 2%
3) Engineering Services		1	1,039	2,999	4,199	A) x 8%
4) Physical Contingency		1	1,195	3,448	4,829	A)-3) x 10%
5) Price Contingency (Phase1-1)		1	719			A)-4) x6.1%(2%- 3years)
5) Price Contingency (Phase2-1)				3,540		A)-4) x10.4%(2%- 5years)
5) Price Contingency (Phase2)					7,101	A)-4) x14.9%(2%- 7years)
6) Import Tax		1	514	1,957	1,876	B) x 8%
7) VAT		1	2,495	7,105	10,122	A)-6) x 20%
C) Total indirect cost			6,222	19,799	29,1767	
Grand Total A)+C)			76,492		81,663	
Grand Total A)+C), Phase 1 -Phase 2			158,155			

Note: Figures in ( ) do not include costs.
Rep: Replacement, Imp.: Improvement

Table II.3.22 Operation and Maintenance Costs for Facilities

Items	Consumption			Cost 1,000 USD/year		Unit Price
	2002	2015	Unit	2002	2015	
Electricity	274.6	101.5	GWh/year	8,238.0	3,045.0	30 USD/1000kWh
Coagulant	2,582.0	4,825.0	t/year	278.3	520.1	107.8 USD/t
Chlorine	672.5	384.3	t/year	115.7	61.5	160 USD/t
Sub-total				8,632.0	3,626.6	
(Operators)	1,695	631	Person	1,017.0	378.6	600USD/person/y
Total				9,649	4,005	
Ratio				1.00	0.42	

Note: Coagulant dosing ratio by the target year will be increased to improve the quality of distributed water

Table II.3.23 Management Components of the LTDP with Respective Costs

No	Items	1,000 USD	Remark
	Staged actions should be taken		
(1)	**Immediate Actions**		
1	Promoting the installation of water meters	17,275	*1
2	Strengthening the management	-	
3	Improving employee training (Part 1)	-	
4	Organizational reform	-	
5	Improving personnel evaluation	-	
6	Developing an IT infrastructure (Part 1)	1,000	
7	Strengthening public relations (Part 1)	-	
8	Development and diffusion of indoor repair appliances	-	
	Subtotal	**18,275**	
(2)	**Actions in parallel to installing meters**		
1	Mid-term assessment of the Program mentioned in (1)-1	-	
2	Reforms in the water tariff system and collection of water bills	-	
3	Developing an IT infrastructure (Part 2)	400	
4	Strengthening public relations (Part 2)	-	
5	Improving employee training (Part 2)	600	
6	Introducing International Accounting Standards	-	
7	Introducing external auditing	50	
	Subtotal	**1,050**	
(3)	**Actions in parallel to the abolishment of the facilities**		
1	Benefits to dismissed employees	-	
(4)	**Items after privatization**		
1	Strengthen the management after privatization	-	
2	Legal system reforms after privatization	-	
3	Consider the issuance of bonds	-	
4	Installation of outdoor water meters	-	
	Total	**19,325**	
		2,050	*2

*1: 2,740 mil soum x 5 years/1,000sum/0.8(contingency)+5 Man Months (hereinafter "MM") x USD 30,000 = USD 17,275,000.

*2: Excluding water meter installation cost

II.3.12 Implementation Schedule

The implementation schedule of the Projects is shown in Figure II.3.5 based on the above-mentioned development plan.

Year		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Daily Ave. Water Demand(1000m³/d)		2,900	2,847	2,794	2,741	2,581	2,420	2,260	2,100	1,919	1,779	1,741	1,702	1,664	1,625	1,625
Daily Max Water Demand(1000m³/d)		3,100	3,072	3,043	3,015	2,845	2,764	2,504	2,333	2,130	1,992	1,949	1,906	1,863	1,820	1,820
Facilities	Meter installation rate-Individuals (%)	19	25	41	57	73	79	100	100	100	100	100	100	100	100	100
	Abandonment of WTPs						▲ Sergeli, Kara-su, Kuiluk, Bectemir					▲ South WTP				
	Number of abandoned booster PSs										45			17		
	Number of Improved booster PSs								15	15	15		8	8		
	Number of Operation staff for facilities	1,695	1,695	1,695	1,695	1,695	1,645	1,372	1,372	1,110	847	793	739	685	631	631
Proposed Projects	Phasing								Phase 1				Phase 2			
	Feasibility Study															
	Detailed Design															
	Bidding															
	Construction of Facilities: Kadirya Improvement and replacement															
	Construction of Facilities: Kibray Improvement															
	Construction of Facilities: Pipe Replacement															
	Construction of Facilities: PSs Improvement															
	Construction of Facilities: Installtion of pressure/flow regulation facilities															
	Construction of Facilities: Reinforcement of Pipes															
	Construction of Facilities: Introduction of monitorig facilities															
	Improvement of Managemen (details are shown in Figure II 3.6): NRW reduction Program (except for Pipe replacemnt)															
	Improvement of Managemen (details are shown in Figure II 3.6): Improvement Program for financial Status															
	Improvement of Managemen (details are shown in Figure II 3.6): Planning and implemention Program of Management for Technical LTDP															
	Improvement of Managemen (details are shown in Figure II 3.6): Improvement Plan for Tariff System															
	Improvement of Managemen (details are shown in Figure II 3.6): Strengthening Program for Management and Organization															
	Improvement of Managemen (details are shown in Figure II 3.6): Information Development and sharing															
	Improvement of Managemen (details are shown in Figure II 3.6): Promotion of Customer participation															
	Disbursement (mil.USD)						9.6	9.6	11.6	21.8	23.9	10.1	35.5	36.0		
EBRD Project	Kabray Replacement															
	Boz-su Replacemnt															
	Kadirya Replacement/Imp.															
	Others															
	Disbursement (mil.USD)					5	7	2								

Project Items of Master Plan
EBRD Project

Note: Reduced operation staff will be engaged in meter installation and maintenance, replacement of pipes and facilities, etc.

Figure II.3.5 Implementation Schedule of the Projects

Program	Necessary Action			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
NRW Reduction Program	1	1	Promotion of meter installation												
		2	Pipe replacement												
		3	Strengthening inspection												
Improvement Program for Financial Status		1	Formulation of a proper Funding Plan												
		2	Implementation of a proper Funding Plan												
Planning and Implementation Program of Management for Technical LTDP	1	Establishment of a Project Management Unit													
	2	Actions for Progressing of WTPs and PSs Restructure (From the year 2007 to 2010)													
Improvement Plan for Tariff System	1	Reforms independent from Metered System													
		1	Reforms in the methods for tariff revision												
		2	IT utilization for billing and collection systems												
	2	Reforms with Metered System													
		1	New Tariff System												
		2	Indoor Repair												
		3	Integrating billing and collection to other public services												
Strengthening Program for Management and Organization	1	Strengthening of management													
		1	Strengthening management for LTDP												
		2	Management based on PDCA Cycle												
		3	Organizational cultural reform												
	2	Reform of Personnel Management													
		1	Improving personnel evaluation												
		2	Employee training												
	3	Organization Reform													
		1	Introducing Private sector												
		2	Organization reform												
Information Development and Sharing	1	Strengthening management information reliability and information sharing													
	2	Strengthening reliability of financial information													
Promotion of Consumer Participation															

Figure II.3.6 Details of the Management Improvement Projects' Implementation Schedule

As it can be seen, the figure contains the following information: the implementation schedule of the proposed projects, the projected results of water demand, the meters' installation ratio for domestic customers, the period for abandoning the WTPs, the number of PSs, the number of operations staff, and the disbursement for construction cost.

The schedule of EBRD Project is also shown in this figure, and it has been decided that the

Project will be carried out using an EBRD loan. The major components of the EBRD project are the replacement of pumps for Kadirya WTP, the replacement of rapid filters and pumps for Boz-su and well pumps for Kibray WTP. Figure II.3.6 shows the detailed implementation schedule for each component of the management improvement program.

II.4 Evaluation of Long-Term Development Plan

II.4.1 Evaluation of Technical Portion

Table II.4.1 summarizes the change from year 2002 to 2015 in line with the implementation of the LTDP on major index of water supply service. Because the losses from the pipeline and the number of WTPs and booster PSs will be drastically decreased, then the number of staff operating these facilities will also need to be reduced, and electricity consumption is also expected to decrease sharply. With regard to the evaluation of the technical portion, the effect of LTDP is very positive.

Table II.4.1 Transition of Major Conditions for Water Supply

Items		Unit	2002	2005	2011	2015	Ratio: 2015/2002
Service population		1,000 persons	2,171	2,178	2,200	2,218	1.02
Daily Production	Average	1,000 m^3/d	2,900	2,741	1,831	1,625	0.56
	Maximum	1,000 m^3/d	3,100	3,015	2,051	1,820	0.59
Losses in the distribution system		1,000 m^3/d	1,161	1,161	646	472	0.41
		%	40	42	35	29	0.73
Required capacity of WTPs		1,000 m^3/d	3,100	3,015	2,130	1,825	0.59
Number of WTPs		Unit	8	8	4	3	0.38
Number of Booster PSs		Unit	134	134	89	72	0.54
Necessary staff number		Number	1,695	1,695	847	631	0.37
Electricity consumption		GWh/year	275	260	120	102	0.37

As for the environmental aspect, since construction works for the LTDP, except for the pipe replacement and reinforcement, will be executed in the existing sites of WTPs and PSs, no big problems are anticipated. Countermeasures for traffic obstructions will be crucial, because pipe replacements will be carried out within the entire city area.

II.4.2 Socio-Economic and Financial Effects of the LTDP

According to the analysis in Section II.3.5, the financial situation will stabilize in the long-run by implementing the LTDP based on a given tariff increase. If the LTDP is not implemented, the financial status beyond the year 2011 will worsen due to an increase of running and repair costs, in spite of adopting a similar level of tariff increase, as the LTDP suggests. It can be concluded that implementing the LTDP is justified also from a financial point of view.

Implementing the LTDP is also necessary from the socio-economic viewpoint. Should the improvement and rehabilitation of facilities not be undertaken within the framework of the LTDP, the capacity and efficiency of the current facilities will gradually decrease. It is reasonably expected that Tashkent city will suffer a water shortage in the future, which would jeopardize the economic growth of the city.

Chapter III　Selection of Priority Project

Chapter III Selection of Priority Project

III.1 Consideration Criteria to Select Priority Project

In selecting the Project Components of LTDP, the following issues must be considered:

(1) The components for NRW Reduction Program:

1) Urgent replacement of deteriorated pipelines;
2) Meter installation schedules must be adhered to as planned; and
3) Water distribution management should be strengthened to eliminate illegal connections and so on.

(2) Deteriorated facilities in Kadirya, Kibray and Boz-su WTPs need to be replaced/renewed, to ensure the adequate distribution of drinking water for the city in the target year;

(3) The existing distribution system's reliance on booster PSs is inefficient, and must be replaced with the more efficient distribution by gravity flow;

(4) Improvement of the distribution network, such as reinforcement of pipelines, improvement of booster PSs, installation of pressure regulation valves and introduction of a monitoring/automatic control system, need to be carried out in order to attain required water pressure by introducing gravity distribution system in the city; and

(5) Management improvement, such as training for employees and development of information technology infrastructure should be instituted.

The results of the priority project selection are shown in Tables III.1.1 and III.1.2.

Table III.1.1 Priority Project Components for Physical Improvement

Name	Facility	Replacement/ Improvement/ /reinforcement	Direct cost 1,000 USD
Kadirya WTP	No.1& No.2 Intake PS	Replacement and repair for PS	(19,292)
	Rapid filters	Replacement/Repair for valves and pipes	(1,198)
		Improvement for auto-washing	(1,226)
	Disinfection facility	Replacement of facilities	535
	Reservoir	Construction: V=45,000m^3	7,650
	Monitoring facilities	Replacement of flow meters	(160)
	Laboratory equipment	Replacement/Improvement of equipment	(200)
Kibray WTP	Well pumps	Replacement/improvement for 63wells	(3,500)
	Distribution pipe	Pipe improvement (For gravity flow)	1,755
		Pipe improvement (for reservoir)	530
	Disinfection facilities	Replacement of facilities	445
	Reservoir	Construction: V= 20,000m^3	2,400
	Distribution PS	Construction: capacity 1000m^3/hr	269
	Power receiver	Replacement	2,516
	Monitoring facilities	Installation of flow meter	(50)
Distribution system	Pipeline network for Vodokanal service area	Replacement L=420km	45,462
		Reinforcement of pipeline、L=16.8km	10,554
		Pressure/flow regulation Valve, 22units	2,090
		Improvement of Booster PSs	9,398
		Monitoring station	427
Preparing O&M manual and training program			0
Total			84,031

Note: The costs in ( ), which involve EBRD or Vodokanal's financed projects, are not included in the total.

Table III.1.2 Priority Project Components for Management Improvement

Items	1,000 USD
Promotion for the installation of water meters	17,275*
Promotion for the development of IT infrastructure	1,000
Total	**18,275**
(Total - excluding cost for the water meters installation)	(1,150)

*: Including cost for the water meters installation is 17,125,000 USD.

III.2 Selected Project Components for Feasibility Study

Feasibility Study (F/S) for short to medium term development is usually carried out on priority projects in line with the established long-term development plan (LTDP). However, the contents of selected priority projects in Table III.1.1 involve relatively simple rehabilitations, which Vodokanal has both the experience and ability that will be needed to

prepare the plans and designs. As a result, the main target of the F/S is set at "establishment of the distribution by gravity flow" excluding simple rehabilitation, which requires special technical and administrative skills. Accordingly it facilitates the F/S to maximize the effectiveness of technology transfer.

Table III.2.1 shows direct costs for the selected F/S project components. For Kibray WTP, some relevant facilities will be improved to enable water to be supplied to the service areas by gravity, which includes construction of a new distribution PS for the surrounding area and a change of distribution system. Improvement of the distribution network, including provision of pressure/flow regulation facilities and improvement of booster PSs for the entire distribution area in the city, will be planned.

Table III.2.1 Selected Project Components for Feasibility Study

Name	Facility	Replacement/ Improvement/ /reinforcement	Direct cost 1,000 USD
Kadirya WTP	Monitoring facilities	Installation of flow meter	(160)
Kibray WTP	Distribution PS	Construction: capacity 1000m^3/hr	269
	Distribution pipes	Improvement to change for gravity system	1,755
	Monitoring facilities	Installation of flow meter	(50)
Distribution Facilities	Distribution Network for Vodokanal service area	Reinforcement of pipeline 16.8km	10,554
		Pressure/flow regulation valves, 22units	2,090
		Improvement of Booster PSs	9,398
		Monitoring stations	427
Total direct cost			24,493

( ) will be carried out by Vodokanal budget

Chapter IV Feasibility Study

Chapter IV Feasibility Study

IV.1 Planning Fundamentals

(1) Methodology of the Study

The Feasibility Study (the "F/S") is to investigate the transition from the existing distribution system to simple and effective system by employing a gravity distribution. As a methodology, firstly, investigation is carried out in the Kibray WTP, water distribution networks, and PSs in the Kibray Distribution Area. Secondly, by employing the investigation results of the Kibray distribution area, improvement of entire distribution network and PSs are planned and designed in order to achieve more efficient water distribution system.

1) Gravity Distribution from Kibray WTP

Shifting the distribution system from pumps to gravity enables improvements in efficiency from Kibray WTP to the City. In order to realize a gravity distribution, an examination for the WTP needs to be carried out in order to design the necessary facilities (for the transition) and estimate construction costs.

2) Improvement of pipeline networks

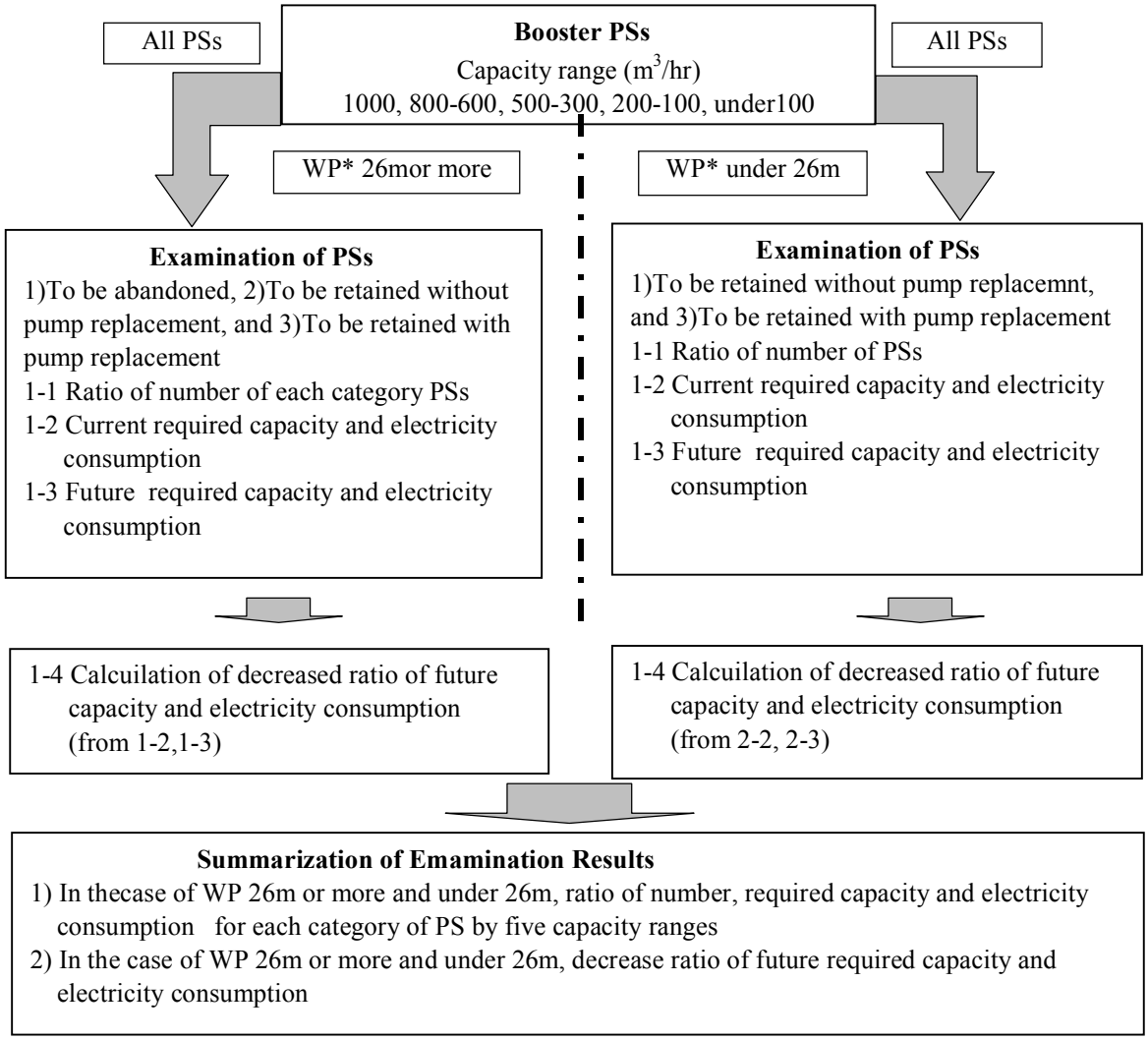
In order to realize efficient water distribution system, an effective utilization of water head, which is expected to increase in the future, will be necessary. Maintaining proper water pressure in the distribution pipeline networks with the utilization of water head will be able to decrease the necessity for pump stations in the future. Therefore, this study investigates pressure & flow regulation valves and reinforcement of pipes in the distribution network, which enable to control water pressure without pumps. In order to realize above investigation, the distribution of the pressure & flow on the entire network is grasped by employing 'hydraulic simulation' under various flow conditions. Based on the results of the simulations and survey results for the pipe conditions in Kibray area, the following elements are examined and decided: (i) required points of pressure & flow regulation valves and the section & diameter of reinforcement pipes, (ii) suitable type for pressure and flow regulation

valves and suitable material for reinforcement pipes, and (iii) the design for those facilities and the construction cost.

3) Improvement plan for booster PSs

In order to achieve efficient water distribution system, the improvement for booster PSs will be necessary. Although booster PSs had basically constructed for high story (most of them are nine-story) buildings, however most of PSs are also supplying water not only to high story buildings, but also to low story (5 or less) buildings due to the low distribution water pressure in many areas. Accordingly if the water pressure of pipelines becomes 26m or more (which allows a gravity distribution to low story apartment), a number of PSs can be abandoned or their capacities can be reduced. Therefore, in this case, the number of PSs, the scale of capacity range and electricity consumption will be decreased, and the facilities will be simplified and improved these efficiency. As a result of the hydraulic simulation, water pressure will be under 26m in a number of areas in 2011 (of the target year of FS) and in 2015 (of the target year of LTDP). Thus an examination for the case of water pressure under 26m in PSs needs to be carried out.

In the Kibray distribution area, the examination process is shown in Figure IV.1.1. Firstly, 33 booster PSs with design capacity 1000 m^3/h or less in the area are examined in the both cases of water pressure 26m or more and under 26m. Secondly, in the case of water pressure 26m or more, PSs are classified into three categories: “to be abandoned”; “to be retained without pump replacement”; and “to be retained with pump replacement” as shown in Figure IV. 1.1. In the case of water pressure under 26m, PSs are classified into two categories: “to be retained without pump replacement” and “to be retained with pump replacement”. Each of ratio of the number, current and future required capacity and electricity consumption for each category are calculated by design capacity ranges. By analyzing these results, total required capacity and electricity consumption in the future in comparison with current value is calculated.



*WP: Water Pressure

Figure IV.1.1 Examination Method for PSs in Kibray Area

Thirdly, by employing examination results in the Kibray distribution area, entire service area in Vodokanal will be also examined in regard to the design capacity ranges of 1000m^3/hr or less (these future required capacity is determined by the examination in the Kibray distribution area). The examination focuses two categories: "to be retained without pump replacement" and "to be retained with pump replacement" in order to make the (preliminary) design and estimate the cost for the improvement of PSs as shown in Figure IV.1.2.

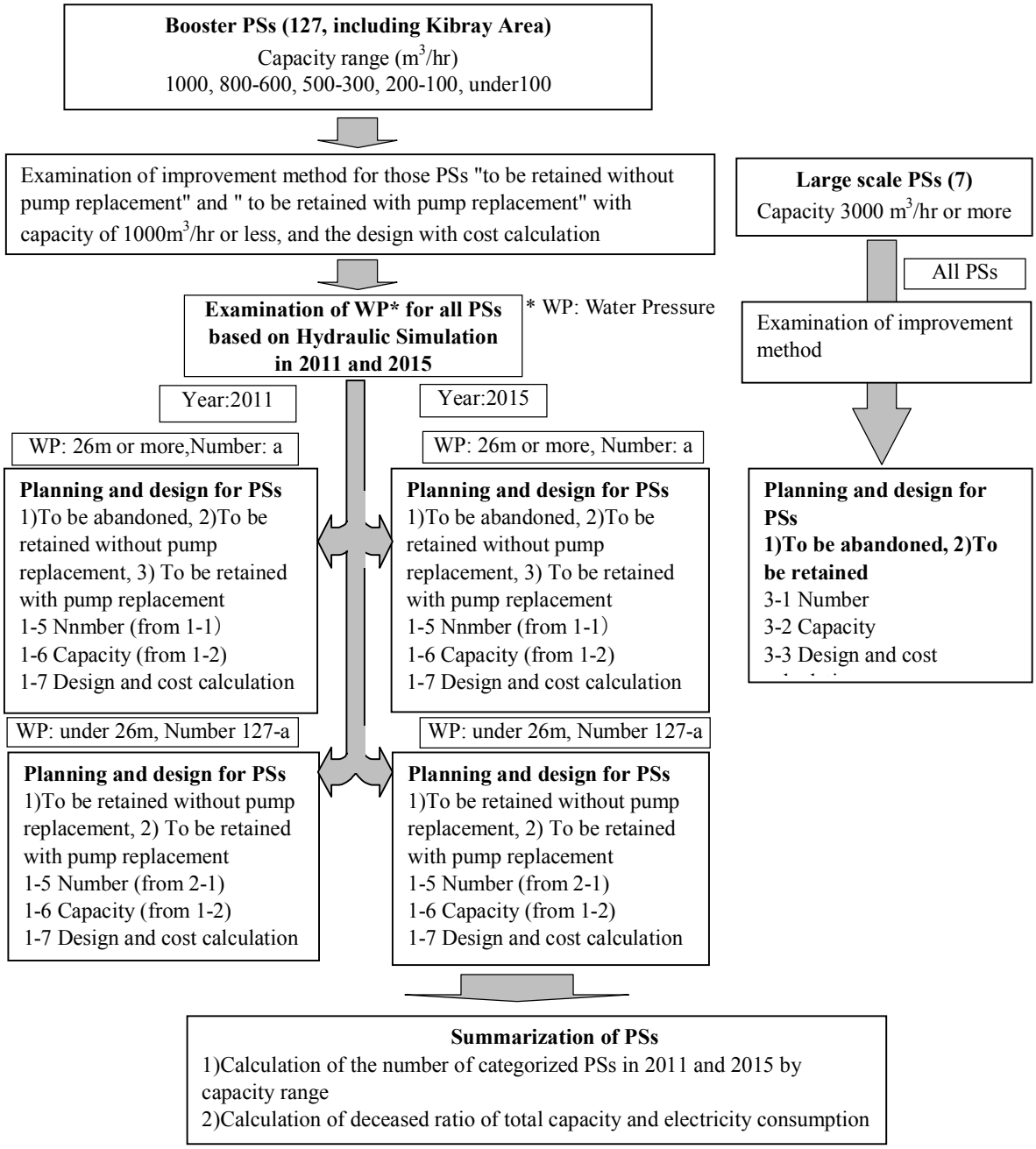


Figure IV.1.2 Examination Method for All PSs

In this stage, 127 PSs with capacity of 1000m^3/hr or less, including the Kibray distribution area, are examined whether the water pressure is 26m or more and under 26m in 2011 and 2015, based on the results of hydraulic simulation. Under the two water pressure conditions, the number of categorized PSs by design capacity ranges will be calculated according to the result of the ratio of the number of categorized PSs examined in the Kibray area in 2011 and 2015. The results of required capacity and costs in the Kibray distribution area are also employed. In addition, large scale PSs with capacity of 3000m^3/hr or more are examined and

categorized individually, in regards to the number of PSs and capacity for designing.

Finally, according to above-mentioned results, the number and required capacity by design capacity ranges for all PSs in 2011 and 2015 are added up for the entire service area. Then, decreased ratio of required capacity and electricity consumption is calculated in 2011 and 2015 by employing the results for the Kibray area, with the decreased ratio of electricity consumption used for electricity costs.

4) Planning of Monitoring Facilities

In addition to the above improvements of the distribution system, in order to realize the decrease in operation staff and precise operation, monitoring facilities to grasp pressure & flow of the distribution network and operation status of PSs is designed.

(2) Target Year and Study Area

The target year of the priority project for the feasibility study will be set in the completion year of the project. If the project is started based on the priority project components, major construction works can commence in early 2007, and the completion of construction will be by 2011, with five years duration for construction. The target year of the project for the F/S is therefore set by 2011. It should be noted that the target area of the F/S is same with that of LTDP.

(3) Project Contents of the F/S

The contents of the Project Components targeted in F/S were selected in Section Ⅲ.2 and shown in Table III.2.1. The F/S will review the existing distribution system, prepare a plan for establishing an energy-efficient and precisely controlled system, and investigate for improvement of the distribution system centering on lessening the number of booster PSs wasting energy.

IV.2 Preliminary Design of Improvement for Water Distribution Network

(1) Design Condition for Entire Service Area

1) Design Criteria

Vodokanal needs to distribute drinking water with proper quality and pressure to customers. For those customers who live below nine-story buildings, there should be a service pressure of 10 m of water head for every floor. The required distribution pressure for buildings are as shown in Table IV.2.1.

Table IV.2.1 Necessary Pressure for Buildings

Story	2	3	4	5	9
Necessary Pressure (m)	14	18	22	26	42

The range of water distribution pressure, as the design criteria in the network, can be categorized as shown in Table IV.2.2.

Table IV.2.2 Distribution Pressure Range and Design Category

Area	Distribution Pressure Range (m)	Design Category
For detached house	under 10	PS is necessary
	10-20	Appropriate
	over 20	The pressure need to be lowered
For apartment building	under 26	PS is necessary
	26-40	Appropriate
	over 40	The pressure need to be lowered

2) Design Flow

The projected water demand in the target year of the F/S of 2011, and in the target year of LTDP of 2015 is utilized for the design flow. The designed hourly maximum water flow is applied for hydraulic calculations as shown in Table IV.2.3.

Table IV.2.3 Design Flow to be Applied for Hydraulic Analysis

Target Year	Designed flow	
	Hourly (m^3/hr)	Daily (1,000 m^3/d)
2011 (Flow of target year of F/S)	95,708	2,297
2015 (Flow of target year of LTDP)	84,917	2,038

(2) Gravity Distribution from Kibray WTP

1) Outline of present system and operation

The current distribution system in Kibray WTP is shown in Figure IV 2.1. The flow rates indicated in the figure are the amount of daily average recorded in December 2004. Distribution areas from those pipes, which form Kibray Distribution Area, are shown in Figure IV 2.2.

The distribution flow rates from Kibray WTP have been recorded as flat all day long. Treated water (384,000m^3 /day) from Kadirya WTP was supplied to the Kibray WTP by gravity, and it was also distributed to the city by gravity. Total amount of water distributed to the city was 734,400 m^3/d.

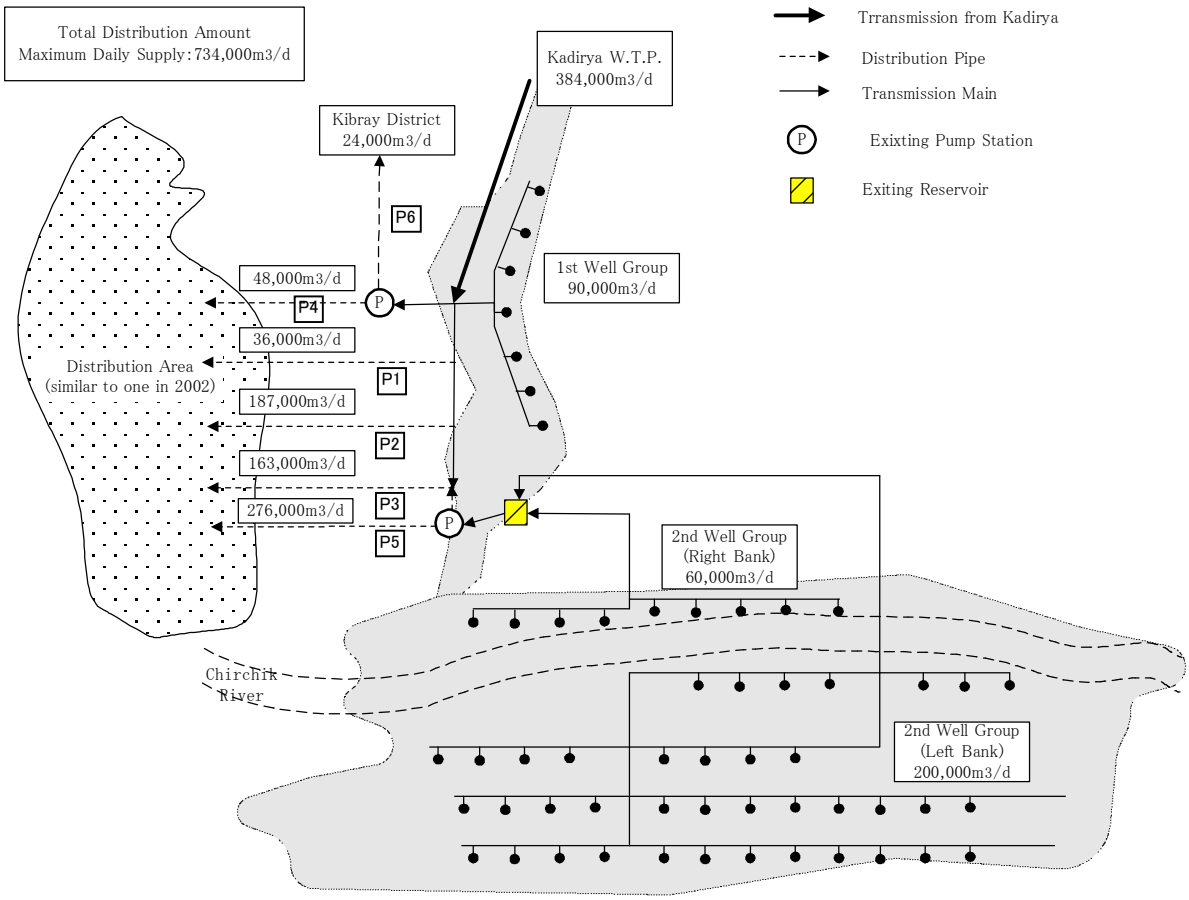


Figure IV 2.1 Water Balance and Distribution System at Kibray WTP

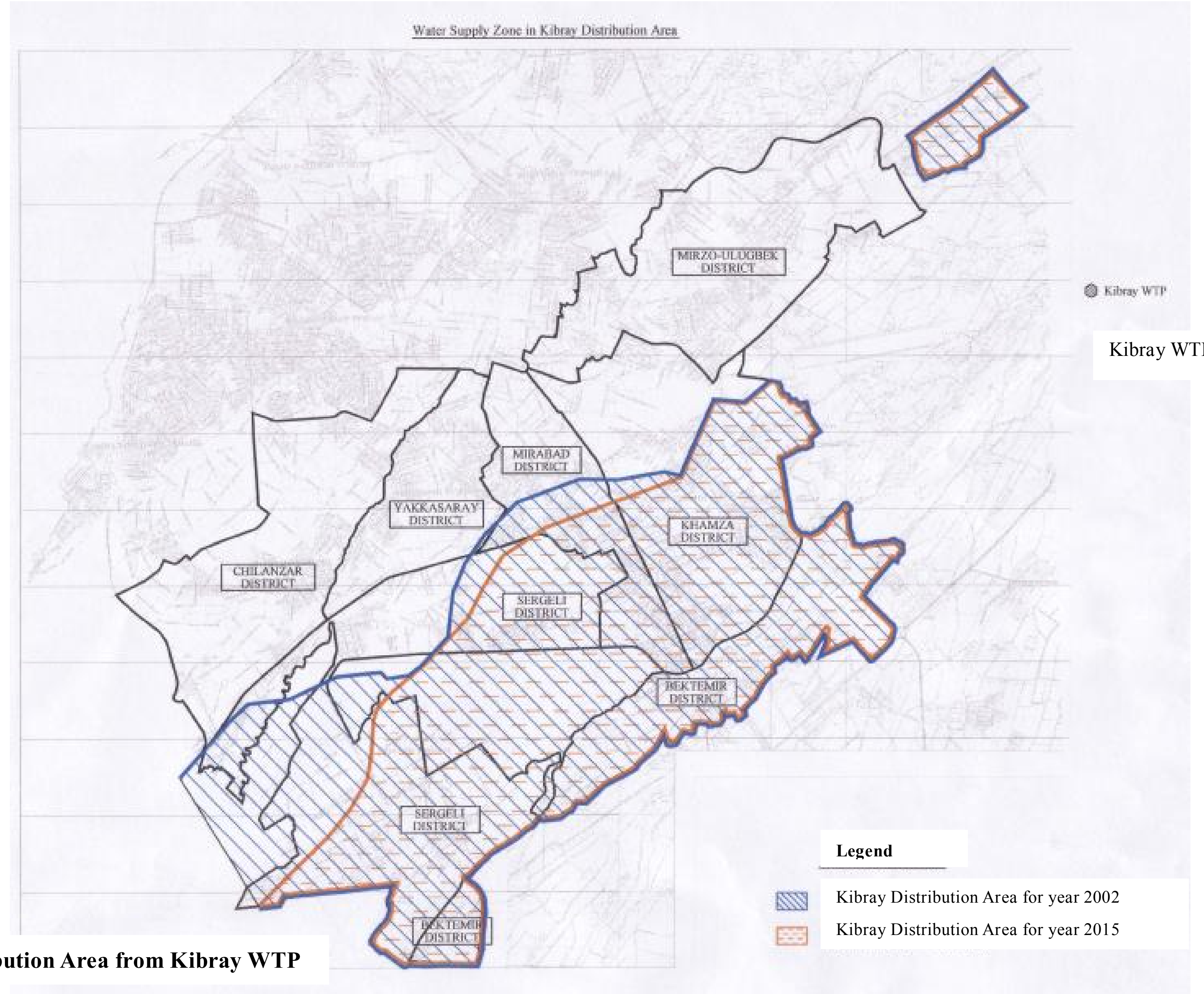


Figure IV 2.2 Distribution Area from Kibray WTP

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2) Water flow of distribution pipes

The expected reduction of water demand in the future will enable the WTP to shift to gravity flow. Hydraulic simulations were carried out using Water CAD based on water supply in the year of 2011. The distribution flow rate for each distribution pipe based on the simulation result in 2011 is shown in Figure IV 2.3 and a total of 32,500m^3/hr of hourly maximum water flow will be distributed from Kibray WTP to the city.

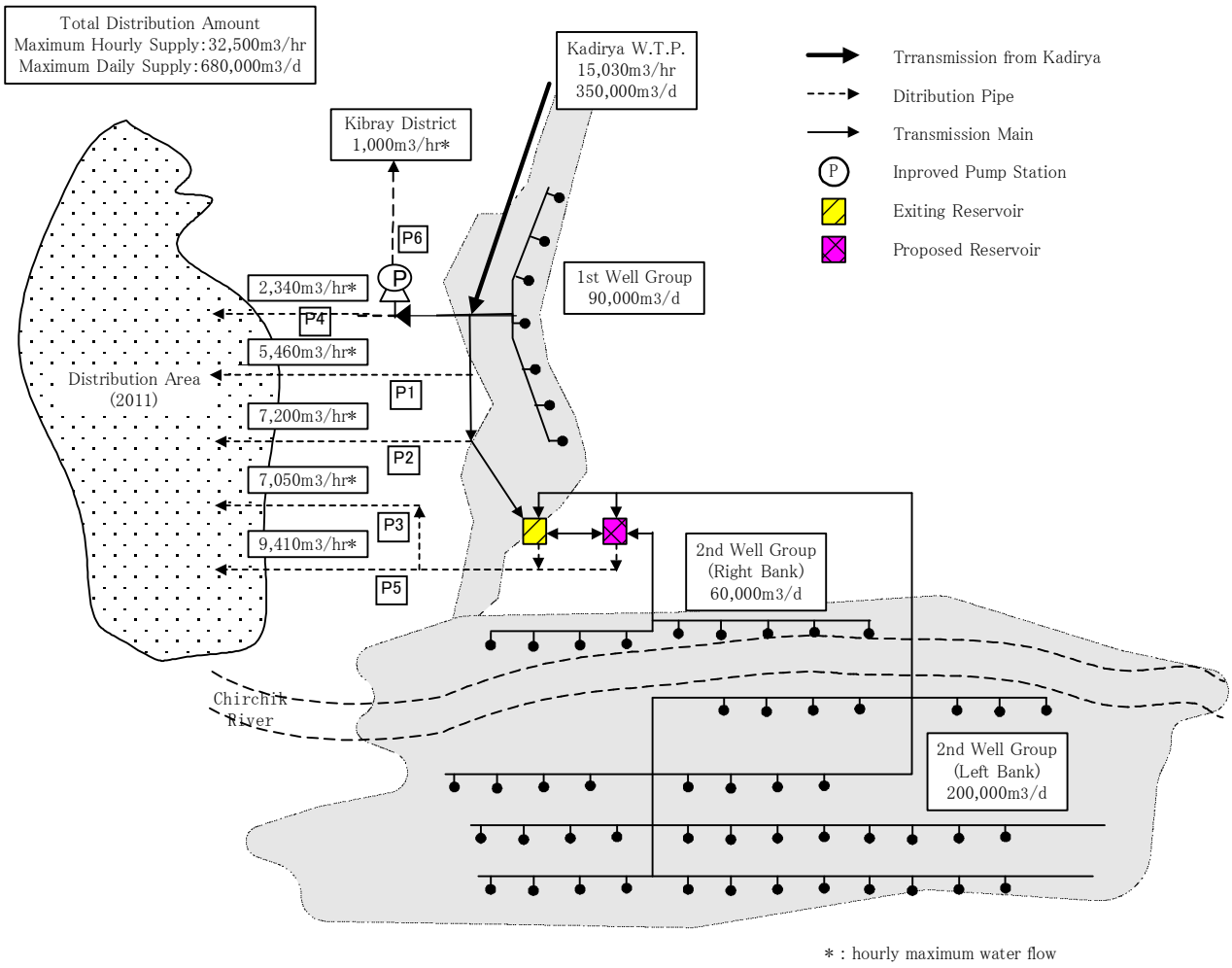

Figure IV 2.3 Distribution Amount from Each Pipe in 2011

As resulted in the hydraulic simulation, the water pressure of 26m cannot be kept in an extensive part of Hamza and Mirabad District in 2011. Alternative plans might be considered as follows: pipe reinforcement from Kibray to the city or construction of a distribution reservoir with higher elevation. However these alternatives involve a very large

investment and do not seem to be practical plan because water demand will further decrease by 2015.

3) Improvement plan for Kibray WTP

The contents of improvement in the WTP are as follows:

- The elevation of the new reservoirs planned in the LTDP shall be the same water level as the existing reservoir, and the low water level set at 500.5m while the high water level is at 505m;
- These reservoirs will be connected by a new pipe with a diameter of 2,000mm, from which existing pipes (Pipe 3 and Pipe 5 as shown in Figure IV.2.3) will be made to branch out;
- Some of the existing pipes will not be able to distribute water by gravity because current level of Pipe 3 (the interval is 1,500m from the existing reservoir) is installed higher than the low water level of the existing reservoir. The replacement pipe for this interval will be reinstalled and the diameter of this pipe will be set at 1,400mm, larger than the existing pipe, which has a diameter of 1,200mm, in order to reduce friction loss;
- Small pumps to distribute water to Pipe 6, which also distributes to the Kibray Area with water pressure of 30m, need to be installed in the existing building for No.1 distribution PS.

(3) Rehabilitation/Improvement of Distribution Networks for Entire Service Area

1) Division of network

The distribution area served by Vodokanal is divided into five areas, in which four are gravity distribution areas, i.e. Kibray, Kadirya Southern, Kadirya Central and Kadirya Northern Distribution Area and the Boz-su pump Distribution Area.

2) Reinforcement of pipes

At present, a lack of flow capacity, even for the future distribution flow, is observed in some

distribution pipes causing a decrease in water pressure in the downstream area. The capacity of these pipes can be reinforced by installing additional pipes. The locations and the diameters of such reinforcement pipes were examined based on the hydraulic analysis by Water CAD. The total length of these pipes is around 16.8km.

3) Replacement of deteriorated pipes

The total length of pipes to be replaced is 420km. Vodokanal plans to replace the pipelines based on an order of priority; the first priority being the upper elevation area with oldest pipes, the second priority will be the middle elevation area, and the last will be those in the low elevation area because most pipes were installed in the 1980s and are relatively new.

(4) Water Pressure and Flow Control of the Network for Entire Service Area

1) Pressure regulation system

It is expected that the hourly flow will fluctuate in the future as well as the water pressure. An automatic pressure control system to regulate water pressure shall be introduced in the distribution network. There were 19 points selected for installation of automatic pressure regulation valve, where the water pressure is over 50m, and a substantial decrease in water pressure will be needed based on hydraulic analysis. Either motor valves controlled by electrical devices (Type 1) or self-actuated valves (Type 2) will be used for the pressure regulation system. There are no considerable differences in the costs between the two types. Type 1 is comprised of standardized equipment. Type 2 valve, on the other hand, has specialized mechanisms that differ depending on the manufacturers. Subsequently, Type 1 will be an easier option for maintenance, operation and repair. Furthermore, Type 1 includes a flow meter and pressure meters, having the advantage of recording pressure and flows and transmitting these at real time to a monitoring station. Therefore, type 1 is the better option and was selected as the pressure regulation system.

2) Flow control system

Three flow control facilities to regulate the water flow for the Kibray distribution area and

for Mirzo-Uulgbek PS have been arranged. Type 1 control facility has been applied for flow control. The valve will be controlled and will maintain the planned flow rate.

(5) Improvement of all Booster PSs

1) Study methods for the improvement of booster PSs

The study method (which was referred in section Ⅳ.1.1) on the improvement of booster PSs in the distribution networks, is being implemented along the lines of the flow chart of Figure IV.2.4. Initially, an examination study was carried out in the Kibray Distribution Area, and then, based on the result of the examination, the whole of distribution area served by Vodokanal would be studied comprehensively. It was decided that the PSs would be categorized into two groups: those to be abandoned or improved. After categorization, contents of the improvement works would be examined for the latter PSs.

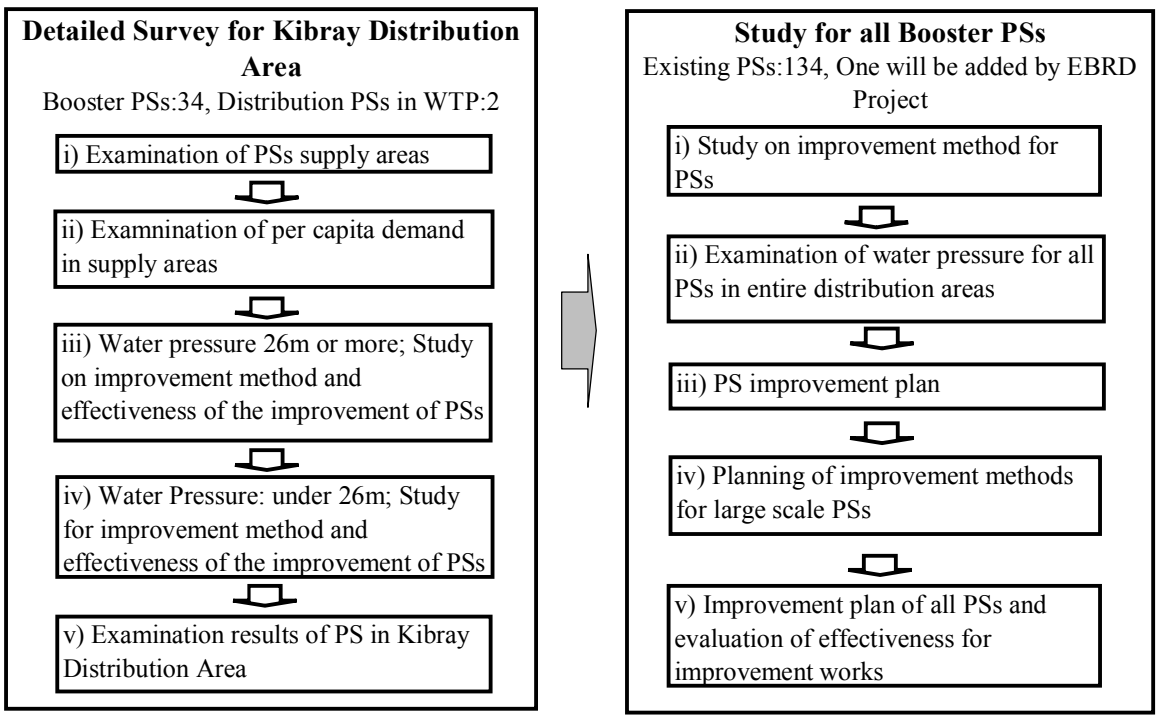

Figure IV.2.4 Study Methods for Improvement of Booster PSs

2) Examination of the Kibray Distribution Area

i) PSs Distribution Area

Booster PSs located in Hamza, Mirabad, Sergeli and Bectemir Districts, which are the distribution areas from Kibray WTP, were surveyed together with the distribution pipelines, and the types/composition of consumers. Surveys for consumers of each PS were carried out, for such categories as apartment buildings and others. Apartment buildings are classified depending on the number of floors or stories, because distribution pressure is decided according to the number of floors, as shown in Table IV.2.4. The number of flats (households) in each story building has been determined by the survey results in each District as shown in the table. The results of the consumers' survey are summarized in Table IV.2.5. The data of TKEO and the city includes all flats/residents in the area. The difference between the data and the survey results is the number of flat and residents, which are not supplied from PSs (supplied by gravity). Most of people receive water that is distributed by PSs in Bectemir District.

Table IV.2.4 Survey Results of Flat Number for Each Story Apartments

Number of Stories	Flat number for apartment buildings			
	Hamza	Mirabad	Sergeli	Bectemir
2	6	6	6	6
3	12	12	12	12
4	70	50	40	55
5	90	60	50	65
7*	60	40	40	40
8*	70	35	35	35
9	120	100	65	90
12	60	48	48	48
14	112	112	112	112
16	128	128	128	128

*The number of seven and eight-story buildings is very few, thus these buildings will be included in nine-story buildings in this study.

Table IV.2.5 Summarized Survey Results of Consumers for PSs

District	Building Number	Flat Number		Resident Number	
		Surveyed	By TKEO	Surveyed	By City
Hamza	430	34,454	42,508	122,054	207,200
Mirabad	460	21,070	26,410	98,912	121,700
Sergeli*1	1,480	40,337	40,211	161,659	282,000
Bectemir*1	3,734*2	5,953*2	5,945	27,217	27,700
Total	6,104	101,814	115,074	409,842	638,600

*1: including area of the distribution PS in WTPs / *2: including detached houses

ii) Determination of per capita demand for PSs supply areas

In order to calculate the required pump capacity for 1,000 people and 1000 beds, unit demand in PSs was decided as shown in Table IV.2.6. Current supply for apartments and detached houses includes 25% of water leakage from the supply pipes (schools and hospitals are not included). The difference between current and future per capita demand (per day) is quite large. However, the current capacity of the pumps is designed by the average hourly flow which is almost flat all day long. On the other hand, the future capacity required for pumps is designed to supply twice that of the average hourly flow, by considering the increase of the flow fluctuation due to the reduction of the leakage. Therefore, the difference between the current and future capacity of the pumps is not as large as that of per capita demand (or per bed demand) as shown in Table IV.2.6.

Table IV.2.6 Unit Demand in PSs

Consumers	Per capita demand (Lpcd)		Required pump capacity (m^3/hr)*6 per 1,000 people	
	Current	Future	Current	Future*7
Apartment	500*1/0.75=667	200*3	27.8	16.7
Detached house	270*1/0.75=400	---*4	15.0	---*4
School	200*2	100*5	8.3	8.3
Consumer	Per bed demand (Lpbd)		Required pump capacity (m^3/hr)*5 per 1,000 beds	
	Current	Future	Current	Future*7
Hospital	500*2	200*5	20.8	16.7

Note:
*1: Refer to Table 4.2.1 in Vol.2 Main Report
*2: Obtained from hearing survey in Vodokanal
*3: This was determined by 150Lpcd of the estimated entire city area's unit demand with added margin of 50Lpcd.
*4: Pumps will not be required due to the future water pressure for 10m or more.
*5: Based on the figures recommended by the structural standards for domestic waste treatment tanks in Japan.
*6: Per capita demand multiplied by 1000 and calculated per capita demand per day, then converted into hourly water demand. (For instance, the current apartment demand is calculated as follows, 667Lpcd x 1,000 people x 1/1,000 x 1/1,000m^3 /ℓ ÷24hr/d = 27.8 m^3/hr).
*7: Peak factor is 2

iii) Study on the improvement method and the effectiveness of the improvement of PSs (Water Pressure for all PSs:26m or more)

Examination of abandonment of PSs and calculation of required capacities

The PSs in Kibray Distribution Area, totaling 36, including the distribution pumps located in WTPs, are listed in Table IV.2.7. Detached houses are not included in the table, because water pressure will reach over 10m in the future. Thus, this table includes only apartments. In the case of water pressure of 26m or more, water for low story buildings will be distributed by gravity. However the majority of large scale PSs distribute to nine-story buildings as well as low story buildings. Those PSs cannot be simply abandoned, or its capacities reduced unless the population figures are reviewed. PS can be abandoned when pump units are installed to supply areas with nine-story buildings in the area. The supply area of each PS and its capacity was investigated and the decision on what PS will be retained or abandoned will be based on the future population. Table IV.2.7 shows examined served population, water demand and required capacity for the improvement plan.

The table shows that a total 23 PSs, including two distribution PSs in WTPs, could be abandoned. The number of customers per PS can be reduced in the future, although for some PSs, the number of customers will stay constant. In the case of other existing PSs, it is not necessary that pumps are replaced if each capacity of the PS is designed in accordance with the installed pumps and the function diagnosis result is acceptable. Most of the pumps installed in PSs have capacities larger than is needed for future requirements. For example, all the existing PSs with the designed capacity of 600-1,000m^3/hr are equipped with pumps of the same capacity of 320m^3/hr. However, the actual water supply is far smaller than the existing capacity in most PSs, which means that the existing pumps cannot properly control the water flow, and are required to be renewed or replaced. For the PSs with a capacity of 1000m^3/hr, the pumps will not be replaced in case the future required capacity exceeds 500m^3/hr and the result of the diagnosis is “good”. In the list of Table IV.2.7, there are no PS pumps which need to be replaced.

Table IV.2.7 Reviewed Supply Customers, water demand and required capacity by PSs

District	PS no.	Capacity of PS	Served Population per PS		Daily Demand (m^3/d)		Required Capacity (m^3/h)	
			Current	Future	Current	Future	Current	Future
Hamza	116	90	3,934	0	2,597	0	108	0
	117	1000	34,399	11,054	22,279	2,211	928	184
	120	300						
	118	1000	38,413	26,601	25,025	5,240	1,043	437
	119	1000	13,047	13,047	8,084	2,479	337	207
	121	1000	4,244	4,244	2,849	859	119	72
	123	200	1,777	0	1,184	0	49	0
	126	600	15,598	1,974	9,112	395	380	33
	124	45	1,152	0	768	0	32	0
	125	20	461	0	307	0	13	0
	127	600	6,623	0	3,737	0	156	0
	128	45	888	0	592	0	25	0
	129	20	632	0	441	0	18	0
	130-1	20	888	0	592	0	25	0
	Total	5940	122,056	56,920	77,567	11,184	3,233	933
Mirabad	10	1000	26,038	26,038	15,912	4,898	663	408
	11	600	11,142	4,606	6,635	921	276	77
	12	1000	8,794	5,431	5,000	1,086	208	91
	17	600	21,479	0	13,546	0	564	0
	13	1000	3,540	658	2,360	132	98	11
	14	150	2,961	2,961	1,974	592	82	49
	15	150	7,787	7,787	5,191	1,512	216	126
	16	90	855	0	570	0	24	0
	18	45	197	0	132	0	5	0
	19	800	9,582	0	5,524	0	230	0
	20	20	329	329	219	66	9	5
	21	20	1,546	0	1,031	0	43	0
	22	60	4,661	0	2,314	0	96	0
	Total	5,535	98,911	47,810	60,408	9,207	2,514	767
Sergeli	130	1,000	13,473	13,473	8,982	2,695	374	225
	131	3,000	23,952	0	13,004	0	542	0
	132*2	1,000	8,808	8,808	4,425	1,452	184	121
	133	1,000	70,342	70,342	43,323	13,293	1,805	1,108
	134	1,000	9,399	9,249	5,542	1,695	231	141
	Sergeli*1	4,000	35,686	0	19,100	0	796	0
	Total	11,000	161,660	101,872	94,376	19,135	3,932	1,595
Bectemir	---	160	4,442	4,442	2,961	888	123	74
	Bectemir*1	960	21,151	0	11,728	0	489	0
	140	100	1,624	0	1,083	0	45	0
	Total	1,220	27,217	4,442	15,771	888	657	74
Total		23,695	409,844	211,044	248,123	40,414	10,336	3,369

*1:Distribution PSs in WTP,/ *2:Pumps need to be replaced due to these deterioration

PSs can be abandoned

PSs to be retained and pumps need to be replaced

Determination of the rates for the categorized PSs and calculation of required capacity

Booster PSs can be categorized into three groups: “to be abandoned”, “to be retained without pump replacement” and “to be retained with pump replacement”. Table IV.2.8

shows the numbers of above categories and the required capacities with ranges.

Table IV.2.8 Number of Categorized PSs and Required Future Capacity, (Water Pressure 26m or more)

Design capacity (m^3/hr)	Number of PSs	Category	Number	Required capacity (m^3/hr)
1000	11	To be abandoned	2	-
		To be retained without pump replacement	0	0
		To be retained with pump replacement	9	312
800-300	6	To be abandoned	6	-
		To be retained with pump replacement	0	-
200-100	5	To be abandoned	2	-
		To be retained with pump replacement	3	83
Under 100	11	To be abandoned	10	-
		To be retained with pump replacement	1	5

Note: 31 PSs, which have design capacity of less than 1000 m^3/hr, are classified, excluding PSs in Sergeli and Bectemir WTPs.

Evaluation of effectiveness of improvement for PSs

Table IV.2.9 summarizes the evaluation results for the planned PSs in each district in the Kibray Distribution Area, in which distribution PSs at Sergeli and Bectemir WTPs are not included. As shown in the table, only 13 booster PSs will be needed, thus out of the 34 PSs, 21 can be abandoned. The required current capacity is 48% of the design capacity and only 18% is required for the future capacity, meaning that the required future capacity shall be reduced to 1/3 (0.18/0.48) of the present. Consequently, the total power consumption of the rehabilitated PSs will drastically decrease.

Table IV.2.9 Evaluation Results of Booster PSs (Water Pressure 26m or more)

District	Design Capacity (m^3/hr)	Number		Population		Required* Capacity (m^3/hr)		Power consumption (kW)	
		Current	Future	Current	Future	Current	Future	Current	Future
Hamza	5,970	14	3	122,054	56,920	3,233	933	569	100
Mirabad	5,535	13	5	98,911	47,810	2,514	767	511	86
Sergeli	7,000	5	4	125,975	101,872	3,136	1,595	551	175
Bectemir	310	2	1	6,066	4,442	168	74	39	21
Total	18,815	34	13	353,008	211,044	9,054	3,369	1,670	382
Ratio	-	1.00	0.38	1.00	0.60	0.48	0.18	1.00	0.23

Note: Distribution PSs in WTPs are not included /*Ratio is compared to the design capacity

Selection of pump-units

The specifications of pump units (they are marked from "a" to "e") are categorized as shown in Table IV.2.10. The units include stand-by pumps, electric panel and pressure tanks. The rotation speed control, which regulates the rotation speed of motors for pumps electrically in order to control the discharge volume of pumps, will be employed for the pump operation.

Table IV.2.10 Lists of Pump Units

Mark	Capacity (m^3/hr)	Head (m)	Power (kW)	Required Number
a	3.3	50	0.75	14
b	5.5	50	1.5	7
c	11	50	2.2	6
d	13.8	50	3.7	2
e	16.5	50	4.5	5
Total				34

Note: Required pump number is total requirement in four districts

Currently, ordinal pumps, which basically discharge constantly, are usually applied as lift pumps for high-stories buildings, due to a large amount of water leakage in buildings. In the future, however, pump-units should be installed to cope with the flow fluctuation in accordance with the progress of leakage reduction works. In Tashkent city, installation of pumps regulated by the motor rotation speed control is progressing. Consequently those pump-units with a flow regulation system will be introduced for lift pumps.

iv) Study on the improvement method and effectiveness of the improvement of PSs (Water Pressure for all PSs: under 26m)

The study in the case of water pressure under 26m is carried out same as section iii). When water pressure is under 26 m, PSs are necessary to distribute water to buildings with even less than five-story. Therefore PSs cannot be abandoned basically. However there are many PSs with excessive capacities in the city, while the actual capacities of many PSs are much smaller than minimum flows. Based on the examination results similar to what is shown in Table IV.2.7, the number of categorized PSs and current/future required capacities are determined as shown in Table IV.2.11. In this case, it was not necessary to replace the pumps of the two PSs with the capacity of 1000 m^3/hr.

Table IV.2.11 Average Required Capacities by Capacity Scale (Water Pressure Under 26 m)

Capacity (m^3/hr)		Number	Average Required Capacity (m^3/h)	
			Current	Future
1000	Without Pump replacement	2	986	593
	With pump replacement	9	447	275
	Total	11	545	333
800-300	With pump replacement	5	321	215
	Abandoned and unified	1	0	0
200-100		5	116	68
Under 100		11	36	24

Note: 101PSs, which have design capacity of less than 1000 m^3/hr, are classified, excluding PSs in Sergeli and Bectemir WTPs.

Table IV.2.12 summarizes the evaluation results for PSs in each District, in which distribution PSs are not included. In the case of water pressure under 26m, because water cannot be supplied to low story buildings by gravity, booster pumps will be retained. The required future capacity is 65% (0.31/0.48) and power consumption is 44% compared with the current condition.

Table IV.2.12 Evaluation Results of Booster PSs (Water Pressure under 26m)

District	Design Capacity (m3/hr)	Number	Served Population		Required Capacity (m^3/hr)		Power consumption (kW)	
			Current	Future	Current	Future	Current	Future
Hamza	5,970	14	122,056	122,056	3,233	2,035	569	280
Mirabad	5,535	13	98,911	98,911	2,514	1,602	511	209
Sergeli	7,000	5	125,975	125,975	3,136	2,100	551	220
Bectemir	310	2	6,066	6,066	168	101	39	26
Total	18,815	34	353,008	353,008	9,054	5,838	1,670	735
Ratio	1.00		1.00	1.00	0.48*	0.31*	1.00	0.44

Note: Distribution PSs in WTP is not included

*: Ratio is compared to the existing design capacity

v) Examination Results of PSs in the Kibray Distribution Area

The survey results for PSs in the Kibray Distribution Area are summarized as follows:

a) Most of the booster PSs are supplying water to apartment and other buildings. The apartment buildings are classified into two types; those with a low number of stories

with five or less, and those with a high number of nine or more stories. Vodokanal does not need to install PSs for high (10 or more stories) story buildings, since necessary pumps have already been installed privately;

b) Due to the presence of many areas having low water pressure, PSs are distributing water even to low story apartment buildings. However if in the future, water in the distribution line is 26m or more in the future, water can be supplied by gravity flow, allowing the PSs to cease operation;

c) PSs with relatively large capacity of more than 600m^3/hr usually supply water to both low and high story apartments with five or less and up to nine-story buildings. Accordingly, when the water pressure is raised to 26m or more in the future, in order to supply water to low story apartments by gravity, the existing connection pipes for low story apartments shall be separated from PSs and be connected to other distribution pipes;

d) Actual supply quantities of PSs are usually much smaller than the designed capacity. In this regard, the capacity of the PSs can be reduced when the PSs are improved, even if the water pressure is under 26m.

e) Booster PSs can be categorized into three groups: " to be abandoned", "to be retained with pump replacement" and "to be retained without pump replacement". The number of PSs in the five capacity ranges of PSs with capacity of 1000m^3/hr or less in this area are shown in Table IV.2.13. The number of above categorized PSs, ratios of the number and required capacities are determined in Table IV.2.13 by the water pressure condition. Due to limited number of PSs in the Kibray Distribution Area, the ratio of numbers of categorized PSs and required capacities are determined by referring to the values of other categories with ranges.

Table IV.2.13 Categorization PSs by Design Capacity Range and Water Pressure

Design capacity (m^3/hr)	Number of PSs	Category	Water pressure: 26m or more		Water pressure: under 26m	
			Ratio (%)	Required capacity (m^3/hr)	Ratio (%)	Required capacity (m^3/hr)
1000	11	To be abandoned	15	-	0	-
		To be retained without Pump replacement	10	593*1	20	593
		To be retained with Pump replacement	75	312	80	275
800-600	5	To be abandoned	60	-	0	-
		To be retained with Pump replacement	40	215*1	100	215
500-300	1	To be abandoned	50	-	0	-
		To be retained with Pump replacement	50	150*2	100	150*2
200-100	5	To be abandoned	50	-	0	-
		To be retained with Pump replacement	50	83	100	68
Under 100	11	To be abandoned	85	-	0	-
		To be retained with Pump replacement	15	24*1	100	24

*1: Water pressure under 26m is employed due to no example of 26m or more in Kibray Distribution Area

*2: Estimation figure due to no example of this capacity range in Kibray Distribution Area

f) When the water pressure reaches 26m or more in the entire distribution area, the required capacity of pumps will decrease to 18% and the electricity consumption will also decrease to 23%, compared with current values. Even if the pressure cannot reach 26m, the required pump capacity and electricity consumption will decrease to 31% and 44%, respectively.

3) Improvement plan of PSs in the entire distribution area

i) Study on improvement methods for PSs

For all PSs that would be retained, a monitoring system and an automatic operation system for the pumps shall be put in place. In this section, therefore, the category of " to be retained without pump replacement" is named "Monitoring" and the category of " to be retained with pump replacement" is named "improvement". The category of " to be abandoned" is named "Abandonment". For PSs of "Monitoring", a system to measure/transmit the water flow/pressure of PSs and to monitor these conditions including breakdowns of facilities, will be installed. The monitoring will be implemented in Vodokanal's head-office. PSs of "Improvement" include a system for automatic pump

operation, as replaced pumps will be automatically control the discharge flow/ pressure with above monitoring system.

ii) Examination of water pressure for all PSs in the entire distribution area

The water pressure in the entire distribution area was analyzed by hydraulic simulation for the year 2011 and 2015, and was examined if the water pressure will be 26m under/more. As a result, the number of booster PSs will decrease significantly in the area where the water pressure will be lower than 26m in 2015, compared to that in 2011 when water pressure increases as a result of the a reduction of the water flow, as shown in Table IV.2.14.

Table IV.2.14 Number of Pumps in Low Pressure Area

Capacity Range (m^3/hr)	Total	Pressure under 26m	
		2011	2015
3000 or more	7	2	0
1000	43	18	8
800-600	14	7	2
500-300	9	5	1
200-100	10	4	0
Under 100	51	15	4
Total	134	51	15
Ratio (%)	100	38	11

iii) PSs Improvement Plan

Table IV.2.15 (1) re-arranges the judgment results of water pressure of PSs as shown in Table IV.2.14 with the capacity of 1000m^3/hr or less in 2011 and 2015, by classifying into (a) 26m or more and (b) under 26m. Table IV.2.15 (1) also shows the transition of water pressure from (b) to (a) in the period of 2011-2015. Table IV.2.15 (2) shows the numbers PSs by existing design capacity, category, and water pressure range (26m or more and under 26m) based on Table IV.2.15 (1) in 2011 and 2015. In the table, the categories shown in Table IV.2.13 is changed to be “abandonment”, “monitoring” and “ improvement” as shown in Table IV.2.15 (2) and mentioned in section ii). The required capacities for each category are shown in Table IV.2.13. The current (in 2002) number of PSs with capacity of 1,000m^3/hr is 43, however a PS will be constructed by the EBRD

Project in an area where water pressure will be under 26m in 2015. This PS was included in the Table IV.2.15 (2) categorized into "monitoring".

Table IV.2.15 (1) Water Pressure Condition of Booster PSs with Capacity of 1000m^3/hr or less

Design capacity (m^3/hr)	Current number of PSs	Estimated results of water pressure condition of PSs				
		26m or more		Under 26m		Transition of water pressure (to become 26m or more)
		2011	2015	2011	2015	2011-2015
1000	44*1	25	35	19	9	10
800-600	14	7	12	7	2	5
500-300	9	4	8	5	1	4
200-100	10	6	10	4	0	4
Under 100	51	36	47	15	4	11
合計	128	78	112	50	16	34

*1: Including new PS by EBRD Project,

Table IV.2.15 (2) Improvement Plan for Booster PSs with Capacity of 1000m^3/hr or less

Design Capacity (m^3/hr)	Category	PSs to became water pressure 26m or more by 2015				PSs with water pressure under 26m in 2015		Total
		Ratio (%)	Action to be taken			Ratio (%)	Action to be taken	
			2011	2012-2015	Total		2011	
1000	Abandonment	15	4	1	5	0	0	5
	Monitoring	10	3	1	4	20	2	6
	Improvement	75	19	8	27	80	6	33
800-600	Abandonment	60	4	3	7	0	0	7
	Improvement	40	3	2	5	100	2	7
500-300	Abandonment	50	2	2	4	0	0	4
	Improvement	50	2	2	4	100	1	5
200-100	Abandonment	50	3	2	5	0	0	5
	Improvement	50	3	2	5	100	0	5
Under 100	Abandonment	85	31	9	40	0	0	40
	Improvement	15	5	2	7	100	4	11
Total			79	34	113		15	128

iv) Planning of the improvement methods for large scale PSs

There are Mirzo-Ulugbek PS with a capacity of 30,000m^3/hr, Chilanzar PS with 7,200m^3/hr and other five PSs with 3,000m^3/hr, excluding PSs from the Table IV.2.15. Examination results for above large scale PSs are as follows:

a) Mirzo-Ulugbek PS will be rehabilitated and the capacity will be changed to 2,600m^3/hr as a result in the hydraulic simulation;

b) Since Chilanzar PS has been constructed in 1996, the result of the diagnosis is good.

It is categorized as "monitoring" because it is distributing water to many nine-story buildings as well as other low story buildings; and

c) Among the five PSs with a capacity of 3000m^3/hr, the one located in Sergeli District will be abandoned, as a result of the detailed survey. Since other four PSs distribute to many 9-story and low story buildings simultaneously, they are categorized as "monitoring".

v) The improvement plan of all PSs and an evaluation of the effectiveness of the improvement works.

Table IV.2.16 shows the number of PSs categorized by capacity range based on the summary of examination results in Table IV.2.15 (2) and the discussion for large scale PSs.

Table IV.2.16 Number of Categorized PSs

Category/capacity(m^3/hr)	Large*2	3000	1000	800-600	500-300	200-100	Under 100	Total
Monitoring	2	4	6	-	-	-	-	12
Improved by 2011	-	-	25	5	3	3	9	45
Improved Later*1	-	-	8	2	2	2	2	16
Sun-total	2	4	39	7	5	5	11	73
Abandoned by 2011	-	1	4	4	2	3	31	45
Abandoned Later*1	-	-	1	3	2	2	9	17
Sub-total	0	1	5	7	4	5	40	62
Total	2	5	44	14	9	10	51	135

*1 :To be conducted between 2012 and 2015

*2:Mirzo-Ulugbek and Chilanzar PS

The number of pump units was estimated at 134 units in 2015, because the necessary number for the Kibray distribution area surveyed is 34 and the ratio of the population in the area out of the city's total population is around 25%. The number of remaining PSs (it is the total number of "monitoring", "improved in 2011" and " improved later" will be 73 of the total existing PSs. The water supply capacity and electricity consumption of PSs will decrease to 22.8% and 31.0% in 2011, respectively, as shown in Table IV.2.17. Thus, the decreased ratios for the water supply capacity and electricity consumption for PSs are expected to be 77.1% and 69.0%, respectively in the target years of F/S (2011).

Table IV.2.17 Comparison between Present and Future of Water Supply Capacity and Electricity Consumption in the Pump Stations

Classifications	Water Pressure	Future decreasing ratio in comparison with present in Kibray Area*1 (%)	PSs in Entire City Area			
			2011		2015	
			Judged PSs *2 (%)	Future in comparison with present*3 (%)	Judged PSs*2 (%)	Future in comparison with present*3 (%)
Water Supply Capacity	26m or more	18	62	22.9	89	19.4
	Under 26m	31	38		11	
Electricity consumption	26m or more	23	62	31.0	89	25.3
	Under 26m	44	38		11	

Note: distribution PSs are not included

*1 : From Table IV.2.9 and Table IV.2.12

*2 : The ratio of under 26m is expected to be 38% in 2011 and 11% in 2015, respectively (refer to Table IV.2.14).

*3 : Multiply the vale of *1 by *2 for pressure range of 26m or more. For under 26m, each of the values are added (for instance, water supply capacity in 2011 is calculated as follows, 18% x 62% / 100 + 31% x 38% / 100 = 22.9%).

(6) Contents of Improvement for Distribution Network

Study results by F/S for the improvement of the distribution network are summarized in Table IV.2.18.

Table IV.2.18 Lists of Improvement Plan in F/S

Facilities	Contents of improvement/replacement
Kibray WTP	Pump distribution system will be changed to gravity
Distribution Network	The network will be divided into five including Boz-su distribution areas
	Automatic pressure and flow regulation system will be introduced
	Reinforcement pipes of 16.8km will be installed
Booster PSs	A monitoring system will be introduced in 12 large scale PSs in 2001 (sift operators are necessary because automatic control will not be introduced)
	Automatic control and monitoring system will be introduced in 45 PSs in 2011 and additional 16 PSs will be improved until 2015
	106 pump units were installed in 2011 for 9-story apartments and an additional 28 units will be installed until 2015
	45 booster PS will be abandoned in 2011, and additional 17 PSs will be abandoned at a later time

IV.3 Operation and Maintenance and Organizational Arrangement

IV3.1 Operation and Maintenance

(1) Staff Assignment

The replacement of the water supply facilities by the EBRD Project, the improvement for the water distribution system and the replacement of deteriorated pipelines for the water supply facilities of Tashkent city will be completed in the target year of 2011. There will be changes in staff assignments as the improvement of the above water supply system progresses. Table IV.3.1 shows a plan of staff assignment for the facilities' operations. Since the rapid filters will be automatically operated for Kadirya and Boz-su WTP, and pumps that will be installed for Kibray WTP by the EBRD Project will also be operated automatically, there will be a reduction in the number of shift operators in these WTPs.

Table IV.3.1 Plan of Staff Assignment

Category		Year	Shift Operation	Operation	Mechanic Electric Repair	Laboratory	Total
WTPs to be operated continuously		Present	199	192	90	32	513
		2011	145	160	88	32	425
South WTP (expected to be abandoned in 2012)		Present	48	39	16	12	115
		2011	24	20	10	12	66
Abandoned WTPs by 2011		Present	178	46	37	12	273
		2011	0	0	0	0	0
Booster PSs	Present		585	173	36	0	794
	2011	Shift	172	44	30	0	246
		Patrol*1	40	60	10	0	110
		Sub-total	212	104	40	0	356
Total		Present	1,010	450	179	56	1,695
		2011	381	284	138	44	847
Effect of Project (Reduction)			629	166	41	12	848

*1: They belong to the operational headquarter in Kara-su WTP and patrol each WTP

There is a number of staff operating booster PSs but this will decrease with the automatic operation and monitoring system in the Project formulated by F/S. For these PSs, the staff in

charge of patrol and some emergency shift operators will only be assigned in the management office in Kara-su. Some shift operators for large-scale booster PSs will remain because these PSs were not installed with automatic control devices. The shift operators for the PSs, which will be abandoned after the completion of the F/S Project for water distribution system, will need to be assigned to the facilities until the close of those PSs.

(2) Electricity/ Chemical Consumption

1) Electricity consumption

In the target year of F/S (2011), power consumption can be calculated as shown in Table IV.3.2. The South WTP will be partly operated, and its power consumption calculated for the WTP. As for the Kibray WTP, unit power consumption will decrease with the replacement of well pumps and the change to the distribution by gravity flow.

Table IV.3.2 Electricity Consumption and Costs in 2011

Category	Name	Unit consumption kWh/m^3		Water Distribution 1,000 m^3/d		Electricity Consumption GWh/y		Annual cost			
								2002		2011	
		2002	2011	2002	2011	2002	2011	Mil. soum	1000 USD	Mil. soum	1000 USD
WTPs to be operated continuously	Kadirya	0.105	0.110	2,100	1,340	80.3	53.8	2,626	2,409	1,759	1,614
	Kibray	0.423	0.200	354	312	54.6	22.8	1,785	1,638	744	683
	Boz-su	0.275	0.290	250	134	25.1	14.2	821	753	464	426
	South	0.170	0.170	142	45	8.8	2.8	288	264	92	84
	Sub-total	0.162	0.140	2,846	1,831	168.8	93.6	5,520	5,064	3,059	2,807
PSs	Existing	0.111	0.039	2,200	1,696	88.8	24.0	2,903	2,664	784	720
	PSs in WTPs	0.043	0.039	700	135	11.0	1.9	360	330	64	58
	Sub-total	0.094	0.039	2,900	1,831	99.8	25.9	3,263	2,994	848	778
Others		0.304	-	54	0.0	6.0	0.0	196	180	-	-
Total		0.259	0.179	2,900	1,831	274.6	119.5	8,979	8,238	3,907	3,585

Note: 1 USD = 1,090 UZS (in 2004)

Power consumption by booster PSs will be decreased sharply by the pressure increase as the reduction of water distribution amount and abandonment and improvement of booster PSs. However, since the amount of water to be distributed to the city in 2011 will be greater than required in 2015 as the target year of the LTDP the pressure of a 26m head cannot provide water consistently in many areas in the city. The estimated ratio of booster PSs with the pressure range over 26m will be 62% in 2011, and 89% in 2015.

Based on a detailed survey carried out for Hamza, Mirabad Sergeli and Bectemir District, it is estimated that in 2011, when the consumption of PSs in WTPs are included, the electricity consumption of PSs will be reduced by 20% of the present consumption in the case that the water pressure is 26m or more, and 38% in case it is under 26m. The decreased ratios of electricity consumption to the current value, when PSs in the City are improved, are calculated in Table IV.3.3, using the two abovementioned decreased ratios. As shown in Table IV.3.3, when the improvement of PSs is implemented, the electricity consumption ratio to the present value decreased to 26.8 % in 2011 and 22% in 2015, as shown in the table.

In the actual calculation of electricity consumption, margin of 50Lpcd was added for the design per capita consumption of 150 Lpcd (thus domestic supply was set at 200 Lpcd). Therefore, the fraction of these values was omitted and was set at 26 % in 2011 and 20 % in 2015, respectively.

Table IV.3.3 Decreasing Ratio of Electricity Consumption

Classifications	Water Pressure Condition	Future decreasing ratio in comparison with present in Kibray Area	PSs in Entire City Area			
			2011		2015	
			Judged PSs *3	Future comparison with present *4	Judged PS *3	Future comparison with present *4
Capacity	26m or more	20% *1	62%	26.8%	89%	22.0%
	Under 26m	38% *2	38%		11%	

*1: Refer to Table 9.1.4 (1) in Vol.2 Main Report.
*2: Refer to Table 9.1.4 (2) in Vol.2 Main Report.
*3: The ratio of under 26m is expected to be 38% in 2011 and 11% in 2015, respectively (refer to Table IV.2.14).
*4: *1 or *2 and *3 are multiplied in the case of the pressure range of 26m or more, and under 26m, respectively, added in 2011 and 2015.

2) Chemical consumption

The injection ratio of chlorine will be the same as the current one, because this is considered as appropriate. However, the dosing ratio of coagulant at Kadirya WTP should be increased to same level as with Boz-su WTP in order to distribute better quality water. The increased dosing ratio will commence in 2011. Calculation results of chemical consumption and costs are shown in Table IV.3.4.

Table IV.3.4 Chemical Consumption and Costs in 2011

WTP Name	Chemicals	Unit consumption mg/L		Distribution 1,000m^3/d		Consumption t/year		Cost USD (soum) / year			
								2002		2011	
		2002	2111	2002	2011	2002	2011	1000 USD	(Mil. soum)	1000 USD	(Mil. soum)
Kadirya	Coagulant	2.0	10.0	2,100	1,340	1,533.0	4,891.0	165.3	(180.2)	527.2	(574.6)
	Liquid chlorine	0.7	0.7			523.3	342.4	83.7	(91.2)	54.8	(59.7)
Kibray	Liquid chlorine	0.4	0.4	354	312	46.9	45.6	7.5	(8.2)	7.3	(8.0)
Boz-su	Coagulant	11.5	11.0	250	134	1,048.7	538.0	113.0	(123.2)	58.0	(63.2)
	Liquid chlorine	0.8	0.8			73.6	39.1	11.8	(12.9)	6.3	(6.9)
South	Liquid chlorine	0.3	0.3	143	45	15.6	4.9	2.5	(2.7)	0.8	(0.9)
Others	Liquid chlorine	-	-	197	0	3.4	0.0	0.5	(0.5)	0.0	(0.0)
	Hypochlorite	-	-			9.7	0.0	9.7	(10.6)	0.0	(0.0)
Total	Coagulant	-	-	-	-	2,582.0	5,429.0	278.3	(303.3)	585.2	(637.8)
	Liquid chlorine	-	-	-	-	615.9	386.4	106.0	(107.4)	69.2	(75.5)
	Hypochlorite	-	-	-	-	9.7	0.0	9.7	(10.6)	0.0	(0.0)
	Total	-	-	2,900	1,831	-	-	394.0	(429.5)	654.4	(713.3)

IV.3.2 Organizational Arrangement

(1) Staff Rearrangement in Vodokanal

One of the expected results of this Project's implementation is the reducing approximately 850 employees in Vodokanal. However, this cutback does not seem to create any significant problems, neither for Vodokanal, nor for the *Hokimiyat*, since this will be done gradually during the period of the Project's implementation. Furthermore, there are other positive developments to alleviate the reduction:

- Natural attrition in Vodokanal due to retirement will account for about 200 people by 2010;
- The implementation of the Project (construction works) will require additional labor; and
- New employment opportunities in the newly established subsidiaries.

(2) Project Implementation Arrangement

Just like all other projects implemented in Tashkent and financed by international donors, Tashkent city *Hokimiyat* would take the overall responsibility for project implementation

and would be the borrower of the funds, and would re-lend this to Vodokanal.

For Project management and implementation, the Project's executing agency would be required to be established under *Hokimiyat*, namely under its Investments Department. In this case, the Project's management organization would be very similar to that of the on-going EBRD Projects. It would be desirable for a new executing agency to be established on the basis of the existing EBRD project implementation unit.

IV.4 Project Costs and Implementation Plan

IV.4.1 Procurement Plan for Materials

(1) Necessary Materials and Equipment

The required materials and equipment for each facility are listed in Ⅳ4.1.

Table IV.4.1 Lists of Necessary Materials and Equipment

Facilities	Equipment and Material
Kibray distribution facilities	Pumps
	Pipes with valves
	Electrical equipment
	Instrumentation facilities
Pressure and flow regulation system	Automatic valves
	Instrumentation facilities
Monitoring station	Monitoring system
Pipe replacement and reinforcement	Pipes with valves
Booster PS	Pumps
	Pipes with valves
	Electrical equipment
	Instrumentation facilities

(2) Procurement Plan

To procure the needed materials and equipment, the Study Team surveyed current procurement conditions in Tashkent city, and as a result of the survey, a procurement plan is proposed as shown in Table IV.4.2.

Table IV.4.2 Proposed Procurement Plan

Material/Equipment		Country of Production for existing facilities	Proposed countries for procurement	Note
Pumps	Volute pumps	Russia/Uzbekistan	European countries/ Japan	
	Pump units	Germany	European countries/ Japan	
Pipes	Steel pipe	Russia	Russia/Turkey	
	Cast iron pipe	Russia	-	Not to be used
	Ductile iron pipe	-	Russia/ Turkey	
	PVC/ Polyethylene	Russia/Uzbekistan	Russia/ Turkey/ Uzbekistan	For small dia
Valves	Manual Valves	Russia/Uzbekistan	Russia/Turkey	
	Automatic Valves	Russia	Russia/Turkey	
	Automatic Valves (pressure & flow regulation)		European countries/ Russia	
Electrical material/ equipment	High voltage switch gear	Russia	European countries/ Russia	
	Low voltage switch gear	Russia	European countries/ Russia	
	Cable electrical materials	Russia	European countries/ Russia	
Instrumentation facilities		Russia	European countries/ Japan	
Monitoring system		-	European countries/ Japan	Currently no monitoring

IV.4.2 Construction Plan

(1) Contents of Construction

The contents of construction works are listed in Table IV.4.3.

Table IV.4.3 Contents of Construction Works

Facilities	Contents of works
Improvement for Kibray distribution facilities	Pipe installation outside
	Pump installation and pipe works in building
	Electrical works
Pressure and flow regulation System	Valve installation on road
	Electrical works
Monitoring station	Electrical works in buildings
Pipe replacement and reinforcement	Pipe installation in the city
Improvement of booster PS	Pump installation and pipe works in buildings
	Electrical works
	Pipe refurbishing outside

(2) Preparation of Construction

In Uzbekistan, strict official procedures are required for construction works similar to other

countries of former Soviet Union. The procedures for pipe installation are described as follows:

1) To purchase maps for job sites from "Tashkent State Institute of Engineering". The cost is 600,000 soum/ km;
2) To request "Design Authority of Tashkent city" to design the installation works, or to acquire the evidence that shows "designed by the Authority". (Some payment for the costs will be charged);
3) To submit the design for the evaluation by "Evaluation Authority for Construction" (Some payment for the costs will be charged);
4) To obtain construction permission by "Permission Authority for Construction" (Payment of 0.1% of construction costs will be charged);
5) To obtain permission for the road occupation from "Tashkent city Traffic Authority"; and
6) After construction completion, as-built drawings of installed pipeline data shall be submitted to "Tashkent State Institute of Engineering". The pipeline will be integrated in the Digital Map of Tashkent city.

(3) Construction Plan

1) Construction work at Kibray WTP and booster PS facilities

There are no restrictions with traffic or by the residents at surrounding area for renovation works at Kibray WTP and for the renovation of booster PSs facilities. Work on the facilities will have to be well planned to prevent any disruption in water distribution services.

2) Replacement and Installation of Pipes

The installation of approximately 17 km of reinforcement pipes will fall under the Project F/S. Since most of the pipes are located in highly populated residential areas, vehicular traffic is quite heavy. Therefore, countermeasures to mitigate traffic congestion must be made, such as limiting working time and coming up with a detour plan, which will help prevent accidents; as well as preparing public information campaigns and plans to avoid

extended water interruptions. While Vodokanal has continuously implemented replacement works, it should be able to execute the countermeasures on its own.

IV.4.3 Project Costs

(1) Construction Costs

Total construction costs including indirect costs have been calculated and are shown in Table IV.4.4

Table IV.4.4 Total Construction Costs

Name	Facility	Value	Cost (Thousand US$)			Remarks
			Phase 1		Phase 1	
			2007-2008	2009-2011	2012-2014	
Kibray WTP Replacement/ Improvement	Pipe rearrangement	1		1,755		
	Distribution PS	1		269		
	Sub-total			2,024		
Booster PS Improvement	Mirzo-Ulugbek	1		1,440		
	Other PSs	1		7,958		
	Sub-total			9,398		
Pipeline Network Improvement	Reinforcement of Pipes	16.8km		10,554		
	Pressure Regulation Valves	22units		2,090		
	Monitoring station	1		427		
	Sub-total			13,071		
Total of F/S Project				24,493		
Pipeline Replacement	D1200-D100	120km	12,989			Upper area
	D1200-D100	120km		12,989		Middle area
	D1200-D100	180km			19,484	Low area
	Sub-total	420km	12,989	12,989	19,484	Total 45,462
A) Total direct cost			12,989	37,482	19,484	Total 69,955
B) Total imported material cost			6,431	24,459	9,646	
1) Land acquisition cost		-	0	0	0	
2) Administration cost:		-	260	750	390	A) x 2%
3) Engineering Services:		-	1,039	2,999	1,559	A) x 8%
4) Physical Contingency		-	1,195	3,448	1,793	A)-3) x 10%
5) Price Contingency (Phase1-1)		-	719			A)-4) x6.1%(2%- 3years)
5) Price Contingency (Phase1-2)		-		3,540		A)-4) x10.4%(2%- 5years)
5) Price Contingency (Phase2)		-			2,636	A)-4) x14.9%(2%- 7years)
6) Import Tax		-	514	1,957	772	B) x 8%
7) VAT		-	2,495	7,105	3,741	A)-6) x 20%
C) Total indirect cost			6,223	19,798	10,891	
Grand Total A)+C)			76,492		30,375	
Grand Total A)+C), Phase 1 -Phase 2			106,867			

Note: When the investment will be financed from foreign donor/bank, import tax and VAT will not be necessary

(2) Operation Costs

Operation costs for the facilities are shown in Table IV.4.5.

Table IV.4.5 Operation Cost of Electricity, Chemical and Labor

Items	Consumption/Number			Cost USD (soum) / year				Unit price
				2002		2011		
	2002	2011	Unit	1000 USD	(Mil. soum)	1000 USD	(Mil. soum)	
Electricity	274.6	119.5	GWh/year	8,238	(8,979)	3,585	(3,907)	30USD/1000kWh
Coagulant	2582	5429	ton/year	278.3	(303.4)	585.2	(637.8)	107.8 USD/t
Liquid Chlorine	615.9	386.4	ton/year	106	(115,5)	61.8	(67.4)	160 USD/t
Solid Chlorine	9.7	0	ton/year	9.7	(10.5)	0	0	1,000 USD/t
Sub-total				8, 632	(9,408)	4,232	(4,612)	
Operators	1,695	847	person	1,017	(1,109)	508	(554)	600 USD/person/y
Total				9, 649	(10,517)	4,740	(5,166)	

Note: 1 USD = 1,090 UZS (in 2004)

IV.4.4 Implementation Schedule

(1) Phasing of the Project

The replacement of deteriorated pipes is a precondition for the implementation of the Project formulated by the F/S. This is because the move to the distribution by gravity flow will require the reduction of the current water supply. Accordingly the replacement of deteriorated pipelines shall be executed simultaneously with the F/S Project and the combined Project, which includes the F/S Project and the pipe replacement, is named to be "Highest Priority Project". Vodokanal must secure adequate funding for the pipe replacement work to start early. The construction period will take eight years, with 60 km of pipelines to be installed annually, for a total of 420 km of pipelines to be replaced. The construction period will be divided into two phases: Phase 1 (2007-2011) is composed of the replacement of the pipes and major components of the F/S Project. The first stage (period: 2007-2008) will take two years and will entail pipe replacement in the high elevation area. This is the first priority area for pipe replacement. The second stage (period: 2009-2011) will take three years, and will consist of pipe replacement in the middle elevation area, together with the implementation of the components of the F/S Project. Phase 2 will take another three years (2012-2014) and will involve pipe replacement in low elevation area.

(2) Implementation Schedule

The implementation schedule for the Highest Priority Project is shown in Figure IV.4.1 and is based on the aforementioned development plan. The schedule of the EBRD Project is also shown in the figure.

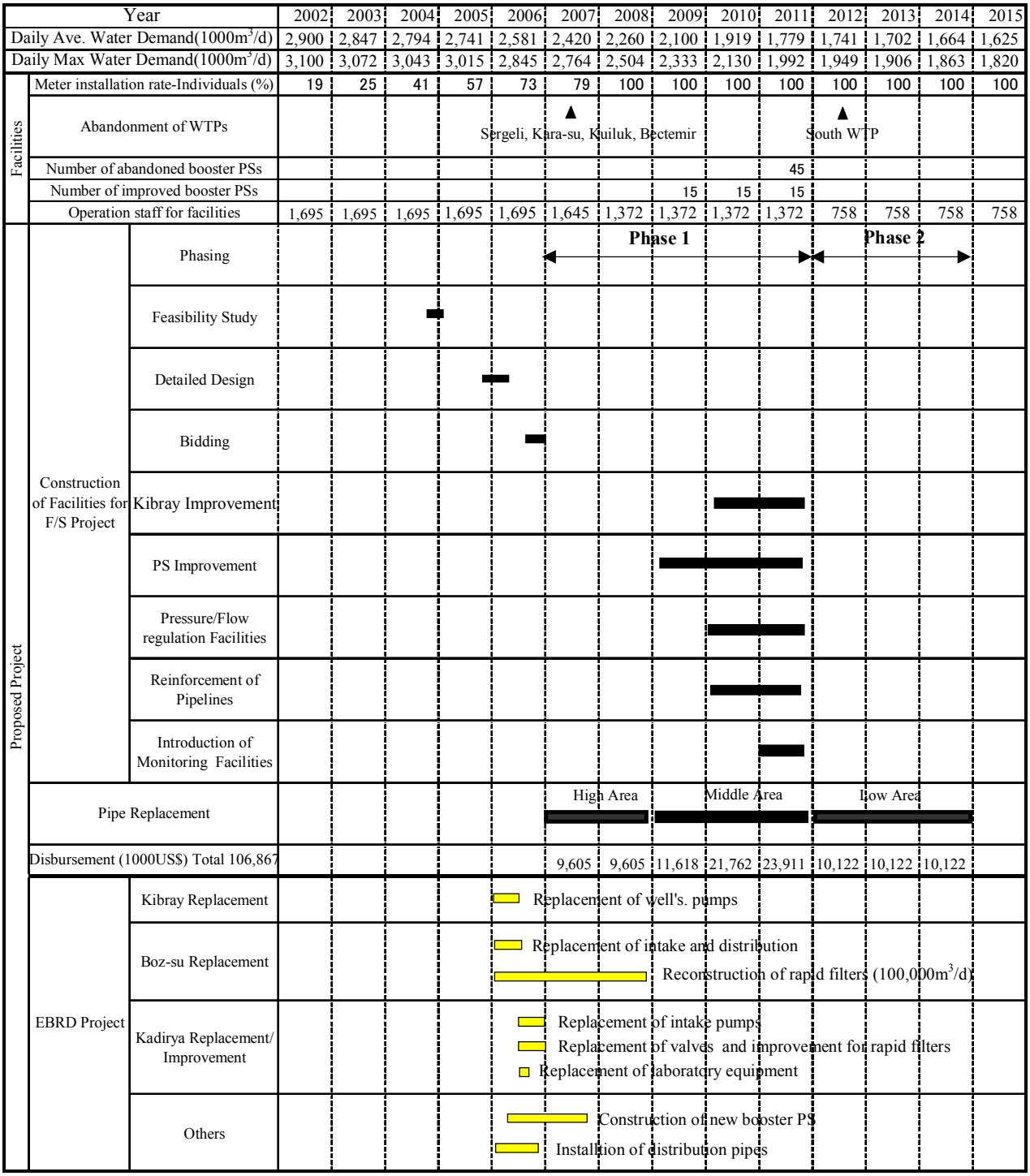

Figure IV.4.1 Implementation Schedule of Highest Priority Project

IV.5 Project Evaluation

IV.5.1 Financial Evaluation

In this section, a financial evaluation was conducted by adding the replacement of pipelines in the F/S project. The Equalizing Discount Rate (EDR) was employed as the evaluation indicator.

(1) General Definitions and Assumptions

1) "With" and "Without" scenarios

i) "With" scenario

The "With" scenario is the case when the F/S project is implemented and the pipeline is replaced. In addition, the EBRD projects and meter installation are also assumed to be completed as planned.

ii) "Without" scenario

In Tashkent city's case, the "Without" scenario does not mean that there are no changes from the current status, but some factors, such as leakage increase and considerable amount of continuous repairs due to insufficient investment and further deterioration of facilities, will be considered. In this scenario, water production volume will increase as the leakage rate increases in order to meet the water supply. The EBRD projects and meter installation are also assumed to be completed as planned because these plans have already commenced.

2) General assumptions

i) Water Demand - Revenue

In the assumption of both "With" and "Without" scenarios, the demand of water is the same. As Vodokanal has estimated that it will be able to meet the demand in the future,

the amount of revenues will be the same in both scenarios. In this connection, tariff increase will have no impact on the incremental benefits or costs for EDR calculation;

ii) Economic Life

The average economic life of new assets provided under the F/S project was assumed to be 40 years. For new assets whose economic life is less than 40 years, recurring capital costs are included in EDR calculation;

iii) The evaluation was carried out in USD at current prices with no adjustments for the effects of inflation and exchange rate fluctuations; and

iv) Since at this moment, the source of the investment fund is unknown, VAT and import duties are included in the total investment cost.

3) Incremental Financial Benefits and Costs

Under the above-mentioned definitions and assumptions, namely the two scenarios, the incremental financial benefits and cost are summarized as follows;

i) Incremental Financial Benefits

- Differences in the operation costs due to production volume difference, i.e. Production volume difference [m^3/d] x unit production cost (electricity and chemical) [kWh/m^3 or t/m^3]. Production volume reduction through meter installation is considered as a precondition for both "With" and "Without" scenarios;
- Reduction in the number of employees due to the optimization of the distribution system and the reduction of the production volume;
- Differences in the maintenance/repair cost; and
- Differences in energy efficiency through the optimization of the distribution system, i.e. unit production cost difference [kWh/m^3] x production volume [m^3/d]. Efficiency improvement with the implementation of the EBRD projects is considered as a precondition for both "With" and "Without" scenarios.

ii) Incremental Financial Costs

- Initial capital investment cost of the Highest Priority Project, 100 million USD, excluding price contingency; and
- Recurring capital investment cost of the equipment of Highest Priority Project, e.g. pumps, control and monitoring equipment, etc.

(2) EDR Calculation Results

Results of the EDR calculation with sensitivity analysis is shown in Table IV.5.1.

Table IV.5.1 EDR Calculation Results with Sensitivity Analysis

Benefit / Initial Cost	+ 10 %	Base Case	- 10 %
+ 10 %	9%	8%	7%
Base Case	10%	9%	8%
- 10 %	11%	10%	9%

(3) Effects of the F/S Project and Replacement of Pipelines on Vodokanal's Overall Management

1) Results of financial simulations

i) A slow tariff increase scenario

Table IV.5.2 presents the results of the financial simulation, showing changes in the borrowing rate of interest, and taking into consideration the affordability of domestic customers by employing a slow tariff increase scenario. It assumes the annual tariff will increase by 3% from 2006 to 2016, 2025, 2030, and 2040, respectively.

Table IV.5.2 Simulation Results of Slow Tariff Increase by Interest Rate

Interest Rates	Tariff increase until			
	2016 Cumulative increase: 1.4 folds	2025 Cumulative increase: 1.8 folds	2030 Cumulative increase: 2.1 folds	2040 Cumulative increase: 2.8 folds
1.3%	No cash shortage during 2005 to 2040 Cash surplus of USD 7 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 130 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 185 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 239 million by 2040
5.0%	Cash shortage*	No cash shortage during 2005 to 2040 Cash surplus of USD 68 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 123 million by 2040	No cash shortage during 2005 to 2040 Cash surplus of USD 177 million by 2040
10.0%	Cash shortage	Cash shortage	Cash shortage	Cash shortage

Note: Tariff increase rate (per year) during 2006-2040: 3%

* If tariff increases until 2016, cash shortage will occur after the period (see Volume 3, S 11-1-3)

ii) Tariff increase required under a 10% interest rate

Table IV.5.3 Tariff Increase Simulation for 10% Interest Rate

Interest rate	Annual Tariff Increase				Results
10%	2006 – 2014	2015 - 2019	2020 - 2026	2027 - 2040	Cash surplus of 133 million USD by 2040
	4%	5%	3% Cumulative increase: 2.2 folds	0%	

iii) Cash shortages by adopting a 3% annual tariff increase.

Table IV.5.4 Cash Shortages under the Slow Tariff Increase Scenario

Interest Rate	Annual Tariff increase				Results
	2005 – 2010	2011 - 2015	2016 - 2020	2021 - 2030	
10%	3%	3%	3%	3% by 2027 Cumulative increase 1.9 folds	Cash surplus of 72 million USD by 2040
Cash shortage for the period (Cumulative)	0	3 mil. USD (3 mil. USD)	20 mil. USD (23 mil. USD)	41 mil. USD (64 mil. USD)	

2) Conclusions

Table IV.5.5 Feasibility and Minimum Financial Requirements

Borrowing Interest Rates	Feasibility of the F/S Project and the pipeline replacement*	Minimum Required Financial Measures
1.3 %	Feasible	Tariff increase by 3% per annum
5 %	Feasible	Tariff increase by 3% per annum
10 %	Not Feasible*	Tariff increase of more than 3%per annum or Government's Subsidy

* Refer to Table IV.5.1

In order to keep the annual tariff increase rate less than 3%, it is necessary to borrow at an interest rate 1.3 % to 5%. If the interest rate exceeds 10%, the Highest Priority Project is not feasible and a more severe tariff increase or a larger amount of government subsidy will be necessary. When Vodokanal examines the actual funding plan, the following issues are required to be addressed:

i) It is unlikely that Vodokanal will be able to secure funds at such unrealistically low interest rate of 1.3%;
ii) It will be necessary to consider the possibility of an Uzbekistan internal fund, if Vodokanal could borrow the funds from international financial institutions or foreign governments. In general, international financial institutions do not finance the full amount of a project and require the borrowing country to finance a part of the necessary investment amount. The internal funds will be mostly used for civil engineering works and installation of machineries, which will be conducted by Vodokanal's affiliated companies.
iii) In the financial simulation, income tax is assumed to be exempted during the borrowing period. Otherwise, further tariff increases will be unavoidable. One of the reasons of this assumption is that the Highest Priority Project is both rehabilitation projects and do not generate extra revenue.

IV.5.2 Socio-Economic Evaluation

A stable supply of water is one of the Basic Human Needs (BHN). The F/S project and the pipeline replacement are essential for people living in Tashkent. Therefore, in the evaluation of the economic viability, Economic Internal Rate of Return or other indicators were not included in this analysis. Instead, the economic benefits realized by the Highest Priority Project were calculated and described.

The economic benefits provided by this project after its implementation can be summarized into the following:

- Public health benefits
- Improvements in living conditions

(1) Public health benefits

The F/S project, especially the pipe replacement project, will improve the quality of water being supplied to households, positively contributing to the improvement of public health. In addition, without the F/S project, water supply facilities will be further deteriorated, putting public health at risk, which in turn, would lead to potential reduction in the opportunity costs of labor.

(2) Improvements in living conditions

Living conditions will improve for not only the same reasons as stated above, but there also will be less water supply interruptions caused by accidents in the distribution system after the new pipes are installed.

IV.5.3 Technical Evaluation

The study is mainly composed of activities that would lead to the formulation of an efficient distribution system. The study was carried out by preparing preliminary design, developing O&M policies and procedures, preparing the procurement and construction plans, calculating the project cost, formulating the implementation schedule, and project evaluation. These improvement plans were formulated to save energy, to establish efficient and effective facilities' operation, to have the right mix of required manpower, and to attain minimum construction costs while maintaining conformity with the technical conditions prevalent in Uzbekistan. With all these taken into consideration, the project is assessed to be appropriate.

IV.5.4 Environmental Evaluation

The implementation of the project will not generate any serious environmental problems, since

much of the work will focus on improvement works of existing system. However it is anticipated that the construction component of the Highest Priority Project, particularly the installation of pipe reinforcement and pipe replacement, will affect traffic in the city.

The installation of pipe reinforcement and pipe replacement will have to be carried out on city thoroughfares. Many of these roads are located inside residential areas, which may not be major roads but are used by the residents. Therefore, detour roads must be prepared when construction on the pipe replacement/reinforcement starts, in addition to the preparation of plans to mitigate noise, vibration and dust.

The main roads in Tashkent city are generally wide with a center island, and ample space for sidewalks. If the pipes are installed in either the center island or the sidewalks, then traffic would not be affected. Some roads in residential areas are relatively narrow (around 6m), but detour roads can be prepared when pipe replacement is done. In addition pipe installation work will not adversely affect the residents along the roads because apartment building and detached houses have buffer zones or setbacks. Therefore, proper planning is required and mitigating countermeasures be put in place before construction works can proceed. Some of these are the construction of detour roads, the selection of proper construction time, and the development of an information dissemination campaign on the Project for the people who would be affected by the construction

Chapter V Conclusions and Recommendations

Chapter V Conclusions and Recommendations

V.1 Conclusions

The overall goal of the LTDP is to achieve a "stable supply of safe water by 2015" under sustainable management by Vodokanal. To accomplish this goal, the following targets have been set:

- Providing a stable supply of water;
- Establishing self-financed management; and
- Establishing an efficient management organization.

Present Situation in Vodokanal

Firstly, the analysis of the present situation in Vodokanal is shown as follows.

(1) In 2002, NRW in Tashkent city amounted to 1,400,000 m^3/d (per day), and the ratio of NRW in the total production of water of 2,900,000 m^3/d (per day), which totals approximately 48 percent.

(2) In the tariff structure in 2003, 16 percent of individual consumers made the transition to the metered system. However the remaining consumers are still using the norm system, which does not encourage an awareness of water saving.

(3) In regards to the facility, there are eight WTPs (three of which are large-scale operations such as Kadirya, Kibray and Boz-su). Even the most recent facility, which was built in the 1960s, is suffering from serious deterioration, due to a chronic lack of funds allocated to repairs, maintenance and operations.

(4) The service reservoirs in the Kadirya and Kibray WTPs are situated at a higher altitude than the city, and as such, they can employ gravity flow for their operation. However, the PSs were not designed for such a geographical advantage. Furthermore, it is estimated that the pipelines have ten leakage points per kilometer per year for the deteriorated pipeline.

(5) By the end of 2003, there were 4,695 employees of Vodokanal. Of this number, 1,695 were located within the operations of the facilities, with 1,010 of those located as shift operators.

(6) In order to solve the above-mentioned problems, Vodokanal implemented a project to rehabilitate its facilities, borrowing funds from the EBRD, and attempting to make the transition from the norm system to the metered system in the tariff scheme. However, the attempt to change to the metered system has faced delays. In addition to this, Vodokanal does not have a long-term investment plan, due to an inability to insure investment funds.

(7) While increases in the tariff system have been made in the last few years, it is difficult to increase tariffs, due to the living standards of the inhabitants.

(8) As in the above-mentioned, there are many challenges facing Vodokanal. However, as in the case of delays in the transition to a metered system, Vodokanal has not taken adequate measures to solve the problems presented, and needs to have a proper management structure put in place.

Proposed Project Objectives

In response to the above-mentioned problems, the following objectives for the proposed project will be addressed as below.

(1) Current NRW stands at 48 percent. In order to reduce this to 29 percent by 2015, there needs to be an implementation of the NRW Reduction Program, the Rehabilitation Program of Deteriorated Facilities and the Water Distribution Improvement Program.

- NRW Reduction Program concentrates on the replacement of pipelines and the installation of water meters, and the strengthening of management for the NRW.
- The Rehabilitation Program of Deteriorated Facilities will concentrate on looking at water demand. It is estimated that there will be a reduction in water demand, once other implementations are underway. According to estimates that will be made on the level of that reduction, WTPs will be closed one by one, with an eventual use of only three WTPs, such as Kadirya, Kibray and Boz-su.

- The Water Distribution Improvement Program will improve the pipelines, introduce pressure regulation functions, and improve pump stations which have the ability to use the gravity system, while abandoning others.

(2) By implementing the LTDP, necessary operation employees decrease from 1,695 at the end of 2003 by 60 percent, to 631 by 2015. It is also possible to reduce electricity consumption by more than 60 percent, as a result of the rehabilitation and improvement of the facilities.

(3) USD158 million in construction costs will be required to rehabilitate and improve the facilities.

(4) A large amount of investment funds will be required. Financial simulation was undertaken with regard to the required financial resources for the rehabilitation of the facilities and its repayment scheme. The analysis indicates that if funds are available at an interest rate of below 5% per year, Vodokanal will not have to rely on government subsidy, and so consumers will not be excessively burdened by excessive water tariffs (see Table II.3.14). However, if the interest rate is above 5% per year, it will be a tremendous financial burden for consumers, (especially tariff increases will be sharp). But to avoid such a situation, the government's subsidy might be necessary to reduce the burden for the consumers (see Table II.3.15 and 16).

(5) In order to improve the strength of the Vodokonal management system, this study proposes: (i) an improvement in the tariff structure, which takes into the consideration each stage of transition to a metered system, (ii) a management and organizational improvement program, which emphasizes the measurement for effective resolution of problems within this area, making it more sustainable unto itself, (iii) information sharing program, which targeted to share management information and (iv) co-operation program with domestic customers.

(6) The F/S project was formulated on the basis of improving the water distribution system, which is expected to save energy in parallel with the implementation of the plan to reduce NRW and to rehabilitate the deteriorated facilities. The implementation of the F/S project and replacement of pipelines will reduce electricity by 57%, and the number of employees

by 50% in 2011. The financial resources and repayment in the F/S project is same as referred in (4). Furthermore, since it is difficult to analyze the profitability of the project by employing the IRR method, the EDR (equivalent discount rate) was more appropriate for the analysis, and the result indicated an EDR of approximately 9%.

V.2 Recommendations

In order to improve Tashikent's water supply operations in the future, the LTDP proposed in this study should be carried out and ultimately realized. Vodokanal will play a core role in the actual implementation process. Thus, the following recommendations are proposed for Vodokanal and the government.

Recommendations to Vodokanal

(1) It is important to precisely understand the current business situation for the improvement of water supply management in the future as below:

- To understand consumer's propensity to contribute to NRW, such as illegal connections by investigating improper usage;
- To establish facilities (almost all existing facilities are dilapidated) that would be able to provide accurate data on the amount of water at the intake and sent to the WTPs, the amount of water actually being distributed through the system and the water pressure during distribution;
- To utilize data information, collected and analyzed by computers including the quality of water analysis and so on.

(2) In the proposed LTDP, the plan to reduce NRW must be given priority in implementation;

(3) As for the issues that the F/S will not be able to cover, Vodokanal will study and assess these issues;

(4) The importance of daily operation and maintenance activities must be recognized, so a certain portion of the budget must be allocated to maintenance operations;

(5) In implementing the LTDP, the necessary funds would be 158 million USD for the facility plan and 19 million USD for the management plan. Vodokanal should understand the significance of the plan, have accountability to the government, and seek their cooperation in order to procure the necessary funds;

(6) In implementing the LTDP, setting up of the range and subject matter for the training programs, as well as developing the capacity of the trainers are necessary; and

(7) It is vital to get the support of the people through PR activities and increased interaction with the consumers through PR activities because the new programs to be implemented will require tariff increases in the future.

Recommendations to the Government

(1) The government should consider its role in assisting this program in regards to issues of salaries for employees and the implementation of the tariff structure, which will make Vodokanal's water supply more stable.

(2)As the water supply is closely related to other public services and is important to the daily life of the population as a whole, it is necessary to ensure the consistency of the LTDP with the plans and programs of the other public services, and that the Government should cooperate in disclosing and providing information on the project.

(3) As mentioned in the section II.3.8 (2), the government is strongly advised to reform its legal system by introducing international Accounting Standards.

Attachment

A.1 Project Component List

Name	Facility		Number	Project				
				LTDP	EBRD&Others	Priority	F/S	Highest Priority
Kadriya WTP Replacement and Improvement	No.1 Intake PS Rep.		1	○	○	○		
	No.2 Intake PS Rep.		1	○	○	○		
	Sedimentation Imp.		1	○				
	Coagulant Facilities Imp.		1	○				
	Rapid sand filters	Rep.	1	○	○	○		
		Imp.	1	○	○	○		
	Disinfection Facilities		1	○		○		
	Reservoir Reinforceme	V=45,000m^3	1	○		○		
		V=45,000m^3	1	○				
	Distribution PS Rep.		1	○		○		
	Power Receiver Rep.		1	○		○		
	Administration Building		1	○		○		
	Monitoring facilities		1	○	△	○		
	Lab. Equipment Rep.		1	○	○	○		
Kibray WTP Replacement and Improvement	Rep. of well pumps		1	○	○	○		
	Pipe rearrangement		1	○		○	△	△
	Abandonment of PS					○	○	○
	Disinfection Facilities		1	○		○		
	Power Receiver		1	○		○		
	Reservoir	V=20,000m^3	1	○		○		
	Distribution PS(1000m^3/hr)		1	○		○	○	○
	Monitoring facilities		1	○	△	○		
Boz-suWTP Replacement	Intake PS Rep.		1	○	○			
	Rapid Filter Pep.		1	○	○			
	Distribution PS Rep.		1	○	○			
Pipeline Rep.	D1,200-100mm		(420km)	○		○		○
Booster PS Improvement	Mirzo-Ulugbek		1	○		○	○	○
	New PS(1,000m^3/hr)		1	○	○			
	Large scale Monitoring		12	○		○	○	○
	Improvement		45	○		○	○	○
	Improvement		16	○				
	Abandonment		45	○		○	○	○
	Abandonment		17	○				
Pipeline Network Improvement	Reinforcement of Pipes		(2km)	○	○			
	Reinforcement of Pipes		(16.8km)	○		○	○	○
	Pressure Regulation		22	○		○	○	○
	Monitoring facilities		1	○		○	○	○

Note: △is partly included.

A.2 Definition of Non-Revenue Water

<table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th></tr>
<tr><td rowspan="6">System Input Volume

M^3 / year</td><td rowspan="3">Authorised Consumption

M^3 / year</td><td rowspan="2">Billed Authorised Consumption

M^3 / year</td><td>Billed Metered Consumption (including water exposed)</td><td rowspan="2">Revenue Water

M^3 / year</td></tr>
<tr><td>Billed unmetered* Consumption</td></tr>
<tr><td>Unbilled Authorised Consumption

M^3 / year</td><td>Unbilled Metered Consumption</td><td rowspan="4">Non-Revenue Water**

M^3 / year</td></tr>
<tr><td rowspan="3">Water Losses

M^3 / year</td><td rowspan="2">Apparent Losses

M^3 / year</td><td>Unbilled Unmetered Consumption</td></tr>
<tr><td>Unauthorized Consumption</td></tr>
<tr><td rowspan="3">Real Losses

M^3 / year</td><td>Metering Inaccuracies</td></tr>
<tr><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Shortage Tanks</td></tr>
<tr><td colspan="3">Leakage on Service Connections up to point of Customer metering</td></tr>
</table>

* Difficulty may be experienced in completing the water balance with reasonable accuracy where a significant number of customers are not met. In such cases, authorized unmetered consumption should be derived from sample metering of sufficient number of statically representative individual connections of various categories, and /or by measurement of inflows into discrete areas of uniform customer profile (with data adjusted for leakage and diurnal pressure variation as appropriate).

** The IWA Task Force on Performance Indicators recommended that, if the term 'Unaccounted-for-Water (UFW) is used, it should be defined and calculated in the same way as 'Non-Revenue Water (NRW) in the above Table.

Steps for Calculating Non-Revenue Water and Water Losses

Step 1: Define System Input Volume and enter Col.A
Step 2: Define Billed Metered Consumption and Billed Unmetered Consumption in Col.D; enter total in Billed Authorised Consumption (Col.C) and Revenue Water (Col.E)
Step 3: Calculate the volume of Non-Revenue Water (Col.E) as system Input Volume (Col.A) minus Revenue Water (Col.E)
Step 4: Define Unbilled Metered Consumption and Unbilled Unmatered Consumption in Col.D; Transfer to total Unbilled Authorised Consumption in Col.C
Step 5: Add volumes of Billed Authorised Consumption and unbilled Authorised Consumption in Col.C; enter sum as Authorised Consumption (top of Col.B)
Step 6: Calculate Water Losses (Col.B) as the difference between System Input Volume (Col.A) and Authorised Consumption (Col.B)
Step 7: Asses components of Unauthorised Consumption and Metering Inaccuracies (Col.D) by best means available, add these and enter sum in Apparent Losses (Col.C)
Step 8: Calculate Real Losses (Col.C) as Water Losses (Col.B) minus Apparent Losses (Col.C)
Step 9: Asses components of real losses (Col.D) by best means available (night flow analysis, burst frequency / flow rate/ duration calculations, modeling etc), add these and cross-check with volume of Real Losses in Col.C which was derived from Step 8

Source: International Water Association (2000)
"Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures", IWA, p.5