5.5 Management Plan for Implementation of Rehabilitation

5.5.1 Considerations for Optimum Management

Ideally, the water supply system in Tashkent City by the year 2015 should be able to offer a stable, adequate and reliable water supply to its customers. This can be achieved through the adoption of management improvement programs that aim for organizational excellence.

The first program is the adoption of strategic management practices that will serve as the driving force in creating and sustaining Vodokanal. Strategic plan formulation, strategy implementation, and evaluation and control are the steps that Vodokanal must link to its mandate (vision and mission). Strategies and policies will be put into action through the development of programs, budgets, and procedures and the establishment of evaluation and control systems to ensure that strategic objectives are realized.

The second program will focus on processes for total quality improvement. This involves examining areas in the organization that need improvement. Since processes make up systems, and a set of inter-related systems make up the organization, process improvement measures will help solve problems and, therefore, improve management as a whole. One of the more successful models in achieving organizational excellence is the continuous process improvement called the "Plan-Do-Check-Act"[15] or the PDCA cycle. This model is appropriate for Vodokanal because it is a problem solving process that can be successfully initiated by management and finding solutions can be found with the active involvement of senior and middle management and the rank-and-file employees.

[15] The concept of the PDCA Cycle was originally developed by Walter Shewhart in the US during the 1930's. It is often referred to as the "Shewhart Cycle". It was taken up and promoted very effectively from the 1950s on by the famous Quality Management authority, W. Edwards Deming, and is consequently known by many as the "Deming Wheel". The PDCA Cycle is used to coordinate continuous improvement efforts. It both emphasizes and demonstrates that improvement programs must start with careful planning, must result in effective action, and must move on again to careful planning in a continuous cycle.

Both strategic management and process improvement programs will lay the foundation toward sustainable management of Vodokanal so that it can continue to provide uninterrupted, efficient, effective, safe and reliable water supply services to its area of operation.

(1) Strategic Management

Strategic management is the set of managerial decisions and actions that determine the long-term performance of Vodokanal. It seeks to manage all Vokokanal's resources to develop its water supply service objectives and sustain future operations. The development of strategy may be a lengthy process, but it will be supportive of Vodokanal's transition to an independent, financially viable and sustainable organization. As of the present time, Vodokanal is not yet at that stage of practicing strategic management where it relates holistically to environmental scanning, strategic plan formulation, implementation and evaluation and control. However, this does not preclude the ability of Vodokanal to initiate and execute this dynamic management system, considering that it is transitioning to a business-like and service-oriented operation. Hereunder are the elements in the strategic management framework.

1) Environmental Scanning

In strategic plan formulation, a practical scanning of Vodokanal's internal environment (strengths and weaknesses) and the external environment (opportunities and threats) must be done. This is known as the SWOT analysis. The issue here is to leverage the identified weaknesses in Vodokanal (such as lack of autonomy as shown in the command-and-control type management decision flows, financial insufficiency, inadequate O&M, among others) against its perceived strengths (sources of water) in order to take advantage of opportunities and minimize the effect of threats/risks in order to create a sustainable organization.

For example, strengths or weakness may be revealed in examining management capabilities, performance capabilities and financing capabilities. Some examples of

the capabilities and questions to be asked during a SWOT analysis session by Vodokanal's management are:

- Organizational structure: Does Vodokanl's organizational structure hinder or facilitate a free flow of information? What about customer-responsiveness implementation of activities, such as metering?

- Planning: Have feasible mid-term and long-term plans been made by participatory processes involving staff and community?

- Coordination: How well do different departments of Vodokanal cooperate and coordinate with each other?

- Staffing: Are staff roles clear? Does staff have performance-based appraisals and salary schemes to ensure high performance?

- Supervision: Do all staff meet regularly with a supervisor? Does staff view the supervisor's role as one of guidance, assistance and support?

- Training: Are training needs of staff regularly assessed and the training provided to keep staff adapted and updated with new business practices and water supply technologies?

- Management Information System: Do the top managers have accurate information on the progress made toward the objectives of the programs, such as metering, public relations and fund sourcing?

- Capacity: What is the potential capacity of the different programs to provide water supply services? Does the current level of activities match this capacity?

- Quality: How the quality of water supply services can be improved or the NRW reduced? What is the level of customer satisfaction as shown through complaints and requests?

- Self-financing: What is the current level of self-financing through tariffs?

- Outside funding sources: What are the current sources of financing for the planned improvement programs? How stable are these sources?

The factors in the macro-environment, such as the politico-legal framework (laws, regulations and institutions), the socio-economy (GDP and physical resources) and technological factors (communication, information technology, physical infrastructures) also have considerable impact on strategic plan formulation; therefore, it is important to identify such issues in the strategic plan itself.

The success of the strategic plan, and its eventual implementation, hinges on the re-alignment of the organization – its structure and its people – to the strategies selected, and with the vision and mission, or mandate of Vodokanal. The re-alignment of human resources may mean restructuring or retrenching, transferring and separating and retooling and reengineering. What is important is backstopping plans with adequate financial resources to ensure that planned projects and activities are realized. The other resources that are needed for the plan implementation are natural/physical resources (raw materials) technology, knowledge, and information.

2) Strategic Plan Formulation

For Vodokanal, strategic plan formulation starts with a vision for the future; or in other words, the vivid description of the organization as it effectively carries out its operations. Vision inspires the commitment of everyone in the organization for change, and provides direction for doing right things. Then a clear and focused mission statement must be drawn up, which will define why and what Vodokanal does. While this can be found in the legal mandate of the organization, mission also addresses opportunities and matches organizational competencies to exploit, use and develop the opportunities. Modern-day organizations look upon the vision-mission statements as strategic requirements that bind each individual in the company to the achievement of objectives.

3) Strategic Implementation

The relationship between strategy formulation and implementation can be viewed from the perspective of who implements the plan. Plan implementation must be led by the top management team, such as the directors; the senior to lower level managers, or the deputy directors, and all administrative and technical support personnel. They must be able to transform available resources of Vodokanal into performance and achievement through the practice of good management. Plan implementation, therefore, is where strategies and policies are put into action and are translated as programs, budgets and procedures involving changes within the overall culture, structure, and/or management and organizational decisions on resource allocation. Good management practice requires each functional manager to be proficient in planning, organizing, leading and controlling; and that each person in the organization knows his/her place and contributes his/her share in attaining the goals and objectives of Vodokanal. Each functional area or department of Vodokanal – general services, finance and accounting, sales and marketing, and technical operations – must be able to function as one part of the whole organization, not merely an island to itself. Departments and divisions must be able to coordinate, cooperate, share knowledge, experience and information among each other.

4) Strategic Evaluation and Control

The final step in strategic management is evaluation and control, in which organizational activities and performance results are monitored so that actual performance can be compared with desired performance. This is the area where Vodokanal can supervise its various functional departments and keep tab of the achievement of outputs and results based on the plan. However, the parameters that will be measured must be well defined, as well as the target values for these parameters. An example is the development of a performance-based human resource evaluation, where the performance of the employees is tied up with pre-defined targets and standards. Management, operational, financial audits are utilized to assess key organizational activities and provide in-depth feedback.

(2) PDCA Cycle for Process Improvement

The PDCA cycle (Plan, Do, Check, Act) is used to coordinate the continuing improvement efforts. It emphasizes and demonstrates that improvement programs must start with careful planning, must result in effective action, and must move on again to careful planning in a continuous cycle. The need for continuous improvement efforts can be found in Vodokanal's processes and activities, such as in the meters installation, public Information, Education and Communications (IEC) of which public relations is a part, and billing and collection. The PDCA cycle is then used in team meetings where process improvements are discussed and analyzed. It takes stock of what stage improvement initiatives are, and chooses the appropriate tools to see each stage through to successful completion. Thus, PDCA is an empowering tool; it promotes participatory decision-making by bringing it down to a decentralized level; and it encourages the involvement of everyone in problem solving. It can be said that while Vodokanal is hardly utilizing the PDCA cycle for its process improvement initiatives, it can and must do so by adhering to the four-stage cycle as detailed below:

1) Plan

Plan to improve operations first by making an appraisal of the situation (that is, identifying the problems faced), and coming up with countermeasures for removing obstacles for a stable and sustainable delivery of water supply services. As mentioned earlier, Vodokanal can establish *ad hoc* teams whose first step is to "plan" process improvement by: (1) selecting the problem/s to be analyzed; (2) clearly defining the problem and establishing a precise problem statement; (3) setting a measurable goal for the problem solving effort; and (4) establishing a process for coordinating with and gaining approval of leadership.

The second step in the "plan" process is making an analysis of the problem by using these steps: (1) identifying the processes that impact on the problem; (2) listing the steps in the process as it currently exists; (3) mapping and validating the process; (4) identifying potential causes of the problem and collecting and analyzing data related to the problem; and (5) verifying and identifying the root causes of the problem.

Making a plan for process improvement is not currently institutionalized at Vodokanal. Neither are there process improvement teams formed for the purpose of solving process quality problems.

2) Do

Do changes designed to solve the problems on a small or experimental scale first. This minimizes disruption to routine activity while testing whether the changes will work or not. The first step in the "do" process is developing solutions or countermeasures by: (1) establish criteria for selecting a solution; (2) generate potential solutions that will address the root causes of the problem; (3) select a solution; (4) gain approval and supporter the chosen solution; and (5) plan the solution.

The second step in the "do" process entails implementing a solution either on a trial or pilot basis, or when tested to be effective, making the solution permanent. In Vodokanal, for example, proper resources (human, financial, physical and natural, and information) should have been allocated for a successful implementation/solution of a problem, such as for instance the delay in meters installation, which has not been fully implemented yet as originally scheduled because of lack of funds.

Currently, funding for the meters installation is being provided either by Vodokanal or by the government depending on the types of apartments. The funding problem is not an issue that can be solved by Vodokanal alone. However, Vodokanal must take more proactive measures by taking leadership in any issue related to the water supply services by raising the problems and cooperating with the government to solve them. In addition, since funds are not the only problem, Vodokanal must clarify what kind of resources is required and exert efforts for its procurement.

3) Check

Check to see whether the implemented changes are achieving the desired result or not, and also to monitor if the quality of the output is at all times as expected, or to identify any new problems when they crop up.

In the implementation of a project, it is necessary to gather and analyze data on the solutions by comparing and evaluating the progress of the project against what was planned originally. In the process of evaluating the project's degree of attainment, specific factors that led to its success or failure must also be analyzed. The results of such evaluations should then be reflected in the actions that must be taken next. However, in Vodokanal's case, it can hardly be said that such evaluations have been conducted in all areas, nor can it be said that the results of such evaluations have been properly reflected in the subsequent planning. Therefore, from now on, it is necessary that evaluations be more thoroughly implemented in each area.

4) Act

Act means implementing process improvement changes and training needs for full implementation. This means looking at the original plan and deciding on whether this can be revised or not, based on the results/solutions. Through action, changes are made a routine part of the organization's activity, involving other persons (other departments, suppliers, or customers) affected by the changes and whose cooperation you need to implement on a larger scale, or those who may simply benefit from what you have learned. Only by completing this step, it will be possible to continue on to the next PDCA cycle, once again looking for another improvement opportunity.

5.5.2 Analysis for the Formulation of Management Action Plans

The main reason why the current water supply operations in Tashkent City suffer from huge NRW and deterioration of facilities lies in the fact that the government as well as Vodokanal did not make appropriate appraisals of their roles and the forms of their activities. Proper planning of operations and investments were also neglected in the past.

In order to implement the long-term plan for the improvement of facilities, the role of Vodokanal and the government would be to develop and procure the necessary resources (human, financial, physical and natural, and information) and plan out their optimum utilization, but taking into consideration the institutional reforms that are necessary.

In addition, in order not to fall into critical situations -such as the current one- after the LTDP is implemented, it is necessary to appropriately plan the organizational, institutional and management improvements in the LTDP, so that sustainable replacement and improvement of facilities can be carried out. In Table 5.5.1, measures and policies are indicated by each resource (human resources, financial resources, physical/natural resources, and information) and necessary actions to solve possible problems related to each of the measures are shown. In addition, evaluation of these actions (expected results if actions are implemented), their importance and timing are also included. Lastly, for each action to be taken, the status of the consultations between the executing agency and the Study Team is also shown.

As previously cited, the LTDP should contain (1) the NRW Reduction Program, (2) formulation of replacement, improvement and operational planning of facilities in accordance with water demand after the NRW Reduction Program has been implemented, (3) implementation of the operations required, and (4) planning the necessary improvements in management for the effective operation of facilities.

Table 5.5.1 Analysis for the Formulation of Management Action Plans

Resources	No.	Objectives	Countermeasures	Current problems and problems that may arise during implementation	Actions that should be taken by Vodokanal or the Government: Actions	Status of the discussions (Note1)	Executing agent (Note2)	Implementation period (Note3)	Evaluation (Expected Effects)	Remarks on the importance, implementation period and others
Physical and Natural Resources	1	Provision of stable, adequate, reliable supply of safe water	- Facilities' long-term plan (Reinforcement of pipes, replacement of deteriorated facilities in proper scale and scope, improve the efficiency of various facilities	- Fund requirements	- Study and consider 2	4	G,V	S	- Enforcement of MP becomes possible	- Since it is a prerequisite for the implementation of the MP, it should be given the highest priority
				- Overstaffing	- Enforce 4	4	V	WTP	-Concerns on employment will be solved	-Should be implemented in accordance with the progress of the facilities' long-term plan. However, deliberations should be made before the implementation of the facilities' long-term plan
				- Use of the vacated land after dismantling and disposal of facilities	- Make plan on the use of the vacant land after facilities are dismantled	5	V	M	- Efficient utilization of land and facilities	
				-Technology planning, design capability	- Enforce 6	1	V	S	- Improvement of skills and self-resolution capability	- It will be incorporated in the implementation of the MP
Financial Resources	2	Secure funds for the implementation of the facilities' long-term plan	- Contribution or subsidy from Tashkent City Hokimiyat, the Government of the ROU and/or other governmental authorities (the "government" hereinafter)	-Securing government funds	-Government approval	5	G	S	-Securing funds for the implementation of the facilities' long-term plan	- Since it is a prerequisite for the implementation of the MP, it should be given the highest priority
			-Increase of water tariffs	-Government authorization -Opposition from the community -Poverty reduction measures	-Government approval -Enhance IEC and PR activities -Enhance safety net	5 1 5	G V G	S M S	-Same as above	- Since it is a prerequisite for the implementation of the MP, it should be given the highest priority
			-External loans	-Vodokanal's creditworthiness	-Improve financial status -Ensure accountability measures such as the introduction of external auditing -Government guarantee	3 4 5	G,V V G	S M M	- Implementation remains uncertain	- Since it is a prerequisite for the implementation of the MP, it should be given the highest priority
			-Privatization by the government decision	-Attracting investors -Privatization will be temporality suspended while projects with external loans are being implemented -Sustainability after privatization	-Long-term issues	3	G,V	L	- Implementation remains uncertain	-Should be considered in the future
	3	Improvement in financial status	-NRW reduction	-Slow progress in the transition to the Metered Tariff System (delay in meter installation)	- Promote transition to the Metered Tariff System - Promote the NRW Reduction Program	2	V,G	S	-NRW reduction by reducing indoor leakage and wastage -Reduced investments and O&M costs of facilities due to their rightsizing	- For being one of the prioritized projects, this consideration should be given the highest priority
				-Significant wastage in apartments without meters	-Progress in meters installation, transition to the Metered Tariff System（NRW Reduction Program）	1	V,G	S	Reduce wasteful use of water	- For being one of the prioritized projects, this consideration should be given the highest priority
					-Development of repair parts	4	V,G	S	-Assurance of the effects of indoor repairs	- Should be given a high priority as a problem that appears with the transition to the metered system
					-Improve IEC, including PR activities	1	V	M	-Water wastage reduction	- As it is an existing problem, it should be given a high priority
				-Leakages from distribution pipes	-Implement 1 (NRW Reduction Program)	1		L,	-NRW reduction	- For being one of the prioritized projects, this consideration should be given the highest priority
				-Water losses other than leakages from the distribution network -Proper knowledge and understanding of correct data on the water supply volume	-Implement 7 (NRW Reduction Program)	2	V	S	-NRW reduction, Revenue increase	
			-Review of the current tariff system	-Small impact on reduction of wastage -Difficult to build in safety nets -Worsening of the financial status in the short term due to the reduction of consumption	-Introduce the Two-Tier Tariff System -Introduce the Progressive Tariff System	3 3	V,G	Met	-Country's institutional system remains an obstacle	-Although it is a problem that arises with the transition to the Metered Tariff System, it should be implemented while taking proper care of the community's perception

			Financial measures	-Low collection rate particularly from communal services	- Get sufficient Budget allocations from the government to budgetary organizations	4	G	L	-Mitigation of funds shortage	-As a problem related to the government budget, it cannot be easily solved, however, it should be given due importance and proper consideration
				-Under-recognized depreciation	-Introduce accounting system compliant with the IAS	4	V,G	M	-Proper financial controls -Appropriate tariff setting	-An issue related to institutional reforms; should be given proper consideration, although it cannot be solved easily
			Cost reduction - Reduction of the number of staff - Number of facilities' operators	- Necessity for provision of employment measures	- Implement 1	2	V,G	M	-Reduced personnel cost as part of the operational costs	-Should be implemented in accordance with the progress in the facilities' long-term plan; but deliberations should be completed before the implementation of the facilities' long-term plan.
			- Number of inspectors	-Indoor water meters -Inefficient billing-and-collection practices	-Introduce outside meter installation -Spin-off the meter inspection and billing into a separate company and provide similar services together with other public services	3 2	V,G V	L S	-Minimized number of inspectors and cost reduction	- An issue that impacts on related costs and the community's perception; an important item that should be given proper consideration - An issue related to organizational reform; one of the items that should be given proper consideration
			-Number of administrative staff	-Inappropriate financial data	-Implement 7	1	V	S	-Impossible to analyze the current situation	- For being one of the prioritized projects; should be given the highest priority
			- Reduction of O&M cost	-Significant amount of NRW that requires large scale operations and water treatment	-Implement NRW reduction program -Implement 1	1 2	V,G	S L	-Reduced electricity and chemical costs -Reduced personnel expenses	-For being one of the prioritized projects; should be given the highest priority
			Improvement in management efficiency by attracting the private sector participation	Detailed measures must be discussed	- Introduce organizational reforms such as outsourcing	2	V	S	-Improved management efficiency	-An issue related to organizational reforms; must be given proper consideration, although it cannot be solved easily
Human Resources	4	Allowances that must be given to the excessive staff at the facilities due to the implementation of the long-term plan （1,400 people）	- Attrition due to retirement: 400 people -Workforce requirements for the transition to the metered system: 500 people -Workforce requirements for the implementation of the facilities' LT plan: 350~500people. - Total reallocation of 1,400 employees	-Need for occupational and career counseling -Measures to train and/or educate unskilled workers - Fund retirement plan package	-Offer outplacement counseling and programs for people not aligned to strategic shift -Establish in-house training; or offer short education programs for affected personnel with public-private partnership - Fund and implement retirement packages - Offer livelihood programs and entrepreneurship ventures with initial capital from public and private sector financial institutions	5 5 5	V V V	WTP WTP WTP	- Maintained employee morale - Increased productivity - Balanced allocation of personnel	-Should be implemented in accordance with the progress of the facilities' long-term plan; but deliberations should be completed before the implementation of the facilities' long-term plan.
	5	Improve personnel efficiency and effectiveness	-Performance-based employee appraisal and evaluation system	-Reconciliation with the current system	-Establish a performance-based employee appraisal and evaluation system	2	V	S	-Strengthened institutional capacity	-Although it cannot be solved easily as there are institutional obstacles, it is one of the items that should be given proper consideration due to its importance
	6	Improve personnel competencies	-Enhancing employee training and development systems -Development of manuals	- Inadequate training programs - Lack of adequate manuals	-Develop an employee training and education system -Develop manuals on general management, operation and regulations	1 1	V V	S S	-Strengthened institutional capacity -Improved competencies of each employee	-Implementation should be prior to the facilities' long-term plan
Information	7	Provide adequate and reliable technology-based business information	-Thorough collection, integration and analysis of information -Information sharing	-Inadequate experience of personnel -Lack of organizational capability -Lack of IT infrastructure	-Implement 6 -Strengthen internal control, monitoring and evaluation for continuous improvement -Enhanced IT readiness	1 2 2	V V V	S S M	-Clear knowledge, understanding, control, and sharing of data -Improved in operational efficiency -Improved decision-making flow and response time to problems	-A prerequisite for the implementation of the MP, must be given the highest priority

Note 1: Status of the discussions on the contents of the Action with the Study team: *1=C/P（counter part）is active in the implementation、 *2=C/P has accepted、 *3=C/P is passive、 *4=Contents have been explained. *5=Not discussed.
Note 2: Executing agency of the Action: V=Vodokanal has the leading role、 G=Government has the leading role、 G,V= Both Government and Vodokanal as a unit have the leading role
Note 3: Implementation period of the Action: S=Short-Term M=Mid-Term L=Long-Term Met=According to the progress of the transition to the metered system WTP=According to the restructuring of the WTPs and PSs

5.5.3 Establishment of a Unit for the Promotion of the LTDP

Project management is a carefully planned and organized effort to accomplish a specific action, for example, the meters installation project. Project management entails developing a project plan which includes defining project goals and objectives, specifying tasks or how goals will be achieved, what resources are need, and associating budgets and timelines for completion. It also includes implementing the project plan, along with careful controls to stay on the "critical path", that is, to ensure the plan is being managed according to plan.

Since the LTDP has many components that, in themselves, are usually stand alone projects, there is a need to create a department that would keep a tab of all on-going projects of Vodokanal. This department will be the Unit for the Promotion of the LTDP that will be established under the General Director. It will operate using the project management framework as the basic structure for understanding the environment in which the projects operate. The nine knowledge areas under the project management framework include Integration, Time, Cost, Risk, Quality, Communication, Human Resource, Procurement and Scope Management.

This department will ensure that projects for the short, mid-term and long term will be properly planned, coordinated, executed and controlled. Costs will be more carefully planned, budgeted and controlled; human resources more effectively utilized and developed; work quality assured; information and communication on performance reported; risks minimized, and project procurement better planned and controlled.

5.5.4 Actions for Progressing of WTPs and PSs Restructure

(1) Countermeasures for the Issues from the Restructuring of the WTP

With the restructuring of the WTPs, the estimate of “excess” employees will reach 1,000, those mainly working at the water treatment facilities. Although this will cut payroll and employee benefit costs, it will represent a serious problem for those laid off. Therefore, preparing for this eventuality is an important action to be taken. Fortunately, the target

year for the restructuring of WTPs is 2015, which gives space for the measures discussed below to be implemented.

Since the restructuring will take place in a period of ten years, the employees' headcount is expected to decrease by 400, or 40 people per year, due to attrition. With the facilities upgrading, the focus of administration will be on the recruitment of highly educated and skilled people. Thus, the annual recruitment of new personnel will be halved compared to the current situation. On the other hand, with progress in the installation of water meters, the need for inspectors and maintenance personnel is expected to grow. It may seem that new personnel will have to grow proportionally with the water meter installation rate. But this is not the case since the current inspectors now make periodic visits to customers under both the Metered and the Norm Tariff Systems. It may be safe to say, then, that the current number of inspectors will have to double, which implies that additional 500 people will be required. In addition to this, for the demand of the Long Term Development Plan for Water Supply, specifically pipeline replacement needs, about 50 to 200 new workers will be needed depending on the construction schedule.
On top of this, although its outcome will depend on Uzbekistan's economic conditions, if the subsidiary construction company that was spun off last year increases its efforts to develop new customers, or if Vodokanal moves into new business areas (such as for instance sales of water in plastic bottles), the demand for new personnel will further grow. In addition, new skills acquisition for such positions requiring specialized skills in management information systems, computer and database operations, public information, education, and communications, operation and maintenance and others, will require either reshuffling, reassignment, retraining, and retooling; and if such skills are not found, new personnel will have to be hired to fill the skill-employment gap.

In any case, Vodokanal must have a program of training deserving employees to acquire new skills either in-house or by sending them to educational institutions in Tashkent. This would increase employees' awareness of the importance of learning new skills so they may be ready for the demand of a new job. It would be best for Vodokanal to develop and implement employee development packages such as designing, developing

and implementing appropriate in-house training programs for the acquisition of technical knowledge and skills that are necessary for re-assignment or re-employment.

For those whose services may voluntarily or involuntarily not be renewed or extended, then a retirement package must be designed; livelihood programs, entrepreneurship ventures, and alternative forms of employment can be encouraged with initial capital coming from public and private sector financial institutions; and lastly, outplacement counseling and re-employment assistance for those not aligned with the strategic shift must be provided.

Table 5.5.2 Employee Relocation/Separation Plan according to Restructuring of Facilities

No	Items	Reasons of reduction/increase	2003	~2005	~2010	~2015	Total
1	Personnel cuts due to restructuring of facilities	Restructuring of facilities			-850	-210	**-1,060**
2	Natural attrition	Retirement			200	200	**400**
3	Construction for the LTDP	Pipe replacement			40		**40**
4	For meters	Inspection and maintenance		100	400		**500**
5	Transfer	To new departments				120	**120**
	Total（Note1）	1~5		100	-210	110	**0**

Note1: Besides the employment opportunities indicated in the Table, it is estimated that new hiring might become necessary with the transition to the Metered Tariff System, such as personnel for the repair of indoor water leakages.

(2) Measures to be Done with the Vacant Lots after the Disposal of Facilities

Measures to be taken with the vacant lots after facilities have been disposed of or dismantled will have to be taken into account in this Study. Needless to say, 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 approval. Therefore, easy sell-off of these lots to developers is not an option at the moment, although such measures would attract new investments, which would be very important in order to invigorate Tashkent City's economy.

The following cases can be expected, assuming that the government approves the disposal of vacant lots:

- Sell-off to a private developer or a private sector company, which could include costs for ground leveling;
- Utilization by the government, like the construction of public facilities.

5.6 Improvement Program for 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.

5.6.1 Measures to Acquire Funds for the LTDP

The present water supply system in Tashkent City has significant non-revenue water (NRW) due to leakages in the distribution system and errors in bill estimates for the water consumed. All of these problems, which are further compounded by low collection efficiency, contribute to the liquidity problems of Vodokanal.

Fund sourcing in order to keep water supply available to all customers has always been the major challenge to Vodokanal and *Hokimiyat*. Where the required capital can be sourced and how the costs should be fully recovered are always among the issues that need to be resolved in most, if not all, development plans of the government. Ideally, capital and O&M costs should be fully recovered from water charges. However, for big development projects, where capital costs are large, in order for the costs to be fully covered water charges have to be high enough, to the extent of becoming unaffordable particularly to the lower income groups. The government can intervene through subsidies, but government funds are usually too limited and allocation of the limited funds has to be made among various projects that are also important and necessary.

With the present economic scenario, it has become necessary for Vodokanal and *Hokimiyat* to find innovative ways to finance capital projects besides depending on traditional methods of funding based on grants from higher levels of the government. Financing through private sector participation or capital markets has to be explored. There are various innovative ways by which the public sector can participate, and one of this is through a build-operate-transfer (BOT) arrangement.

The total amount of investment funds needed to implement the LTDP is 158 million USD. The following are some of the possible sources of funds, which may be taken individually or in combination:

- Self-financing through management efforts,
- Borrowing from outside,
- Subsidy from the government,
- Privatization,
- Grant aid from international cooperation agencies.

(1) Self-Financing through Management Efforts

Self-financing relies on the organization's own resources to cut costs and improve water charges collection. Thus, costs may be reduced with more efficient use of resources and income may also be increased with more efficient collection of water charges. However, the amount that could be acquired through this option is limited since cost-cutting measures cannot be easily implemented and tariffs cannot be unduly increased without affecting the affordability of the lower income groups.

(2) Borrowing from Outside

Borrowing from international aid agencies/international financial institutions may be considered, but due to the high country risk, it might be quite difficult to pursue this alternative. In addition, a precondition to these kinds of borrowing is to secure the transparency of Vodokanal's financial status as well as a guarantee from the Government.

(3) Subsidy from the Government

Ideal water supply management presumes coverage of all necessary expenses by the income derived from collection of water charges. In addition, Vodokanal will hardly be able to get support from the government because of its policy. However, only a few water suppliers in the world are actually able to operate recovering full costs, and in most cases, the governments provide investment funds for huge projects. The results of a study, which estimated how the increase of domestic water charges necessary to move toward the "full cost

recovery" would affect household incomes, are presented in Table 5.6.1. The results indicate that the need to raise water charges is considerable in most countries, even in the UK, where water companies have to cover their operation and infrastructural costs from the charges received for the their services. Although the water suppliers in the UK are generally liable to pay corporate taxes, some tax relieves in the form of capital allowances are granted to them.

Table 5.6.1 Effect of "Full Cost Recovery" on Household Incomes in Selected OECD Countries

Per cent		
	Water charges as a portion of household income	
	Existing water	Full cost tariffs recovery
Portugal	0.5	2.8
Greece	0.4	2.1
Ireland	0.3	1.9
Spain	0.4	1.6
France	1.1	1.5
UK (England and Wales)	1.2	1.3
Germany	1.0	1.2
Denmark	0.8	0.9
Korea	0.6	0.9

Source: The Price of Water: Trends in OECD Countries, OECD, 1999.

(4) Privatization

Vodokanal's privatization policy has been already announced by the Government. There are many other methods for privatization and thus, there might be more space for consideration. Although fund procurement through privatization would be highly desirable, in reality, there are still many factors that lead to uncertainty, including the existence of investors who could turn plans into reality.

The participation of the private sector in the provision of safe drinking water has two considerations: (a) access to professional expertise in the technical and managerial aspects of service delivery; and (b) access to additional sources of capital. It has been observed in other developing countries that the second consideration is not always realistic. Various constraints have inhibited actual private investments in the sector.

In most developing countries, the water supply sector will attract little private capital due to under-pricing against capital intensive investment, thereby giving rise to long payback periods and associated risks. To enhance private sector investments in the water supply

services sector, the issues on low tariffs and the lack of a clear and independent regulatory framework will need addressing through appropriate legal and regulatory reform, as well as the design of more innovative financing mechanisms that help to mitigate some of the risks. A fresh approach is needed focusing on more appropriate risk sharing, managing expectations from both the government and private sector, and more reasonable service standards. Efficiency gains can free up a substantial amount of resources and simpler forms of private sector participation such as performance-based management contracts, which have resulted in increased efficiency and greater internal surplus for service providers. Increased efficiency has been observed to lead to an improvement in services, expanded coverage, and increasing of revenues.

(5) Grant Aid from International Cooperation Agencies

Aid from international cooperation agencies is an option. However, there are many political problems, and even if accepted, the amount of such aid would be very limited.

As can be seen, there are many alternatives for sourcing of funds. However, under the current conditions, it is primarily important to 1) carry out financial improvements through self-support efforts; 2) seek government support as much as possible, and 3) limit outside borrowing as much as possible.

5.6.2 Formulation of a Fund Procurement Plan

As mentioned above, seeking governmental support will be considered at the very end; however, it can not be considered as a precondition at this moment because the government announced that Vodokanal must achieve the self-financed management, which is also one of the final targets of the LTDP. Therefore in this section, to formulate a proper funding plan for the LTDP, some funding cases are simulated with preconditions to carry out financial improvements through self-support efforts, as well as borrowings with a variety of interest rates under affordable for domestic customers tariff levels as follows:

(1) Financial improvements through self-support efforts,

(2) Funds to be procured,

(3) Consideration on the rate of tariff increase,

(4) Considerations on the validity of the tariff increase rates, and

(5) Considerations on proper funds planning.

(1) Financial Improvements through Self-Support Efforts

The following resources might be procured by the year 2015 through improvements in Vodokanal's financial status:

1) NRW Reduction Program

Reducing the NRW will result in decreasing of the operating costs (or increasing of the operating income). The NRW Reduction Program is composed of the promotion of meters installation, the well-planned replacement of pipelines and the strengthening of management. While it is necessary to prepare significant investment amounts for the replacement of pipelines, the others can be done without such investments.

i) Promotion of meters installation

Installation of water meters will have several effects on Vodokanal's finance. It must be pointed out that a possible increase in the number of inspectors and repair and maintenance personnel could increase labor costs. However, it is assumed in Table 5.6.2 that increments in labor costs will be absorbed by the improvements in operational efficiency that organizational reforms will bring, yielding a net result of zero. Also, even though the revenue from operations will temporarily decrease due to the water saving caused by installation of water meters, this decrease will be compensated by introducing the Two-Tier Tariff System mentioned in 5.7. Ultimately, it will be possible to procure 1,682 million soum by the year 2015.

Table 5.6.2 Financial Impact from the Meters Installation

	Item	Source		Source		Impact until The year 2015
Merit	Cost Reduction	Domestic customers in Table 4.2.1	NRW reduction 469 (1,000m^3/d) = 843-374	Table 6.2.6	Variable cost 2.5 (soum/m^3)	3,852 mil soum =469*365 day * 2.5/1000 * (2015-2006) year
Merit	Personnel cut	Operating staffs in Figure 5.13.1	Personnel cut 323 persons due to decrease of water distribution volume =1,695 - 1,372	Table 6.2.8	Salary 650,000 /year/person (1,108 mil/ 1,695)	1,890 mil soum =0.65*323* (2015-2006) year
Demerit	Meters installation costs	Annual installation:80,000 Ratio between number of apartments and detached houses: 75%:25%= 60,000:20,000	1,015mil soum/year =(33,000-17,600) *75%*60,000+(38,000-21,910)*20,000 excluding meter cost		25% of meters for apartments will be installed by TKEO.	-4,060 mil soum =1,015 * 4 year
Total						1,682 mil soum (1,682,000 USD)

ii) Strengthening of management

By conducting an analysis of water losses other than leakages, it is assumed that collection of 10% of these water losses through water charges will be ultimately possible. As a result, 3,411 million soum will be available.

Table 5.6.3 Financial Impact from Strengthening of Management

	Source		Source		Impact until the year 2015
Increase of chargeable water volume	Water loss in Table 4.2.4	Water loss reduction 47.2 (1000m^3/d) =472(1000m^3/d)*10 %	Tariff	22(soum/m^3)	3,411 mil soum =47.2*365day*22 /1000* (2015-2006) year
Total					3,411 mil soum (3,411,000 USD)

2) Collection of bad debts

The biggest bad debts are those from Tashteplocentral and TAPOiCh Aircraft Production Company. Although Vodokanal alone can not solve this issue, the collection of these debts could be considered as potential funding resources. As can be seen from Table 2.3.39, 4,902 million soum (890 million soum + 4,012 million soum) could become

available through the collection of these debts. However, these amounts are basically used for working capital, such as retarded payments of wages to employees payments of accounts payable, etc.

3) Expected funding by the improvements in Vodokanal‘s financial status

The total expected financial resources, which are available until the year 2015 through improvements in Vodokanal’s management, are summarized as follows：

Table 5.6.4 Summary of Funding by the Improvements in Vodokanal’s Financial Status

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

(Estimation does not include rate of inflation)

Through a self-financed management, about 5 million USD in funds can be expected (see Table 5.6.4). Reduction of NRW requires organizational restructuring. For instance, one option suggests providing incentives for finding freeloaders 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.

(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 the required 153 million USD have to be recovered in 30 years, 5 million USD a year will be necessary. Since the current annual revenue from

collection of water charges (excluding revenue from sewage services) is approximately 15 million USD, it could be derived from here that the actual minimum water tariff has to be increased 1.3 times in real terms.

(4) Consideration of the Tariff Increase Rate

As mentioned in Section 2.3.7, 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 customers. On the other hand, if we assume that the domestic customers' income will increase as the country's economy grows, a tariff increase equivalent to the expected real GDP growth would be permitted. Therefore, Uzbekistan's real economic growth rate for the past several years has been 4%; hence the expected real GDP growth rate would be 4%.

(5) Considerations of Proper Funding planning

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 5.6.5, 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 5.6.5.

Table 5.6.5 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 5.6.6 Tariff Increase Trajectory for a 10% Interest Rate

Interest Rate	Annual Tariff Increase				Results
	2006 - 2010	2011 - 2020	2021 – 2022	2023 - 2040	
10%	5%	5%	3% Cumulative increase: 2.2 folds	0%	Cash surplus of 77 million USD by 2040

As shown in Table 5.6.6, 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 5.6.5 and 5.6.6 assume that all funds are borrowed from outside, if governmental subsidies are available, these tariffs increase rates can be lowered as presented in Table 5.6.7.

Table 5.6.7 Cash Shortages under the Slow Tariff Increase Scenario

Interest rate	Annual Tariff increase				Results
	2006 - 2010	2011 - 2015	2016 - 2025	2026 - 2029	
10%	3%	3%	3%	3% by 2029 Cumulative increase 2.0 fold	Cash surplus of 40 million USD by 2040
Cash shortage for the period (Cumulative)	0	9 mil. USD (9 mil. USD)	55 mil. USD (67 mil. USD)	30 mil. USD (95 mil. USD)	

Details of the simulation are shown in Table S 6.2.6.

(6) Evaluation

As a result of several simulations in section (5) above, when no governmental subsidy is available, 1.3% of interest rate is desirable for procuring funds to implement the LTDP, as shown in Table 5.6.6, taking affordability for the domestic customers into consideration. In all cases, tariff increases are unavoidable and the ultimate increased tariff is compared with the tariffs in other countries with a similar GDP level.

Table 5.6.8 Ultimate Increased Tariff, by Interest Rate

Interest rate	1.3%	5%	10%
Reference	Table 5.6.6	Table 5.6.6	Table 5.6.7
Ultimate increased tariff (tariff for domestic customers in 2005 =0.030 USD/m^3)	1.4 fold 0.042 USD/m^3	1.8 fold 0.057 USD/m^3	2.2 fold 0.066 USD/m^3
Tariff increase up to (year)	2017	2025	2022
Projected GDP per capita in 2019 with 4% annual growth	876 USD	1,199 USD	1,066 USD

Table 5.6.9 Tariff Comparison

County	Kazakhstan (Astana)	China (Beijing)	Indonesia (Jakarta)	Philippines (Manila)	Sri Lanka (Colombo)	Egypt (Cairo)
GDP per capita in 2002 (USD)	1,400[1]	989[2]	817[2]	975[2]	872[2]	1,354[2]
Tariff for domestic customers (USD/m^3)	0.27[1]	0.3[3]	0.45-0.61[3]	0.10-0.29[3]	0.01-0.47[3]	0.019-0.026[3]

Notes:
[1]Source: JICA studies, 2002
[2]Source: the World Bank, World Development Indicators
[3]Source: Japan External Trade Organization (JETRO), JETRO-file, as of Nov. 2003 except for Egypt, which is as of Jan. 2004

The maximum ultimate and most rapid increased tariff for the domestic customers in Tashkent is 0.066 USD/m^3 in 2022 at 10% interest rate. In the 1.3% and 5% interest rate cases, the ultimate tariff in 2022 is less than 0.066 USD/m^3. Among the countries with a similar GDP, the tariffs for domestic customers are in the range from 0.019 to 0.61 USD/m^3. As a result of this comparison, the ultimate increased tariffs in Tashkent, provided in Table 5.6.9, are not unreasonable.

(7) Results

As it can be seen from Table 5.6.5, 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 5.6.6, 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 project. Thus, in this case, Vodokanal will be required to directly provide labor costs or the government will be required to prepare the necessary budgets.

5.7 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 5.2.2. The future tariff levels in relation to the repayment were examined in Section 5.6.

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.

5.7.1 Items to be Reformed Independent from the Transition to the Metered Tariff System

(1) Reforms for the Methods for Tariff Revision

As mentioned in Section 2.3.7, tariff revisions have been conducted in order to recover the costs reported in the income statement. Although such tariff revision method based on costs is appropriate when tariffs are considered in the long-run, in the short- to medium-term, such revisions must be based on the expected amount of cash outflow and depreciation expense. A short to medium term tariff revision will be needed after formulating a proper funding plan as mentioned in 5.6. 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.

Recommended tariff revision in the short- to medium-term:

1) Planning

It is necessary to estimate or plan the following items:

- Estimated water demand,
- Water distribution plan,
- Construction of facilities plan,
- Business management plan and improvement plan,
- Finance plan.

2) Estimating cash flows

It is necessary to estimate the following cash flows:

- Cash flows from capital income and expenditures,
- Cash flows from operating income and expenditure.

Capital cash outflow regarding constructing facilities are basically covered by external borrowings, cash surplus from operating income, etc. On the other hand, operating cash outflows are covered by collection of water charges.

3) Setting tariff

As a result of estimating the cash flows, tariff is set as shown in the following flowchart:

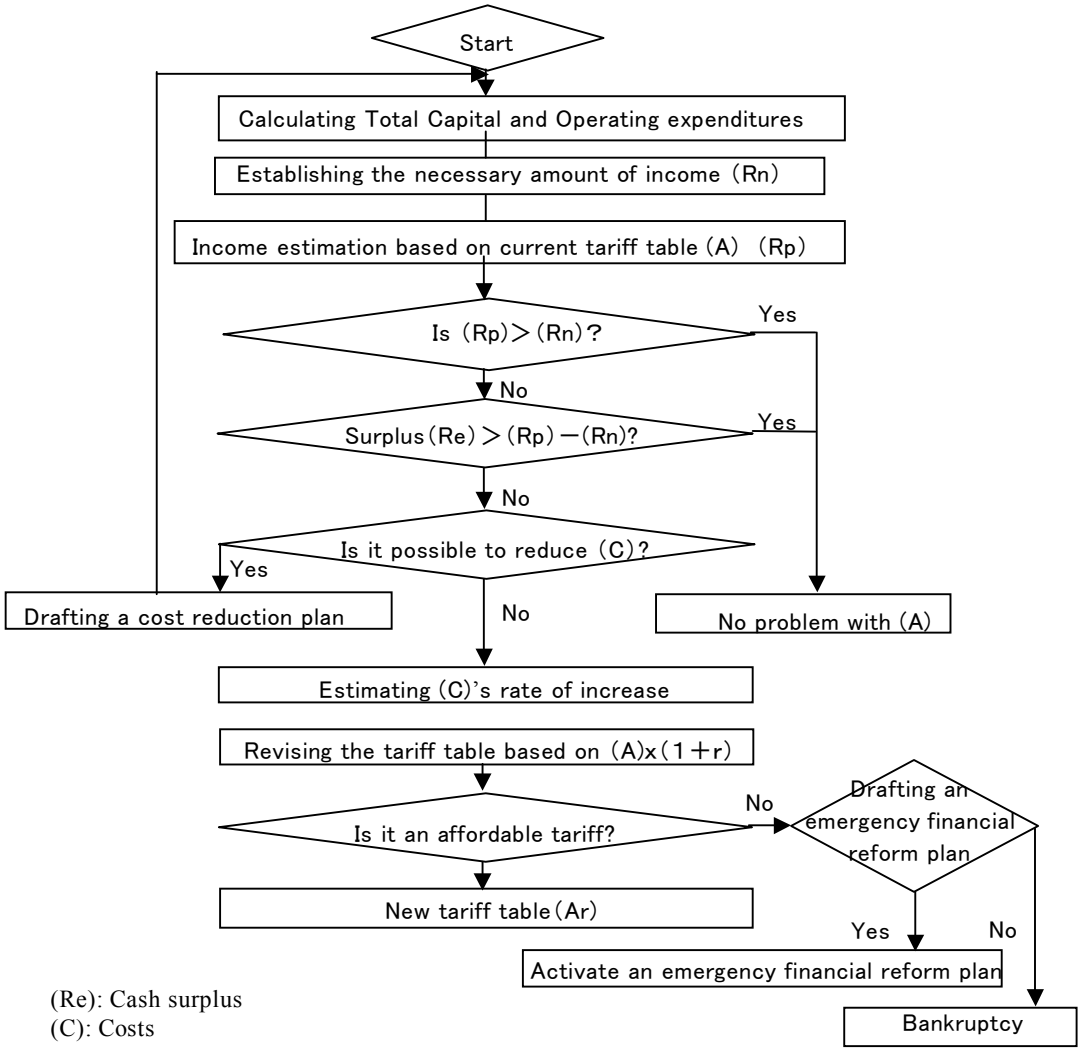


Figure 5.7.1 Process to Revise the Tariff Table

(2) Reform of the Tariff Collection Systems

Improvement of the existing billing and collection systems is a priority task faced by Vodokanal and its newly established wholesale subsidiary. For this purpose, the digitalization of information can be considered to include all data, not only those for the Tariff Collection System, but also data collected at banks and post offices that are currently written on paper. Thus, it is necessary for Vodokanal to sign contracts with the post office as well as with the banks to facilitate and improve water bills collection procedures. As the use of bank accounts is still not common in Uzbekistan, the method of automatic debit transfers from the customers' bank accounts is considered quite difficult to introduce under the current circumstances.

1) Data management within Vodokanal

For effective management, analysis based on accurate data is essential. For instance, the first step towards improving the situation with the water bills in arrears is to correctly understand the current status. The data for collection and billing in Vodokanal are, however, not well organized or updated, though IT is utilized to some extent. One of the reasons is that the current Vodokanal system is based on a stand-alone application and those billing and collection data are prepared by Rayon Vodokanals and manually transferred on paper and re-inputted in the headquarters of Vodokanal. In order to improve this situation, a centralized information management system through a network established up to Rayon Vodokanals would be effective. This system will contribute to the elimination of some of the manual procedures such as data transfer from Rayon Vodokanals to the headquarters and data re-input. This will reduce not only the manpower but also the risks of errors.

2) Data transfer from banks and post offices

As for the data on the customers' payment at banks or post offices, paper format is also used and data are re-inputted by Vodokanal. Manual process requires not only manpower, but also increases the risks of error. Electronic data transfer through mobile data storage devices such as a floppy disc or a CD is, therefore, necessary at the minimum. As described above, if data can be shared via network, it is more preferable because this will reduce the data collection task for Vodokanal employees. For this, it is necessary for Vodokanal to sign contracts with the post office as well as with the banks. As the use of bank accounts is still not common in Uzbekistan, the method of automatic debit transfers from the customers' bank accounts is still considered difficult to introduce under the current conditions.

3) Water charges calculation

Currently, even with manual procedures, risk of incorrect billing is not high owing to the low meters installation rate and a simple single-rate tariff. When more meters are installed and a two-tier progressive rate tariff system is adopted, the process of water charges calculation will become complicated and the risk of error will increase. IT

utilization will help reduce the risks of incorrect billing. For this purpose, a handheld terminal with billing algorithm preinstalled will be useful. If the device has a printing function, this will further reduce the risks of error. In addition, if the data can be electronically transferred to Vodokanal's main system, this will drastically reduce the work of inspectors and increase the accuracy of the customers' data.

4) Prevention of corruption in tariff collection

Tariff collection is carried out either through the user paying at banks or direct tariff collection by water meter readers. Water meter readers' tariff collection often involves potential corrupt practices as addressed in Section 3.2.3. 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.

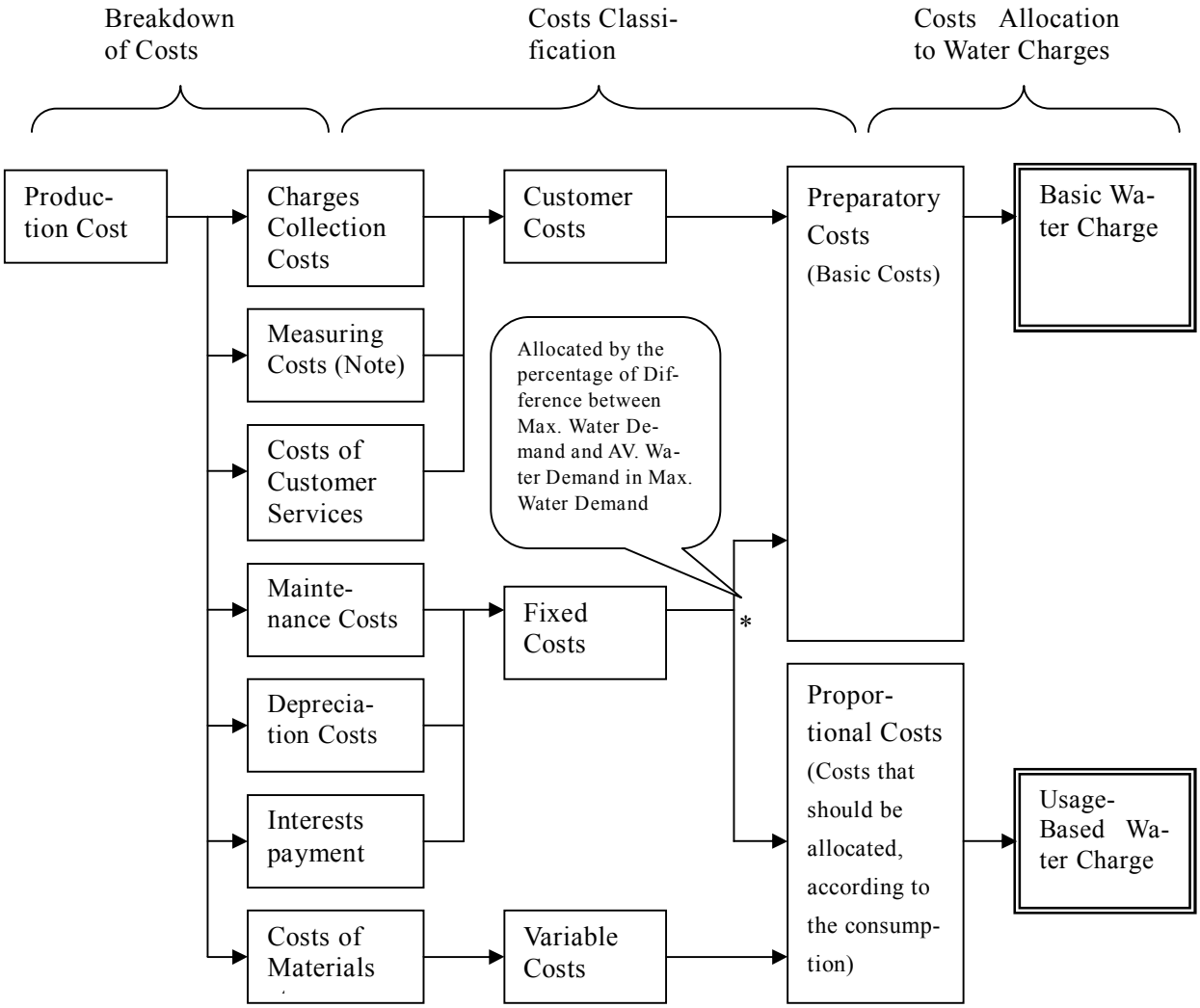
5.7.2 Items to be Taken into Account in the Transition to the Metered Tariff System

(1) Introducing the New Tariff System

1) Transition to the Two-Tier Tariff System

When meters for apartments are installed in Tashkent City, water charges will decrease because of the reduction in the billed water volume from 300-330 lpcd under the Norm Tariff System, to 150 lpcd of metered volume as shown in Table 2.3.5. The current number of the domestic customers who are charged based on the Norm Tariff System is about 1,246,000. If all meters are installed, the billed water volume for 1,246,000 customers will decrease by 150-180 lpcd (a difference between 300-330 lpcd under the Norm Tariff System and 150 lpcd under the Metered Tariff System). The current tariff for the domestic customers is 22 soum/m^3 and therefore, the formula below shows the amount of Vodokanal's revenue decrease: 150 (or 180) / 1000 x 365 x 1,246,000 x 22 (soum/year). As a result, the amount of revenue decrease of Vodokanal will be approximately 1,500-1,800 million soum.

As to the revenue earned by Vodokanal from the customers living in detached houses, the currently billed water volume for those who are charged based on the Norm Tariff System is low and is nearly the same as that of the customers who are charged based on the Metered Tariff System. Therefore, the impact from the decreased amount of revenue will be minimal for this category of the customers. As estimated above, as the meters installation progresses, revenue will be reduced and become unstable. A Two-Tier Tariff System will, therefore, be necessary. The Two-Tier Tariff System is a system where the fixed costs (i.e. depreciation, capital repair etc.) are charged through the basic water charges, and the variable costs (i.e. electricity, materials etc.) are charged according to the metered amounts, as shown in the figure below.



Note: Including meter installation cost

Figure 5.7.2 Breakdown, Classification and Allocation of Costs

In addition, and in consideration of the low-income domestic customers, a basic amount, such as for instance, 10 m³ per month, will be established, so that paying the basic tariff, customers can consume water without additional charges as long as the consumed volume does not exceed this basic amount.

2) 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 5.7.1 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 5.7.1 An 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

(Fractions will be rounded off the closest to figure)

(2) Repairing Indoor Water Fixtures and Development and Diffusion of Spare Parts

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

(3) Integrating the Billing and Payment Collection 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.

5.8 Improvement in Management and Organization

As mentioned in Section 3.3, 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 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.

5.8.1 Strengthening of Management

(1) Strengthening Management under the LTDP

As mentioned in Section 5.5, the top management has to correctly understand the problems, set the necessary targets for solving those problems and making improvements as necessary, and formulate the strategies that are required to attain such targets. In this Study, the thing that will bring about such process is the LTDP.

Vodokanal managers must examine and correctly understand the content of the LTDP. Based on the comprehension, the top management of Vodokanal has to explain it to all related governmental institutions in order to gain their support to attain the goals set in the LTDP, as well as to introduce the necessary legal reforms.

The top management and managers also have to explain the contents of the LTDP to all employees persistently, in order to gain their understanding of the delineated picture of the future of Vodokanal, and to ask for their cooperation. In order to improve water supply services, it is very important to share between management and employees common sense regarding what are the obstacles to attain the goals and what should be done as countermeasures.

(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. 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 3.3, 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.①In order to put oneself in the customer's place, a Customer's Service division, as well as a PR division as shown in Figure 5.8.1 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.

5.8.2 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 and 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 inform all employees on the standards by which they will be evaluated so as to gain support from them. In the long term, current seniority-based evaluation system should be replaced with a performance-based system.

(2) Training System

1) Present situation

As described in 2.3.9 (10), Vodokanal has some training program. However, the technologies being taught are outdated, pointing to the need for continuing educational programs designed to update the existing technologies.

2) Recommendations for the Improvement of the Training System

Training is important to any organization. It is an activity that is aimed at developing the full potential, the talents, skills and abilities of all Vodokanal's human resources in order to ensure productivity based on clearly defined needs specific to the organization. Training helps in creating an environment conducive to work collaboration, which positively impacts on product and service quality, as well as overall organizational performance. Training is, therefore, an investment in people and the future of Vodokanal, so that it remains vibrant, flexible and adaptable to change.

Before any training is conducted, Vodokanal must conduct training needs assessment (TNA). A needs assessment is a systematic exploration of existing conditions and how they should be improved. Assessments are usually associated with organizational and/or individual performance. The TNA will answer the following: (i) who will be trained; (ii) what type of training will be conducted; (iii) what learning will be

accomplished; (iv) what changes in behavior and performance are expected; and (v) what are the expected economic costs and benefits of any projected solutions.

After the TNA, training objectives will have to be formulated for each type of training. Then the selection of trainers – either in-house expertise or outsourced training specialists – who have the technical and professional expertise will be made; plus the participants who will best benefit from the training. The trainers will also have to study and select training methods appropriate to their personal training styles, and to the learner-participants. It will also be the trainers who will develop the course curriculum or content that would close the training gap that exists within Vodokanal. At the end of each training session, the participant-trainees will make an evaluation of the training received against the training objectives. They will then prepare an after-training report to see how learning has been applied in their jobs. 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 1970's Soviet times. Therefore, proposed training will mainly focus on the study and acquisition of modern water and sewage technology, thereby getting basic knowledge in relation to the planned new and rehabilitated facilities.

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.

Another method of training that Vodokanal can employ is on-the-job training, which is used for broadening employee skills and increasing productivity. OJT is

one of the best training methods because it is planned, organized, and conducted at the employee's worksite. It is particularly appropriate for developing proficiency skills unique to an employee's job – especially jobs that are relatively easy to learn and require locally-owned equipment and facilities. High levels of morale, productivity, and professionalism result in sound OJT programs.

To get the most of OJT, an analysis of the major job requirements (identified in the position description and performance plan) and related knowledge, skills, and abilities must be prepared to form the basis for setting up an OJT plan. To be most effective, an OJT plan should include: (i) the subject to be covered; (ii) number of hours; (iii) estimated completion date; and (iv) method by which the training will be evaluated. Exchange participant training is another method of training where trainees with related background, position/rank, and work assignments are provided a venue to exchange experiences and knowledge. This type of training could be proposed for CIS countries' participants so that problem-and-solutions can be shared considering that they have similar work experiences.

3) Training Programs Offered by Aid Agencies (e.g. JICA)

Government-based technical cooperation schemes that are implemented by JICA include a) dispatch of experts, b) acceptance of trainees, c) provision of equipment, and d) project-type technical cooperation which combines all three above-mentioned schemes in an integral manner.

Dispatch of Experts

The dispatch of experts is a type of technical cooperation whereby experts dispatched in response to requests made by developing countries transfer knowledge and technologies which are appropriate *vis-a-vis* the conditions of the recipient countries according to their respective fields of expertise.

As mentioned above, it is necessary to select appropriate trainers after the TNA. In this case, Vodokanal can ask JICA to dispatch experts through an official request

letter from GOU to JICA. If the requirement is suitable and reasonable for a program to dispatch experts, JICA will select appropriate experts and dispatch them. The dispatching period will depend on the contents of the requirement.

Acceptance of Trainees

The acceptance of trainees is a type of technical cooperation whereby people responsible for the nation building of developing countries are accepted in Japan or other developed countries as trainees to learn expert knowledge and technologies in their respective fields of expertise.

As mentioned above, OJT is one of the best training methods. In this case, Vodokanal have to formulate appropriate programs and bring up good trainers with enough skills for the programs. To accelerate the formulation of the OJT program, it is recommended for Vodokanal to ask JICA to accept trainees through an official request letter. If the requirement is suitable and reasonable for the acceptance of such trainees program, JICA will set up appropriate programs.

Project-Type Technical Cooperation

Project-type technical cooperation integrates the above-mentioned dispatch of experts and acceptance of trainees, as well as provision of equipment into a single project. For instance, for development of IT skills, provision of equipment is often necessary. In such case, a project-type technical cooperation will be recommended. JICA procedures to request this type of cooperation are similar to those for other JICA programs.

5.8.3 Organizational Reform

(1) Strengthen of Private Sector Participation

Although Vodokanal's privatization has already been decided by the Government, its exact schedule has yet to be decided as aforementioned. Under privatization stipulated by the government, Hokimiyat's participation in Vodokanal will decrease from 100% to not less than 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 the private sector into water supply operations can be considered. Operational efficiency should be improved by introduction of such alternatives. Improvement of operational efficiency should be result. Under Vodokanal's current conditions, Service Contract and Management Contract are two alternative methods to bring in the participation of the private sector.

(2) Outsourcing

Depending on the content, services that can be outsourced should be done so in order to improve the efficiency of overall operations with a proactive use of the private sector. However, in order to carry this out there might be some difficulties such as problems with the employees currently hired and difficulties related to finding a company that fits the requirements for outsourcing. Therefore, one good alternative to consider is what Vodokanal is currently carrying out: spin-off some of the operations into a separate company. Departments recommended to be outsourced in the future are shown in Figure 5.8.1.

Since the degree of freedom for the management of such a company is higher, it can then continue on the road of higher efficiency and increase its operations as well. 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.

(3) Organization Reform

Other organizational reforms shall be conducted to achieve the following objectives:

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

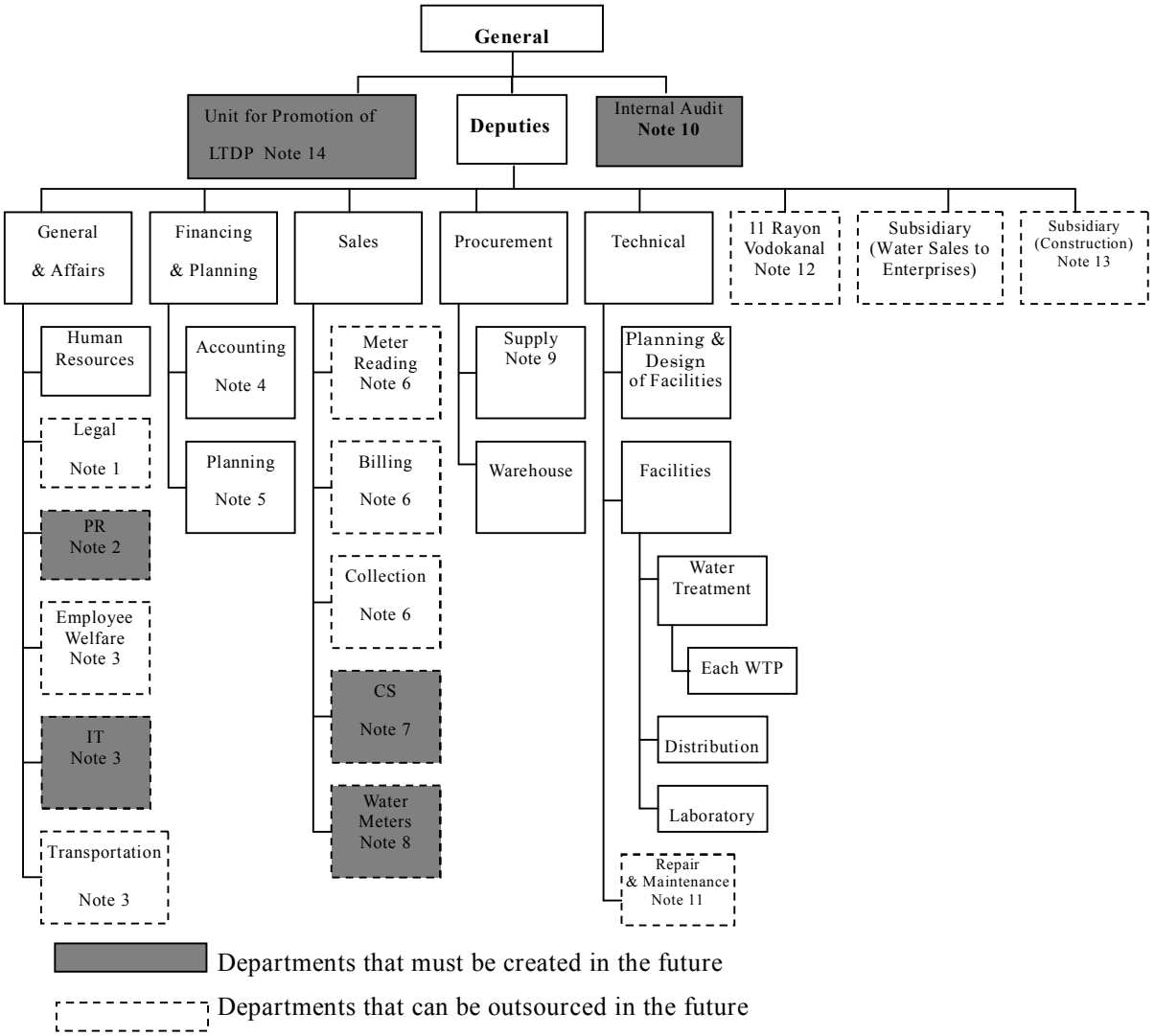
bills can be done jointly with other public services such as electricity and gas. This way, outsourcing costs can be kept down.

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, 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.

iv) Specific directions of the reforms are illustrated in Figure 5.8.1.



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.
Note 14: The Unit will be established in order to promote the implementation of LTDP.

Figure 5.8.1 Proposed Organization Chart of Vodokanal

Table 5.8.1 and 5.8.2 indicate potential changes of personnel due to the restructuring of facilities and organizational reforms, including personnel cuts, which are shown in Figure 5.8.1. 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 5.8.1 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 personnel at year-end			= Number of personne1 at previous year-end+1+2+3+4	3,649	3,749	3,469	2,589	

Table 5.8.2 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 personnel at year-end			= Number of personne1 at previous year-end+1+2+3	1,046	1,046	1,526	1,706	

5.9 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.

5.9.1 Strengthening the Reliability of the Management Information and Information Sharing

Information is an essential ingredient in making policy and operational decisions. Information to be provided to decision-makers must be timely, consistent, reliable, and adequate so that it can be used to prevent problems, or solve those that have emerged. Information generated must come from all operating and administrative and technical support departments and must be processed and well-analyzed to be meaningful. It must be shared across horizontal and vertical lines of the entire organization. This can be done by developing and maintaining a database of technical and management (financial and administrative) information, including a management information system that includes both software and hardware. A department should be appointed to be in-charge of data generation, analysis and maintenance. Delegating responsibility and accountability to one department as a data base center will be more effective and efficient because of easier access to tested and verified data and information. 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.

However, due to the establishment of the division directly under the General Director, the result of the inspection and validation will have some limitations in objectivity for the outside world.

(1) Developing Management Information

1) Information sharing

Information that is important for management and administration is generally obtained at the work sites. However, the top-down decision-making process inherited from the old system is still strongly in place. Even if the information is transmitted from the work site to the middle management, sometimes it will stop there without flowing further. Thus, as an alternative to solve such problems, a bottom-up, participatory decision-making process should be put in place. This can be reinforced by introducing scheduled weekly meetings among work staff with the senior and middle managers present, by enforcing a reporting and monitoring system for work activities and by identifying action officers who can make on the spot decisions for critical work activities.

2) Information analysis

An equally important aspect is being able to analyze information and share it vertically and horizontally across the different functional areas of Vodokanal's organization. It is imperative to clarify the department and the persons responsible for gathering, analyzing, integrating, and then transmitting or disseminating the different types of information necessary for quick-response decision-making of the different levels of management. Some examples are the creation of internal memorandums, monthly reports, in-house magazines, annual reports and brochures.

(2) Developing Financial Management Systems

Vodokanal needs to replace the existing financial management systems, which are currently manual to a large extent, and thus can not provide timely or detailed information. The goal of this component of the LTDP is to improve the financial management and planning capacity and to provide adequate accounting and financial

management information about Vodokanal's activities. The timely information that is available will help control operating costs, manage assets and projects, provide customers with better service, among others. Key tasks will be the installation of adequate computerized financial, accounting and information systems in Vodokanal and its subsidiaries, the development of proper internal procedures and the training of the staff. The major financial management systems that were proposed for the installation of Vodokanal in the future, are briefly discussed below.

1) Billing and collection system

As mentioned in 5.7.1, improvement of the existing billing and collection systems is a priority task faced by Vodokanal and its newly established wholesale subsidiary. A billing and collection system that would be appropriate for Vodokanal was proposed in the previous JICA Study, with only minor changes pertaining to the characteristics of the latest hardware platforms and operating systems to be employed. Functions of the proposed Billing and Collection System will include, but will not limited to, such items as: (i) water users management; (ii) meter reading; (iii) water charges calculation and billing; (iv) collection; (v) outstanding water charges management; (vi) statistics; (vii) security and backup; (viii) data exchange with financial institutions; and (ix) meter reading by handheld terminals. Regarding billing and collection, digitalization of information can be considered for all data, not only from the Tariff Collection System, but also those collected at banks and post offices, as these are currently written on paper. For this, it is necessary for Vodokanal to sign contracts with the post office and the banks. This scheme is worth considering in order to increase efficiency in the water bills collection procedure.

2) Financial accounting system

All accounting functions of Vodokanal need computerization. Thus, the new Financial Accounting System, one of the key financial management systems in Vodokanal, will support the general ledger and produce Vodokanal's statutory financial statements and tax returns. Other financial management systems will be linked to this one. The system will conform to the national accounting, tax and reporting regulations,

including the chart of accounts. On the other hand, this system will allow the compilation of Vodokanal's financial statements, after making a number of adjusting entries, to be in accordance with the IAS. Significant efforts will be required to replace the existing document flow, which is suitable only for the manual ledger bookkeeping. A new document flow suitable for the computerized system will be set up, new accounting procedures will be developed and adequate training in accounting and IT for all accounting staff and the management of the company will be provided.

3) Cost accounting system

The Cost Accounting System will enable Vodokanal to generate timelier, accurate and relevant information required for decision-making at management and department levels. This system will enable the tracking of performance by Vodokanal's departments, business lines (e.g. water *vs*. sewerage), as well as the control of actual costs as compared to the budget.

4) Budgeting and financial planning system

The Budgeting and Financial Planning System will incorporate Vodokanal's production, sales, costs, investment and financing plans, as well as allow the comparison of actual figures to the approved budgets.

5) Assets management system

The Assets Management System will replace the existing Fixed Assets System. The new system will contain all data pertaining to titling, registration, characteristics, valuation (including details on all revaluations), depreciation, cost additions, relevant maps/plans, and others.

6) Project management system

The Project Management System will capture information about scope, costs and timelines of Vodokanal's projects on a daily basis.

7) Suppliers management system

The Suppliers Management System will contain a comprehensive data base of suppliers and process suppliers' invoices. It will allow the control of disbursements and optimize cash management.

8) Inventory management system

The Inventory Management System will allow the processing of information relevant to stocks and inventories, and will be capable of tracking all movements of materials and other assets at the central warehouse and also those stocked at other Vodokanal sites.

9) Human resources and payroll system

The Salary Calculation System currently used by Vodokanal will be enhanced. The new Human Resources and Payroll System, which replaces the existing system, will be based on a modern platform and will be integrated with the above-mentioned Financial Accounting System. The system will be applicable for performance measurement of Vodokanal's employees under new evaluation systems to be developed in the future.

The most important thing is that the new system will not be limited to the payroll calculation, but will also include a comprehensive employee database, containing all personal data, details of employment, qualifications, training, etc. Such database will be used by the HR Department and the management of the company for maximizing the potential and productivity of Vodokanal's employees.

10) Public relations system

This system will govern Vodokanals' relationship with its network of suppliers and customers as well as other stakeholders in all stages, starting from marketing and water saving campaigns to customer service and support. This system will cover, among other things, the customer complaints center, which should be established in Vodokanal. Vodokanal will create and support an Internet site, containing all

information relevant to customer relations and enabling customers to request for service. Also, leaflets on water saving and other brochures could be produced using this system.

11) Data exchange system

This system will ensure an efficient manner of inter-company data sharing and exchange between Vodokanal's head office, Rayon Vodokanals and recently established subsidiaries, as well as exchange of information with external organizations such as banks (installation of an adequate "bank-client" system could become the first step), tax authorities, Pension Fund, State Statistics Committee, TKEO, major customers and suppliers, and others.

12) Control and monitoring systems

Stand-alone computerized Control and Monitoring Systems will be installed in each of water treatment plants. In the future, these systems shall be linked together and could probably be integrated with other management systems employed by Vodokanal.

5.9.2 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 an independent and 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.

5.9.3 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, immediate and complete installation of personal computers must be done, 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.

5.10 Promotion of Customer Participation

5.10.1 Public Information, Education and Communication (IEC) and Public Relations

A comprehensive public Information, Education and Communications (IEC) program is a strategic move to link Vodokanal with all its stakeholders. It aims to inform, educate and communicate to the public in order to get important messages across utilizing print, broadcast (radio and TV) and the Internet technologies to bring across important messages. The ultimate goal of the IEC program, however, is promote awareness and elicit understanding of and support of the customers, the government decision-makers, and the general public of programs and projects of Vodokanal.

The IEC program should become largely the reason behind the increased awareness of water conservation efforts among the customers. Public relations strategies, such as the use of the radio, TV and print media to bring the message across should reinforce the vivid messages of the need to conserve. This awareness should be transformed into actual action, when indeed, water consumption will be reduced due to abandonment of wastage of water.

Moreover, not only one-way, but two-way strategies should be applied, such as the establishment of customer service desks at Rayon Vodokanals and Vodokanal head office in order to interact with the domestic customers and reflect their needs in the services and operations of Vodokanal. Recommended IEC activities are summarized in the following table.

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.

Table 5.10.1 Examples of IEC Activities

Purpose	Detailed Contents (Means)	Expected effects
To inform the public of the current situation of Tashkent's water service	Produce info-mercials on TV and radio	Support to the projects such as facilities' rehab. and water conservation policies
To inform the public of the current situation of Vodokanal	Produce information leaflets	Support to future increases in water tariffs
To inform and educate the customers of water conservation measures	Circulate leaflets (already prepared within the pilot project) and conduct face-to-face meetings with domestic customers	Transforms awareness into actual water conservation practice
To receive feedback from customers in the form of complaints and/or requests	Install customer counters and counseling counters at Rayon Vodokanals and Vodokanal	Improved relationship with customers
To educate the customers of the water supply operations	Produce curriculum enhancement materials for inclusion in the basic education curriculum	Sustained support to water supply plans and programs from younger generation
To educate the customers on water supply operations	Set up inspection tours at water treatment plants	Understanding and support to future increases in water tariffs, used to improve facilities
To establish interactive communication with the customers and the general public	Upload a website	Provision of two-way information in an efficient manner

5.11 Management Action Plans

In formulating management action plans, it is necessary to consider not only the progress of restructuring facilities such as the WTPs, but also changes in the internal/external management environment. The following staged actions should be taken:

1) In the short-term;

2) According to the progress of installing meters or the change of internal/external management environment;

3) According to the progress of restructuring the WTPs; and

4) After privatization.

The proposed Management Action Plans for Water Supply are as follows:

I. Funding Plan

Based on the facts mentioned in 5.6, necessary actions that Vodokanal as well as the government must carry out are explained below.

Actions that should be taken by Vodokanal

After having thoroughly understood and analyzed the LTDP, Vodokanal needs to source funds to finance the components of the project. Systematically, it needs to: (i) Formulate a plan to procure investment funds; (ii) Examine in detail the amount of funds that will become available through internal management efforts. (iii) After the detailed and consistent plan has been laid, it will be presented to the government for official approval (iv) Vodokanal, with the government's cooperation, will have to prepare and provide all required information as well as to meet all formalities for funds procurement. Some specific examples are: dealing with the borrowing procedures (please refer to 5.6.2) and conducting publicity work that will be needed to obtain an approval and compliance of the customers when increasing water tariffs.

Actions that should be taken by the government

The government, on the other hand, will have to do the following: (i) Examine the plan proposed by Vodokanal; (ii) Undertake necessary revisions in the plan in order to finalize it. *Hokimiyat* will play a leading role coordinating with other related governmental ministries and agencies in order to assure the effectiveness of the plan. Hokimiyat's role will also cover issues such as providing loan guarantees and examine safety nets that will be necessary when increasing water tariffs.

II. Program to Promote Installation of Water Meters

Actions that should be taken by Vodokanal

Vodokanal should ensure the following: (i) Promote the installation of water meters based on a plan and abide by the exact installation schedule (see (1) below). Depending on the progress of water meters installation, Vodokanal needs to: (ii) Examine the revision of the Norm Tariff System and consider funding resources for water meters installation (see (2) and (3) below). When the validity of these actions is verified, Vodokanal will: (iii) Submit a proposal to the government.

Actions that should be taken by the government

The government will examine the plan proposed by Vodokanal, and will make necessary revisions with a view to approving the final plan. In this whole process, *Hokimiyat* will play a lead role in coordinating with other related governmental ministries and agencies in order to assure the effectiveness of the plan.

(1) Planning and abiding by the defined installation schedule

- Evaluation of both technical and financial aspects of the pilot project regarding installing water meters in detached houses, to be conducted by Vodokanal;
- Technical evaluation of the meters newly installed by the outsourced installation company;

- Determining water meters installation methods;
- Determining how to raise funds for installing water meters;
- Planning a defined installation schedule up to 2009; and
- Designating metering monitoring task force to follow the schedule.

(2) Revision of the Norm Tariff System

- In determining water tariffs according to the Norm Tariff System, the standard consumption volume of water will be increased based on the actual usage;
- If authorities disagree with revision in the Norm Tariff System, introduction of the Bulk Metered Tariff System will be considered. The Bulk Metered Tariff System presupposes that the actual consumption volume of water at each apartment building is measured by a bulk meter, and each apartment is billed based on the bulk meter readings. If some of the apartments disagree with this system, a water meter will have to be installed individually. (Under the current system, the domestic customers have to bear the costs of the meter procurement). The bottomline is the option of domestic customers - applying the Bulk Metered Tariff System or installing a water meter individually, that would depend on their choice. The introduction of the Bulk Metered Tariff System alternative appears to require new legislation that will mandate its use and spell out implementing rules and regulations pertinent to costs, tariff setting, installation techniques, among others.

(3) Considering funding resources for water meter installation

If water meters installation does not progress as planned, one of the main reasons would be funding problems. Under the current situation, funding problems will arise due to the fact that domestic customers cannot bear the meter procurement costs. In addition, if neither subsidies nor capital injections from the government can be expected, the need for an external loan will arise. In this case Vodokanal must prepare the following data:

- Computation of the required investment amount to install water meters and calculation of the corresponding loan;

- Securing funds for the repayment of the loan;

- In case domestic customers cannot bear the meter procurement costs individually, alternative sources for the repayment of the loan are cost cutting through decreasing the proportion of unaccounted for water supply volumes with the collection of charges under the Metered Tariff System, or increased income through increments in real term growth of water tariffs, which would include inflation rates. Generally speaking, it will be difficult to receive a loan from aid agencies to renew the debt. Therefore, if Vodokanal or Hokimiyat expects funds from ODA agencies, it will be necessary to change the current laws and to collect the costs of installing water meters through the water charges. In any case, it will be imperative to plan for the securing of funds according to the loan repayment schedule.

- Guarantee and collateral

  It will be quite difficult to borrow from the private sector. There seems to be no other way except to obtain a loan from aid agencies, for which a guarantee from the government will be necessary. In this regard, cooperation from Hokimiyat as well as TKEO will be indispensable.

III. Program to Strengthen Management in Vodokanal

Actions that should be taken by Vodokanal

Besides implementing the actions indicated in 5.2.4 of the NRW Reduction Program, Vodokanal should consider and implement the following actions: develop a water supply technical and managerial database, develop a management information system with components for information sharing, analysis, as well as adopt policies and systems of information disclosure (see (1) to (3) below).

Actions that should be taken by the government

Consider and carry out information disclosure (see (3) below).

(1) Developing a Water Supply Technical and Managerial Database

Essential data required for water supply management will be gathered and developed into meaningful information. These will include technical as well as management data. Data such as those indicated in the Study can be of reference to obtain a specific idea of their characteristics. With regard to either the information that is currently non-existent or that lack reliability, after clarifying these items, the responsible department should be appointed to gather and develop the database. It must ensure that the information obtained is tested and verified for reliability and consistency. The Internal Audit Department will finally handle the data generated for the database.

(2) Developing a Management Information System

1) Information Sharing

Information that is important for management and administration is generally obtained at the work sites. However, the "top-down" decision-making process inherited from the old system is still strongly in place. Even if the information is transmitted from the work site to the middle management, sometimes it will stop there without flowing further. Thus, as an alternative to solve such problems, a "bottom-up", participatory decision-making process should be put in place. This can be reinforced by introducing scheduled weekly meetings among work staff with the senior and middle managers present; by enforcing a reporting and monitoring system for work activities; and by identifying action officers who can make on the spot decisions for critical work activities.

2) Information Analysis

An equally important aspect is being able to analyze information and share this vertically and horizontally across the different functional areas of Vodokanal's organization. It is imperative to identify the department and the persons responsible for gathering, analyzing, integrating, and then transmitting or disseminating the different types of information necessary for quick-response decision-making of the different levels of management. Some examples are the creation of internal memorandums, monthly reports, in-house magazines, annual reports and brochures.

(3) Disclosure of Information through the Comprehensive Information, Education and Communication (IEC) Program

Water supply service is an important public service. Being one that practically touches the very lives of all citizens, it is urgent that customers understand and support the many initiatives of Vodokanal. Thus, disclosing or disseminating basic information to the public in a planned regular manner, through the IEC program, using available media of communication is necessary. Control over technical information regarding water supply operations is currently tight in Uzbekistan, especially for foreign nationals. However, there are sensitive data that, due to their nature and content, should be disclosed to Vodokanal. Therefore, in organizing the information, a classification of the data by area and level of importance should be carried out in close cooperation with the National Security Commission, in order to make progress in the field of information disclosure. Such disclosure will be more necessary and important in the application for foreign assistance or funds for future investment regarding water supply service. However, as this is not an issue that can be solved in the short-term, it will be considered in the medium-term.

IV. Employee Training

Employee training will aim to strengthen and enhance the management capacity and competence of the employees through programs on information collection and organization, as well as on technology and management. Training will be outsourced to

an external consultant or supported by training programs offered by aid agencies. Recognizing the importance of self-sustaining development, these educational programs will focus initially on the formation of trainers.

Actions that should be taken by Vodokanal

In order to carry out employee training as explained above, Vodokanal will have to define the detailed contents of these training programs. In addition, in the particular case of requesting other aid agencies' support, this shall be done promptly.

- External consultants

  Regarding the employment of external consultants, as per terms of reference (TOR), their performance evaluation will be based on specific tangible results, or on target indicators and their degree of attainment. External consultants will basically be paid in proportion to their output. To determine the target indicators, it should be kept in mind that sustainable upgrading of skills must be implemented through On-the-Job Training (OJT) at Vodokanal.

V. Organizational Reform

Specific directions of proposed organizational reforms are mentioned in 5.8.3 "Organizational Reform". For its successful implementation, Vodokanal must carefully study the plan for organizational reform and take specific actions keeping in mind the following points:

- Assess any potential legal problems or problems with the labor union that might arise if organizational reforms take place;
- Implementing training programs for the acquisition of technical knowledge and skills that are necessary for reassignment or for re-employment; and
- Providing re-employment assistance and counseling services.

VI. Improving Personnel Evaluation (Performance Appraisal)

The details for the improvement of personnel evaluation or performance appraisal system have been mentioned in 5.8.2. Thus, this section will concentrate on the actions that Vodokanal must take in this regard.

Firstly, Vodokanal should evaluate whether under the current system, it is possible to improve the personnel evaluation or performance appraisal system. If so, Vodokanal will have to analyze different evaluation methods and implement suitable ones. If, on the contrary, this is not possible, Vodokanal must submit a proposal for institutional reform to the government to get its approval.

If the personnel evaluation or performance appraisal system is renovated, Vodokanal must carry out a post-evaluation of its effects, and make modifications if necessary.

VII. Information Technology Infrastructure

Actions that should be taken by Vodokanal

- Improve IT infrastructure;
- Clarify the specification of the IT system and conduct a pre-evaluation of the investment effects and its relevance;
- Consider options to fund IT related investments; and
- In order to increase operational efficiency through the expanded use of computers, all departments will need to be equipped with computers with general-purpose software installed. The existing LAN in the Sales Section will be improved in terms of functionality, due to its high investment impact. All compute- related matters, such as installation, promotion of their wide spread use and employee IT education will fall under the responsibility of an IT Department

whose creation was suggested previously in "Organizational Reform". Even though there are some employees with IT skills, it will be necessary to recruit additional skilled IT personnel for further improvement of the IT Infrastructure.

VIII. Information, Education and Communication (IEC) and Public Relations

A description related to Information, Education, Communication (IEC) and Public Relations is indicated in 5.10. Based on this, the actions that should be taken by Vodokanal are the following:

- Study in detail the points indicated in 5.10, and carry out actions as explained;
- Funds must be provided if necessary, after estimating the cost for the different activities stated in Table 5.10.1; and
- A short video will be prepared for TV airing/broadcast with the aim of reducing both water wastage and the unaccounted for water supply volume that occurs under the Norm Tariff System. This will fall under the responsibilities of the Public Relations Department whose creation was suggested previously in "Organizational Reform". The PR Department personnel will have to be skilled people recruited from the outside.

IX. Repairing Indoor Water Fixtures and Development and Diffusion of Spare Parts

Actions that must be taken by Vodokanal

Vodokanal must, in the first place, make a correct assessment of the current situation in order to carry out the actions presented below.

- Study if the plan is relevant from the technical point of view;
- Formulate the plan and submit it to the government.

Actions that must be taken by the government

- Study carefully the validity of Vodokanal's proposed plan;
- Analyze funding measures; and
- Define who the responsible organization will be, and subsequently implement the plan.

Some of the main reasons for water wastage under the Norm Tariff System are problems linked to inefficient/corroded water tap and flush toilet fixtures. Especially for the latter, high quality spare parts are not currently available. Thus, Vodokanal (or TKEO) will have to subcontract some company to develop appropriate spare parts and diffuse the use of such parts.

Actions- progressing meter installation

I. A Mid-Term Assessment of the Program to Promote Installation of Water Meters

Actions that must be taken by Vodokanal

The status regarding the operation of water meters and the collection of water bills under the Metered Tariff System will be evaluated. If revisions are required, an improvement plan will be presented and implemented.

II. Reforms in the Tariff System and Collection of Water Bills

(1) Reforms in the collection of water bills

Actions that must be taken by Vodokanal

Implement actions indicated under "Organizational Reform".

Regarding the indoor metering system, if the billing and collection department is spun off as a subsidiary, water bill collection costs can be lowered by simultaneously

collecting the bills of other public services that have an indoor metering system such as for instance electricity and gas suppliers.

(2) Introducing the New Tariff System

The Progressive Water Tariff System, as well as the Two-Tier Water Tariff System will be introduced if laws are changed.

Actions that must be taken by Vodokanal

Vodokanal shall study the introduction of the New Tariff System and based on the obtained information, should submit a proposal to the government.

Actions that must be taken by the government

The government shall examine Vodokanal's proposal and approve it after including necessary changes and revisions. In addition, it should consider various measures leading to the institution of safety nets. The above will be carried out in accordance with the progress of water meters installation.

III. Information Technology Infrastructure

Actions that must be taken by Vodokanal

A LAN that will cover other departments, besides the Sales Section, shall be developed.

IV. Strengthening IEC and Public Relations

Actions that must be taken by Vodokanal

Public information activities should include not only broadcast media such as TV and radio networks, but also cover the production and circulation of print materials such as brochures and leaflets, which shall be promoted. In addition, a curriculum enhancement material will be produced and this should be integrated in the basic education of schools to sustain support for the plans and programs of Vodokanal. Inspection tours at the water treatment plants will also be launched as part of an educational tour package for school children and adult citizens.

V. Employee Training

Actions that must be taken by Vodokanal

In addition, if support from JICA and/or other international aid agencies becomes necessary, Vodokanal must immediately request the government for training assistance.

Employee training will be reinforced. In addition to the current program for newly hired employees, three and five year training programs as well as Advanced Programs will be offered according to the technical and management portion. In addition, for these training programs, outside programs will be used, taking also full advantage of the programs offered by aid agencies (e.g. Programs offered at the JICA Japan Center).

Actions that must be taken by the government

The government must submit the required petitions to the international donor agencies if Vodokanal makes a request for the support of such agencies

VI. Introducing International Accounting Standards

Actions that must be taken by Vodokanal

Vodokanal must study and consider the measures recommended, and if any legal reforms become necessary, Vodokanal will submit a corresponding petition to the government.

International Accounting Standards (IAS) will be introduced. With this, costs that are currently not accounted for will be recognized, and Vodokanal's investment funds will be secured by establishing a new tariff system based on the correct figures of items such as depreciation, allowance for rehabilitation and allowance for doubtful debts. However, it should be noted that the foregoing presupposes that a reform in Uzbekistan's legal system takes place.

Actions that must be taken by the government

The government is expected to carefully consider any proposal presented by Vodokanal regarding institutional changes required for the introduction and adoption of IAS.

VII. Introduction of External Auditing

Actions that must be taken by Vodokanal

External auditing will be introduced to fulfill accountability.

Actions- progressing of WTPs restructuring

Actions that must be taken by Vodokanal

According to the progress of WTPs restructuring, actions mentioned in 5.5.4 "Countermeasures for the issues from the restructuring of the WTP" must take place. With reference to the benefits of employees who might be laid off, urging and increasing the awareness of current staff to the need for acquisition of new skills and to the need for positional movements/re-assignments is necessary. In order to do this, Vodokanal needs to implement the following actions:

- Curbing new hires and thorough implementing the retirement packages;

- Implementing training programs for the acquisition of technical knowledge and skills that are necessary if separation occurs, and/or for re-employment; and
- Providing re-employment assistance and counseling services.

Actions that must be taken by the government

On the other hand, regarding the vacant lots after the disposal of facilities, the following cases can be expected assuming that the government approves the disposal of these vacant lots:

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

Vacant lots can be kept as they are. However, it is necessary to take full consideration of the potential environmental problems that may arise.

Actions-after privatization

I. Strengthening the management (after privatization)

Actions that must be taken by Vodokanal

The Cabinet of Ministers of the ROU has already endorsed Vodokanal's privatization. Although management policies will be decided at the shareholders' meetings, this implies that management decisions will be made with more latitude and freedom. Therefore, a wider and deeper management reform can be expected.

II. Legal System Reforms

Actions that must be taken by the government

(1) Risk avoidance will be raised after privatization

With Vodokanal's privatization, the emergence of a management leadership concerned with efficiency and effectiveness as it affects profitability will be possible. However, an excessive focus on short-term profits might threaten the public welfare content of water supply operations. Risks related to the availability of long-term investment funds and interruptions in water supply services following withdrawal from unprofitable operations are some specific examples. These risks will be avoided with the government holding at least 51% of shares for the newly established company. However, if the proportion of shares held by government becomes less than 50%, it will be necessary to amend the law to avoid these risks.

(2) New standard for water tariff revisions

Theoretically, the optimal water tariff should be equal to the sum of long-term marginal costs and a constant and fair profit level. On the other hand, the current method used to determine water tariffs reduces the incentive for a better management because even if a cost reduction results from increased management efficiency, the tariffs should be reduced accordingly. Therefore, after the new company is established, a new method to determine water tariffs that adequately reflects management efforts should be created.

III. Considering the issuance of bonds

Actions that must be taken by Vodokanal

The issuance of bonds will be considered as a way to procure funds.

IV. Installation of Outdoor Water Meters

Actions that must be taken by Vodokanal

A transition to the installation of outdoor water meters will take place if a social consensus on the issue can be achieved in the future due to changes in the external environment or in the attitude of domestic customers.

5.12 Components of the Long-Term Development Plan with Respective Project Costs

5.12.1 Physical Components

The physical components of the long-term development plan with their respective construction costs are shown in Table 5.12.1. The components are divided into two phases:

Phase 1: 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 soft-data of the pipeline has already prepared. Therefore the installation work can be started even before the improvement of the other facilities in the first two years. During the period, detailed design of improvement for Kibray WTP and distribution system will be conducted. Upon completion of the detailed design, improvement of distribution system can start,

Phase 2: The rest of the Mater Plan projects to be implemented by the target year will be executed.

5.12.2 Operation and Maintenance Costs

O&M costs for the facilities are shown in Table 5.12.2. Current unit prices (in 2003) without price for electricity (for which the new price from December 2004 is used because its steep price increase, representing the future trend) are used for the calculation. Repair cost is not included.

5.12.3 Management Components

Table 5.12.3 indicates estimated costs for the purchase of equipment, 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 5.12.1 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
		imp.		(1,226)			By EBRD Project
	Disinfection facilities rep.		1			535	
	Reservoir reinforcement	V=45,000m^3	1			7,650	
		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. rquipment 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		1		269		
	Monitoring facilities		1	(50)		340	By Vodokanal budget
	Sub-total		1		2,024	6,231	
Pipeline replacement	D1200-100mm		120km	12,989			High 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	29,176	
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 5.12.2 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	kWh/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 consumption by the target year will be increased to improve the quality of distributed water

Table 5.12.3 List of Management Components of LTDP with Costs

No	Items	thousand USD	Remark
	Staged actions should be taken		
(1)	**In the short-term**		
1	Program to promote the installation of water meters	17,275	*1
2	Strengthen the management	-	
3	Improve employee training (Part 1)	-	
4	Organizational reform	-	
5	Improve personnel evaluation	-	
6	Develop an IT infrastructure (Part 1)	1,000	
7	Strengthen public relations (Part 1)	-	
8	Development and diffusion of indoor repair appliances	-	
	Subtotal	**18,275**	
(2)	**According to the progress of 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	Develop an IT infrastructure (Part 2)	400	
4	Strengthen public relations (Part 2)	-	
5	Improve employee training (Part 2)	600	
6	Introduce International Accounting Standards	-	
7	Introduction of external auditing	50	
	Subtotal	**1,050**	
(3)	**According to the progress of restructuring**		
1	Benefits to employees will be laid off	-	
(4)	**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: 2,740mil soum*5years/1,000soum/0.8(contingency)+5man-months (hereinafter "MM") x30 thousand USD= 17,275 thousand USD.

*2: Excluding water meters installation costs

5.13 Implementation Schedule

The implementation schedule of the LTDP is shown in Figure 5.13.1, based on the development plan.

As it can be seen, the figure contains the following information: the implementation schedule of the proposed projects, including the EBRD project, 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 5.13.2 shows the detailed implementation schedule for each component of the Management Improvement Program.

Year			2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Daily average 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 maximum 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	Construction of facilities	Phasing						◄		Phase 1		►	◄	Phase 2	►		
		Feasibility Study															
		Detailed design															
		Bidding															
		Kadirya improvement and replacement															
		Kibray improvement															
		Pipe replacement															
		PSs improvement															
		Installtion of pressure/flow regulation facilities															
		Reinforcement of pipes															
		Introduction of monitorig facilities															
	Improvement of managemen (details are shown in Figure Ⅱ3.6)	UFW reduction program (except for pipe replacemnt)															
		Improvement program for financial Status															
		Planning and implemention Program of management for Technical LTDP															
		Improvement plan for Tariff System															
		Strengthening program for management and organization															
		Information development and sharing															
		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 LTDP
EBRD Project

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

Figure 5.13.1 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	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 5.13.2 Details of the Management Improvement Projects' Implementation Schedule

Chapter 6 Evaluation of Long-Term Development Plan

Chapter 6 Evaluation of Long-Term Development Plan

6.1 Technical Evaluation

6.1.1 Summary of the Proposed Long-Term Development Plan

The water supply system shall distribute a steady supply of safe water to consumers for a proper cost. For this purpose, the water system needs to ensure enough capacity and good quality of water sources, to construct adequate, reliable and efficient water supply facilities, and to carry out the appropriate operation and maintenance. There are some issues that need to be dealt with regarding the water supply system in Tashkent City to attain the above targets. Table 6.1.1 shows the current issues, countermeasures included in the LTDP and the expected effects.

Table 6.1.1.Current Issues, Countermeasures and Estimated Effects

Current Issue	Countermeasure	Effect
Large water consumption	-Meters installation, -Replacement of pipeline.	-Reduction of water distribution quantity: from 2.9 to 1.6 million m^3/d. -Abandonment of 5 small scale WTPs.
Deterioration of facilities	-Replacement of necessary facilities in the future based on diagnosis	-Sustainable operation, -Introduction of latest systems
Capacity decline of wells	-Replacement/improvement of well pumps at Kibray WTP	-Stable water intake
Inefficient distribution system and operation	-Improvement of pipeline network (division of network and pipe reinforcement), -Introduction of automatic pressure/flow control, -To change from “by pumps” to “by gravity” at Kibray WTP -Improvement/refurbishing of Booster PSs to control automatically, -Introduction of monitoring system. -Construction of reservoir (Retention time: 2 hour),	-Saving electricity consumption, -Decreasing of operation staff -Stable and precise pressure control for distribution network even when the flow fluctuation expands in future
Inappropriate operation and maintenance manner	-Preparation of manuals and training programs -Sufficient funds	-Proper operation and maintenance -Stable and safety water distribution

As shown in the table, the reduction of water demand will be attained not only through water meter installation and replacement of distribution pipes, but also through the repair of water service equipment, water conservation measures by customers, restriction on watering plants, and exposing illegal pipe connections.

The target facilities and contents of the replacement, improvement and reconstruction portion of the LTDP with their purposes are listed in Table 6.1.2. The items in the yellow column will be implemented after 2015.

Table 6.1.2 List of Replacement /Repair/Reconstruction for Facilities in the LTDP

Name	Facility	Replacement/ repair/ Reconstruction	Purpose	Note
Kadirya WTP	No.1and No.2 Intake PS	Replacement and repair for PS	To replace deteriorating facilities	EBRD Project
	Sedimentation basin	Replacement for dredgers and repair for gates	To ensure sustainable operation	
		Improvement of flocculation basin	To improve sedimentation efficiency	
	Coagulation facility	Improvement of injection facilities	To improve sedimentation	
	Rapid filters	Replacement of valves	To replace deteriorating facilities	EBRD Project
		Improvement for auto-washing	To ensure efficient operation	EBRD Project
	Disinfection facility	Replacement of all facilities	To replace deteriorating facilities	
	Reservoir	Construction: V=45,000m^3x2	Regulating the volume for flow fluctuation	
	Distribution PS	Replacement and repair for PS	To replace deteriorating facilities	
	Power receiving facilities	Replacement of all facilities	To replace deteriorating facilities	
	Administration buildings	Refurbishing/expansion including control room	To ensure efficient operation/replace deteriorating facilities	
	Monitoring	Replacement of flow meters	To replace deteriorating facilities	By Vodokanal
		Installation of monitoring system	To improve efficiency & maintain proper operation	
	Laboratory	Replacement of analysis equipment	To ensure sustainable operation	EBRD Project
Kibray WTP	Wells' pumps	Replacement/Improvement of 63units of well pump	To replace deteriorated pump introduction of auto-control	EBRD Project
	Improvement of pipes	Rearrangement of distribution pipe	To establish gravity distribution	
	Disinfection facilities	Replacement of existing facilities	To replace deteriorating facilities	
	Reservoir	Construction: V= 20,000m^3	Regulating the volume for flow fluctuation	
	Distribution PS	Construction: capacity 1000 m^3/hr	Distribution for surrounding area	
	Power receiving facilities	Construction of new plant	To replace deteriorating facilities	
	Monitoring facilities	Flow meters	To replace deteriorating facilities	By Vodokanal
		Radio system	To improve efficiency and maintain proper operation	
Boz-su WTP	Intake PS	Replacement and repair for PS	To replace deteriorating facilities	EBRD Project
	Rapid filter	Replacement of filters with capacity of 100,000m^3/d	To replace deteriorating filters	EBRD Project
	Distribution PS	Replacement and repair for PS	To replace deteriorating facilities	EBRD Project
Distribution facilities	Pipelines	Replacement L=420 km, D100-1,600mm	To replace deteriorating facilities	
		Reinforcement of pipelines, L=16.8km	To improve distribution condition	
		Pressure/flow regulation valve 22units	To improve distribution condition	
	Booster PS	Improvement with automatic control and abandonment of PSs	To reduce power consumption and number of operation staff	
	Monitoring facilities	Monitoring pressure/flow of distribution network and booster PSs	To improve efficiency and maintain proper operation	
Preparing O&M manual and training program			To ensure proper O&M and skill-up for O&M staff	

6.1.2 Technical Evaluation

Table 6.1.3 shows a comparison of the water distribution system and facilities condition between 2002 and the target year (2015). The values in 2015 are estimated in Chapter 4 and Chapter 5.4.

Table 6.1.3 Comparison of Water Demands and Facilities Condition between 2002 and 2015

Items		Unit	2002	2005	2011	2015	Ratio: 2015/2002
Service population		1000 persons	2,171	2,178	2,200	2,218	1.02
Daily distribution amount	Average	1000m^3/d	2,900	2,741	1,831	1,625	0.56
	Maximum	1000m^3/d	3,100	3,015	2,051	1,820	0.59
Losses in the distribution system		1000m^3/d	1,161	1,161	646	472	0.41
		%	40	42	35	29	0.73
Actual capacity of WTPs		1000m^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 shown in the table, positive effects expected in 2015 are as follows:

- Daily average distribution amount is estimated to be reduced from 2,900,000 to 1,625,000 m^3/year;
- Loss of water quantity from the pipeline will-be reduced from 1,161,000 to 472,000 m^3/day;
- Current WTPs number will be reduced from eight to three;
- Current booster PS number will be reduced from 134 to 72
- Required number of staff for the facilities will be reduced from 1,695 to 631; and
- Electricity consumption for operation will be reduced from 275 to 102 GWh/year.

Aside from the above, the following will also be expected:

- Proper and precise operation of the water supply system will be carried out, because the operational status of the whole system will be monitored at the Vodokanal Head Office;,
- Deteriorated facilities will be replaced to ensure stable operation;
- Proper and stable operation of Kadirya WTP will be carried out, since deteriorated facilities will be replaced and some facilities will be improved; and
- Intake capacity of Kibray WTP will be recovered at 350,000m^3/d because the existing well pumps will be improved and auto-control for the pumps introduced.

The implementation of the LTDP program is necessary to ensure stable and safe operation of the water supply system, to reduce water consumption and losses, and to save on manpower and electricity consumption.

6.1.3 Environmental Evaluation

Saving water and electricity consumption will be attained by the implementation of this LTDP project. Therefore, the problems caused by water source over-exploitation, which frequently leads to environmental issues, will not occur. The total length of 420m pipe due for replacement in the congested City may cause some environmental issues, such as traffic jams, noise/vibration nuisance, dust generation; however appropriate countermeasures should be undertaken.

Vodokanal is firm in its position that annually, the length pipeline replacement/installation in the City should be pegged to 60km in order to prevent above problems. Therefore, in consideration of this decision, this plan that the annual pipe replacement/installation length be less than 60km.

6.1.4 Implementation of Long Term Development Plan

To effectively plan and design the proposed projects in the LTDP, Uzbekistan requires input from foreign construction consultants that would work together with local consultants.

Equipment and materials such as pumps, machines, electrical equipment (panels, transformers, cables, instrumentation and others) and pipe materials, to be used for the project, will be mainly procured from foreign countries. Since some required quipment and materials, such as pumps, valves and pipes, are being produced in Uzbekistan these should be used for the Project if the quality and the date of delivery meet the requirement of the project.
Based on survey results of the Team, the quality of most products made in Uzbekistan does not meet the requirement at present.

As for construction work, buildings and civil structures can be constructed by local workers using local materials. However foreign contractors should carry out the construction supervision because of the same reason for planning and design.

Pipe installation, especially for replacement, is usually carried out by Vodokanal, which hires local contractors. Replacement of pipelines can be carried out by Vodokanal if proper pipe materials are provided through international competitive biddings.

6.2 Socio-Economic and Financial Effects of LTDP

Evaluation of the Long-Term Development Plan for the water supply system of Tashkent City from both financial and economic aspects is made in this chapter.

6.2.1 Financial Simulation under the Optimum System

The Optimum System is identified in Section 5.3. In this section, financial simulations for entire Vodokanal operations based on the identified Optimum System were conducted for the following two cases:

- With LTDP
- Without LTDP, but only water meters will be installed as the LTDP

In both cases, the EBRD project is assumed to be completed as planned and its effect is incorporated.

(1) Assumptions for Financial Simulation

The following assumptions were made for the projections:

1) General Assumptions

i) Common elements

- The period of the projections is from 2005 to 2040;
- No adjustments for the effect of inflation and exchange rate fluctuations were considered;
- Meters will be installed for all customers by 2009 as planned by Vodokanal. It is assumed that 25% of meters for apartments will be installed by TKEO;
- Accounts receivable balance is assumed to be 80% of one third of the revenue in the same year;
- Current liabilities' balance is assumed to be half of the current assets' balance less cash;
- 75% of the entire cash surplus was assumed to be generated from the water supply activity. This ratio corresponds to the ratio between water supply and sewerage costs in 2002; and

- For the EBRD project, 3.5% per annum is assumed for the interest rate with 15-year repayment period inclusive of three-year grace period. Among the total cost estimate of 14.67 million USD, 4.67 million USD is co-financing part, Uzbekistan's internal fund.

ii) For "with LTDP" only

- The efforts of Vodokanal for cost reduction and revenue increase are considered;
- Funds will be borrowed from international financial institutions at 1.3%, 5%, and 10% interest rates (USD basis) with a 30-year repayment period inclusive of ten-year grace period;
- The total number of employees of Vodokanal and the spun-off companies was applied in this analysis because the outsourcing cost, which Vodokanal would pay to the spun-off companies, was considered to be equal to the labor costs of the employees reassigned to those companies;
- Personnel required for the implementation of the facilities' Long-Term plan (400 employees) were not included in the total number of employees because they were included in the Capital Investment costs of the facilities' Long-Term plan (Refer to Table 5.8.1 for the details on personnel projection); and
- It is assumed that the collection rate for the big debts will be improved in 2007.

2) Expenses

i) Common elements

- The material costs were projected based on the distribution amount;
- The cost of electricity was basically projected based on the electricity consumption. The unit price of electricity was assumed to remain constant;
- The sewerage cost of materials and electricity was calculated based on the ratio between the water supply and sewerage costs in 2002;
- The labor costs were projected based on the number of employees.
- The meters' acquisition costs were not included in the meters installation costs because the customers are to purchase them; and
- Other sales and administration cost were assumed to remain constant.

- Additional coagulant usage for water quality improvement was added from 2011.

3) Revenue

i) Common elements

- Water tariffs in 2005: 30 soum/m^3 for the domestic customers and communal services including hot water supply company -Tashteplocentral, and 55.8 soum/m^3 - for industries;
- Sewerage tariffs in 2005: 20 soum/m^3 for the domestic customers and communal services including hot water supply company, and 25 soum/m^3 - for industries; and
- Charges for sewerage were calculated based on the water supply consumption. The ratio between water supply and sewerage for the first half of 2003 was applied for the calculation.

ii) For "with LTDP" only

- It was assumed that as a result of the projects aimed at reduction of NRW it would become clear who are the consumers of 44 thousands m^3/day of the NRW, and the relevant revenue was added after 2007.

(2) Results of Financial Simulations

1) Case "with LTDP"

i) A Slow Tariff Increase scenario

Table 6.2.1 presents the results of the calculations in which the borrowing interest rate was changed, the affordability for the domestic customers is fully considered and a Slow Tariff Increase scenario, which assumes the annual tariff increase by 3% from 2006 to 2017, 2025, 2030, and 2040, is adopted respectively.

Table 6.2.1 Simulation Results of Slow Tariff Increase, by Interest Rate

Interest Rates	Tariff increase until			
	2017 Cumulative increase: 1.4 fold	2025 Cumulative increase: 1.8 fold	2030 Cumulative increase: 2.1 fold	2040 Cumulative increase: 2.8 fold
1.3%	No cash shortage during 2005 to 2040 Cash surplus of 10 million USD at 2040	No cash shortage during 2005 to 2040 Cash surplus of 119 million USD at 2040	No cash shortage during 2005 to 2040 Cash surplus of 173 million USD at 2040	No cash shortage during 2005 to 2040 Cash surplus of 228 million USD at 2040
5.0%	Cash shortage*	No cash shortage during 2005 to 2040 Cash surplus of 26 million USD at 2040	No cash shortage during 2005 to 2040 Cash surplus of 81 million USD at 2040	No cash shortage during 2005 to 2040 Cash surplus of 135 million USD at 2040
10.0%	Cash shortage	Cash shortage	Cash shortage	Cash shortage

Note: Tariff increase rate (per year): 2006-2040 by 3%
*If tariff increases until 2017, cash shortage will occur after this period (see Volume 3, S 11-1-3).

As a result, for the 1.3% interest rate, if tariffs are increased up to 2017, there will be the most desirable conditions for Vodokanal from financial point of view and also taking the affordability of domestic customers into account. The details of the simulation under this condition are presented in Table S 6.2.2 in Volume 3: Supporting Report. For the 5% interest, further tariff increase, by 3%, until 2025 will be necessary and its simulation details are presented in Table 6.2.2 below. For the 10% interest rate, either further rapid tariff increase or other financial measures such as government subsidy is necessary as will be discussed in ii) and iii).

Table 6.2.2 Results of Simulation under Slow Tariff Increase Scenario and 5% Interest Rate (Tariff Increase by 2025 = 1.8 fold)

Real Tariff Level	100%	103%	106%	109%	113%	116%	119%	123%	127%	130%	134%	138%	143%	147%	151%	156%	160%	165%
																		Unit: Thousand US$
Income Statements																		
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Revenue	24,822	24,898	25,169	24,984	24,913	25,264	25,912	26,576	27,256	27,954	28,669	29,523	30,403	31,309	32,243	33,204	34,195	35,215
Expense																		
Operating Expense other	21,397	20,485	19,588	18,553	17,415	16,611	16,332	16,031	15,733	15,487	15,244	15,253	15,262	15,271	15,282	15,292	19,463	19,475
Loss on Write off	1,655	1,660	1,678	1,666	1,661	1,684	1,727	1,772	1,817	1,864	1,911	1,968	2,027	2,087	2,150	2,214	2,280	2,348
Depreciation (Investment)	460	1,119	2,380	3,262	4,401	6,489	8,528	9,155	11,408	13,818	13,264	12,401	10,930	9,557	8,738	7,113	5,111	3,996
Depreciation (Existing)	2,101	1,978	1,854	1,730	1,607	1,483	1,360	1,236	1,112	989	865	742	549	0	0	0	0	0
Interest Cost	100	257	584	1,049	1,469	2,118	3,011	3,665	4,541	5,931	6,613	6,580	6,536	6,472	6,386	6,271	6,120	5,944
Expense for M/P	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Expense	26,362	25,499	26,084	26,259	26,552	28,385	30,958	31,858	34,611	38,088	37,898	36,944	35,304	33,388	32,555	30,889	32,974	31,763
Net Income	-1,540	-601	-915	-1,275	-1,639	-3,121	-5,046	-5,283	-7,355	-10,135	-9,229	-7,421	-4,901	-2,079	-312	2,315	1,221	3,452
Balance Sheets																		
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Asset																		
Fixed Asset																		
Acquisition Cost																		
New Investment	5,890	10,780	24,084	32,098	41,477	59,039	78,351	86,366	114,569	143,119	143,119	143,119	143,119	143,119	143,119	143,119	143,535	143,535
Existing Asset	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182
Less: Accumulated Depreciation																		
New Investment	-460	-1,579	-3,959	-7,220	-11,621	-18,110	-26,638	-35,792	-47,200	-61,018	-74,282	-86,684	-97,614	-107,171	-115,909	-123,022	-128,133	-132,129
Exisiting Asset	-21,677	-23,655	-25,509	-27,239	-28,846	-30,329	-31,689	-32,925	-34,037	-35,026	-35,891	-36,633	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182
Other long term assets	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662
Total Fixed Asset	22,597	24,391	33,461	36,483	39,854	49,444	58,869	56,493	72,176	85,919	71,789	58,647	47,167	37,610	28,872	21,759	17,064	13,068
Current Asset																		
Cash	1,409	2,337	6,514	9,977	13,799	17,770	21,692	25,878	30,119	33,865	37,755	42,447	47,572	53,192	59,288	65,781	68,071	71,766
Government Subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Receivable	11,521	11,541	6,712	6,662	6,643	6,737	6,910	7,087	7,268	7,454	7,645	7,873	8,107	8,349	8,598	8,854	9,119	9,391
Other Current Asset	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107
Total Current Asset	14,037	14,985	14,332	17,746	21,550	25,615	29,709	34,072	38,495	42,427	46,507	51,427	56,786	62,648	68,993	75,742	78,296	82,263
Total Asset	36,634	39,376	47,793	54,230	61,403	75,059	88,578	90,565	110,671	128,346	118,296	110,073	103,953	100,258	97,865	97,502	95,360	95,331
Equity and Liablities																		
Equity																		
Capital	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164
Government Subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained Earnings	-827	-1,428	-2,343	-3,619	-5,258	-8,379	-13,425	-18,708	-26,063	-36,197	-45,427	-52,847	-57,748	-59,827	-60,139	-57,824	-56,602	-53,150
Total Equity	25,337	24,736	23,821	22,545	20,906	17,785	12,739	7,456	101	-10,033	-19,263	-26,683	-31,584	-33,663	-33,975	-31,660	-30,438	-26,986
Liabilitites																		
Current Liabilities	6,314	6,324	3,909	3,885	3,875	3,922	4,008	4,097	4,188	4,281	4,376	4,490	4,607	4,728	4,853	4,981	5,113	5,249
Loan	4,983	8,316	20,063	27,800	36,622	53,351	71,830	79,012	106,382	134,098	133,183	132,267	130,930	129,193	126,987	124,181	120,686	117,069
Total Liabilities	11,297	14,640	23,973	31,684	40,497	57,273	75,839	83,109	110,570	138,379	137,559	136,757	135,538	133,921	131,840	129,162	125,799	122,318
Total Equity & Liabilities	36,634	39,376	47,793	54,230	61,403	75,059	88,578	90,565	110,671	128,346	118,296	110,073	103,953	100,259	97,865	97,502	95,361	95,332

Note: New investment excludes VAT, Price Contingency, and Import Tax (in Table 5.12.1) and includes EBRD loans, IT infrastructure and replacement costs in the future.

Table 6.2.2 Results of Simulation under Slow Tariff Increase Scenario and 5% Interest Rate (Tariff Increase by 2025 = 1.8 fold)

Real Tariff Level	170%	175%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%
																		Unit: Thousand US$
Income Statements																		
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Revenue	36,266	37,348	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463	38,463
Expense																		
Operating Expense other	19,487	19,500	19,514	20,568	20,583	20,599	19,575	20,633	20,633	20,633	20,633	20,633	20,633	20,633	20,633	20,633	20,633	20,633
Loss on Write off	2,418	2,490	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564
Depreciation (Investment)	3,195	2,393	2,335	3,680	3,969	2,850	2,807	2,807	2,807	2,344	940	0	0	0	0	0	0	0
Depreciation (Existing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest Cost	5,728	5,441	5,118	4,795	4,472	4,150	3,827	3,504	3,181	2,859	2,536	2,213	1,893	1,574	1,266	978	712	480
Expense for M/P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Expense	30,828	29,824	29,531	31,607	31,589	30,162	28,773	29,508	29,185	28,399	26,673	25,410	25,089	24,771	24,463	24,175	23,909	23,677
Net Income	5,438	7,524	8,932	6,855	6,873	8,300	9,690	8,955	9,278	10,064	11,790	13,053	13,373	13,692	14,000	14,288	14,553	14,785
Balance Sheets																		
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Asset																		
Fixed Asset																		
Acquisition Cost																		
New Investment	143,535	143,535	143,535	152,895	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255	162,255
Existing Asset	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182	37,182
Less: Accumulated Depreciation																		
New Investment	-135,324	-137,717	-140,052	-143,732	-147,702	-150,551	-153,358	-156,165	-158,971	-161,315	-162,255	-162,255	-162,255	-162,255	-162,255	-162,255	-162,255	-162,255
Exisiting Asset	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182	-37,182
Other long term assets	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662
Total Fixed Asset	9,873	7,480	5,145	10,825	16,215	13,366	10,559	7,752	4,946	2,602	1,662	1,662	1,662	1,662	1,662	1,662	1,662	1,662
Current Asset																		
Cash	75,231	78,549	83,212	77,932	72,960	77,655	83,696	89,002	94,632	100,584	106,859	113,456	120,457	127,776	135,825	144,561	154,032	164,614
Government Subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts Receivable	9,671	9,959	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257	10,257
Other Current Asset	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107	1,107
Total Current Asset	86,009	89,615	94,575	89,295	84,323	89,018	95,059	100,366	105,995	111,947	118,222	124,820	131,821	139,140	147,188	155,925	165,396	175,977
Total Asset	95,882	97,095	99,720	100,120	100,539	102,384	105,618	108,118	110,941	114,550	119,884	126,482	133,483	140,802	148,850	157,587	167,058	177,639
Equity and Liablities																		
Equity																		
Capital	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164
Government Subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained Earnings	-47,712	-40,189	-31,257	-24,402	-17,529	-9,229	461	9,416	18,693	28,757	40,547	53,599	66,972	80,664	94,664	108,952	123,505	138,290
Total Equity	-21,548	-14,025	-5,093	1,762	8,635	16,935	26,625	35,580	44,857	54,921	66,711	79,763	93,136	106,828	120,828	135,116	149,669	164,454
Liabilitites																		
Current Liabilities	5,389	5,533	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682	5,682
Loan	112,042	105,587	99,132	92,677	86,222	79,767	73,312	66,857	60,402	53,947	47,492	41,037	34,665	28,292	22,341	16,790	11,708	7,504
Total Liabilities	117,431	111,120	104,814	98,359	91,904	85,449	78,994	72,539	66,084	59,629	53,174	46,719	40,347	33,974	28,023	22,471	17,389	13,185
Total Equity & Liabilities	95,882	97,095	99,720	100,121	100,539	102,384	105,619	108,119	110,941	114,550	119,885	126,482	133,483	140,802	148,851	157,587	167,058	177,640

Table 6.2.2 Results of Simulation under Slow Tariff Increase Scenario and 5% Interest Rate (Tariff Increase by 2025 = 1.8 fold)

Real Tariff Level	100%	103%	106%	109%	113%	116%	119%	123%	127%	130%	134%	138%	143%	147%	151%	156%	160%	165%
Overall Cash Flow Projection																		
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Operating activity																		
Net Income	-1,540	-601	-915	-1,275	-1,639	-3,121	-5,046	-5,283	-7,355	-10,135	-9,229	-7,421	-4,901	-2,079	-312	2,315	1,221	3,452
+ Depreciation	2,561	3,097	4,234	4,992	6,008	7,972	9,887	10,391	12,520	14,807	14,129	13,143	11,479	9,557	8,738	7,113	5,111	3,996
- Increase in receivables	-1,298	-20	4,830	49	19	-94	-173	-177	-181	-186	-191	-228	-235	-242	-249	-256	-264	-272
+ Increase in current liablities	649	10	-2,415	-25	-9	47	86	89	91	93	95	114	117	121	124	128	132	136
Cash from operating activity	372	2,485	5,734	3,741	4,378	4,804	4,755	5,019	5,074	4,579	4,805	5,608	6,461	7,358	8,302	9,300	6,200	7,312
Investment activity																		
Investment	5,890	4,890	13,304	8,014	9,378	17,562	19,312	8,014	28,204	28,550	0	0	0	0	0	0	416	0
Cash used for investment activity	-5,890	-4,890	-13,304	-8,014	-9,378	-17,562	-19,312	-8,014	-28,204	-28,550	0	0	0	0	0	0	-416	0
Financial activity																		
Loan borrowed	4,983	3,333	11,747	8,014	9,378	17,562	19,312	8,014	28,204	28,550	0	0	0	0	0	0	0	0
Principal repayment	0	0	0	278	556	833	833	833	833	833	916	916	1,336	1,737	2,206	2,806	3,494	3,617
Cash from (used for) finanicial activity	4,983	3,333	11,747	7,736	8,823	16,729	18,479	7,181	27,371	27,716	-916	-916	-1,336	-1,737	-2,206	-2,806	-3,494	-3,617
Increase (decrease) in cash during the year	-535	928	4,177	3,464	3,822	3,971	3,922	4,186	4,241	3,746	3,889	4,693	5,124	5,621	6,095	6,493	2,290	3,695
Cash at beginning of the year	1,944	1,409	2,337	6,514	9,977	13,799	17,770	21,692	25,878	30,119	33,865	37,755	42,447	47,572	53,192	59,288	65,781	68,071
Cash at end of the year	1,409	2,337	6,514	9,977	13,799	17,770	21,692	25,878	30,119	33,865	37,755	42,447	47,572	53,192	59,288	65,781	68,071	71,766
Cash Flow Projection for Water Supply																		
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cash from operating activity	372	2,485	5,734	3,741	4,378	4,804	4,755	5,019	5,074	4,579	4,805	5,608	6,461	7,358	8,302	9,300	6,200	7,312
+Interest expense	100	257	584	1,049	1,469	2,118	3,011	3,665	4,541	5,931	6,613	6,580	6,536	6,472	6,386	6,271	6,120	5,944
+Expense for M/P	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+Capital Repair for Water supply	50	74	99	124	174	199	199	149	99	99	99	108	117	127	137	147	4,319	4,330
①Cash from operating activity before interest, M/P, repair	1,171	2,817	6,417	4,914	6,021	7,121	7,965	8,833	9,715	10,609	11,517	12,296	13,114	13,956	14,824	15,718	16,638	17,586
②Cash from Water supply operation(①X75%)	878	2,112	4,813	3,685	4,515	5,341	5,973	6,625	7,286	7,957	8,638	9,222	9,835	10,467	11,118	11,788	12,479	13,190
③Repayment	0	0	0	278	556	833	833	833	833	833	916	916	1,336	1,737	2,206	2,806	3,494	3,617
④Interest payment	100	257	584	1,049	1,469	2,118	3,011	3,665	4,541	5,931	6,613	6,580	6,536	6,472	6,386	6,271	6,120	5,944
⑤Cash used for M/P	6,540	4,890	13,304	8,014	9,378	17,562	19,312	8,014	28,204	28,550	0	0	0	0	0	0	416	0
⑥Cash used for repair	50	74	99	124	174	199	199	149	99	99	99	108	117	127	137	147	4,319	4,330
⑦Loan Borrowed	4,983	3,333	11,747	8,014	9,378	17,562	19,312	8,014	28,204	28,550	0	0	0	0	0	0	0	0
⑧Balance(⑩'(last year) +②−③−④−⑤−⑥+⑦)	261	485	3,057	5,292	7,609	9,800	11,731	13,708	15,521	16,615	17,625	19,243	21,089	23,221	25,610	28,174	26,304	25,603
⑨Government Subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
⑩Ending Balance(⑧+⑨)	261	485	3,057	5,292	7,609	9,800	11,731	13,708	15,521	16,615	17,625	19,243	21,089	23,221	25,610	28,174	26,304	25,603

Table 6.2.2 Results of Simulation under Slow Tariff Increase Scenario and 5% Interest Rate (Tariff Increase by 2025 = 1.8 fold)

Real Tariff Level	170%	175%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%	181%
Overall Cash Flow Projection																		
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Operating activity																		
Net Income	5,438	7,524	8,932	6,855	6,873	8,300	9,690	8,955	9,278	10,064	11,790	13,053	13,373	13,692	14,000	14,288	14,553	14,785
+ Depreciation	3,195	2,393	2,335	3,680	3,969	2,850	2,807	2,807	2,807	2,344	940	0	0	0	0	0	0	0
- Increase in receivables	-280	-289	-297	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ Increase in current liablities	140	144	149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash from operating activity	8,493	9,773	11,118	10,535	10,843	11,150	12,496	11,762	12,084	12,407	12,730	13,053	13,373	13,692	14,000	14,288	14,553	14,785
Investment activity																		
Investment	0	0	0	9,360	9,360	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash used for investment activity	0	0	0	-9,360	-9,360	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial activity																		
Loan borrowed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Principal repayment	5,027	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,372	6,372	5,952	5,551	5,082	4,204
Cash from (used for) finanicial activity	-5,027	-6,455	-6,455	-6,455	-6,455	-6,455	-6,455	-6,455	-6,455	-6,455	-6,455	-6,455	-6,372	-6,372	-5,952	-5,551	-5,082	-4,204
Increase (decrease) in cash during the year	3,465	3,318	4,663	-5,280	-4,972	4,695	6,041	5,307	5,629	5,952	6,275	6,598	7,001	7,319	8,048	8,736	9,471	10,581
Cash at beginning of the year	71,766	75,231	78,549	83,212	77,932	72,960	77,655	83,696	89,002	94,632	100,584	106,859	113,456	120,457	127,776	135,825	144,561	154,032
Cash at end of the year	75,231	78,549	83,212	77,932	72,960	77,655	83,696	89,002	94,632	100,584	106,859	113,456	120,457	127,776	135,825	144,561	154,032	164,614
Cash Flow Projection for Water Supply																		
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Cash from operating activity	8,493	9,773	11,118	10,535	10,843	11,150	12,496	11,762	12,084	12,407	12,730	13,053	13,373	13,692	14,000	14,288	14,553	14,785
+Interest expense	5,728	5,441	5,118	4,795	4,472	4,150	3,827	3,504	3,181	2,859	2,536	2,213	1,893	1,574	1,266	978	712	480
+Expense for M/P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+Capital Repair for Water supply	4,343	4,355	4,369	5,423	5,438	5,454	4,430	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488
①Cash from operating activity before interest, M/P, repair	18,563	19,569	20,605	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754	20,754
②Cash from Water supply operation(①X75%)	13,922	14,677	15,454	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565	15,565
③Repayment	5,027	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,455	6,372	6,372	5,952	5,551	5,082	4,204
④Interest payment	5,728	5,441	5,118	4,795	4,472	4,150	3,827	3,504	3,181	2,859	2,536	2,213	1,893	1,574	1,266	978	712	480
⑤Cash used for M/P	0	0	0	9,360	9,360	0	0	0	0	0	0	0	0	0	0	0	0	0
⑥Cash used for repair	4,343	4,355	4,369	5,423	5,438	5,454	4,430	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488
⑦Loan Borrowed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
⑧Balance(⑩'(last year) +②－③－④－⑤－⑥＋⑦)	24,427	22,853	22,364	11,896	1,735	1,242	2,095	2,213	2,654	3,418	4,504	5,913	7,726	9,857	12,716	16,265	20,547	25,940
⑨Government Subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
⑩Ending Balance(⑧＋⑨)	24,427	22,853	22,364	11,896	1,735	1,242	2,095	2,213	2,654	3,418	4,504	5,913	7,726	9,857	12,716	16,265	20,547	25,940

ii) Required tariff increase scenario under the 10% interest rates

If Vodokanal borrows the funds at 10% p.a. interest rate, further tariff increase would be necessary. Table 6.2.3 shows the required tariff increase if the interest rate increases to 10%.

Table 6.2.3 Tariff Increase Trajectory for the Interest Rate 10%

Interest rate	Annual Tariff Increase				Results
	2006 - 2010	2011 - 2020	2021 - 2022	2023 - 2040	
10%	5%	5%	3% Cumulative increase: 2.2 fold	0%	Cash surplus of 77 million USD by 2040

iii) Cash shortages under the Slow Tariff Increase scenario

If any cash shortfalls are to be compensated by the government, tariff increase could be minimized even under 10% interest rates. Table 6.2.4 presents the results of the calculations of the amount of cash shortages under the Slow Tariff Increase scenario as 3 % per annum. The cumulative tariff increase by 2029 will be 2.0 fold

Table 6.2.4 Cash Shortages under the Slow Tariff Increase Scenario

Interest rate	Annual Tariff increase				Results
	2006 - 2010	2011 - 2015	2016 - 2025	2026 - 2029	
10%	3%	3%	3%	3% by 2029 Cumulative increase 2.0 fold	Cash surplus of 40 million USD by 2040
Cash shortage for the period (Cumulative)	0	9 mil. USD (9 mil. USD)	55 mil. USD (65 mil. USD)	30 mil. USD (95 mil. USD)	

The simulation details in Table 6.2.4 are presented in Table S 6.2.4 in Supporting Report.

2) Case “without LTDP”

In this section, financial simulation for “without LTDP” case is presented. Even under this case, the EBRD project and meter installation are assumed to be completed as planned.

When the Slow Tariff Increase scenario, 3 % per annum, is applied from 2006 to 2040 and cumulative tariff increase is 2.8 fold, the financial status of Vodokanal will fall into deficit during 2013 to 2034 as presented in Table S 6.2.6 in Supporting Report. Since the EBRD loan is guaranteed by the government, cash required to repay the loan will be compensated by the government, at least temporary. If Vodokanal alone is to carry out its responsibility of interest and principal repayment obligation, further tariff increase is necessary as presented in Table 6.2.5.

Table 6.2.5 Tariff Increase Trajectory for "without LTDP"

Annual Tariff Increase				Results
2006 - 2010	2011 - 2015	2016 - 2022	2023 - 2040	
5%	4%	3% Cumulative increase: 1.9 fold	0%	Cash surplus of 52 million USD by 2040

(3) Results

In order to implement the Long-Term Development Plan, a considerable amount of investment funds will be necessary. Even if water charge is increased, it is impossible to secure necessary funds for the recommended plan by Vodokanal alone within a tight time frame before implementing the Long-Term Development Plan and thus, borrowings or government subsidy will be essential. As a result of the simulation, if the borrowing rate is 10 %, government subsidy will be necessary to repay the borrowed funds as shown in Table 6.2.4. If the borrowing interest rate does not exceed 5% per annum, it will be enough for the annual real tariff increase to be limited to 3%, in consideration of the repayment of borrowed funds and affordability of water charges for domestic customers. Since 1.3 % interest rate is almost unrealistic term, it is unlikely that Vodokanal could secure the funds with such a low interest rate.

In addition, if Vodokanal could borrow the funds from an international financial institution or a foreign government, co-finance is usually required for certain amount. In order to cover this co-finance portion of the fund, subsidy from the government or other commercial loan need to be considered. It should be also emphasized that in the simulation,

income tax is assumed to be exempted during the borrowing period; otherwise, further tariff increase is unavoidable.

If Vodokanal could not secure any funds at all and keeps annual tariff increase at 3 %, the financial status will fall into deficit. In order to keep positive cash balance throughout the period, either further rapid tariff increase or government subsidy will be necessary. In this context, it can be concluded that if Vodokanal could secure the funds with less than 5% or 5% interest rate, implementing LTDP will bring better financial condition and avoid excessive burden on the domestic customers.

6.2.2 Expected Cost Reduction by Implementation of LTDP

Implementation of each project in the Long-Term Development Plan will bring several benefits mentioned below.

(1) Decrease of Non-Revenue Water (NRW)

After installation of water meters for all customers and rehabilitation of the distribution pipelines, NRW volume will be reduced and variable costs will be decreased by 920 million soum per year, as calculated in Table 6.2.6.

Table 6.2.6 Reduction of Variable Costs for NRW

Year	Note	2002	2015	Difference
Distribution Volume (1000m^3/day)	1	2,900	1,625	
Rate of Unaccounted-For Water	2	51%	29%	
Unaccounted-For Water (10000m^3/day)	3	1,479	471	
Variable Costs (Soum/ m^3)	4	2.5	2.5	
Variable Costs for Unaccounted-For Water (mil. soum/year)	5	1,350	430	920

Note1: From Table 6.1.3
Note2: From Tables 2.3.1 and 6.1.3
Note3: Calculated by Distribution Volume * Rate of Unaccounted-For Water
Note4: 2.5(soum/m^3)=(2,338+271) mil. soum /(2,900 thousand m^3*365days), material and electricity costs in 2002 in Table 2.3.42
Note5: Calculated as Unaccounted-for water * Variable costs

(2) Decrease of electricity costs

After the replacement of water supply facilities, electricity consumption will be reduced and electricity costs will be decreased by 889 million soum per year, as calculated in Table 6.2.7.

Table 6.2.7 Reduction of Electricity Costs

Year	Note	2002	2015	Difference
Electricity consumption including the effect from reducing distribution volume (1,000,000kwh/y)	1	275	102	
Electricity consumption excluding the effect from reducing distribution volume (1,000,000wh/y)	2	275	182	
Electricity cost (soum/ m^3)	3	4.4	2.9	
Impact of Electricity Efficiency	4	2,609	1,720	889

Note1: From Table 6.1.3
Note2: 182=102*2,900/1,625. 2,900 and 1,625 is from Table 6.1.3.
Note3: 4.4 soum/ m^3 is from Table 2.3.42. 2.9 soum/ m^3=4.4*182/275.
Note4: 1,720 million soum=2.9soum*1,625thousand*365days.

(3) Decrease of the Labor Costs

After reforming the water supply system, the number of staff will be reduced and labor costs will be decreased by 695 million soum per year, as calculated in Table 6.2.8.

Table 6.2.8 Reduction of Labor Costs

Year	Note	2002	2015	Difference
Number of staff	1	1,695	631	
Employees' wages & salaries for water distribution (mil. soum/year)	2	1,108	413	695

Note1: From Table 6.1.3
Note2: =1,108*631/1,695=631*0.654

(4) Expected Cost Reduction

In total, 2,504 (920 plus 889 plus 695) million soum will be saved after completing all the projects in the LTDP, which is approximately 17% of water supply costs in 2002.

6.2.3 Socio-Economic Benefits of LTDP

Almost all projects proposed in the Long-Term Development Plan are aimed to avoid future terrible accidents like a stop in the water supply. Even though it is a very contro-

versial issue, the economic impact due to a stop in the water supply is evaluated as below by using some assumptions.

Assumptions:

- Water supply cannot be provided to 50% of domestic customers in Tashkent, if a stop in the water supply happens;
- 30 lpcd is the minimum requirement for a domestic customer's living; and
- The cost of 30 liters of bottled drinking water is 2 USD.

In this case, the economic impact due to the stop of water will be 730 million USD (2 USD *1,000,000 person*365day) per year. The economic impact exceeds the total economic project costs amounting to 140 million USD mentioned above. This means that avoiding future terrible accidents is very significant from the economic point of view.

If domestic customers do not want to buy the bottled water, they will use water from the canal. However it is necessary to establish a way to access the canal, and also it is risky for their health to drink water without necessary treatment (e.g. boiling) even if the accessing way is established. There will be a problem to attain providing safe water to all domestic customers.

As we examined this chapter, 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 7 Selection of Priority Projects

Chapter 7 Selection of Priority Projects

7.1 Proposed Projects for the Long-Term Development Plan

In order to select the prioritized projects, some evaluation items should be chosen. As mentioned earlier, the NRW Reduction Program should be taken up as first priority, and the facilities required to operate and distribute water to the city in the target year should be rehabilitated and improved as management improvement also progresses.

The items for selection are shown as follows:

1. Deteriorated pipelines need to be replaced under the NRW Reduction Program;
2. Deteriorated facilities in Kadirya, Kibray and Boz-su WTPs need to be replaced/repaired since these WTPs have to produce drinking water for the City in the target year;
3. Improvement of the distribution network, such as reinforcement of pipelines, improvement of booster PSs, installation of pressure regulation valves and introduction of a monitoring system, need to be carried out in order to attain required water pressure in the City;
4. Program to promote the installation of water meters needs to be implemented in order to prevent wastage; and
5. Management strengthening, including internal control, needs to be implemented in order to reduce water losses, and other items for management improvement, such as training for employees and development of information technology infrastructure need to be taken up.

The NRW Reduction Program shall be taken up as the first priority and the facilities that will be needed to distribute adequate water to the City in the target year should be rehabilitated and improved as management improvement also progresses.

7.2 Project Prioritization

7.2.1 Selecting Priority Projects for the Facilities Improvement

The facilities projects proposed in the Long-Term Development Plan (LTDP) are listed in Table 7.2.1. Priority projects are selected from the LTDP based on the criteria described in Chapter 7.1. In Chapter 7.3, F/S projects are selected from the priority projects and are limited to those components that require technical and management expertise going beyond the local capabilities. In Table 7.2.1, the selected priority projects are marked.

The selected priority projects for facilities improvement are shown in Table 7.2.3, which shall be implemented urgently. In implementing these projects, the detailed design and construction supervision work will be a required engineering service.

7.2.2 Selecting Priority Projects for Management Improvement

Table 7.2.2 shows the projects for management improvement proposed in the LTDP. The results of the selection of the priority projects for management improvement are shown in Table 7.2.4.

Management improvements do not require large investments compared to physical components, and actions proposed in Table 7.2.4 can be taken at the same time.

Table 7.2.1 Selection Sheet for Priority Projects for Facilities Improvement

Name	Facility	Replacement/ repair/ reconstruction	Direct cost 1000USD	Selection Priority Projects
Kadirya WTP	No.1& No.2 intake PS	Replacement and repair for PS	(19,292)	○
	Sedimentation basin	Improvement of flocculation basin	1,400	
	Coagulation facility	Improvement for injection facilities	1,446	
	Rapid filters	Repair for pipes and others	(1,198)	○
		Improvement for auto-washing	(1,226)	○
	Disinfection facility	Replacement of facilities	535	○
	Reservoir	Construction: V=45,000m^3	7,650	○
		Construction: V=45,000m^3	6,900	
	Distribution PS	Replacement and repair for PS	910	
	Power receiver	Replacement of all facilities	3,714	
	Administration building	Expansion and Repair	600	
	Monitoring	Replacement of flow meters	(160)	○
		Installation of monitoring system	1,555	
	Laboratory	Replacement of equipment	(200)	○
Kibray WTP	Well's pumps	Replacement/improvement for 48wells	(3,500)	○
	Distribution pipe	Pipe rearrangement (For gravity)	1,755	○
		Pipe rearrangement (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	Construction for new plant	2,516	○
	Monitoring facilities	Installation of flow meter	(50)	○
Distribution facilities for Vodokanal service area	Pipeline	Replacement L=420km	45,462	○
		Reinforcement of pipeline	10,554	○
		Pressure/flow regulation Valve, 22units	2,090	○
	Booster PS	Improvement	9,398	○
	Monitoring facilities	Monitoring stations	427	○
Preparing O&M manual and training program			0	○
Total direct cost			100,556	84,031

Note: ○ Selected priority project,
The costs in ( ) are EBRD or Vodokanal individual Project and are not included

Table 7.2.2 Selection Sheet for Priority Projects for Management Improvement

No	Items	Cost	Selection
	Staged actions should be taken	1000USD	
1)	**In the short-term**		
1	Program to promote the installation of water meters	*1 17,275	○
2	Strengthen the management	600	○
3	Improve employee training (Part 1)	600	○
4	Organizational reform	150	
5	Improve personnel evaluation	150	
6	Develop an information technology infrastructure (Part 1)	1,000	○
7	Strengthen public relations (Part 1)	100	
8	Development and diffusion of indoor repair appliances	200	
	Sub-total	**20,075**	
2)	**According to the progress of installing meters or the change of environment**		
1	Mid-term assessment of the Program mentioned in (1)-1	30	
2	Reforms in the water tariff system and collection of water bills	180	
3	Develop an information technology infrastructure (Part 2)	400	
4	Strengthen public relations (Part 2)	50	
5	Improve employee training (Part 2)	600	
6	Introduce International (Public) Accounting Standards	300	
7	Introduction of external auditing	50	
	Sub-total	**1,610**	
3)	**According to the progress of restructuring WTPs**		
1	Benefits to employees will be laid off due to the restructuring of the WTP	90	
	Sub-total	**90**	
4)	**After privatization**		
1	Strengthen the management after privatization	60	
2	Legal system reforms after privatization	60	
3	Consider the issuance of bonds	100	
4	Installation of outdoor water meters	N/A	
	Sub-total	**220**	
	Total	**21,995**	19,475
		*2 **(4,870)**	

*1: Cost for the water meters installation is 17,125 thousand USD.
*2: in the case of no water meters installation

Table 7.2.3 Selected Priority Project for Facilities Improvement

Name	Facility	Replacement/ Repair/ Reconstruction	Direct cost 1000USD
Kadirya WTP	No.1& No.2 intake PS	Replacement and repair for PS	(19,292)
	Rapid filters	Repair for pipes and others	(1,198)
		Improvement for auto-washing	(1,226)
	Disinfection facility	Replacement of facilities	535
	Reservoir	Construction: V=45,000m^3	7,650
	Monitoring	Replacement of flow meters	(160)
	Laboratory	Replacement of equipment	(200)
Kibray WTP	Well's pumps	Replacement/improvement for 48wells	(3,500)
	Distribution pipe	Pipe rearrangement (For gravity)	1,755
		Pipe rearrangement (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	Construction for new plant	2,516
	Monitoring facilities	Installation of flow meter	(50)
Distribution facilities for Vodokanal service area	Pipeline	Replacement L=420km	45,462
		Reinforcement of pipeline	10,554
		Pressure/flow regulation Valve, 22units	2,090
	Booster PS	Improvement	9,398
	Monitoring facilities	Meters and radio system	427
Preparing O&M manual and training program			0*2
Total			84,031

Note: The costs in ( ) are EBRD or Vodokanal individual Project and are not included

Table 7.2.4 Selected Priority Projects for Management Improvement

Items	Cost	Reference
	1000 USD	
Program to promote the installation of water meters	*1 17,275	5.2.2
Strengthen the management	600	5.2.4
Improve employee training (Part 1)	600	5.8.2
Develop an information technology infrastructure (Part 1)	1,000	5.7.1(1),5.9.1(2)
Total Cost	**19,475**	
	*2 **2,350**	

*1: Cost for the water meter installation is 17,125 thousand USD.
*2: in the case of no water meter installation

7.3 Selected Projects for Feasibility Study

A Feasibility Study (F/S) for short- to medium-term development is usually carried out for priority projects in line with the established long-term development plan. In this Study, the projects to be covered by the F/S shall be limited to works that require technical and management expertise, so that effect of the technical transfer is most effective. However, the contents of selected priority projects in Table 7.2.1 involve relatively simple rehabilitations. Subsequently, the Uzbekistan counterparts have the ability to make such plans and designs. As a result, along with the enhancement of ODA purposes, F/S projects should be limited and required to special technical and administrative skills in order to maximize the effectiveness of technology transfer capacity.

In Tashkent City, the implementation of NRW Reduction Program is the first priority. The technical component of the program is the replacement of deteriorated pipes, therefore this component will be executed when the F/S Projects are implemented. This component was not included in F/S Study since all pipes sections were already chosen by Vodokanal; however they need to be included in F/S Project.

Many pump stations for water distribution have been constructed in Tashkent City, although the topography of the City allows distribution by gravity. The existing distribution system consumes too much electricity and requires a large number of PSs. There will be an effective and positive impact of shifting from the current pump system to a gravity system. Going into a gravity distribution system requires technical expertise, but this is the most suitable component for the F/S.

Table 7.3.1 shows the selected projects for the F/S. While the water supplied from Kadirya WTP is distributed by gravity, the water from Kibray WTP is distributed by pumps although its location and topography allow a gravity distribution. Thus, distribution system of Kibray WTP shall be changed to a gravity-type system from the current pump system. Direct costs for pipeline replacement and reinforcement, and installation of pressure regulation valves are shown in Table 7.3.1.

For Kibray WTP, some relevant facilities will have to be improved to enable the gravity-type water supply distribution to the service areas. There will be the construction of distribution PS for the surrounding area and a rearrangement to allow the change in the distribution system. In this connection, improvement of the distribution network, including provision of pressure/flow regulation facilities and improvement of booster PSs for the entire City's distribution areas will be planned.

Table 7.3.1 Selected F/S Projects for Facilities Improvement

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 valve, 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 8 Preliminary Design for Priority Project

Chapter 8 Preliminary Design for Priority Project

8.1 Planning Fundamentals

8.1.1 Methodology of the Study

Contents of the project for F/S were selected in Chapter 7 as shown in Table 8.1.1.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 planed and designed in order to achieve more efficient water distribution system.

Table 8.1.1 Contents of the Project for Feasibility Study

Name	Facility	Replacement/ improvement
Kadirya WTP	Monitoring facilities	Installation of flow meters
Kibray WTP	Distribution PS	Construction: capacity 1000m^3/hr
	Distribution pipes	Refurbishing to change the distribution system
	Monitoring facilities	Installation of flow meters
Distribution facilities	Pipelines/ booster PSs	Replacement of deteriorated pipes
		Reinforcement of pipelines to ensure proper pressure in the City
		Introduction of an automatic pressure regulation system
		Abandonment/improvement of booster PSs
		Introduction of a monitoring system

(1) Gravity Distribution from Kibray WTP

A shift from a "pump system" to a "gravity system" enables the distribution system to improve the distribution 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 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: (1) required points of pressure & flow regulation valves and the section & diameter of reinforcement pipes, (2) suitable type for pressure and flow regulation valves and suitable material for reinforcement pipes, and (3) 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 the scale of them 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 8.1.1. 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 8.1.1.

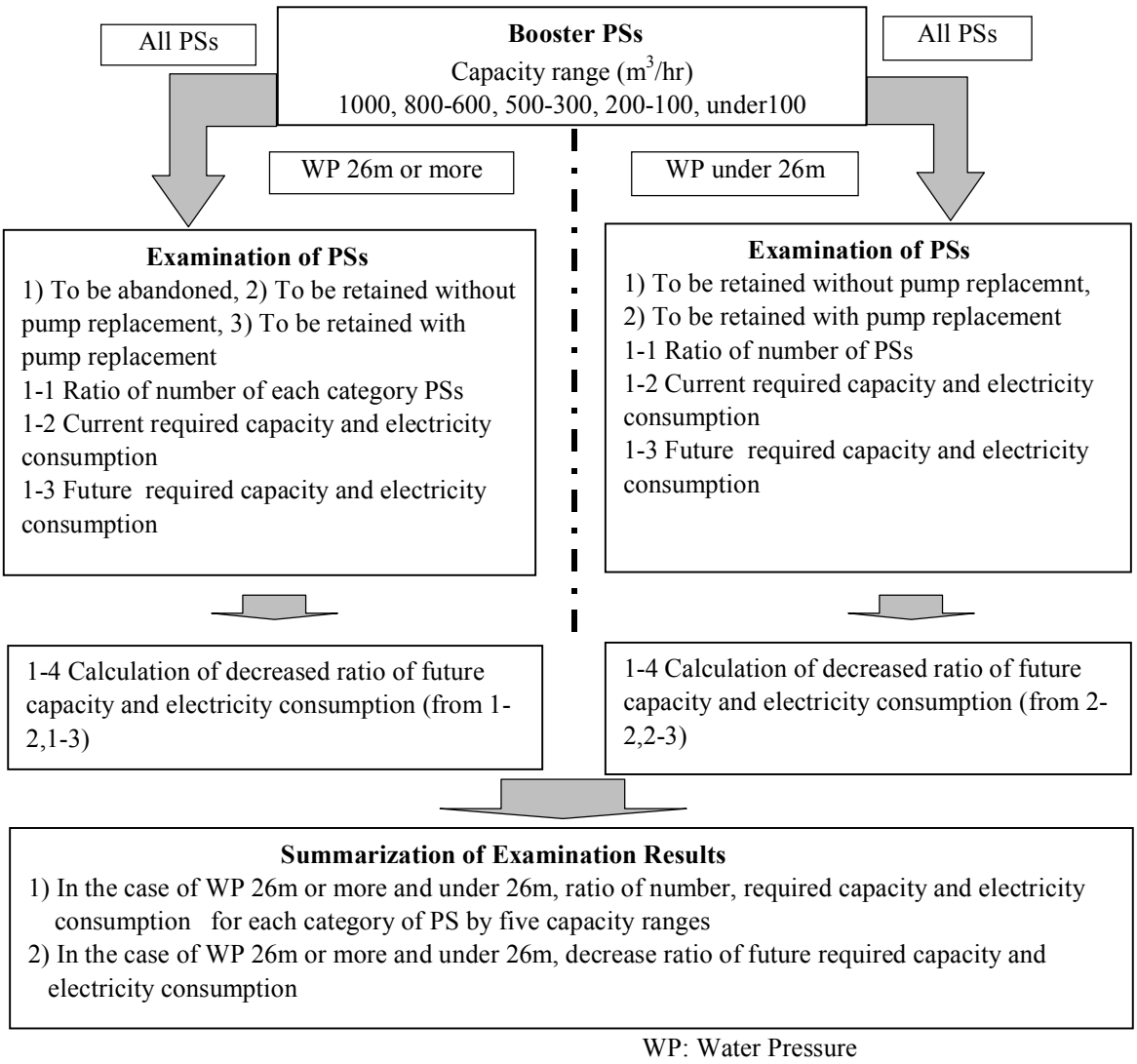


Figure 8.1.1 Examination Method for PSs in Kibray Area

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.

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 8.1.2.

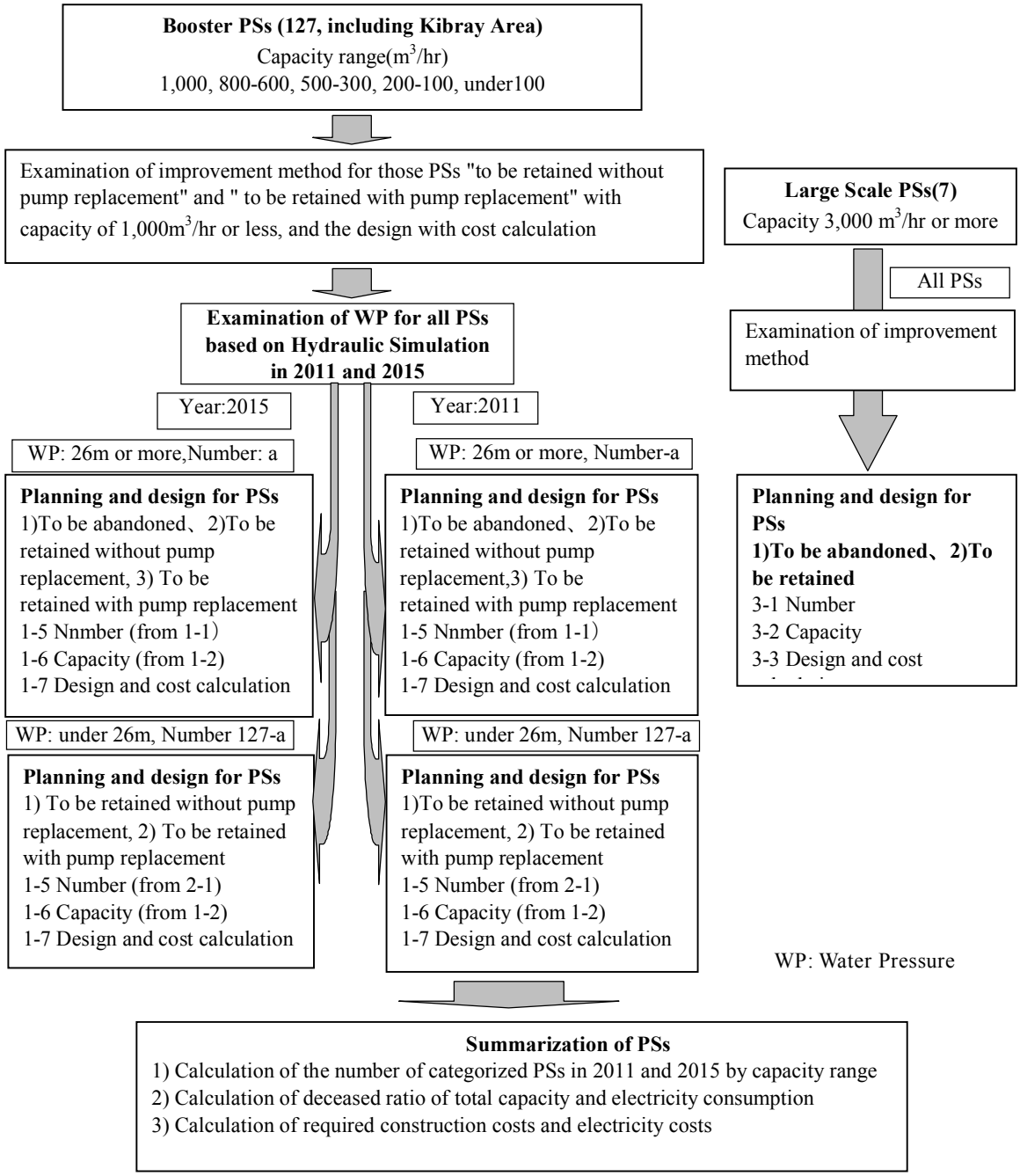


Figure 8.1.2 Examination Method for All PSs

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.

8.1.2 Target Year and Study Area

The target year of the Master Plan is 2015. Therefore, it follows that the target year of the priority project for the Feasibility Study (the "F/S") must be set before 2015. If the priority project components are started immediately, it is anticipated that the construction work for most components will commence in early 2007, with five-year duration. From this vantage point, it seems reasonable to set the F/S project target to 2011. On the other hand, construction work for replacement/installation of distribution pipeline will require eight years because of the limitations on the annual replacement length. It is not deemed appropriate to extend the implementation period of the F/S to that of the pipe replacement/installation, which is eight years, or up to 2014, as this will unnecessarily prolong project completion. There fore, the target year of 2011 is hereby set.

The study areas of the F/S have been set as those areas where Tashkent Vodokanal currently distributes water, as shown in Figure 8.1.3.

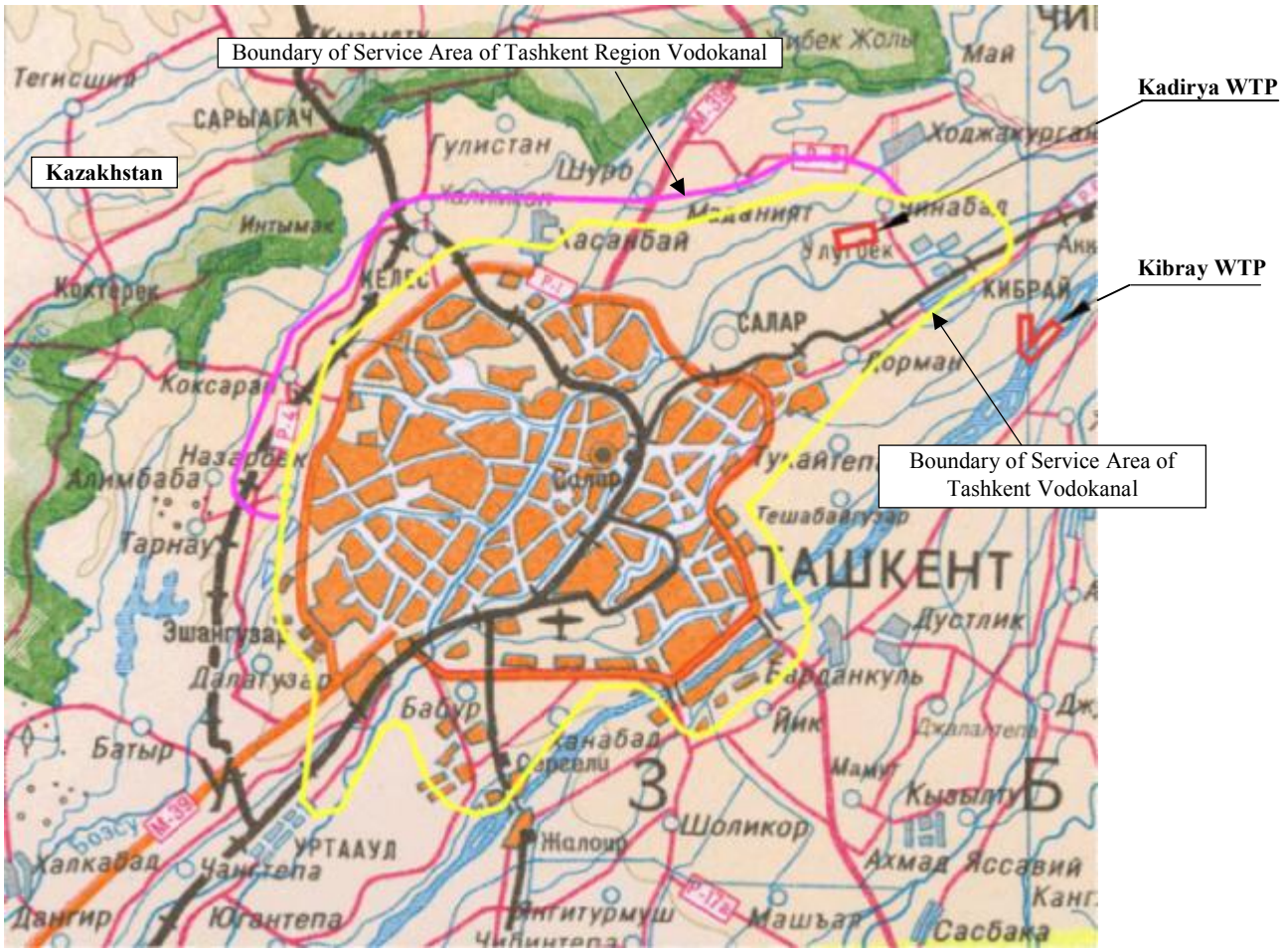


Figure 8.1.3 Study Area for Feasibility Study

8.2 Preliminary Design of Improvement for Water Distribution Network

8.2.1 Design Condition and Concept

(1) Design Criteria

1) Obligation of Vodokanal for water distribution to consumers

Vodokanal has the responsibility to distribute drinking water having the proper quality and pressure to its consumers. The quality standard is regulated by the Standard as shown in Chapter 2.3.6. The service pressure of 10m of water head is needed to ensure that consumers living in maximum 9-story buildings can receive reliable water service.

2) Distribution pressure

The required distribution pressures for buildings are as follows:

For ground floor: 10m

For over second floor: 4m for each additional floor

Required pressures for buildings by the number of story in the City are shown in Table 8.2.1.

Table 8.2.1 Necessary Water Pressure for Buildings

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

The required pressure for detached houses is 10m. In addition to this, the pressure shall be restricted to less than 20m because of deterioration of distribution pipes in the areas for detached houses.

For distribution pipes' protection, excessive pressure, such as 40m of water head, should not be kept in the network.

Accordingly, the range of water distribution pressure in the network can be categorized as shown in Table 8.2.2.

Table 8.2.2 Water Distribution Areas and Water Pressure Range

Area	Pressure range (m)	Category
For detached house	Under 10	PS is necessary
	10-20	Proper
	Over 21	The pressure need to lower
For building	Under 25	PS is necessary
	26-40	Proper
	Over 40	The pressure need to lower

(2) Design Flow

The projected water demand in 2011, the target year of the F/S components, is basically used for the design flow. The projected water demand in 2015, the target year of M/P, and in 2011, that of F/S, were applied in the hydraulic calculations. These calculations were conducted using Water CAD. The results of the calculations were used for the following: the arrangement of pressure regulation points, the design of reinforcement pipes, the evaluation as to the necessity of existing booster PSs, the confirmation of the validity of the design, as well as the analysis of current problems in existing distribution networks.

The design flow applied to the hydraulic calculations is shown in Table 8.2.3.

Table 8.2.3 Design Flow to be applied for Hydraulic Calculation

Category	Design flow		Daily average flow ($1000m^3/d$)
	Hourly (m^3/hr)	Daily ($1000m^3/d$)	
Flow in 2011(target year of F/S)	95,708	2,297	1,831
Flow in 2015(target year of LTDP)	84,917	2,038	1,625

The design average flow is regarded as the hourly maximum flow in the present hydraulic analysis.

(3) Design Concept

The basic concept for the preliminary design are described as follows:

- Due to the lack of meters to measure flows in the distribution pipes, the exact amount of water being distributed from the WTPs has not been identified so far. However,

Vodokanal has already decided to install flow meters for each distribution pipe in Kadiyra, Kibray and Boz-su WTP and this shall be incorporated in the Design;

- The existing distribution network, which forms one large network and is too complicated to properly control the flow and pressure, shall be divided into five distribution areas namely, Kibray, Boz-su, Southern Kadirya, Northern Kadirya and Central Kadirya.
- In Kibray WTP, the gravity distribution system shall be introduced as much as possible. However, there may exist areas where treated water cannot be distributed by gravity because of hydraulic constraints (e.g., the area of which elevation is higher than the WTP, where the lot of the President's House is located). In this case, a small distribution PS shall be introduced instead of utilizing existing pumps because the capacity of the existing distribution PSs is too large for this purpose;
- If necessary, some part of existing distribution pipes from Kibray WTP shall be replaced to change the system from "by pumps" to "by gravity";
- Replacement of the deteriorated distribution pipes selected by Vodokanal shall be incorporated in the Design. This pipe replacement should be concentrated in a certain distribution area to get a early effect for the area;
- Reinforcement of distribution pipes shall be planned to ensure proper pressure distribution to the whole City. The specifications and locations of pipes will be determined based on hydraulic calculations using Water CAD;
- An automatic pressure regulation system shall be introduced to regulate the pressure in the pipes. For this purpose, some constant pressure valves, which can regulate the discharge pressure at a certain value even if the inlet pressure varies, will be installed at the points where necessity of the valve is verified by the hydraulic calculations;
- All of the booster PSs scattered in the Kibray distribution area shall be surveyed and evaluated to examine their necessity and/or the measures for their improvement; and
- For proper control of the distribution system, a monitoring system shall be introduced. The system will monitor the situations with regard to pressure and flow rates at main points and operation of booster PSs.

8.2.2 Gravity Distribution from Kibray WTP

(1) Analysis of Present Distribution System

1) Outline of present system and operation

The current water balance and the distribution system in Kibray WTP are shown in Figure 8.2.1.

The flow rates indicated in the Figure are the amount of daily average recorded in December 2004.

Table 8.2.4 shows flow rates, velocity and water pressures in these distribution pipes. Distribution areas from those pipes, the whole of which forms Kibray Distribution Area, are shown in Figure 8.2.2.

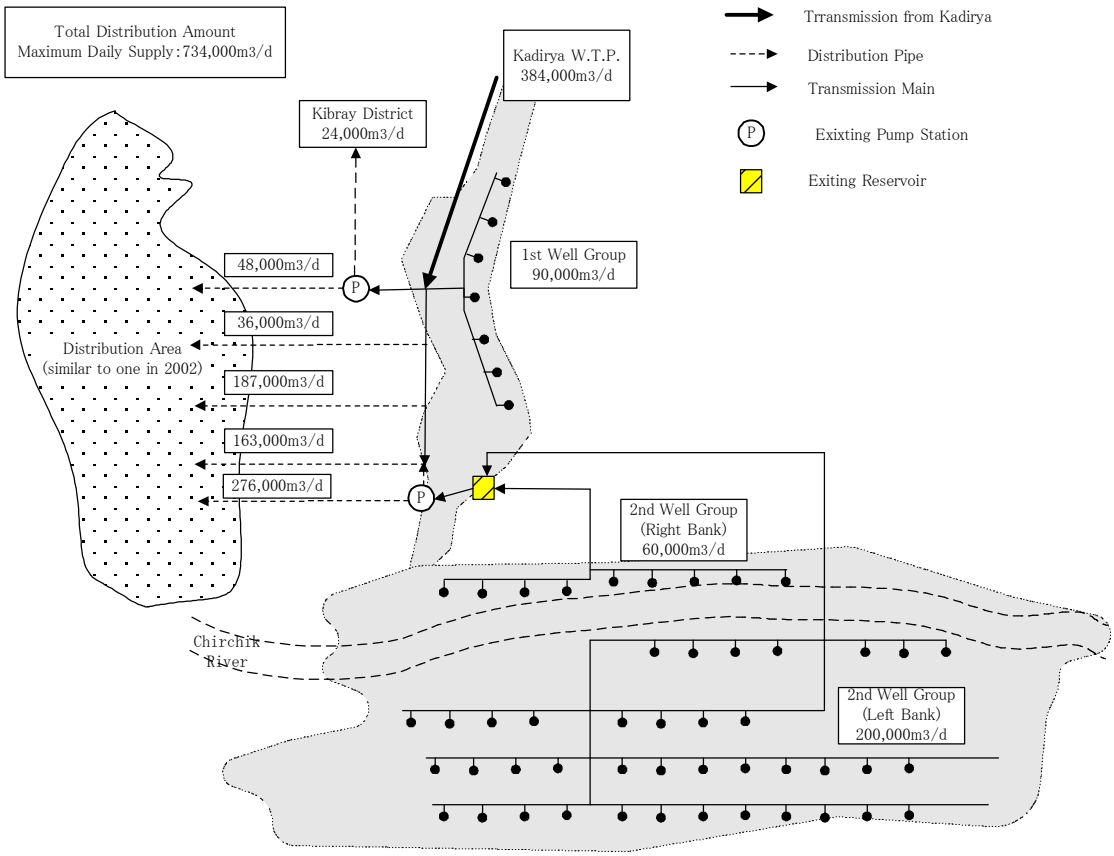


Figure 8.2.1 Water Balance and Distribution System at Kibray WTP

Figure 8.2.2 Distribution Area form Kibray WTP

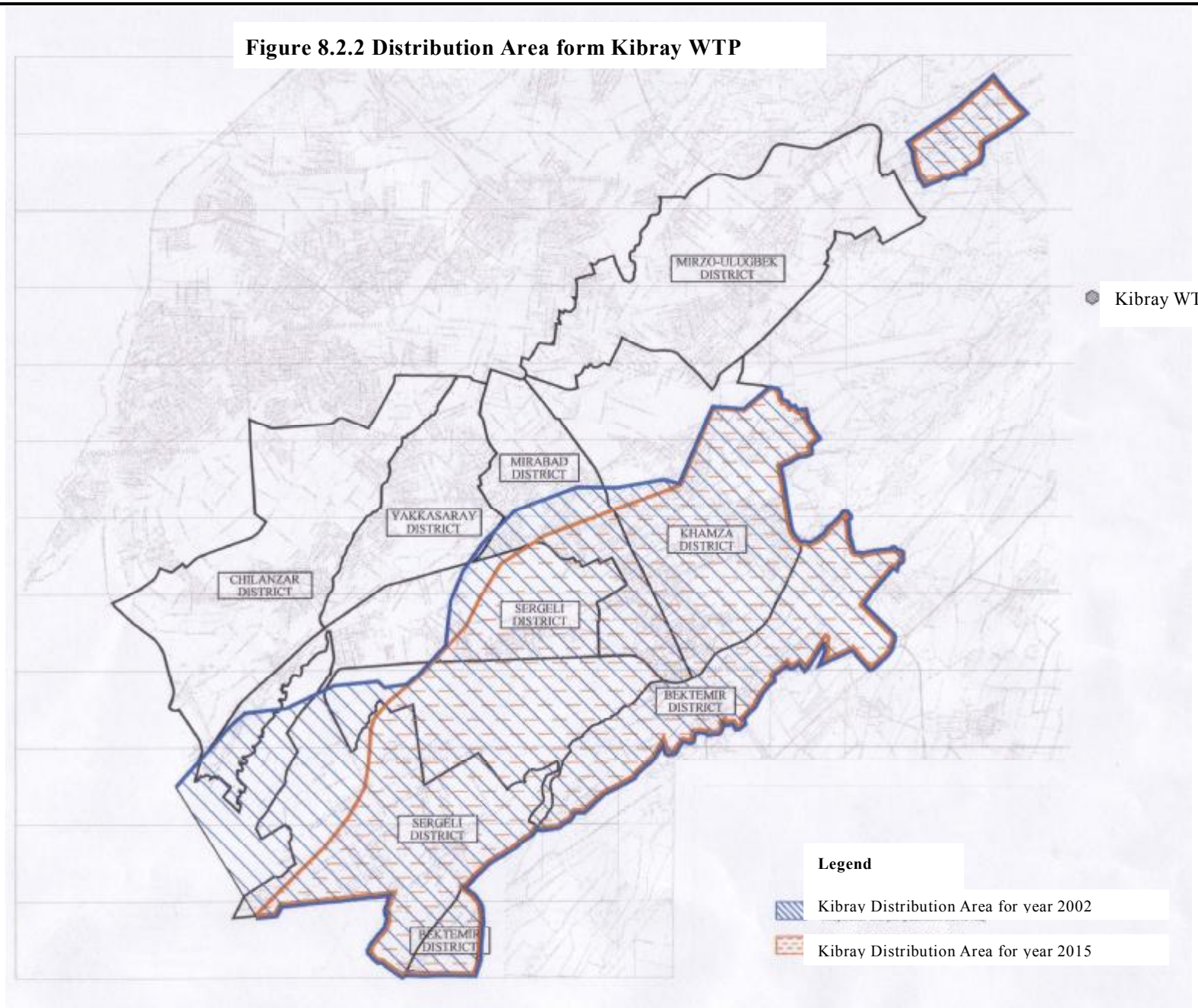


Table 8.2.4 Water Flow Rates of each Distribution Pipes

Pipe No.	Diameter (mm)	Current average flow		Velocity (m/s)	Pressure (m)	Water source
		Hourly (m^3/hr)	Daily (m^3/d)			
1	900	1,500	36,000	0.65	3	From Kadirya
2	1200	7,800	187,200	1.92	4	Kadirya + well group 1
3	1200	6,800	163,200	1.67	6	Well group 2
4	700	2,000	48,000	1.44	24	Well group 1
5	1400	11,500	276,000	2.08	1	Kadirya + well group 2
6	800	1,000	24,000	0.55	30	Well group 1
Total		30,600	734,400			

The distribution flow rates from Kibray WTP have been recorded as flat all day long. The water transmitted from Kadirya WTP is supplied by gravity, and it was also distributed to the city by gravity. Total distribution amount to the City was 734,400m^3/day.

2) Distribution Area from Kibray WTP

Currently, water from Kibray WTP is distributed to Hamza, Mirabad, Sergeli and Bectemir District in Tashkent City and a part of Kibray Region as shown in Figure 8.2.2. In the future, some parts of the Area in Mirabad and Sergeli District will be separated from the Area as shown in Figure 8.2.2.

The Kibray distribution area will contain major part of Hamza, Mirabad, Sergeli and Bectemir District, and a part of Kibray Region as shown in Figure 8.2.2. Booster PSs including its supply area and pipelines in this area were surveyed in detail as mentioned later.

3) Current distribution situation from Kibray WTP

Currently, distribution pumps shown in Table 8.2.5 distribute only well's yield water. In December 2004, one No.1 pump in No.1 PS and two No.1 pumps at No.2 PS were operational. The total capacity of functioning pumps was 15,600m^3/hr (374,400m^3/d). Although Pipe No.4 and No.6 were kept high pressure, the distribution pressures of Pipe 2, 3 and 5 were quite low because the pumped water was mixed with the water transmitted by gravity from Kadirya WTP.

Table 8.2.5 Lists of Distribution PS

PS No.	Pump No.	Q (m^3/hr)	Head (m)	D (in,out) (mm)	Power (kw)	Number
1	1	5200	51	1000, 800	1000	2
	2	3600	52	800, 600	630	2
	3	2500	58	800, 600	500	1
2	1	5200	51	800, 500	1000	4
	2	5200	51	800, 500	1000	1

Currently the water pressure in the Kibray distribution area is low due to a large friction loss of the pipes although elevation difference between the WTP and the distribution area is high.

It means that the water flow in the distribution pipes need to be reduced or to be boosted by the existing distribution pumps. However, the quantity of water was is not sufficient to meet the water demand of the distribution area.

The water being distributed by Pipe 3 and Pipe 5 should be boosted by the pumps of No.2 Distribution PS. Since the water transmitted from Kadirya WTP needs to be boosted, the water must flow in the existing reservoir from which pumps of No.2 PS withdraw. While the current pipe network in the WTP does not allow this operation, then a remodeling of pipes will be required.

In order to establish a gravity distribution system in Kibray WTP, water needs to be distributed from the existing reservoir by gravity, where water level of the expanded reservoirs constructed for M/P project should be same with that of the existing reservoir).. Therefore installation level of effluent pipes of Pipe 3 and 5 must be lower than the low water level of the reservoir. The installation level of Pipe 5 is lower than that level, hence, Pipe 3 needs to be lowered further.

(2) Examination of Building Gravity Distribution System

1) Water flow of distribution pipes

The expected reduction of water demand in the future will enable the WTP to shift to the gravity system. Hydraulic simulations have been carried out using Water CAD based on

water demand in the year of 2011 and 2015. Based on the simulation, the amount of water discharge from each distribution pipe of the WTPs has been decided as well as the water pressure distribution in the City and water flow/velocity of each pipe.

The quantity in 2011 and 2015 for Kibray WTP is shown in Figure 8.2.3(1) and (2). The result of the simulation confirms that the water pressure of 26m cannot be kept in large areas of Hamza and Mirabad District in 2011, however most of area will be improved in 2015.

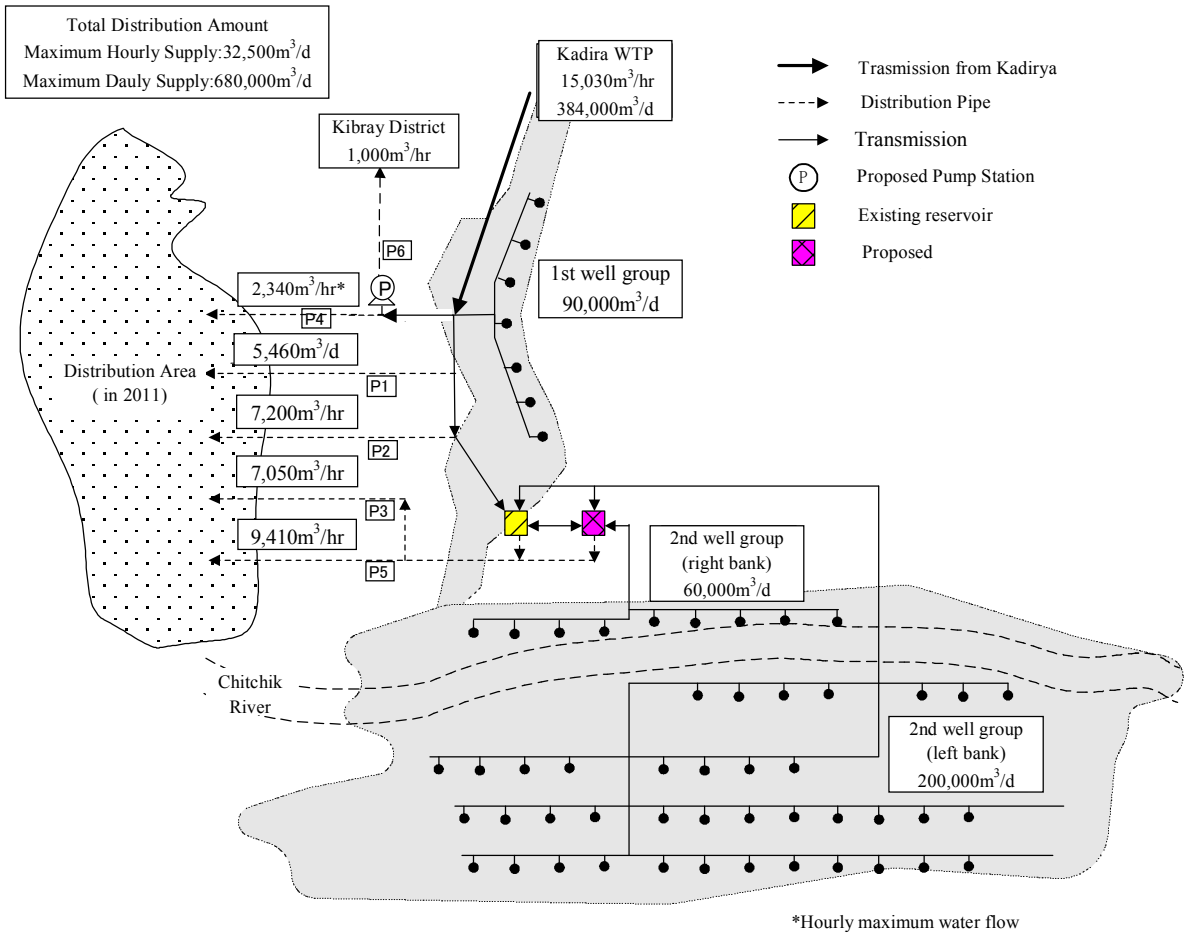


Figure 8.2.3(1) Distribution Amount from each Pipes in 2011

To improve the situation in 2011, alternative plans of pipe reinforcement from Kibray to the City or construction of a distribution reservoir with higher elevations should be considered. However these alternatives impose very large investment and do not seem to

be a wise plan because the situation will improve by 2015 by further decrease in water demand.

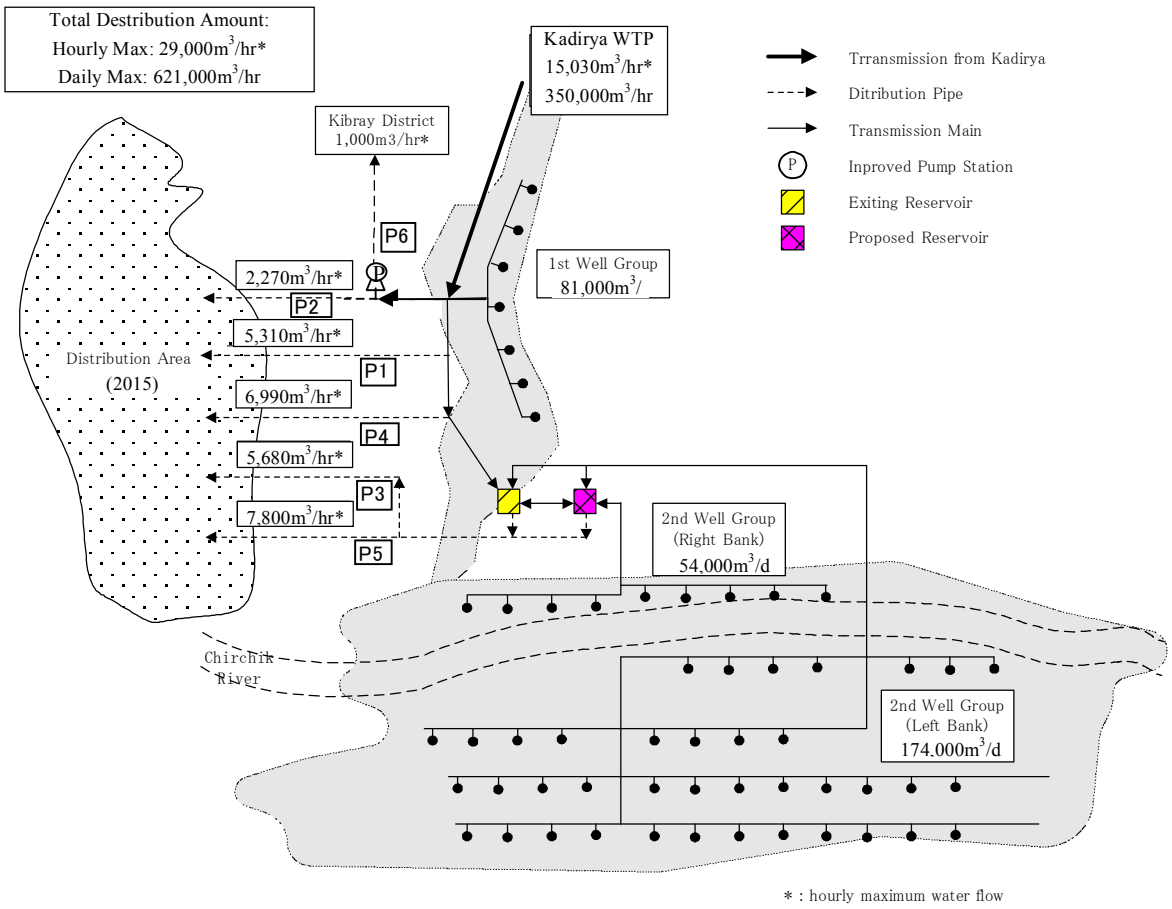


Figure 8.2.3 (2) Distribution Amount from each Pipe in 2015

2) Improvement plan for Kibray WTP

Pipes 4, 1, and 2, which mainly distribute the transmitted water from Kadirya WTP to the City, will not need to be improved because the outlet pressure from Kibray WTP will exceed 25m of water head. The Pipes 3 and 5 will distribute water from the existing reservoir (LWL: 500.5m) to establish the gravity distribution as mentioned in sub-section 1). Pipe 6 will distribute pumped water from the new distribution pumps, which will be installed in the existing building for No.1 Distribution PS.

Figure 8.2.4 (1) shows a layout plan of Kibray WTP, and Figure 8.2.4(2) and (3) show a detailed plan for the surrounding No.1 and No.2 Distribution PS.

As shown in the figures, contents of improvement are as follows:

- The elevation of the new reservoir planned in the M/P shall be same water level as existing one, and the low water level is 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 the existing pipes (Pipe 3 and Pipe 5 as shown in Figure 8.2.3(2)) will be made to branch out;
- Some of existing pipes will not be able to distribute by gravity because the current installation level of Pipe 3 (the interval is 1500m 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 the friction loss; and
- 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.

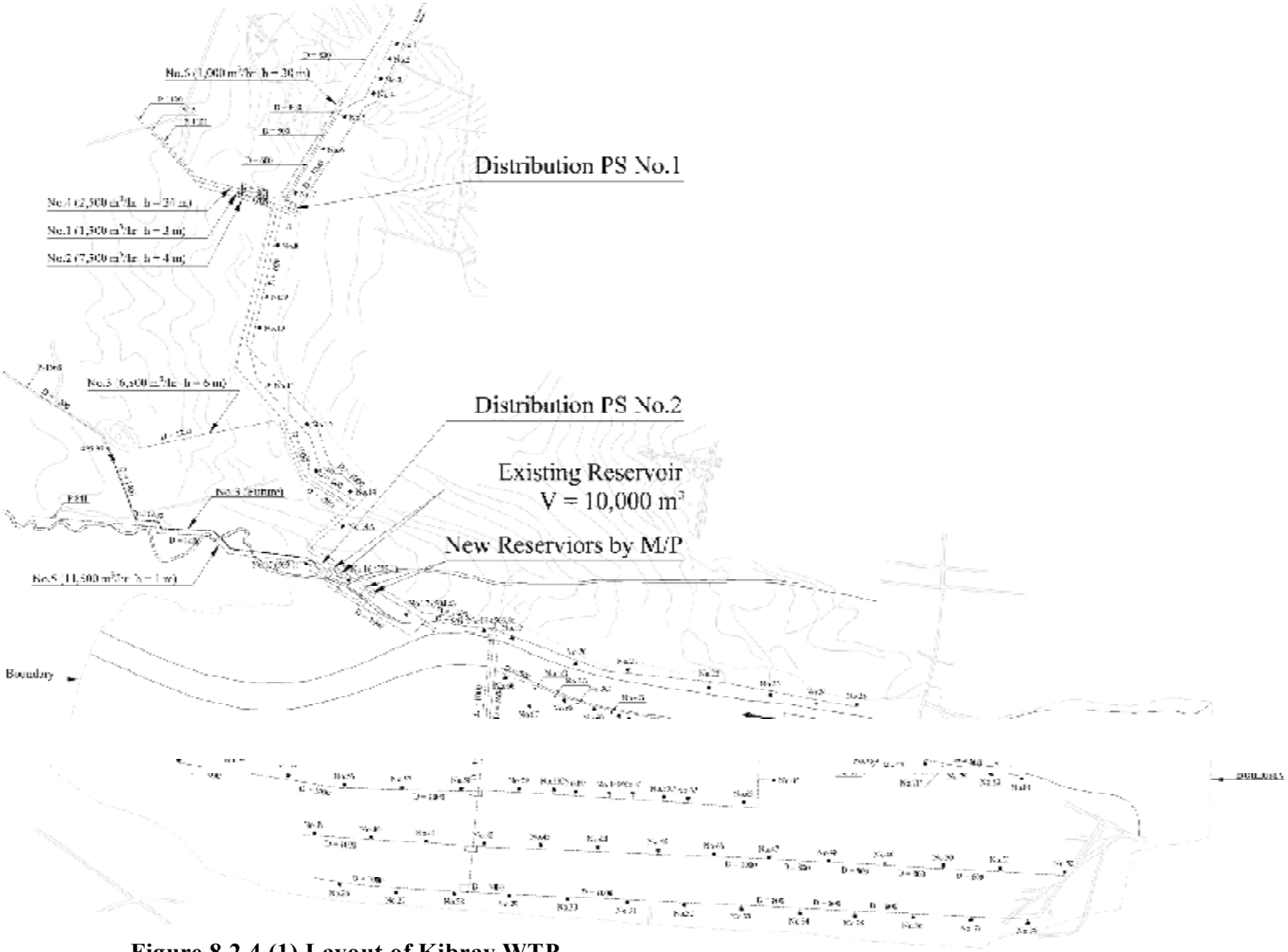


Figure 8.2.4 (1) Layout of Kibray WTP

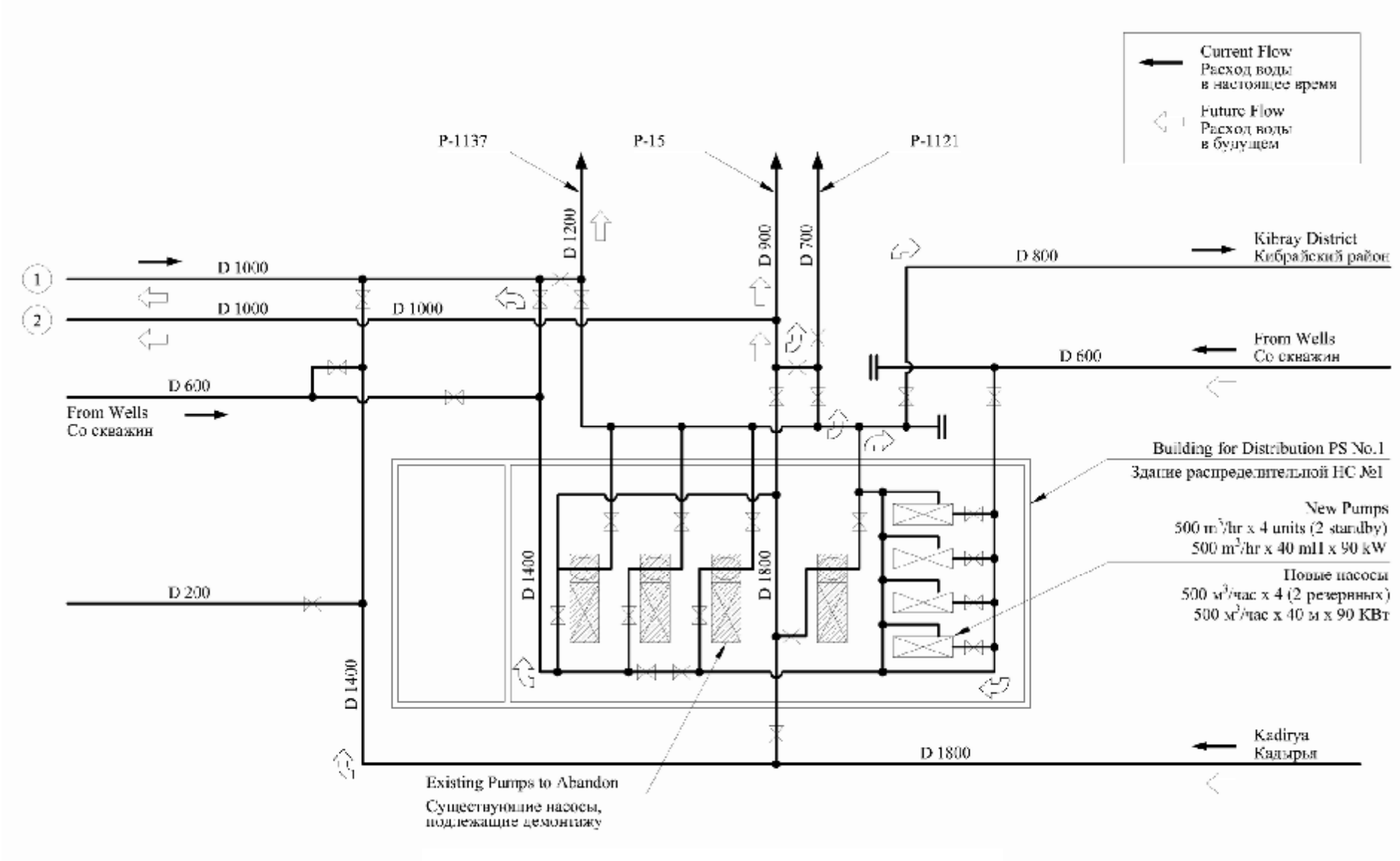


Figure 8.2.4 (2) Layout of No.1 PS in Kibray WTP

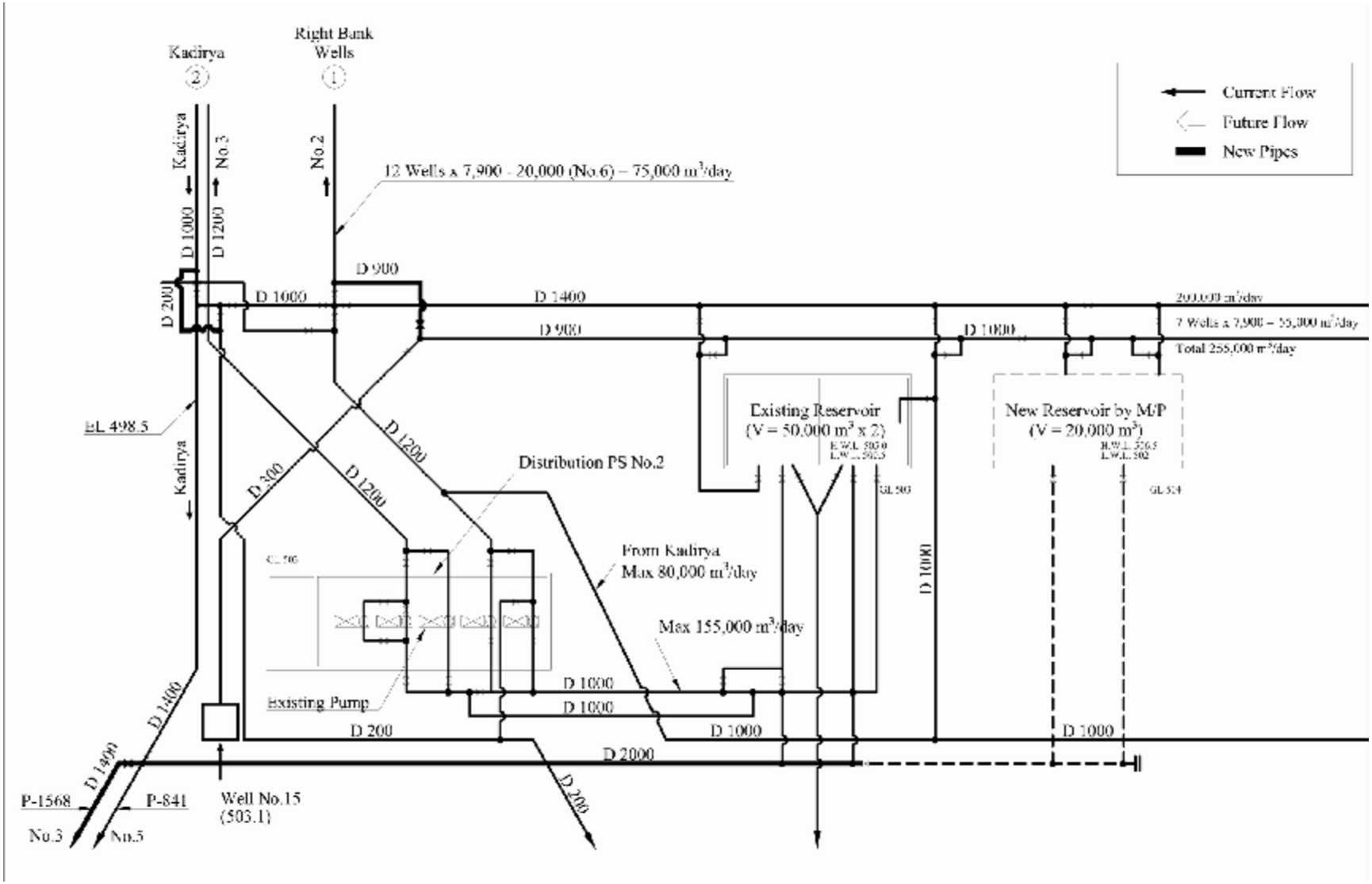


Figure 8.2.4 (3) Layout surrounding Rservoir in Kibray WTP

8.2.3 Improvement of Distribution Networks

(1) Division of Network

As described in Section 5.4.5 (Figure 5.4.10), the distribution area is divided into five areas, in which four are gravity distribution areas, i.e. Kibray, Southern Kadiyra, Central Kadirya and Northern Kadirya distribution Area. Kibray distribution Area is comprised of Hamza, Mirabad, Sergeli and Bectemir District, and Central Kadirya, which consists of Mirzo Ulugbek, Mirabad, Shayhantabur, A.Ikaramov and Yakkasaray and Chalanzar Districts; and the Northern Kadirya which includes Yanusabad, Shayhantabur, S, Rahimov and A.Ikramov District; and the Southern Kadirya which includes Mirzo Ulugbek, Yakkasary and Chilanzar District. The rest is Boz-su distribution Area in Yanusabad and Mrzo Ulugbek Districts is distributed water by pumps.

Although these distribution areas are inter-connected by some valves in the end pipe, they form an independent distribution area if the valve is shut down.

A detailed survey was carried out for Kibray Distribution Area and the result is shown as a map in Figure 8.2.5.

(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 checked based on the hydraulic analysis by Water CAD. The total length of these pipes is around 16.8km as presented in Figure 8.2.6 by diameter ranges.

Table 8.2.6 List of Reinforcement Pipes

Diameter (mm)	Length (m)
1,400	2,820
1,200	8,200
1,000	4,807
500	1,000
Total	16,827

(3) Replacement of Deteriorated Pipes

The total length of replacement pipes is 420km as shown in Chapter 5.2.3.

Vodokanal is planning to divide the replacement area in to three; the first priority is the high elevation area with the oldest pipes, the second priority is middle elevation areas, and the third priority is the low elevation area with relative new pipes which were installed in 1980th. Ac-

cordingly, the upper elevation area should be implemented first, the middle elevation area, second and low elevation area, last.

The approximate replacement length of each area is calculated in Table 8.2.7.

Table 8.2.7 Replacement Length for each Distribution Area

District	Length (m)	Name of distribution area		
		High	Middle	Low
Mirzo Ulugbek	67,265	100%		
Yunusabad	30,162	70%	30%	
Hamza	34,317	70%	30%	
Mirabad	35,145	20%	30%	50%
Yakkasaray	31,066		80%	20%
Sabir Rahimov	28,242		70%	30%
Chilanzar	33,248		40%	60%
Sergeli	51,520		30%	70%
Bektemir	8,420		30%	70%
Akmal Ikramov	52,700			100%
Shayhantahur	47,996		30%	70%
Total (km)	420,081	119,429	120,189	180,462

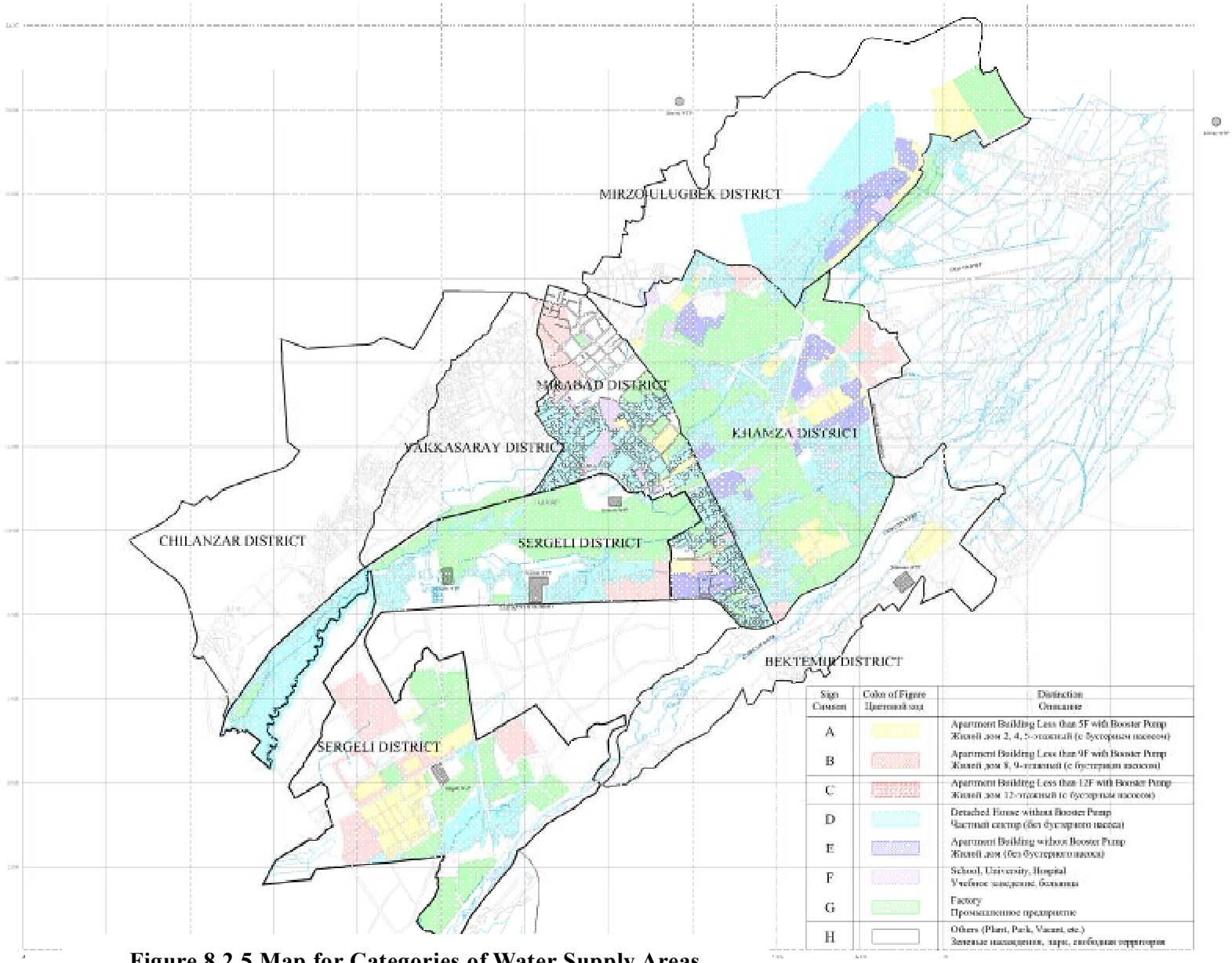


Figure 8.2.5 Map for Categories of Water Supply Areas

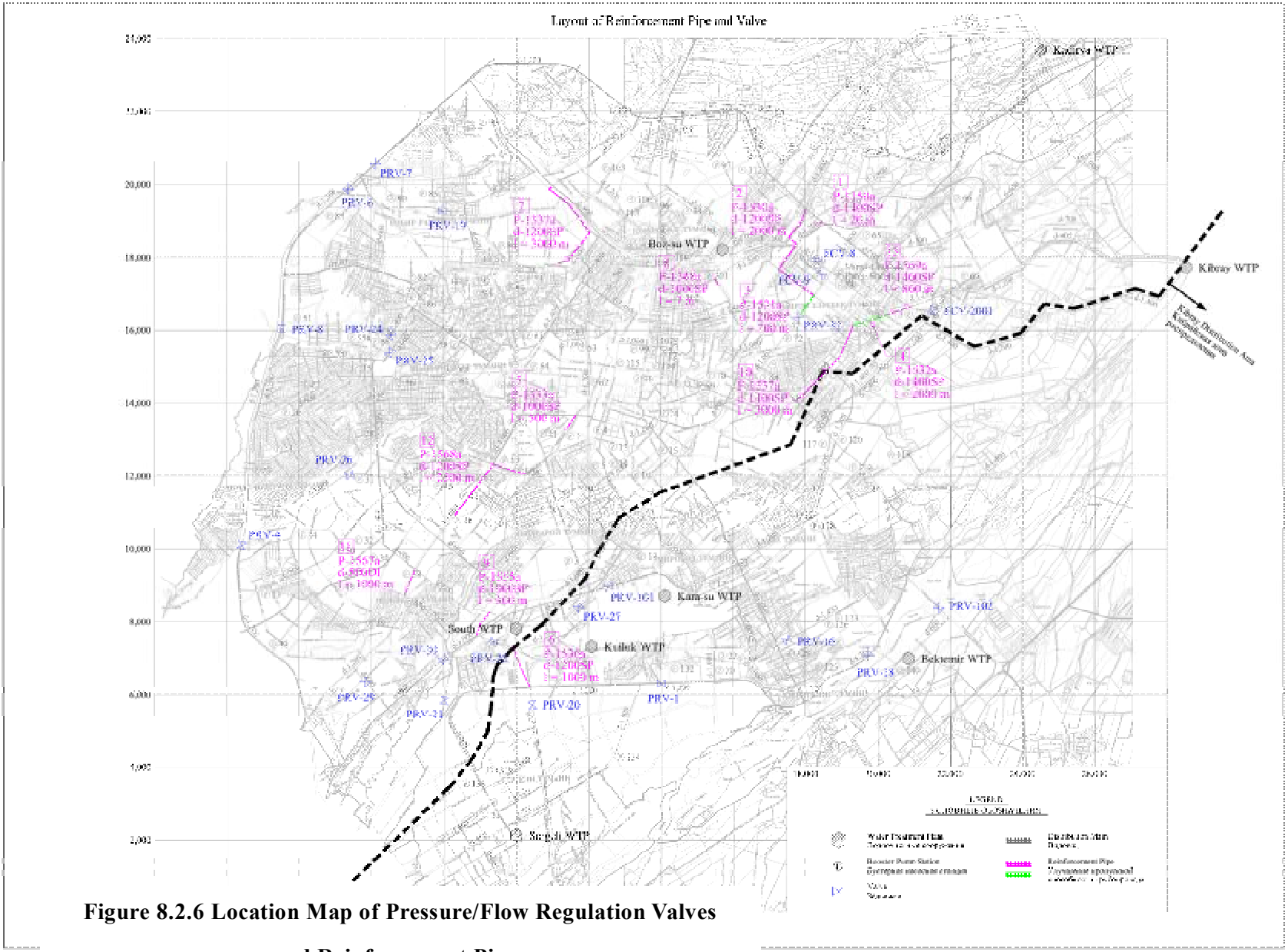


Figure 8.2.6 Location Map of Pressure/Flow Regulation Valves and Reinforcement Pipes

8.2.4 Water Pressure and Flow Control of the Network

(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.

The required points for the pressure control are selected where water pressure is over 50m and a substantial decrease in water pressure is needed based on hydraulic calculations. The result is listed in Table 8.2.8 and their locations are also shown in Figure 8.2.6.

Table 8.2.8 List of Pressure/Flow Regulation Valves

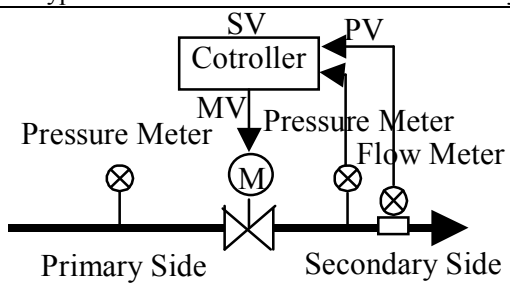
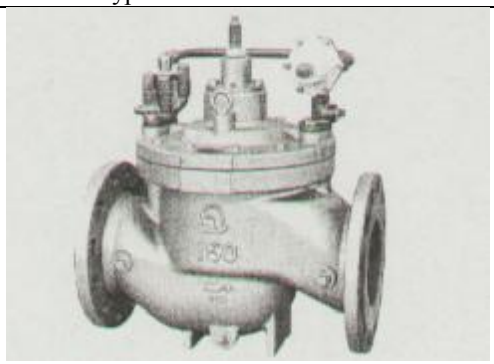
Division	Diameter (mm)	Number
Pressure regulation valve	1,200	3
	1,000	9
	900	2
	600	5
	Sub-Total	19
Flow regulation valve	1,600	1
	1,200	1
	1,100	1
	Sub-Total	3
Total		22

In order to minimize the number of the planned automatic control valves, existing manual valves will be utilized for the regulating for the area where there are detached houses through slight control of pressures.

Either motor valves controlled by electrical devices or self- actuated valves are used for the pressure regulation system. Their features and advantage/disadvantage are shown in Table 8.2.9. There is no considerable difference in the costs between the two types. Type 1 is composed of a lot of equipment and needs electricity supply for its operation, while type 2 functions with one apparatus and can be operated automatically without any electricity supply. Type 1 uses standardized equipment, while the valve of type 2 is more specialized with mechanisms that are different depending on the manufacturers. In addition, type 1 includes a flow meter and pressure meters, therefore it has an advantage in that the records of pressure and flow can be easily transmitted to monitoring station at the same time.

Accordingly, type 1 is selected as the pressure regulation system

Table 8.2.9 Comparison of Pressure Regulation System

Item	Type 1: Motor valve controlled electrically	Type 2: Self-actuated valve
Figure		
Feature	The system consists of a controller, a motor-driven valve and a pressure meter as shown on the figure. The controller can keep the secondary pressure or flow constant by varying the manipulated value according to the difference between the process value (measured value by the pressure meter) and the set value set on the controller	The system consists of a main valve and a pilot valve. The secondary pressure can be kept automatically at pre-set constant value by varying opening ratio of the valve using primary hydraulic power according to the detected primary pressure.
Advantage	-Easy to maintain, because the situation of the system can be monitored remotely through the remote monitoring system propose in this F/S. -High reliability, because the system is widely applied to the water supply system, industrial field, irrigation system etc., -Easy repair because of composition by ordinary equipment. -Flow and pressure can be monitored.	-Because external power is not required, the unit is compact and no incidental component is necessary.
Disadvantage	-The pressure sensor is required to protect against being frozen. -The installation work and start-up adjustment service are complicated.	-Not easy to maintain compared to the motor driven type, because regular inspections one or twice a year on site are required. -The control pilot part is required to be protected against freezing. -The length of the valve becomes longer according to nominal size of diameter. -For monitoring of pressure and flow, other meters will be required.
Cost	Even: Both are around 100,000 USD for D-1000mm	

(2) Flow Control System

Three flow control facilities to regulate the water flow for Kibray distribution area and for Mirzo-Ulugbek PS are arranged as shown in Figure 8.2.6.

The type 1 control facility as shown in Table 8.2.9 is also applied for flow control, where the valve will be controlled in order to keep a certain flow rate.

8.2.5 Improvement of Booster PSs (Details are referred to S 8.2.5)

(1) Study Methods for the Improvement of Booster PS

The study on the improvement of booster PSs, which are located on distribution networks in Tashkent City, is being implemented along the lines of the flow chart, as shown in Figure 8.2.7.

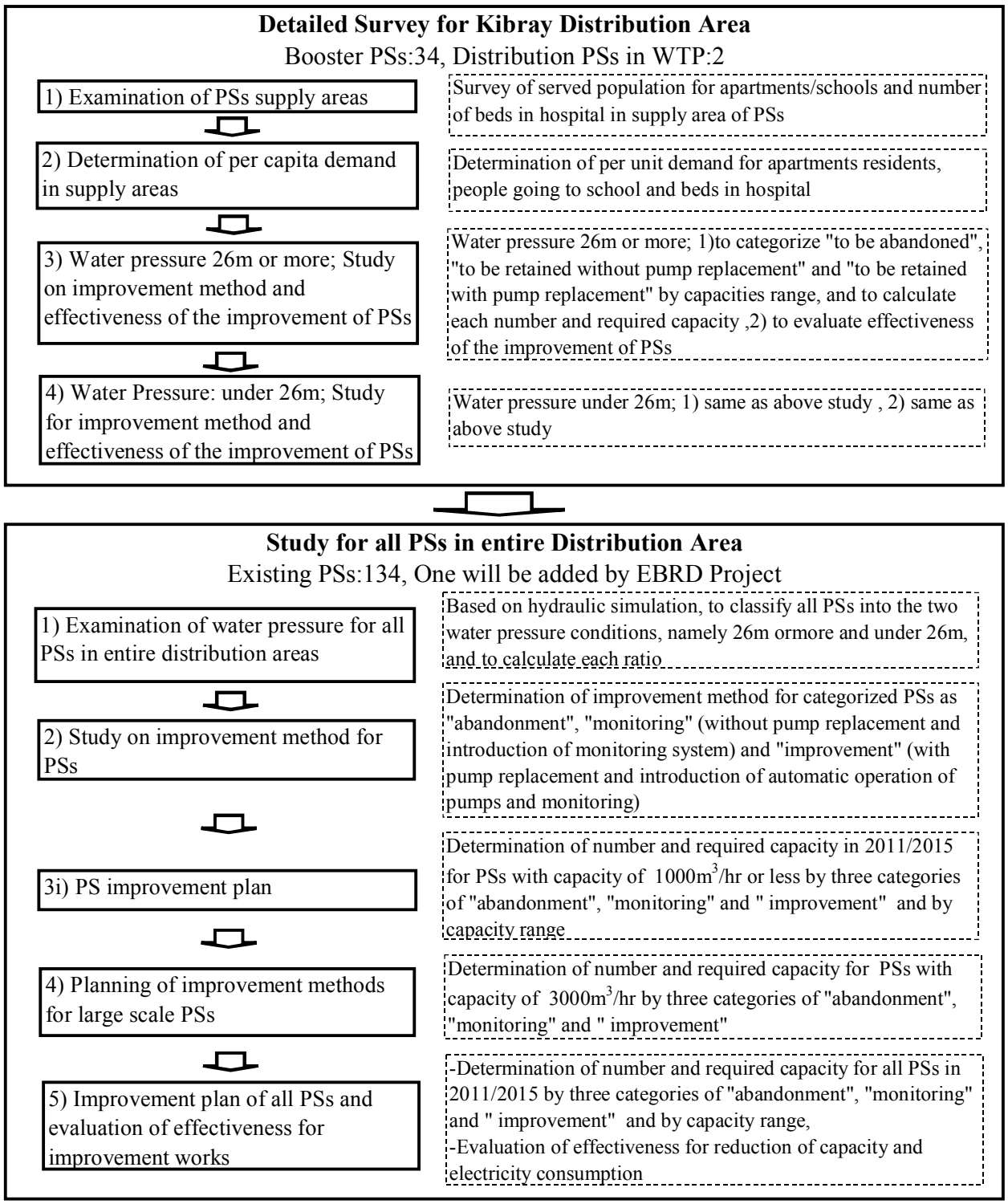


Figure 8.2.7 Study Methods for Improvement of Booster PSs

Initially, an examination study was carried out in the Kibray Distribution Area, and then, based on the result of the examination study, 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.

(2) Examination of the Kibray Distribution Area

1) PSs Distribution Area

Booster PSs located in Hamza, Mirabad, Sergeli and Bectemir Districts were surveyed together with distribution pipelines and the composition of consumers, such as apartment buildings, detached house, school, hospital and public facilities in their supply areas. Based on the survey, the areas are divided into some categories as shown in Figure 8.2.5. The survey was carried out for booster PSs as well as distribution PSs in Sergeli and Bectemir WTP.

The surveys for consumers of each PS were carried out, and the categories are apartment buildings and others. The apartment buildings are classified according to the number of story, because distribution pressure is decided according to number of floor as shown in Table 8.2.1. The flat number of each story building is decided by the survey results in each District as shown in Table 8.2.10.

The numbers of consumers for other categories are shown in Table 8.2.11.

Table 8.2.10 Flat Number for Apartment Buildings

Story of apartment	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 results of the consumer survey are summarized in Table 8.2.12. The data by TKEO and by the City includes all flats/residents in the Area, and the difference between the data and survey results

is the number of flat (family) and residents, which are not supplied from PSs (supplied by gravity).

Table 8.2.11 Consumer Number for each Category of Building

Building	Consumer number
School	1,400
Preschool	150
Hospital	150
Police office	300
Dormitory	500

Table 8.2.12 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	2,370	95,861	115,074	409,842	638,600

*1: Including area of the distribution PS in WTPs
*2: Including detached house

2) Determination of per capita demand for PSs supply areas

To decide on the required capacity for pumps (in PSs) depends on per capita supply as shown in Table 8.1.13.Current supply includes 25% of water leakage from the supply pipes. The difference between current and future per capita consumption (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 flow fluctuation. Therefore, the difference between current and future capacity of the pump is not as large as that of per capita demand (or per capita bed) in Table 8.2.13.

Table 8.2.13 Unite Demand in

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

The required capacity of a PS is calculated as follows:

- Current required capacity

  Required daily supply water

  Q1 = N1 x 500 Lpcd/1000/0.75 (25% of leakage) + N2 x200 Lpcd/1000 + N3 x 500 Lpcd/1000 + others

  N1: Number of apartment residents,

  N2: Number of consumers in School,

  N3: Bed number in hospital

  Required pumps capacity

  Capacity = Q1 x 1/24; and

- Future required capacity:

Required daily supply water

Q2 = N1 x 150 Lpcd/1000 + N2 x 60 Lpcd/1000 + N3 x 200 lpdc/1000 + Others

N1: Number of apartment residents,

N2: Number of consumers in School,

N3: Bed number in hospital

Required pumps capacity

Capacity = Q2 x 2/24 m^3/hr –for fluctuation of water demand

3) Study on the improvement method and the effectiveness of the improvement of PSs

(Water Pressure: 26m or more)

i) 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.8.2.14. 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 low story buildings as well as 9-story buildings.

Those PSs cannot be simply abandoned, but if the population to be supplied was set at excessive, the capacity can be reduced through reviewing the population. Since a PS can be abandoned when pump units are installed in 9-story buildings in the supply area of it, an installation of pump units are planned if 9-story buildings are relatively few in the area. The supply area of each PS was investigated and the PSs to be abandoned have been decided. The specifications of the remaining PS were determined based on the future design population.

Table 8.2.14 Reviewed Supply Population, Water Demand and required Capacity by PSs

District	No.	Capacity of PS	Population		Daily Demand (m^3/d)		Required Capacity (m^3/h)	
			Future	Current	Future	Current	Future	Current
Hamza	116	90	0	3,934	0	2,597	108	0
	117	1000	11,054	34,399	2,211	22,279	928	184
	120	300						
	118	1000	26,601	38,413	5,240	25,025	1,043	437
	119	1000	13,047	13,047	2,479	8,084	337	207
	121	1000	4,244	4,244	859	2,849	119	72
	123	200	0	1,777	0	1,184	49	0
	126	600	1,974	15,598	395	9,112	380	33
	124	45	0	1,152	0	768	32	0
	125	20	0	461	0	307	13	0
	127	600	0	6,623	0	3,737	156	0
	128	45	0	888	0	592	25	0
	129	20		632		441	18	0
	130-1	20	0	888	0	592	25	0
	Total	5940	56,920	122,056	11,184	77,567	3,233	933
Mirabad	10	1000	26,038	26,038	4,898	15,912	663	408
	11	600	4,606	11,142	921	6,635	276	77
	12	1000	5,431	8,794	1,086	5,000	208	91
	17	600	0	21,479	0	13,546	564	0
	13	1000	658	3,540	132	2,360	98	11
	14	150	2,961	2,961	592	1,974	82	49
	15	150	7,787	7,787	1,512	5,191	216	126
	16	90	0	855	0	570	24	0
	18	45	0	197	0	132	5	0
	19	800	0	9,582	0	5,524	230	0
	20	20	329	329	66	219	9	5
	21	20	0	1,546	0	1,031	43	0
	22	60	0	4,661	0	2,314	96	0
	Total	5,535	47,810	98,911	9,207	60,408	2,514	767
Sergeli	130	1,000	13,473	13,473	2,695	8,982	374	225
	131	3,000	0	23,952	0	13,004	542	0
	132	1,000	8,808	8,808	1,452	4,425	184	121
	133	1,000	70,342	70,342	13,293	43,323	1,805	1,108
	134	1,000	9,249	9,399	1,695	5,542	231	141
	Sergeli*	4,000	0	35,686	0	19,100	796	0
	Total	11,000	101,872	161,660	19,135	94,376	3,932	1,595
Bectemir	---	160	4,442	4,442	888	2,961	123	74
	Bectemir*	960	0	21,151	0	11,728	489	0
	140	100	0	1,624	0	1,083	45	0
	Total	1,220	4,442	27,217	888	15,771	657	74
Total		23,695	211,044	409,844	40,414	248,1263	10,339	3,366

*: Distribution PS in WTP

PSs to be able to be abandoned

Table 8.2.15 shows the reviewed supply population, water demand and required capacity for the improvement plan in Kibray Distribution Area. As shown in the table, the future supply population can be reduced in many PSs, while the population will stay constant in some PSs. A sample of a reviewed case for a PS supply area is shown in Figure 8.2.8.

Table 8.2.15 Improvement Plan for PSs (Water pressure 26m or more)

District	No.	Capacity of PS	Required capacity (m^3/h)		New pump specifications				Power consumption (kW)	
			Future	Current	Q(m^3/h)	h(m)	kw	Number	Current	Future
Hamza	116	90	0	108	Abandonment				21.0	0.0
	117	1,000	184	928	a			5	160.0	18.6
	120	300			b			3		
					c			3		
					d			1		
					e			3		
	118	1,000	437	1,043	150	50	30.0	4(1)	180.0	47.2
					c			2		
	119	1,000	207	337	70	50	15.0	4(1)	45.0	22.5
	121	1,000	72	119	30	50	7.5	4(1)	45.0	7.5
	123	200	0	49	a			2	10.8	0.9
	126	600	33	380	e			1	46.2	3.0
	124	45	0	32	Abandonment				3.0	0.0
	125	20	0	13	Abandonment				3.3	0.0
	127	600	0	156	Abandonment				33.0	0.0
	128	45	0	25	Abandonment				9.0	0.0
	129	20	0	18	Abandonment				3.3	0.0
	130-1	20	0	25	Abandonment				9.0	0.0
	Total	5,940	933	3,233					568.6	99.7
Mirabad	10	1,000	408	663	140	50	30.0	4(1)	112.5	45.0
	11	600	77	276	a			4	52.5	3.7
					b			2		
					c			1		
	12	1,000	91	208	45	50	11.0	3(1)	38.5	12.9
					a			5		
	17	600	0	564	Abandonment				77.0	0.0
	13	1,000	11	98	d			1	33.0	1.8
	14	150	49	82	25	50	5.5	3(1)	7.7	5.5
	15	150	126	216	45	50	11.0	4(1)	36.0	16.5
	16	90	0	24	Abandonment				4.5	0.0
	18	45	0	5	Abandonment				6.6	0.0
	19	800	0	230	Abandonment				120.0	0.0
	20	20	5	9	No Change			1	9.6	0.9
	21	20	0	43	Abandonment				9.6	0.0
	22	60	0	96	Abandonment				3.3	0.0
	Total	5,535	767	2,514					510.8	86.3
Sergeli	130	1,000	225	374	80	50	22.0	4(1)	66.0	33.0
	131	3,000	0	542	Abandonment				105.0	0.0
	132	1,000	121	184	60	50	15.0	3(1)	33.0	15.0
	133	1,000	1,108	1,805	260	50	55.0	6(1)	313.6	110.0
	134	1,000	141	231	50	50	11.0	4(1)	33.0	16.5
	Sergeli	4,000	0	796	Abandonment				162.5	0.0
	Total	11,000	1,595	3,932					713.1	175.0
Bectemir	---	160	74	123	Existing		3.7	8	21.0	21.0
	Bectemir	960	0	489	Abandonment				68.0	0.0
	140	100	0	45	Abandonment				18.0	0.0
	Total	1,220	74	657					107.0	21.0
Total		23,695	3,369	10,336					1,923.5	382.0

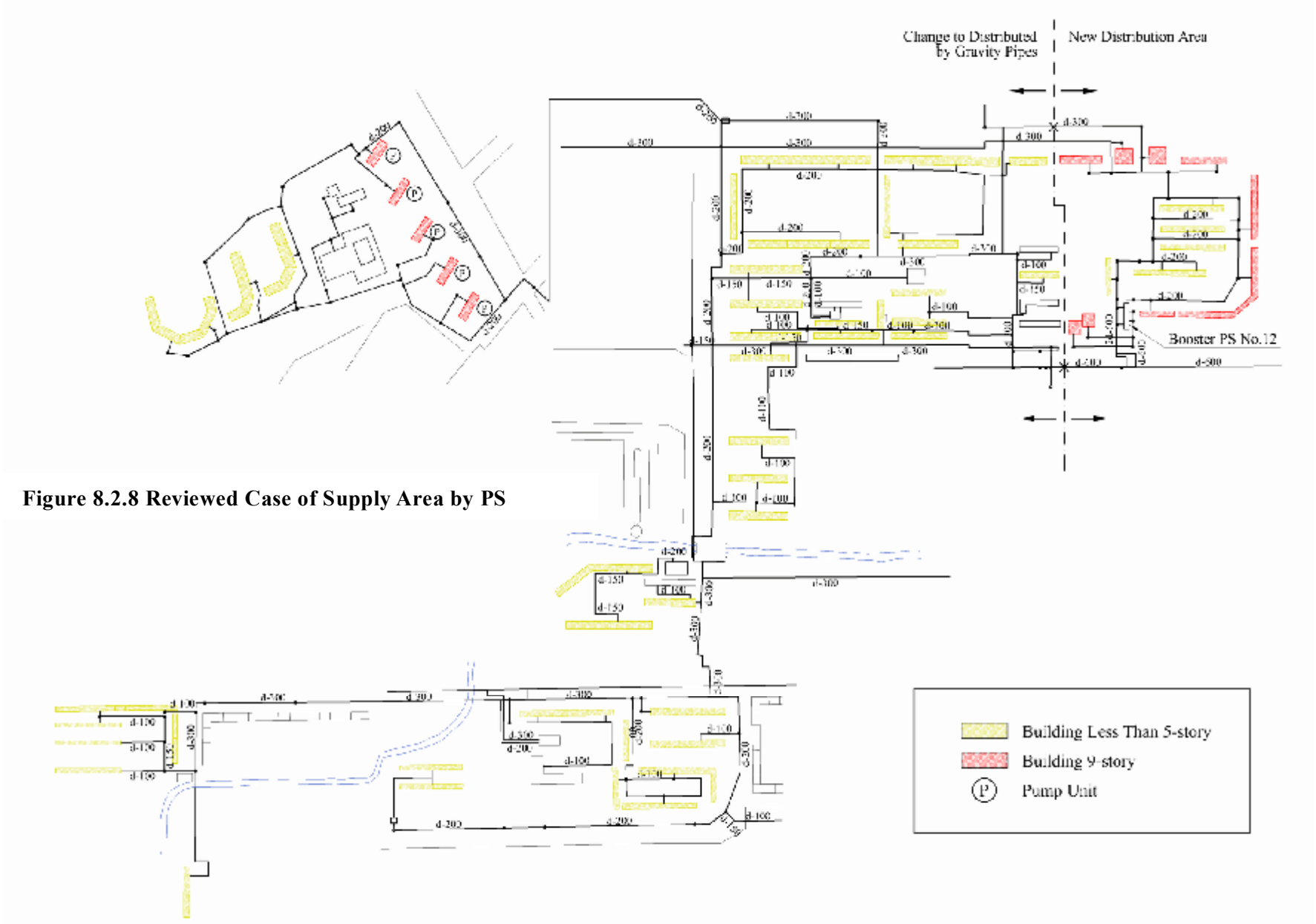


Figure 8.2.8 Reviewed Case of Supply Area by PS

Since the improved PSs will be operated automatically by the step control of the pump number according to the flow rate, the duty pumps should have several numbers to ensure a proper control. The number of duty pumps will be basically more than three. For small scale PSs, however, two duty pumps will be allowed as a minimum.

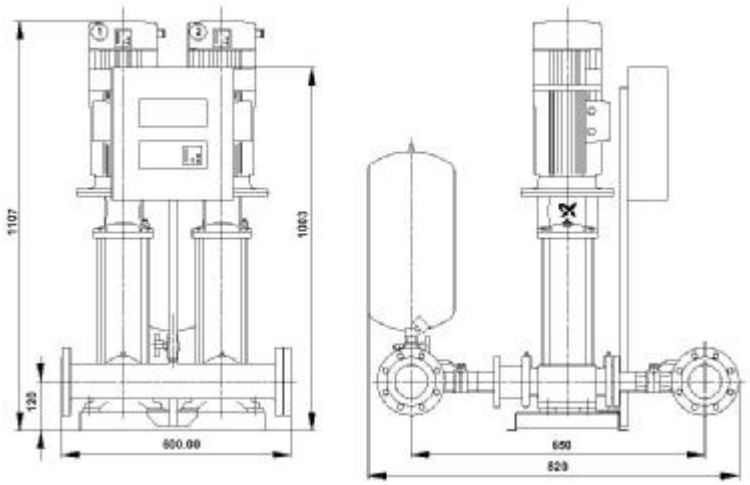
ii) Selection of pump-units

Table 8.2.15 shows improvement plan for PSs. In the table, pump units shown as "a" to "e" are listed. These pump units (they are marked from "a" to "e") will be installed for 9-story buildings, and the PS can be abandoned because water for other low story buildings can be distributed by gravity. The specifications of each pump unit are shown in Table 8.2.16 and Figure 8.2.9.

Table 8.2.16 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 4 District



Specifications of Pump Units
1. Flow control: variable speed control for Pump
2. With pressure tank
3. With control panel
4. With inlet and outlet pipes

Figure 8.2.9 Standard Drawings of Pump Unit

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

Table 8.2.17 shows the number of PSs that will remain (distribution PSs in WTPs are excluded), and the average capacity required.

All PSs with a capacity of 1,000m^3/hr will be made to distribute to 9-story buildings as well as to low story buildings, and only two PSs can be abandoned with the installation of pump units at the 9-story buildings. The required capacity can be decreased to an average of 312 m^3/hr for PSs which will be retained with capacity of 1000m^3/d.

Table 8.2.17 Evaluation of Retained PSs

Capacity (m^3/h)	Number			Total remained capacity (m^3/h)	Average remained capacity (m^3/h)
	Total	Abandoned	Remained		
3000	1	1	0	0	
1000	11	2	9	2,810	312
600-800	5	5	0	0	
500-300	1	1	0	0	
200-100	5	2	3	249	83
Under 100	11	10	1	5	5
Total	34	21	13		
Ratio (%)	100	62	38		

iv) Evaluation of effectiveness of improvement for PSs

Table 8.2.18 summarizes the evaluation results for the PSs in each District, in which distribution PSs are not included. As shown in the table, 13 booster PSs will be re-tained, meaning, 21 out of 34 PSs can be abandoned. The required current capacity is 48% of the design capacity and only 18% is required for the future capacity. It means that the required future capacity shall be reduced to 1/3 (0.18/0.48) of the present capacity.

The total power consumption of refurbished PSs will be drastically reduced as well.

Table 8.2.18 Summarized Evaluation Results of Booster PSs

District	Capacity (m^3/hr)	Number		Population		Required capacity*1 (m^3/hr)		Power consumption (kW)	
		Current	Future	Current	Future	Current	Future	Current	Future
Hamza	5,970	14	3	122,056	56,920	3,233	932	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	1.00	0.38	1.00	0.60	0.48	0.18	1.00	0.23

Note: Distribution PSs in WTPs are not included

*1 : Ratio is compared to the design capacity

4) Study on the improvement method and effectiveness of the improvement of PSs

(Water Pressure: under 26m)

i) Examination of abandonment of PSs and calculation of required capacities

When water pressure is under 26 m, PSs distributing to no more than 5-story buildings will not be abandoned. In this case, if the PSs are designed with a proper capacity and the pumps will not need to be replaced as long as the condition of diagnosis resulted in "A" or "B" as mentioned Chapter 3.1.2. Majority of the pumps installed in PSs have excessive capacity compared with the required future water demand.

For example, all the existing PSs with the capacity of 600-1,000m^3/hr are equipped with pumps of a same capacity of 320m^3/hr. However, the actual water demand is far smaller than the existing capacity in most PSs. This means that water flow cannot be controlled by using the existing pumps, and therefore renew/replacement of pumps will be necessary.

The average required capacity against the design capacity by the capacity range is shown in Table 8.2.19. As shown in the tables the difference in the required capacity between current and future is not that significant.

Table 8.2.19 Average Required Capacities

Capacity (m^3/hr)		Number	Average required capacity (m^3/h)	
			Current	Future
1000	To retain Pumps	2	986	593
	To replace Pumps	9	447	275
	Total	11	545	333
800-600		5	321	215
200-150		3	116	68

For PSs with capacity of 1000m^3/hr, as long as the future required capacity exceeds 500m^3/hr and the diagnosis result is "good", pumps will not be replaced. Two PSs meet this condition. Pumps in other PSs need to be replaced.

Table 8.2.20 shows the improvement plan for the area with a pressure of under 26m. As shown in the table, pump units shown in Table 8.2.16 can be applied for the improvement of small scale PSs.

Table 8.2.20 Improvement Plan for PSs

District	No.	Capacity of PS	Required capacity(m^3/h)		New pump specifications				Power consumption (kW)	
			Future	Current	Q(m3/h)	h(m)	kW	Number	Current	Future
Hamza	116	90	66	108	40	50	11.0	3(1)	21.0	11.0
	117	1000	573	928	320	50	75.0	5(2)	160.0	80.0
	120	300								
	118	1000	640	1,043	320	50	75.0	5(2)	180.0	100.0
	119	1000	217	337	70	50	15.0	4(1)	45.0	22.5
	121	1000	72	119	40	50	7.5	3(1)	45.0	7.5
	123	200	30	49	E			2	10.8	4.5
	126	600	260	380	90	50	22.0	4(1)	46.2	27.0
	124	45	19	32	C			2	3.0	3.0
	125	20	8	13	C			1	3.3	1.5
	127	600	110	156	40	50	11.0	4(1)	33.0	16.0
	128	45	15	25	E			1	9.0	2.5
	129	20	11	18	C			1	3.3	1.5
	130-1	20	15	25	E			1	9.0	2.5
	Total	5940	2,036	3,233					568.6	279.5
Mirabad	10	1000	408	663	140	50	30.0	4(1)	112.5	45.0
	11	600	186	276	70	50	15.0	4(1)	52.5	23.0
	12	1000	147	208	50	50	11.0	4(1)	38.5	17.0
	17	600	358	564	120	50	30.0	4(1)	77.0	45.0
	13	1000	59	98	30	50	7.5	3(1)	33.0	11.0
	14	150	49	82	25	50	5.5	3(1)	7.7	5.5
	15	150	130	216	45	50	11.0	4(1)	36.0	16.5
	16	90	14	24	25	50	5.5	3(1)	4.5	5.5
	18	45	3	5	A			1	6.6	0.5
	19	800	160	230	60	50	15.0	4(1)	120.0	22.5
	20	20	5	9	B			1	9.6	0.9
	21	20	26	43	E			2	9.6	5.0
	22	60	78	96	50	50	11.0	3(1)	3.3	12.0
	Total	5,535	1,623	2,514					510.8	209.4
Sergeli	130	1,000	225	374	80	50	22.0	4(1)	66.0	33.0
	131	3,000	399	542	140	40	30.0	4(1)	105.0	45.0
	132	1,000	147	184	60	50	15.0	3(1)	33.0	15.0
	133	1,000	1,172	1,805	260	50	55.0	6(1)	313.6	110.0
	134	1,000	157	231	50	50	11.0	4(1)	33.0	16.5
	Sergeli	4,000	0		----					0.0
	Total	11,000	2,100	3,136					550.6	219.5
Bectemir	---	160	74	123	10	50	5.5	8	21.0	21.0
	Bectemir	960			----					
	140	100	27	45	D			2	18.0	5.0
	Total	1,220	101	168					39.0	26.0
Total			5,860	9,051					1,669.0	734.5

Pumps are remained

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

Table 8.2.21 shows comparisons of required capacity for PSs at the present and in the future. As shown in Table 8.2.21, there are two categories of PSs with capacity of 1000m^3/hr. The first are existing pumps that will be retained, and not replaced if the required future capacity will exceed 500m^3/hr and the diagnosis result is "A" or "B". The second are existing pumps that will be replaced and whose capacities will be changed if the required capacity will be lower than 500m^3/hr or the diagnosis result is "C1" or "C2".

Table 8.2.22 summarizes the evaluation results for PSs in each District, in which distribution PSs are not included.

Table 8.2.21 Comparisons between current and future required Capacity

Capacity (m^3/hr)	No.	Required capacity (m^3/hr)		Capacity (m^3/hr)	No.	Required capacity (m^3/hr)	
		Current	Future			Current	Future
1000	117	928	552	800-600	19	230	160
	118	1,043	634		126	380	260
	119	337	207		127	156	110
	121	119	72		11	276	186
	10	663	408		17	564	358
	12	208	131		Total	1,606	1,074
	13	98	59		Average	321	215
	130	374	225	200-150	123	49	30
	132	184	121		14	82	49
	133	1,805	1,108		15	216	126
	134	231	141		140	45	27
	Total	5,990	3,658		Total	392	232
	Average	545	333		Average	98	58

iii) Evaluation of effectiveness of improvement for PSs

Booster pumps will not be abandoned in case water pressure is under 26m, because water cannot be supplied to low story buildings. The required future capacity is 65% (0.31/0.48) and power consumption is 44% as compared with the current condition.

Table 8.2.22 Summarized Evaluation Results of Booster PSs (Water pressure: Under 26m)

District	Capacity (m^3/hr)	Number	Population		Required capacity*1 (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	9,051	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
*1 : Ratio is compared to the design capacity

(3) Improvement plan of PSs in the entire Distribution Area

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

The water pressure in the entire distribution area was analyzed in the case of 2011 as well as 2015. The pressure distribution in 2015 is shown in Section 5.4.5, and that in 2011 is shown in Figure 8.2.10. As a result, the number of booster PSs located in the area where the water pressure will be under 26m decreased significantly, as shown in Table 8.2.23. This means that a great part of existing booster pumps will be located in the area where the water pressure will be under 26m in 2015 compared to that in 2011 due to rise in the water pressure with the reduction of water flow, as shown in Table 8.2.23. This also means that the water pressure will be 26m or more in majority of the areas where existing booster PSs are located, implying that a considerable number of existing booster pumps can be abandoned in the future.

Table 8.2.23 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 (%)		38	11

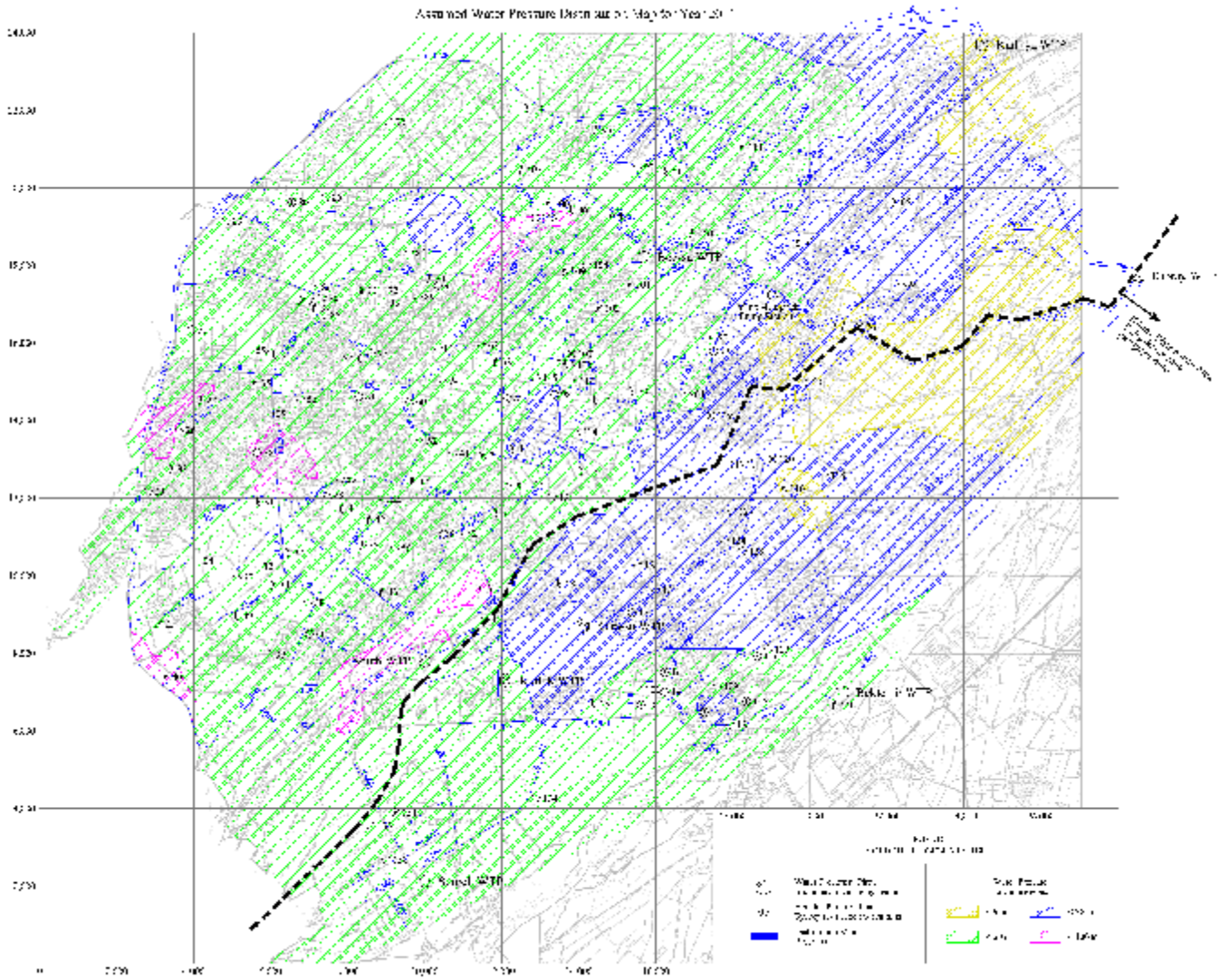


Figure 8.2.10 Pressure Distribution in 2011

2) Study on improvement methods for PSs

On the other hand, the remaining booster PSs have three categories; " To be abandoned", " To be retained with pump replacement" and "To be retained without pump replacement" In this case, "improvement" which means replacing pumps and carrying out monitoring and automatic control, and "monitoring" which means installing only a monitoring system without reinstallation of pump facilities have been categorized except for "abandonment" as shown in Table 8.2.24

Table 8.2.24 Improvement Plan for two cases of Pressure Range

Capacity (m^3/hr)	Category	Pressure 26m or more		Pressure: under 26m	
		Ratio (%)	Ave.cap. (m^3/hr)	Ratio (%)	Ave.cap. (m^3/hr)
1000	Abandonment	15	---	0	---
	Monitoring	10	593	20	593
	Improvement	75	312	80	275
800-600	Abandonment	60	---	0	---
	Improvement	40	215	100	215
500-300	Abandonment	50	---	0	---
	Improvement	50	150	100	150
200-100	Abandonment	50	---	0	---
	Improvement	50	83	100	70
Under 100	Abandonment	85	---	0	---
	Improvement	15	30	100	30

3) PSs Improvement Plan

Table 8.2.25(1) re-arranges the judgment results of water pressure of PSs as shown in Table 8.2.23 with the capacity of 1000m^3/hr or less in 2011 and 2015, by classifying into (1) 26m or more and (2) under 26m. Table 8.2.25 (1) also shows the transition of water pressure from (2) to (1) in the period of 2011-2015.

Table 8.2.25(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
Total	128	79	113	49	15	34

*1: Including new PS by EBRD Project,

Table 8.2.25(2) shows the numbers of PSs by existing design capacity, category, water pressure range (26m or more and under 26m) based on the result of pressure as shown in Table8.2.23. The required capacities for each category are shown in Table 8.2.24, and the numbers of PSs of each category in 2011 and 1015 were calculated in the table. There are 43 PSs (in 2004) with capacities of 1,000m^3/hr.

Table 8.2.25(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

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 categorized as "monitoring".

4) 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, excluded PSs from the Table8.2.25(1). Examination results for above large scale PSs and follows:

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

ii) Since Chilanzar PS was newly constructed in 1996, the diagnosis result is good. It is categorized as "monitoring" because it is distributing to many 9-story buildings as well as low story buildings; and

iii) Among 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 the other four PSs simultaneously distribute to many 9-story and low story buildings, these are categorized as "monitoring".

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

Table 8.2.26 shows the number of PSs categorized by capacity range based on the summary of examination results in Table 8.2.25(2) and the discussion for large scale PSs. The estimated number of pump units was 134 units in 2015. The required number of pump-units for the surveyed area is 34, and the ratio of the population out of total population in the City is around 25%.

As shown in Table 8.2.26, the number of remaining PSs (it is the total number of "monitoring", "improved in 2011" and " improved later" shown in Ⅳ.2.15) will be 73 or half in the total existing PSs. However the capacity and electricity consumption of PSs will be reduced at 26% and 36%, respectively, as shown in Table 8.2.27.

The decreased ratios for the supply capacity and the electricity consumption for PSs when these improvement will be carried out are calculated in Table 8.2.27 in the target years of 2011 and 2025.

Table 8.2.26 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 in F/S			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 in F/S		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

Table 8.2.27 Decreasing Ratio of Capacity and Electricity Consumption (%)

Classifications	Water pressure	Future decreasing ratio in comparison with present in Kibray Area*1 (%)	PSs in Entire City			
			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 PS are not included
*1: Refer to Table 9.1.4 (1) and (2) in Vol.2 Main Report.
*2: The ratio of under 26m is expected to be 38% in 2011 and 11% in 2015, respectively
*3: *1 and *2 are multiplied in the case of the pressure range of 26m or more, and under 26m, respectively, added in 2011 and 2015.

An improvement plan for Mirzo-Ulugbek PS and a typical plan for an improved PS are shown in Figure 8.2.11, and Figure 8.2.12, respectively.

8.2.6 Introduction of Monitoring System

(1) Outline of the Remote Monitoring System

A remote monitoring system for booster pump stations and pressure/flow-regulating points, which will be scattered around Tashkent city, will be introduced as a result of the feasibility study for Tashkent water supply improvement project.

As shown Chapter 8.2.5, 73 booster PSs will remain in 2015. However small PSs with less than 100 m^3/hr will be changed by pump units. Basically those pump units will be installed in the basement of apartment buildings, and should be observed by the buildings' O&M staff. Therefore 49 PSs with capacities of over 100m^3/hr will be improved with monitoring system in 2011, and 65 in 2015.

These PSs and 22 pressure/flow-regulating points will be observed/supervised from monitoring stations.

(2) Radio System

There are voice communication systems over radio networks among Vodokanal headquarters and WTPs, and between Kara-su WTP and each booster pump station, to which 40.05 MHz frequency band and 46.6 MHz frequency band have been allocated. These existing radio frequencies will be utilized as data transmission channels to collect field data for the water distribution network's remote monitoring system. Two more new frequencies will be proposed to cover the 22 pressure/flow-regulating points, and 48 another booster pump stations.

A master station for the remote monitoring system will be located at Vodokanal Headquarters taking into consideration its key role. Furthermore the data gathered at Vodokanal Headquarters will be transmitted to the PS management office in Kara-su, because maintenance staffs for the booster pump stations are on duty there.

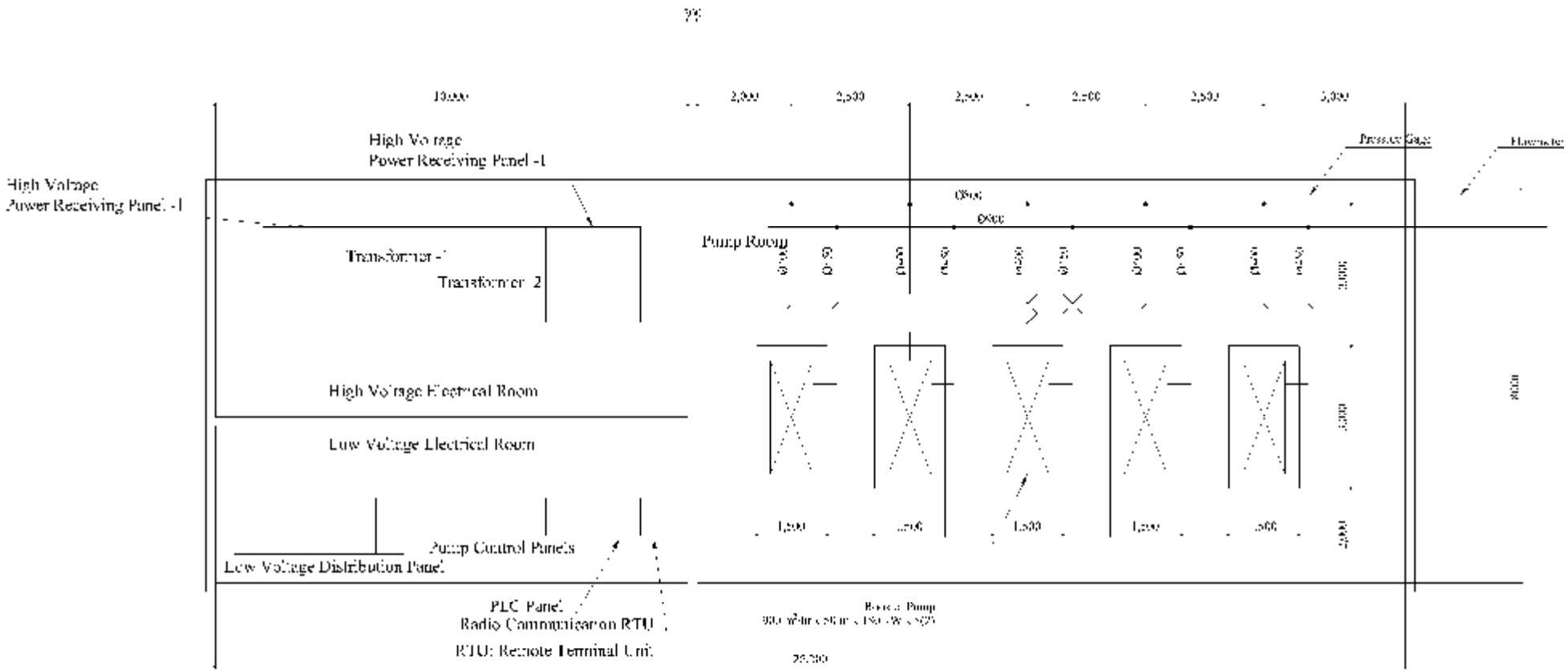


Figure 8.2.11 Improvement plan for Mirzo Ulugbek PS

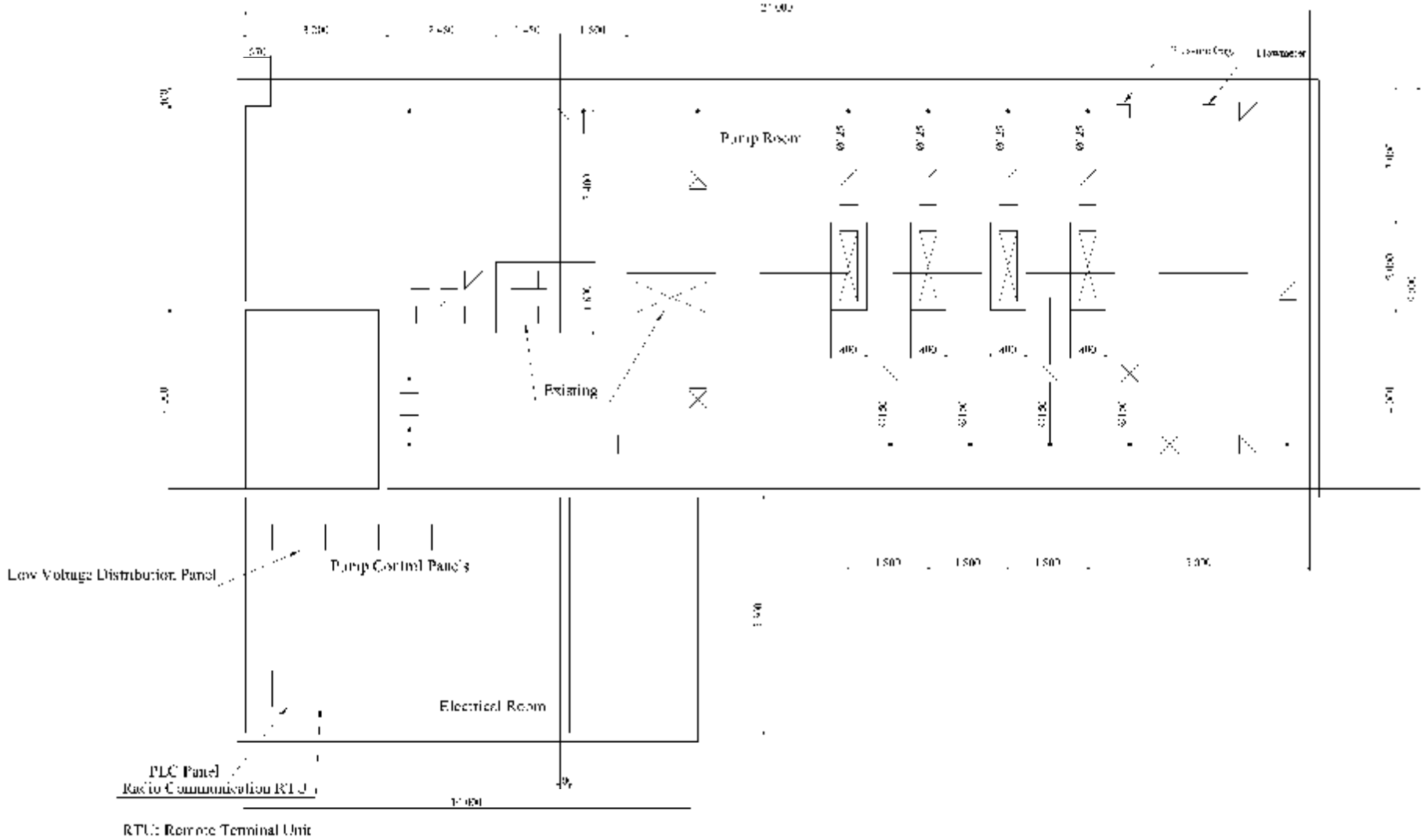


Figure 8.2.12 Typical Improvement Plan for PS

RTUs (Remote Terminal Unit) will be located at the booster pump stations and the pressure/flow-regulating points to collect field data and transmit them to the master station over the radio network. The RTUs will be separated into groups and by areas to limit the number having the same radio frequency. The data transmission from the RTUs can be achieved over the same radio frequency by the polling method which enables the master station to cyclically change over the communication channel to each RTU. The existing and proposed frequencies are summarized as shown in Table 8.2.28.

Table 8.2.28 Radio Frequency and Purpose of Communication

Radio Frequency	Purpose of Communication
Existing 40.000 MHz	Voice communication among Vodokanal and WTPs
Existing 46.600 MHz	Currently voice communication between Kara-su and each booster pump station, In this feasibility study to be utilizes as data communication between Vodokanal Headquarters and each booster pump station in Kibray distribution area
Proposed 50.000 MHz	Data communication between Vodokanal Headquarters and each pressure/flow-regulating points
Proposed 50.125 MHz	Data communication between Vodokanal Headquarters and each booster pump station except the Kibray distribution area

The remote monitoring system covering the booster pump stations and the pressure/flow-regulating points is shown on the Figure 8.2.13.

(3) Master Station and RTUs (Remote Terminal Unit)

The master station at Vodokanal Headquarters consists of two PCs, one server, two printers, three radio devices, three radio modems, one distributor and one antenna for the proposed data communication system. The antenna and the radio devices will be the communication medium to connect the master station and the RTUs. The above proposed communication equipment such as the radio devices and the modems will be mounted in a cubicle called the communication panel.

The typical proposed RTU is composed of a PLC as a main component, to which the required modules are connected the plug-in method. The typical configuration of the RTUs is shown on the below Figure 8.2.13. The size of data points for each RTU is summarized in Table 8.2.29.

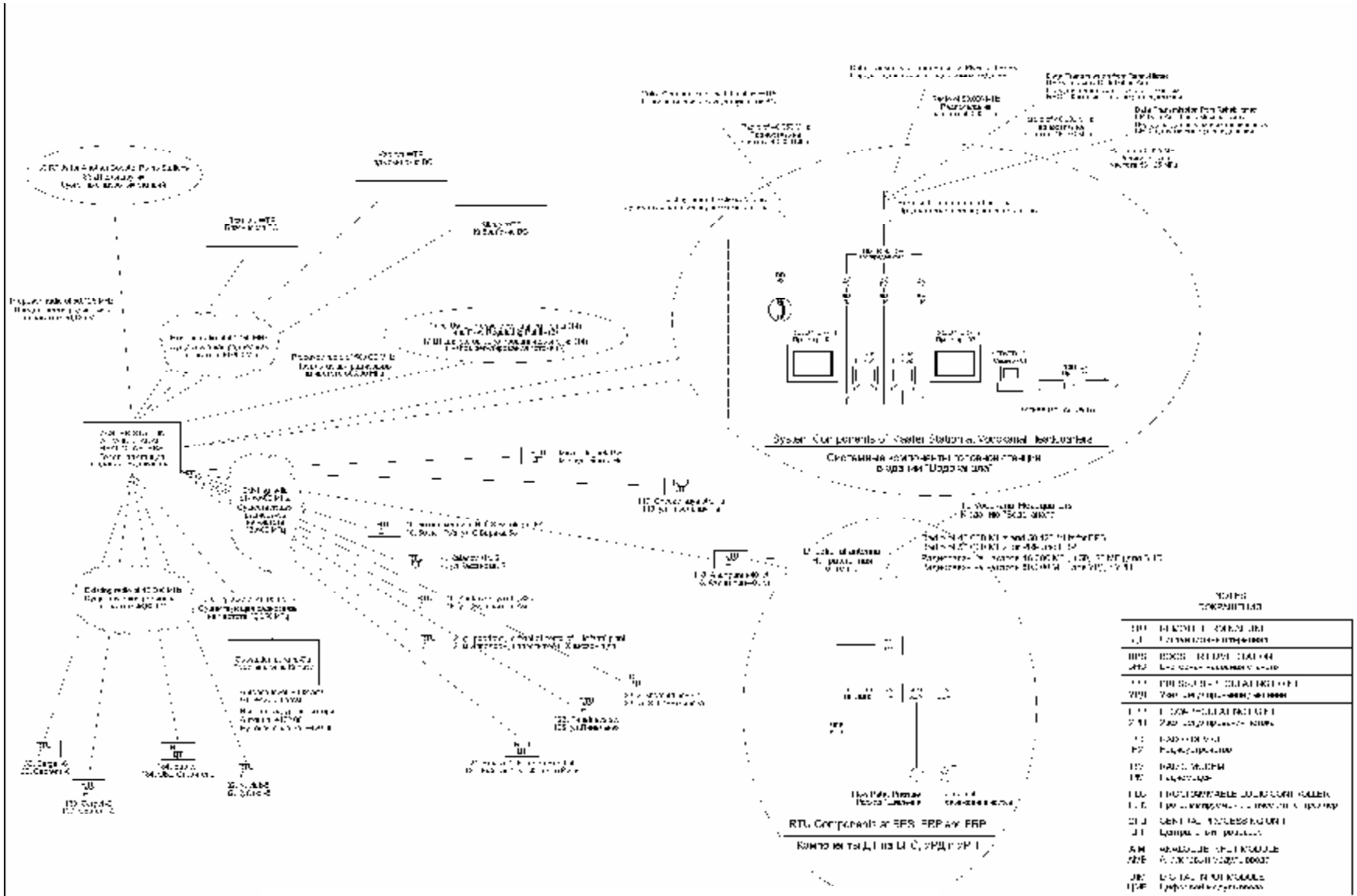


Figure 8.2.13 Diagram of Remote Monitoring System

Table 8.2.29 Size of Data Points for each RTU

Target facilities	Summarized data points
Booster pump stations	Analogue 1) Suction side pressure 2) Discharge side pressure 3) Discharge flow rate Digital 4) pump fault 5) power failure 6) door open 6 digit BCD data 7) Integrated flow rate 8) power consumption in kWh 3 analogues, 3 digitals and 2 BCD signals
Pressure/flow-regulating points	Analogue 1) Discharge flow rate 2) Primary pressure 3) Secondary pressure Digital 1) Valve fault 2) Power failure BCD 1) Integrated flow rate 3 analogues, 2 digitals and 1 BCD signals

(4) Constant Pressure Control for Booster Pumps

The booster pumps at each station are basically to be controlled automatically according to distribution flow, measured by a flow meter on the discharge pipe to keep the required pressure at the discharge side of the pumps. In other words, the number of operating pumps is proportional to the discharge water flow to cope with demand increase. This automatic control, so called step control for the booster pumps, can be achieved by components of a PLC, a pressure meter, and a flow meter. Furthermore, the set value of the pressure will be possible to be sent to each booster pump station from the master station by an operating staff. The system of constant pressure control is shown in Figure 8.2.14.

(5) Control for Pressure/Flow-Regulating Points

The pressure and/or the flow at each point are also each to be controlled automatically according to the set value in the PLC to keep it at the discharge side of the pumps. This automatic control can be achieved by components of a PLC, a pressure meter, and a flow meter. The set value can be sent to each pressure/flow-regulating point from the master station over the radio system like as the booster pump stations.

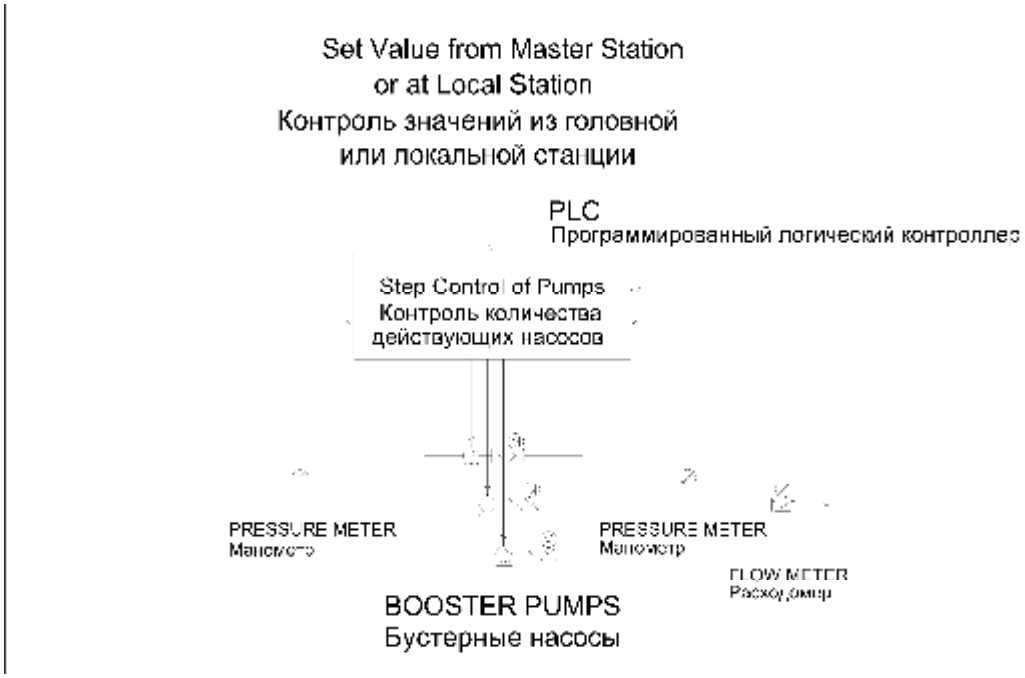


Figure 8.2.14 Constant Pressure Control

The control system for the pressure/flow-regulating system is almost the same as the pressure constant control for the booster pump stations.

(6) Monitoring and Logging

The data collected from the booster pump stations, and the pressure/flow-regulating points will be monitored on the PC screen, and logged out automatically in a daily report, a monthly report and a yearly report at the master station by the proposed remote monitoring system for the water distribution network. The alarm events and historical trends for the process will also be printed out automatically, if required. Then theses are utilized as the basic data to analyze the trend of water demand or for other purposes.