MDG ACHIEVEMENT FUND

INVESTOR:
MDG-F DEMOCRATIC ECONOMIC GOVERNANCE OF WATER ACCESS

PROJECT: WATER SUPPLY STUDY FOR PARTNER MUNICIPALITIES

WATER SUPPLY STUDY

FOR MUNICIPALITIES ISTOČNO NOVO SARAJEVO AND ISTOČNA ILIDŽA

Voding-92 d.o.o.

AUGUST 2011

Voding-92 d.o.o.
Engineering, Design and Consulting Company
Bijeljina

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WATER SUPPLY STUDY

FOR MUNICIPALITIES ISTOČNO NOVO SARAJEVO AND ISTOČNA ILIDŽA

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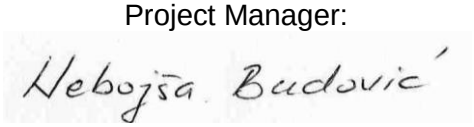

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WATER SUPPLY STUDY

FOR MUNICIPALITIES ISTOČNO NOVO SARAJEVO AND ISTOČNA ILIDŽA

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1 REGISTRATION

1.1 COMPANY LICENSE

1.2 COMPANY REGISTRATION

2 MASTER PLAN

2.1 INTRODUCTION

2.1.1 INTRODUCTORY EXPLANATIONS

In both municipalities, Istočno Sarajevo and Istočna Ilidza the water is supplied by city water supply system Tilava as well as a number of minor water supply systems. Water system Tilava is inter-municipal water system, and along with Banjaluka water supply system, is being unique to Republika Srpska. In terms of organised water supply of municipality areas of Istočno Novo Sarajevo and Istočna Ilidza, there is no one integral water supply system as minor local water systems are also being used.

Utility company 'Vodovod i kanalizacija' AD Istočno Sarajevo manages the following water supply systems:

- **Water Supply System Istočno Sarajevo (Tilava)**, water supply of both municipalities Istočna Ilidza and Istočno Novo Sarajevo;
- **Water System Grabski mlini** – water supply of Kijevo area – municipality of Trnovo;
- **Water System Trnovo** – water supply of the centre of the municipality and surrounding settlements of municipality Trnovo;
- **The part of Jahorina's water system**–an area that is being supplied from the reservoir Babe;
- **An Area of Vraca** that is water supplied from Federation of BiH by Sarajevo water supply system.

From the above stated it can be concluded that the area covered by 'Water Supply and Sewerage' Istočno Sarajevo is jagged and enormous. Actually, it covers an area of three municipalities:

- Istočna Ilidža;
- Istočno Novo Sarajevo;
- Trnovo.

Furthermore, there is the question of six independent water supply systems of which the largest is certainly Tilava water system and for that reason the main topic of this Master Plan. Besides water system Trnovo, there are real prospect of connecting these separate water systems into one integral water supply system i.e. connecting these systems into water system Tilava.

Name Water System Istočno Sarajevo is being used for the future water system of municipalities Istočna Ilidza and Istočno Novo Sarajevo as well as for the part of municipality Trnovo, that relates to Water supply system Grabski mlini.

2.1.2 GEOGRAPHICAL POSITION, DEMOGRAPHIC DATA AND ECONOMY OF MUNICIPALITIES ISTOCNO NOVO SARAJEVO AND ISTOČNA ILIDŽA

In the previous chapter, the area that covers Water supply system Istočno Sarajevo is being introduced.

Basic data concerning municipalities Istočno Novo Sarajevo and Istočna Ilidza are given in the following.

Data concerning municipality of Trnovo are no subject of our study because one smaller part of territory of municipality Trnovo might become in the future part of Water System Istočno Sarajevo.

The following maps depict geographical position of municipalities of Bosnia and Herzegovina as well as the borders of municipalities Istočno Novo Sarajevo and Istočna Ilidža.

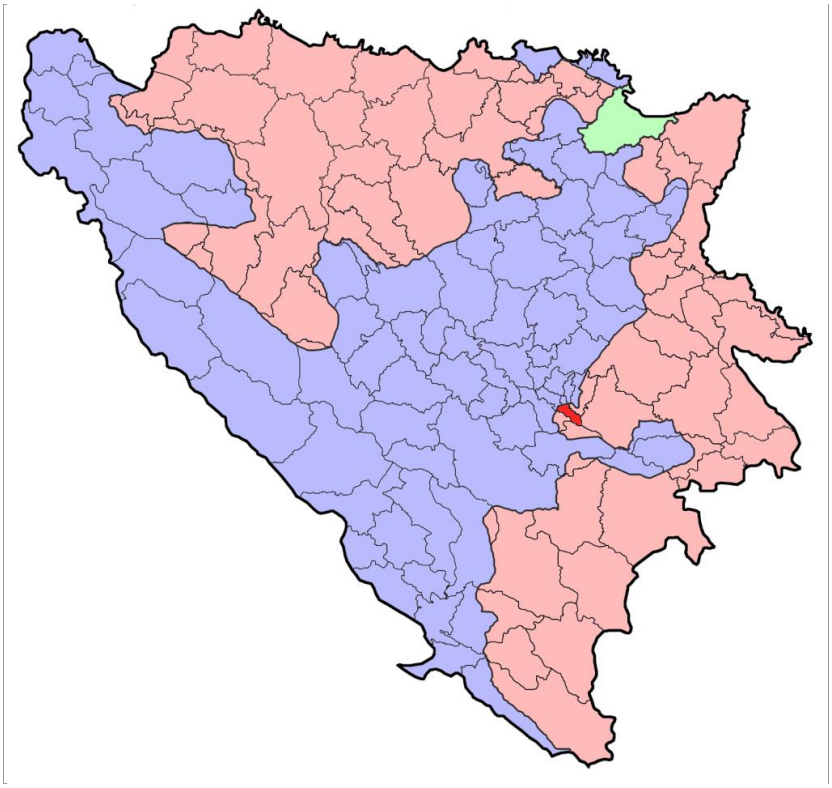


Figure 1: Location of Municipalities Istočna Ilidža and Istočno Novo Sarajevo in BiH and RS

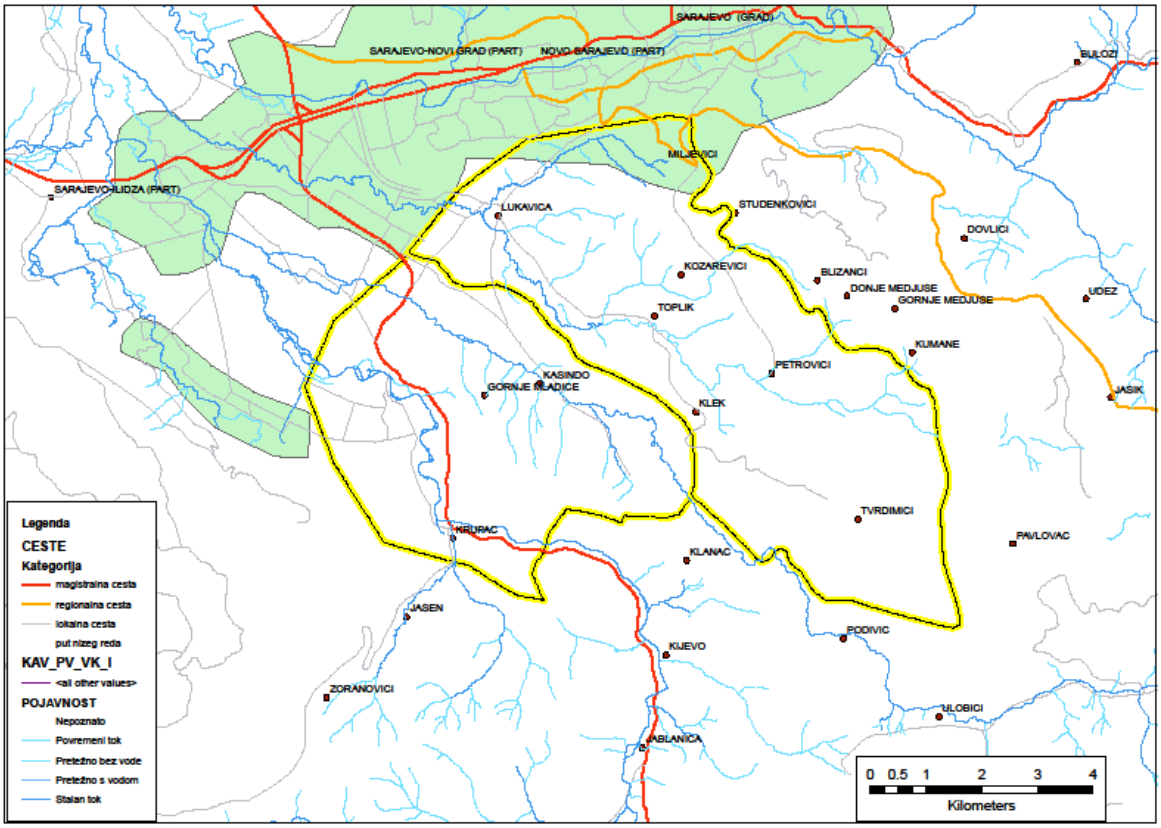


Figure 2: Map of Municipalities Istočno Novo Sarajevo and Istočna Ilidža

2.1.2.1 ISTOČNO NOVO SARAJEVO

Municipality Istočno Novo Sarajevo (previously known as Srpsko Novo Sarajevo) is one of the municipalities of the City Istočno Sarajevo in Republika Srpska (BiH).

Coat of arms

Location (dark red)

General information	
Entity	Republika Srpska
Area	38 km²
Population2010 - Estimates	11.510
Population1991 - Estimates	?

GEOGRAPHY

Municipal area covers 38 km² with population density of 302 inhabitants per km², and the average elevation is around 500 m.a.s.l.

SETTLEMENTS

Municipal area of Istočno Novo Sarajevo consists of the following settlements: Lukavica, Klek, Kozarevići, Miljevići, Petrovići, and Sarajevo – the part of Novo Sarajevo, Toplik and Tvrdimići.

Municipal area of Istočno Novo Sarajevo consists of the local communities: LC Vraca, LC Lukavica, LC Lukavica-Centre, LC Miljevići, LC Petrovići, LC Toplik-Tilava.

Municipality Istočno Novo Sarajevo along with the municipality Istočna Ilidža is situated in southeaster part of Sarajevo field that is after Dayton Agreement become a part of Republika Srpska, and its settlements which are situated on the slopes of Trebević and Jahorina. The municipality consists of local communities that had belonged to pre-war municipalities Novo Sarajevo and Sarajevo Centre: Lukavica, Pavlovac, Tilava, Toplik, the part of municipalities Vraca and Gornji Kovačići, (urban settlements) and settlements of Trebević, Tvrdimići, Petrovići, Miljevići, Klek, Kozarevići.

POPULATION

Since there has not been Census conduction in these municipalities since 1991, it is hard to estimate the total number of inhabitants. According to estimates of Bureau of Statistics of Republika Srpska, in Banja Luka, the municipality has 9,129 inhabitants (2004) while the local government deals with number of 15,000 inhabitants, mainly Serbs. Taking into account great differences in estimates made by municipality, Institute for Statistic as well as in planning documents, an expert assessment of population numbers was carried out and the basis for assessing was electoral register from 2010. According to this assessment, **number of inhabitants is 11,510**.

DEVELOPMENT OF THE MUNICIPALITY AFTER 1995

The area of today's municipality Istočno Novo Sarajevo was poorly urbanised before the war, but after 1995 this has been changed rapidly. New urban core of the municipality represent residential buildings built in the former barracks of JNA and VRS "Slobodan Princip Seljo" and "Slaviša Vajner Čiča", as well as many sports and cultural facilities, stadium FK Slavija, sports hall "Slavija", theatre, cultural centre, secondary school centre, Lukavica Market, shopping malls.

Ten companies that comprise "Energoinvest" ("RAOP", "Automatika", "TAT", etc.) with its significant development capacities represent the backbone of municipal development. Not less important are the capacities of UNIS "Lasta", Special Vehicle Factory as well as major private companies.

In the centre of Lukavica there are The Faculty of electrical engineering, The Faculty of mechanical engineering and The Faculty of agriculture, Music academy, Parliament of the City Istočno Sarajevo, Central library, administration buildings and production facilities of FAMOS, Radio Istočno Sarajevo, Primary and Secondary schools, Hospital, and many other important institutions.

NAME

From 1992 – 2003 this municipality was called Srpsko Novo Sarajevo. For a short period it was also called Lukavica, and the name of that settlement is used in jargon, especially in Federation BiH, also for the entire city Istocno Sarajevo or at least its lower part, in municipalities Istočna Ilidža and Istočno Novo Sarajevo. Its former name was Srpsko Novo Sarajevo, but by the decision of Constitutional Court of BiH, it was declared unconstitutional on 22 September 2004 and the same Court declared provisional decision allowing municipality Srpsko Novo Sarajevo usage of the name "Lukavica". By the applying of The Low on Amendments to The Low on Territorial organization of Republika Srpska ("RS Official Gazette", No: 103/05) municipality name was changed into Istočno Novo Sarajevo.

2.1.2.2 ISTOČNA ILIDŽA

Municipality Istočna Ilidža (previously known as Srpska Ilidža) is one of the six municipalities of the City of Istočno Sarajevo within Republika Srpska, BiH. It consists of four local communities: LC Vojkovići, LC Dobrinje, LC Kula and LC Kasindo.

Coat of Arms

Municipality location (dark red)

General information	
Entity	Republika Srpska
Area	29 km²
Population2010 - Estimates	16,839
Population1991 - Estimates	?
Coordinate	43°75′N 18°41′E

GEOGRAPHY

Municipality Istočna Ilidža covers an area of 29 km². Population density is 580 inhabitants per km^2. The average elevation of 500 m.a.s.l. It is situated on the far south-eastern end of Sarajevo field at the bottom of mountain Igman.

Via main road it has connections with Foča, via local regional road via Trebevića with Pale, and via local network of roads with the city of Sarajevo, Federation BiH. The border between municipality Istočna Ilidža and The Federation BiH is unmarked, however in practice, one street can represent the border that separates two residential buildings that belong to two separate entities.

SETTLEMENTS

Municipal area Istočna Ilidža consists of the following settlements: Bijelo Polje, Vojkovici, Grlica, Gornji Kotorac, Gornje Mladice, Dobrinja I (part of), Dobrinja IV (part of), Donji Kotorac (part of), Donje Mladice, Kasindo, Krupac, Kula, Mladicko Polje, Naselje Starosjedilaca, Pavlovac.

(The following urban settlements are on the list of Government of Republika Srpska: Gornje Mladice, Kasindo, Krupac, part of Sarajevo – Ilidža and part of Sarajevo– Sarajevo Novi Grad.

There are four local communities in the municipal area of Istočna Ilidža: LC Vojkovići, LC Dobrinja, LC Kasindo, LC Kula. Grlica i Krupac had previously existed local communities.

Municipality Istočna Ilidža derived from the parts of pre-war Sarajevo Municipality called Ilidza on those parts of the municipality that become the part of Republika Srpska after Dayton Agreement. Pre-war municipality covered an area of 162 km². Before application of Dayton Agreement, 2/3 of former Municipality Ilidža had been under control of Republika Srpska.

The largest settlements are Vojkovići, Dobrinja I, Dobrinja IV, Kasindo. The other settlements are Krupac, Grlica, Gornji Kotorac, Donji Kotorac (part of), Bijelo Polje, etc. Some years after the war a vast housing estate was build in Mladici, for Serb refugees from other municipalities of Sarajevo.

POPULATION

The majority of the municipal population are Serbs who made their refuge from other parts of Sarajevsko polje. The municipality covers an area of 29 km² and has 16,754 inhabitants (official estimates of RS Central Bureau of Statistics for the year 2004). In the same year, there has been 136 new-borns while 173 inhabitants died that makes the negative natural increase of -37 inhabitants (we are witnessing negative rates of natural increase in the last few years). With 580 inhabitants per km², municipality Istočna Ilidža is the most populated municipality of Istočno Sarajevo.

HISTORY

In a place called Gornji Kotorac, on the hill called Ilinjača (also known as Gavrića brdo) there are remains of the medieval town, which most historians consider the town called Kotorac. The town was mentioned in Constantine Porphyrogenitus's famous book *De Administrando Imperio* (On the Administration of the Empire), where the name of Bosnia is mentioned for the first time, as a land of Serbs.

NAME

Municipality Istočna Ilidža derived from the former municipality Ilidža, with its official name Srpska Ilidža. The Constitutional Court of BiH declared this name unconstitutional on 27. April 2004. In a short notice, The National Assembly of the Republika Srpska gave the name Kasindo, which was in use for a short time. The National Assembly of the Republika Srpska by The Low on Amendments to The Low on Territorial organization of the Republika Srpska («RS Official Gazette», No: 103/05) changed the name of this municipality into Istočna Ilidža.

HEALTH SERVICES

Within the municipal territory, there is a respectable hospital known as Klinički centar Kasindo.

ECONOMY

Production facilities of FAMOSA, GP Budućnost, GP Put, Union-invest, UNIS-MGA, Napredak, Carpet- Weaving Factory, and others, make the backbone of municipal development. There are the headquarters of companies Centrotrans and GRAS, which deal with urban, suburban and interurban passenger transport.

2.1.3 BACKGROUNDS

Backgrounds for draft of the Master plan are as follows:

GEODETIC SURVEYING MAPS

For the Master plan development, geodetic surveying maps are being used for the Lukavica - Kasindo area with a scale of 1:25 000 and 1:10 000.

URBANISTIC BACKGROUND

In 1996, the company 'Studio' from Belgrade designed the Urban Plan of the area, which served as basis for designing of Conceptual Solution of the Water Supply System.

Beside The Urban Plan, the Action plan for current and long-term solution of water supplying, wastewater disposal and flood protection in area of Srpsko Sarajevo designed by Institute for water management, Srpsko Sarajevo, in July 1996 was also used as a background.

Conceptual solution of water supplying in the area of Lukavca – Kasindo, designed by The Institute for water management, Srpsko Sarajevo, 1997, was also used.

2.1.4 PROJECT DOCUMENTATION

PROJECT DOCUMENTATION – CONCEPTUAL SOLUTION

Priority task for an area of Istočno Novo Sarajevo i Istočna Ilidža, i.e. in the Lukavica – Kasindo area (project documentation is conducted for a current area of municipalities Istočna Ilidža and Istočno Novo Sarajevo called Lukavica – Kasindo Area), is to provide sufficient amounts of potable water for the both inhabitants and economy consumption. Due to major migrations, damages and destruction, underdevelopment of the system and inadequate system maintenance, significant water supply problems occurred in this area.

There are app. 35.000 inhabitants currently settled in this area but according to Action development plan of Lukavica – Kasindo Area for a planned period by 2020, development of new settlements for app. 50.000 inhabitants is envisaged. At the same time, choice and determination for building a new town and new industrial facilities, make strong pressure for building new and expanding current capacities of water supply system.

In accordance with above-mentioned, during 1997, Directorate for Reconstruction and Development of Srpsko Sarajevo, took appropriate action, to produce project documentation on the level of Conceptual solution for the Lukavica – Kasindo Area, for the parts of water system that represent weaknesses and are bottle neck of the system and as well as the development of the system, with the aim of improvement in current water supply.

In that respect, Conceptual Design of overall water system of the Lukavica – Kasindo Area was conducted, with the main system facilities: water source, reservoirs, pumping stations and main transmission and distribution pipelines. Beside these system facilities, primary water supply pipelines were designed, for regions aimed for building new settlements and industrial facilities.

This Conceptual Solution represents long-term concept of water supply for Lukavica – Kasindo area.

PROJECT DOCUMENTATION – MASTER PLAN

During 2007 "Master Plan of Water Supply of Istočno Sarajevo" was designed. This Master plan was designed taking into consideration previous project documentation with certain changes that occurred in the Master Plan development period. Master Plan covers an area of central city water system.

MAIN PROJECT - WATER SYSTEM OF ISTOČNO SARAJEVO (TILAVA) – SECOND PRESSURE ZONE OF WATER SUPPLY KASINDO

Main water supply project of Second pressure zone for Kasindo settlement as well as for the settlements Pavlovac and part of Gornji and Donji Mladici was conducted during 2008. In the meantime, this project was implemented and the second pressure zone was developed in the current state WSS Istočno Sarajevo. It is important to emphasize that after project realisation, reservoir capacity in WSS Istočno Sarajevo has been increased in volume for 1000 m^3.

CONCEPTUAL SOLUTION - WATER SYSTEM TILAVA – HIGHER ZONE OF TREBEVIC'S SLOPS

This Conceptual solution was developed at the end of 2008 and it dealt with water supply issues of the areas currently water supplied via other water supply systems.

This applies to the following areas:

- **part of Jahorina water system** – water supplied area from reservoir Baba (Zlatište) – settlements Miljevići, Petrovići, Stanojevići, Kozarević and other settlements;
- **Vraca area** - water supplied from Federation BiH, from water system Sarajevo.

The solution is given in the direction of connecting these settlements to water system Tilava.

SPATIAL PLAN OF CITY OF ISTOČNO SARAJEVO, 2008

The Institute for urbanism of Republika Srpska AD Banja Luka conducted spatial Plan of City Istočno Sarajevo in 2008.

Spatial Plan among other topics, presented a chapter on population and demographic predictions for the period up to 2015.

In addition, it contains some hydro-technical infrastructure data.

STRATEGIC DEVELOPMENT PLAN OF CITY OF ISTOČNO SARAJEVO, 2010

Just before the development of the Feasibility Study, Strategic Development Plan of City Istočno Sarajevo is also being developed.

MAIN PROJECTS

All main projects that have been conducted in the recent years were also at our disposal. The following projects are of special importance:

- Water system – Lukavica – Kasindo Area, Srpsko Sarajevo, Main project, Book 1, Main distribution pipelines, year 1997 – The Finnish Government Donation,
- Main distributive network project for settlement Donje Mladice, 1997 – The Finnish Government Donation,
- Main distributive network project for settlement Škrbino Polje, year 1997 –The Italian Government Donation,
- Main distributive network project for settlement Donje Mladice, 2005,
- Main water system project for Gornje Mladice, 2005.

The other documentation concerning water system Istočno Sarajevo was also at our disposal.

2.1.5 OBJECTIVE AND ASSIGNMENT OF THE STUDY

2.1.5.1 ASSIGNMENT 1: INCEPTION REPORT INCLUDING ANALYSIS OF THE CURRENT SITUATION

As part of the Inseption report, the consultant will handle the following:

c) Current situation analysis:

- defining the area covered by the **water supply service and specifying the number of users and connections** in each relevant category, e.i. households in individual residential units, households in collective residential units, industry, public institutions, businesses, farms for raising cattle, chickens...
- **analysis of consumption, or needs for water**; overview of current situation by user category, average consumption per inhabitant, needs of industry and cattle-raising, public consumption; analysis of the quantities of captured water at the sources and assessment of total losses.
- **description of existing network**, including sources and water supply zones, measure of protection of sources, water treatment, water quality, length, diameter and material of main water pipes, reservoir space, pumping and re-pumping stations, including installed equipment and any other technical characteristics of the water supply network;
- **map** of existing systems, facilities and assets;
- **assessment of system components** in terms of capacities, efficiency, performance, reliability, adequacy, maintenance practices, age and quality of material and equipment, quality and quantity of raw water at the sources and treated water at the sources and in the network, source protection measures...
- **description and assessment of the management system**, assessment of losses by water supply zones;
- **assessment of the functioning of the water supply network;**
- **analysis and assessment of the capacities of the partner municipality and associated Water Utility Company** in terms of management and running the existing and future infrastructural facilities, considering technical capacities, human and financial resources. The Consultant should make a critical assessment of the current management of the system, human resources, organization, availability of technical equipment, operation and maintenance concept. Where necessary, the Consultant should identify a need for future reforms, capacity building and propose concepts for future management (organization, needs for human resources, needs for equipment, enhancement of operation and maintenance...);
- **socio-economic situation, financial analysis of the company's operation, analysis of current tariff system;**
- **analysis of institutional and legal regulatory framework** – laws, regulations, rule books, standards, norms and directives which will be applied during the drafting of the Study and with which the Study will be aligned.

d) **Analysis of development projects, studies, project solutions and harmonization of development of water supply systems with development plans and projects**.

2.1.5.2 ASSIGNMENT 2: WATER SUPPLY MASTER PLAN FOR PARTNER MUNICIPALITY

Water Supply Master Plan contains the following elements:

a) **Demographic projection for the planning period of 20 years** based on an analysis of strategic planning documentation from the aspect of ensuring necessary quantities of drinking water and industrial water. Defining the **area covered by the water supply service** provided via water utility company and specification of the number of users and

connections in each relevant category, e.i. households in individual residential units, households in collective residential units, industry, public institutions, businesses, farms for raising cattle, chickens...Defining potential scenarios for development of the areas, number of inhabitants and industrial, commercial and public activities;

b) **Balance of available and required water quantities for the 20 year planning period** (drinking and industrial water). Capacities of available resources. Assessment of future needs for the planning period by zones and consumption groups. Assessment of possibility to provide industrial water from alternative sources (pumping water from water flows, using sources that cannot be used for drinking...).

c) **Quality of drinking water at the sources and in the network.** Detailed analysis and interpretation of existing physical and chemical and bacteriological findings.

Sampling and extended physical and chemical and bacteriological analyses of water from the sources on three occasions in the course of drafting the Study in different hydrological conditions.

Interpretation of all results and proposal of measures – types of water treatment for each of the listed sources.

d) **Drafting two to three variants of conceptual solutions** for the water supply system which ensure achievement of the overall goal in the 20 year planning period, including cost assessment, investment into construction, management and maintenance. Long-term financial comparisons of proposed solutions and proposal for adoption of one of the solutions.

The conceptual solution should define the complete system, including water source, water treatment, main pipelines, pumping and re-pumping stations, reservoir capacity and other system elements. For each solution, the Consultant will provide hydraulic modelling.

e) **Macro-available assessment and socio-economic analysis**, investment capability to invest into the water supply system. The Consultant should asses the macro-available amount of investment for implementation of measures. This indicative value will lead the Consultant in the definition of an acceptable technical framework of measures. The total price should include the cost of investment and reinvestment, cost of functioning and maintenance and cost of general management.

The assessment of macro-availability should be based on the assessment of the real capacity of users within local community to pay, which will be based on a socio-economic analysis, including all users (households, commercial, industrial and institutional), with a view to having an integrated approach to water supply systems, sewage systems and waste water treatment.

An assessment of overall capacities in terms of community contribution should be made for the period used in the Master Plan, based on the current situation and results of the socio-economic evaluation, assessment of household reception needs and a projection of commercial and industrial development. These scenarios should be studied: „optimistically“, „averagely“ and „pessimistically“. Each scenario should contain a forecast of the state, entity, cantonal and municipal gross product in absolute values and in percentages of the GDP and gross income per capita in partner municipality.

The analysis of availability should end with an assessment of users' will to pay for water supply, sewage system and waste water treatment services. This assessment should be based on existing data, including all user categories. User community's will and their contribution capacities should be taken into account, which may give rise to a situation that the necessary investments would be carried out in time phases.

f) **Long-term water supply development plan**. The plan will be based on the adopted concept – conceptual solution with defined water management facilities, water supply delineated by systems, zones and subzones, calculated maximum needs for water,

defined water treatment at source locations, locations and capacities of reservoirs, pumping and re-pumping stations, main pipelines, hydraulic calculations, management system and other technical elements. The long-term development plan will identify facilities and costs and provide criteria for prioritization of the project, including risk assessment and mitigation of consequences for realization of full efficiency of the project.

2.1.5.3 ASSIGNMENT 3: PRIORITIZED PLAN OF INVESTMENT MEASURES FOR THE PERIOD OF 10 YEARS

On the basis of the criteria developed in the long-term water supply plan and taking into consideration macro-available assessment and investment capability, the Consultant will define:

- Prioritized project list with dynamic implementation plan;
- Funding sources (delineated external and internal funding sources), time lines, expected outputs and risks in implementation.

2.1.5.4 ASSIGNMENT 4: FEASIBILITY STUDY FOR PRIORITY INVESTMENT MEASURES

Inception and implementation of this stage will follow as a result of the findings of the Master Plan. For the priority investment component/components identified as investment measure/measures, the Consultant should ensure that adequate considerations and alternative solutions are given. The Consultant should pay special attention to the assumptions for engineering (input data) and ensure that designing of plants and networks is in accordance with the current situation and realistic forecasts. The Consultant will be asked to draft a Feasibility Study for the proposed priorities for the investment measure(s) in order to prove that the proposed solutions are the best possible solutions feasible in the planned period. The Feasibility Study should consider all technical, socio-economic, financial and environmental aspects of measures.

The Consultant should ensure that the partner municipality and associated Water Utility Company, authorities responsible for issuing permits/ licenses, as well as all other parties be informed on the progress of the Feasibility Study.

Sub assignment 1- Identifying technical scope for investment measures

The Consultant should prepare a short summary of the technical scope of work for identification of investment measures and submit it to all interested parties for discussion (Project Steering Board, Working Group or any other interested party for which the Consultant considers it is necessary to be included). The short summary should be detailed enough to describe the background, proposed solutions and possible benefits/enhancements. The summary should be corroborated with location maps and drawings where necessary.

Sub assignment 2 - Cost assessment

After an appropriate technical solution is made, which will lead to the goals of investment measures, the Consultant should ensure that the protection measures, network and facilities are designed in line with the assumed projection. It also needs to be ensured that the proposed technical solutions are the best value for money during the operational period of the facilities and network.

The cost assessment should be based on a conceptual solution. An accurate cost assessment is an important element of the Feasibility Study. It should show clearly unforeseen physical and financial situations in the course of implementation / construction.

Sub assignment 3- Financial analysis

The Consultant will be required to construct a financial model which will cover the exploitation period of the project (10 year period). The financial model should contain all elements of costs, capital expenditures, all additional operational costs and maintenance costs.

The analysis of cost recovery should contain an assessment of investment costs, operation and maintenance and an assessment of expected revenues based on specification of tariffs to be applied to main user categories (households, commercial, industrial). These revenues should cover, as a minimum, investment, operation and maintenance costs, as well as costs of depreciation of the building, assets and equipment.

It will probably be possible to increase tariffs during the project implementation period. There are specified and acceptable limitations in terms of maximum percentage of the financial load on households' income (it is usually 3-5% of the household income for water supply services and collection and treatment of waste waters, based on instructions of the Council of Europe).

The financial system needs to be used to determine appropriate adjustments of policies and tariffs/prices, which will ensure financial sustainability of water utility company operation, provide enough room to those providing loans and ensure that tariffs remain within acceptable boundaries and are raised each year up to acceptable limits. The Consultant should consider impact of all agreed and specified types of subsidies for socially excluded categories (differential prices according to revenues, subsidies by the partner municipality...).

Results of the analysis should manifest through several indicators (e.g. financial internal return rate and net current value). The Consultant should discuss the interpreted indicators generated by the financial model and stated assumptions with the UNDP/MDG-F, partner municipality, associated Water Utility Companies and other parties the Consultant thinks need to be involved in this project phase.

The financial analysis will show sustainability of the proposed investment measures(s) in different scenarios. It should also contain an assessment of work of the Water Utility Company in charge of rendering services of water supply and the burden the proposed investment measure(s) can cause with their financial adjustment. This assessment should contain a projection of cash flow which is based on a sensible assumption of cost recovery, examine under which circumstances the Water Utility Company will have sufficient resources to render services, maintain the system and realize investments in the future.

Sub assignment 4 - Economic analysis

The economic impact should be described in a quantifying form, as much as possible. Economic benefit, together with social, environmental and health benefits, generated by the Project should be described. If all relevant expenses and benefits could be quantified, the results of the analysis should be presented with the use of accepted indicators, such as financial and internal return rate, net current value, and benefit – cost ratio.

It is usually difficult to quantify all economic benefits of an infrastructural project. In this case, other kinds of quantifying analyses can be used such as multi-criterion analysis and cost effectiveness analysis.

The cost effectiveness analysis should presume that the Project should achieve the level of rendering services and standards set by relevant environmental analyses. Therefore, relevant EU standards can be treated as objective goals that need to be achieved with optimal economic effectiveness during the operational period of the project.

Sub assignment 5 - Preliminary assessment of environmental impact

The preliminary assessment of environmental impact will be performed in accordance with the Rule Book on production plants requiring a mandatory environmental impact assessment and plants that may be built and become operational only with an environmental approval.

The Consultant will be obliged to analyse the environmental impact of the works that should be undertaken within the Project and verify whether the works can lead to soil degradation, jeopardize the sources and water courses, environment and natural habitats, as well as neighbouring areas.

Sub assignment 6 - Implementation plan and strategy

The Consultant will be obliged to prepare an implementation plan and strategy for investment measure(s) which the study proves to be feasible. The implementation plan should contain:

- Deadlines to carry out implementation measures with mandatory accompanying management and maintenance measures,
- Management of implementation of investment measures,
- Financial plan and funding sources,
- Technical standards and alignment with development projects,
- Public procurement procedures,
- Monitoring and reporting systems.

2.2 POPULATION AND SPATIAL COVERAGE

2.2.1 POPULATION

2.2.1.1 POPULATION OF GIVEN AREA THROUGH HISTORY

This Master Plan, i.e. Feasibility Study, covers an area of three municipalities:

- Municipality Istočno Novo Sarajevo,
- Municipality Istočna Ilidža,
- The part of Municipality Trnovo.

Official list of households, conducted in Republika Srpska in 1996, showed the significant growth in population of City Istočno Sarajevo (for over 25.000 inhabitants) from 1991 – 1996, because of war migrations in municipalities Istočna Ilidža and Istočno Novo Sarajevo, where number of inhabitants doubled since 1991. Municipality Sokolac has slight population decline, while the population of municipality Trnovo fell to app. 46 % of population in 1991. Otherwise, urban population has already come into the phase of demographic ageing in 1991 (average age is over 35 years).

Population of the City Istočno Sarajevo is spatially unevenly distributed. Approximately 75% of total city population lived in municipalities Istočna Ilidža, Istočno Novo Sarajevo and Pale (app. 39 % territory of the city) in 2008.

Population in urban settlements makes 66.55 % of total population (nearly 2/3 of population), which makes urbanization rate (urban/total population) significantly above average for Republika Srpska.

Since 1998, all municipalities of City Istočno Sarajevo have negative population growth rate. In five year period from 2004 to 2008, average natural increase on city level is -3.5 ‰.

Municipalities Istočna Ilidža and Istočno Novo Sarajevo undoubtedly represent immigration areas within the city of Istočno Sarajevo. This is a result of pre-war trends, as well as increased attractiveness of these municipalities, which derives from better infrastructure, public services and better employment opportunities.

2.2.1.2 CURRENT AND PLANNED POPULATION

In chapter 2.2.1.3 POPULATION OF GIVEN AREA THROUGH HISTORYwe are presented with an analysis of number of inhabitants in the past, as well as current and planned number of inhabitants conducted by Institute of Urbanism in the Spatial Plan of Istočno Sarajevo. Unfortunately, we cannot rely on this analysis due to some illogical explanations in Annex. Furthermore, number of inhabitants of municipalities, especially for Istočno Novo Sarajevo significantly deviates from Electoral Register data for 2010.

For the purpose of this Study, Expert assessments of inhabitants number for these two municipalities was given, as well as, projected population growth for the planned period of 20 to 25 years. It is difficult to estimate fluctuation in number of inhabitants and foreseen the development of this area for a given period. There are no any statistical data series we can rely on, because the data up to 1991 relate to the City of Sarajevo as a whole, i.e. for former Sarajevo municipalities. Only available data are those concerning smaller settlements that did not become the part of urban area. On the other hand, from 1991 – 2010, due to war activities, huge demographic changes occurred and they are not usual pattern for the period of peace ahead.

If we focus only on natural growth in number of inhabitants, estimates of planned increase in number of inhabitants cannot be a great mistake. Still, remains the question of a number of inhabitants we are counting on, in a year 2010. Due to changing political condition during this

period, major changes in inhabitants number can occur, which can not be foreseen nor calculate.

In the following table, estimated number of inhabitants is given based on Electoral Register.

Estimated total number of inhabitants of the municipality area of Istočna Ilidža and Istočno Novo Sarajevo is **26,501**. This number of inhabitants can increase on a small scale due to lack of exact Electoral Register as well as for the students and others who live in this area but are on Electoral Register of other municipalities. Estimates propose enlargement of this number for 5 - 10 % of total number, which would amount to 28,350inhabitants.

Table 1: Assessed number of inhabitants based on Electoral Register for 2010

Settlement	Number of inhabitants (expert assessment for 2011) in WSS			
	Number of voters for 2010 – population older than 18	Percentage of population older than 18 – assessment in %	Total population in 2010	Total population in 2010 with correction of 5 % for I.Ilidžu and 10 % for I.N.Sarajevo
Istočna Ilidža	12,830	20%	16,038	16,839
Istočno Novo Sarajevo	8,371	20%	10,464	11,510
Total:	**21,201**	**20%**	**26,501**	**28,350**

2.2.1.3 POPULATION OF GIVEN AREA THROUGH HISTORY

Present Master Plan, i.e. Feasibility Study, covers the area of three municipalities:

- Municipality of Istočno Novo Sarajevo,
- Municipality of Istočna Ilidža,
- One part of Municipality Trnovo.

Official households list, conducted in Republika Srpska in 1996, provided data on significant increase in population of the City Istočno Sarajevo (for about 25.000 inhabitants) in period 1991 – 1996, which is, mainly, due to war migration in municipalities Istočna Ilidža and Istočno Novo Sarajevo, where the population numbers, after 1991 doubled. Municipality Sokolac has experienced a small decline in population, while the population of Municipality Trnovo fell to app. 46 % of the population in 1991. Otherwise, population of the city has already in 1991, entered a phase of demographic age (average age is over 35 years).

Population of City Istočno Sarajevo is unevenly distributed. In municipalities Istočna Ilidža, Istočno Novo Sarajevo and Pale (app. 39 % of city's territory), in 2008, lived app. 75% of the total population of the city.

Population of urban settlements makes 66.55 % of total population (nearly 2/3 of the population), which makes the urbanisation rate (urban/total population) significantly above the national average of Republika Srpska.

Since 1998, all municipalities of the city Istočno Sarajevo have negative population growth. In five-year period, 2004 – 2008 average population growth on the city level is app. -3.5 ‰.

Municipalities Istočna Ilidža and Istočno Novo Sarajevo undoubtedly represent immigration area within the city of Istočno Sarajevo. This is the result of pre-war trends, as well as increased attractiveness of these municipalities, which derives from better infrastructure, public services and better employment opportunities.

Spatial plan of City of Istočno Sarajevo *developed by Institute for Urbanism of Republic of Srpska AD Banja Luka, in 2008, and which relates to population.*

Population represents basic planning parameter to align other planning solutions with. As with other planning documents that were made in last twenty years, key problem is lack of Census. Additional problem is absence of an unofficial census within municipalities, if not already conducted an official national census of population, households, dwellings and agricultural

holdings. Unofficial census would be a valuable aid not only for planners, but also for local government that could, based on census data, manage their territory more efficiently.

Therefore, the planning team made estimates based on known statistical data from various sources (Electoral Registrars, number of pupils in primary schools) that existed at the time, and municipalities were obtained reliable estimates, on the ground from local authorities. In the text on the movement of population and housing, official census data were used and the most resent data were given as estimates. Population density proved to be the best spatial indicator related to population.

Population movement trends by municipality in the scope of this Study are shown in the table below:

Table 2: Population trends by municipalities within the scope of Plan in the period 1948 – 2004

Municipality	Year							
	1948	1953	1961	1971	1981	1991	1996	2004
Istočna Ilidža	2,010	2,465	3,076	5,157	6,437	8,283	16,190	15,130
Istočno Novo Sarajevo	2,246	2,180	2,574	3,297	3,737	4,310	8,807	8,300
Trnovo	2,492	2,703	2,965	2,845	3,337	3,975	1,645	2,091
Total	**6,748**	**7,348**	**8,615**	**11,299**	**13,511**	**16,568**	**26,642**	**25,521**

The area of Kijevo that falls within the scope of this Master Plan and makes a part of Municipality Trnovo, covers the following settlements: Kijevo, Bogatići, Grab, Donja Presjenica, Jablanica, Klanac, Podivič, Ulobić. Total surface area is 64.35 km^2, with 480 inhabitants.

Table indicates that the number of inhabitants in the scope of this Plan has grown continuously since World War II. Census of households from 1996 provided the data on significant growth of population (for over 10,000 inhabitants) in period 1991 – 1996, which is mainly due to war migrations. Growth in population is evident in the area of municipalities Istočna Ilidža and Istočno Novo Sarajevo for about 1,000 inhabitants, while Municipality Trnovo experiences fall in population numbers for app. 2,300 inhabitants. Estimate from 2004 provides data on a population decline, which is due to negative growth rate and, presumably, negative migration balance. Here is, again, evident the population decline in the area of municipalities Istočna Ilidža and Istočno Novo Sarajevo, while the area of Municipality Trnovo has an increase in population. Generally speaking, the main factor affecting the population movement trends i.e. population dynamics was mechanical movement. This can be concluded by comparing annual population movement rate and annual growth rate. Growth rates are always higher than population movement rates. Negative net migration in period 1948 – 1991 caused lower rate of population growth, than it could be in terms of positive migration balance or migration balance around zero value. Simply, Sarajevo as a centre of Republic and a strong economic centre, attracted the people from its hinterland, in which present-day territory of Plan scope, along with other municipalities of City of Istočno Sarajevo, was the most significant part.

The most significant population growth in the area of City of Istočno Sarajevo had today's municipalities Istočna Ilidža (population had increased 4 times in period 1948 – 1991) and Istočno Novo Sarajevo (population increased 2 times in the period 1948 – 1991.) and Trnovo (with an exception of the period 1961 – 1971 when the stagnation is observed). Comparing 1991 and 2004, one can notice significant population growth in municipalities Istočna Ilidža and Istočno Novo Sarajevo. Municipality Trnovo recorded drastic decline in population. Reasons for these population movements by municipality are the same for the entire territory of the City. Simply, mechanical movement was the main demographic modificator in municipalities. Current number of inhabitants was mainly influenced by war migration.

2.2.1.4 NATURALPOPULATION MOVEMENT

It is known that the population trends and population dynamics are consequence of natural and mechanical (migrational) movement of population. Table below shows average of annual natural increase rate in the period 1981 – 1991 for pre-war municipalities. However, the actual

rate of the then population growth is probably, for territory of today's municipalities, slightly lower (primarily refers to the area of municipalities Istočna Ilidža, Istočni Stari Grad and Istočno Novo Sarajevo). It is estimated that the then average growth rate for today's scope of the Plan, was not lower than 8 ‰..

Table 3: Natural population increase in the pre-war municipalities in the period 1981 – 1991

Municipality	Average natural increase in the pre-war municipalities in the period 1981 - 1991
Ilidža	12.26 ‰
Novo Sarajevo	8.57 ‰
Trnovo	4.31 ‰

For the post-war period, there are reliable data on population growth rate published by Statistical Office of Republika Srpska. The following table shows rate of natural increase by municipality for period 1996 – 2004:

Table 4: Natural population increase by municipality in the period 1996 – 2003

Municipality	Natural increase by year in ‰							
	1996	1997	1998	1999	2000	2001	2002	2003
Istočna Ilidža	-0.80	0.55	-3.06	1.39	-2.48	-3.42	-1.75	-3.86
Istočno Novo Sarajevo	-2.84	-1.02	-4.71	-4.16	-6.40	-4.21	-3.76	-3.93
Trnovo	0.00	-3.34	-2.29	-8.33	-12.11	-6.67	-8.50	-5.29

Comparing pre-war and post-war period, one can notice that natural increase in all municipalities of plan coverage experienced extreme changes: from very positive in pre-war period become negative. Natural population increase for entire plan coverage is ranging from +0.23 to -3.63 ‰. Average in the post-war period is app. -2 ‰. What is worrying is that population growth is declining consistently and is getting worse year after year.

2.2.1.5 MECHANICAL POPULATION MOVEMENT

As it has been previously written, mechanical movement, or to be precise, negative net migration had the greatest impact on the population movement in an area of plan coverage. Negative net migration implies that more people leaving the area (emigration) than entering it (immigration). It is estimated that negative net migration has already been present in the period 1953 – 1961, and than a sharp deterioration in migration balance occurred, especially during the period 1971 – 1981, and subsequently in the period 1981 – 1991 a migration balance has improved. It is estimated that the average annual rate of migration balance during the period 1981 – 1991 amounted to app. -5.5 ‰ and it was significantly lower than the average rate in the period 1971 – 1981 which is estimated to be over -12 ‰. Concerning war migration, it is estimated that this area in the period 1991 – 2004 has experienced growth of app. 32.500 - 33.000 new residents, and about 22.500 former residents had left the area.

It is hard to determine the average annual rate of migration balance by municipality, primarily because of the fact that natural increase rate in pre-war period is related to pre-war municipalities. However, one can reach unquestionable conclusion that there are great differences in migration balance between municipalities. Municipality Istočna Ilidža continuously had a positive migration balance, while, on the other hand, municipalities Rogatica, Sokolac and Istočni Stari Grad continuously had negative net migration. In other municipalities, changes in migration balance were present during the entire period. Such movement of migration balance was also present in Municipality Pale, with the difference that there was a change in the period 1981 – 1991, when Municipality recorded positive migration balance of approximately 2.4 ‰. Municipality Istočno Novo Sarajevo also records positive migration balance from 1981, while Municipality Trnovo from the year 1971. In fact, by 1991, municipalities Rogatica, Sokolac and

Istočni Stari Grad were dominantly emigration area; Municipality Istočna Ilidža immigration areas, and municipalities Pale, Istočno Novo Sarajevo and Trnovo were «intermediate» areas with a trend towards immigration. Concerning settlements, despite the lack of data, certain trends can be observed in the period 1981 – 1991: municipal seats and some secondary municipality centres (Pustopolje, Podgrab, Knežina, Kaljina) and suburban settlements (Brejakovići, Novo Selo, Seljani, Plješevica, Tošići, Gornje Mladice etc.) have had positive migration balance. For the increase in population growth in the period 1991–2004, in above-mentioned 79 settlements with growth rate of over 10 %, immigration is primarily responsible (war immigration).

2.2.1.6 POPULATION PROJECTIONS

Projections of population and household of specific territory represents an important initial element in the process of spatial planning. According to number of inhabitants, other spatial components are dimensioned, such as housing funds, commercial facilities, technical and social infrastructure, etc.

Unfortunately, the results of planning Projections can only be given up to the municipal level or the zones of secondary and local centres, since there is not enough information for projections by settlements. Two basic components that influence on projections are natural and mechanical movement of population.

For the area of plan coverage, it is anticipated that mechanical movement will play major role in future population trends. Natural population increase at the beginning of time horizon would be negative, but moving toward the end of time horizon it would gradually increase and reach a value of average 1.5 – 2 ‰ at the entire area of plan coverage. Negative net balance would represent the underlying cause of stagnating trends at the beginning of the period, despite the assumption of positive migration balance. Average annual growth rate at the level of plan coverage would amount to 4.7 ‰.

Additionally, the average annual population growth rate by projections of RS Institute for Statistics by 2015 is 4 ‰.

Projection by municipality shows differences in projected population trends.

Table 5: Projected population by municipality in the scope of the Plan in the period 2004 – 2015

Municipality	Year				
	2004	2005	2007	2010	2015
Istočna Ilidža	15,130	15,206	15,350	15,582	15,897
Istočno Novo Sarajevo	8,300	8,400	8,600	8,730	8,906
Trnovo	2,091	2,090	2,092	2,122	2,187
Total	**25,521**	**25,696**	**26,042**	**26,434**	**26,990**

The highest population growth by 2015 in the area of City Istočno Sarajevo will record municipalities Pale, Istočna Ilidža, Istočno Novo Sarajevo and Trnovo (average annual rate over 4 ‰). Slightly lower growth rate are projected in municipalities Rogatica and Sokolac, while the Municipality Istočni Stari Grad will have a drop at a rate of -2.4 ‰. Concerning settlements, it is assumed that a slight population increase may occur in municipal centres, their suburban settlements, as well as in secondary municipal centres. Local centres will experience stagnation, and primary settlements a population decline.

2.2.1.7 CONCLUDING REMARKS ON POPULATION OF MUNICIPALITIES ISTOCNA ILIDŽA AND ISTOCNO NOVO SARAJEVO

So far, planning documentation has been made in various fields. In the previous text, the analysis was given, which was carried out within Spatial Plan. One can notice many inconsistencies in this material. As one of the most important is certainly the number of

inhabitants in Municipality Istočno Novo Sarajevo. According to data from Spatial Plan, current population in municipality is **8730**.

Based on data from 2010 on number of voters registered in this municipality, there are **8,371** registered voters. That means that there are 8,371 inhabitants older than eighteen. According to some research, number of inhabitants younger than eighteen makes approximately 20 % of the total population. Consequently, number of inhabitants in the Municipality Istočno Novo Sarajevo should be **10,464**. This number should be definitely corrected because of lack of exact electoral registers. In the area of Istočno Novo Sarajevo there is also a University, which means that certain number of students live here and they were not registered in the electoral register in this municipality. It is estimated that the number of inhabitants based on the electoral register should be increased by 10 %.

On the other hand, according to data from municipality, the number of inhabitants is app. **20,000**. Therefore, there are big differences in population due to various sources. Unfortunately, Census has not been taken since 1991, so that we have to estimate the population in this Study. This will certainly result in making mistakes in population estimates for the period by 2030 i.e. by 2035.

As for Istočna Ilidža Municipality, the population data obtained from electoral registers and the population data obtained from municipality match.

In Table 1: Assessed number of inhabitants based on Electoral Register for 2010, shows an estimated population in the area of these two municipalities that amounts to **28,350 - 16,839 in Istočna Ilidža Municipality and 11,510 in Istočno Novo Sarajevo Municipality**.

2.2.2 SPATIAL COVERAGE

Water Supply System Istočno Sarajevo covers a large part of municipalities Istočna Ilidža and Istočno Novo Sarajevo. Only the bordering parts of Trebevića are practically out of reach of the system. For the time being, these settlements are water supplied from local rural water systems that need recovery and reconstruction. Once reconstructed, these water systems will be connected to the urban water supply system. Existing water sources, used for water supply of these settlements, are unexplored, thus, the exploration of these sources should be carried out. After determining the yield of the sources it should be given the proposal for connecting these sources to urban water supply system. In case of insufficient yield, these sources would be used for local needs of water supply.

Water Supply System Grabski Mlini, i.e. Kijevo is today a separate system. In future, water surplus from the source Grabski mlini will be used for the needs of Water Supply System Istočno Sarajevo. Accordingly, the water system Kijevo will also fall within the scope of water supply system Istočno Sarajevo.

Water Utility Company „Vodovod i kanalizacija“ AD Istočno Sarajevo actually maintains these systems and Water Supply System of Trnova is the responsibility of the same company.

2.3 CURRENT WATER SUPPLY SYSTEM

2.3.1 WATER SUPPLY SYSTEM ISTOČNO SARAJEVO (TILAVA)

2.3.1.1 INTRODUCTION

Water system Istočno Sarajevo (Tilava), covers the part of settlements Tilava, Lukavica, Dobrinja I and IV, Donje Mladice, Gornje Mladice, Škrbino Polje, Kula, Donji Kotorac, Vojkovići and Grlica and with development of second pressure zone Kasindo, this system also covers settlements Kasindo and Pavlovac.

During the last fifteen years, significant project concerning this water system were carried out:

- construction of main distributive pipeline from Lukavica to Vojkovići (Finnish Government Project) which connected the system from Water Treatment Plant Tilava to settlement Vojkovići and
- construction of Second pressure zone Kasindo (Government of Republika Srpska and municipalities Istočno Novo Sarajevo and Istočna Ilidža).

By implementation of these two projects, Water Supply System Istočno Sarajevo has the backbone of the system, which can serve as a scope of further development of distributive network.

One chamber of unfinished reservoir Donji Kotorac is needs to be constructed and it could be connected to the system, and by doing this finish the main pipeline infrastructure of water supply system.

Water system Istočno Sarajevo has been divided into several supply zones. Main source of the system is Tyrolean water intake on the river Tilava, from where, water is transported to the Potable Water Treatment Plant Tilava. Beside this water source, wells Toplik and Topličina located in the close vicinity of Potable Water Treatment Plant are also being used for water supply.

Distributive system of WSS Istočno Sarajevo is divided into several supply zones. Potable Water Treatment Plant Tilava, along with its reservoir, covers the first pressure zone. Further, the pumping stations, propel water to higher zones. The largest is the second pressure zone Kasindo and Pavlovac (this project was finished just before completing this Feasibility Study).

The system has a number of small pumping stations for pumping water to certain settlements, as shown in Appendix 1.

MAIN FACILITIES OF THE SYSTEM ARE, AS FOLLOWS:

The First pressure zone

- Water source Tilava with water intake of capacity 150 lps,
- Transmission pipeline ø 500 mm, in length of 2,300 m, for water supply from the source to the Potable water treatment plant, (section: 0 – 1 in Conceptual solution).
- Potable water treatment plant with capacity of 180 lps and reservoir with capacity of 600 m3 with bottom level 576 m a.s.l.
- Main distribution pipeline ø 500 mm, length 2,730 m, from the facility Tilava to Tešanovo Brdo (section: 1 – 3 in Conceptual Solution).
- Distribution pipeline ø 200 mm, length 1,520 m, from the facility Tilava to Energoinvest (section: 1 - 20).
- Distribution pipeline ø 150 mm, length 600 m, from Tešanovo Brdo to Prljevo Brdo (section: 3 - 21).

- Main distribution pipeline ø 400 mm (hard polyethylene PE DN 450/397,5 mm/10 bar), length 1,857.69 m from Lukavica to Bijelo Polje (section: 3 - 5).
- Connective distribution pipeline ø 300 mm (polyethylene pipes (hard polyethylene) PE 355/313.7 mm / 10 bar), length 770.01 m, for settlement Dobrinja IV (section: 4 - 19).
- Main distribution pipeline ø 300 mm, length 1,430 m, from Dobrinja to Limara (section: 14 - 15).
- Current distribution pipeline ø 300 mm, length 1,350 m, from Donje Mladice to Gavrići (section: 5 - 8).
- Current distribution pipeline ø 200 mm, length 400 m, Škrbino polje (section: 17 - 18).
- Reservoir Donji Kotorac, volume V=2 * 5000 m3 with bottom level 565 m a.s.l, completed ca 90 %, and with its capacity exceeds the needs for planned period up to 2035. Reservoir Gornji Kotorac was built for previously planned local water system Bijela rijeka. This reservoir has not been finished yet and has no pipeline connection to the system.
- Main distribution pipeline Ø 355 mm (polyethylene pipeline (hard polyethylene) PE 355/313.7 mm/10 bar), length 1,053.82 m and pipeline Ø 323/313.48 mm, length 52.86 m, from Donji Kotorac to Vojkovići (section, 8 - 10).
- Main distribution pipelines ø 400 mm length 1,730 m and ø 300 mm, length 1,250 m, from the bridge on the river Željeznica in Vojkovići to the settlement Grlica (section: 10 – 11- 12).
- Distribution network of the settlements

The second pressure zone of Kasindo

- Pumping station Tilava 1 with capacity of Qmax=48 lps, H=45 m, P=30 kW
- Reservoir Kasindo - Križ. Required reservoir capacity 2*500 m3, with bottom level 647.18 m a.s.l. and overflow level 651.68 m a.s.l.
- Supply pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 144.87 m, from the reservoir Tilava to P.S. Tilava 1
- Pressure pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 327.15 m and PE HD main Sdr 11, NP 16 bar ø 280/229.2 mm, length 333.20 m, from P.S. Tilava 1 to the reservoir Kasindo
- Distribution pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 763.14 m and PE HD pipeline Sdr 17, NP 10 bar ø 110/96.8 mm, length 66.52 m, from the point T34 to the school
- Transmission distribution PE HD pipeline Sdr 17, NP 10 bar ø 280/246.8 mm, length 538.92 m and PE HD pipeline Sdr 17, NP 10 bar ø 180/158.6 mm, length 558.54, from R. Kasindo do R. Pavlovac
- Distribution network for settlement Kasindo, Pavlovac and the part of Škrbino Polje.

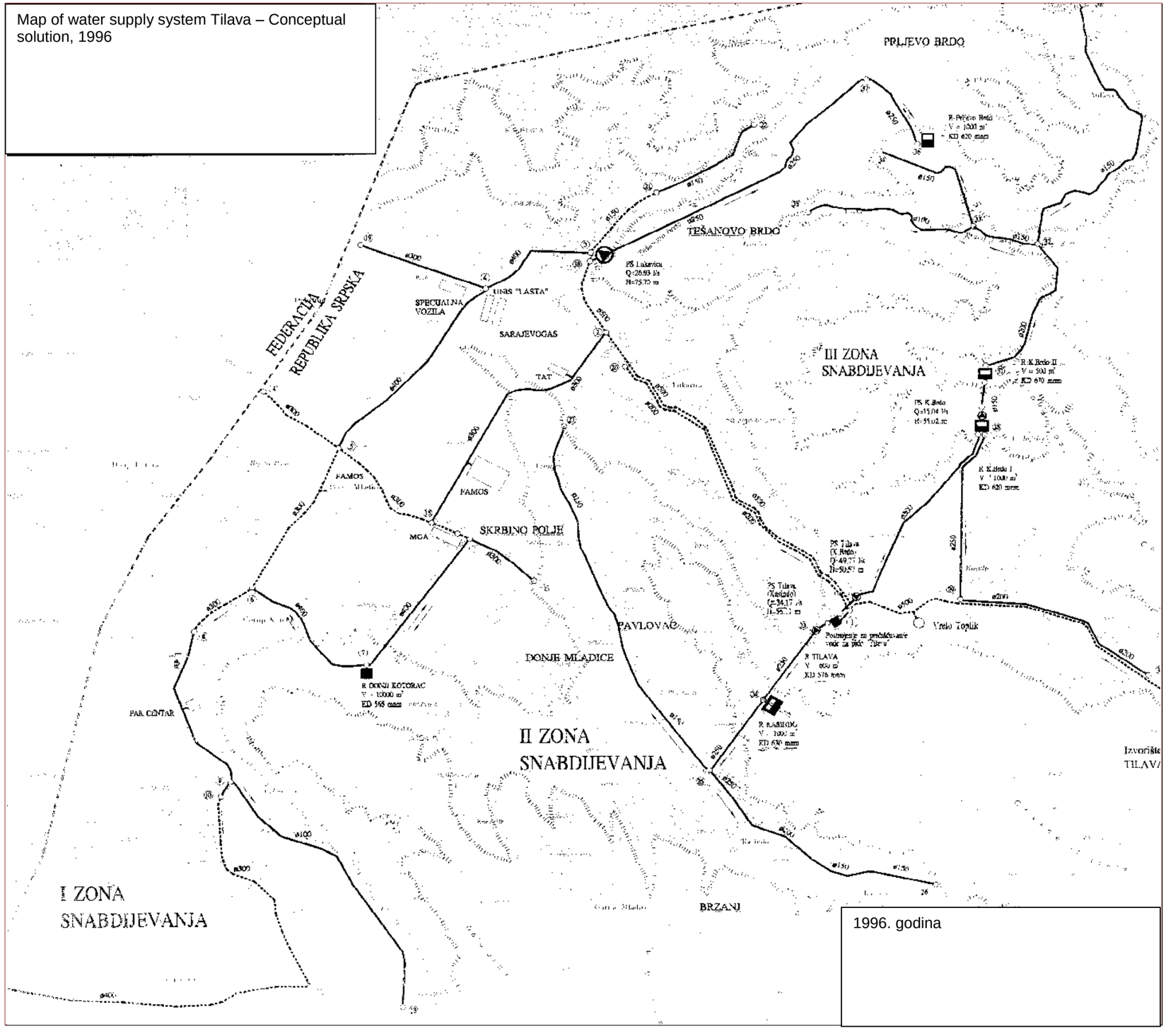
The following scheme depicts the basic facilities of water supply system.

In addition to existing facilities, the planned facilities are also presented and they will represent the backbone of future water supply system.

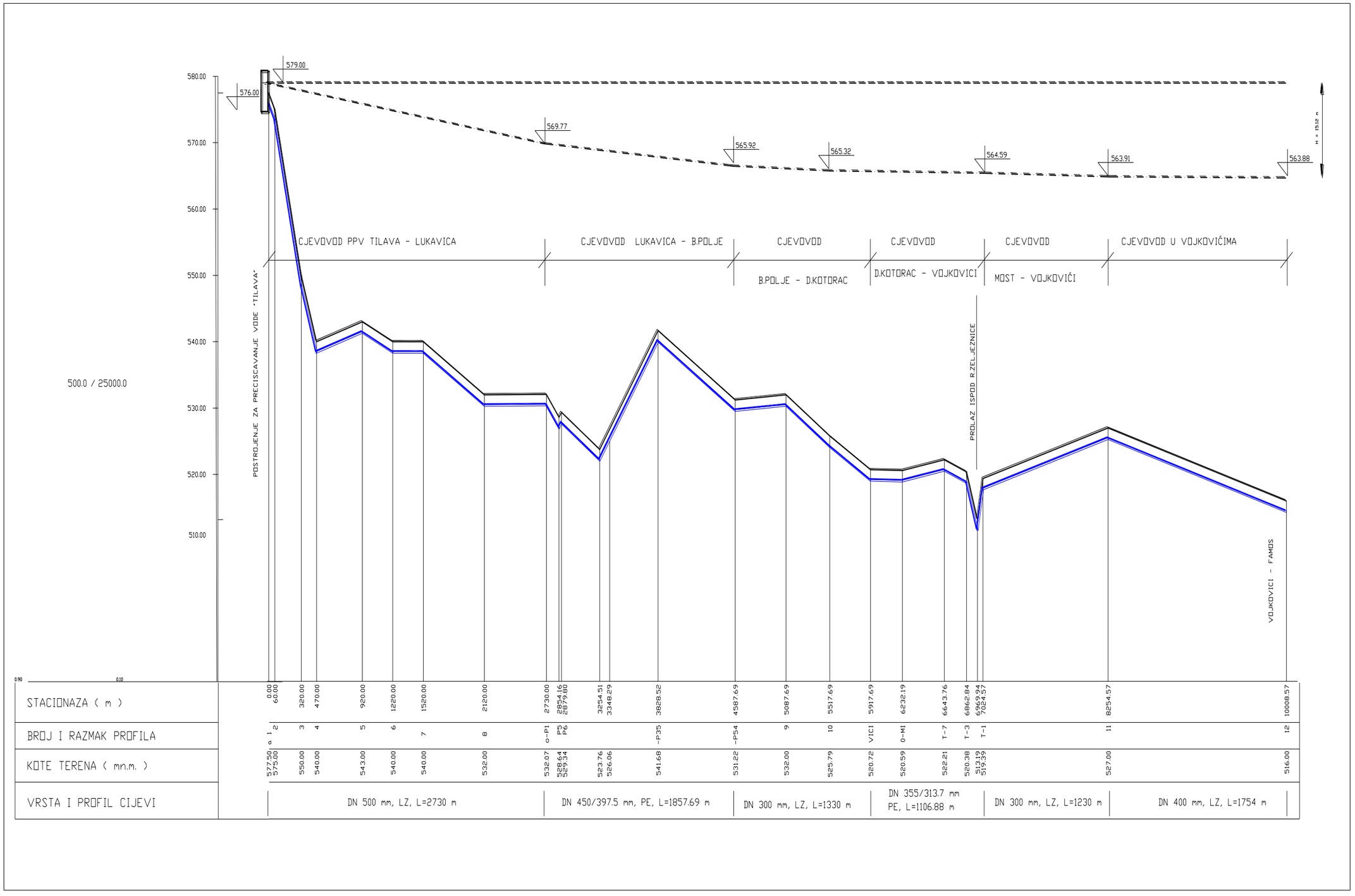
The scheme also shows a hydraulic longitudinal profile of the main transmission distribution pipeline from the Tilava Plant to Vojkovići settlement. Total length of this pipeline is around 10 km which makes a very long system. This pipeline is located (in its full length) in the first pressure zone.

Scheme 1: Planned water supply system Tilava scheme- Conceptual solution, 1996

Map of water supply system Tilava – Conceptual solution, 1996



Scheme 2: Hydraulic longitudinal profile of the main transmission distribution pipeline from Potable Water Treatment Plant Tilava to Vojkovići



Higher water supply zones in WSS Istočno Sarajevo

- An area of the system Gornje Mladice
  - Pumping station Donje Mladice
  - Pumping station Gornje Mladice
  - Pressure pipeline
  - Reservoir Gornje Mladice capacity of 120 m3,
  - Distributive network
- An area of parts of Vraca and Prljevo brdo
  - Pumping station Vraca
  - Pressure pipeline
  - Distribution network
- Remaining areas on pumping stations Ivanići, Katića brdo, Tomino brdo and Slavija
- An area of the settlement Tilava, located above Potable Water Purification Plant.

2.3.1.2 SOURCES

According to Long-term programme for supply of drinking water for population and industry of BiH (1988), water system Istočno Sarajevo is water supplied from water source Tilava.

Water source Tilava is situated south of Sarajevo X:6533711; Y:4851234; Z:585; and includes water intake of **spring Tilava, spring Toplik**. Spring Tilave is situated at the altitude of 585 m a.s.l. It is a typical karst spring with large variations in flow and water quality. **Minimal yield of the spring Tilava is 125 lps, the source Toplik and Topličina 25 lps, so the minimal yield of these springs is app. 150 lps**. Due to often and periodical intensive turbidity, in 1968 Potable Water Treatment Plant was built, with the capacity of 180 lps, and it is in use to the present day.

Figure 3: Water intake structure on the Tilava river

Still, measurements made in 2003, showed that the capacity of the source Tilava is less than 125 lps and is approximately 80 lps. This source must be under continuous observation for the risk of reduction of source yield.

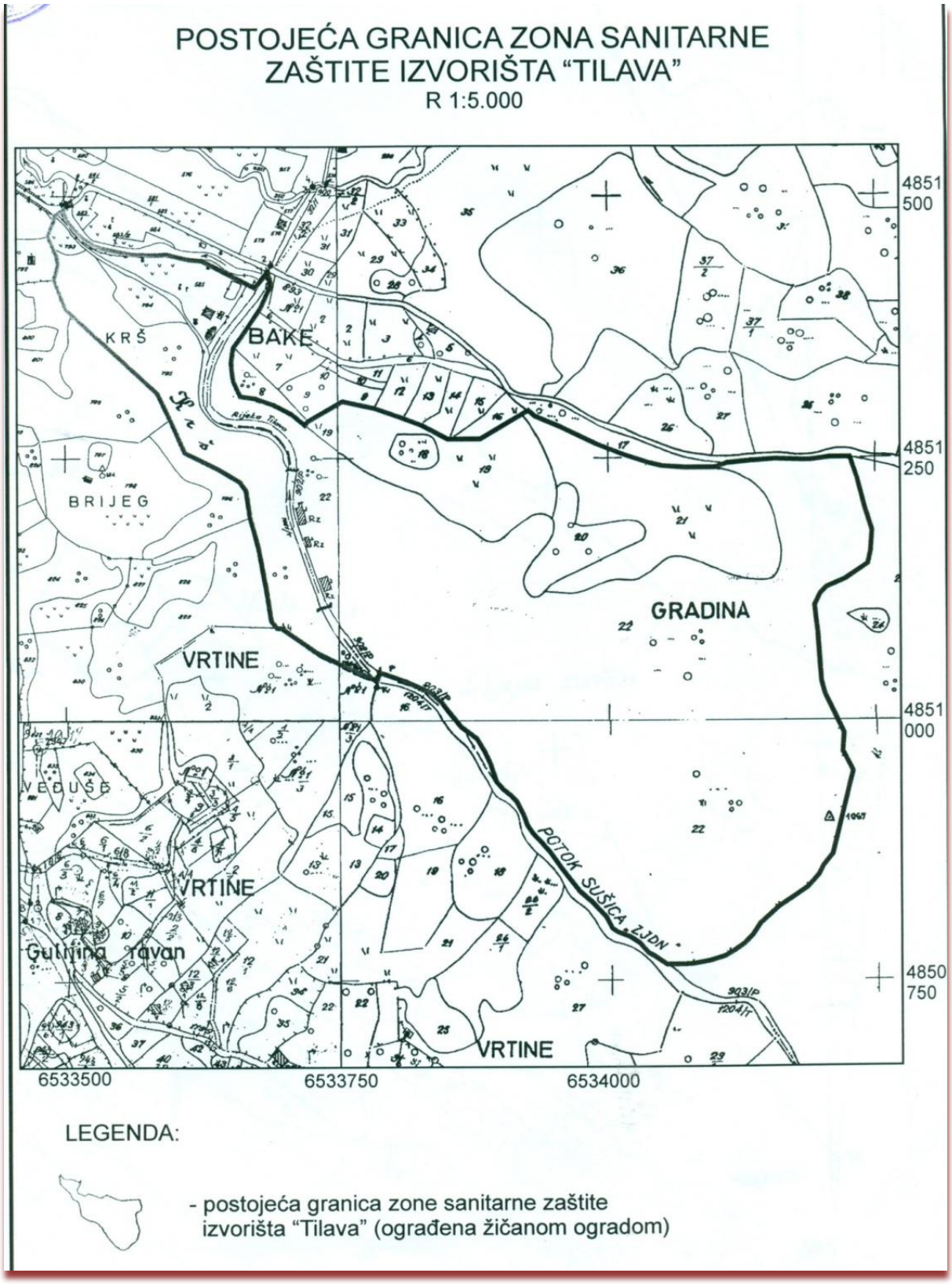
WATER QUALITY

Due to the periodic occurrence of large-scale turbidity, water quality was not within permissive values under the current laws, so the Potable water treatment plant was built in 1968. On the grounds of above-stated, besides regular water inspection, it is necessary to conduct detailed analysis with the aim of determining quality of potable water, in order to reveal possible pollution in time and respond appropriately.

In the last twenty years, the turbidity problems have been intensified due to unplanned forest cutting.

In order to protect water sources, Study for sanitary protection zones of water sources was developed.

Scheme 3: Scope of the water protection zone for the source



The Source Tilava Water Protection Study was drafted in 2008 while the Source Ljuštra and Grabski mlin Water Protection Study was drafted in 2009. Protection zones have been made in line

with Regulations on protection measures, the manner of determining and maintaining zones and areas of sanitary protection and corresponding sources, as well as the water facilities and water intended for human consumption (Republic of Srpska Official Gazette No. 7/03). Sanitary Water Source Protection Program of "Tilava" was adopted by the Municipal Assembly of Istočno Novo Sarajevo on 13 Nov 2009 (No.:01-022-46-1/09). Sanitary Water Source Protection Program of Ljuštra and Grabski mlin was drafted in accordance with terms of reference (Decision No: 02-014-86/09 of 15 June 2009).

Monitoring of potable water quality is performed at the source Tilava and at the exit behind the Water treatment plant "Tilava" through 72 testings with 9 samples each. Physic-chemical parameters that are being monitored are: smell, taste, temperature, colour, turbidity, pH, KMnO4 consumption, evaporation, el. conductivity, ammonia (NH3), residual chlorine, chloride (Cl), nitrite (NO2), nitrate (NO3), iron(Fe), manganese (Mn). Microbiological parameters that are monitored are: total number of aero mesophilic bacteria in 100 ml, total number of coliform bacteria in 100 ml, coliform bacteria of faecal origin in 100 ml, streptococci of faecal origin in 100 ml, sulphite reducing cloctridia in 100 ml, proteus species in 100 ml, Pseudomonas aeruginosa in 100 ml, isolated bacteria identified as.

The Appendix gives the analysis of water quality at this source.

2.3.1.3 TILAVA POTABLEWATER CONDITIONING PLANT

The plant is situated one kilometre from the water source, with the capacity of 180 lps. Treatment system includes sedimentation with coagulation, filtration and water chlorination.

During periods when source yield is lower than 180 lps, the plant is water supplied from water sources Toplik.

Within the plant, there is a reservoir for clean water with volume of 600 m3 with bottom level 576 m a.s.l.

For washing filters, a reservoir with capacity of 190 m3 was built next to the plant and it is connected with water source Toplik.

Figure 4: Potable water treatment plant Tilava – sedimentation tank andFigure 5: Potable water treatment plant Tilava – washing out of sedimentation tankshows a part of Potable water treatment plant Tilava.

Figure 4: Potable water treatment plant Tilava – sedimentation tank

Figure 5: Potable water treatment plant Tilava – washing out of sedimentation tank

2.3.1.4 PUMPING STATIONS

In water supply system Istočno Sarajevo (Tilava) there are several pumping stations.

Pumping stations Tilava and Toplik were set for the needs of the water treatment plant and the water source itself.

Pumping stations Vraca and Ivanići are connected to the Tilava system.

Pumping station Dom Zdravlje - Pavlovac water supplies the inhabitants of second pressure zone via reservoir Pavlovac. This pumping station will be closed after the construction of second pressure zone Kasindo.

Pumping station Tilava I – Kasindo water supplies the second pressure zone Kasindo. The reservoir Križ is being filled via PS.

Besides pumping stations, which are used for water production and pumping station Tilava - Kasindo, other pumping stations have the low capacity and provide water supply of small number of users in higher pressure zones.

Table 6: Pumping station and pump types provides an overview of pumping stations and the type of pumps that are being set.

Table 6: Pumping station and pump types

Pumping station	Location	Number of pumps (pcs)	Type of Pumps	Pump power (kW)	Capacity (l/s)	Water raising level (m)
Source Tilava	X:6533711; Y:4851234; Z:585;	1	Jastrebac	3,0	1.4-3.6 l/s	46/47-25
		1	italian	1,5	1,1 - 5,55 l/s	46/47-25
Toplik	X:6532134; Y:4851797; Z:561.5;	1	Vogel – CN65-200/220	22,0	35 l/s	62,00
		1	Vogel – CN65-200/220	22,0	35 l/s	62,00
Tilava I - Kasindo	X:6531720; Y:4851780; Z:563,84;	1	Grundfos CR 90-40-2	24,2	25,00	76,00
		1	Grundfos CR 90-40-2	24,2	25,00	76,00
		1	Grundfos CR 90-40-2	24,2	25,00	76,00
Tomino brdo	X:6532709; Y:4852203;	1			0,55 - 2,75 l/s	108,00
Katića brdo	X:6531994; Y:4851906; Z:584;	2			0,83 - 2,58 l/s	70/30
Ivanići	X:6531208; Y:4853426; Z:554;	1	Vogel – SV416F30T	3,0	2,22 l/s	136,00
		1	Vogel – SV416F30T	3,0	2,22 l/s	136,00
Slavija	X:6530537; Y:4853956; Z:544;	2	Calpeda NMD20/140AE	7,5	0,28 - 1,3 l/s / 1,67 l/s	64.5/67
Vraca	X:6531295; Y:4854600; Z:550.5;	2	Elektrokovina VCV-250/5T		0,28 - 1,2 l/s / 0,83 - 2,58 l/s	64.5/70
Pavlovac	X:6529640; Y:4853383; Z:541;	1	Espa– VE121-10	15,0	0,83 - 8,33 l/s	72-172
		1	Espa– VE121-10	15,0	0,83 - 8,33 l/s	72-172
Gornje Mladice	X:6530337; Y:4851112; Z:567.1;	2	Willo MVI814-2P1V/3-400-50-2	5,5	1.86 l/s	168,00
Gornje Mladice buster	X:6530468; Y:4849882; Z:693.9;	1	Willo MVI207-1/16/E/3-400-50-2/EC/B	1,1		/
Donje Mladice - frequent	X:6530154; Y:4851736; Z:544.5;	2	Willo MVIE 3203-7,5-3/16/E/3-2	7,5		/
Gornji Kotorac	X:6528809; Y:4851619; Z:566.3;	1	ESPA-Multi 204	1,1	0,17-0,85 l/s	51,50
Naklo	X:6528462; Y:4849572; Z:536;	1				

2.3.1.5 RESERVOIRS

Within the plant there is also clean **water reservoir** with a capacity of **V=600 m^3** with bottom level 576 m a.s.l. This reservoir is the only one in distribution system of the first pressure zone of Tilava water system.

Reservoir Pavlovac was built for the second pressure zone of water supply on the Pavlovac hill. The bottom level of reservoir is 614 m a.s.l. with a capacity of V=180 m^3. It consists of two chambers with volume of 100 m^3 and 80 m^3.

During 2010, the construction of **reservoir „Križ"** was finished. It is situated above Kasindo at an elevation of 630 m a.s.l. and it was built within the second pressure zone Tilava – Kasindo. Reservoir has volume of **V=1,000 m^3** and it is the largest reservoir at the moment. This reservoir should have a very good effect on stabile operation of the system.

Reservoir Gornji Kotorac with volume of 10.000 m^3, and bottom level of 565 m a.s.l, was built just before the war, to become a part of Bijela rijeka water system. It is out of service and incomplete, in spite of the fact that it meets the needs during planned period by 2035. With its elevation and disposition, it fits fairly into new water system Tilava.

For II pressure zone on a hill **Prljevo brdo,** the reservoir was constructed, with capacity of **V=1.00 m^3**.

To meet the hospital needs, a **Hospital reservoir** was built, with volume of **V=100 m^3**and bottom level of 642 m a.s.l. This reservoir for the time being has not been included into city water supply system.

The following table gives an overview of existing reservoirs.

Table 7: Existing reservoirs in WSS Istočno Sarajevo

Reservoir	Pressure zone	Bottom level (m a.s.l.)	Volume (m^3)
Tilava – water treatment plant	I pressure zone	576.00	600.00
Pavlovac - II pressure zone	II pressure zone	614.00	180.00
Gornje Mladice	II pressure zone		100.00
Kasindo - Bolnica	II pressure zone	642.00	100.00
Križ - Kasindo	II pressure zone	630.00	1,000.00
Total:			**1,980.00**

2.3.1.6 TRANSMISSION SYSTEM

For water transmission from the source of water intake Tilava to Potable Water Treatment Plant Tilava, the pipeline was made, of ∅ 500 mm, in length of 2,300.00 m.

Transmission, pressure pipeline for the second pressure zone Kasindo was also made:

- Supply pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 144.87 m, from reservoir Tilav to P.S. Tilava 1
- Pressure pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 327.15 m and PE HD pipeline Sdr 11, NP 16 bar ø 280/229.2 mm, length 333.20 m, from P.S. Tilava 1 to reservoir Kasindo

2.3.1.7 DISTRIBUTION NETWORK

Distribution network of water system Tilava did not follow the development of this region. Main problem of the distribution system was the fact that it was disconnected after signing of The Dayton Peace Agreement. Part of the system, which remained in Republika Srpska, had insufficiently developed distribution network, with certain area's parts still connected to water

system Sarajevo (FBiH). With the help of Finnish Government Donation, main distribution mains were built, which connected the system from Tilave to Vojkovići.

Distribution system is divided into three pressure zones. First pressure zone covers an area up to the elevation of 550 m a.s.l. and this system is relatively well covered with distribution pipelines. However, both, the second and the third pressure zones are only partially covered with this system. For the time being, the second pressure zone which covers Kasindo and Pavlovac has been completed.

In chapter ***2.7 Rehabilitation of water supply system in municipalities Istočna Ilidža and Istočno Novo*** Sarajevo, details of zoning and development plans for the system were described.

The following tables show an overview of distribution and transmission pipelines.

Table 8: Distribution and transmission pipelines of the first pressure zone

Section	Pipeline diameter (mm)	Pipeline length (m)	Pipeline
0 - 1	500	2,300.00	Transmission pipeline
II pressure zone Kasindo	250	800.00	
Transmission pipelines total:		*3,100.00*	
1 - 3	500	2,730.00	Main distribution pipelines of First pressure zone
1 - 20	200	1,520.00	
3 - 21	150	600.00	
14 - 15	300	1,430.00	
5 - 8	300	1,350.00	
10 - 11	300	1,250.00	
11 - 12	400	1,730.00	
3 - 5	400	1,900.00	
8 - 10	300	1,100.00	
4 - 19	300	850.00	
17 - 18	300	400.00	
Main distribution mains in reservoir zone "Križ" - settlement Kasindo - section 1 - 25	250	760.00	Distribution Water Pipelines of Second pressure zone Kasindo
	250	540.00	
	150	560.00	
	100	70.00	
Distribution water mains total:		*16,790.00*	
Pipelines of 80 to 200 mm in I pressure zone		70,840.00	Secondary distribution pipelines
Distribution pipelines in II pressure zone Kasindo		3,200.00	
Distribution pipelines total:		*74,040.00*	
Grand Total Distribution and transmission pipelines:		**93.930,00**	

Total length of **transmission pipelines is3,100 m**. Total length of **main distribution mains is 16,790.00 m**. Total length of **secondary distribution pipelines is 74,040 m**. **Total length** of all pipelines is **93,930 m**.

Participation of secondary distribution pipelines is 78.90 %. These pipelines have a diameter of Ø 80 mm to Ø 200 mm.

Table 9: Diameter of distribution and transmission pipelines

Pipeline diameter (mm)	Pipeline length (m)	Percentage by profiles
150.00	1,160.00	1.23
200.00	1,520.00	1.62
250.00	2,100.00	2.24
300.00	6,380.00	6.79
400.00	3,630.00	3.86
500.00	5,030.00	5.36
of 80 to 200 mm	74,110.00	78.90
Total:	**93,930.00**	**100.00**

Big problem of water system Tilava is lack of cadastre of underground installations. Water system is drawn in AUTOCAD on the scanned maps. These maps are quite well, still, pipelines built before 1991 has not got geodetic surveying maps. There are 380 hydrants built in the system, but its validity is questionable. According to water utility company data, about 23,000 inhabitants are connected to the system, with over 3,867 connections. Specific water consumption, compared to the amount of produced water, is rather high - 365 l/inhabitants per day (it also includes water losses in the system).

There are 5,271 water meters in the system. Lump sum water meter reading is conducted on 1,353 connections. Current water meters are working properly and their calibration is regular, so the readings can be taken with great certainty.

2.3.2 WATERSUPPLY SYSTEM OF KASINDO SETTLEMENT

In Water Supply System of Kasindo area, water system designed for the needs of the hospital Kasindo was firstly constructed. Water intake structure and pumping station were built on the right bank of Kasindo stream, above the Kasindo hospital, with capacity of ca 3.00 lps, than the reservoir with capacity of 10 m3, pressure pipeline pumping station – reservoir of ø 80 mm, with length of 200 m and distribution pipeline of ø 100 mm with length of 600 m.

With the development of hospital in Kasindo, existing water system becomes insufficient to the needs arising, so the reconstruction was carried out. New source "Vrelo" was tapped with yield of 5 lps, a new reservoir of capacity 100 m3 was constructed and, instead of pump, gravitational water supply was implemented.

Immediately after reconstruction of hospital's water system, in 1975, the hospital submitted it to the management of M.Z. Kasindo existing water system, which developed further in an area of Local community, and its water supplies the inhabitants of Kasindo area.

After the construction of Second pressure zone Kasindo, in 2010, this **system was connected to Urban Water Supply System**. It is uncertain whether the Kasindo hospital will remain detached from urban system or it will be connected.

SOURCE KASINDO

Water intake structure and pumping station of the source of Kasindo settlement are situated on the right bank in inundation of Kasindo Stream (Kasindolski potok), and it has no established source protection zone, and is subjected to flooding of Kasindo stream. Due to poor sanitary protection of the source, this source is not included in balance.

New source Vrelo of hospital water system is abstracted in the basin of Kasindolski potok upstream from the hospital at the distance of ca 5,000 m. In this source, it is possible to establish protection zone and its water suits the demands prescribed for potable water, so the source Vrelo is included in water balance. Minimal capacity of the source is 5 lps.

Water quality

Water quality in this source is in line with values and water quality standards of applicable laws, and consequently, only water chlorination is carried out, as prevention.

2.3.3 WATERSUPPLY OF THE SETTLEMENTS ON THE SLOPES OF TREBEVIĆA

In the area of slops of Trebević there are following settlements, which are water supplied via water supply system Jahorina (Prača), WSS Federal Sarajevo and some smaller local water systems:

- **settlement Vraca** is connected to Water System Sarajevo (FBiH);
- **settlements Miljevići, Petrovići** and other, are water supplied from Jahorina system via Babe Reservoir.
- smaller settlements from Petrovici to Tvrdimici which are supplied with water via several smaller sources.

2.3.3.1 INTRODUCTION

Municipality Istočno Novo Sarajevo consists of local communities that was part of pre-war municipality: Lukavica, Pavlovac, Tilava, Toplik, part of local communities Vraca and Gornji Kovačići, (urban settlements) and settlements on Trebević - Tvrdimići, Petrovići, Miljevići, Klek, Kozarevići...

Municipality is mainly supplied from Water Supply System Tilava. Eastern part that is comprised of local communities Tilava, Toplik, part of local communities Vraca and Gornji Kovačići, (urban settlements) and settlements on Trebević - Tvrdimići, Petrovići, Miljevići, Klek, Kozarevići and others, are not connected to Water System Tilava. These settlements are situated at an elevation between 550 m a.s.l. and 850 m a.s.l, so gravity water supply of these settlements from Water Supply System Tilava is not possible. This is the reason why these settlements, even in pre-war period were not water supplied from Tilava, than from other parts of Water System Sarajevo that could provide water pressure in pipelines.

2.3.3.2 WATER SUPPLY OF SETTLEMENTS VRACA AND PRLJEVO BRDO

Parts of settlements Vraca and Kovačići are water supplied from **Water Supply System Sarajevo** that belongs to Sarajevo Canton, Federation BiH. The System consists of pipelines laid along the road which leads to Vrace and further to Sarajevo. This part of the settlement is out of reach of PS Vraca.

Other part of Vraca is water supplied from Water System Tilava via **pumping stationVraca** that is situated at the elevation of 550 m a.s.l. Through this pumping station, water is pumped towards Vrace and the settlement Prljevo brdo. Quantity of pumped water is approximately **Q_{sr}=0.80 lps**.

PS Vraca

PS Vraca is an aboveground facility situated in VRP street, at the first entrance to the streets Njegoševa and Beogradska.

In PS Vraca, the pumps of ESPA Type with following nominal characteristics are installed:

- P1 „Multi 20-5“ Q (l/min) 17 – 72

	H (m)	64.5 – 30
	Hmax (m)	68
- P2 „Multi 30-6“	Q (l/min)	50 – 155
	H (m)	75 – 30
	Hmax (m)	83

Appendices give an overview of Water Supply System Tilava, along with water system of settlements Vraca, Kovačići and Prljevo brdo.

Chart 9: PS Vraca – Water Quantityshows data concerning measured water quantities pumped via this pump.

2.3.3.3 WATER SUPPLY OF SETTLEMENTS MILJEVIĆI, PETROVIĆI AND OTHER

Settlements Miljevići, Petrovići, Kozarevići are situated at an elevation between 600 m a.s.l. and 800 m a.s.l. Elevation of Potable Water Treatment Plant Tilava and Tilava reservoir is 576 m a.s.l. Due to this altitude differences solution to water supply of these settlements is oriented toward Jahorina Water System.

Water System of Jahorina's springs Prača, Vlahovići, Stanića vrelo water supplied in pre-war period, settlements and hotels on mountains Jahorina and Trebević, along with higher zones of Sarajevo. During the last few years, this system was connected to water system Pale, so certain amount of its water also supplies Pale. Part of this water is still going to the Federal part of Sarajevo.

As a last stage of Jahorina Water System, a reservoir Baba (Zlatište) was constructed located at the elevation of 824.40 m a.s.l. Volume of this reservoir is V=500 m^3. From reservoir Baba water is transported by pipeline of Ø 150 mm towards the node, which is located above break-pressure chamber Projište. From this junction onwards two pipelines branch out:

- the one that goes towards the settlement and reservoir Kozarevići with bottom level of 700.50 m a.s.l. and further toward manhole from where water is transported toward settlement Petrovići and
- other branch toward pressure relief chamber Projište located at the elevation of 767.14 m a.s.l..

From pressure relief chamber Projište water is transported to pressure relief chamber Petrušići which is located at the elevation of 679.60 m a.s.l. From this pressure relief chamber, water is distributed to settlement Miljevići.

In the settlement Miljevići there is also water source Tomića vrelo with capacity of approx. Q=2.00 lps. At the spring, the pumping station PS „Tomića vrelo“ was installed which is used to pump water into distribution system Miljevići.

According to measurements that were carried out on 28/29 July 2005, water quantity injected into the system was Qsr**=1.09 lps**.

In the following text and tables are given individual parts of water supply system.

PS Tomića vrelo

PS „Tomića vrelo“, located in the settlement Donji Miljevići, is a built above ground facility, equipped with three pumps with the nominal characteristics:

- Vogel	Type SV 411 F 22 T	Q (l/min)	0 – 135
		H (m)	110 – 30

Currently, PS operates with three pumps in function with approximately 2 lps at pressure pipeline, depending on the network and discharge pressure which ranges from 8.2 – 8.9 bar.

Table 12: Springs and reservoirs on the hillside area of Trebevićshows measurements of water quantity injected into distribution system via this pumping station. This chart was designed on 28/29 July 2005.

Water quality at the spring is satisfactory.

Table 10: Reservoirs in WSS Baba (Zlatište)

Reservoir	Pressure zone	Bottom level (m a.s.l.)	Volume (m^3)
Baba (Zlatište)	VI pressure zone	824.40	500.00
R.K. Projište	VI pressure zone	767.14	50.00
Reservoir Kozarevići	VI pressure zone	700.50	50.00
R.K. Petrušići	III pressure zone	679.60	20.00
Total:			**620.00**

There is also Stanojevićs' reservoir that is not in use.

Table 11: Existing pipelines WSS Baba (Zlatište)

Section	Pipeline diameter (mm)	Pipeline length (m)
Reservoir Baba - PK Projište	150	1.840,00
PK Projište – Junction in Kozarevićima	150	1.432,00
Junction in Kozarevićima – Manhole for Petrovići	150	360,00
PK Projište - PK Petrušići	80	1.100,00
Distribution network	80	5.000,00
Total:		**9732,00**

Total length of the **pipeline** is approximately **10 km**. Current pipelines mainly do not satisfy demands of the diameter and it is necessary to examine its quality.

2.3.3.4 WATERSUPPLY OF THE SETTLEMENTS NOT COVERED BY URBAN WATER SUPPLY SYSTEMS

One part of population is water supplied from local water systems. The text below gives short descriptions of the systems.

WATER SUPPLY SYSTEM DOBRIK AND STUDENAC

Water sources Dobrik and Studenac are used for water supply, but there are no data on springs' yield. Water is transported from these sources to the reservoirs:

- Podstrana, with volume of V=50 m^3 located at the elevation of 823 m a.s.l. This reservoir water supplies 127 households or approx. 350 inhabitants. From this reservoir, water is transported to the following reservoirs:
  - Igrišta, volume of V=20 m^3 located at the elevation of .....m a.s.l. This reservoir water supplies 16 households or approx. 50 inhabitants.
  - Izlazine, volume of V=46 m^3 located at the elevation of 778.2 m a.s.l. This reservoir water supplies 80 households or approx. 240 inhabitants.
- Dobrik, with volume of V=46 m^3 located at the elevation of 900 m a.s.l. This reservoir water supplies 80 households or approx. 240 inhabitants.

Total reservoir volume is V=162 m^3. The system is connected to 303 households, and approx. 880 inhabitants are water supplied from this system.

Data on sources and reservoirs are given in Table 12: Springs and reservoirs on the hillside area of Trebević.

From **the source Dobrik** transmission pipeline leads to **the source Studenac** and than, water is sent via transmission pipeline to **reservoir Podstrana**. From reservoir Podstrana water is transported to **reservoir Izlazine (Logor)** and **reservoir Igrišta**. Each of these three reservoirs has its own distribution system. Taking into account elevation of these reservoirs, it can be noticed that the system is divided, via the three reservoirs, into three pressure zones of water supply. There are no precise data on pipelines. It is estimated that these pipelines have small diameter and they should be restored in the future.

In this area is also located the source Sušica (Grčko vrelo) that is under the concession, but given that this source so far is not in use, or not being exploited, it should be considered whether it is possible to use this source in the future for water supply of these settlements.

SOURCE TRVRDIMIĆI (VOJNO VRELO)

For settlement Tvrdimići, water is abstracted from Vojno vrelo. As well for the other sources, we have no water yield data. However, according to information from local residents, capacity of this spring is greater than the needs of settlement Tvrdimići. There are no data on these pipeline, but it is presumed that these are a small diameter pipelines which should be restored and, in the future, replace them with the pipelines of larger diameter.

SOURCE STUDENAC (MILINKOVIĆI)

This source is located above the settlement Tilave. There are no data on the source capacity.

The following Figures show water sources and reservoirs.

Figure 6: Source Studenac (Milinkovići)

Figure 7: Source Dobrik

Figure 8: Reservoir Igrišta

Figure 9: Reservoir Podstrana

Figure 10: Source Sušica

Figure 11: Source Studenac (Petrovići)

Figure 12: Tvrdimići – Vojno vrelo

Table 12: Springs and reservoirs on the hillside area of Trebević

Springs at the hillside area of Trebević				
Water Source Name	**Elevation and water source coordinate**	**Number of Households in the source zone**	**Capture structure volume (m^3)**	**Note**
Tvrdimići (Vojno vrelo)	X: 6536944,6; Y: 4848412, 2; Z: 1064,7			
Sušica (Grčko vrelo)	X: 6535945,5; Y: 4850298, 6; Z: 739,6			Source is under the concession
Studenac (Milinkovići)	X: 6533895,1; Y: 4850688,7; Z: 657,1			
Dobrik spring	X: 6536282,2; Y: 4851462,1; Z: 1006,7	303		Tapped and in function
Studenac (Terezija)	X: 6536150,9; Y: 4851405,5; Z: 968,6			Tapped and in function
Reservoirs at the hillside area of Trebević				
Reservoir Name	**Elevation and reservoir coordinate**	**Number of Households in the reservoir zone**	**Volume (m^3)**	**Note**
Podstrana	X: 6535716,3; Y: 4851203,7; Z: 823	127	50,0	Two chambers V=30+20 m^3
Izlazine (Logor)	X: 6535212,8; Y: 4851393,8; Z: 778,2	80	46,0	
Reservoir Dobrik	Z: 900 m.a.s.l.	80	46,0	
Reservoir Igrišta		16	20,0	
Total:		**303**	**162,0**	

2.3.4 WATER SUPPLY SYSTEM GRABSKI MLINI

This water supply system belongs to Trnovo municipality, RS. However, due to the amount of water that could be introduced in WSS Tilava, this water supply system was also considered in our Study.

In an area of settlement Kijevo, population, part of economy and other users are water supplied via autonomous Water Supply System Grabski mlini as well as number of local rural water supply systems and individual local water systems for water supply of small number of individual facilities.

2.3.4.1 SOURCE GRABSKI MLINI

Main source for water supply in WSS Kijevo is water source Grabski mlini, X:6535120; Y:4842160; Z:730.

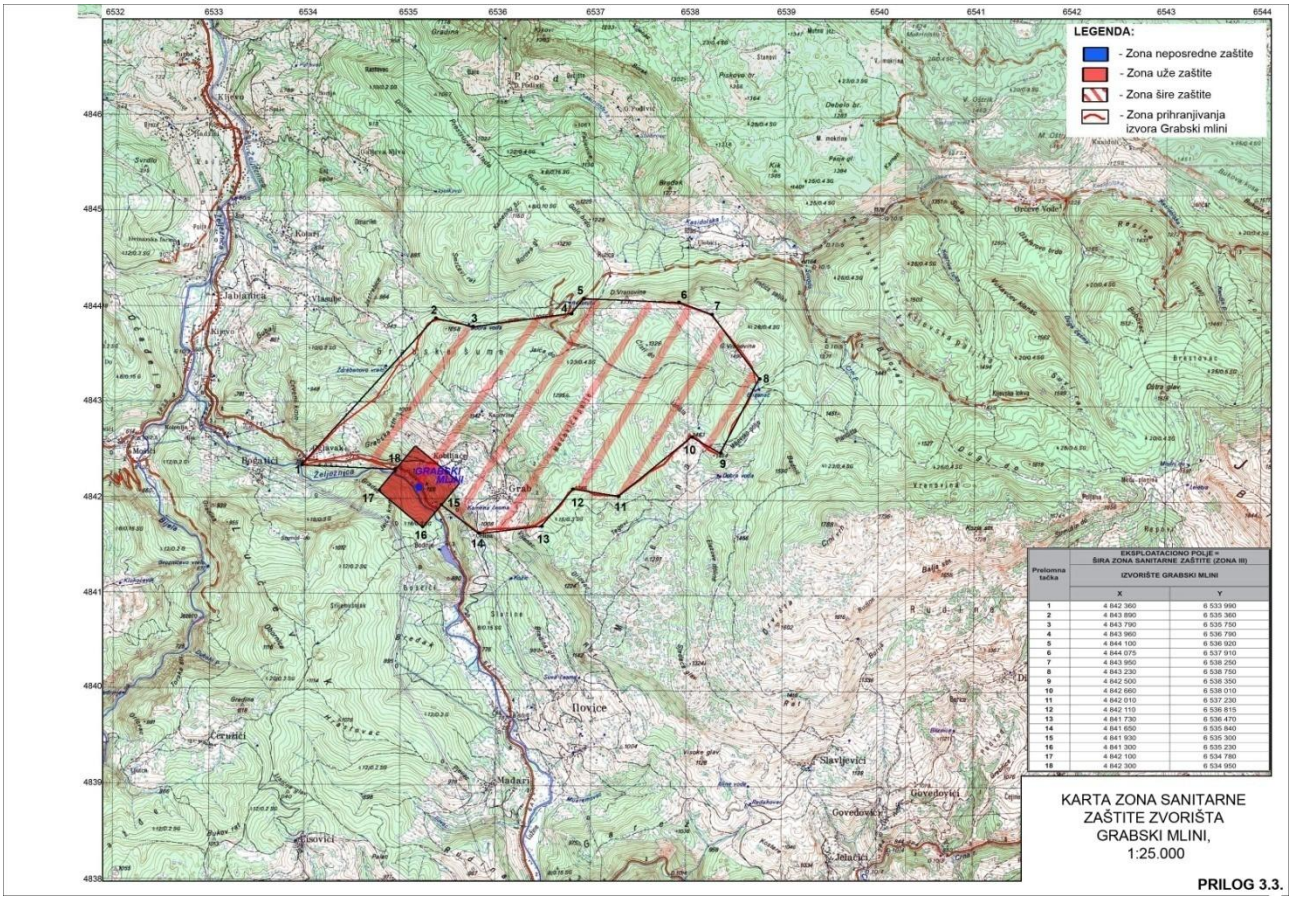
For the needs of construction site and the construction of accumulation Bijela rijeka, upstream of Kijevo, in 1987, water supply is ensured via reaching water from the source Grabski mlini with maximum spring yield capacity of ca 45 lps for the return period of 1/20 years. Minimum spring yield for return period of 1/20 years is 25 lps. Bottom level of the spring is 720 m a.s.l. There is also a water chamber with volume of V=2 m3.

There are no measurements of water quantities.

The protection of Narrow Protection Zone was carried out.

This source is included in water requirements balance of Water Supply System Tilava (Istočno Sarajevo) for planning period from 20 to 25 years.

Scheme 4: Scope of water source protection zone for Grabski mlin



Study on Grabski mlini source water protection was drafted in 2009 under the Terms of reference (Decision No.: 02-014-86/09 of 15 June 2009). Protection zones have been made under the Book of Rules on protection measures, the manner of determining and maintaining zones and sanitary protection area corresponding to the source, as well as water facilities and water intended for human consumption (Republic of Srpska Official Gazette No. 7/03). Appendix 1 gives the location/scope of water protection zone for the source Grabski mlini.

WATER QUALITY

Water quality of this source is in accordance with water quality standards for drinking water, thus, in terms of prevention, only water chlorination is being carried out.

The appendix gives analysis of water quality at this source.

2.3.4.2 TRANSMISSION PIPELINES

Transmission pipeline is constructed of the pipeline with diameter of Ø 200 - 100 mm made of steel pipe and asbestos cement pipes. Capacity of transmission pipeline is Q=45 lps.

Table 13: Transmission pipelines – WSS Grabski mlini provides data on transmission pipelines in water supply system Grabski mlini – Kijevo.

Table 13: Transmission pipelines – WSS Grabski mlini

Pipeline Diameter (mm)	Pipeline Length (m)
transmission	6,000.00
Total:	**6,000.00**

2.3.4.3 DISTRIBUTION PIPELINES

A branched type distribution network has 85 facilities connected to the pipelines. There are estimates of very high water losses in the pipeline.

Following table shows data on the distribution pipelines.

Table 14: Distribution pipelines – WSS Grabski mlini

Pipeline diameter (mm)	Pipeline length (m)	Percentage by diameter
to 100 mm	1.000,00	17%
100-200 mm ACC	4.500,00	75%
100-200 mm steel	500,00	8%
Total:	**6.000,00**	**100%**

Total length of pipelines in the system is ca 12 km.

2.3.4.4 RESERVOIRS

WSS Grabski mlini has two reservoirs with the following characteristics.

Table 15: Reservoirs in WSS Grabski mlini

Reservoir	Pressure zone	Bottom level (m.a.s.l.)	Volume (m^3)
Kijevo - Jablanica	Grabski mlini	662,00/665,00	100,00
Kijevo - Hadžići	Grabski mlini	658,00/661,00	100,00
	Total:		**200,00**

2.4 DATA ON CONSUMERS, PRODUCTION AND WATER CONSUMPTION IN WSS TILAVA

2.4.1 CONSUMERS, PRODUCTION OF WATER AND WATER CONSUMPTION FOR WATER SUPPLY SYSTEMS MANAGED BY VODOVOD I KANALIZACIJA LTD ISTOČNO SARAJEVO

According to data obtained from water utility company, there is total of **8,492 connections** in all water supply systems which are under control of this company – WSS Tilava, slopes of Trebević, Ljuštra (Trnovo) and Grabski mlini, and types of connections are given in the table below.

According to the abovementioned number of connections, it was estimated the number of inhabitants using these system services and it makes **28,043 inhabitants**.

Table 16: Connections to WSS Tilava, hillside area of Trebević, Ljuštra and Grabski mlini

Consumer type	Number of Connection	Population -users
Individual consumers	7.158	19.970
Collective residential units	378	8.073
Industrial and commercial consumers	956	
Total:	**8.492**	**28.043**
Number of water meters	7.726	
Number of lump sum consumers	766	

Total amount of revenue water in 2010 was **V=1,882,782.31 m^3**, and following table gives an overview of revenue water amount by consumer type. Average specific consumption of population without economy and losses was **q_{sp}=132 l per capita per day**. Average specific consumption of population including economy is **q_{sp}=183.9 l per capita per day.**

Table 17: Revenue water quantity and specific consumption in the area of all systems

Revenue amount of water by consumer type	Revenue Water Amount (m^3/god)	Percentage	Specific consumption of population (l per capita per day)	Specific consumption with economy (l per capita per day)
Amount of revenue water for population	**962.847,05**	51,14%	**132,09**	**183,94**
Amount of revenue water for collective residential units	**389.284,10**	20,68%	**132,11**	
Amount of revenue water for industrial and commercial consumers	**530.651,16**	28,18%		
Total:	**1.882.782,31**			

The following table depicts data on number of connections in the largest water supply system of WSS Tilava by consumer type along with number of inhabitants that use this system.

This water supply system has **6,522** connections. Total number of inhabitants using this system is **22,256**.

All these data must be taken with a slight grain of salt because the population is estimated.

Table 18: Connections to WSS Tilava

Consumer type	Number of connections	Population –users
Individual consumers	5.290	14.898
Collective residential units	327	7.358
Industrial and commercial consumers	905	
Total:	**6.522**	**22.256**

The following table also shows data on number of connections in WSS Tilava and WSS Jahorina's spring.

This water supply system has **7,686** connections. Total number of inhabitants using this system is **25,398**.

Table 19: Connections to WSS Tilava and Jahorinska vrela

Consumer type	Number of connections	Population –users
Individual consumers	6.454	18.040
Collective residential units	327	7.358
Industrial and commercial consumers	905	
Total:	**7.686**	**25.398**

Total amount of Revenue water in 2010 was **V=1,796,990.41m^3**,and the table below provides an overview of the amount of Revenue water by type of consumer. Average specific water consumption for population without economy and losses was **q_{sp}=140 l per capita per day**. Specific consumption for population including economy is **q_{sp}=193.85 l per capita per day.**

These numbers are slightly larger than the average for the entire area.

Table 20: Revenue water quantity and specific consumption in WSS Tilava

Amount of Revenue water	**Tilava**	Specific consumption of population (l per capita per day)	Specific consumption of population with economy (l per capita per day)
Amount of Revenue water for population	**1.137.144,00**	**139,21**	**193,85**
Amount of Revenue water for collective residential units			
Amount of Revenue water for industrial and commercial consumers	**509.976,00**		
Total:	**1.796.990,41**		

The following table Table 21: Consumers in the area of all water supply systems in municipalities Istočno Novo Sarajevo, Istočna Ilidža and Trnovo – water supply systems Tilava, Ljuštra, Grabski mlini, Jahorinski sistemprovides data on all water supply systems concerning connections, type of connections and inhabitants using the system. Data are presented collectively, by area (settlements), municipalities and water supply systems.

All these data are presented separately for the largest water supply system WSS Tilava in Table 22: Consumers in the area of water supply system Tilava and Jahorinska vrela

Table 21: Consumers in the area of all water supply systems in municipalities Istočno Novo Sarajevo, Istočna Ilidža and Trnovo – water supply systems Tilava, Ljuštra, Grabski mlini, Jahorinski sistem

Area of the system	Municipality	Number of connections by area	Number of connections by municipality	Number of connections by type			Number of inhabitants using the system	Number of inhabitants using the system - Individual dwellings	Number of inhabitants using the system – Collective residential units	Number of consumers by water supply system – population			
				Individual consumers	Residential units	Industrial and commercialc onsumers				Tilava	Hillside area of Trebević - Jahorinski sistem	Ljuštra	Grabski mlini
Ilidža	Istočna Ilidža	3.645	4.103	3.418	203	482	14.514	9.845	4.669	14.514			
Dobrinja I and IV-FBiH		457											
Butmir		1											
Istočno Novo Sarajevo	Istočno Novo Sarajevo	3.583	3.583	3.035	124	423	10.884	8.195	2.689	7.742	3.142		
Kijevo	Trnovo	237	806	225	10	2	623	505	118				623
Trnovo		541		480	40	49	2.023	1.425	598			2.023	
Trnovo-FBiH		28											
Total:		**8.492**	**8.492**	**7.158**	**378**	**956**	**28.043**	**19.970**	**8.073**	**22.256**	**3.142**	**2.023**	**623**

Table 22: Consumers in the area of water supply system Tilava and Jahorinska vrela

Area of the system	Municipality	Number of connections by area	Number of connections by municipality	Number of connections by type			Number of inhabitants using the system	Number of inhabitants using the system - Individual dwellings	Number of inhabitants using the system – Collective residential units
				Individual consumers	Residential units	Industrial and commercialconsumers			
Consumers in the area of water supply system Tilava									
Ilidža	Istočna Ilidža	3.645	4.103	3.418	203	482	14.514	9.845	4.669
Dobrinja I and IV-FBiH		457							
Butmir		1							
Istočno Novo Sarajevo	Istočno Novo Sarajevo	2.419	2.419	1.871	124	423	7.742	5.053	2.689
TOTAL		**6.522**	**6.522**	**5.290**	**327**	**905**	**22.256**	**14.898**	**7.358**
Consumers in the area of water supply system Jahorinska vrela									
Istočno Novo Sarajevo	Istočno Novo Sarajevo	1.164	1.164	1.164	0	0	3.142	3.142	0
TOTAL		**1.164**	**1.164**	**1.164**	**0**	**0**	**3.142**	**3.142**	**0**
Total consumers in the area of water supply systems Tilava and Jahorinska vrela									
WSSTilava and Jahorinska vrela	Istočna Ilidža and Istočno Novo Sarajevo	7.686	7.686	6.454	327	905	25.398	18.040	7.358
TOTAL		**7.686**	**7.686**	**6.454**	**327**	**905**	**25.398**	**18.040**	**7.358**

2.4.2 WATER PRODUCTION AND WATER CONSUMPTION IN WSS TILAVA

This Master plan gives analysis of water production and water consumption for 2007 and 2010.

PRODUCTION AND WATER CONSUMPTION IN 2007

According to data given by company Water Supply and Sewerage, Istočno Sarajevo, in September 2007 it was produced 98.4 lps or 255,052.80 m3 of water in Potable water treatment plant Tilava.

Revenue Water makes 53.82 % of that number or 137.260,00 m3. Non-Revenue Water is 117,792.80 m3 or 46.18 %.

Table 23: An overview of quantity of produced and revenue water in WSS Tilava in September 2007

Water production	*Revenue Water m^3*				*Non-Revenue Water*	
	Population	*Economy*	*Krteljimilitary base*	*Total*	*m^3*	*%*
255,052.80	94,762.00	28,241.00	14,257.00	137,260.00	117,792.80	46.18%

PRODUCTION AND WATER CONSUMPTION IN 2010

Data obtained for 2010 differ from these data. Amount of Revenue water is almost the same. The difference occurs in the amount of Non-revenue water. However, the difference may be also that in 2006/07 water balance did not include the water obtained from Jahorina's system. In balances for 2010, that amount of water has been estimated at Q=5.0 l/s.

Table 24: Revenue and Non-Revenue Water Quantity in 2010 -Total

Water quantities	Unit of measurement		
	Average in lps	m^3/year	In percentage
Revenue water	56,98	1.796.990,41	47,84%
Non-revenue water	62,14	1.801.850,39	52,16%

Table 25: Comparison of water quantities for 2006/2007 and 2010

Water Amount	*Year and unit of measurement*					
	2010	*2006/2007*	*2010*	*2006/2007*	*2010*	*2006/2007*
	average in lps		*m^3/year*		*in %*	
Revenue Water	56,98	56,56	1.796.990,41	1.783.525,91	47,84%	53,82%
Non-Revenue Water	62,14	48,53	1.959.530,39	1.530.346,09	52,16%	46,18%

Generally, it can be said that the company Vodovod i kanalizacija is investing great efforts to reduce losses in the system. The company has experts who are familiar with the matter; it has devices for metering flow and pressure, but in insufficient number.

However, if we compare data for 2006/2007 with data obtained in 2010, it can be said that in period between, an increase of non-revenue water quantities occurred and/or an increase of physical losses in the system. Amounts of revenue water for both years are approximately the same and it is Q2010 =56.98 lps and/or V=1,796,990.41 m3/year. If we look at the year

2006/2007 these amounts are Q2006/07 =56.56 lps and/or V=1,783,525.91 m3/year. Therefore, on an annual basis, these are approximately the same values.

However, if we look at the amount of non-revenue water, it amounts to Q2010 =62.14 lps and/or V=1,801,850.39 m3/year. For the year 2006/2007, these amounts are Q2006/07 =48.53 lps and/or V=1,530,346.09 m3/year. There is a big difference between these results. However, if we add the amount of water that enters the system from Jahorina's spring Q=5,0 l/s, the amount of non-revenue water is Q=48,53+5,0=53,53 l/s.

The conclusion is that the amount of physical losses in the system has actually been increased. The amount of losses has increased for around Q=8.6 l/s i.e. for around 7.0 % of total produced water amount. However, we should be cautious because the data for 2007 was taken for September when the yield of Tilava was lower than the average yield.

Losses can be kept under control, which requires funds and above all, well-trained team for detection of losses as well as financial incentives for experts dealing with this difficult and demanding job.

Detection and removal of losses in water supply system should be approached in systematic and continuous manner. This is the only way to achieve good results.

Detailed analysis of production, amount of Revenue and Non-revenue water was given in the following chapters.

2.4.3 WATER PRODUCTION AND WATER CONSUMPTION IN 2006/2007

Data on water production are being registered with a mobile flow meter at the outflow pipeline from Potable Water Treatment Plant Tilava.

Diagrams of water production for the period **07 April to 10 April** then **24 Aug to 03 Sept** and **05 Oct to 15 Oct 2007** are presented in the Charts 5, 6 and 7.

Average water production was, as follows:

- for the period **07 April to 10 April2007** - 102.54 lps;
- for the period **24 Aug to 03 Sept2007** - 108.10 lps;
- for the period **05 Oct to 15 Oct 2007** - 102.95 lps.

These are normal differences in production by month, because of increased water consumption during summer months.

Also Table 20: Revenue water quantity and specific consumption in WSS Tilava, it is given a water production by month for the period September 2006 to September 2007. According to these data, average water production is 105.03 lps.

Amount of water which is being obtained from Jahorina's system is not included in these balances because it is not metered on a daily basis.

Table 26: Water production at the Potable Water Treatment Plant Tilava, and Revenue and Non- revenue water in 2006/2007

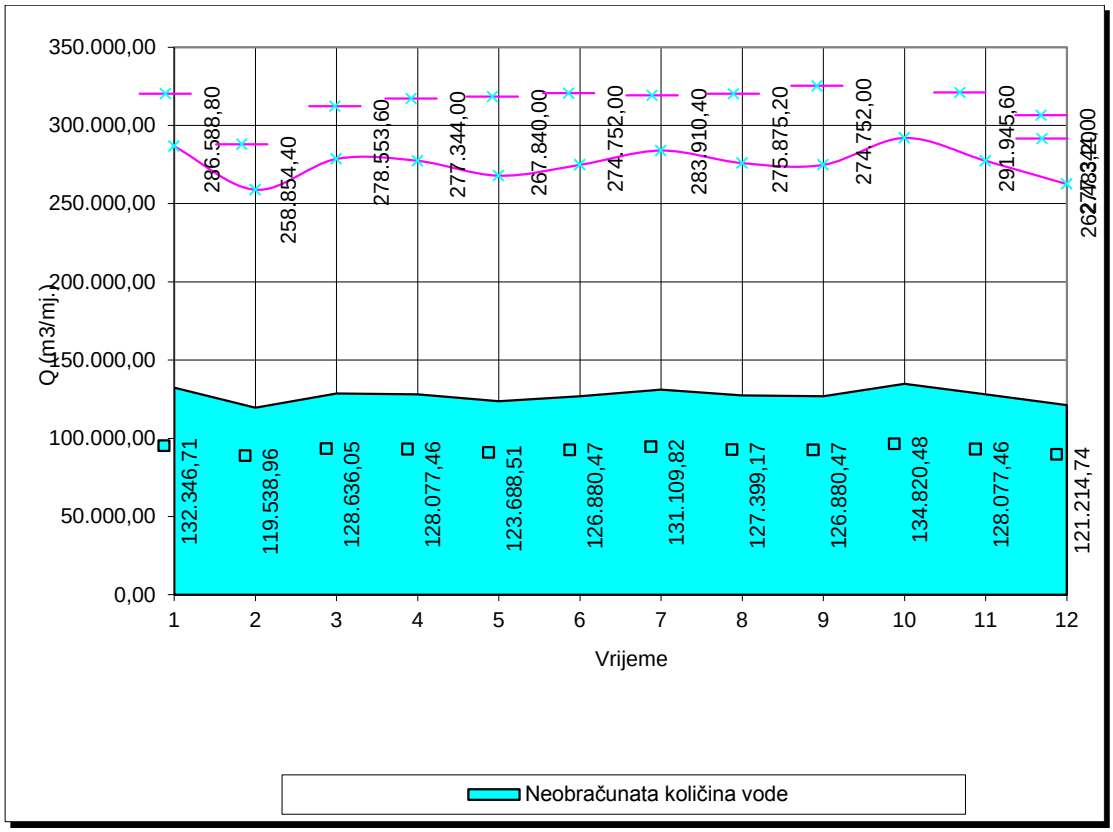
Year	Month	Water Production				Revenue Water		Non-Revenue Water	
		lps	Days	m^3/day	m^3/month	m^3/ month	%	m^3/ month	%
2006	October	107.00	31	9,244.80	286,588.80	154,242.09	54%	132,346.71	46.18
	November	107.00	30	9,244.80	277,344.00	149,266.54	54%	128,077.46	46.18
	December	104.00	31	8,985.60	278,553.60	149,917.55	54%	128,636.05	46.18
2007	January	107.00	31	9,244.80	286,588.80	154,242.09	54%	132,346.71	46.18
	February	100.00	28	8,640.00	241,920.00	130,201.34	54%	111,718.66	46.18
	March	106.00	31	9,158.40	283,910.40	152,800.58	54%	131,109.82	46.18
	April	106.00	30	9,158.40	274,752.00	147,871.53	54%	126,880.47	46.18
	May	103.00	31	8,899.20	275,875.20	148,476.03	54%	127,399.17	46.18
	June	106.00	30	9,158.40	274,752.00	147,871.53	54%	126,880.47	46.18
	July	109.00	31	9,417.60	291,945.60	157,125.12	54%	134,820.48	46.18
	August	107.00	31	9,244.80	286,588.80	154,242.09	54%	132,346.71	46.18
	September	98.40	30	8,501.76	255,052.80	137,269.42	54%	117,783.38	46.18
	Total		**365**		**3,313,872.00**	**1,783,525.91**		**1,530,346.09**	
	Average:	**105.03**		**9,074.88**	**276,156.00**	**148,627.16**		**127,528.84**	
	Coefficient of seasonal variations					**1.05**			

Percentage of Non-Revenue Water is 46.18 % as it was in September 2007. For other months, there is no data and this percentage is taken for the entire year. According to this data, total Revenue Water for one year is 1,783,525.91 m^3/year. It can also be seen that water consumption during the year does not vary much. Consequently, this makes the coefficient of seasonal variation relatively low. If we consider peak annual consumption (in July it was 157,125.12 m^3/month) and the average consumption (148,627.16 m^3/month) that means that coefficient of seasonal variation is $K_{seasonal}$=1.05.

When we talk about coefficient of daily variation, for this type of city, the coefficient should be 1.50.

From the following Chart 1:Water production on the Tilava expressed in m^3 per monthit can be concluded that there are no major fluctuations during the year in the production and/or consumption of water. According to information obtained from utility company Vodovod i kanalizacija Istočno Sarajevo, fluctuations in production occur mainly due to new leakages in the system.

Chart 1:Water production on the Tilava expressed in m^3 per month



The following diagrams provide an overview of water production measurements at Tilava.

These charts indicate the relationship between daily and nightly water consumption. Daily production is more than two times the nightly consumption. This ratio is excellent in our circumstances. Water consumption during the night hours is a good indicator of system water losses. According to these charts, in August, minimum nightly consumption of water was **60 lps, and average daily water consumption was Q=108.1 lps**. It could be a good reference for physical losses of water in the system. Certainly, one part of this water is billed. That relates to water losses on household installations behind the water meters. If water meter operates properly, this water is being read and billed. However, one part of water is being consumed, without billing. Expressed in percentage, minimum nightly consumption is 55.5 % of average daily consumption. Therefore, the losses are certainly lower than 55 %, and that percentage is much lower due to above-mentioned reasons. Unfortunately, metering in the system is not regular and it is difficult to calculate water balance.

Chart 2: Water production at the Potable Water Treatment Plant Tilava – 07 April 2007 to 10 April 2007

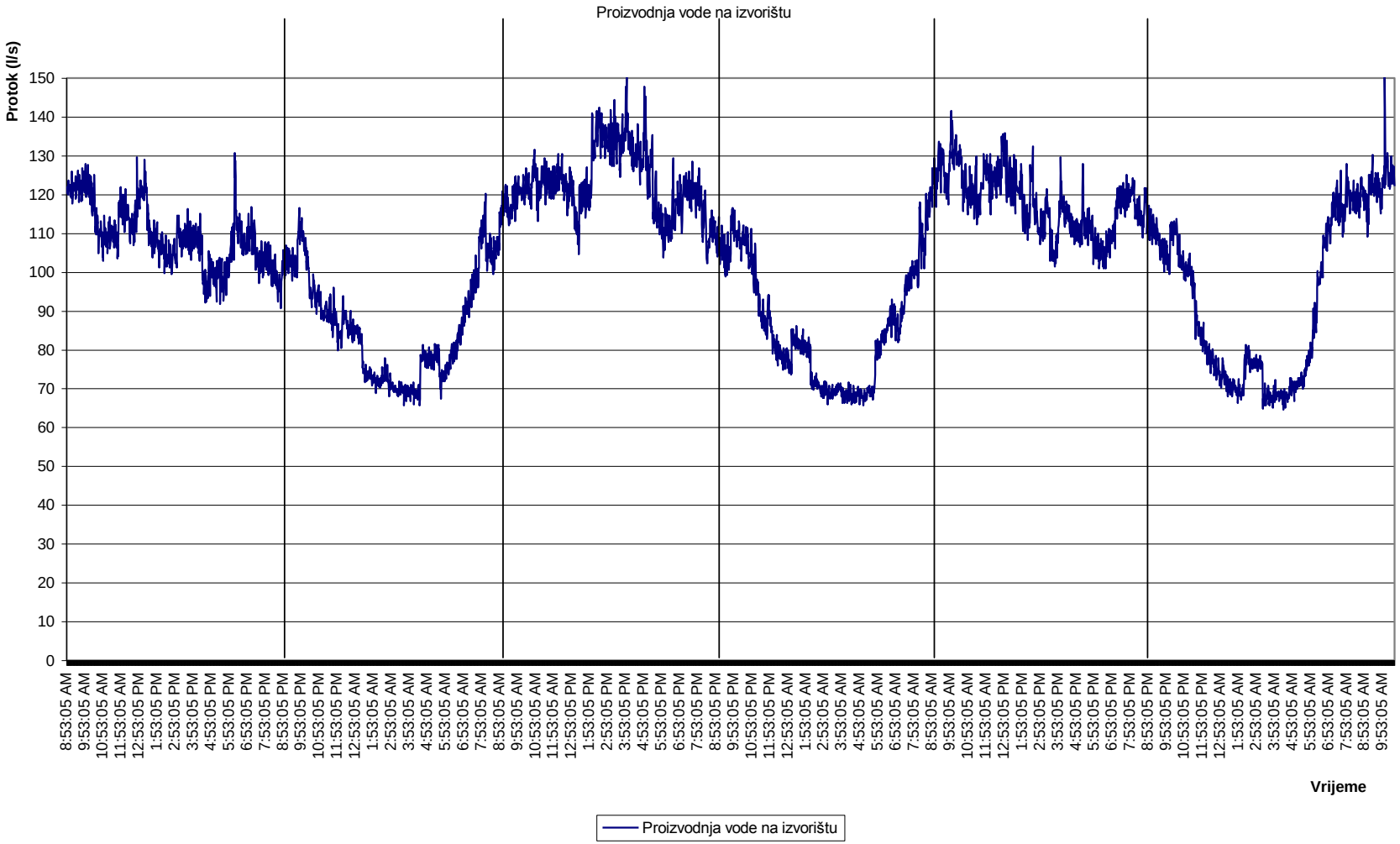


Chart 3: Water production at the Potable Water Treatment Plant Tilava – 24 Aug 2007 to 03 Sept 2007

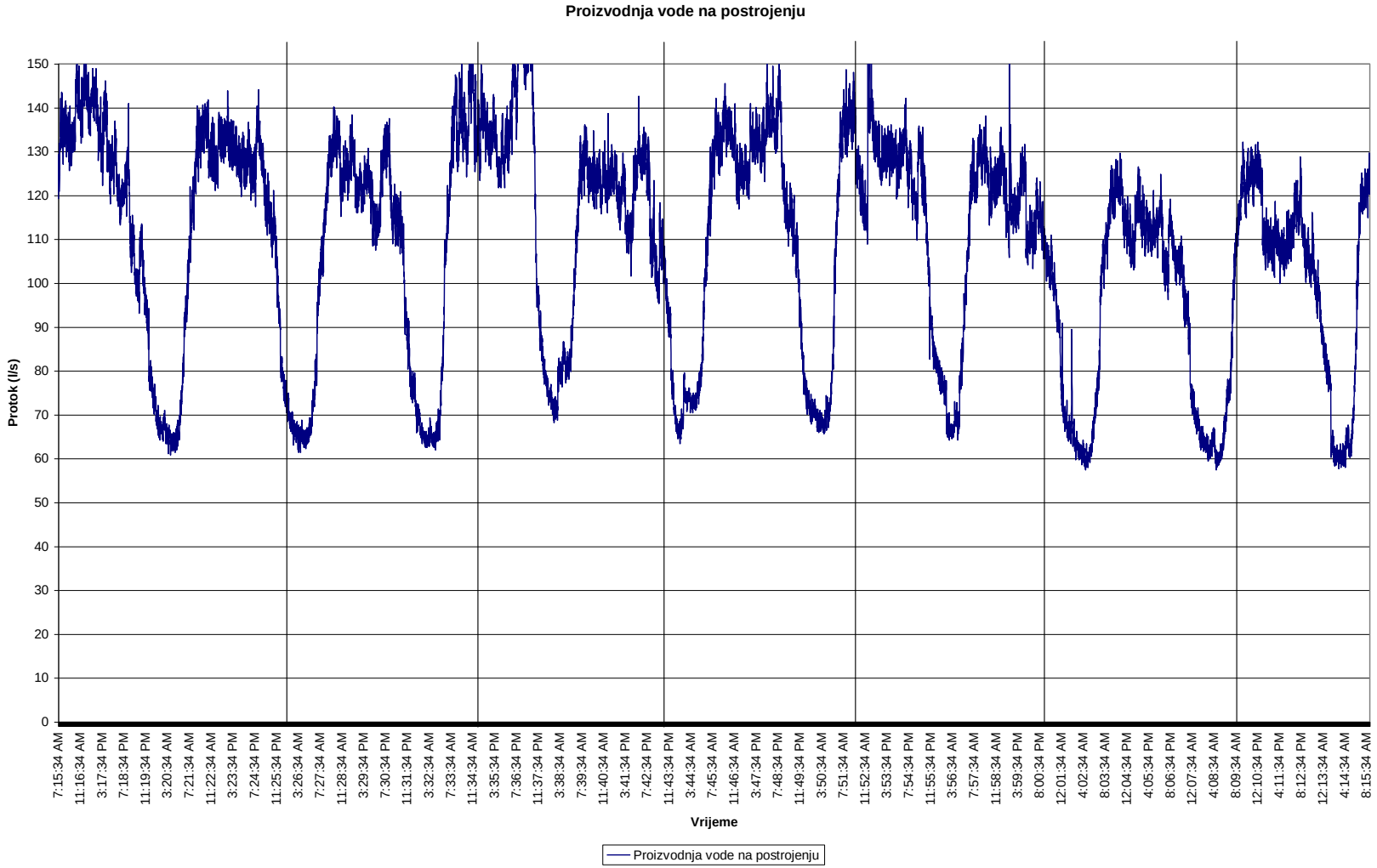


Chart 4: Water production at Potable Water Treatment Plant Tilava – 05 Oct 2007 to 15 Oct 2007

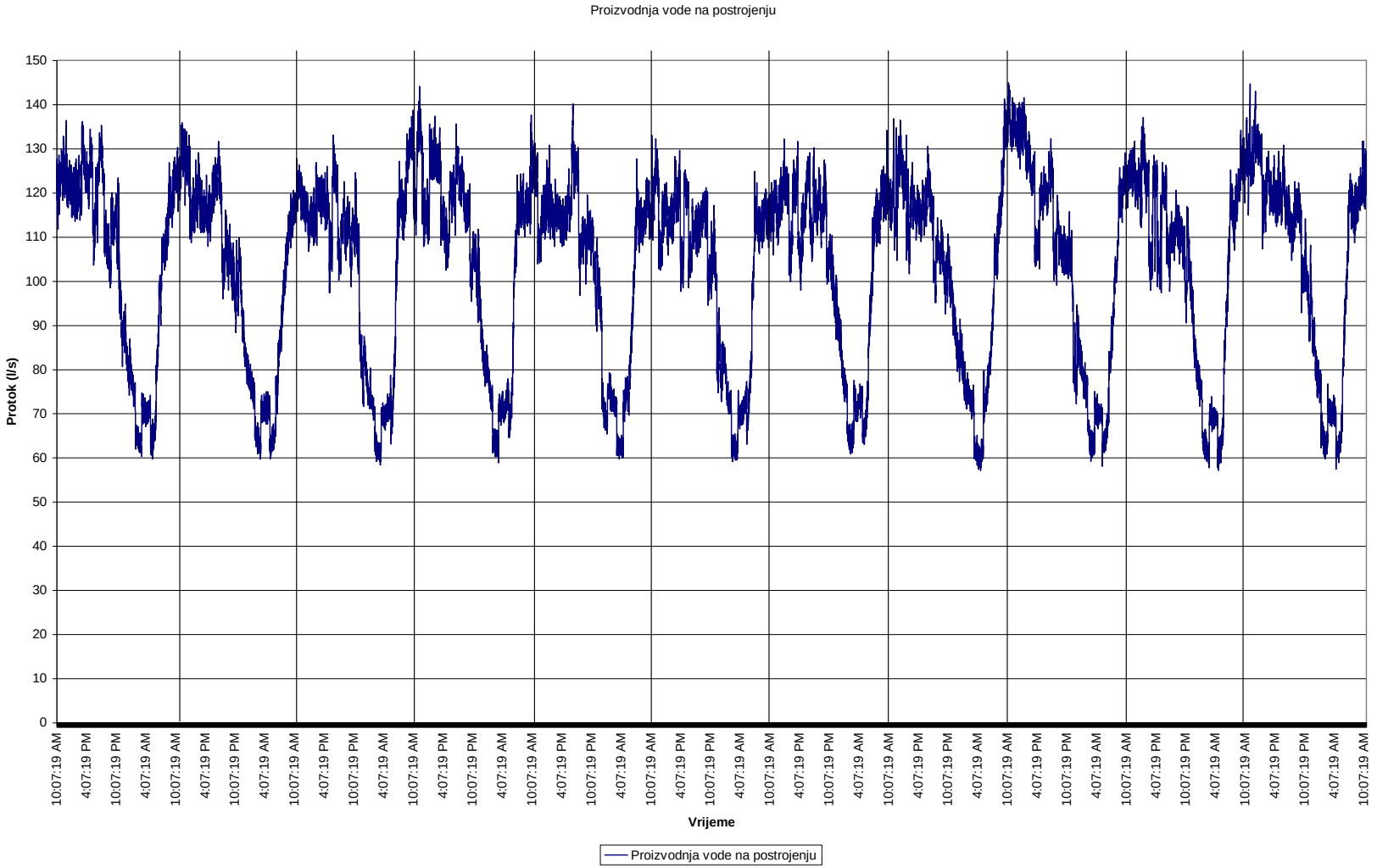


Chart 5: Water consumption – Residents Association at Karađorđeva street No. 26

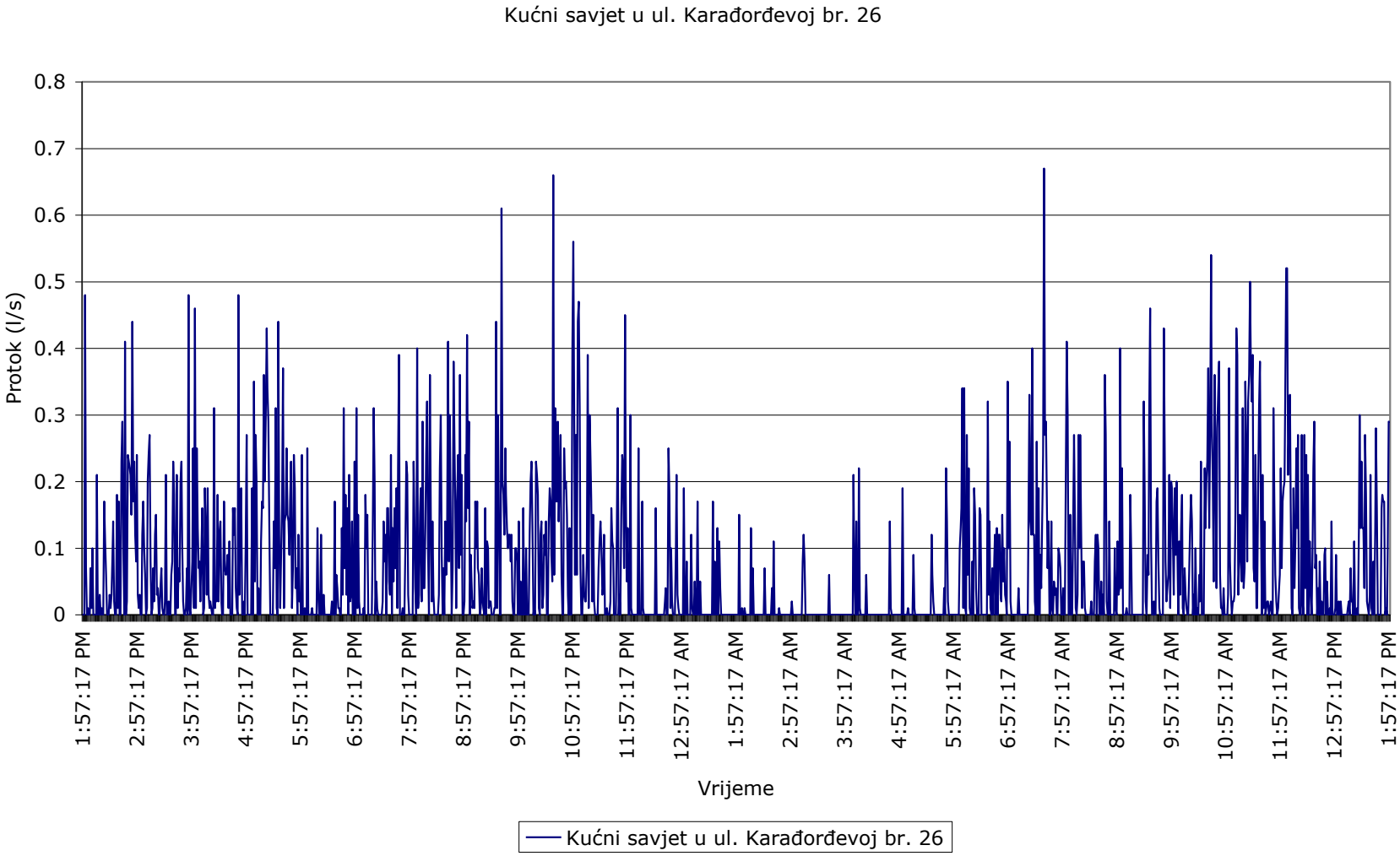


Chart 6: Water consumption– Residents Association at Šekspirova street No. 1

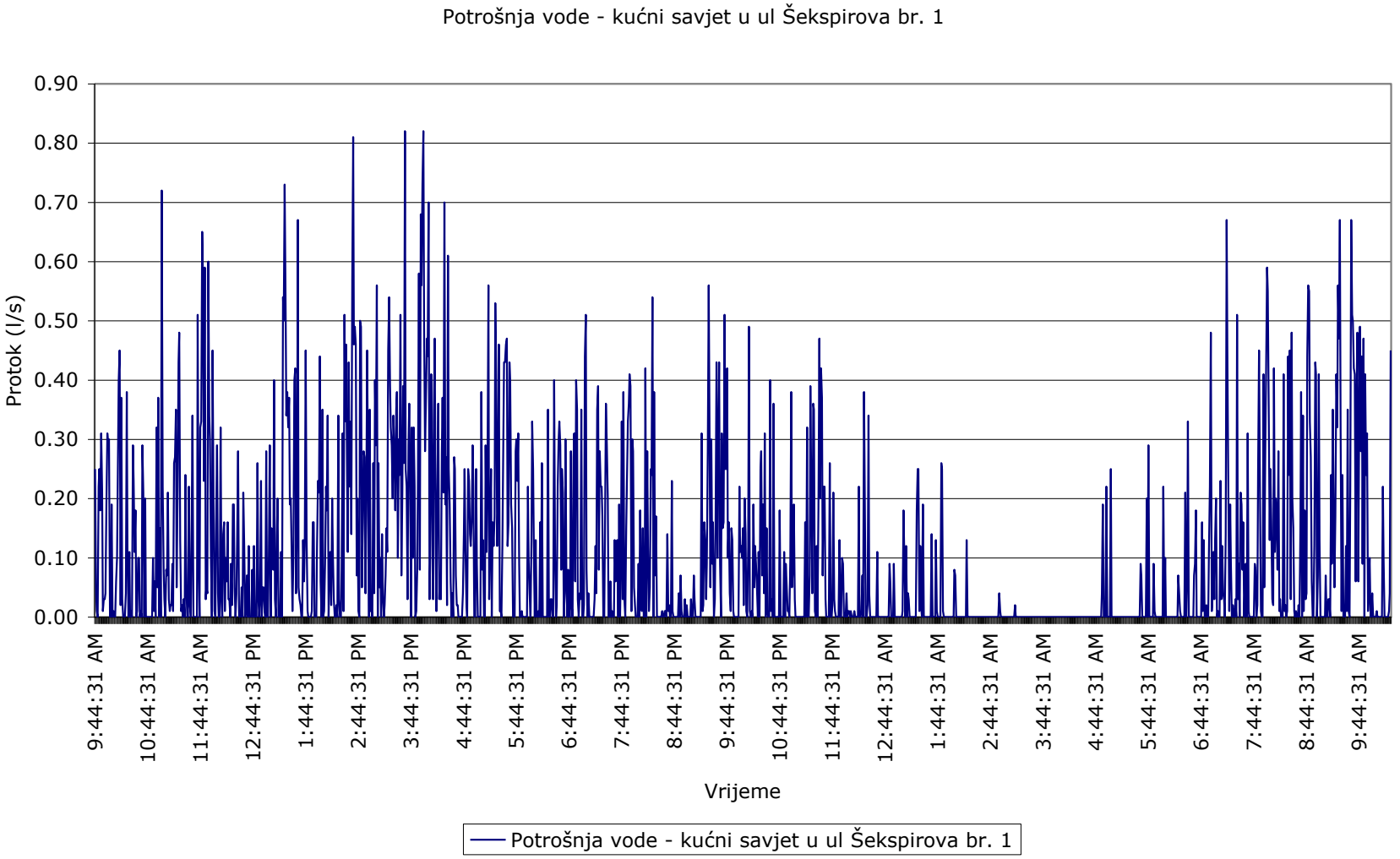


Chart 7: Water consumption– Kasindo Hospital

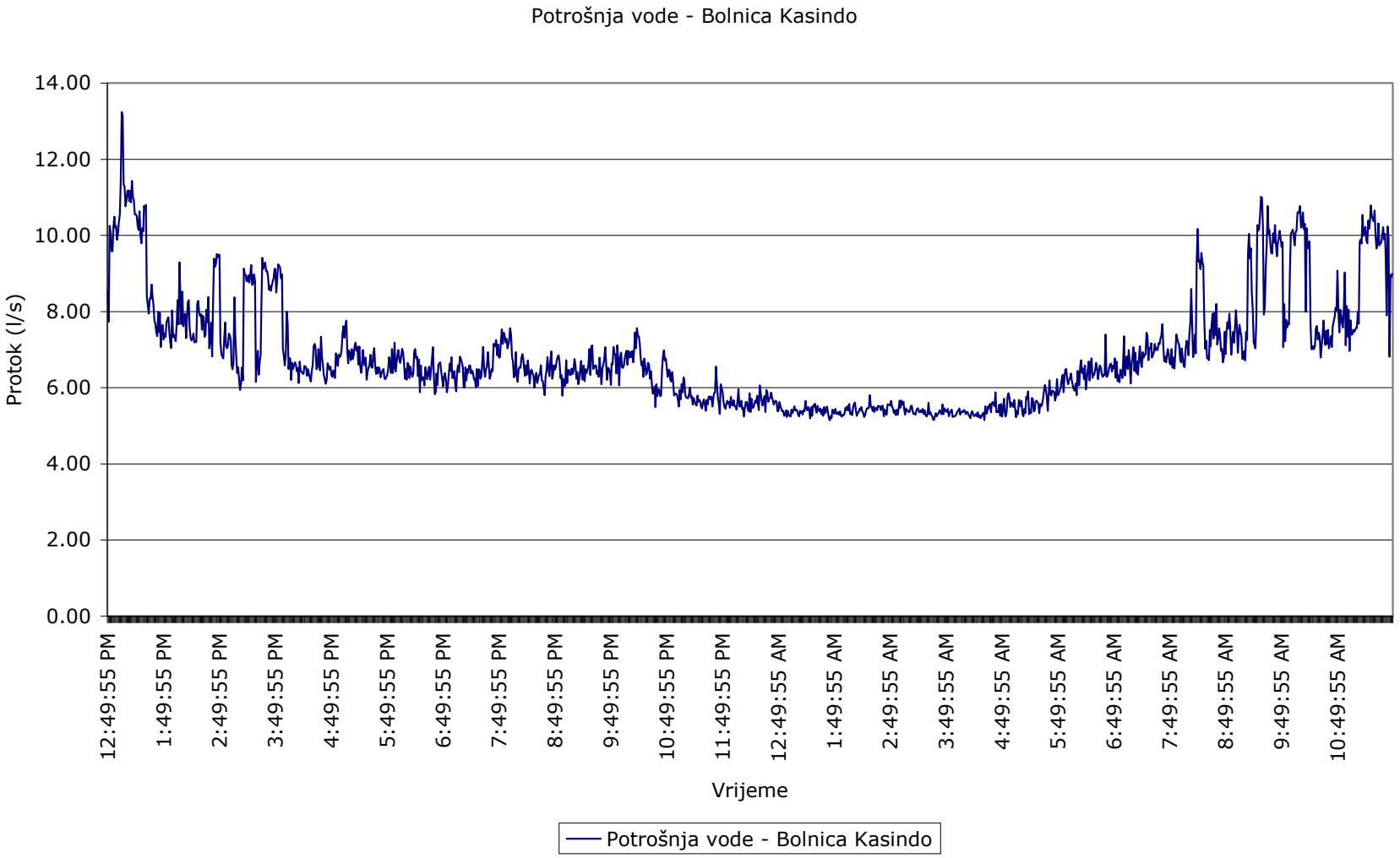


Chart 8: PS Tomića vrelo – Water Quantity

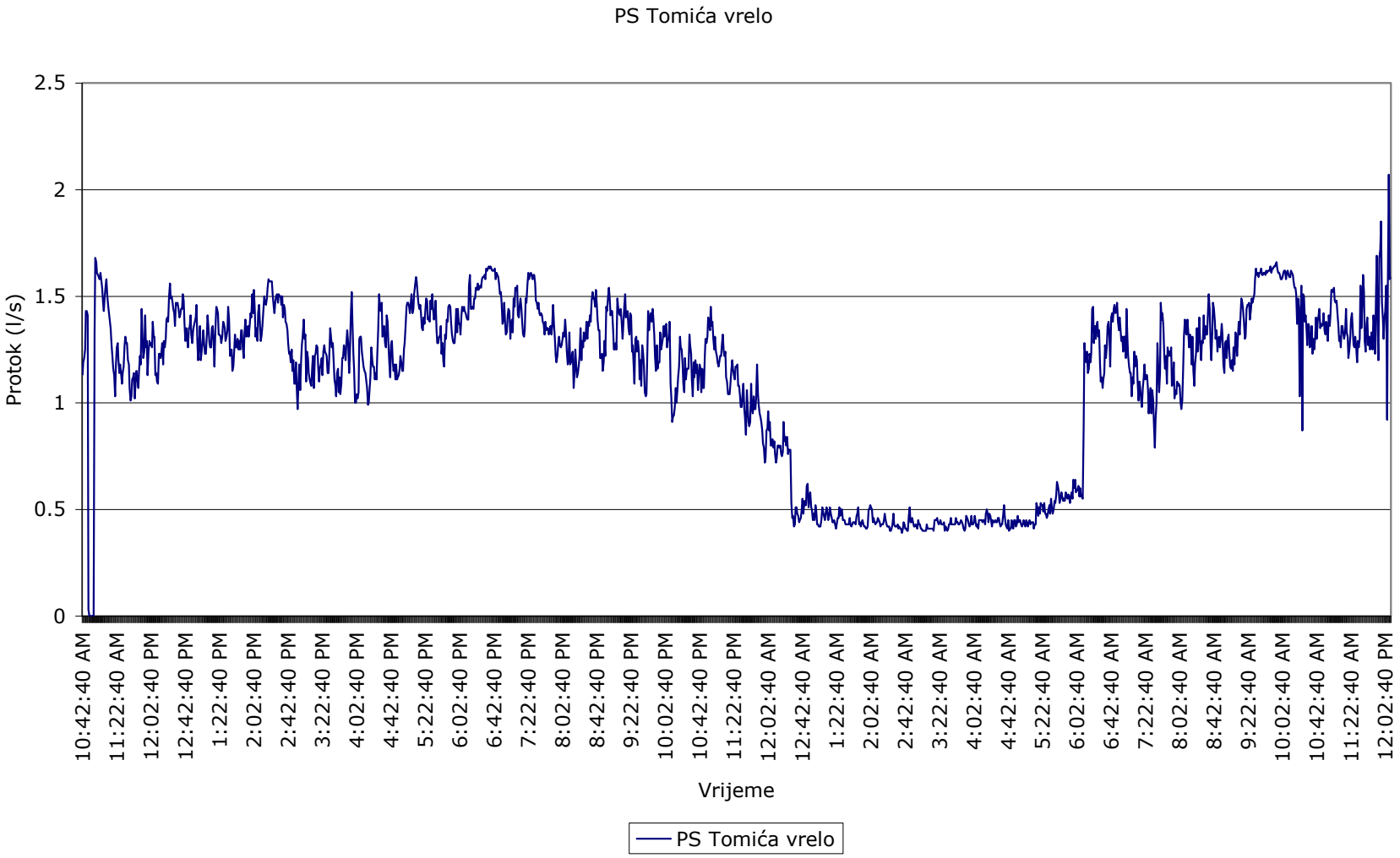


Chart 9: PS Vraca – Water Quantity

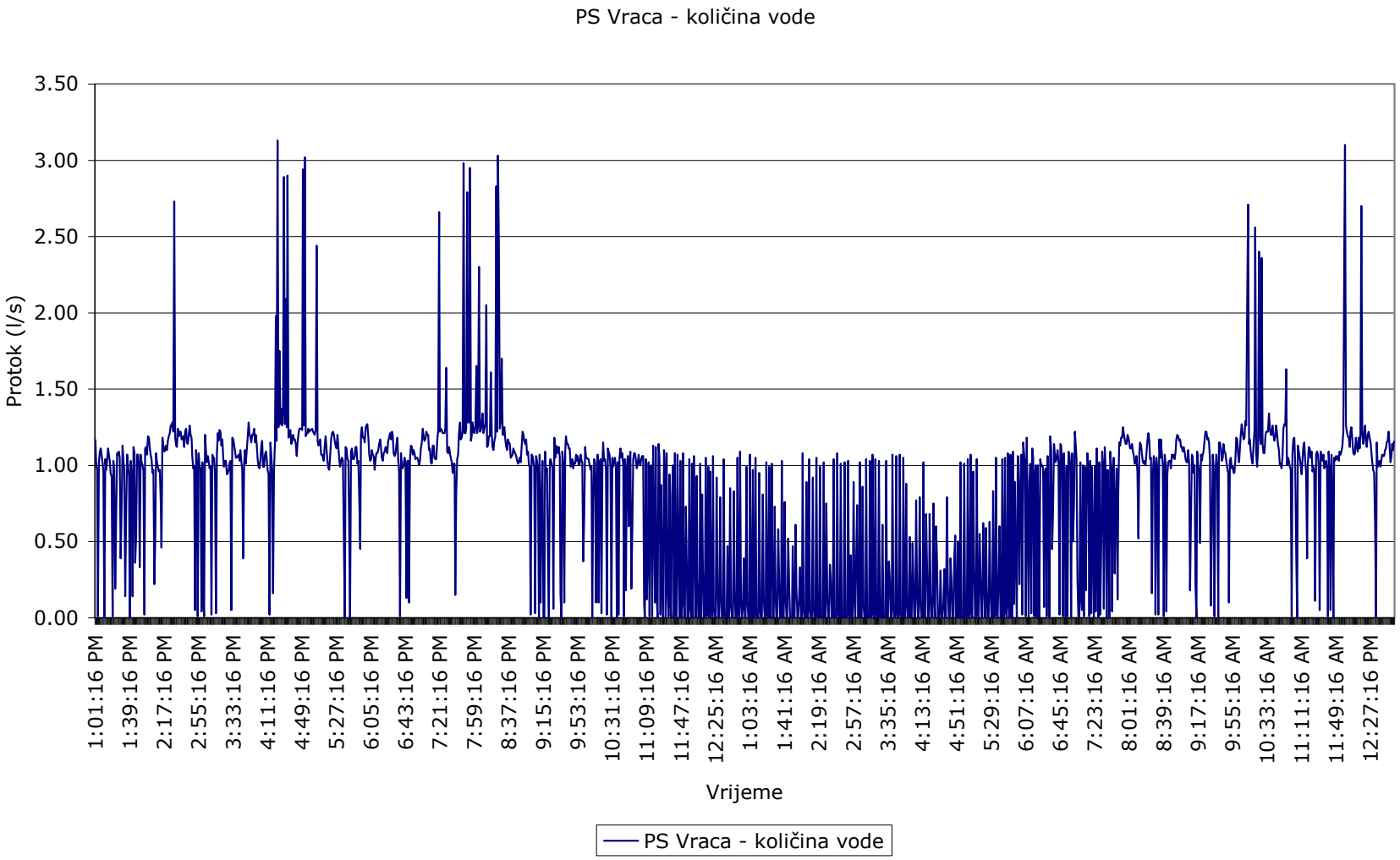
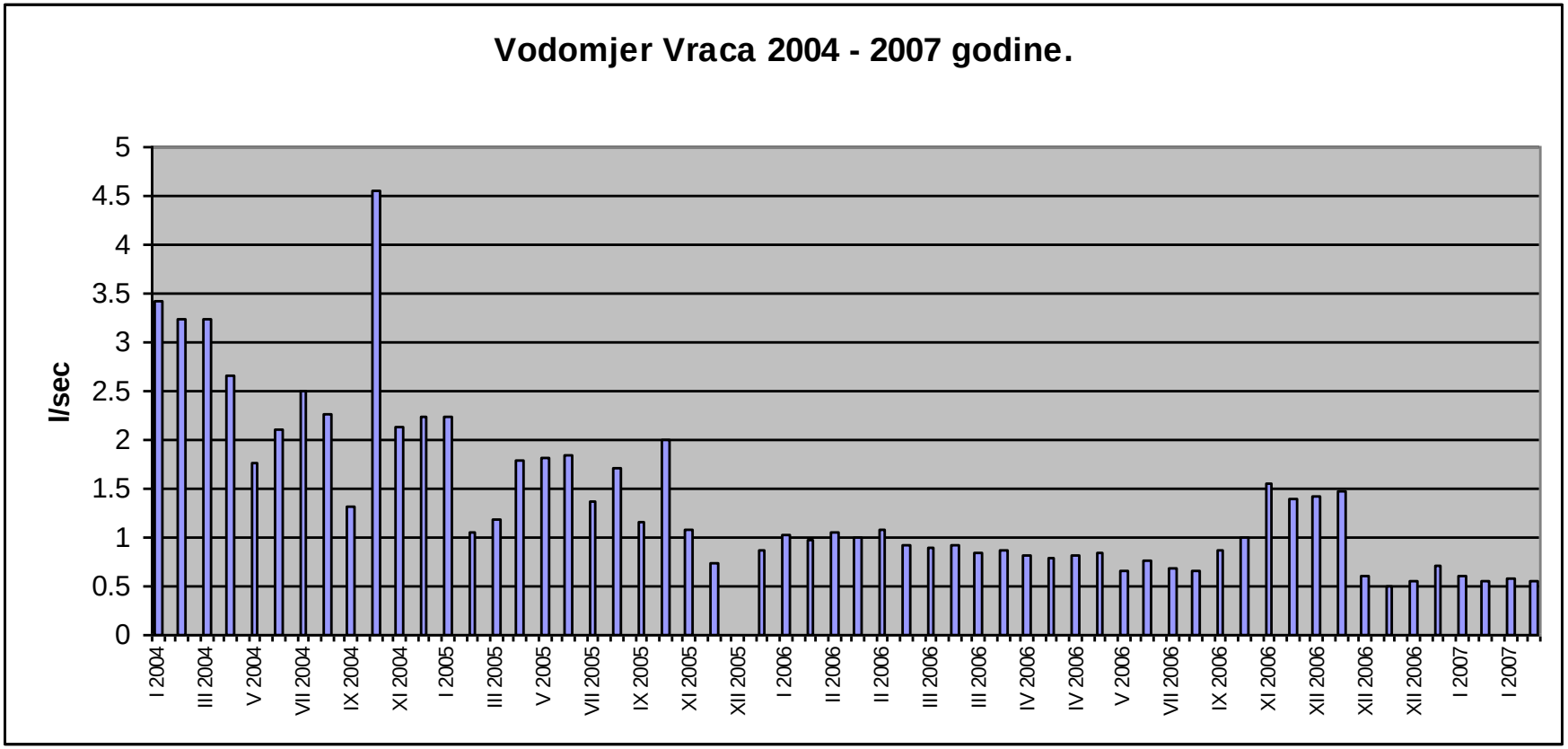


Chart 10: PS Vraca – water quantity at water meters



The Chart 5: Water consumption – Residents Association at Karađorđeva street No. 26 and Chart 6: Water consumption– Residents Association at Šekspirova street No. 1, shows water consumption metering at two Residents Associations.

Calculated specific water consumption for inhabitants of the Šekspirova street is 210 l per capita per day, and of Karađorđeva street is 135 l per capita per day. Such a large difference indicates that water losses in household installations in Šekspirova street, where a specific consumption amounts to 210 l per capita per day, are quite high. At the same time, in Karađorđeva street, where specific consumption is 135 l per capita per day, it can be concluded that water losses are either very low or it is also a possible error in metering. In item ***2.4.1 Consumers, production of water and water consumption for water supply systems managed by Vodovod i kanalizacija Ltd Istočno Sarajevo*** is calculated specific consumption of the population**excluding industry and losses is approximately q_{sp}=140 l per capita per day**.

It can also be concluded that a significant percentage of losses occurs in household installations (experience shows a 15 – 20 % loss in household installations).

Table 27: Analysis of water consumption at Šekspirova street No 1

Water consumption (lps)	Water consumption (m^3/day)	Number of inhabitants	Specific consumption (l/inhabitant per day)
0.104	9012.6	43	**210**

Table 28: Analysis of water consumption at Karađorđeva street No. 26

Water consumption (lps)	Water consumption (m3/day)	Number of inhabitants	Specific consumption (l/inhabitant per day)
0.073	6328.4	47	**135**

Water consumption in water supply system of Kasindo Hospital is 6.83 lps. This metering refers to 297 individual consumers and the Kasindo hospital itself.

Chart 10: PS Vraca – water quantity at water metersshows the effects of water loss reduction in the area of PS Vraca.

2.4.4 PRODUCTION AND CONSUMPTION OF WATER IN 2010

During the development of the Study, data for 2010 were also obtained. These data will provide even better insight into water supply system issues and associated changes in the last three years.

According to data from ViK Istočno Sarajevo, obtained results are given in the table below.

Table 29: Revenue water in 2010 by area

System Area	Revenue water quantity (m^3/year)	
Ilidža	751,973.44	1,593,977.31
Kijevo	13,284.00	
Novo Sarajevo	761,474.97	
Trnovo	67,244.90	
Butmir - FBiH	152,365.00	288,805.00
Dobrinja I - FBiH	51,711.00	
Dobrinja IV - FBiH	79,466.00	
Trnovo - FBiH	5,263.00	
Total:	**1,882,782.31**	

The text below provides an analysis of these results.

Balances of produced amounts of water include the source Tilava and water which is being taken from Jahorina's system.

Chart 11: Revenue water quantities in 2010 by area

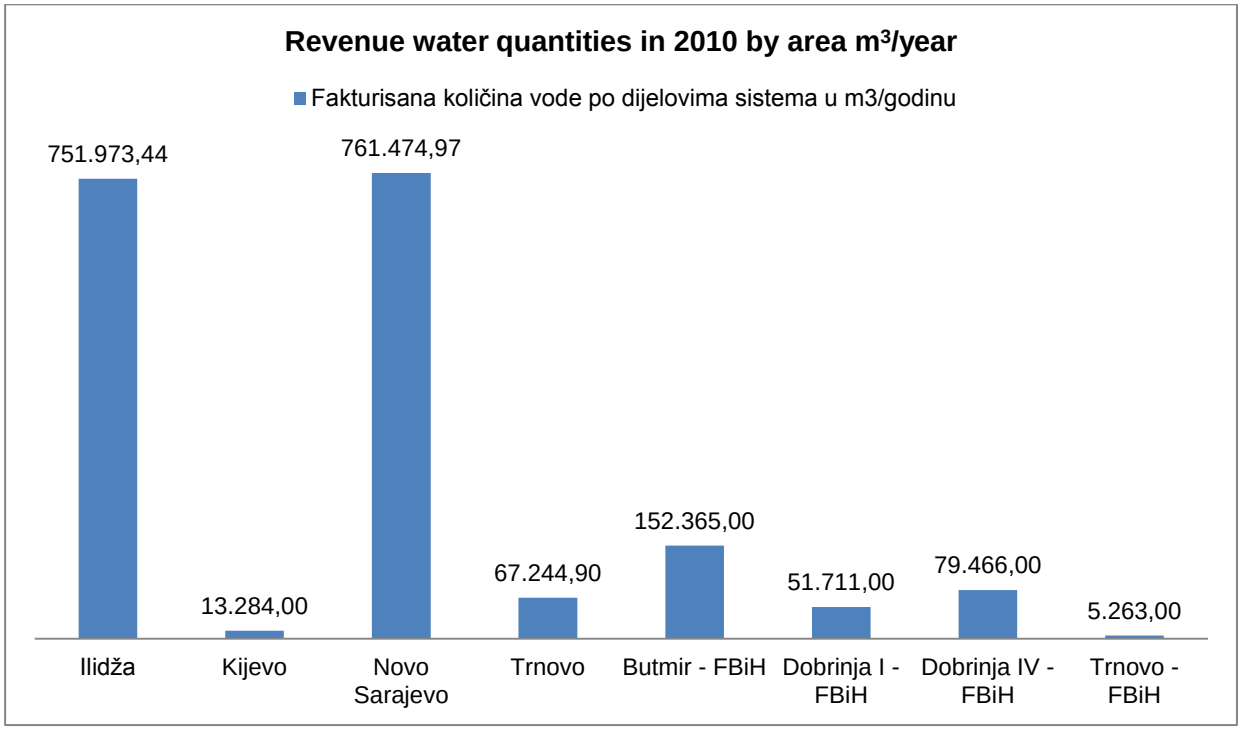


Table 30: Revenue and Non-Revenue Water Quantity in 2010 -Total

Water quantities	Unit of measurement		
	Average in lps	m^3/year	In percentage
Revenue water	56.98	1,796,990.41	47.84%
Non-revenue water	62.14	1,959,530.39	52.16%

Table 31: Coefficients of variations

Coefficients	**Coefficient for:**	
	Produced water	Revenue water
Seasonal variation	**1.06**	**1.14**
Daily variation	**1.50**	**1.50**

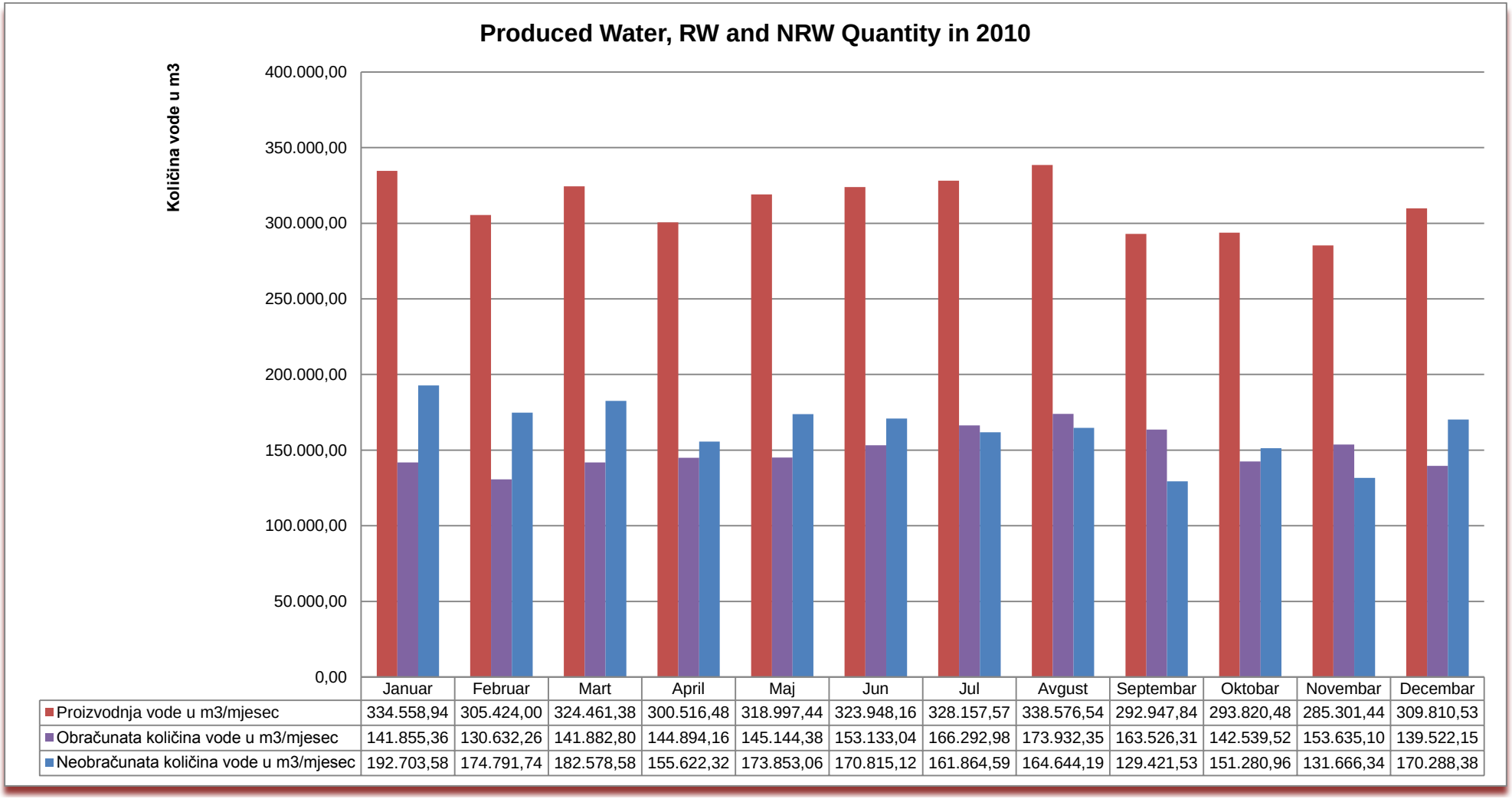
Coefficient of daily variation is based on data from the literature, and not based on metering during the year. The problem in most water supply systems is lack of measurements in the system. These measurements must be systematic.

Tables below present data on measurements in the system and/or produced water quantity during the year, revenue and non-revenue water.

Table 32: Produced Water, RW and NRW Quantity in 2010 by month – Tilava and Jahorina's system

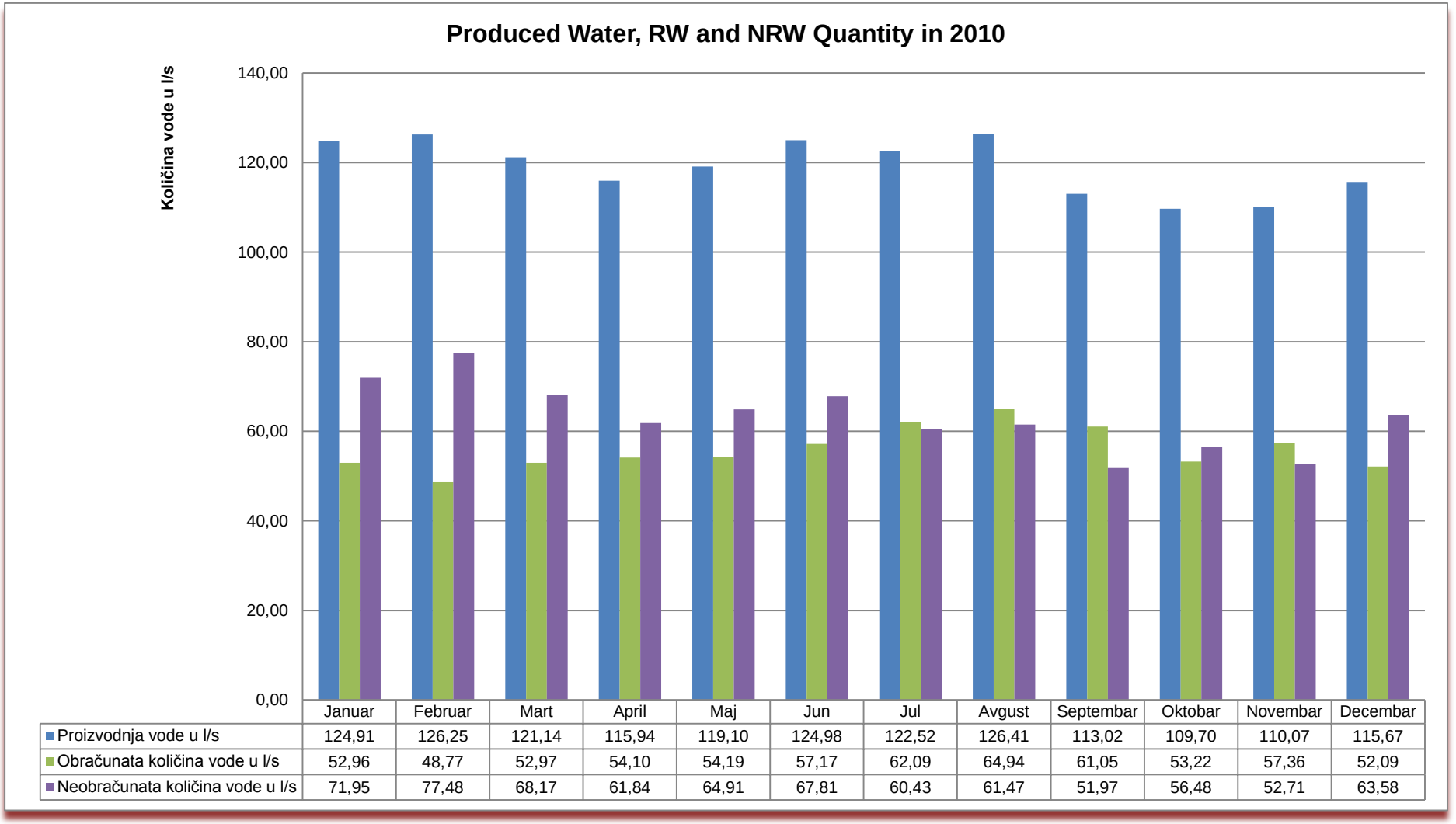
Source	Month	Produced amount of water at the source Tilava		Fetched water from Jahorina's system - estimate		Total water production in WSS Istočno Sarajevo		Revenue water amount		Non-revenue water amount	
		average in l/s	m^3/month	average in l/s	m^3/month	average in l/s	m^3/month	average in l/s	m^3/month	average in l/s	m^3/month
Tilava and Jahorina's system	January	119,91	321.166,94	5,00	13.392,00	124,91	334.558,94	52,96	141.855,36	71,95	192.703,58
	February	121,25	293.328,00	5,00	12.096,00	126,25	305.424,00	48,77	130.632,26	77,48	174.791,74
	March	116,14	311.069,38	5,00	13.392,00	121,14	324.461,38	52,97	141.882,80	68,17	182.578,58
	April	110,94	287.556,48	5,00	12.960,00	115,94	300.516,48	54,10	144.894,16	61,84	155.622,32
	May	114,10	305.605,44	5,00	13.392,00	119,10	318.997,44	54,19	145.144,38	64,91	173.853,06
	June	119,98	310.988,16	5,00	12.960,00	124,98	323.948,16	57,17	153.133,04	67,81	170.815,12
	July	117,52	314.765,57	5,00	13.392,00	122,52	328.157,57	62,09	166.292,98	60,43	161.864,59
	August	121,41	325.184,54	5,00	13.392,00	126,41	338.576,54	64,94	173.932,35	61,47	164.644,19
	September	108,02	279.987,84	5,00	12.960,00	113,02	292.947,84	61,05	163.526,31	51,97	129.421,53
	October	104,70	280.428,48	5,00	13.392,00	109,70	293.820,48	53,22	142.539,52	56,48	151.280,96
	November	105,07	272.341,44	5,00	12.960,00	110,07	285.301,44	57,36	153.635,10	52,71	131.666,34
	December	110,67	296.418,53	5,00	13.392,00	115,67	309.810,53	52,09	139.522,15	63,58	170.288,38
Total for 2010:		**114,12**	**3.598.840,80**	**5,00**	**157.680,00**	**119,12**	**3.756.520,80**	**56,98**	**1.796.990,41**	**62,14**	**1.959.530,39**

Chart 12: Produced Water, RW and NRW Quantity in 2010 by month – expressed in m3/month - Tilava and Jahorina's system



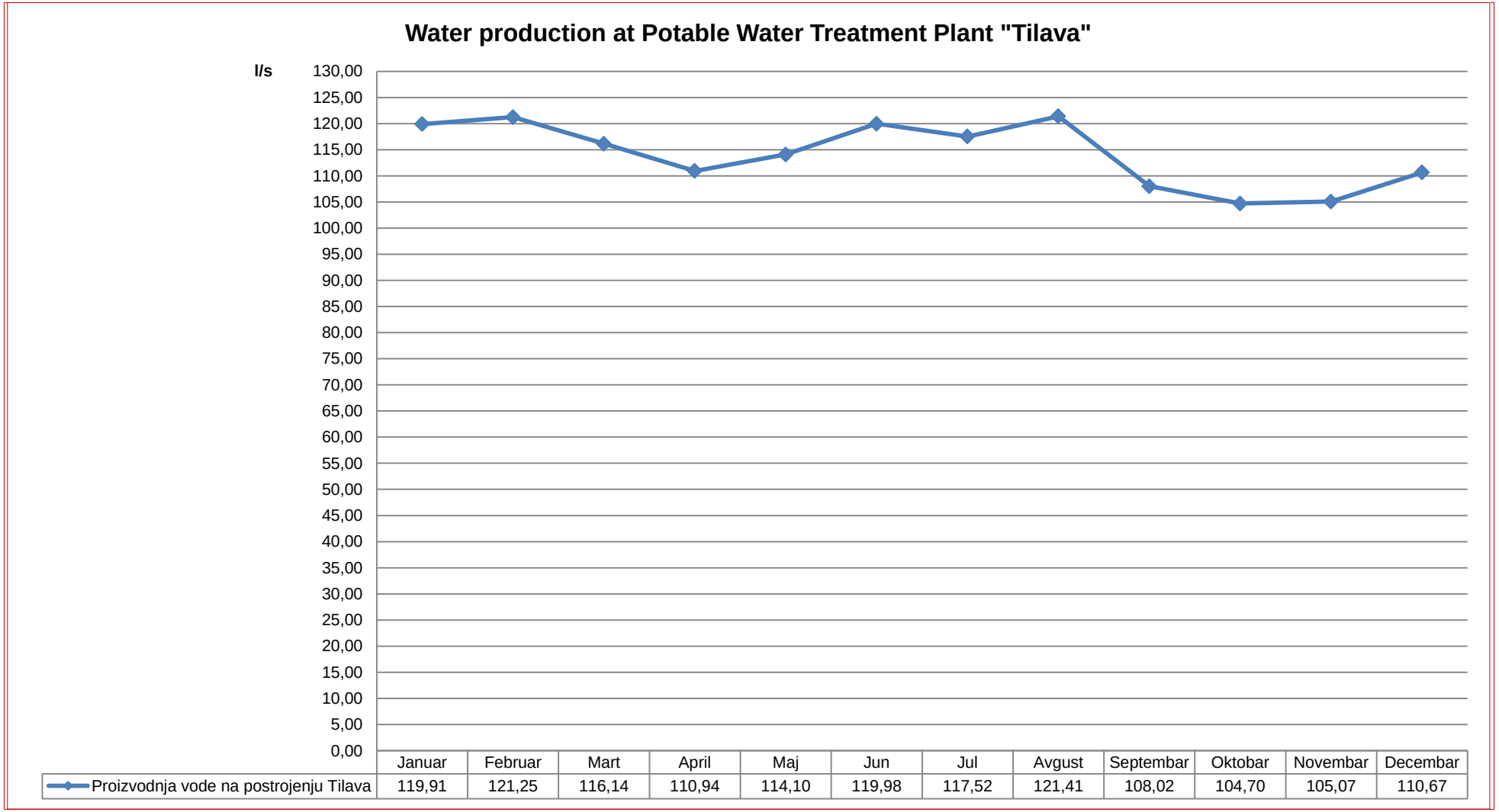
	Januar	Februar	Mart	April	Maj	Jun	Jul	Avgust	Septembar	Oktobar	Novembar	Decembar
Proizvodnja vode u m3/mjesec	334.558,94	305.424,00	324.461,38	300.516,48	318.997,44	323.948,16	328.157,57	338.576,54	292.947,84	293.820,48	285.301,44	309.810,53
Obračunata količina vode u m3/mjesec	141.855,36	130.632,26	141.882,80	144.894,16	145.144,38	153.133,04	166.292,98	173.932,35	163.526,31	142.539,52	153.635,10	139.522,15
Neobračunata količina vode u m3/mjesec	192.703,58	174.791,74	182.578,58	155.622,32	173.853,06	170.815,12	161.864,59	164.644,19	129.421,53	151.280,96	131.666,34	170.288,38

Chart 13: Produced Water, RW and NRW Quantity in 2010 by month – expressed in lps - Tilava and Jahorina's system



	Januar	Februar	Mart	April	Maj	Jun	Jul	Avgust	Septembar	Oktobar	Novembar	Decembar
Proizvodnja vode u l/s	124,91	126,25	121,14	115,94	119,10	124,98	122,52	126,41	113,02	109,70	110,07	115,67
Obračunata količina vode u l/s	52,96	48,77	52,97	54,10	54,19	57,17	62,09	64,94	61,05	53,22	57,36	52,09
Neobračunata količina vode u l/s	71,95	77,48	68,17	61,84	64,91	67,81	60,43	61,47	51,97	56,48	52,71	63,58

Chart 14: Water production at Potable Water Treatment Plant "Tilava"



	Januar	Februar	Mart	April	Maj	Jun	Jul	Avgust	Septembar	Oktobar	Novembar	Decembar
Proizvodnja vode na postrojenju Tilava	119,91	121,25	116,14	110,94	114,10	119,98	117,52	121,41	108,02	104,70	105,07	110,67

Table 33: Revenue water quantity by settlements and months in 2010– system area managed by LTD Vodovod i kanalizacija Istočno Sarajevo

Water supply system	Part of the system		Data for 2010												
	Settlement	Label	January	February	March	April	May	June	July	August	September	October	November	December	Total
Tilava	Butmir	SAR.B	13.405,00	12.720,00	14.663,00	12.290,00	11.895,00	12.632,00	12.964,00	13.106,00	12.024,00	11.432,00	12.566,00	12.668,00	152.365,00
	Dobrinja I	SAR.D-I	4.260,00	4.220,00	4.265,00	4.554,00	4.316,00	4.185,00	4.243,00	4.431,00	4.336,00	4.254,00	4.243,00	4.404,00	51.711,00
	Dobrinja IV	SAR.D-IV	6.695,00	5.987,00	6.980,00	6.687,00	6.764,00	6.718,00	6.759,00	7.314,00	6.740,00	5.896,00	6.879,00	6.047,00	79.466,00
	Ilidža	SSS.II.	58.353,16	52.200,29	54.264,72	60.335,36	60.175,71	63.981,25	73.485,14	77.573,91	72.402,23	59.874,37	62.979,60	56.347,70	751.973,44
	Novo Sarajevo	SSS.NS.	59.142,20	55.504,97	61.710,08	61.027,80	61.993,67	65.616,79	68.841,84	71.507,44	68.024,08	61.083,15	66.967,50	60.055,45	761.474,97
		Total:	**141.855,36**	**130.632,26**	**141.882,80**	**144.894,16**	**145.144,38**	**153.133,04**	**166.292,98**	**173.932,35**	**163.526,31**	**142.539,52**	**153.635,10**	**139.522,15**	**1.796.990,41**
Trnovo	Trnovo	SSS.TR.	5.202,70	4.842,50	5.395,20	5.266,80	5.219,60	5.592,00	7.027,30	7.171,70	5.866,10	6.390,50	5.276,10	3.994,40	67.244,90
	Trnovo	SAR.TR.	356,00	423,00	371,00	423,00	404,00	436,00	492,00	505,00	458,00	417,00	406,00	572,00	5.263,00
		Total:	**5.558,70**	**5.265,50**	**5.766,20**	**5.689,80**	**5.623,60**	**6.028,00**	**7.519,30**	**7.676,70**	**6.324,10**	**6.807,50**	**5.682,10**	**4.566,40**	**72.507,90**
Grabski mlini	Kijevo	SSS.KI.	665,00	586,00	640,00	776,00	772,00	1.178,00	2.108,00	2.483,00	1.293,00	721,00	532,00	1.530,00	13.284,00
		Total:	**665,00**	**586,00**	**640,00**	**776,00**	**772,00**	**1.178,00**	**2.108,00**	**2.483,00**	**1.293,00**	**721,00**	**532,00**	**1.530,00**	**13.284,00**
Grand Total:			***148.079,06***	***136.483,76***	***148.289,00***	***151.359,96***	***151.539,98***	***160.339,04***	***175.920,28***	***184.092,05***	***171.143,41***	***150.068,02***	***159.849,20***	***145.618,55***	***1.882.782,31***

Table 34: Comparison of water quantities for 2006/2007 and 2010

Amounts of water	Year and unit of measurement					
	2010	2006/2007	2010	2006/2007	2010	2006/2007
	average in lps		m^3/year		In percentage	
Revenue water	56,98	56,56	1.796.990,41	1.783.525,91	47,84%	53,82%
Non-revenue water	62,14	48,53	1.959.530,39	1.530.346,09	52,16%	46,18%
Total:	119,12	105,08	3.756.520,80	3.313.872,00	100,00%	100,00%

Source	Month	2010						2006/2007					
		Produced water amount		Revenue water amount		Non-revenue water amount		Produced water amount		Revenue water amount		Non-revenue water amount	
		Average in lps	m^3/month	Average in lps	m^3/month	Average in lps	m^3/month	Average in lps	m^3/month	Average in lps	m^3/month	Average in lps	m^3/month
Tilava	January	119,91	321.166,94	52,96	141.855,36	66,95	179.311,58	107,00	286.588,80	57,59	154.242,09	49,41	132.346,71
	February	121,25	293.328,00	48,77	130.632,26	72,48	162.695,74	100,00	241.920,00	48,61	130.201,34	41,71	111.718,66
	March	116,14	311.069,38	52,97	141.882,80	63,17	169.186,58	106,00	283.910,40	57,05	152.800,58	48,95	131.109,82
	April	110,94	287.556,48	54,10	144.894,16	56,84	142.662,32	106,00	274.752,00	55,21	147.871,53	47,37	126.880,47
	May	114,10	305.605,44	54,19	145.144,38	59,91	160.461,06	103,00	275.875,20	55,43	148.476,03	47,57	127.399,17
	June	119,98	310.988,16	57,17	153.133,04	62,81	157.855,12	106,00	274.752,00	55,21	147.871,53	47,37	126.880,47
	July	117,52	314.765,57	62,09	166.292,98	55,43	148.472,59	109,00	291.945,60	58,66	157.125,12	50,34	134.820,48
	August	121,41	325.184,54	64,94	173.932,35	56,47	151.252,19	107,00	286.588,80	57,59	154.242,09	49,41	132.346,71
	September	108,02	279.987,84	61,05	163.526,31	46,97	116.461,53	98,40	255.052,80	51,25	137.269,42	43,98	117.783,38
	October	104,70	280.428,48	53,22	142.539,52	51,48	137.888,96	107,00	286.588,80	57,59	154.242,09	49,41	132.346,71
	November	105,07	272.341,44	57,36	153.635,10	47,71	118.706,34	107,00	277.344,00	55,73	149.266,54	47,82	128.077,46
	December	110,67	296.418,53	52,09	139.522,15	58,58	156.896,38	104,00	278.553,60	55,97	149.917,55	48,03	128.636,05
	Total for 2010:	**114,12**	**3.598.840,80**	**56,98**	**1.796.990,41**	**57,14**	**1.801.850,39**	**105,30**	**3.312.872,00**	**56,56**	**1.783.525,91**	**48,53**	**1.530.346,09**

Table 35: Water production at Potable water treatment plant "Tilava" by day in 2010 and at various time intervals

January	00-06,[59]	07-10,[59]	11-18,[59]	19-23,[59]	Average	Total
	lps	lps	lps	lps	lps	m^3/day
01.01.10	86.36	108.89	125.57	110.92	108.30	9,357.26
02.01.10	78.92	115.61	124.54	112.60	107.26	9,267.12
03.01.10	82.43	117.14	125.40	119.49	110.26	9,526.39
04.01.10	88.82	131.49	133.31	125.40	118.38	10,228.25
05.01.10	91.40	130.45	132.60	128.65	119.40	10,316.34
06.01.10	92.40	130.04	134.53	140.72	122.78	10,608.48
07.01.10	99.19	121.27	118.19	113.99	112.29	9,701.57
08.01.10	86.90	121.55	125.10	111.82	110.60	9,555.84
09.01.10	85.97	124.28	125.62	113.48	111.30	9,616.57
10.01.10	92.90	129.30	132.82	125.63	119.09	10,289.56
11.01.10	93.38	131.75	132.63	123.07	119.04	10,285.38
12.01.10	91.02	130.37	130.90	125.07	117.97	10,192.21
13.01.10	91.80	132.63	133.02	123.32	118.91	10,273.97
14.01.10	95.36	126.11	127.10	122.58	116.74	10,085.98
15.01.10	106.61	137.45	132.68	123.72	124.00	10,714.00
16.01.10	90.98	131.79	137.56	124.24	120.24	10,388.52
17.01.10	90.08	128.95	134.91	137.88	121.46	10,494.14
18.01.10	102.43	134.89	133.37	129.64	123.82	10,698.23
19.01.10	96.76	128.22	129.99	126.11	119.19	10,298.41
20.01.10	94.05	132.73	126.06	120.84	116.75	10,087.02
21.01.10	98.60	135.41	133.90	125.26	122.06	10,545.62
22.01.10	97.53	130.62	135.23	128.26	122.01	10,541.99
23.01.10	98.81	137.47	139.55	125.43	124.38	10,746.36
24.01.10	93.66	127.94	137.64	130.34	121.68	10,512.72
25.01.10	95.39	143.30	135.03	127.09	123.19	10,643.83
26.01.10	95.37	132.34	131.36	128.69	120.47	10,408.61
27.01.10	101.26	129.64	127.57	124.41	119.58	10,331.96
28.01.10	96.28	133.92	130.10	126.87	120.20	10,385.24
29.01.10	95.82	131.18	131.22	126.56	119.92	10,360.87
30.01.10	96.76	139.15	146.33	127.99	126.85	10,960.24
31.01.10	96.69	134.55	140.20	130.81	124.61	10,766.45
average	**93.68**	**129.69**	**131.74**	**124.54**	**118.80**	**318,189.13**
February	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.02.10	98.01	139.63	139.22	131.64	125.69	10,859.58
02.02.10	102.01	140.42	135.31	131.33	125.62	10,853.57
03.02.10	103.92	140.80	134.84	129.61	125.73	10,862.68
04.02.10	103.18	137.92	134.84	127.61	124.61	10,766.56
05.02.10	97.31	141.69	138.88	136.99	126.83	10,958.11
06.02.10	99.79	134.31	135.56	125.73	122.87	10,616.04
07.02.10	98.01	127.95	133.07	127.82	120.90	10,445.51
08.02.10	92.65	133.64	128.74	121.81	117.59	10,159.49
09.02.10	89.99	133.35	130.31	124.41	117.83	10,180.30
10.02.10	94.12	134.82	127.28	124.19	118.22	10,214.32
11.02.10	89.94	128.91	126.90	122.03	115.44	9,974.05
12.02.10	88.80	129.52	125.42	119.98	114.29	9,874.58
13.02.10	87.53	131.99	136.21	122.91	118.54	10,241.64
14.02.10	87.15	125.87	130.13	124.30	115.67	9,993.85
15.02.10	89.92	127.14	122.56	116.22	112.48	9,718.49
16.02.10	90.00	130.41	125.98	119.52	114.88	9,925.49
17.02.10	85.93	130.09	130.94	125.57	116.55	10,070.06

18.02.10	89.90	128.57	120.49	114.95	111.76	9,656.10
19.02.10	81.22	128.83	129.38	125.09	114.35	9,879.66
20.02.10	87.57	135.77	133.61	119.33	117.57	10,157.76
21.02.10	90.18	134.50	140.42	130.34	122.68	10,599.55
22.02.10	98.38	142.10	139.36	135.63	127.09	10,980.32
23.02.10	109.34	143.69	137.06	130.68	128.75	11,124.07
24.02.10	100.63	138.62	133.71	127.89	123.67	10,684.87
25.02.10	94.12	135.01	135.17	126.48	121.36	10,485.50
26.02.10	97.88	133.78	132.12	123.88	120.69	10,427.90
27.02.10	91.00	134.41	135.97	117.69	118.79	10,263.06
28.02.10	84.89	125.55	130.50	120.20	114.23	9,869.15
average	**93.69**	**133.90**	**132.28**	**125.13**	**119.81**	**289,842.26**
March	00-06,[59]	07-10,[59]	11-18,[59]	19-23,[59]	**Average**	**Total**
	lps	lps	lps	lps	**lps**	**m^3/day**
01.03.10	82.10	127.74	127.23	116.31	111.88	9,666.18
02.03.10	84.09	125.02	120.65	117.11	109.98	9,502.06
03.03.10	82.18	124.38	120.62	117.88	109.46	9,457.70
04.03.10	81.12	123.48	119.37	117.80	108.57	9,380.59
05.03.10	81.38	123.31	122.25	117.30	109.48	9,458.64
06.03.10	84.73	133.76	134.97	120.92	117.19	10,125.04
07.03.10	88.46	130.12	131.65	127.49	117.93	10,189.26
08.03.10	97.39	133.94	130.64	125.41	120.40	10,402.78
09.03.10	92.72	134.33	130.03	124.81	118.78	10,262.34
10.03.10	98.37	134.88	128.89	128.59	120.92	10,447.85
11.03.10	100.69	131.50	125.07	120.88	118.16	10,208.84
12.03.10	87.07	130.02	125.63	115.69	113.04	9,767.02
13.03.10	86.48	136.97	136.90	120.81	118.85	10,268.96
14.03.10	87.56	127.57	129.62	125.07	116.06	10,027.84
15.03.10	88.80	137.51	127.69	118.32	116.03	10,025.14
16.03.10	85.25	132.71	127.66	117.37	113.99	9,848.59
17.03.10	84.27	131.36	127.31	114.94	112.85	9,750.64
18.03.10	83.25	133.86	124.81	115.07	112.17	9,691.27
19.03.10	79.88	132.13	126.07	113.98	111.09	9,598.10
20.03.10	78.30	138.84	137.36	116.53	116.04	10,025.96
21.03.10	77.97	129.63	126.84	117.49	111.10	9,599.33
22.03.10	74.26	124.39	116.65	104.75	103.10	8,907.59
23.03.10	68.74	125.00	114.27	101.85	100.19	8,656.52
24.03.10	66.36	119.00	115.09	107.12	99.87	8,628.62
25.03.10	68.38	128.87	116.99	104.82	102.26	8,834.98
26.03.10	63.99	124.81	120.74	106.76	101.95	8,808.80
27.03.10	60.34	119.68	121.05	101.93	99.13	8,564.94
28.03.10	98.30	107.29	119.10	115.77	110.37	9,536.08
29.03.10	69.30	130.80	125.06	115.38	107.74	9,308.45
30.03.10	68.22	123.63	118.20	112.86	103.42	8,935.06
31.03.10	70.12	121.76	115.45	109.38	102.02	8,814.17
average	**86,28**	**131,09**	**127,67**	**119,51**	**110,77**	**296.699,33**
April	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.04.10	68.12	127.63	127.36	109.98	106.51	9,202.10
02.04.10	62.62	115.97	110.72	105.46	96.47	8,335.01
03.04.10	78.93	131.80	137.72	124.51	116.83	10,094.47
04.04.10	73.72	120.44	105.53	103.06	98.22	8,486.42
05.04.10	69.29	115.27	111.58	102.40	97.95	8,462.70
06.04.10	66.76	113.16	112.68	110.06	98.82	8,538.12
07.04.10	81.37	115.78	110.23	111.10	102.92	8,892.18

08.04.10	73.75	125.93	119.47	112.88	105.84	9,144.47
09.04.10	69.46	124.09	114.53	103.27	100.63	8,694.61
10.04.10	65.51	122.96	118.39	106.82	101.32	8,753.87
11.04.10	70.46	111.38	113.68	107.42	99.39	8,587.01
12.04.10	67.02	115.40	114.44	117.16	101.34	8,755.42
13.04.10	62.80	115.29	106.35	93.74	92.51	7,992.94
14.04.10	41.30	100.45	99.16	93.87	81.40	7,032.71
15.04.10	29.36	104.44	91.57	32.33	63.23	5,462.96
16.04.10			117.59	110.91	62.30	5,382.97
17.04.10	75.27	130.87	128.42	117.43	111.04	9,593.57
18.04.10	75.11	126.47	124.59	118.33	109.17	9,432.07
19.04.10	77.96	122.56	119.92	113.79	106.84	9,231.37
20.04.10	77.16	122.31	120.03	115.86	107.04	9,248.04
21.04.10	76.25	128.37	123.44	114.53	108.64	9,386.64
22.04.10	80.36	128.76	122.70	121.50	111.11	9,599.98
23.04.10	79.43	126.73	121.92	113.36	108.55	9,378.32
24.04.10	73.00	123.12	125.06	110.50	106.52	9,203.26
25.04.10	69.84	116.29	122.50	117.50	105.06	9,077.54
26.04.10	76.05	124.29	128.45	114.38	109.54	9,464.44
27.04.10	71.46	123.37	118.84	113.59	104.68	9,044.53
28.04.10	73.04	119.01	124.34	120.74	107.74	9,308.66
29.04.10	82.71	136.23	128.98	121.44	115.12	9,946.55
30.04.10	84.34	135.74	133.36	121.59	117.01	10,109.41
average	**76.57**	**126.00**	**124.46**	**116.75**	**105.30**	**263,842.34**
May	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.05.10	82.90	139.69	125.95	117.41	113.90	9,841.36
02.05.10	77.12	133.64	127.50	114.00	111.02	9,591.84
03.05.10	77.44	134.66	142.01	134.69	120.43	10,404.90
04.05.10	90.29	133.56	120.85	116.51	113.15	9,776.23
05.05.10	77.17	130.16	125.59	122.76	111.64	9,645.66
06.05.10	80.35	128.24	120.90	114.13	108.89	9,407.74
07.05.10	83.32	133.62	128.96	121.33	114.84	9,921.78
08.05.10	82.36	125.27	120.39	112.90	108.55	9,378.79
09.05.10	79.44	130.34	133.37	128.31	116.08	10,029.42
10.05.10	81.23	137.42	131.77	128.65	117.32	10,136.52
11.05.10	78.97	131.91	132.07	127.83	115.67	9,994.10
12.05.10	81.81	130.69	123.60	122.81	112.43	9,713.81
13.05.10	81.71	135.39	125.07	119.01	112.88	9,752.90
14.05.10	80.96	138.49	128.49	123.51	115.26	9,958.14
15.05.10	77.71	121.20	126.84	111.97	108.47	9,372.02
16.05.10	74.82	122.67	122.86	119.18	108.05	9,335.52
17.05.10	81.02	127.79	132.79	122.43	114.70	9,909.97
18.05.10	88.36	129.14	131.89	117.32	115.70	9,996.48
19.05.10	80.96	126.14	118.12	112.70	107.49	9,287.06
20.05.10	70.84	114.92	119.41	112.72	103.10	8,907.98
21.05.10	73.51	125.74	122.22	122.97	108.76	9,396.50
22.05.10	84.29	126.09	128.89	119.11	113.38	9,795.82
23.05.10	78.63	115.40	120.01	113.63	105.84	9,144.86
24.05.10	82.01	124.15	127.18	114.82	110.93	9,583.96
25.05.10	80.07	128.06	125.59	118.28	111.20	9,607.86
26.05.10	79.75	136.73	134.13	124.08	116.61	10,075.00
27.05.10	79.78	132.40	128.71	125.61	114.41	9,884.84
28.05.10	74.86	128.81	127.41	137.29	114.37	9,881.96
29.05.10	72.34	123.79	127.79	118.54	109.02	9,419.62

30.05.10	74.60	126.49	135.69	117.69	112.59	9,727.67
31.05.10	77.64	127.90	117.64	106.89	105.44	9,110.34
average	**79.55**	**129.04**	**126.89**	**119.97**	**112.00**	**299,990.66**
June	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.06.10	74.48	124.52	120.58	110.64	105.72	9,134.21
02.06.10	73.79	129.29	129.51	123.46	111.96	9,673.45
03.06.10	92.51	134.52	129.85	128.00	119.35	10,312.02
04.06.10	104.02	147.72	138.15	132.28	128.57	11,108.23
05.06.10	100.47	133.99	136.37	123.48	122.82	10,611.40
06.06.10	85.67	130.71	137.25	135.66	120.78	10,435.79
07.06.10	93.77	142.24	135.56	133.16	123.98	10,712.27
08.06.10	93.75	152.59	148.43	143.58	132.16	11,419.02
09.06.10	103.57	150.98	148.34	147.85	135.62	11,717.57
10.06.10	102.98	149.73	147.25	149.41	135.20	11,681.39
11.06.10	98.14	150.77	140.56	140.37	129.85	11,219.00
12.06.10	79.05	138.29	139.19	130.59	119.71	10,342.73
13.06.10	65.41	127.21	135.21	137.80	114.06	9,854.60
14.06.10	68.50	135.69	135.39	134.69	115.78	10,003.79
15.06.10	68.16	130.81	128.84	137.58	113.29	9,788.33
16.06.10	67.83	131.81	132.68	148.13	116.84	10,094.90
17.06.10	78.04	139.34	139.81	150.82	124.01	10,714.39
18.06.10	79.12	162.88	163.97	163.29	138.90	12,000.85
19.06.10	122.53	161.73	148.68	140.58	141.54	12,229.09
20.06.10	87.69	128.14	123.47	116.43	112.35	9,706.68
21.06.10	74.75	119.47	120.95	111.99	105.36	9,103.25
22.06.10	70.70	117.44	113.52	111.03	101.17	8,740.69
23.06.10	71.56	118.76	119.12	116.00	104.54	9,032.11
24.06.10	75.31	124.49	119.40	117.18	106.93	9,238.43
25.06.10	75.77	128.49	121.52	115.41	108.07	9,336.82
26.06.10	72.42	120.13	123.02	109.59	104.98	9,070.45
27.06.10	69.43	106.87	126.79	118.94	105.10	9,081.04
28.06.10	80.30	118.99	117.35	114.46	106.22	9,176.98
29.06.10	82.08	128.28	134.00	131.34	117.35	10,138.97
30.06.10	95.43	126.31	129.00	121.24	117.14	10,121.22
average	**83.75**	**133.73**	**132.79**	**129.83**	**117.98**	**305,799.66**
July	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.07.10	82.64	127.74	128.79	123.37	114.03	9,851.80
02.07.10	80.14	129.66	129.42	122.62	113.67	9,821.09
03.07.10	77.92	132.53	137.44	124.15	116.49	10,064.99
04.07.10	72.96	121.15	127.10	121.65	109.18	9,433.33
05.07.10	74.82	134.76	134.11	122.61	114.53	9,895.36
06.07.10	74.86	129.48	129.91	116.07	110.90	9,581.65
07.07.10	67.02	117.04	108.13	106.10	97.20	8,398.22
08.07.10	60.10	119.69	114.48	113.70	99.33	8,581.68
09.07.10	49.01	112.45	129.80	141.67	105.82	9,142.63
10.07.10	91.98	143.99	146.91	139.23	128.80	11,128.50
11.07.10	88.99	135.70	133.84	136.02	121.52	10,499.58
12.07.10	84.91	130.46	126.01	127.86	115.15	9,948.92
13.07.10	79.76	141.74	143.53	147.42	125.44	10,838.23
14.07.10	80.62	140.73	142.00	145.93	124.70	10,774.48
15.07.10	81.99	143.27	142.81	150.50	126.75	10,951.16
16.07.10	89.25	138.76	143.98	149.24	128.24	11,080.19
17.07.10	77.30	151.22	153.48	150.63	130.29	11,257.09

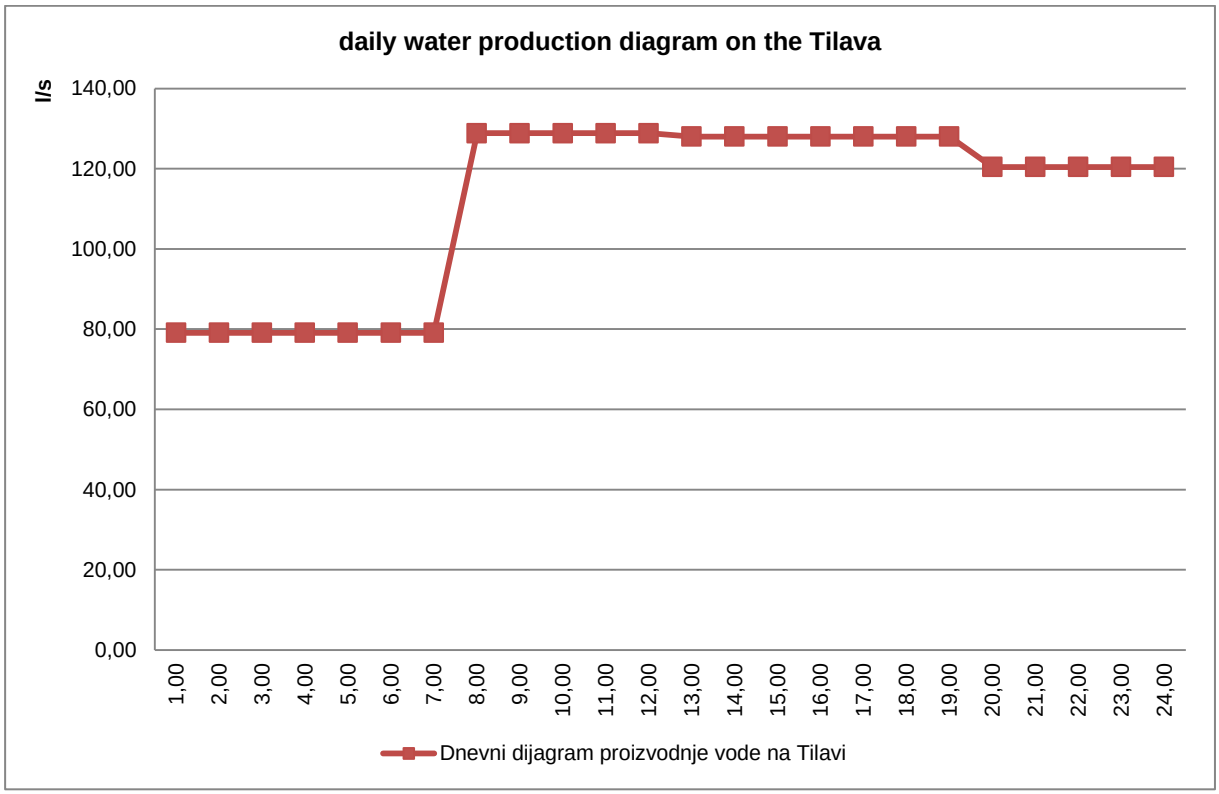
18.07.10	76.27	137.99	133.55	126.64	116.14	10,034.82
19.07.10	72.36	122.90	126.43	131.84	111.20	9,607.54
20.07.10	80.06	145.50	143.05	150.71	126.68	10,945.33
21.07.10	72.27	129.70	127.56	132.58	112.84	9,749.05
22.07.10	87.86	152.24	148.72	151.02	132.04	11,407.82
23.07.10	84.17	145.96	145.78	151.53	129.04	11,148.91
24.07.10	80.84	143.67	130.93	118.23	115.80	10,004.94
25.07.10	85.12	112.74	110.53	107.69	102.90	8,890.16
26.07.10	66.09	113.16	111.56	108.59	97.95	8,462.52
27.07.10	66.06	112.71	119.62	116.32	102.16	8,826.55
28.07.10	68.75	124.07	124.26	115.63	106.24	9,179.14
29.07.10	70.88	133.14	136.15	133.98	116.16	10,036.15
30.07.10	73.64	127.01	123.90	120.97	109.15	9,430.45
31.07.10	69.93	137.69	135.34	122.10	113.90	9,840.56
average	**76.40**	**131.89**	**131.90**	**129.89**	**115.30**	**308,812.86**
August	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.08.10	75.66	118.29	125.70	126.18	109.97	9,501.41
02.08.10	46.57	123.92	127.45	138.12	105.49	9,114.73
03.08.10	77.89	149.14	139.82	131.92	121.66	10,511.82
04.08.10	63.53	110.98	112.86	115.68	98.75	8,531.68
05.08.10	71.33	130.48	135.83	133.31	115.60	9,987.91
06.08.10	69.94	125.03	128.40	126.92	110.48	9,545.40
07.08.10	86.38	140.86	140.65	126.85	121.98	10,539.18
08.08.10	78.86	132.41	130.99	126.54	115.10	9,944.21
09.08.10	79.98	137.21	131.68	132.36	117.66	10,166.18
10.08.10	81.80	142.59	139.66	136.02	122.51	10,585.22
11.08.10	78.58	141.16	139.77	140.37	122.28	10,564.96
12.08.10	80.69	145.19	141.36	142.58	124.56	10,761.73
13.08.10	82.28	143.92	144.90	145.33	126.56	10,934.96
14.08.10	81.31	144.79	142.34	139.19	124.29	10,738.80
15.08.10	77.12	129.93	132.12	138.88	117.12	10,119.31
16.08.10	84.10	150.52	145.85	146.41	128.73	11,122.67
17.08.10	83.86	146.14	138.84	144.31	125.16	10,813.86
18.08.10	82.47	148.04	146.36	144.51	127.62	11,026.37
19.08.10	76.67	133.20	133.58	132.56	116.71	10,083.35
20.08.10	91.85	154.44	147.09	144.72	131.71	11,379.71
21.08.10	80.08	149.49	146.16	137.76	125.69	10,859.76
22.08.10	78.77	139.57	137.99	142.17	121.85	10,527.98
23.08.10	80.63	148.54	141.97	141.35	125.05	10,803.89
24.08.10	79.00	145.99	144.58	145.96	125.98	10,884.24
25.08.10	80.64	134.06	149.46	137.70	124.37	10,745.64
26.08.10	76.35	144.16	144.81	161.83	128.28	11,083.39
27.08.10	83.18	146.62	147.62	156.16	130.44	11,269.80
28.08.10	79.47	141.57	131.06	115.96	114.62	9,903.06
29.08.10	69.78	113.62	120.79	110.17	102.50	8,856.40
30.08.10	63.05	124.53	119.52	111.06	102.12	8,823.35
31.08.10	69.02	119.78	122.21	111.80	104.12	8,996.18
average	**77.12**	**137.29**	**136.49**	**134.98**	**119.00**	**318,727.15**
September	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.09.10	64.89	116.34	121.74	112.82	102.40	8,847.40
02.09.10	69.63	127.12	124.83	116.02	107.28	9,268.67
03.09.10	71.07	128.20	127.30	121.05	109.75	9,482.18
04.09.10	73.57	135.37	135.30	115.09	113.10	9,771.55

05.09.10	72.18	119.74	129.04	121.44	109.32	9,445.46
06.09.10	74.04	131.86	120.57	113.29	107.36	9,276.23
07.09.10	74.43	128.27	127.31	121.69	110.88	9,579.67
08.09.10	75.42	134.36	148.38	124.79	119.85	10,354.93
09.09.10	79.58	135.42	134.00	122.01	115.87	10,010.84
10.09.10	73.41	117.17	116.51	109.93	102.68	8,871.41
11.09.10	66.10	121.22	114.48	116.74	101.96	8,809.63
12.09.10	77.81		127.45		65.18	5,631.37
13.09.10					0.00	0.00
14.09.10		113.11	121.66	115.19	83.40	7,206.01
15.09.10	78.40	131.57	124.68	111.42	109.57	9,466.63
16.09.10	59.41	128.46	125.97	114.56	104.59	9,036.97
17.09.10	63.68	126.99	118.04	109.46	101.89	8,803.22
18.09.10	69.02	127.32	131.17	111.14	108.23	9,350.93
19.09.10	100.78	120.38	116.99	110.12	111.40	9,624.60
20.09.10	66.77	123.09	123.19	112.67	104.53	9,031.03
21.09.10	68.02	118.92	114.49	104.03	99.50	8,596.40
22.09.10	63.88	123.74	119.99	108.52	101.86	8,800.70
23.09.10	69.54	121.18	122.60	112.95	104.88	9,061.38
24.09.10	61.71	127.08	124.08	107.38	102.91	8,891.39
25.09.10	80.56	133.22	123.41	104.31	108.57	9,380.27
26.09.10	59.97	117.13	120.22	112.66	100.56	8,688.13
27.09.10	62.13	118.26	109.72	100.18	95.28	8,231.80
28.09.10	62.02	128.44	126.26	110.25	104.55	9,033.23
29.09.10	65.08	118.96	124.17	106.73	102.43	8,850.28
30.09.10	66.16	132.56	125.09	102.92	104.53	9,031.25
average	**70.33**	**125.19**	**124.09**	**112.47**	**107.65**	**260,433.58**
October	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.10.10	52.48	118.96	113.30	102.11	94.17	8,136.54
02.10.10	51.93	120.11	123.14	104.35	97.95	8,462.95
03.10.10	50.22	114.86	114.89	103.40	93.63	8,089.56
04.10.10	53.04	117.51	118.49	101.50	95.70	8,268.26
05.10.10	54.04	116.58	112.70	102.75	94.16	8,135.82
06.10.10	56.59	113.49	121.48	104.31	97.65	8,436.53
07.10.10	57.97	92.19	114.37	106.03	92.49	7,990.78
08.10.10	52.41	125.08	121.38	105.07	98.48	8,508.89
09.10.10	57.41	118.62	125.11	97.03	98.43	8,504.57
10.10.10	62.76	119.81	122.86	113.94	102.96	8,896.10
11.10.10	66.73	127.93	126.18	116.95	107.21	9,262.87
12.10.10	78.32	125.87	126.75	118.08	110.67	9,562.03
13.10.10	75.13	130.78	124.14	116.85	109.43	9,455.04
14.10.10	67.58	119.52	111.06	105.76	98.68	8,526.31
15.10.10	62.59	122.35	120.46	104.33	100.54	8,686.30
16.10.10	63.25	118.71	127.82	107.77	103.29	8,924.40
17.10.10	72.10	119.80	132.04	120.02	110.01	9,505.15
18.10.10	76.26	127.93	127.68	115.61	110.21	9,522.11
19.10.10	76.01	121.78	121.94	112.38	106.53	9,203.80
20.10.10	73.53	123.60	126.72	117.96	108.86	9,405.61
21.10.10	77.60	129.53	130.84	116.65	112.14	9,688.64
22.10.10	66.19	123.72	128.12	111.47	105.86	9,145.87
23.10.10	71.78	124.47	135.04	109.56	109.52	9,462.46
24.10.10	70.30	116.59	127.41	117.56	106.90	9,235.94
25.10.10	68.90	122.83	117.73	107.85	102.28	8,836.96
26.10.10	64.44	115.42	114.85	107.61	98.73	8,530.60

27.10.10	66.57	113.20	110.63	100.94	96.19	8,310.71
28.10.10	68.03	124.55	124.16	113.60	105.65	9,128.48
29.10.10	75.81	126.25	129.44	114.75	110.21	9,521.78
30.10.10	71.86	123.47	134.45	116.52	110.63	9,558.36
31.10.10	76.41	126.97	119.94	105.69	105.45	9,110.59
average	**65.74**	**120.72**	**122.74**	**109.62**	**103.05**	**276,014.02**
November	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.11.10	65.76	130.40	122.18	106.10	103.74	8,963.50
02.11.10	67.39	129.78	120.69	106.60	103.72	8,961.73
03.11.10	74.61	131.49	125.81	114.04	109.37	9,449.68
04.11.10	79.49	138.73	131.63	119.20	115.02	9,937.40
05.11.10	74.95	131.79	124.79	109.34	108.20	9,348.59
06.11.10	74.03	137.58	132.97	110.24	111.81	9,660.56
07.11.10	74.41	130.03	132.35	115.48	111.55	9,637.88
08.11.10	74.81	124.44	113.82	106.09	102.60	8,864.78
09.11.10	73.15	126.44	119.54	107.90	104.73	9,049.07
10.11.10	68.54	121.68	113.47	105.08	99.99	8,638.78
11.11.10	64.38	127.03	119.88	112.97	103.44	8,937.61
12.11.10	76.44	128.63	127.28	112.58	109.61	9,470.66
13.11.10	78.79	140.78	135.53	115.79	115.74	10,000.22
14.11.10	80.84	126.57	130.97	117.26	112.76	9,742.39
15.11.10	79.36	134.54	131.00	103.37	110.77	9,570.71
16.11.10	71.87	122.34	113.49	96.65	99.32	8,581.03
17.11.10	61.62	114.44	109.62	101.81	94.80	8,190.40
18.11.10	63.08	121.26	114.23	100.83	97.69	8,440.52
19.11.10	58.15	118.29	109.72	99.84	94.05	8,125.81
20.11.10	64.24	124.18	123.33	101.00	101.59	8,776.94
21.11.10	53.62	108.99	108.36	95.36	89.79	7,757.93
22.11.10	54.32	108.86	107.84	100.15	90.80	7,844.94
23.11.10	62.65	116.25	112.22	102.36	96.38	8,327.20
24.11.10	62.15	111.74	108.90	101.55	94.21	8,139.46
25.11.10	62.19	118.35	118.42	110.80	100.42	8,676.32
26.11.10	69.35	118.18	115.13	103.83	99.93	8,634.10
27.11.10	70.35	123.97	133.25	114.68	109.49	9,459.83
28.11.10	83.17	117.42	122.64	107.95	107.20	9,261.86
29.11.10	69.48	124.31	115.25	102.49	100.75	8,704.98
30.11.10	64.69	114.20	110.15	102.77	96.03	8,296.85
average	**69.26**	**124.08**	**120.14**	**106.80**	**99.86**	**267,451.74**
December	**00-06,[59]**	**07-10,[59]**	**11-18,[59]**	**19-23,[59]**	**Average**	**Total**
	lps	**lps**	**lps**	**lps**	**lps**	**m^3/day**
01.12.10	64.11	119.26	114.89	110.41	99.87	8,629.13
02.12.10	73.07	122.32	116.86	108.34	103.22	8,918.46
03.12.10	77.64	117.79	119.28	115.95	106.19	9,175.07
04.12.10	77.06	112.70	122.31	123.30	107.72	9,306.72
05.12.10	77.40	107.09	151.78	127.21	117.52	10,153.62
06.12.10	74.53	127.75	123.22	110.47	107.12	9,254.95
07.12.10	69.11	122.61	116.12	107.77	101.75	8,791.27
08.12.10	67.82	123.78	118.41	106.42	102.05	8,817.26
09.12.10	68.20	118.12	114.49	109.64	100.58	8,690.40
10.12.10	76.52	121.20	107.29	98.75	98.85	8,541.04
11.12.10	61.82	118.68	119.23	100.92	98.58	8,517.24
12.12.10	58.48	110.35	133.50	118.85	104.71	9,046.84
13.12.10	62.08	114.34	108.54	105.15	95.25	8,229.56
14.12.10	65.18	127.09	132.16	107.19	106.58	9,208.26

15.12.10	76.76	120.84	151.74	124.72	119.09	10,289.52
16.12.10	79.28	140.30	119.93	118.05	111.08	9,597.06
17.12.10	87.39	135.78	123.49	125.00	115.32	9,963.97
18.12.10	87.58	128.75	138.01	122.76	118.58	10,245.38
19.12.10	86.23	126.49	127.55	113.66	112.43	9,713.77
20.12.10	88.50	127.40	136.70	139.33	121.64	10,509.66
21.12.10	89.50	133.28	122.41	114.20	112.91	9,755.64
22.12.10	85.11	120.75	127.31	116.86	111.73	9,653.58
23.12.10	77.62	127.03	118.35	118.75	108.00	9,331.24
24.12.10	77.92	124.49	124.44	115.57	109.03	9,420.37
25.12.10	78.05	124.32	125.90	111.56	108.69	9,391.07
26.12.10	76.10	115.30	124.13	119.62	107.71	9,306.14
27.12.10	91.81	135.82	128.30	125.35	118.30	10,220.76
28.12.10	91.06	134.36	129.70	125.21	118.27	10,218.64
29.12.10	96.13	129.44	126.05	118.06	116.22	10,041.73
30.12.10	88.50	129.74	123.88	119.08	113.54	9,809.64
31.12.10	83.52	125.08	131.87	111.60	112.41	9,712.51
average	**77.87**	**123.94**	**125.09**	**115.79**	**109.19**	**292,460.51**
Total average:	**79.11**	**128.86**	**128.02**	**120.45**	**110.93**	**3,498,263.24**
Coefficient of daily variation					**1.28**	

Chart 15: Average daily water production diagram on the Tilava in 2010



2.5 ANALYSIS OF WATER SUPPLY SYSTEM ISTOČNO SARAJEVO

2.5.1 WATER SUPPLY SYSTEM OPERATION

Water supply system Istočno Sarajevo is not an integral system. Besides the largest water supply system WSS Tilava, there is also a number of minor systems of water supply. Future task is to connect all these systems into one integral system.

The main problem of water supply system is control over the system. Unlike most companies in BiH, AD Vodovod i kanalizacija has its team which deals with GIS and measurements and water balance in the system. However, this is still below satisfactory level. GIS database is not complete. Cadastre of underground installation exists only partially. One is currently working on inserting data on pipelines and facilities in the system – pumping stations and reservoirs. There is still no information on consumers in GIS database. Consequently, now we have situation that the program, in which we insert the data on readings of water production and water consumption, cannot provide data on consumption by system zones, whether it is a reservoir zone or pressure zone. It still takes a lot of time and resources to compete the GIS database. It is also necessary to link departments within the company, so that the readings of consumption are directly being inserted into GIS database in order to provide the collection service with this information, but also the technical sector that needs to conduct some analysis of the system.

There is no water system hydraulic model which would be linked to GIS database. Hydraulic model is significant for several reasons. It is only by developing hydraulic model, can we control the system completely. Hydraulic model offers great opportunities in both the control of the system operation and in future plans for system and city development.

Loss control has been carried out continuously, but without hydraulic model and detailed plans, measurement programs and loss detection, there will be no significant success in this field. Water losses are the biggest problem in all BiH water utilities. Physical losses as a part of Non-revenue water quantities certainly make its largest part. However, we should not neglect other parts of Non-revenue water which also make the system unprofitable. For the company every financial loss is the same no matter which way the water is lost. Therefore, it is necessary to draft urgently plans of Non-revenue water quantities control, and in parallel with development of GIS and water system hydraulic model, to work on reducing this amount of water. GIS and hydraulic model is the main tool in the fight against losses in the system.

When we speak about water supply network and system facilities, water supply system has not been completed yet. Here we stress the lack of reservoir space in First pressure zone of supply.

At this point, hillside area of Trebević is not supplied with water from the source Tilava. The tendency of municipalities and water utility company is to cover all parts of municipality with city's water supply system.

According to calculated balances of water quantities, this will be possible. At the end of planned period there will be a minor water deficit, but in future one of the activities will certainly be research works aimed at finding additional amounts of water. One of the sources that will certainly be interesting is the source Grabski mlini which supplies the settlement Kijevo in Trnovo municipality. However, capacity of this source significantly exceeds the needs of this settlement. Consequently, it will be possible to take part of the water from this source for the needs of WSS Istočno Sarajevo. Still, besides these measures, there will be expressed water deficit in the future at the sources which needs to be solved by future investigation activities.

2.5.2 CITY WATER SUPPLY SYSTEM COVERAGE

Water Supply System Istočno Sarajevo manages only partially to satisfy the needs of the population and economy in the area of municipalities Istočna Ilidža and Istočno Novo Sarajevo. Percentage of population water supplied from urban water supply system and other water supply systems maintained by Water Supply and Sewerage Istočno Sarajevo (this does not include the area of Municipality Trnovo), is quite high, and is 89,6 % as shown in the table below. This is above average for Bosnia and Herzegovina and Republika Srpska, where this percentage is not higher than 50 %.

Table 36: Population supplied with water from WSS Istočno Sarajevo

Municipality	Total Population in 2010	Population connected to WSS Tilava and WSS Jahorinska vrela	Percentage of population connected to WSS Tilava and WSS Jahorinska vrela
Istočna Ilidža	16.839	22.256	78,50%
Istočno Novo Sarajevo	11.510	3.142	11,08%
Total:	**28.350**	**25.398**	**89,6%**

There are real prospects for water supply for the rest of population, via water supply systems that will be under the management of ViK Istočno Sarajevo. Some of the systems, which currently have no connection to urban Water supply system will be connected, in the future, to WSS Istočno Sarajevo, while the other systems, although remaining separate, will be under the management of ViK Sarajevo. This will be one of the few municipalities that will have Urban water supply system coverage of over 90 %.

Urban water supply system does not cover the hillside area of Trebević with settlements which are water supplied via water supply system Jahorina (Prača), WSS of Federal Sarajevo and some smaller local water supply systems:

- **settlement Vraca** is connected to Water System Sarajevo (FBiH);
- **settlements Miljevići, Petrovići** and other, are water supplied from Jahorina system via Babe Reservoir.
- smaller settlements **from Petrovici to Tvrdimici** which are supplied with water via several smaller sources.

Urban water supply system does not cover the part of Kasindo and Gornje Mladice.

There are technical solutions that propose inclusion of these settlements into one water supply system. This would mean that almost 100 % of the population would be connected to urban water supply system which is managed by AD Vodovod i kanalizacija Istočno Sarajevo.

2.5.3 SOURCES AND BALANCE OF WATER QUANTITIES

2.5.3.1 ABSTRACTED WATER QUANTITIES

Main source of Water Supply System is water intake on Tilava River and Potable Water Purification Plant. Plant requires regular maintenance and minor repairs. Currently, project on filter replacement is under way.

Study for protected zones of water intake on the river Tilava has been carried out.

Other water sources are of smaller capacity and require minor repairs.

Based on the analysis of Water Supply System Istočno Sarajevo, the following can be concluded:

- **Current amounts of water at the sources are sufficient.**

  In Table 52: Balance of water quantities in the area of WSS Istočno SarajevoTable 52: ***and Table 42: Estimate of required water quantities for the area currently supplied from WSS Tilava***, it can be seen that the amounts of water for the coming period are insufficient. Currently, the existing water sources can satisfy needs for water of both, population and economy, but in the future, for 7 to 10 years, there will be water shortage in the system. Water source Grabski mlini would be introduced, in the future, into the WSS Istočno Sarajevo. However, despite these amounts of water, **at the end ofplanning period, water deficit of 39,6lps are expressed at the water sources**. One can see the difference in the estimations, which were made in Master Plan in 2007. The reasons for this are population numbers lower than expected for water supply via this water supply system. Leakage in water supply system should be reduced to a reasonable level (for our currant situation 20 – 30 %) and than, if water deficit reappears, explore the options of finding new quantities of water for the system. In order to satisfy the needs from existing sources for the period from 5 to 10 years, it is necessary to reduce losses to economically justified minimum. If they fail to take action to reduce losses in the system, insufficient amount of water in the system can already appear in the near future.
  Water balances does not include minor sources on the slopes of Trebević, which are currently unexplored and have no data on yield.

- Qualityof water is satisfactory.

2.5.3.2 TILAVA POTABLE WATER CONDITIONING PLANT

The plant requires regular maintenance of its facilities and equipment. In 2010, filter fields rehabilitation project was drafted and it represents one of the priority projects in water supply system Tilava. Facilities itself are in relatively good condition.

2.5.3.3 BALANCE OF WATER QUANTITIES

Water Balances (partial) are given in Chart 16: Diagram of relation between Revenue and Non-Revenue Water Quantities– September 2007.

This Chart shows balance of produced and lost annual water quantities.

The conclusion follows:

- **According to data obtained in company Vodovod i kanalizacija Istočno Sarajevo, in September 2007, it is produced 98.4 lps or 255,052.80 m^3 of water at Potable Water Purification Plant Tilava.**
- **Of which Revenue Water is 137,269.42 m^3 or 53.82 %.**
- **Non-Revenue Water makes 117,783.38 m^3 or 46.18 %.**

Percentage of Non-Revenue Water is high (46.18 %), but compared to other water systems in Republic of Srpska, this system is in good condition. In the majority of systems, this percentage reaches from 60 % up to 85 %, making these systems unprofitable.

Table 37: Produced and consumed water in September 2007

Water Balance	Produced and consumed water (m3/month)	Percentage
Revenue Water for population	94,762	37.15%
Revenue Water for economy	28,241	11.07%
Revenue Water for military base in Krtelji	14,257	5.59%
Non-Revenue Water	117,792.8	46.18%

Produced Water	**255,052.8**	**100%**

The results form the previous table should be interpreted with caution because the amount of water produced does not include water amounts from Jahorina's system (approx. 5.0 l/s) which would partially worsened the result.

Table 23: An overview of quantity of produced and revenue water in WSS Tilava in September 2007gives an overview of Revenue and Non-Revenue Water.

According to new data for the year 2010, the rate of Revenue and Non-Revenue Water is even more unfavourable. In the meantime, conditions of the system worsened, probably due to increased physical losses in the system.

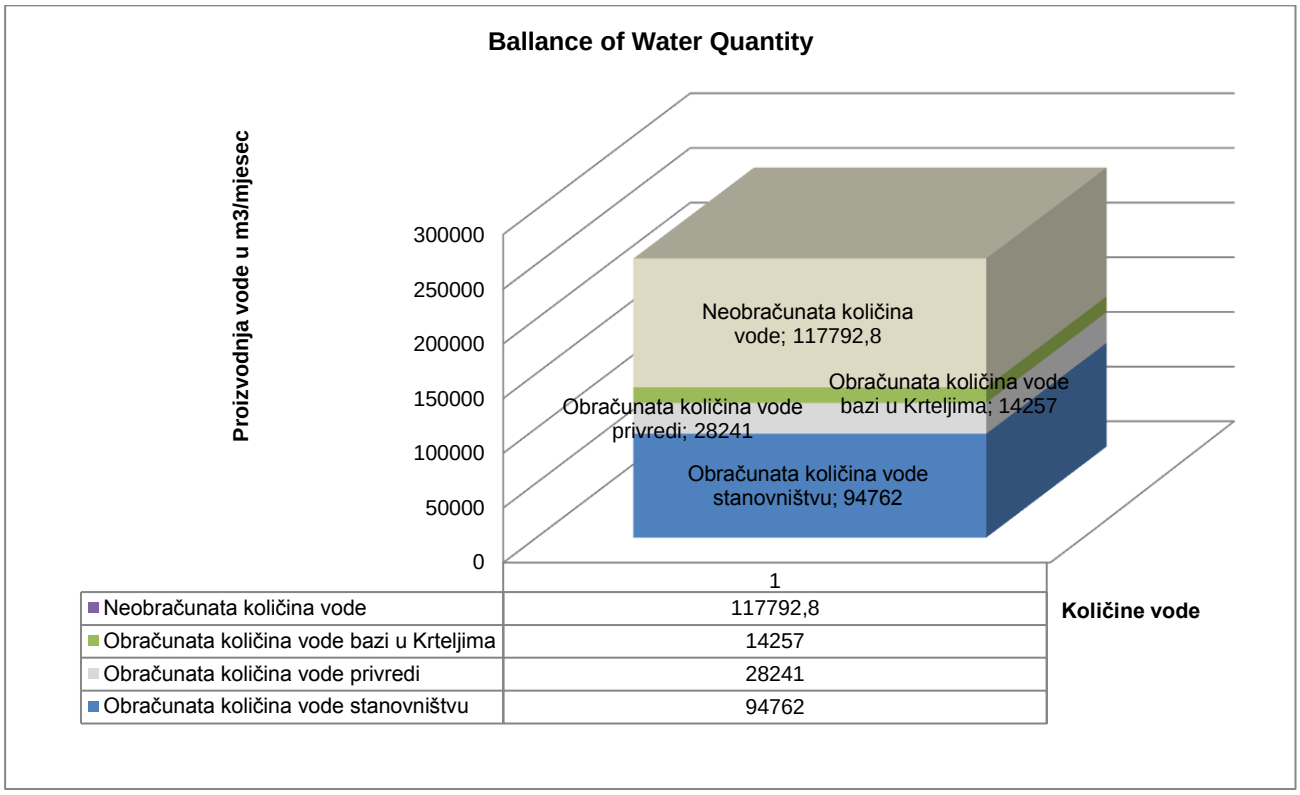
In**Table 25: Comparison of water quantities for 2006/2007 and 2010**this change can be seen. According to present data, **percentage of Non-Revenue water hasincreasedfrom 46.18 % in 2007 to 52.16 % in 2010.**

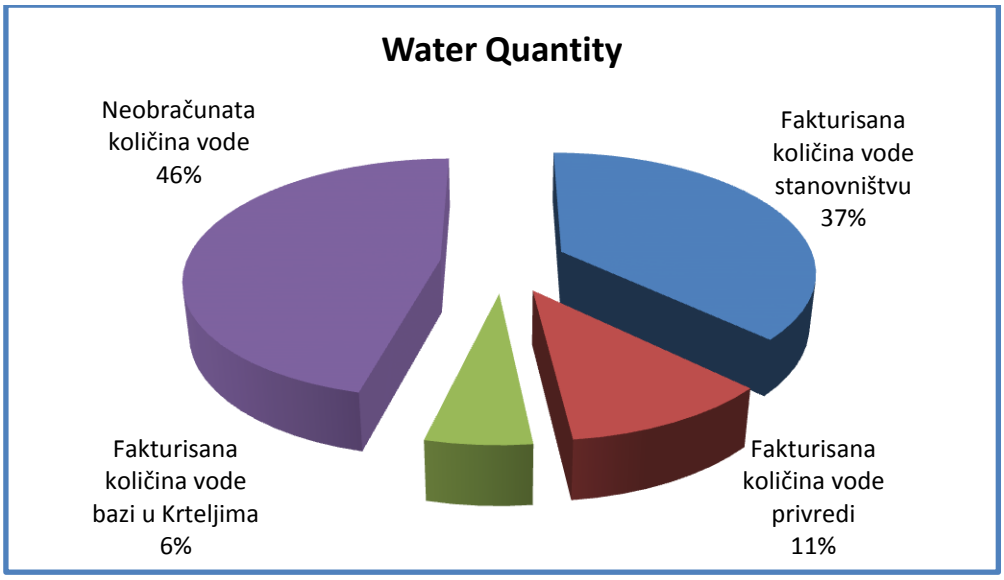
Detailed data on connections are given in chapter***2.4.1Consumers, production of water and water consumption for water supply systems managed by Vodovod i kanalizacija Ltd Istočno Sarajevo.***

The system services around **25,000 inhabitants**. **Specific Water Consumption** je is very high, compared to the amount of produced water, and it reads **– q_{sp}=414,51 l per capita per day. Specific Water Consumption for population and industry without losses is,** according to these balances **app q_{sp}=193,85 l per capita per day. Specific Consumption for population** is estimated at **q_{sp}=140 l per capita per day.**

Percentage of Physical Losses in the system, which is the part of Non-Revenue water, can be only estimated, for the lack of researches and data considering water quantity. However, one can say with certainty that these losses are below 50 %, if the percentage of Non-Revenue Water is 52.16 %.

Chart 16: Diagram of relation between Revenue and Non-Revenue Water Quantities– September 2007





ACTUAL WATER BALANCE of WSS Istočno Sarajevo cannot be calculated at this point. In order to determine balance of water, it requires measurements that are more precise. At this point, one can hardly calculate water balance for any water supply system in BiH.

Chart 17: Water balance which is the necessity of every water supply system

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water	Paid accounts
			Billed Unmetered Consumption		Unpaid calculated water
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water	Non-Revenue Water
			Unbilled Unmetered Consumption		
	Water Losses	Commercial Losses	Unauthorized Consumption		
			Customer Meter Inaccuracies and Data Handling Errors		
		Physical Losses	Leakage on Transmission & Distributions Mains		
			Leakage and Overflows at Thanks		
			Leakage on Service Connections up to metering point		

2.5.4 PIPELINES IN THE SYSTEM

In chapter 2.3 CURRENT WATER SUPPLY System, and tables - **Table 8: Distribution and transmission pipelines of the first pressure zone,Table 9: Diameter of distribution and transmission pipelines**, **Table 11: Existing pipelines WSS Baba (Zlatište)**, **Table 13: Transmission pipelines – WSS Grabski mlini**, **Table 14: Distribution pipelines – WSS Grabski mlini**, an overview is given of existing pipelines in WSS Istočno Sarajevo and some minor systems, which will become, in future, an integral part of this system.

Total length of the pipeline is over 100 km. Pipes are made of different kinds of material, but newer pipes are made of polyethylene, which is good. This is good quality material, and its price is acceptable.

Basic characteristics are, as follows:

- Capacity of transmission pipeline is sufficient.
- Distribution network is in poor condition and it requires rehabilitation of losses, replacement of pipelines with observed losses as well as replacement of pipelines which represent bottleneck in the system. Also, construction of new pipelines is needed, in order to connect to the system the remaining population, currently lacking access to water supply system.

Pipeline coverage of the system is quite good. However, main problem are certainly water losses in the system. This problem is present throughout BiH, but, unfortunately, few programs to reduce losses are done. This issue must be approached systematically, for activities to reduce losses in the system are permanent. It is not possible to reduce the losses in a certain year and then do nothing in the following year, as that will almost certainly result in repeated losses.

It has already been mentioned that water balance calculation implies that these losses will be reduced to minimum in the coming period, if we do not want to include in the system some new sources, already lacking in this area. So only the maintenance of the system, reduction of losses can lead to regular water supply.

Besides replacement of pipelines that represent bottlenecks in the system, it is necessary to built new distribution pipelines in the future, especially in higher zones of water supply.

EFFICIENCY OF DISTRIBUTION NETWORK

Efficiency of the system can be expressed with the ratio. In the case of water supply system Istočno Sarajevo it can be approximately given ratio of Network efficiency.

Efficiency of network is, as follows:

$$\textbf{Network efficiency} = 1 - \frac{\text{Water losses}}{\text{Inserted water}} = 1 - \frac{\mathbf{1.796.990,41}}{\mathbf{1.801.850,39}} = \mathbf{0.50}$$

Efficiency of network is 0.50, which represent very low coefficient. Namely, in the European Union countries this coefficient ranges from **0.80** to **0.85**. However, compared to other water supply systems in Republika Srpska, where this coefficient is lower than 0.4, this coefficient is good. These are data for the year 2010.

The following activities are the responsibility of Water utility company:

- construction and maintenance of Water Supply System,
- detection and reduction of water losses from the source to Consumer Water Meters,
- water billing for end users.

In this part of the system there are various categories of losses. One of the possible divisions is on:

- visible, i.e. those easily detected without any complex research,
- and invisible, i.e. those whose detection requires various measurements, analysis of research, etc.

In the part of water supply system from the Water Meter to the Consumer i.e. at the individual consumer point, there are water losses. This part of network i.e. these losses are responsibility of owners of associated facilities or Housing Funds responsible for

maintenance of residential buildings. In circumstances when water meters operate properly or when the water has an economic cost, Water Utility company has no interest in reducing this consumption or losses.

But in present circumstances, when the price of water charged by water utility is unrealistically low, it is in the utility company's best interest to reduce these losses, because unnecessary waste of water or water leakage in some consumer connections have resulted in irregular water supply of other, than irregular payments all leading to a 'vicious circle'. Therefore, water losses after the water meter are not responsibility of water utility company, but it is in its best interest to reduce them. Water utility can affect it by education of the population through the media and forums as well as educational institutions.

Moreover, water utility should organise its own team for repair of these defects at minimum maintenance costs. This would also have a favourable impact on citizens' trust in water supply company.

Invisible water losses occur in the following points in the system:

- water leakage in the water supply network, underground,
- losses due to defective water meter,
- losses due to unauthorized consumption,
- losses in household installations.

2.5.5 RESERVOIRS

One of the fundamental flows in WSS Tilava i.e. WSS Istočno Sarajevo is the lack of reservoir space.

Analysis of WSS Istočno Sarajevo, led to the following conclusions:

- Existing **reservoir storage capacity** is insufficient. This deficit is expressed primarily in **the I pressure zone**. Main reservoir for this zone is a reservoir at facility Tilava with the volume of **V=600 m^3**. Taking into consideration that this reservoir also supplies II pressure zone of Kasindo using pumps, it can be concluded that the I pressure zone, in fact, has no reservoir for smoothing out daily fluctuation in water consumption. In the First pressure zone, shortage of reservoir storage capacity is, at this time, approx.**V=3,200.0 m^3**.

  Position of the reservoir Tilava is very unfavourable concerning hydraulic requirements. Reservoir covers a system area of around 10 km in length which is very unfavourable concerning equalization of daily water requirements.

  Finishing one chamber of the **reservoir Donji Kotorac** volume of **V=5,000.0 m^3** located at the elevation of **565.0 m.a.s.l.** will certainly solve this problem.It has good position in relation to reservoir Tilava. This reservoir is only partially completed and its volume (only one chamber) would meet long-term needs for reservoir space in the first pressure supply zone.

Required water amount in I pressure zone (l/s)	Required reservoir volume (m^3)	Existing reservoir storage capacity (m^3)	Reservoir space deficit (m^3)
135,33	3.897,61	600,00	3.297,61

- In the Second pressure zone of Kasindo, a reservoir "Križ" - Kasindo volume of **V=1,000.0 m^3** was finished in 2010. This reservoir also covers future reservoir space requirements in this supply zone.

- In higher parts of water supply – hillside area of Trebević,and in part that covers Jahorina's water supply system as well as in the part which cover local springs (Petrovići), reservoir space is currently sufficient.

  Therefore, in the higher zones reservoir space meets current reservoir space requirements.

- Reservoir space deficit in the future was given in table below.

  At the moment, deficit is expressed only in the First zone of supply which is solved by completion of one chamber of reservoir Donji Kotorac. Development of the system will require construction of new reservoirs in the Second pressure zone – reservoirs Katića brdo and Prljevo brdo, and reservoir Kadino brdo that is required for the Third and higher pressure zones of water supply.

  Total required new reservoir space besides Donji Kotorac is **V=950.0 m^3**. This volume is much smaller than in Conceptual solution plans. The reason for this certainly lies in development plans of the area of Toplik and Kadino and Prljevo brdo. At the time when Conceptual solution was planned, there were development plans for Istočno Sarajevo which was very ambitious. We believe that in this moment such solution should be given for practical reasons.

Table 38: Estimate of requirements for reservoir space by water supply zones

Area - Supply Zone		Reservoir Coverage Area	Required amount of water for the area supplied from the reservoir (l/s)	Required reservoir volume (m^3)	Existing Reservoir Name	Existing reservoir space volume (m^3)	Existing Reservoir Space Bottom level (m.a.s.l.)	Reservoir space deficit (m^3)	New Reservoir Name	Adopted new reservoir volume (m^3)	New reservoir bottom level (m.a.s.l.)
I zone	I pressure zone Tilava	I Supply Zone	132,17	3.425,97	Tilava – potable water treatment plant	600,00	576,00	2.825,97	Reservoir Donji Kotorac	5.000,00	565,00
II zone	II pressure zone Kasindo	II Supply Zone - settlement Kasindo, Pavlovac and Gornje Mladice	44,98	1.165,85	Križ - Kasindo	1.000,00	630,00	0,00			
					Pavlovac - II pressure zone	180,00	614,00				
	II pressure zone Gornji Kotorac	II Supply Zone - Gornji Kotorac area			Gornji Kotorac	100,00	637.8				
	II pressure zone Tilava and water transmission toward R. Kadino brdo	II Supply Zone - settlement Toplik	5,74	148,68		0,00		244,52	Katića brdo	250,00	620,00
		Water transmission towards Kadino brdo	13,31	95,84		0,00					
	II pressure zone Tilava	II Supply Zone - settlement Toplik			Tomino brdo	100,00	660,10				
	II pressure zone Prljevo brdo	II Supply Zone - settlements Prljevo brdo and part of Vraca	6,60	171,10		0,00		171,10	Reservoir Prljevo brdo	200,00	632,50
III zone	III pressure zone Kadino brdo	II zone and system reservoir for hillside area of Trebević	13,31	345,02		0,00		345,02	Reservoir Kadino brdo	500,00	670,00
IV zone	IV pressure zone Trebević	IV Supply Zone	1,54	40,04	Reservoir Kozarevići	30,00	700,50	10,04			
V zone	V pressure zone Trebević	V Supply Zone	1,54	40,04	R.K. Projište	30,00	767,14	10,04			
VI zone	VI pressure zone Trebević	VI Supply Zone	1,54	40,04	Baba (Zlatište)	500,00	824,40	-459,96			
LC Petrovići	LC Petrovići – hillside area of Trebević	V Supply Zone	1,51	39,11	Izlazine (Logor)	50,00	823,00	-30,89			
					Igrišta	20,00					
		VI Supply Zone	2,00	51,74	Podstrana	50,00	823,00	1,74			
		VII Supply Zone	1,26	32,59	Dobrik	46,00	900,00	-13,41			
		Total:	**225,51**	**5.845,21**		**2.706,00**		**3.104,18**		**5.950,00**	

2.5.6 PUMPING STATIONS

Water Supply System Istočno Sarajevo is mainly gravitational. The I pressure zone, which represents the largest part of the system, is gravitational.

There is only one significant pumping station, and that is new pumping station for II pressure zone Kasindo.

Other pumps have low capacity.

Part of pumping stations has to be reconstructed.

2.5.7 MEASUREMENTS IN THE SYSTEM

It is necessary to carry out measurements at water sources, reservoirs, as well as at control metering points and at the end users. In recent years, by installing water meters for the end users, the situation, concerning the amounts of Revenue Water and reducing the amounts of Non-Revenue Water, has significantly improved. Due to lack of measurements of water consumption for the end users, and lump sum water billing, considerable amount of water is lost or spent.

One of the main reasons for conduction of frequent measurements in the system is, certainly, to control and monitor the system, which would be impossible without necessary measurements, and this would be one of the future priorities.

2.5.8 NON-REVENUE WATER AMOUNT

The following text presents issues often encountered in the operation of the water supply systems related to the amounts of non-revenue water as well as the principles related to the reduction of non-revenue water. Namely, it has already been noted that water utility with existing water price and amounts of non-revenue water is not economically viable. The following text presents the losses in company business, which are not only the cause of physical losses of water in the system, and which are, also, the main subject of this project.

2.5.8.1 DEFINITIONS

Non-revenue water can be roughly defined as the difference between the volumes of water inserted into distribution network against the volume of revenue water for users. In this way non-revenue water presents water utility revenue loss. Main categories of non-revenue water are, as follows:

I Physical water losses:

- Losses in the main pipelines and connections
- Leakage from the reservoir
- Other technical losses

II Unmeasured delivered water free of charge:

- water delivered to the fountains, a market, etc.
- water used by military, official institutions and religious societies
- water use in households of company employees and government officials with exemption of payments
- water used by municipal services (fire fighting, cisterns and premises cleaning, streets cleaning, sewerage flushing)
- unmetered water used in the processing plants (using large flow meters)

III Unmeasured water delivered to the consumers with obligation to pay:

- insufficient water metering with poorly operating water meters or deficient water meters
- inaccurate routine water meter reading
- users that cheat by breaking and destroying the water meters
- illegal unmetered consumer connections

IV Insufficient payments:

- lump sum billing by uniform tariffs instead of water metering (underestimating consumption)
- failure in sending bills

Additional category of financial losses is the bills being sent but remained unpaid (or only partially paid). It should be noted that these payment losses are not strictly the part of non-revenue water, because all revenue water is by definition included in the bill. Otherwise, reduction of these payment losses is included as part of non-revenue water reduction program.

2.5.8.2 WATERCALCULATION RATIOS

NRW in the given distribution system can be expressed as a ratio between different water volume types. Since the water volumes are always measured during the given time period, the relevant units are, i fact, the volume per time (such as m^3/per day).

Water volumes of our interest are as follows:

Available water = water that can be taken

Abstracted water = water abstracted from the sources

Consumed water = delivered to the consumers

Measured water = measured by consumers water gauges

Calculated water = invoiced water

Paid water = water for which the payment received

The first ratio can be expressed for any production and distribution system. This ratio will express the losses in the production system, which may depend on processing methods, loss or expenditure systems, etc.:

$$\textbf{Water production efficiency} = \frac{\text{Available water}}{\text{Abstracted water}}$$

In WSS Bosanski Petrovac we can not speak about this efficiency, since no measurement of the source capacity, or the abstracted water amounts is taking place. The rest of the four ratios can be measured at any water supply distribution system. That system can be the entire municipal network or its smaller part, such as the pilot zone. All four ratios are expressed since the water amount volume inserted into the system is the same. The inserted water is measured by a large flow meter or estimated (for instance, based on the prescribed pumping amount). Inserted water can be lost in the following way:

Inserted water = Consumed water + Water losses

″Consumed water″ in the mentioned formula is the water that flows into the consumer's water connection and goes to the consumer's water gauge, if any. ″Losses″ are the losses of water from the pipeline upstream of consumer's water gauge. Losses in the private part of consumer's connection downstream of the consumer's water gauge can be called ″waste″. In the mentioned formula, "the waste of consumed water″.

First ratio is ″Distribution system efficiency″, which compares the volume that goes to the consumers' connections with the volume inserted into the network:

$$\textbf{Distribution system efficiency} = \frac{\text{Consumed water}}{\text{Abstracted water}}$$

Transforming the above formula given for the loss of inserted water, the network efficiency can be written as follows:

$$\textbf{Network efficiency} = 1 - \frac{\text{Water losses}}{\text{Abstracted water}}$$

If there are a lot of physical losses in distribution system, the total amount of consumed water will be significantly less than the water inserted into the system, and network efficiency will be low. It is, also, important to know that there can be additional losses or waste after the consumer's water gauge in the private network and inland water supply systems.

Second ratio is the ″Measurement ratio″, which compares the total volume at the consumers water gauges with the volume inserted into the network:

$$\textbf{Measurement ratio} = \frac{\text{Measured water}}{\text{Abstracted water}}$$

The mentioned ratio can be performed using automatic data logger connected to the large flow meter at the pilot zone entrance, between two routine reading the consumers water gauges.

Third ratio is the ″Calculation ratio″, which estimates the water volumes which were actually invoiced. Calculation system must not consider only the measured consumption, but also other calculations which can be performed without measurements, such as the calculation based on the uniform price:

$$\textbf{Calculation ratio} = \frac{\text{Calculated water (measured+uniform price)}}{\text{Abstracted water}}$$

Fourth ratio is the ″Payment ratio″, which estimates the water amount for which the payment is received:

$$\textbf{Payment ratio} = \frac{\text{Paid ratio}}{\text{Abstracted water}}$$

Payment ratio will depend on the payment lag taken into account. For instance, calculating form the moment when all invoices are delivered, some invoices will be paid until the end of the first month, additional invoices will be paid until the end of the second month, and some

invoices can be paid a year later. That is why it is necessary to determine the payment ratio period, such as ″payment ratio within two months″ or ″payment ratio within one year ″.

2.5.8.3 PLAN FOR REDUCING THE AMOUNT OF NON-REVENUE WATER

In order to begin preparing a plan for the reduction of the amount of non-revenue water in water supply system, one should clarify the existing situation of losses, leakage from the network and other components of non-revenue water.

It is necessary to develop a project of rehabilitation of water supply system with the development of hydraulic model. In order to prepare a detailed plan for effective reduction of non-revenue water quantity the following procedure should at least be performed:

1. Metering of inserted water in the network (investments)
2. Study, training and loss detection plan
3. Active consumption metering policy and service management plan

In future, one must make arrangements for regular measurements of both produced water and consumption in certain parts of the system and consumer consumption.

2.5.8.4 METERINGOF WATER INSERTED IN THE NETWORK

One of the first tasks is certainly establishing a measurement system. It is necessary to install water meters at the sources, at the reservoir outlet as well as at the certain system sections. Water meters of large diameter should also be installed at certain branches of distribution network that will enable calculation of non-revenue water at each branch that could be considered as a separate unit. It is also necessary to install missing water meters for the end users, or calibrate existing ones.

2.5.8.5 CALCULATING RATIOS

From the data obtained, we will first calculate N**etwork efficiency ratio.** This ratio describes the current state of network. Long-term measurement process and concurrent consumers' water meter reading would provide data for calculation of another important ratio, **Measurementratio**.

Using data on calculation from the same process it can also be calculated the third ratio, **calculationRatio** and subsequently, using data on payments it can be developed into **Payments ratio**.

In the case of water supply system Tilava, it can be calculated theN**etwork efficiency ratio.** Other ratios cannot be calculated at this point, due to lack of water meters at connections and lump sum reading of water consumption. Only by establishing measurements at consumers, we will be able to talk about all the necessary ratios.

2.6 ANALYSIS AND ASSESSMENT OF THE CAPACITY OF THE PARTNER MUNICIPALITY AND ASSOCIATED WATER UTILITY COMPANY

2.6.1 ANALYSISAND ASSESSMENT OF THE CAPACITY OF THE PARTNER MUNICIPALITIES AND ASSOCIATED WATER UTILITY COMPANIES

Water utility „Vodovod i kanalizacija“ Ltd. Istočno Sarajevo is a company which manages the systems of water supply in the territory of following municipalities

- Istočna Ilidža;
- Istočno Novo Sarajevo;
- Trnovo

Water utility "Vodovod i kanalizacija" Ltd. Istočno Sarajevo was established by the Trustees of city of Istočno Sarajevo, on 25/12/1996,with the aim of ensuring organized water supply and wastewater disposal in the part of the City of Istočno Sarajevo, which consists of three urban municipalities: Istočno Novo Sarajevo, Istočna Ilidža and Trnovo. In 2008, the company completed the registration procedure in the appropriate registers after the change in organisational form JODP ″Vodovod i kanalizacija″ of city of Istočno Sarajevo into Water utility ″Vodovod i kanalizacija″Ltd. Istočno Sarajevo, and is registered in Registry of Issuers with the Securities Commission and in the Central Registry of Securities. In the last year on the occasion of address change of the Company, alignment of the basic laws of the Company was made and registration of these changes in legal and other corresponding registers. Water Utility "VIK" Ltd. Istočno Sarajevo performs the following activities:

- supplying consumers with potable water and safe drinking water,
- wastewater disposal,
- construction, reconstruction and maintenance of the water supply system and wastewater disposal (connections, water and sewage facilities, electro mechanical units, water meters, water disinfection plants, hydrants, measuring and control technology of water supply system, reservoirs and pumping stations)
- managing technical documentation and cadastre of underground assets of water and sewerage system,
- sanitary and technical activities aimed at water quality control,
- setting of pipe installation, designing construction and other facilities.

Licenses

Water utility "VIK" Ltd. Istočno Sarajevo has two licenses issued by the Ministry for Physical Planning, Civil Engineering and Ecology of Republic of Srpska:

- for creating technical documentation for hydro facilities for which building permits issue municipal authorities,
- for the construction of hydro facilities for which building permits issue municipal authorities.

Employees

Currently, Water utility "Vodovod i kanalizacija" have 99 workers which are organized into 7 departments:

- Technical Service

- Legal Service
- Financial Service
- Collection Service
- Maintenance
- Filter plant
- Source Tilava
- Department Trnovo

Water utility company's planning and operation process is defined by:

- Next year's budget
- Business/strategic plan that is adopted for three year period

2.6.2 FINANCIALASSESSMENT OF WATER UTILITY COMPANY

In 2009 , total revenue of Water utility "VIK" a.d. Istočno Sarajevo was BAM 2,843,603.00, and total business expenses were BAM 2,818,292.00. Positive financial outcome (profit) was BAM 25,311.00 or 0.89 % of the total revenue generated.

It is obvious that Water utility "VIK" a.d. Istočno Sarajevo operates on the verge of profitability, and revenues generated from water and sewerage services are additionally substituted by revenues generated by other activities.

The reason for this relatively poor business lies in very low level of collection rate for services which was presented in the following table

Table 39: Collection rate

INVOICED BAM	CHARGED BAM	COLLECTION RATE
3,666,084.12	2,480,240.88	67.65 %

One of the major consumers of Water utility "VIK" a.d. Istočno Sarajevo is the SFOR base that regularly pays all its obligations. If one should exclude this major consumer from the above analysis, collection rate would further decrease to 56.98%.

Collection rate in municipalities is given in the table below

Table 40: Collection rate for households and small businesses

Sequence number	MUNICIPALITY	COLLECTION RATE
1.	I.N. Sarajevo	61.01 %
2.	I. Ilidža	74.30 %
3.	Trnovo	47.36 %

Prices of services are also relatively low considering complexity and size of the system.

Table 41: Prices of water services

	water supply	sewerage
Households (BAM/m^3)	0.64	0.30
Economy (BAM/m^3)	1.06	0.44

2.6.3 INSTITUTIONALAND REGULATORY FRAMEWORK

The following set of laws and decisions make the institutional and regulatory framework:

- Law on Communal Activities (14 June 1995) 11/95 the National Assembly of RS
- Decision on water supply and sewerage in the area of city of Istocno Sarajevo. The Assembly of city of Istočno Sarajevo 30 June 2004
- Decision on change of organizational form JODP „VIK“ IS. Government RS
- Statute of Utility company „VIK“ IS-Government of RS, 23 Feb 2006
- Water permit – Ministry of Agriculture, Forestry and Water Management, 23 March 2010

2.7 REHABILITATION OF WATER SUPPLY SYSTEM IN MUNICIPALITIES ISTOČNA ILIDŽA AND ISTOČNO NOVO SARAJEVO

2.7.1 NECESSARYMEASURES FOR REHABILITATION AND RECONSTRUCTION OF WATER SUPPLY SYSTEM TILAVA

Chapter ***2.5.1 Water Supply System Operation*** presents basic problems in water supply system. Losses in the water supply system are indicated as one of the major problems. Losses must be reduced to a reasonable level, because of the efficiency of water utility and financial losses which company has but primarily because of the lack of available amount of water in the future. Loss reduction in the system is the first measure that should be undertaken in order to provide sufficient amounts of water in the system.

Basic activities that should be implemented with the aim of reducing water losses can be grouped into the following steps:

- **Establishing GIS and developing a Hydraulic model of WSS for better control of the system and better insight into the state of water supply system**
- **Metering and detection of failures in the system,**
- **Repair the defects on the water distribution network,**
- **Replace pipeline sections with the occurrence of major or continuous losses,**
- **Defect removal on the household installations – this must be carried out in coordination with owners of the facilities and Housing companies,**
- **Obtain equipment for detection of failures (correlator and mobile ultrasonic flow meter) and train a team for their detection for this must become regular future activity,**
- **Existing water meters calibrate, defective water meters replace and install water meters on the connections where there are no any,**
- **Make record of all connections,**
- **Eliminate bottlenecks in the system by construction of new pipelines,**
- **Replace pipelines with a diameter of less than DN 80 mm,**
- **Replace defective valves on the junction and construct inspection chambers on those junctions.**

Necessary measures for monitoring of water supply system

In order to establish monitoring of water supply system it is necessary to divide water network into sectors and establish a process of metering of flow, pressure and water quality parameters that are not subject to this project. That refers to:

- **Continuous metering of flow and pressure on the water source,**
- **Continuous metering of flow and water level in reservoirs,**
- **Continuous metering of flow and pressure at characteristic points in the network.**

Beside these measurements, the system must have accurate water meters and perform their regular reading as well as monitoring of consumption trends. Regular monitoring and analysis of these measured quantities will provide control of water production and consumption in water supply system. Monitoring of flow rate and pressure in certain branches, especially flow rates during periods of the night minimum flow, it is possible to detect occurrence of new faults and respond quickly with repairs.

Rehabilitation of Potable water treatment plant Tilava

Replacing filters at the plant is also one of the priorities in water supply system Tilava. Project was drafted in 2010 and it is denoted as urgent.

Priorities in solving problems are, as follows:

- Establishing GIS and developing a hydraulic model of water supply system,
- Detection and removal of water losses as a permanent process (costs of emergency interventions are estimated , but this is a continuous process that needs to be done on the regular basis and, therefore, it is necessary, every year, to secure the funds for this purpose),
- Establishing metering in the system by installing the flow meters for both, the system facilities determined by distribution network zones, and the end users.
- Replacement of pipeline, to reduce losses in the system.

2.7.2 NECESSARYMEASURES FOR REHABILITATION AND RECONSTRUCTION OF WATER SUPPLY SYSTEM IN THE RESERVOIR ZONE BABA

In the first phase, it is necessary to repair and reconstruct the following water supply systems:

- **Settlement Vraca,** which is connected to Water Supply System Sarajevo (FBiH);
- **Settlements Miljevići, Petrovići** and other, which are water supplied from Jahorina's system via reservoir Babe,

When it comes to the settlements Vraca, Miljevići, Petrovići and other settlements, the problem is that these settlements are connected to water supply systems of neighbouring municipalities (cities). For JKP Vodovod i kanalizacija Istočno Sarajevo this is not financially viable and it is necessary to find solution for water supply of these settlements from water source Tilava. Solution was given in Conceptual Design, developed in 2008. Taking into account that reconstruction and expansion of WSS Tilava (Istočno Sarajevo) also covers this part of the system, measures for rehabilitation and expansion are given within WSS Tilava in chapter***2.8Tilava water supply system development - Istočno Sarajevo.***

2.7.3 NECESSARYMEASURES FOR REHABILITATION AND RECONSTRUCTION OF LOCAL WATER SUPPLY SYSTEMS AT HILLSIDE AREA OF TREBEVIĆ - LC PETROVIĆI

- **Smaller settlements on the slopes of Trebević**, from Petrovići to Tvrdimići, which are water supplied via several minor water sources.

Minor settlements, water supplied from local water sources, will also, at first, remain connected to these sources, with possible inclusion of new sources and rehabilitation of existing system facilities and expanding those facilities with insufficient capacity. A particular problem is a lack of data on yield of the existing sources. One of the basic parameters for water supply system calculation is certainly the yield of the source.

In the second phase, the development phase, these water supply systems would be under the management of JKP Vodovod i kanalizacija Istočno Sarajevo with possibility of

connecting these systems to Urban water supply system. Rehabilitation and reconstruction of the system would provide conditions that company ViK Istočno Sarajevo can take the system under control. Within rehabilitation measures of local water supply system, it is necessary to:

- rehabilitate existing water intakes,
- explore the yield of the spring by monitoring source in the next few years,
- repair the protective fence around the source,
- rehabilitate the existing reservoirs,
- record the existing pipelines in the system and remove all visible defects on pipelines,
- install water meters at the sources and reservoirs,
- install water meters at consumers' connections.

2.8 TILAVA WATER SUPPLY SYSTEM DEVELOPMENT - ISTOČNO SARAJEVO

2.8.1 BALANCE OF WATER QUANTITIES AND WATER REQUIREMENTS IN THE AREA OF MUNICIPALITIES AND WATER SUPPLY SYSTEM

Water Supply System Istočno Sarajevo covers a large part of municipalities Istočna Ilidža and Istočno Novo Sarajevo. Municipalities Istočna Ilidža and Istočno Novo Sarajevo have very high percentage of urban water system coverage. Only the bordering parts of Trebević, part of Kasindo and Gornje Mladice are practically out of reach of the system.

For the time being, these settlements are water supplied from local rural water systems that need recovery and reconstruction. Once reconstructed, these water systems would be connected to the urban water supply system. Existing water sources, used for water supply of these settlements, are unexplored, thus, the exploration of these sources should be carried out. After determining the yield of the sources it should be given the proposal for connecting these sources to urban water supply system. In case of insufficient yield, these sources would be used for local needs of water supply.

Part of hillside area of Trebević is supplied with water from Jahorina's spring and distribution system which is water supplied from reservoir Babe belongs to AD Vodovod i kanalizacija Istočno Sarajevo but the source itself in not under control of this company. This is unacceptable for water utility company, since there is enough water at the sources ,for the time being, which could be used for supply of this part of municipality. In addition, the amount of water supplied is metered at the outlet from the reservoir Babe and that amount of water is to be paid. Therefore, loss in distribution system of around 50 % of total water amount is also being paid. In 2008,the Conceptual solution for water supply of hillside area of Trebević from the source Tilava.

Water Supply System Grabski Mlini, i.e. Kijevo is today a separate system. In future, water surplus from the source Grabski mlini would be used for the needs of Water Supply System Istočno Sarajevo. Accordingly, the water system Kijevo would also fall within the scope of water supply system Istočno Sarajevo.

Basic parameter for development planning of the water supply system is certainly source yield but also the position of future water sources. The amount of available water at sources can be one of the main drivers of development for given area but can also be an obstacle for development.

Sources that have strategic importance for municipalities Istočna Ilidža and Istočno Novo Sarajevo are the source Tilava with Toplik and Topličina and source Grabski mlini. All other sources have much smaller capacity (except the source used by Kasindo hospital). Certainly, these sources should not been ignored, but if there is enough water at the main sources, one should avoid the inclusion of these sources in water supply system of the city. In the case of water deficit at the sources, water from the smaller sources is certainly welcomed until new major sources are found.

The following tables (from 42 to 53) present current and future water requirements in the area of WSS Tilava, WSS Grabski mlini as well as for the hillside area of Trebević.

According to estimates based on settlement development assessment and assessments of specific consumption of population, the required water quantities are given for the year: 2010, 2012, 2015, 2020, 2025, 2030 and for 2035. Water requirements are presented individually by water supply systems and areas and as a whole. Balance of water quantities was given at the end – available water quantities at sources and requirements for water.

Growth in population is taken 1.3 % per annum. Aiming at 100 % coverage, in 2035, this number of population will be **40,230**. With the adopted specific consumption at the end of planning period from **q_{sp}=200 l per capita per day**, water requirements in 2035 will be **Q=225.6 l/s**. Amounts of available water at the sources Tilava (with Toplik and Topličina),source Kasindo and sourceGrabski mlini is **Q=186.0 l/s**. Water deficit at the end of planning period can be **Q=39.6 l/s**. For this kind of system, this water deficit is not large and this amount of water could be solved with wells in the alluvium of Željeznica river or in any other way that would investigation works propose.

Buying water from the surrounding water supply systems in the future probably will not be possible. Jahorina's water supply system has increasingly needed for Jahorina tourist and recreation centre but also for settlement Pale. Consequently, it can be expected that in the future, all the water from this source will be directed toward Jahorina and Pale.Additionally, situation in Sarajevo Canton is quite bad concerning water quantities.

The estimates show that the amount of Non-revenue water has been reduced over time and that at the end of planning period we calculate with 20 % of Non-revenue water amount. In developing countries this percentage is ranging from 10 to 20 %. Introducing new quantities of water into systems is very expensive. High percentage of Non-revenue water and new water quantities from new sources do not guarantee a quality water supply. In addition, besides large investments in introducing new water quantities, large amount of water in the system is being lost with introducing that water quantities. This is not technically justified and certainly not financially viable. Percentage of reduction of Non-revenue water quantities will not be the same for all water supply systems. In water supply systems with water deficit, it's in our best interest to reduce this percentage as much as possible. The expert assessments say that is 20 %. In the system with sufficient water quantities at sources and with gravity water supply this percentage is considerably higher. In the case of WSS Istočno Sarajevo, we have water deficit at sources but also conditioning of water at source Tilava which makes water production more expensive. For this reason, it is estimated that the amount of Non-revenue water must be reduced at, at least 20 % of total produced water amount. This process of Non-revenue water reduction is time consuming, requiring great expertise, well-organized activities and resources.

Table 42: Estimate of required water quantities for the area currently supplied from WSS Tilava

Percentage of population growth: **1,30** **%**

Consumption description	Unit of measurement	Projected population in the system scope						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
		24.687	**25.333**	**26.333**	**28.090**	**29.964**	**31.963**	**34.095**
Population connected to the system		**22.016**	**22.799**	**23.700**	**28.090**	**29.964**	**31.963**	**34.095**
Average specific water consumption of the population	l/capita per day	139,21	140	150	170	180	190	200
Percentage of population connected to the system	%	79,00	90,00	90,00	100,00	100,00	100,00	100,00
Average water consumption of population	lps	35,47	36,94	41,15	55,27	62,43	70,29	78,92
Share of economy in water consumption	%	31,2%	30,00	30,00	30,00	30,00	30,00	30,00
Average water consumption of economy	lps	16,06	15,83	17,63	23,69	26,75	30,12	33,82
Total average water consumption of population + economy	lps	**51,53**	**52,78**	**58,78**	**78,96**	**89,18**	**100,41**	**112,75**
Specific consumption of population + economy	l/capita per day	**202,24**	**200,00**	**214,29**	**242,86**	**257,14**	**271,43**	**285,71**
Total daily average water consumption of population + economy	m3/day	**4.452**	**4.560**	**5.079**	**6.822**	**7.705**	**8.676**	**9.742**
Total monthly average water consumption population + economy	m3/month	**135.428**	**138.696**	**154.474**	**207.499**	**234.362**	**263.886**	**296.305**
Total average annual water consumption population+ economy	m3/year	**1.625.133**	**1.664.347**	**1.853.682**	**2.489.991**	**2.812.345**	**3.166.627**	**3.555.662**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	53,21	55,41	61,72	82,90	93,64	105,43	118,39
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	20,08	19,79	22,04	29,61	33,44	37,65	42,28
Total maximum daily water consumption (population+economy)	lps	**73,28**	**75,21**	**83,76**	**112,51**	**127,08**	**143,09**	**160,67**
Total average water losses in the system(non-revenue water amount)	%	54,51%	35,00	30,00	30,00	25,00	25,00	20,00
Total of needed average daily water quantity with losses	lps	**113,27**	**81,19**	**83,97**	**112,80**	**118,91**	**133,88**	**140,94**
Total of needed average daily water quantity with losses	m3/month	297.676	213.378	220.676	296.427	312.483	351.847	370.381
Specific water consumption population + economy with losses	l/capita per day	**444,53**	**307,69**	**306,12**	**346,94**	**342,86**	**361,90**	**357,14**
Total of needed maximum daily water quantity with losses	lps	**161,08**	**115,70**	**119,66**	**160,73**	**169,44**	**190,78**	**200,83**

Table 43: Estimate of required water quantities for the area of higher zones of Tilava, Prljevo brdo, Miljevići, Vrace and hillside area of Trebević which are not connected to WSS Tilava

Percentage of population growth: **1,30** **%**

Consumption description	Unit of measurement	Projected population in the system scope						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
		3.663	**3.759**	**3.907**	**4.168**	**4.446**	**4.743**	**5.059**
Population connected to the system		**3.382**	**3.471**	**3.758**	**4.168**	**4.446**	**4.743**	**5.059**
Average specific water consumption of the population	l/capita per day	139,21	140	150	150	160	160	160
Percentage of population connected to the system	%	92,33	92,33	96,17	100,00	100,00	100,00	100,00
Average water consumption of population	lps	5,45	5,62	6,52	7,24	8,23	8,78	9,37
Share of economy in water consumption	%	0,00	5,26	15,96	16,03	16,03	16,03	16,03
Average water consumption of economy	lps	0,00	0,30	1,04	1,16	1,32	1,41	1,50
Total average water consumption of population + economy	lps	**5,45**	**5,92**	**7,56**	**8,40**	**9,55**	**10,19**	**10,87**
Specific consumption of population + economy	**l/capita per day**	**139,21**	**147,37**	**173,94**	**174,04**	**185,64**	**185,64**	**185,64**
Total daily average water consumption of population + economy	**m3/day**	**471**	**511**	**654**	**725**	**825**	**880**	**939**
Total monthly average water consumption population + economy	**m3/month**	**14.321**	**15.557**	**19.880**	**22.064**	**25.105**	**26.780**	**28.566**
Total average annual water consumption population+ economy	**m3/year**	**171.858**	**186.688**	**238.564**	**264.769**	**301.261**	**321.359**	**342.798**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	8,17	8,44	9,79	10,85	12,35	13,17	14,05
Coefficient of seasonal variation of economy			1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	0,00	0,37	1,30	1,45	1,65	1,76	1,88
Total maximum daily water consumption (population+economy)	**lps**	**8,17**	**8,81**	**11,09**	**12,30**	**14,00**	**14,93**	**15,93**
Total average water losses in the system	%	33,88	5,00	10,00	15,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	lps	**8,24**	**6,23**	**8,41**	**9,88**	**11,94**	**12,74**	**13,59**
Total of needed average daily water quantity with losses	m3/month	21.661	16.376	22.089	25.958	31.381	33.475	35.708
Specific water consumption population + economy with losses	l/capita per day	**210,56**	**155,12**	**193,27**	**204,75**	**232,05**	**232,05**	**232,05**
Total of needed maximum daily water quantity with losses	**lps**	**12,36**	**9,27**	**12,32**	**14,48**	**17,50**	**18,67**	**19,91**

Table 44: Estimate of water quantities required for the area of higher zones – for each settlement

Percentage of population growth: **1,30** **%**

Water supply systems	Unit of measurement	**Projected population in the system scope**						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
		3.663	3.759	3.907	4.168	4.446	4.743	5.059
		Maximum daily water requirements						
Estimate of required water quantities for WSS Jahorina - Baba	l/s	3,62	3,08	4,47	5,61	6,79	7,24	7,72
Estimate of required water quantities for Vraca	l/s	0,48	0,41	0,53	0,60	0,73	0,77	0,83
Estimate of required water quantities for the zone of Prljevo Brdo	l/s	3,87	3,29	4,25	4,80	5,80	6,19	6,60
Estimate of required water quantities for Trebevic slopes	l/s	4,39	2,49	3,07	3,46	4,19	4,46	4,76
Total required maximum daily water quantities with losses	**l/s**	**12,36**	**9,27**	**12,32**	**14,48**	**17,50**	**18,67**	**19,91**

Settlement	**Number of households (estimates)**	**Number of inhabitants (estimates)**	**Supply zone (reservoir)**
LC Petrovići	120	360	Baba
LC Tilava	8	24	Baba
LC Lukavica	200	600	Prljevo brdo
LC Miljevići	300	1020	Baba
LC Vraca	200	600	Prljevo brdo
	50	150	Baba
Hillside area	303	909	Local systems
total:	**1.181**	**3663**	

Table 45: Estimate of required water quantities for WSS Jahorina – Baba – future zone of reservoir Kadino brdo

Consumption description	Unit of measurement	Projected population in the area of the system						
		2010	2012	2015	2020	2025	2030	2035
		1.404	**1.441**	**1.498**	**1.598**	**1.704**	**1.818**	**1.939**
Population connected to the system		**1.123**	**1.153**	**1.348**	**1.598**	**1.704**	**1.818**	**1.939**
Average specific water consumption of the population	l/capita per day	139,21	140	150	150	160	160	160
Percentage of population connected to the system	%	80,00	80,00	90,00	100,00	100,00	100,00	100,00
Average water consumption of population	lps	1,81	1,87	2,34	2,77	3,16	3,37	3,59
Share of economy in water consumption	%	0,00	5,00	15,00	15,00	15,00	15,00	15,00
Average water consumption of economy	lps	0,00	0,10	0,41	0,49	0,56	0,59	0,63
Total average water consumption of population + economy	lps	**1,81**	**1,97**	**2,75**	**3,26**	**3,71**	**3,96**	**4,22**
Specific consumption of population + economy	l/capita per day	**139,21**	**24,10**	**48,20**	**72,30**	**96,40**	**96,40**	**96,40**
Total daily average water consumption of population + economy	m3/day	**156**	**170**	**238**	**282**	**321**	**342**	**365**
Total monthly average water consumption population + economy	m3/month	**4.756**	**5.166**	**7.235**	**8.575**	**9.757**	**10.408**	**11.102**
Total average annual water consumption population+ economy	m3/year	**57.072**	**61.997**	**86.820**	**102.903**	**117.085**	**124.896**	**133.229**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	2,71	2,80	3,51	4,16	4,73	5,05	5,39
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	0,00	0,12	0,52	0,61	0,70	0,74	0,79
Total maximum daily water consumption (population+economy)	lps	**2,71**	**2,92**	**4,03**	**4,77**	**5,43**	**5,79**	**6,18**
Total average water losses in the system	%	25,00	5,00	10,00	15,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	lps	**2,41**	**2,07**	**3,06**	**3,84**	**4,64**	**4,95**	**5,28**
Total of needed average daily water quantity with losses	m3/month	6.341	5.438	8.039	10.088	12.196	13.010	13.878
Specific water consumption population + economy with losses	l/capita per day	**185,62**	**155,12**	**196,08**	**207,61**	**235,29**	**235,29**	**235,29**
Total of needed maximum daily water quantity with losses	lps	**3,62**	**3,08**	**4,47**	**5,61**	**6,79**	**7,24**	**7,72**

Table 46: Estimate of required water quantities for the area of Vraca – III pressure zone – future zone of reservoir Kadino brdo

Percentage of population growth: **1,30** **%**

Consumption description	Unit of measurement	Projected population in the area of the system						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2.035**
		150	**154**	**160**	**171**	**182**	**194**	**207**
Population connected to the system		**150**	**154**	**160**	**171**	**182**	**194**	**207**
Average specific water consumption of the population	l/capita per day	139,21	140	150	150	160	160	160
Percentage of population connected to the system	%	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Average water consumption of population	lps	0,24	0,25	0,28	0,30	0,34	0,36	0,38
Share of economy in water consumption	%	0,00	5,00	15,00	15,00	15,00	15,00	15,00
Average water consumption of economy	lps	0,00	0,01	0,05	0,05	0,06	0,06	0,07
Total average water consumption of population + economy	lps	**0,24**	**0,26**	**0,33**	**0,35**	**0,40**	**0,42**	**0,45**
Specific consumption of population + economy	**l/capita per day**	**139,21**	**24,10**	**48,20**	**72,30**	**96,40**	**96,40**	**96,40**
Total daily average water consumption of population + economy	**m3/day**	**21**	**23**	**28**	**30**	**34**	**37**	**39**
Total monthly average water consumption population + economy	**m3/month**	**635**	**690**	**859**	**916**	**1.042**	**1.112**	**1.186**
Total average annual water consumption population+ economy	**m3/year**	**7.622**	**8.280**	**10.306**	**10.994**	**12.509**	**13.344**	**14.234**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	0,36	0,37	0,42	0,44	0,51	0,54	0,58
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	0,00	0,02	0,06	0,07	0,07	0,08	0,08
Total maximum daily water consumption (population+economy)	**lps**	**0,36**	**0,39**	**0,48**	**0,51**	**0,58**	**0,62**	**0,66**
Total average water losses in the system	%	25,00	5,00	10,00	15,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	lps	**0,32**	**0,28**	**0,36**	**0,41**	**0,50**	**0,53**	**0,56**
Total of needed average daily water quantity with losses	m3/month	847	726	954	1.078	1.303	1.390	1.483
Specific water consumption population + economy with losses	l/capita per day	**185,62**	**155,12**	**196,08**	**207,61**	**235,29**	**235,29**	**235,29**
Total of needed maximum daily water quantity with losses	**lps**	**0,48**	**0,41**	**0,53**	**0,60**	**0,73**	**0,77**	**0,83**

Table 47: Estimate of required water quantities for the area of reservoir Prljevo brdo – II pressure zone

Percentage of population growth: **1,30** **%**

Consumption description	Unit of measurement	Projected population in the area of the system						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2.035**
		1.200	**1.231**	**1.280**	**1.365**	**1.457**	**1.554**	**1.657**
Population connected to the system		**1.200**	**1.231**	**1.280**	**1.365**	**1.457**	**1.554**	**1.657**
Average specific water consumption of the population	l/capita per day	139,21	140	150	150	160	160	160
Percentage of population connected to the system	%	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Average water consumption of population	lps	1,93	2,00	2,22	2,37	2,70	2,88	3,07
Share of economy in water consumption	%	0,00	5,00	15,00	15,00	15,00	15,00	15,00
Average water consumption of economy	lps	0,00	0,11	0,39	0,42	0,48	0,51	0,54
Total average water consumption of population + economy	lps	**1,93**	**2,10**	**2,61**	**2,79**	**3,17**	**3,38**	**3,61**
Specific consumption of population + economy	l/capita per day	**139,21**	**147,37**	**176,47**	**176,47**	**188,24**	**188,24**	**188,24**
Total daily average water consumption of population + economy	**m3/day**	**167**	**181**	**226**	**241**	**274**	**292**	**312**
Total monthly average water consumption population + economy	**m3/month**	**5.081**	**5.520**	**6.871**	**7.329**	**8.339**	**8.896**	**9.489**
Total average annual water consumption population+ economy	**m3/year**	**60.975**	**66.237**	**82.451**	**87.951**	**100.073**	**106.749**	**113.871**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	2,90	2,99	3,33	3,56	4,05	4,32	4,60
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	0,00	0,13	0,49	0,52	0,59	0,63	0,68
Total maximum daily water consumption (population+economy)	**lps**	**2,90**	**3,12**	**3,82**	**4,08**	**4,64**	**4,95**	**5,28**
Total average water losses in the system	%	25,00	5,00	10,00	15,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	lps	**2,58**	**2,21**	**2,90**	**3,28**	**3,97**	**4,23**	**4,51**
Total of needed average daily water quantity with losses	m3/month	6.775	5.810	7.634	8.623	10.424	11.120	11.862
Specific water consumption population + economy with losses	l/capita per day	**185,62**	**155,12**	**196,08**	**207,61**	**235,29**	**235,29**	**235,29**
Total of needed maximum daily water quantity with losses	**lps**	**3,87**	**3,29**	**4,25**	**4,80**	**5,80**	**6,19**	**6,60**

Table 48: Estimate of required water quantities for the area of LC Petrovići – hillside area of Trebevića

Percentage of population growth: **1,30** **%**

Consumption description	Unit of measurement	Projected population in the area of the system						
		2010	2012	2015	2020	2025	2030	2.035
		909	933	970	1.034	1.103	1.177	1.255
Population connected to the system		909	933	970	1.034	1.103	1.177	1.255
Average specific water consumption of the population	l/capita per day	139,21	140	150	150	160	160	160
Percentage of population connected to the system	%	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Average water consumption of population	lps	1,46	1,51	1,68	1,80	2,04	2,18	2,32
Share of economy in water consumption	%	0,00	5,00	10,00	10,00	10,00	10,00	10,00
Average water consumption of economy	lps	0,00	0,08	0,19	0,20	0,23	0,24	0,26
Total average water consumption of population + economy	lps	**1,46**	**1,59**	**1,87**	**2,00**	**2,27**	**2,42**	**2,58**
Specific consumption of population + economy	l/capita per day	**139,21**	**24,10**	**48,20**	**72,30**	**96,40**	**96,40**	**96,40**
Total daily average water consumption of population + economy	m3/day	**127**	**137**	**162**	**172**	**196**	**209**	**223**
Total monthly average water consumption population + economy	m3/month	**3.849**	**4.181**	**4.916**	**5.243**	**5.966**	**6.364**	**6.789**
Total average annual water consumption population+ economy	m3/year	**46.188**	**50.174**	**58.987**	**62.922**	**71.594**	**76.370**	**81.465**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	2,20	2,27	2,53	2,69	3,06	3,27	3,49
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	0,00	0,10	0,23	0,25	0,28	0,30	0,32
Total maximum daily water consumption (population+economy)	lps	**2,20**	**2,37**	**2,76**	**2,94**	**3,35**	**3,57**	**3,81**
Total average water losses in the system	%	50,00	5,00	10,00	15,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	lps	**2,93**	**1,67**	**2,08**	**2,35**	**2,84**	**3,03**	**3,23**
Total of needed average daily water quantity with losses	m3/month	7.698	4.401	5.462	6.169	7.458	7.955	8.486
Specific water consumption population + economy with losses	l/capita per day	**278,42**	**155,12**	**185,19**	**196,08**	**222,22**	**222,22**	**222,22**
Total of needed maximum daily water quantity with losses	lps	**4,39**	**2,49**	**3,07**	**3,46**	**4,19**	**4,46**	**4,76**

Table 49: Estimate of required water quantities for the area of WSS Istočno Sarajevo – WSS Tilava + other systems

Percentage of population growth: **1,30** **%**

Consumption description	Unit of measurement	Projected population in the area of the system						
		2010	2012	2015	2020	2025	2030	2035
		28.350	**29.091**	**30.241**	**32.258**	**34.410**	**36.706**	**39.154**
Population connected to the system		**25.398**	**26.245**	**27.432**	**32.258**	**34.410**	**36.706**	**39.154**
Average specific water consumption of the population	l/capita per day	139,21	140,00	150,00	167,59	177,59	186,38	195,17
Percentage of population connected to the system	%	89,59	90,22	90,71	100,00	100,00	100,00	100,00
Average water consumption of population	lps	40,92	42,53	47,63	62,57	70,73	79,18	88,45
Share of economy in water consumption	%	28,18	38,24	39,41	39,95	39,93	40,06	40,19
Average water consumption of economy	lps	16,06	16,26	18,77	24,99	28,24	31,72	35,55
Total average water consumption of population + economy	lps	**56,98**	**58,79**	**66,39**	**87,56**	**98,96**	**110,90**	**123,99**
Specific consumption of population + economy	l/capita per day	**193,85**	**193,53**	**209,11**	**234,53**	**248,49**	**261,05**	**273,61**
Total daily average water consumption of population + economy	**m3/day**	**4.923**	**5.079**	**5.736**	**7.565**	**8.551**	**9.582**	**10.713**
Total monthly average water consumption population + economy	**m3/month**	**149.749**	**154.497**	**174.481**	**230.115**	**260.078**	**291.452**	**325.854**
Total average annual water consumption population+ economy	**m3/year**	**1.796.990**	**1.853.968**	**2.093.778**	**2.761.377**	**3.120.933**	**3.497.422**	**3.910.253**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	lps	61,38	63,79	71,44	93,85	106,09	118,77	132,67
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	20,08	20,33	23,46	31,24	35,30	39,65	44,43
Total maximum daily water consumption (population+economy)	lps	**81,46**	**84,12**	**94,90**	**125,10**	**141,39**	**158,42**	**177,10**
Total average water losses in the system	%	53,23	33,02	28,31	28,88	24,58	24,60	20,00
Total of needed average daily water quantity with losses	lps	**121,85**	**87,77**	**92,61**	**123,11**	**131,21**	**147,08**	**154,99**
Total of needed average daily water quantity with losses	m3/month	320.216	230.666	243.384	323.543	344.817	386.519	407.318
Specific water consumption population + economy with losses	l/capita per day	**414,51**	**288,95**	**291,69**	**329,75**	**329,45**	**346,20**	**342,01**
Total of needed maximum daily water quantity with losses	**l/s**	**174,19**	**125,59**	**132,37**	**175,89**	**187,45**	**210,10**	**221,38**

Table 50: Estimate of required water quantities for the area of WSS Grabski mlini

Percentage of population growth: **1,30** **%**

Consumption description during the summer season	Unit of measurement	**Projected population in the area of the system**						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Population which gravitates toward WSS Grabski mlini		**779**	**799**	**831**	**886**	**945**	**1.008**	**1.076**
Population connected to WSS Grabski mlini		**623**	**799**	**831**	**886**	**945**	**1.008**	**1.076**
Number of households using the system (3,5members per household)		**178**						
Number of legal entities using the system		**2**						
Percentage of population connected to the WSS Ljuštra - Trnovo	%	80%	100%	100%	100%	100%	100%	100%
Population of Kijevo		*198*	*203*	*211*	*225*	*240*	*256*	273
Population of Jablanica			*0*	*0*	*0*	*0*	*0*	0
Population of Klanac			*0*	*0*	*0*	*0*	*0*	0
Number of weekend homes (3,5 inhabitants per weekend home)		*425*	*436*	*453*	*484*	*516*	*550*	587
Average specific water consumption for population	l/ capita per day	120,00	120,00	130,00	150,00	175,00	180,00	180,00
Maximum monthly water consumption for population	l/s	0,87	1,11	1,25	1,54	1,91	2,10	2,24
Share of economy in water consumption	%	2,00	10,00	20,00	20,00	20,00	20,00	20,00
Maximum monthly water consumption for economy	l/s	0,02	0,11	0,25	0,31	0,38	0,42	0,45
Total maximum monthly water consumption population+ economy - **invoiced**	**l/s**	**0,88**	**1,22**	**1,50**	**1,85**	**2,30**	**2,52**	**2,69**
Consumption description out of season	Unit of measurement	**Projected population in the area of the system**						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Population which gravitates toward WSS Grabski mlini		**198**	**203**	**211**	**225**	**240**	**256**	**273**
Population connected to WSS Grabski mlini		**158**	**163**	**169**	**180**	**192**	**205**	**219**
Number of inhabitants		**198**						
Number of legal entities using the system		**2**						
Percentage of population connected to the WSS Ljuštra - Trnovo	%	80%	100%	100%	100%	100%	100%	100%
Population of Kijevo		*198*	*203*	*211*	*225*	*240*	*256*	273
Population of Jablanica			*0*	*0*	*0*	*0*	*0*	0
Population of Klanac			*0*	*0*	*0*	*0*	*0*	0
Average specific water consumption for population	l/capita per day	120,00	120,00	130,00	150,00	175,00	180,00	180,00

Average water consumption for population out of season	l/s	0,22	0,23	0,25	0,31	0,39	0,43	0,46
Share of economy in water consumption	%	2,00	10,00	20,00	20,00	20,00	20,00	20,00
Average water consumption of economy	l/s	0,00	0,02	0,05	0,06	0,08	0,09	0,09
Total average water consumption population+economy out of season - **invoiced**	**l/s**	**0,22**	**0,25**	**0,31**	**0,38**	**0,47**	**0,51**	**0,55**
Consumption description during summer season – maximum consumption in August	Unit of measurement	**Year**						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Specific consumption population+economy	l/capita per day	**122,40**	**132,00**	**156,00**	**180,00**	**210,00**	**216,00**	**216,00**
Total daily average water consumption population+economy	**m^3/day**	**76,26**	**105,49**	**129,59**	**159,50**	**198,50**	**217,79**	**232,32**
Total monthly average water consumption population+economy	**m^3/month**	**2.319,43**	**3.208,50**	**3.941,68**	**4.851,51**	**6.037,69**	**6.624,49**	**7.066,42**
Total average annual water consumption population+economy	**m^3/year**	**27.833,15**	**38.502,04**	**47.300,18**	**58.218,08**	**72.452,25**	**79.493,86**	**84.797,06**
Coefficient of daily variation consumption of population		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption for population	l/s	1,08	1,39	1,56	1,92	2,39	2,63	2,80
Coefficient of seasonal variation for economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	0,02	0,14	0,31	0,38	0,48	0,53	0,56
Total maximum daily water consumption (population+economy) - **invoiced**	**l/s**	**1,10**	**1,53**	**1,87**	**2,31**	**2,87**	**3,15**	**3,36**
Percentage of Revenue amount of water	%	4,40%	20,00%	50,00%	80,00%	80,00%	80,00%	80,00%
Percentage of Non-revenue amount of water	%	95,60%	80,00%	50,00%	20,00%	20,00%	20,00%	20,00%
Non-revenue water amount	l/s	**23,97**	**6,10**	**1,87**	**0,58**	**0,72**	**0,79**	**0,84**
Total of needed average daily water amount with losses in the season	**l/s**	**20,06**	**6,10**	**3,00**	**2,31**	**2,87**	**3,15**	**3,36**
Specific consumption population+economy with losses	l/capita per day	**2.781,82**	**660,00**	**312,00**	**225,00**	**262,50**	**270,00**	**270,00**
Total of needed maximum daily water amounts with losses	**l/s**	**25,07**	**7,63**	**3,75**	**2,88**	**3,59**	**3,94**	**4,20**

Table 51: Estimate of required water quantities for the area of municipalities Istočna Ilidža, Istočno Novo Sarajevo and WSS Grabski mlini-Total

Percentage of population growth:	**1,30**	**%**						
Consumption description	Unit of measurement	**Projected population in the area of the system**						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
		29.128	**29.891**	**31.071**	**33.144**	**35.355**	**37.714**	**40.230**
Population connected to the system		**26.021**	**27.044**	**28.263**	**33.144**	**35.355**	**37.714**	**40.230**
Average specific water consumption of the population	l/capita per day	138,75	139,41	149,41	167,12	177,52	186,21	194,76
Percentage of population connected to the system	%	89,33	90,48	90,96	100,00	100,00	100,00	100,00
Average water consumption of population	lps	***41,79***	***43,64***	***48,87***	***64,11***	***72,64***	***81,28***	***90,69***
Share of economy in water consumption	%	38,47	37,52	38,91	39,47	39,40	39,55	39,69
Average water consumption of economy	lps	***16,08***	***16,37***	***19,02***	***25,30***	***28,62***	***32,14***	***35,99***
Total average water consumption of population + economy	lps	**57,86**	**60,01**	**67,89**	**89,41**	**101,26**	**113,42**	**126,68**
Specific consumption of population + economy	l/capita per day	**192,14**	**191,72**	**207,55**	**233,07**	**247,46**	**259,84**	**272,07**
Total daily average water consumption of population + economy	m3/day	**5.000**	**5.185**	**5.866**	**7.725**	**8.749**	**9.800**	**10.945**
Total monthly average water consumption population + economy	m3/month	**152.069**	**157.706**	**178.423**	**234.966**	**266.115**	**298.076**	**332.921**
Total average annual water consumption population+ economy	m3/year	**1.824.824**	**1.892.470**	**2.141.078**	**2.819.595**	**3.193.385**	**3.576.915**	**3.995.051**
Coefficient of seasonal consumption variation of population		1,49	1,49	1,49	1,49	1,49	1,49	1,49
Maximum daily water consumption of the population	lps	62,46	65,18	73,00	95,78	108,48	121,40	135,47
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	lps	20,10	20,47	23,77	31,63	35,78	40,18	44,99
Total maximum daily water consumption (population+economy)	lps	**82,56**	**85,64**	**96,77**	**127,40**	**144,26**	**161,57**	**180,46**
Total average water losses in the system	%	59,22	36,08	28,99	28,71	24,48	24,50	20,00
Total of needed average daily water quantity with losses	lps	**141,91**	**93,88**	**95,61**	**125,42**	**134,08**	**150,23**	**158,35**
Total of needed average daily water quantity with losses	m3/month	372.930	246.709	251.268	329.607	352.364	394.800	416.151
Specific water consumption population + economy with losses	l/capita per day	**471,19**	**299,91**	**292,29**	**326,95**	**327,66**	**344,16**	**340,09**
Total of needed maximum daily water quantity with losses	lps	**202,47**	**133,98**	**136,28**	**178,72**	**191,01**	**214,00**	**225,58**

Table 52: Balance of water quantities in the area of WSS Istočno Sarajevo

Water balance in the area of WSS Istočno Sarajevo

Water supply system	Requirements (maximum daily) (l/s)						Provided from the water source (l/s)							Missing water amount (l/s)					
	2010	2015	2020	2025	2030	2035	Source	2010	2015	2020	2025	2030	2035	2010	2015	2020	2025	2030	2035
First pressure zoneWSS Istočno Sarajevo and Second pressure zone - Kasindo	162,4	120,8	162,3	171,1	192,6	202,8	Tilava	125,0	125,0	125,0	125,0	125,0	125,0	6,4	-35,2	6,3	15,1	36,6	46,8
							Toplik - Vojno vrelo	6,0	6,0	6,0	6,0	6,0	6,0						
							Topličina - Bijelo vrelo	20,0	20,0	20,0	20,0	20,0	20,0						
							Kasindo	5,0	5,0	5,0	5,0	5,0	5,0						
Jahorina's system	11,6	11,5	13,5	16,3	17,4	18,6	Jahorina's system	5,0	0,0	0,0	0,0	0,0	0,0	6,6	11,5	13,5	16,3	17,4	18,6
Total	**173,9**	**132,3**	**175,8**	**187,4**	**210,1**	**221,4**	***Total***	**161,0**	**156,0**	**156,0**	**156,0**	**156,0**	**156,0**	**12,9**	**-23,7**	**19,8**	**31,4**	**54,1**	**65,4**

Table 53: Balance of water quantities in the area of water supply system Istočno Sarajevo with Grabski mlini

Water balance in the area of WSS Istočno Sarajevo with Grabski mlini

Water supply system	Requirements (maximum daily) (l/s)						Provided from the water source (l/s)							Missing water amount (l/s)					
	2010	2015	2020	2025	2030	2035	Source	2010	2015	2020	2025	2030	2035	2010	2015	2020	2025	2030	2035
First pressure zoneWSS Istočno Sarajevo and Second pressure zone - Kasindo	162,4	120,8	162,3	171,1	192,6	202,8	Tilava	125,0	125,0	125,0	125,0	125,0	125,0	6,4	-35,2	6,3	15,1	36,6	46,8
							Toplik - Vojno vrelo	6,0	6,0	6,0	6,0	6,0	6,0						
							Topličina - Bijelo vrelo	20,0	20,0	20,0	20,0	20,0	20,0						
							Kasindo	5,0	5,0	5,0	5,0	5,0	5,0						
WSS Grabski mlini	25,1	3,7	2,9	3,6	3,9	4,2	Grabski mlini	30,0	30,0	30,0	30,0	30,0	30,0	-4,9	-26,3	-27,1	-26,4	-26,1	-25,8
Jahorina's system	11,6	11,5	13,5	16,3	17,4	18,6	Jahorina's system	5,0	0,0	0,0	0,0	0,0	0,0	6,6	11,5	13,5	16,3	17,4	18,6
Total	**199,0**	**136,0**	**178,7**	**191,0**	**214,0**	**225,6**	***Total***	**191,0**	**186,0**	**186,0**	**186,0**	**186,0**	**186,0**	**8,0**	**-50,0**	**-7,3**	**5,0**	**28,0**	**39,6**

2.8.2 DEVELOPMENTOF TILAVA WATER SUPPLY SYSTEM

2.8.2.1 BASIS FOR ESTIMATES

In chapter***2.8.1Balance of water quantities and water requirements in the area of municipalities and water supply*** system, estimates of development are given along with required water amounts. The end of planning period is the year 2035. According to these estimates, amounts of water at the sources are, currently, sufficient. Still, in the coming years, it is necessary to include the source Grabski mlini into the system and carry out exploration of new sources.

In these estimates, it is taken the increase in population numbers of app. 1.30 % and the data of current number of inhabitants are provided by water utility company and based on the estimates.

Specific consumption of the population is taken 140-160 l per capita per day and by the end of 2035 planning period, this consumption has been increased to 200 l per capita per day in lower zones of water supply and in the area of Kasindo while in the higher zones of Trebević at the end of planning period, it has been taken a specific consumption of 160 l per capita per day.

Consumption of economy is estimated at 20-30 % of population consumption.

Coefficient of daily variation is 1.50 for population and economy.

Losses have been reduced from existing 45-50 % to 20 % at the end of planning period, which is realistic scenario. The biggest step towards reduction of losses should be carried out in the first few years. Later, it is understandable, that this process will slow down, for after reduction of certain percentage of losses, it is difficult to detect them. In addition, with reduction of losses, pressure in the system increases and this leads to new losses. Process of detection and removal of losses is a continuous process.

In line with the increase of water quantities in the system, enlargement of water supply system would be performed, along with increase in pipeline diameter and enlargement of reservoirs that no longer meet the needs.

After rehabilitation and reconstruction, local water supply systems should be connected to the urban water supply system.

2.8.2.2 SOURCE

For planning period by the year 2035 , **maximum daily water quantity requirements are Q=225,6 l/s. Deficit in relation to existing capacity is 65,4 l/s.** Therefore, it is necessary to provide new water quantities for the system. This primarily relates to water source **Grabski mlini** that would partially ‘quench the thirst’. But even after introducing source **Grabski mlini** in the system, at the end of planning period, deficit would be**Q=39,6 l/s**. These amounts of water are not too big and water shortage problem would be easily solved by including of a new source. In addition, the balance of water does not include smaller sources **on the slopes ofTrebević** that are unexplored and that will certainly reduce this water deficit.

Therefore, in the planning period, it is necessary to built supply system from the source Grabski mlini to distribution network in Vojkovići.

It is also necessary to start research and findings of new amounts of water in the area of municipalities Istočna Ilidža and Istočno Novo Sarajevo, as well as in the area of Trnovo municipality in its northern part around settlements Kijevo and Jablanica. If water sources near Grabski mlini would be found, water would be transported via one system to WSS Tilava. For this reason, it would be necessary to immediately begin research in the area around Grabski mlini, before construction of supply system from Grabski mlini.

In parallel with these investigations, one should also do some investigations in municipalities Istočna Ilidža and Istočno Novo Sarajevo.

2.8.2.3 RESERVOIRS

In chapter***2.5.5Reservoirs***it is shown that there is a significant deficit in reservoir storage capacity both currently and at the end of 2035 planning period.

Current deficit in reservoir storage capacity is approx. V=3,200 m^3 in the first pressure zone. Taking into account the fact that this is mainly about the first supply zone, it is necessary to enable one chamber of reservoir Donji Kotorac with capacity of 5.000 m^3. This reservoir should become in future, along with water source, key point in the system.

Besides this reservoir, it is necessary to construct reservoir storages of II and III pressure zone.

An overview of needs for reservoir space is given in **Table 38: Estimate of requirements for reservoir space by water supply zones**.

The following reservoir needs to be constructed in the future:

- complete one chamber of the reservoir Donji Kotorac with volume of V=5,000.0 m^3,
    - Quality of the built reservoir should be inspected since the construction of this reservoir is at the standstill for almost twenty years.
    - Surveying record of the reservoir should be made along with the Conceptual Solution for inclusion of the reservoir into WSS Tilava. Tilava reservoir elevation is 576.0 m.a.s.l.so it is questionable whether Donji Kotorac reservoir can be feed with water from the Tilava reservoir which is certainly a goal.
    - If reservoir Donji Kotorac is not suitable due to elevation, a new location for the new reservoir should be found that will have in future the storage volume of V=3,000 m^3. This is certainly a more expensive option.
- construct reservoirs for higher zones of water supply:
    - reservoir Katića brdo volume V=150.0 m^3,
    - reservoir Prljevo brdo volume V=150.0 m^3,
    - reservoir Kadino brdo volume V=500.0 m^3.

2.8.2.4 TRANSMISSION PIPELINES

According to previous analysis, capacity of transmission pipelines is sufficient even for future demand.

It is necessary to construct transmission pipelines for higher pressure zones.

It is also necessary to connect reservoir Donji Kotorac with distribution system of WSS Tilava.

2.8.2.5 DISTRIBUTION PIPELINES

For the development of the system, it is necessary to construct new pipelines, especially for the second and the third pressure zone.

For this Master Plan, we can adopt some European Union standards that set the average of ca 2 m of pipeline per inhabitant in the system. With type of settlements for this area in mind, we plan 2.5 m of pipeline per inhabitant. According to estimated population numbers, at the end of 2035 planning period, this water supply system will service approx. 40,000 inhabitants. That means that it will be necessary to construct around 100 km of distribution

pipelines. Current length of distribution network is approx. 88 km. Therefore, it is necessary to construct approx. **L=32 km** of pipelines, in the future.

The Conceptual Design has proposed expending of water supply system and, thus, it should serve as a landmark for planned pipelines. According to this design, it is planned to construct app. 24.5 km of pipeline. Conceptual Design included main distribution pipelines and transmission pipelines, as well as one part of secondary pipelines.

The chapter ***2.8.4 System development plan***, provides an overview of required pipelines in water supply system Istočno Sarajevo.

2.8.3 HYDRAULIC ANALYSIS AND ESTIMATES

2.8.3.1 NETWORK ESTIMATE

In the Conceptual Design, a Hydraulic estimates of distribution network was developed, using TK-Net program, with checking the system behaviour during a 24-hour simulation. The following hydraulic parameters were selected for hydraulic estimate:

- Taking into account polyethylene as a proposed pipe material, the following absolute roughness coefficients are selected: for supply pipelines 0.01 mm and for distribution pipelines 0.1 mm.
- It is selected an Hourly Variation Diagram that is common for small towns, with maximum value of Kd=1.8 for maximum hourly consumption and 0.24 for minimal hourly consumption (nightly consumption).

2.8.3.2 SYSTEM FACILITY ESTIMATE

Reservoirs in the system are dimensioned at 30% of maximum daily consumption with the exception of R. Kotorac, which is as existing reservoir (with volume of 2*5,000 m3) which was retained as main distribution reservoir of lower zone.

2.8.4 SYSTEM DEVELOPMENT PLAN

2.8.4.1 SYSTEM DISPOSITION

Conceptual Design that was developed in 1997 is largely acceptable. Besides this project, we also used a project „ Conceptual design of Water Supply System Tilava – higher zones of the slopes of Trebević“.

The major difference is in planned specific population and commercial consumption, thus, despite approximate number of inhabitants, water requirements numbers are different. According to Conceptual Design, water demand for 2020 amounts to approx. **344 lps**.

According to **Water requirements** analysis presented in **Table 51: Estimate of required water quantities for the area of municipalities Istočna Ilidža, Istočno Novo Sarajevo and WSS Grabski mlini-Total**, the required water amount for **2020 is 178.7 l/s and at the end of the 2035 planning period 225.6 l/s**.

Terrain configuration of Lukavica – Kasindo area, which is a subject to this water supply proposal, dictated zoning of the system into three zones as it was shown in Appendix.

First pressure zone covers an area up to the elevation of 550 m a.s.l. and it is, mainly, in the zone of reservoir Tilava and reservoir Donji Kotorac.

Second pressure zone covers an area from 550 m a.s.l. to 600 m a.s.l.

Third pressure zone covers an area from 600 m a.s.l. to 650 m a.s.l. After Third pressure supply zone, there are higher zones of supply for hillside area of Trebević.

There are total of six pressure zones of supply in the system which is affected by the terrain especially in hillside area of Trebević. However, most consumers are located in the First pressure zone. There is also a significant percentage of population in the Second pressure zone while in other zones of supplying, total of around 10 % of the total municipal population.

Disposition of the system is composed of both existing system facilities and newly designed. In system disposition, main system facilities are given, as follows: facilities of water source Tilava, facilities of pumping stations, facilities of reservoirs, main transmission and distribution pipelines, and primary pipelines for water delivery to priority location, that have priority in building urban settlements and industrial facilities.

This Design does not cover distribution network of urban settlements that will be dealt within regulatory and zoning plans.

2.8.4.2 FIRSTPRESSURE ZONE

It has been already stated that the first pressure zone covers an area up to an elevation of 550 m a.s.l.

EXISTING SYSTEM CONSISTS OF:

- Water source Tilava with water intake capacity of 150 lps,
- Transmission pipeline ∅ 500 mm, with length of 2.300 m, for transport of water from source to treatment plant (section: 0 – 1 in Conceptual Design).
- Potable Water Treatment Plant with capacity of 180 lps and reservoir with volume of 600 m^3 with bottom level of 576 m a.s.l.
- Main distribution pipeline ∅ 500 mm, with length of 2,730 m, from Water treatment plant Tilava to Tešanovo Brdo (section: 1 – 3 in Conceptual Design).
- Distribution pipeline ∅ 200 mm, length of 1,520 m, from treatment plant Tilava to Energoinvest (section: 1 - 20).
- Existing distribution pipeline ∅ 150 mm, length of 600 m, from Tešanovo Brdo to Prljevo Brdo (section: 3 - 21).
- Main distribution pipeline ∅ 400 mm, length of 1,900 m, from Lukavica to Donje Mladice (section: 3 - 5).
- Connective distribution pipeline ∅ 300 mm, length of 850 m, for settlements Dobrinja IV (section: 4 - 19).
- Main distribution pipeline ø 300 mm, length of 1,430 m, from settlement Dobrinja I to Limari (section: 14 - 15).
- Existing distribution pipeline ∅ 300 mm, length of 1,350 m, from Donje Mladice to Gavrići (section: 5 - 8).
- Existing distribution pipeline ∅ 300 mm, length of 400 m, Škrbino polje (section: 17 - 18).
- Reservoir Donji Kotorac, with volume of 2 * 5000 m^3 with bottom level of 565 m a.s.l. This reservoir is finished ca 90 % and it meets the needs for 2020 planning period. Reservoir Gornji Kotorac was constructed for then planned regional water supply system Bijela rijeka. This reservoir is unfinished and it is not connected to pipeline system.
- Distribution pipeline ∅ 355 mm, length of 1,100 m, from Donji Kotorac to Vojkovići (section, 8 - 10).

- Main distribution pipeline ∅ 400 mm length of 1,730 m and ø 300 mm with length of 1,250 m, from the bridge on the river Željeznica in Vojkovići to the settlement Grlica (section: 10 – 11- 12).
- Distribution network for the settlement

SYSTEM FACILITIES PLANNED FOR CONSTRUCTION ARE AS FOLLOWS:

- New distribution pipeline ∅ 400 mm, length of 900 m, from Donji Kotorac to reservoir Donji Kotorac (section: 6 - 7).
- New main distribution pipeline ∅ 400 mm and ø 300 mm length of 1,330 m, from reservoir Donji Kotorac to settlement Škrbino Polje (section: 7 - 18).
- Secondary distribution network with diameter of ∅ 80 mm to the diameter of ∅ 250 mm. At this point, one can give only rough estimate of length of these pipelines.
- Planned pipeline from Lukavice to Škrbino polje (in Conceptual Solution section 2-15) would not be constructed. This pipeline would be very important for First pressure zone, still due the demanding terrain problems with pressure would occur in this pipeline. This requires detailed research in future, more detailed projects.

Existing and new system facilities, in the hydraulic sense, are controlled and dimensioned, and with its capacity correspond to the system development for 2020 planning period. Total water demands for this pressure zone, for 2020 planning period, according to Conceptual Design are **Q=234 lps**. That means that First pressure zone needs 68.02 % of water. Compared to calculations from Master Plan where the amounts of water needed at the end of planning period are **Q=225,26 l/s**, 68 % of water would be **Q=153,4 l/s**.

The Design has envisioned gravitational water supply from the source Tilava.

2.8.4.3 SECOND PRESSURE ZONE

Due terrain configuration, the second pressure zone is not compacted, and, in relation to the source Tilava, that is used for water supply of this zone, it is divided into:

- the area of Kasindo,
- the area of Toplik (Tilava),
- the area of Tešano and Prljevo brdo.

It is necessary to built new facilities in the second pressure zone, because there are no constructed system facilities that could be included in the newly designed systems.

According to Conceptual solution from 1996, the total water requirements in the second pressure zone are **$Q_{max\ dn}$=95.87 l/s**. This is maximum daily consumption with daily variation coefficient for the 2020 planned period.

Estimated water consumption by area: **Kasindo $Q_{max\ day}$=34.13 l/s, Tilava $Q_{max\ dn}$=34.73 l/s and Tešanovo and Prljevo brdo $Q_{max\ dn}$=26.93 l/s** (according to Conceptual solution).

In the meantime, the second pressure zone development concept was changed and these amounts of water were significantly reduced.

Water supply of the second pressure zone is envisaged from the source Tilava via pressure systems. The existing constructed facilities in the system enable the gravitational water supply of Kasindo area from the source Grabski mlini, in the amount of 30 l/s.

The second pressure zone of Kasindo was largely resolved in2010. Water supply system for this area was constructed – a pumping station near the reservoir and treatment plant Tilava was constructed, pressure pipeline from pumping station to newly built reservoir „Križ" with volume of V=1,000 m^3 and main distribution pipelines to reservoir Pavlovac and to

Kasindo settlement centre. The part of distribution network of Kasindo settlement still remains to be done.

The second pressure zone of Tilava (Toplik), Prljevo brdo, Vraca and hillside area of Trebević which covers the settlements Miljevići and Petrovići and that from the second pressure zone crosses into higher zones of supply (the highest zone is the sixth zone of supply) have been solved partially. Currently, in this area live around 3,700 inhabitants. Water requirements are given in the tables below:

- Table 43: Estimate of required water quantities for the area of higher zones of Tilava, Prljevo brdo, Miljevići, Vrace and hillside area of Trebević which are not connected to WSS Tilava
- Table 44: Estimate of water quantities required for the area of higher zones – for each settlement
- Table 45: Estimate of required water quantities for WSS Jahorina – Baba – future zone of reservoir Kadino brdo
- Table 46: Estimate of required water quantities for the area of Vraca – III pressure zone – future zone of reservoir Kadino brdo
- Table 47: Estimate of required water quantities for the area of reservoir Prljevo brdo – II pressure zone
- Table 48: Estimate of required water quantities for the area of LC Petrovići – hillside area of Trebevića.

All these settlements are water supplied from the WSS Tilava or WSS Jahorinska vrela or from local water supply systems, but it is necessary to provide a solution that would integrate this area into one sypply system. As noted above,one cannot count on water supply from Jahorina's system in a long term, and minor sources are still uncertain in terms of water supply.

Three variants were proposed for solving a problem of water supply in this area.

The first variant proposes: from reservoir Tilava water is being pumped to planned reservoir Katića brdo. From the reservoir Katića brdo water would be further pumped into two directions: towards planned reservoir Kadino brdo and towards existing reservoir Tomića brdo. Reservoir Tomića brdo would supply water to higher parts of Toplik while reservoir Katića brdo would cover lower parts of Toplika. Pumping station Tomino brdo would become unnecessary once this pumping station is constructed.

From the reservoir Kadino brdo water would be conveyed into three directions:

- toward the settlement Miljevići,
- toward Vrace which would be covered by gravity,
- toward PS Miljevići (Vraca) for smaller part of the settlement located at the higher elevation,
- toward PS Miljevići from which water would be pumped into higher zones – to reservoir Projište which would cover fourth pressure zone.

From the reservoir Projište water would be pumped toward existing reservoir Baba which would supply with water the area from reservoir Babe to Stanojevići.

Water would also be conveyed from reservoir Babe into pressure relief chamber Kozarevići covering the settlement below this reservoir.

In the future, reservoirs Logor and Igrišta would be supplied with water from reservoir Babe. Reservoir Podstrana has approximately the same elevation as reservoir Babe which enables it being filled with water from the existing local springs Dobrik and Studenac.

It would be certainly needed to re-record the elevation of reservoir Babe and reservoir Podstrana in order to define precise elevation and give hydraulic calculations of possibility of filling the reservoir Podstrana from reservoir Babe.

In addition to these reservoirs and pumping stations, it is also necessary to built transmission pipelines and new distribution pipelines for this area.

The area of Prljevo brdo and part of Vraca would be solved by construction of new pumping station on the main transmission pipeline Ø 500 mm through which water would be pumped into planned reservoir Prljevo brdo. Reservoir Prljevo brdo would cover the area of second pressure zone of Prljevo brdo area and part of Vraca and Lukavica. The largest part of settlement can be supplied with water from the planned reservoir Prljevo brdo.

This variant was rated as the best and it was adopted in Conceptual solutions.

Second variant is similar to the first one only water from the reservoir Tilava would be directly pumped into reservoir Kadino brdo for the area of Miljevići, Vraca and other parts which would be located within the area of Kadino brdo reservoir.

Second pump would pump water directly into existing reservoir Tomino brdo.

Third pump would pump water into planned reservoir Katića brdo and that reservoir would only be used to cover lower parts of Toplika.

This variant was dropped since the pressure pipelines toward Kadino brdo and Tomino brdo would be under high pressure of over 10 bar. It would also require more powerful pumps.

Third variant considered is the construction of pumping station in Lukavica, from where water would be directly pumped from the main transmission pipeline Ø 500 mm into planned reservoir Prljevo brdo. Gravitational water supply would be provided for settlements Prljevo brdo and part of Vraca from the reservoir Prljevo brdo. Pumping station near the reservoir Prljevo brdo, water would be pumped into higher zones which are described in variant I. This variant is also not good because around Q=20.0 l/s of water would be pumped directly from the main transmission pipeline Ø 500 mm. It would be also necessary to provide electricity and space for larger pumping station.

Fourth variant is similar tothel variant but the difference is that the reservoir of the second pressure zone Prljevo brdo would be filled with water from the reservoir Kadino brdo. The advantage of this solution is avoiding the construction of pumping station in Lukavica, but the flaw/disadvantage is that the amount of water of Q=6,60 l/s would be unnecessarily elevated at greater height for h=37.5 m. This would be unnecessary waste of energy in the future.

The given solutions are in accordance with Conceptual solution of water supply for hillside area of Trebević which was drafted in 2008 but it was added to wider area of this part of municipality. Conceptual solution of water supply system of Kasindo – Lukavica area, which was drafted in 1996, differs from the given solution primarily in the capacity of the system. Then there were high hopes for the construction of this part of municipality, but in the meantime a lot has changed resulting in decreased water requirements for the future period than it was planned before.

The following text represents existing and planned facilities in some parts of higher zones of water supply.

KASINDO AREA

Existing system

For the construction of water supply system of second pressure zone in the Kasindo Area, construction of the following facilities was completed in 2010:

- **Pumping station Tilava 1** capacity of **Q_{max}=48 l/s, H=45 m, P=30 kW**

- **Reservoir Kasindo - Križ**. Needed reservoir capacity **V= 2*500 m^3**, with bottom level of 647.18 m a.s.l. and overflow level of 651.68 m a.s.l.
- Supply pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 144.87 m, from reservoir Tilava to P.S. Tilava 1
- Pressure pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 327.15 m and PE HD pipeline Sdr 11, NP 16 bar ø 280/229.2 mm, length 333.20 m, from P.S. Tilava 1 to reservoir Kasindo
- Distribution pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length 763.14 m and PE HD pipeline Sdr 17, NP 10 bar ø 110/96.8 mm, length 66.52 m, from the point T34 to the school
- Transmission distribution pipeline PE HD Sdr 17, NP 10 bar ø 280/246.8 mm, length of 538.92 m, and PE HD pipeline Sdr 17, NP 10 bar ø 180/158.6 mm, length of 558.54, from R. Kasindo to R. Pavlovac
- Distribution network of settlements Kasindo, Pavlovac, and part of Škrbino Polje.

The following system facilities are planned for construction:

- Distribution pipeline in the „Križ“ reservoir zone with total length of L=3,000 m.

TOPLIK (TILAVA) AREA

For the formation of the Second pressure zone in the area of settlements Tilava and Toplik, it is necessary to construct the following facilities:

- Pumping station Tilava 2 (Katića brdo), capacity of Q=19.33 l/s and water raising level of 40 m. Pumping station covers 30 m^2, and electrical power supply is provided from Potable Water Treatment Plant.
- Pressure pipeline ∅ 200 mm, length 400 m, from P.S. Tilava 2 (Reservoir Tilava) to reservoir Katića brdo 1 (part of the section: 1 - 28).
- Reservoir Katića brdo, volume 250 m^3, bottom level 620 m.a.s.l..
- Distribution pipeline ∅ 100 mm. length 2,000 m, from reservoir Katića brdo to lower parts of Toplik.
- Pumping station Katića brdo that pumps water into two directions:
  - PS Katića brdo 1 – pumping direction is planned reservoir Kadino brdo, Q=13.31 l/s, pumping height level h=55 m
  - PS Katića brdo 2 – pumping direction is existing reservoir Tomino brdo, Q=5.74 l/s, pumping height level h=40 m
- Pressure pipeline from PS Katića brdo 1 to reservoir Kadino brdo, Ø 125 mm, L=1.410 m
- Pressure pipeline from PS Katića brdo 2 to reservoir Tomino brdo, Ø 80 mm, L=1.500 m
- Distribution network in Tomino brdo reservoir zone, with pipeline diameter of Ø 80-100 mm total length of L=3.000 m.

AREA OF TEŠANOVO AND PRLJEVO BRDO

In order to form a system at these localities, it is necessary to construct the following facilities:

- Pumping station Lukavica at the location Tešanovo brdo, capacity of Q=6.60 l/s (according Conceptual Design Q=26.93 l/s), and delivery head of 75.7 m. Pumping

station covers an area of 30 m^2, and electrical power supply is provided from the distance of 1.00 km.

- Pressure distribution pipeline, ∅ 250 mm, length of 2,550 m, from P. S. Lukavica to reservoir Prljevo brdo (section: 38-37-36).
- Reservoir Prljevo brdo volume of 200 m^3, (point 36), with bottom level 632.50 m.a.s.l.
- Distribution network in the Prljevo brdo reservoir zone, with diameter of Ø 100 mm, total length L=5,000 m.

2.8.4.4 THIRD PRESSURE ZONE AND HIGHER ZONES OF WATER SUPPLY AT THE HILLSIDE AREA OF TREBEVIĆ

SOLUTION CONCEPT

Water supply system of the third pressure zone covers urban area of Kadino brdo, Miljevići, Petrovići, part of Vraca and part of Prljevo brdo.

The part of this system was dealt during the planning of water supply system Toplik (Tilava). Consequently, one part of water supply to the planned reservoir Kadino brdo has already been drafted.

For the formation of this system, it is necessary to construct following facilities:

- Reservoir Kadino brdo volume of 500 m^3, first phase 250 m^3 (point 31), with bottom level 675 m.a.s.l.
- Distribution pipeline ∅ 200 mm, length 1100 m, from reservoir Kadino brdo to Prljevo brdo (section: 31 - 32).
- Distribution pipeline ∅ 200 mm, length 2390 m, from Prljevo brdo to Miljevići (section 32 -38).
- Distribution pipeline ∅ 150 mm, length 1150 m, from Prljeva brda to Batinića (Section 32 - 33 - 34).
- Distribution pipeline ∅ 100 mm, length 950 m, from Prljeva brda to Ivanića (Section 33 -35).
- Distribution pipeline ∅ 150 mm, length 1020 m, from Miljevića to Vraca (Section 38 – Vraca).
- Distribution pipeline ∅ 100 mm, length 420 m, pressurepipeline from PS Miljevići to Kovačići (section 38 –Kovačići).
- Pumping station Miljevići, capacity of 6.75 l/s, and discharge height of around 100 m. This pumping station pumps water to RK Petrušići for higher zones of supply.
- Distribution pipeline ∅ 80 mm, length 1070 m, (section 32 (PS Projišta) - RK Petrušići – pressure pipeline).
- Pumping station Projišta, capacity 3.37 l/s, and discharge height of around 70 m. Via this pumping station water is pumped to reservoir Baba for higher zones of supply.
- Distribution pipelines.

In hydraulic sense, all pipelines are dimensioned for the 2020 planning period.

The following table gives an overview of required pipelines in WSS Miljevići. Existing DN 150 mm pipeline which leads from reservoir Babe to manhole for Petrovići should be certainly kept in function if it is in good condition.

The plan is to build 16,755.0 m of new pipelines.

System disposition is given in the Appendix.

2.8.5 REHABILITATION, RECONSTRUCTION AND DEVELOPMENT OF LOCAL WATER SUPPLY SYSTEMS - LC PETROVIĆI AND TVRDIMIĆI

2.8.5.1 WATER SUPPLY OF LC PETROVIĆI

It has already been stated that Water supply system Dobrik and Studenac (LC Petrovići) will be, in the future, under control of ViK Istočno Sarajevo. In order to achieve this goal, rehabilitation and reconstruction of this water supply system is required. Basic data on this

water supply system are given in the chapter ***2.3.3Watersupply of the settlements on the slopes of Trebevića***.

Certainly, one of the first activities is developing of project documentation that would include the following:

- testing yield of the existing springs used for water supply,
- water quality testing at this sources (according to provided information, water quality is satisfactory and only preventive chlorination will be needed),
- Research and mapping existing system pipelines,
- developing project documentation at the level of Conceptual Design for this water supply system,
- drafting detailed design.

Water balance is already presented in Table 44: Estimate of water quantities required for the area of higher zones – for each settlement, and here we present only part that relates to these settlements. Estimates say that this area today has app. 303 households with app. 909 inhabitants.

Table 54: Requirements for water in the settlements of LCPetrovići

Water supply systems	Unit	**Projected population in the scope of the system**						
		2010	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
		909	933	970	1.034	1.103	1.177	1.255
		Maximum daily water requirements						
Estimate of water quantities for the hillside area of Trebević	l/s	4,39	2,49	3,07	3,46	4,19	4,46	4,76

Given the estimated large percentage of physical losses, it is evident that, at first, after rehabilitation and reconstruction of the system, water requirements will reduce and than will grow in line with the increase of population.

At the end of planned period, water requirements will amount to $\mathbf{Q_{max\ dn.}}$**=4,76 l/s**.

At this point, we cannot calculate water balance of available water due to lack of data on sources' yield.

Needs for reservoir storage capacity are listed in the following table.

Table 55: Requirements for reservoir space in LC Petrovići

2010			
Required water quantity (l/s)	**Required reservoir volume (m^3)**	**Existing reservoir space (m^3)**	**Needs**
4,39	113,79	162,00	0,00
2020			
Required water quantity (l/s))	**Required reservoir volume (m^3)**	**Existing reservoir space (m^3)**	**Needs**
3,46	89,68	162,00	0,00
2035			
Required water quantity (l/s)	**Required reservoir volume (m^3)**	**Existing reservoir space (m^3)**	**Needs**
4,76	123,38	162,00	0,00

These estimates show that the volume of reservoir space is sufficient for future needs.

In the description of the system, it is mentioned that lack of data on the pipelines in the system is evident. It is assumed that pipelines diameter do not meet standards. In addition, due to manner of constructing the pipelines in local water supply systems and pipeline age, it is assumed they are in poor condition and they need to be replaced and upgrade the distribution network. This needs to be proven in the future by measurements in the system. Rough estimates say that it takes to replace and construct new pipelines in the length of approx. 6.5 km. Pipeline diameter would be Ø 80 mm and Ø 100 mm.

Taking into account possibility of inclusion of a new source Sušica (Grčko vrelo), it is necessary to explore this source. With elevation of this spring in mind, at the future source it would be necessary to construct pumping station along with pressure pipeline from the source to the reservoir.

In order to put this system under control of AD Vodovod i Kanalizacija Istočno Sarajevo, it is certainly necessary to perform measurements in the system. Water flow meters should be installed at sources, reservoirs and by end users' location.

2.8.5.2 SOURCE TRVRDIMIĆI (VOJNO VRELO)

The settlement Tvrdimići is water supplied from the source Vojno vrelo. As well as other sources, there are no data on the yield of this source. However, according to information from local residents, the capacity of this spring is larger than needed for the settlement Tvrdimići. Data on pipelines also lacking, but it is presumed that these are small diameter pipelines that need repair and, in the future, replacement with larger diameter pipelines.

It is assumed that total length of pipeline is 2 km.

2.8.6 OVERVIEWOF EXISTING AND PLANNED FACILITIES AND PIPELINES

It has already been said that specific consumption for population and economy has been estimated at a higher level than in Master Plan. According to the practice that prevailed in the design before 1991, above-mentioned specific consumptions were very high. In the Conceptual Design these quantities are significantly reduced. However, these quantities might be high even in the Conceptual Design. Master Plan has been developed with specific population consumption as taken in developed countries. However, the problem of planned specific consumption for population and economy is that there are no plans for the economic development and, thus, one cannot have a real picture of the water requirements for economy.

For this reason, capacity of pipeline, pumping stations and reservoirs were retained from Conceptual Design. The following tables give an overview of existing and planned pipelines.

2.8.6.1 EXISTING PIPELINES IN THE SYSTEM

Table 56: An overview of existing pipelines in WSS Tilava

Section	Pipeline diameter (mm)	Pipeline length (m)	Pipeline
0 - 1	500	2,300.00	Transmission pipeline
II pressure zone Kasindo	250	800.00	
Transmission pipelines total:		**3,100.00**	
1 - 3	500	2,730.00	Main distribution pipelines of First pressure zone
1 - 20	200	1,520.00	
3 - 21	150	600.00	

14 - 15	300	1,430.00	
5 - 8	300	1,350.00	
10 - 11	300	1,250.00	
11 - 12	400	1,730.00	
3 - 5	400	1,900.00	
8 - 10	300	1,100.00	
4 - 19	300	850.00	
17 - 18	300	400.00	
Main distribution mains in reservoir zone "Križ" - settlement Kasindo - section 1 - 25	250	760.00	Distribution Water Pipelines of Second pressure zone Kasindo
	250	540.00	
	150	560.00	
	100	70.00	
Distribution water mains total:		**16,790.00**	
Pipelines of 80 to 200 mm in I pressure zone		70,840.00	Secondary distribution pipelines
Distribution pipelines in II pressure zone Kasindo		3,200.00	
Distribution pipelines total:		**74,040.00**	
Grand Total Distribution and transmission pipelines:		**93.930,00**	

Table 57: An overview of existing pipelines according to diameter in WSS Tilava, WSS Kasindo and WSS Grabski mlini

Pipeline diameter (mm)	Pipeline length (m)	Percentage by diameter
150,00	1.160,00	1,23
200,00	1.520,00	1,62
250,00	2.100,00	2,24
300,00	6.380,00	6,79
400,00	3.630,00	3,86
500,00	5.030,00	5,36
from 80 to 200 mm	74.110,00	78,90
Total:	**93.930,00**	**100,00**

Table 58: An overview of existing pipelines in Babe reservoir zone

Section	Pipeline diameter (mm)	Pipeline length (m)
Reservoir Baba - PK Projište	150	1.840,00
PK Projište – Junction in Kozarevići	150	1.432,00
Junction in Kozarevići – Manhole for Petrovići	150	360,00
PK Projište - PK Petrušići	80	1.100,00
Distribution network	80	5.000,00
Total:		**9732,00**

Table 59: An overview of existing pipelines in WSS Grabski mlini

Pipeline diameter (mm)	Pipeline length (m)
transmission	6,000.00
distribution	6,000.00
Total:	**12,000.00**

Distribution pipelines in WSS Grabski mlini according to diameter:

Pipeline diameter (mm)	Pipeline length (m)	Percentage by diameter
up to 100 mm	1.000,00	17%
100-200 mm ACC	4.500,00	75%
100-200 mm steel	500,00	8%
Total:	**6.000,00**	**100%**

2.8.6.2 PLANNED PIPELINES IN THE SYSTEM

Table 60: An overview of planned transmission and main distribution pipelines in WSS Tilava, WSS Kasindo and WSS Grabski mlini

PLANNED PIPELINES IN THE FIRST PRESSURE ZONE

Section	Pipeline diameter (mm)	Pipeline length (m)
6 - 7	400	900,00
7 - 17	400	930,00
Total:		**1.830,00**

PLANNED PIPELINES IN THE SECOND PRESSURE ZONE

New pipelines – Kasindo area

Section	Pipeline diameter (mm)	Pipeline length (m)
distribution pipelines	80 - 150	3.000,00
Total:		**3.000,00**

New pipelines – Toplik - Tilava area

Section	Pipeline diameter (mm)	Pipeline length (m)
Section	200	400,00
PS Tilava 2 -R.Katića brdo	100	2.000,00
R. Katića brdo - Toplik	80	1.500,00
Pressure pipeline PS Katića brdo 2 - R. Tomino brdo	100	3.000,00
Total:		**6.900,00**

New pipelines – area of Tešanovo and Prljevo brdo

Section	Pipeline diameter (mm)	Pipeline length (m)
Pressure pipeline	80	2.550,00

Distribution network	100	5.000,00
Total:		**5.000,00**
Total second pressure zone:		**14.900,00**

Planned pipelines in the third pressure zone

Section	Pipeline diameter (mm)	Pipeline length (m)
Pressure pipeline R: Katića brdo - R. Kadino brdo	125	1.410
31 - 32	200	1.100,00
32 - 38 (planned PS)	200	2.390,00
38 - Vraca	150	1.020,00
38 (planned PS) - Kovačići	100	420,00
32 - 33 - 34	150	1.150,00
33 - 35	100	950,00
32 (PS Projišta) - RK Petrušići – Pressure pipeline	80	1.070,00
T1-T3	100	404,00
T3-T4'	100	1.079,00
T3-T6	100	422,00
T6-Petruše	100	618,00
Kozarevići	100	330,00
	100	980,00
	100	312,00
Stanojevići	100	700,00
Remaining part of distribution network	100	2.000,00
Connections and water meters		
Total third pressure zone:		**16.355,00**

PLANNED PIPELINE- WATER SUPPLY FROM THE SYSTEM GRABSKI MLINI

Section	Pipeline diameter (mm)	Pipeline length (m)
R.Kijevo-R.D.Kotorac	250	8.500,00
Total:		**8.500,00**

NEW PIPELINES–AREA OF LC PETROVIĆI

Section	Pipeline diameter (mm)	Pipeline length (m)
Transmission	80	2.000,00
Distribution	100	4.500,00
Total:		**6.500,00**

RECAPITULATION OF EXISTING AND PLANNED PIPELINES

Existing pipelines	**115.662,00**
Planned pipelines	**46.255,00**
Grand Total:	**161.917,00**

2.8.6.1 EXISTING AND PLANNED RESERVOIRS

EXISTING AND PLANNED RESERVOIRS IN WSS ISTOČNO SARAJEVO

Reservoir	Location (x, y, z)	Area of water supply	Pressure zone	Reservoir shape	Bottom level (m. a.s.l.)	Overflow level (m. a.s.l.)	Volume (m^3)
Tilava – Potable water treatment plant	X=6531840; Y=4851856; Z=576	I.N.Sarajevo andI.Ilidža	I pressure zone	Rectangular	576,00	579,00	600,00
Pavlovac - II pressure zone	X=6531053; Y=4851974; Z=614	I.N.Sarajevo and I.Ilidža	II pressure zone	Circular	614,00	617,00	180,00
Gornje Mladice I (G. Kotorac)	X=6529147; Y=4851118; Z=640.7	I.Ilidža	II pressure zone	Rectangular	637.8	640,70	100,00
Gornje Mladice II (G.Kotorac)	X=6528966; Y=4851389; Z=607.3	I.Ilidža	II pressure zone	Rectangular	607,30		10,00
Kasindo - reservoir Bolnice		I.Ilidža	II pressure zone	Rectangular	642,00		100,00
Križ - Kasindo		I.N.Sarajevo and I.Ilidža	II pressure zone	Rectangular	630,00		1.000,00
Baba (Zlatište)		I.N.Sarajevo	VI pressure zone	Rectangular	824,40		500,00
R.K. Projište		I.N.Sarajevo	VI pressure zone	Rectangular	767,14		30,00
Reservoir Kozarevići		I.N.Sarajevo	IV pressure zone	Rectangular	700,50		30,00
R.K. Petrušići		I.N.Sarajevo	III pressure zone	Rectangular	679,60		20,00
Tomino brdo	X=6533496; Y=4852199; Z=660	I.N.Sarajevo	II pressure zone		660,10		100,00
Prljevo Brdo		I.N.Sarajevo	II pressure zone	Rectangular	632,50		50,00
Total:							**2.720,00**

EXISTING RESERVOIRS IN WSS PETROVIĆI – HILLSIDE AREA OF TREBEVIĆ

Reservoir	Location (x, y, z)	Area of water supply	Pressure zone	Reservoir shape	Bottom level (m. a.s.l.)	Overflow level (m. a.s.l.)	Volume (m^3)
Dobrik	Z: 900 m.a.s.l.	80	IV pressure zone	Rectangular	900,00		46,00
Podstrana	X: 6535716,3; Y: 4851203,7; Z: 823	127	VII pressure zone	Rectangular	823,00		50,00
Izlazine (Logor)	X: 6535212,8; Y: 4851393,8; Z: 778,2	80	VI pressure zone	Rectangular	778,20		46,00
Igrišta		16	VI pressure zone	Rectangular			20,00
Total:		***303***					**162,00**

EXISTING RESERVOIRS IN WSS GRABSKI MLINI

Planned reservoirs	Location (x, y, z)	Area of water supply	Pressure zone	Reservoir shape	Bottom level (m. a.s.l.)	Overflow level (m. a.s.l.)	Volume (m^3)
Kijevo - Jablanica		LC Kijevo	I pressure zone	Rectangular	662,00	665,00	100,00
Kijevo - Hadžići		LC Kijevo	II pressure zone	Rectangular	658,00	661,00	100,00
						Total:	**200,00**

PLANNED RESERVOIRS

Planned reservoirs	Location (x, y, z)	Area of water supply	Pressure zone	Reservoir shape	Bottom level (m. a.s.l.)	Overflow level (m. a.s.l.)	Volume (m^3)
Donji Kotorac[1]		I pressure zone	I pressure zone	Rectangular	565,00		5.000,00
Prljevo brdo		II pressure zone	II pressure zone	Rectangular	632,50		200,00
Katića brdo (Kadino brdo 1)		II pressure zone	II pressure zone	Rectangular	620,00		250,00
Kadino brdo 2		III pressure zone	III pressure zone	Rectangular	670,00		500,00
						Total:	**5.950,00**

[1]Existing reservoir which is unfinished. It has two chambers volume of V=5.000 m^3each, i.e. total of V=10.000 m^3. Only one chamber is needed.

2.9 PRICED BILL OF QUANTITY FOR REHABILITATION AND DEVELOPMENT

2.9.1 SYSTEM REHABILITATION

GIS, hydraulic model, defect removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation	Total cost (BAM)
Developing hydraulic model of water supply system	200.000,00
Conceptual Solution for inclusion of Gornji Kotorac Reservoir into WSS Tilava and inspection of facilities	30.000,00
Procurement of equipment and monitoring of water supply system	200.000,00
Developing project documentation at the level of main projects	338.103,42
Rehabilitation of the source and Tilava Potable water Conditioning Plant	500.000,00
SCADA remote control system	100.000,00
Network research and defect rehabilitation in first 10 years	1.000.000,00
Network research and defect rehabilitation in period 2021 - 2035	1.400.000,00
Total:	**3.738.103,42**

2.9.2 CONSTRUCTION OF NEW MAIN DISTRIBUTION TRANSMISSION PIPELINES

2.9.2.1 PLANNEDPIPELINES IN THE FIRST PRESSURE ZONE

Construction of new main distribution transmission pipelines				
Section	**Pipeline Diameter (mm)**	**Pipeline Length (m)**	**Unit Cost (BAM/m)**	**Total Cost (BAM)**
6 - 7	400	900,00	313,90	282.510,00
7 - 17	400	930,00	313,90	291.927,00

Distribution pipelines	80-150	5.000,00	90,00	450.000,00
	Total:	**6.830,00**	**Total:**	**1.024.437,00**

2.9.2.2 PLANNEDPIPELINES IN THE SECOND PRESSURE ZONE

New pipelines – Kasindo area				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
distribution pipelines	80-150	3.000,00	90,00	270.000,00
Total:			**Total:**	**270.000,00**
New pipelines – Tilava area				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
PS Tilava 2 -R.Katića brdo	200,00	400,00	148,40	59.360,00
R. Katića brdo - Toplik	100,00	2.000,00	71,76	143.520,00
Pressure pipeline PS Katića brdo 2 - R. Tomino brdo	80,00	1.500,00	65,88	98.820,00
R. Tomino brdo - Toplik	100,00	3.000,00	71,76	215.280,00
Total:		**6.900,00**	**Total:**	**516.980,00**
New pipelines – area of Tešanovo and Prljevo brdo				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
Force main	80	2.550,00	65,88	167.994,00
Distribution network	100	5.000,00	71,76	358.800,00
Total:		**5.000,00**	**Total:**	**358.800,00**
Total second pressure zone:		**11.900,00**	**Total:**	**1.145.780,00**

2.9.2.3 PLANNEDPIPELINES IN THE THIRD AND HIGHER PRESSURE ZONES

Planned pipelines in the third pressure zone - R. Kadino brdo zone and higher zones				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
Force main R: Katića brdo - R. Kadino brdo	125	1.810	113,08	204.674,80
31 - 32	200	1.100,00	148,40	163.240,00
32 - 38 (planned PS)	200	2.390,00	148,40	354.676,00
38 - Vraca	150	1.020,00	113,08	115.341,60
38 (planned PS) - Kovačići	100	420,00	71,76	30.139,20
32 - 33 - 34	150	1.150,00	113,08	130.042,00
33 - 35	100	950,00	71,76	68.172,00
32 (PS Projišta) - RK Petrušići – Pressure pipeline	80	1.070,00	65,88	70.491,60
T1-T3	100	404,00	71,76	28.991,04
T3-T4'	100	1.079,00	71,76	77.429,04
T3-T6	100	422,00	71,76	30.282,72
T6-Petruše	100	618,00	71,76	44.347,68
Kozarevići	100	330,00	71,76	23.680,80
	100	980,00	71,76	70.324,80
	100	312,00	71,76	22.389,12
Stanojevići	100	700,00	71,76	50.232,00
Other part of distribution network	100	2.000,00	71,76	143.520,00
Connections and water meters				71.700,00
Total third pressure zone:		**16.755,00**	**Total:**	**1.699.674,40**

2.9.2.4 PLANNED PIPELINES IN LC PETROVIĆI AND TVRDIMIĆI

New pipelines –area of LC Petrovići and Tvrdimići				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
Transmission	80	2.000,00	65,88	131.760,00
Distribution	100	4.500,00	71,76	322.920,00
Connections and water meters				45.450,00
Total :		**6.500,00**	**Total:**	**500.130,00**

2.9.2.5 PLANNEDPIPELINE- WATER SUPPLY FROM THE SYSTEM GRABSKI MLINI

Planned pipeline – water supply from the system Grabski mlini				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
R.Kijevo-R.D.Kotorac	250	8.500,00	162,60	1.382.100,00
Total:		**8.500,00**	**Total:**	**1.382.100,00**
Grand Total pipelines:		**47.555,00**		**6.291.560,60**

2.9.3 REHABILITATIONOF CAPTURE STRUCTURES AND RESERVOIRS – AREA OF LC PETROVIĆI AND TVRDIMIĆI

Section	**Reservoir volume (m^3)**	**Reservoir bottom level**	**Unit cost (BAM/m^3)**	**Total cost (BAM)**
Reservoirs	162		300,00	48.600,00
Capture structures				30.000,00
			Total:	**78.600,00**

2.9.4 CONSTRUCTIONOF NEW RESERVOIRS

Reservoir	Reservoir volume (m^3)	Reservoir bottom level	Unit cost (BAM/m^3)	Total cost (BAM)
Donji Kotorac - 1 chamber	5.000	565,00	250,00	1.250.000,00
Donji Kotorac - 2. chamber	5.000	565,00		Will not be constructed
Reservoir Prljevo brdo	200	633	1.200,00	240.000,00
Katića brdo	250	620	1.200,00	300.000,00
Reservoir Kadino brdo	250	670	1.200,00	300.000,00
	250		1.200,00	300.000,00
Total:	**10.950,00**		**Total:**	**2.390.000,00**

2.9.5 CONSTRUCTIONOF NEW PUMPING STATIONS

Pumping station	Capacity (l/s)	Water raising level - geographical (m)	Water raising level (m)	Pump power (kW)	Unit cost (BAM/W)	Total cost (BAM)
Tilava 2 (Katića brdo)	19,05	44,00	50,00	19,53	1.750,00	34.185,78
PS Katića brdo - towards R. Kadino brdo	13,31	55,00	60,00	16,38	1.750,00	28.668,77
PS Katića brdo - towards R. Tomino brdo	4,59	40,00	45,00	4,24	1.750,00	7.412,50
Miljevići	7,08	100,00	100,00	14,52	1.750,00	25.413,40
Projište	6,31	60,00	70,00	9,06	1.750,00	15.848,78
Vraca	0,83	50,00	50,00	0,85	1.750,00	1.480,92
Lukavica (Tešanovo -Prljevo brdo)	26,93	75,00	75,70	41,82	1.750,00	73.176,97
Total:	**51,16**				**Total:**	**186.187,13**

Pumping station	Pumping station Surface area	Unit cost (BAM/m^2)	Total cost (BAM)
Tilava 2 (Katića brdo)	30,00	1.000,00	30.000,00
PS Katića brdo – towards R. Kadino brdo	30,00	1.000,00	30.000,00
PS Katića brdo - towards R. Tomino brdo			
Miljevići	30,00	1.000,00	30.000,00
Projište	30,00	1.000,00	30.000,00
Vraca	10,00	1.000,00	10.000,00
Lukavica (Tešanovo -Prljevo brdo)	30,00	1.000,00	30.000,00
Total:	**160,00**	**Total:**	**160.000,00**

2.9.6 OPENINGOF NEW WATER SOURCES

Description	Capacity (l/s)	Unit cost (BAM/l)	Total cost (BAM)
New source	38,95	35.000,00	1.363.189,14
Total:			**1.363.189,14**

2.9.7 RECAPITULATION

Activities			Cost (BAM)	
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation				**3.738.103,42**
Construction of new main distribution transmission pipelines				**5.752.121,40**
	Planned pipelines in the first pressure zone		1.024.437,00	
	Planned pipelines in the second pressure zone		1.145.780,00	
		New pipelines – Kasindo area	*270.000,00*	
		New pipelines – the area of Tilava	*516.980,00*	
		New pipelines – the area of Tešanovo and Prljevo brdo	*358.800,00*	
	Planned pipelines in third pressure zone - R. Kadino brdo zone and higher zones		1.699.674,40	
	New pipelines – area of LC Petrovići and Tvrdimići		500.130,00	
	Planned pipelines – water supply from the system Grabski mlini		1.382.100,00	
Rehabilitation of capture structure and reservoirs – area of MZ Petrovići and Tvrdimići				**78.600,00**
Construction of new reservoirs				**2.390.000,00**
Construction of new pumping stations				**346.187,13**
Opening of new water sources				**1.363.189,14**
Total:				**13.668.201,09**

Note: Unit cost of the pipeline was calculated with demolishing and repaving of roads along which pipelines are laid.

3 PRIORITIZED PLAN OF INVESTMENT MEASURES FOR A 10 YEAR PERIOD

3.1 INTRODUCTION

On the basis of the criteria developed in the long-term water supply plan and taking into consideration macro-available assessment and investment capability, the Consultant will define:

- Prioritized project list with dynamic implementation plan;
- Funding sources (delineated external and internal funding sources), time lines, expected outputs and risks in implementation.

3.2 PRIORITIZED PROJECT LIST WITH DYNAMIC IMPLEMENTATION PLAN

3.2.1 INTRODUCTION

As a priority in solving water supply issues in municipalitiesIstočna Ilidža and Istočno Novo Sarajevo the following activities have been determined:

- Development of project documentation for the development of water supply system Istočno Sarajevo (Tilava)
- GISdevelopment
- Development of water supply system's hydraulic model
- Rehabilitation of the source and Tilava Potable Water Conditioning Plant
- SCADA remote control system
- Network research and defect repairin water supply system
- Construction of pipeline Ø 400 mm to planned reservoir of the first pressure zone Donji Kotorac
- Construction of pipeline in the first pressure zone length of cca L=5.000 m
- Constructionof pipeline in the second pressure zone length of cca L=11.900 m
- Constructionof pipeline in the third pressure zone length of cca L=16.755 m
- Distribution network development in settlementsPetrovići and Tvrdimići in total length L=6.500 m
- Obtaining water supply from WSS Grabski Mlini
- Rehabilitation of capture structures and reservoirs
- Construction of new reservoirs

Reservoir	Reservoir storage volume (m^3)
Donji Kotorac –1 chamber	5.000
Reservoir Prljevo brdo	200
Katića brdo	250
Reservoir Kadino brdo	250
	250
Total:	**5.950,00**

- Construction of new pumping stations

Pumping station	Capacity (l/s)
Tilava 2 (Katića brdo)	19,05
PS Katića brdo - toward R. Kadino brdo	13,31
PS Katića brdo - toward R. Tomino brdo	4,59

Miljevići	7,08
Projište	6,31
Vraca	0,83
Lukavica (Tešanovo -Prljevo brdo)	26,93
Total:	**51,16**

Estimates of required funds for priority project are given in the text below.

3.2.2 SYSTEM REHABILITATION

GIS, hydraulic model, defect removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation	Total Cost (BAM))
Developing hydraulic model of water supply system	200.000,00
Conceptual Solution for inclusion of Gornji Kotorac reservoir in WSS Tilava and inspection of facilities	30.000,00
Procurement of equipment and monitoring of water supply system	170.000,00
Developing project documentation at the level of main projects	338.103,42
Rehabilitation of the source and Tilava Potable water Conditioning Plant	500.000,00
SCADA remote control system	100.000,00
Network research and defect rehabilitation in first 10 years	1.000.000,00
Total:	**2.338.103,42**

3.2.3 CONSTRUCTION OF NEW MAIN DISTRIBUTION TRANSMISSION PIPELINES

3.2.3.1 PLANNEDPIPELINES IN THE FIRST PRESSURE ZONE

Construction of new main distribution transmission pipelines				
Section	**Pipeline Diameter (mm)**	**Pipeline Length (m)**	**Unit Cost (BAM/m)**	**Total Cost (BAM)**
6 - 7	400	900,00	313,90	282.510,00
7 - 17	400	930,00	313,90	291.927,00
Distribution pipelines	80-150	5.000,00	90,00	450.000,00
	Total:	**6.830,00**	**Total:**	**1.024.437,00**

3.2.3.2 PLANNEDPIPELINES IN THE SECOND PRESSURE ZONE

New pipelines – Kasindo area				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
distribution pipelines	80-150	3.000,00	90,00	270.000,00
Total:			**Total:**	**270.000,00**
New pipelines – Tilava area				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
PS Tilava 2 -R.Katića brdo	200,00	400,00	148,40	59.360,00
R. Katića brdo - Toplik	100,00	2.000,00	71,76	143.520,00
Pressure pipeline PS Katića brdo 2 - R. Tomino brdo	80,00	1.500,00	65,88	98.820,00
R. Tomino brdo - Toplik	100,00	3.000,00	71,76	215.280,00
Total:		**6.900,00**	**Total:**	**516.980,00**
New pipelines – area of Tešanovo and Prljevo brdo				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
Pressure pipeline	80	2.550,00	65,88	167.994,00
Distribution network	100	5.000,00	71,76	358.800,00
Total:		**5.000,00**	**Total:**	**358.800,00**
Total second pressure zone:		**11.900,00**	**Total:**	**1.145.780,00**

3.2.3.3 PLANNEDPIPELINES IN THE THIRD AND HIGHER PRESSURE ZONES

Planned pipelines in the third pressure zone - R. Kadino brdo zone and higher zones				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
Pressure pipeline R: Katića brdo - R. Kadino brdo	125	1.810	113,08	204.674,80
31 - 32	200	1.100,00	148,40	163.240,00
32 - 38 (planned PS)	200	2.390,00	148,40	354.676,00
38 - Vraca	150	1.020,00	113,08	115.341,60
38 (planned PS) - Kovačići	100	420,00	71,76	30.139,20
32 - 33 - 34	150	1.150,00	113,08	130.042,00
33 - 35	100	950,00	71,76	68.172,00
32 (PS Projišta) - RK Petrušići – Pressure pipeline	80	1.070,00	65,88	70.491,60
T1-T3	100	404,00	71,76	28.991,04
T3-T4'	100	1.079,00	71,76	77.429,04
T3-T6	100	422,00	71,76	30.282,72
T6-Petruše	100	618,00	71,76	44.347,68
Kozarevići	100	330,00	71,76	23.680,80
	100	980,00	71,76	70.324,80
	100	312,00	71,76	22.389,12
Stanojevići	100	700,00	71,76	50.232,00
Other part of distribution network	100	2.000,00	71,76	143.520,00
Connections and water meters				71.700,00
Total third pressure zone:		**16.755,00**	**Total:**	**1.699.674,40**

3.2.3.4 PLANNED PIPELINES IN LC PETROVIĆI AND TVRDIMIĆI

New pipelines –area of LC Petrovići and Tvrdimići				
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
Transmission	80	2.000,00	65,88	131.760,00
Distribution	100	4.500,00	71,76	322.920,00
Connections and water meters				45.450,00
Total :		**6.500,00**	**Total:**	**500.130,00**

3.2.3.5 PLANNEDPIPELINE- WATER SUPPLY FROM THE SYSTEM GRABSKI MLINI

Planned pipeline – water supply from the system Grabski mlini				
Section	**Pipeline Diameter (mm)**	**Pipeline Length (m)**	**Unit cost (BAM/m)**	**Total cost (BAM)**
R.Kijevo-R.D.Kotorac	250	8.500,00	162,60	1.382.100,00
Total:		**8.500,00**	**Total:**	**1.382.100,00**
Grand Total pipelines:		**43.985,00**		**5.752.121,40**

3.2.4 REHABILITATIONOF CAPTURE STRUCTURES AND RESERVOIRS – AREA OF LC PETROVIĆI AND TVRDIMIĆI

Section	**Reservoir Storage Volume (m^3)**	**Unit Cost (BAM/m^3)**	**Total cost (BAM)**
Reservoirs	162	300,00	48.600,00

Capture structures			30.000,00
		Total:	**78.600,00**

3.2.5 CONSTRUCTION OF NEW RESERVOIRS

Reservoir	Reservoir storage volume (m^3)	Reservoir bottom level	Unit cost (BAM/m^3)	Total Cost (BAM)
Donji Kotorac - 1 chamber	5.000	565,00	250,00	1.250.000,00
Donji Kotorac - 2. chamber	5.000	565,00		Will not be constructed
Reservoir Prljevo brdo	200	633	1.200,00	240.000,00
Katića brdo	250	620	1.200,00	300.000,00
Reservoir Kadino brdo	250	670	1.200,00	300.000,00
	250		1.200,00	300.000,00
Total:	**10.950,00**		**Total:**	**2.390.000,00**

3.2.6 CONSTRUCTION OF NEW PUMPING STATIONS

Pumping Station	Capacity (l/s)	Water raising level - geographical (m)	Water raising level (m)	Pump power (kW)	Unit Cost (BAM/W)	Total cost (BAM)
Tilava 2 (Katića brdo)	19,05	44,00	50,00	19,53	1.750,00	34.185,78
PS Katića brdo - towards R. Kadino brdo	13,31	55,00	60,00	16,38	1.750,00	28.668,77
PS Katića brdo - towards R. Tomino brdo	4,59	40,00	45,00	4,24	1.750,00	7.412,50
Miljevići	7,08	100,00	100,00	14,52	1.750,00	25.413,40

Projište	6,31	60,00	70,00	9,06	1.750,00	15.848,78
Vraca	0,83	50,00	50,00	0,85	1.750,00	1.480,92
Lukavica (Tešanovo -Prljevo brdo)	26,93	75,00	75,70	41,82	1.750,00	73.176,97
Total:	**51,16**				**Total:**	**186.187,13**

Pumping station	**Pumping station Surface area**	**Unit cost (BAM/m^2)**	**Total cost (BAM)**
Tilava 2 (Katića brdo)	30,00	1.000,00	30.000,00
PS Katića brdo - towards R. Kadino brdo	30,00	1.000,00	30.000,00
PS Katića brdo - towards R. Tomino brdo			
Miljevići	30,00	1.000,00	30.000,00
Projište	30,00	1.000,00	30.000,00
Vraca	10,00	1.000,00	10.000,00
Lukavica (Tešanovo -Prljevo brdo)	30,00	1.000,00	30.000,00
Total:	**160,00**	**Total:**	**160.000,00**

3.2.7 RECAPITULATION

Activities			Cost (BAM)	
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation				**2.338.103,42**
Construction of new main distribution transmission pipelines				**5.752.121,40**
	Planned pipelines in the first pressure zone		1.024.437,00	
	Planned pipelines in the second pressure zone		1.145.780,00	
		New pipelines – Kasindo area	*270.000,00*	
		New pipelines – the area of Tilava	*516.980,00*	
		New pipelines – the area of Tešanovo and Prljevo brdo	*358.800,00*	
	Planned pipelines in third pressure zone - R. Kadino brdo zone and higher zones		1.699.674,40	
	New pipelines – area of LC Petrovići and Tvrdimići		500.130,00	
	Planned pipelines – water supply from the system Grabski mlini		1.382.100,00	
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići				**78.600,00**
Construction of new reservoirs				**2.390.000,00**
Construction of new pumping stations				**346.187,13**
Total:				**10.905.011,95**

3.3 FUNDING SOURCES

3.3.1 ANALYSISOF MACRO-AVAILABILITY AND SOCIO-ECONOMIC ANALYSIS

The analysis of macroeconomic availability of funds will be based on the analysis of three main sources of funding, such as:

- Potential savings in operation of Water Utility Company Vodovod i kanalizacija Istočno Sarajevo
- Analysis of price policy and the increase of revenues from services
- Analysis of wider community capacity, especially municipalities in whose territory Water Utility Vodovod i kanalizacija Istočno Sarajevo operates

3.3.1.1 WATER UTILITY COMPANY VODOVOD I KANALIZACIJA ISTOČNO SARAJEVO CAPACITY ANALYSIS

The following table presents data on the structure of revenues and expenditures of Water Utility Company

All values are expressed in BAM	**2009**	**2010**
Water	1.630.250,00	1.559.158,00
Waste water	433.358,00	414.459,00
Total	***2.063.608,00***	***1.973.617,00***
Other revenues (BAM)		
Services and connections	440.365,00	413.512,00
Donations	363.604,00	62.737,00
Reclamation of Write Off Debts and Refunds	133,00	19.340,00
Financial revenues	4.314,00	3.248,00
Other revenues	54.485,00	176.917,00
Total	***862.901,00***	***675.754,00***
Accrued Expenses (BAM)		
Electricity and fuel	197.861,00	199.077,00
Material	406.896,00	216.754,00
Salaries and Wages	1.426.278,00	1.459.472,00
Taxes and Contributions	7.413,00	12.876,00
Maintenance and Repairs	94.362,00	81.411,00
Renewable Materials		

Transportation, Digging	79.766,00	77.572,00
Other expenses	697.859,00	590.876,00
Total	**2.910.435,00**	**2.638.038,00**

The structure of water utility company expenditures	**(BAM)**	**Expenses Percentage**
Regular activity revenues	2.612.179	
Water supply revenues	1.559.158	
Regular activity expenditures	2.560.768	
Costs of material for construction	430.286	16,80%
Costs for salaries, wages and other personal expenses	1.542.511	60,24%
Depreciation costs	258.642	10,10%
Electricity costs	199.077	7,77%
The structure of water utility company revenues	**(BAM)**	**(%)**
Regular activity revenues	2.649.371	
Water supply revenues	1.559.158	60,89%
Waste water revenues	414.459	16,18%
Other revenues	675.754	26,39%

It is noticeable that the Utility company ViK Istočno Sarajevo financially speaking, operates very balanced, especially, bearing in mind situation in utilities sector in BiH.

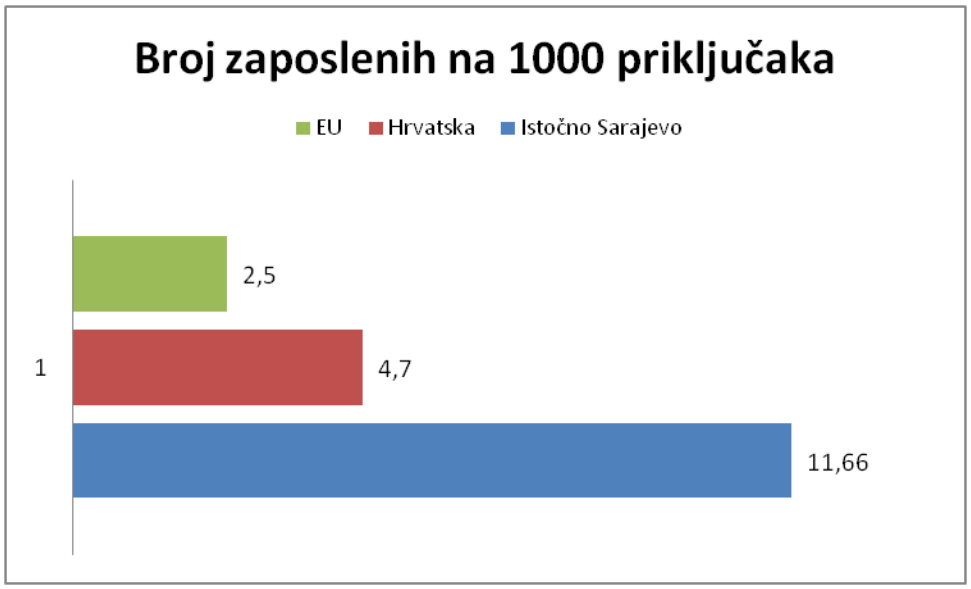
However, the successful business performance of Utility company ViK Istočno Sarajevo is not based on a stabile long-term basis, but on the significant revenues which are not exclusively tied to core business of water supply services and sewerage, but for the designing and construction works, as well as for a regular income from special consumer EUFOR base in Krtelji which represents significant and regular inflow of cash.

On the other hand, it is obvious that the aforementioned 'additional' revenues compensate the revenues from the provision of basic service, i.e. provision of services of water supply, waste water collection and disposal of waste water.

The weakest points in Utility company business policy are, as follows:

- Low collection rate of services which is app. 65%
- Unrealistically high prices of services for commercial/industrial consumers which are significantly higher than for households
- Large number of employees which significantly contributes to the increase in fixed costs of company

	Employees	Connections	Employees per 1000 connections
Istočno Sarajevo	99	8.492	11,66
Croatia			4,7
EU			2,5



Prices for consumer groups and share of water supply component in the total tariff

	Water supply	Sewerage	Total
Households (BAM/m3)	0,64	0,3	0,94
Economy (BAM/m3)	1,06	0,44	1,50
Households (%)	68,09%	31,91%	100,00%
Economy (%)	70,67%	29,33%	100,00%

What are positive in the work of Utility company are a relatively affordable price ratio and therefore revenues and expenses between water supply component and sewerage component.

	Total	Water supply	Sewerage
Maintenance and reinvestment costs	688.928	544.253,12	144.674,88
Operational costs	1.741.588,00	1.375.854,52	365.733,48

The table below provides an overview of fixed and variable costs.

Fixed and variable costs overview			
	Fixed Costs (BAM)	Variable Costs (BAM)	
Workforce	1.459.472	179.169	
Taxes and Contributions	12.876	216.754	
Depreciation	258.642	158.983	
Electrical Power	19.908		
Total	1.750.898	554.906	

Connections			
8.492,00	206,18	65,34	BAM per connection
Total Costs		271,53	BAM per connection
Water supply	175,25	55,54	BAM per connection
Total costs for water supply		230,80	BAM per connection

It is obvious that the fixed costs are too high, primarily due to large share of labour costs. In the above table fixed and variable costs are presented in proportion to the number of users and connections of water supply and sewerage. These high fixed costs are compensated by other incomes outside of core business. It remains to be seen to what extent this situation will be sustainable.

As for depreciation, Utility company being conscious of its obligations, makes efforts to cover these expenses. Officially, depreciation expenses are covered in value of 1,27 percent which is less than the values prescribed by law of 2%. However, it should be noted that the law in RS puts a high limit to which investment can be treated as depreciation expense and for this reason, significant resources/funds which are invested in maintenance of the system have not been officially presented as the depreciation expense.

Depreciation percentage	The Missing Percentage	
1,27%	0,73%	
Loss per year	148.003,58	BAM per year
Period	15,00	year
Loss on fixed assets	2.220.053,70	BAM

3.3.1.2 PRICEPOLICY ANALYSIS OF UTILITY COMPANY VODOVOD I KANALIZACIJA ISTOČNO SARAJEVO

The analysis of price policy is very important because income from services should represent a basic and stable source of income that will enable the realization of investment cycle defined by this Master Plan and priority measures.

Pricing policy is especially important for Utility Company ViK Istočno Sarajevo which already has a well developed network and covers a significant number of residents with its services. For this reason, future revenues will solely depend on price of services and the increase of collection rate and to a much lesser extent from the increase of number of future users.

Price for water supply service of is 0,64 BAM/m3 extremely low and underestimated by all parameters.

Official data provided by the RS Institute of Statistics provide an overview of income per capita

Municipality	2006		2007		2008		2009		2010	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Istočno Novo Sarajevo	694	456	713	478	1.081	719	1.259	822	1.083	682
Trnovo	813	535	843	567	1.183	787	1.221	796	1.184	772
Istočna Ilidža	749	490	839	557	1.477	979	1.325	868	1.226	799

Average Current Price for Water Supply Services as a Percentage of Households Revenues		
Specific Consumption	l per capita per day	140
	m3/month	4,2
Price of Service	BAM/m3	0,64
Cost of Water Supply	BAM	2,688
As a Percentage of Revenues	(%)	
Istočno Novo Sarajevo	(%)	0,99%
Trnovo	(%)	0,87%
Istočna Ilidža	(%)	0,84%

It is obvious that the current price of water supply service amounts only 0,87% of household income which is 2,3 times less than the recommended amount of water supply cost participation in the total household income of 2%.

The analyses of household consumption made by RS Institute for Statistics also show that the share of the costs of water supply in total household expenses is even lesser.

Statistical Household			
Average number of household members	3,11		
Household by type of settlement			
Urban	34,50%		
Other	65,50%		
CATEGORY OF EXPENSES	Value		
	(BAM)		
	Rural/Semi Urban	Urban	Other
Total Monthly Consumption	1364,31	1.623,86	1.223,64
Percentage Share in Consumption of Energy and Utilities	(BAM)	(%)	
Total Monthly Consumption	1.623,86		
Electricity, Gas, Water, other energy resources	113,67		
Water Supply as a share of costs for Electricity, Gas, Water, other energy resources	8,36%	7,35%	
Total Water and Sewerage as a share of costs for Electricity, Gas, Water, other energy resources	15,54%	13,67%	
Share of Costs of Water and Sewerage in the Household Income and expenditures			
Water supply as a Percentage of Revenues	0,87%		
Water supply as a Percentage of Expenditures	0,51%		
Total Water and Sewerage As the Percentage of revenues	1,14%		
Total Water and Sewerage As the Percentage of Expenditures	0,96%		

Relative Poverty		
The Relative Poverty Line per Adjusted Member per month	350,22	(BAM)
Percentage of Poor per Adjusted Member	15,64	(%)

Share of Water Supply Costs in Total Consumption		
	(BAM)	(%)
The Relative Poverty Line per Adjusted Member per month	350,22	
Water Supply	8,36	2,39%
Total Water and Sewerage	15,54	4,44%

The last table shows that the current pricing policy is based on the group of 15% of poor users of services and that is adapted to their capacities. This so to say 'social' pricing policy has enabled that the remaining 75% of users, which cannot be regarded as the poor, achieve additional benefits through a low cost of utilities.

It is obvious that there is a great scope for increasing prices of services in line with actual household capability to pay services.

Theoretically possible price of service in accordance with household capability is BAM 1.30 i.e. 50% more than the current price of the service which is 0.64 BAM/m3.

Assumption	2% from revenues	
Price of service	BAM/m3	1,30

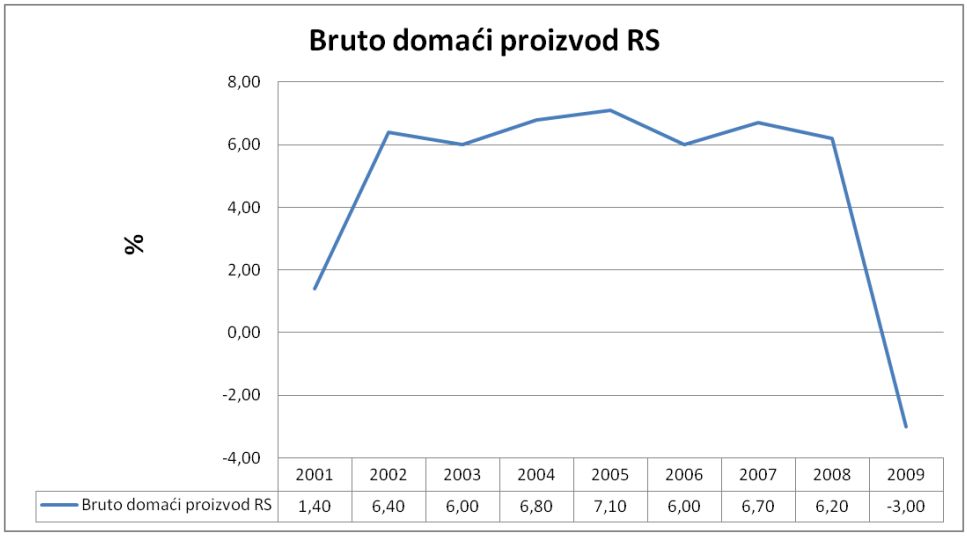
3.3.1.3 MACROECONOMIC PROJECTIONS

Since the assessment of future revenue depends entirely on revenues generated by providing water supply services which in turn depend on prices of service but also on the income of consumers, it is very important to make analysis of future macroeconomic trends and assess the income of households.

The assessment of economic growth expressed by an increase in GDP in BiH is very ungrateful and unreliable and it was so mainly for the following reasons:

- Statistical monitoring of the relatively short duration
- The economy is still in transition
- The introduction of VAT has positive effect on GDP growth but the impact was of short duration
- World economic recession also has a significant influence on macroeconomic trends in BiH which cannot be accurately predicted.

The following diagram shows that the GDP of the RS has fluctuated significantly in a relatively short time, as a consequence of the above-mentioned influences.



	2001	2002	2003	2004	2005	2006	2007	2008	2009
Bruto domaći proizvod RS	1,40	6,40	6,00	6,80	7,10	6,00	6,70	6,20	-3,00

In order to assess future revenues, the simple estimates of future projections have been made for three cases:

- Moderate projection, increase in GDP for 2% per annum for the entire analysed period
- Pessimistic projection, the negative GDP growth of - 3% per annum for the entire analysed period
- Optimistic projection, the positive GDP growth of 4% per annum for the entire analysed period

Inflation was not taken into account i.e. they went with the assumption of 0% inflation. The results of projection are presented in the tables below.

Moderate Projection

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net
Istočno Novo Sarajevo	818	835	851	868	886	904	922	940	959	978	998	1.018	1.038	1.059	1.080	1.101
Trnovo	926	945	964	983	1.003	1.023	1.043	1.064	1.085	1.107	1.129	1.152	1.175	1.198	1.222	1.247
Istočna Ilidža	959	978	998	1.017	1.038	1.059	1.080	1.101	1.123	1.146	1.169	1.192	1.216	1.240	1.265	1.290
GDP Growth		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Pessimistic Projection

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net
Istočno Novo Sarajevo	818	794	770	747	725	703	682	661	641	622	604	585	568	551	534	518
Trnovo	926	899	872	846	820	796	772	749	726	704	683	663	643	623	605	587
Istočna Ilidža	959	930	902	875	849	823	799	775	751	729	707	686	665	645	626	607
GDP Growth		-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%

Optimistic Projection

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net	Net
Istočno Novo Sarajevo	818	859	902	947	995	1.045	1.097	1.152	1.209	1.270	1.333	1.400	1.470	1.543	1.620	1.701
Trnovo	926	973	1.021	1.072	1.126	1.182	1.241	1.304	1.369	1.437	1.509	1.584	1.664	1.747	1.834	1.926
Istočna Ilidža	959	1.007	1.057	1.110	1.165	1.224	1.285	1.349	1.417	1.487	1.562	1.640	1.722	1.808	1.898	1.993
GDP Growth		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

Service Price Depending on Income 2,2% from Income

Pessimistic Projection

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Istočno Novo Sarajevo	1,43	1,39	1,34	1,30	1,27	1,23	1,19	1,15	1,12	1,09	1,05	1,02	0,99	0,96	0,93	0,90
Trnovo	1,62	1,57	1,52	1,48	1,43	1,39	1,35	1,31	1,27	1,23	1,19	1,16	1,12	1,09	1,06	1,02
Istočna Ilidža	1,67	1,62	1,58	1,53	1,48	1,44	1,39	1,35	1,31	1,27	1,23	1,20	1,16	1,13	1,09	1,06
GDP Growth		-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%

Moderate Projection

Istočno Novo Sarajevo	1,43	1,46	1,49	1,52	1,55	1,58	1,61	1,64	1,67	1,71	1,74	1,78	1,81	1,85	1,89	1,92
Trnovo	1,62	1,65	1,68	1,72	1,75	1,79	1,82	1,86	1,90	1,93	1,97	2,01	2,05	2,09	2,13	2,18
Istočna Ilidža	1,67	1,71	1,74	1,78	1,81	1,85	1,89	1,92	1,96	2,00	2,04	2,08	2,12	2,17	2,21	2,25
GDP Growth		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Optimistic Projection

Istočno Novo Sarajevo	1,43	1,50	1,58	1,65	1,74	1,82	1,91	2,01	2,11	2,22	2,33	2,44	2,57	2,69	2,83	2,97
Trnovo	1,62	1,70	1,78	1,87	1,97	2,06	2,17	2,28	2,39	2,51	2,63	2,77	2,90	3,05	3,20	3,36
Istočna Ilidža	1,67	1,76	1,85	1,94	2,03	2,14	2,24	2,36	2,47	2,60	2,73	2,86	3,01	3,16	3,31	3,48
GDP Growth		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

Service Price Depending on Income 1,3% from Income

Pessimistic Projection

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Istočno Novo Sarajevo	0,84	0,82	0,79	0,77	0,75	0,73	0,70	0,68	0,66	0,64	0,62	0,60	0,59	0,57	0,55	0,53
Trnovo	0,96	0,93	0,90	0,87	0,85	0,82	0,80	0,77	0,75	0,73	0,70	0,68	0,66	0,64	0,62	0,61
Istočna Ilidža	0,99	0,96	0,93	0,90	0,88	0,85	0,82	0,80	0,78	0,75	0,73	0,71	0,69	0,67	0,65	0,63
GDP Growth		-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%

Moderate Projection

Istočno Novo Sarajevo	0,84	0,86	0,88	0,90	0,91	0,93	0,95	0,97	0,99	1,01	1,03	1,05	1,07	1,09	1,11	1,14
Trnovo	0,96	0,97	0,99	1,01	1,03	1,06	1,08	1,10	1,12	1,14	1,17	1,19	1,21	1,24	1,26	1,29
Istočna Ilidža	0,99	1,01	1,03	1,05	1,07	1,09	1,11	1,14	1,16	1,18	1,21	1,23	1,25	1,28	1,31	1,33
GDP Growth		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Optimistic Projection

Istočno Novo Sarajevo	0,84	0,89	0,93	0,98	1,03	1,08	1,13	1,19	1,25	1,31	1,38	1,44	1,52	1,59	1,67	1,76
Trnovo	0,96	1,00	1,05	1,11	1,16	1,22	1,28	1,34	1,41	1,48	1,56	1,63	1,72	1,80	1,89	1,99
Istočna Ilidža	0,99	1,04	1,09	1,15	1,20	1,26	1,33	1,39	1,46	1,53	1,61	1,69	1,78	1,87	1,96	2,06
GDP Growth		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Inflation		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

3.3.1.4 ELASTICITY OF DEMAND FOR SERVICES AND WILLINGNESS TO PAY THEM

Price elasticity of demand for water is the change in demand divided by the change in the price of water at any point on the curve of demand. Usually, the demand for water is considered 'inelastic' because the elasticity is less than +/- one, indicating that one percent increase in price leads to lesser (or higher) change in demand of one percent. The calculations of elasticity are usually being done in natural logarithms as the coefficients of elasticity are returned as a percentage change making them easier to interpret. Elasticity is calculated for an average price and consumption variable.

Price elasticity of demand for water is the increase of consumed quantity per unit of increase in income or consumption. Although demand can drop in a response to price increase, demand will respectively increase as a result of real growth of household income.

Such analysis have not been conducted in BiH and the a single attempt to estimate elasticity of demand has been given within the European Commission's project: Water Quality Management at River Basins Level in Bosnia and Herzegovina, Europe Aid/119168/C/SV/BA

This attempt was based on data of ISMS study on household consumption drafted in 2002. The document estimated elasticity that the one-percent water price increase will lead to 0.5 percent decline in volume of water consumption, and one-percent increase in real household income will lead to 0.8 percent increase in quantity of water consumption.

Since there was a significant increase in prices of water supply services in BiH in the meantime, it has been adopted for this Study purposes, elasticity of demand of 0.25%, i.e. price increase of 1% will lead to reduction in consumption of 0.25%. This assumption seems to be real with the respect to estimated specific consumption of 140 l/capita/day in Istočno Sarajevo. This means that the increase in prices in line with the current income and the estimated revenue growth of 50% will lead to reduction in consumption to approx.120 l/capita/day in Istočno Sarajevo. If we add to this value of consumption similar reduction in consumption due to increase in prices of sewerage and water treatment, we will get the estimated specific consumption of app. 105 l/capita/day in Istočno Sarajevo, which corresponds to values and experience of the countries in the region and transition.

Potential consumption increase due to increase in household income has not been taken into account, because it is considered that the real income growth will be sufficient to amortize expected price increase. Only with a significant absolute increase in income and reduction of water supply cost share below 1.2% for the economic price of water, it can be expected the increase in consumption, as a result of revenue growth.

The following table contains projections of specific water consumption, depending on the increase in price of services.

Moderate Projection

Municipality Istočno Novo Sarajevo		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Average Monthly Household Income		818	835	851	868	886	904	922	940	959	978	997	1.016	1.035	1.054	1.073	1.092
								4									
Service Price	BAM/m3	0,64	0,70	0,80	0,90	1,00	1,00	1,10	1,20	1,30	1,30	1,30	1,30	1,30	1,30	1,30	1,30
Percentage of increase	%		9,37%	14,29%	12,50%	11,11%	0,00%	10,00%	9,09%	8,33%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Percentage of reduction in consumption	%		2,34%	3,57%	3,13%	2,78%	0,00%	2,50%	2,27%	2,08%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Specific Consumption	l/capita/day	140	136,72	131,84	127,72	124,17	124,17	121,06	118,31	115,85	115,85	115,85	115,85	115,85	115,85	115,85	115,85
	m3/month	4,2	4,10	3,96	3,83	3,73	3,73	3,63	3,55	3,48	3,48	3,48	3,48	3,48	3,48	3,48	3,48
Revenue from water supply per household per month including elasticity of demand	BAM	8,36	8,93	9,84	10,72	11,58	11,58	12,42	13,25	14,05	14,05	14,05	14,05	14,05	14,05	14,05	14,05
Revenue from water supply per household per month without elasticity of demand	BAM	8,36	9,14	10,45	11,76	13,06	13,06	14,37	15,67	16,98	16,98	16,98	16,98	16,98	16,98	16,98	16,98

Willingness to pay services and consumer surplus

Assessment of willingness to pay services is one of the most controversial issues when it is about preparation of financial and economic plans for the development of Utility companies. Analysis to assess the readiness of user to pay for a particular service are designed and primarily used for economic evaluation of investments that cannot be evaluated in market or money. Therefore, these analysis became very popular when it comes to environmental projects that will have the consequence in improving environment and life conditions.

The implementation of such analysis in cases when it comes to monopoly services under the mores of state regulations has proved to be less successful because they do not take into account other non-financial mechanisms that affect the willingness to pay for certain services.

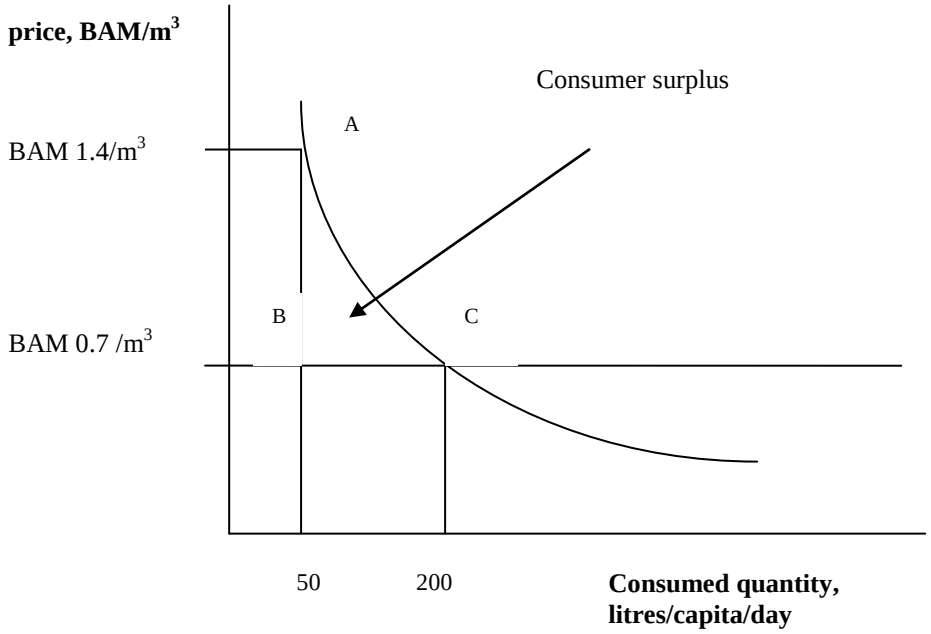
The experience of all transition countries say that, when it comes to water supply service, a key issue is 'unwillingness to charge services' while a lot less problem is 'willingness of consumers to pay'.

In the case of Utility company ViK Istočno Sarajevo low collection rate of app. 67% and according to estimate of utility company itself, without a couple of large consumers percentage of collection rate falls below 60%, is a consequence of:

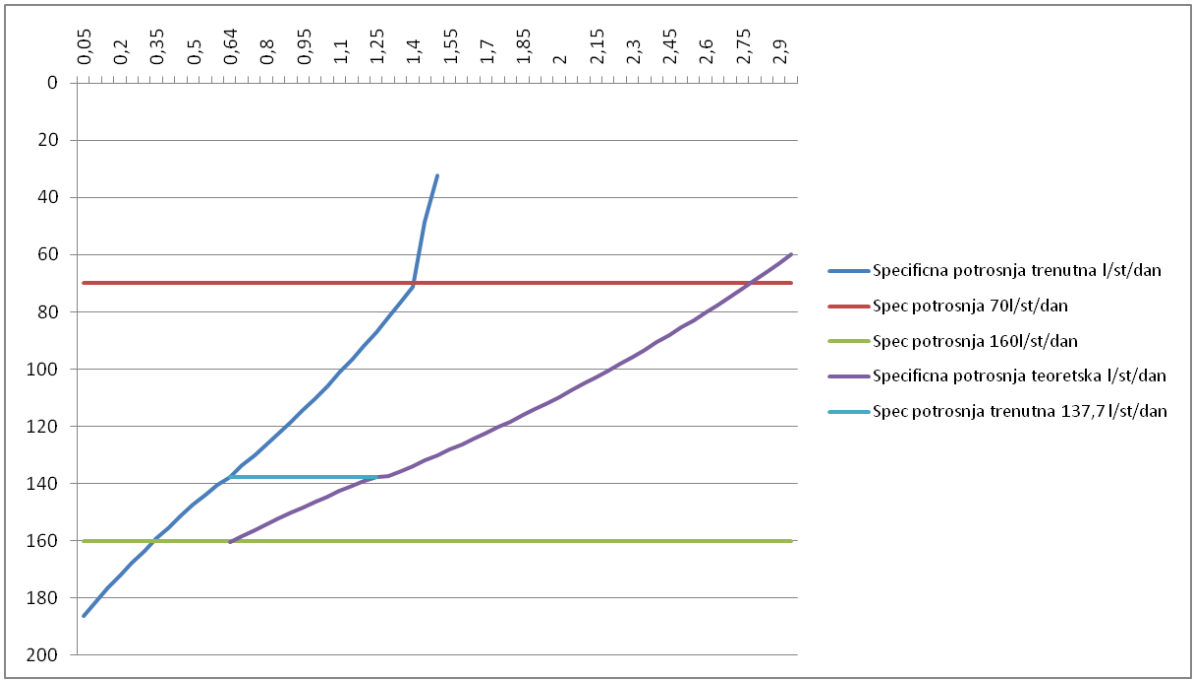
- migration of population during and immediately after the war, and unresolved Property Rights
- social policy of billing for services which was expressed in unrealistically low prices of services and releasing consumers of obligation to pay for services

The method that is used more often and is more exact when it comes to assessing willingness to pay for services is the evaluation of consumer surplus.

Consumer surplus concept is presented in brief in the following chart.



Analyses of consumer surplus were made for the purpose of this Study, and they show, as we can see in the following diagram, that the assessed willingness to pay for services ranges around 1.4 BAM/m^3.


0,05
0,2
0,35
0,5
0,64
0,8
0,95
1,1
1,25
1,4
1,55
1,7
1,85
2
2,15
2,3
2,45
2,6
2,75
2,9
0
20
40
60
80
100
120
140
160
180
200
Specificna potrosnja trenutna l/st/dan
Spec potrosnja 70l/st/dan
Spec potrosnja 160l/st/dan
Specificna potrosnja teoretska l/st/dan
Spec potrosnja trenutna 137,7 l/st/dan

3.3.2 ANALYSIS OF INVESTMENT OPPORTUNITIES IN ACCORDANCE WITH DEFINED PRIORITY PROJECTS

Analysis was done based on the following assumptions.

All prices are calculated based on current prices without inflation, VAT and other taxes and tax.

The discount rate is 8%.

Possible sources of income are defined as:

- Revenues from providing water supply services with prices for services up to the household financial capacity i.e. 2% from estimated revenues.
- Revenues from other utility services which are reduced for the purpose of this Study from the current app. BAM 550,000, on the real BAM 300,000 in the considered period.
- Investments of Municipalities in water supply systems are taken into consideration as the possible source of funding, the following table gives an overview of investments over the past five years. For the purpose of our analysis it was assumed that municipalities will continue to invest in proposed priority plan in the amount of 60% from the average of investments during the first 6 years of implementation.
- Credit Debt by the Utility company under the following conditions

Value of Credit Debt	BAM 5.000.000,00
Annual interest rate	5,00%
Repayment in years	15
Initial date of repayment	2016

Repayment in equal monthly instalments

Costs are defined as

- Investment costs
- Capital Costs
- Costs of maintenance and reinvestment

The costs of company operation, operational costs

Recovery costs Type I	Difference between operational costs and total revenues after investments
Recovery costs Type II	Difference between operational and maintenance costs and total revenues after investments

Investments in water supply sector for the period 2006 – 2010

	Istočna Ilidža Municipality			Trnovo Municipality			I.Novo Sarajevo Municipality		
Year	Total investments in infrastructure	Investments in water supply and sewerage network	%	Total investments in infrastructure	Investments in water supply and sewerage network	%	Total investments in infrastructure	Investments in water supply and sewerage network	%
2006	1.589.258,00	312.718,00	19,68	304.606,00	98.620,00	32,38	213.054,00	106.849,00	50,15
2007	3.822.654,00	785.885,00	20,56	253.004,00	84.850,00	33,54	7.603.067,00	334.830,00	4,40
2008	5.471.293,00	1.122.974,00	20,52	578.895,00	81.946,00	14,16	5.675.718,00	29.645,00	0,52
2009	926.623,00	647.121,00	69,84	439.593,00	34.623,00	7,88	824.989,00	59.579,00	7,22
2010				538.948,00	59.000,00	10,95	3.606.608,00	236.590,00	6,56
∑	11.809.828,00	2.868.698,00	24,29	2.115.046,00	359.039,00	16,98	17.923.436,00	767.493,00	4,28
Average		717.174,5			89.759,75			191.873,25	
Adopted for the projection purposes 60% of the average during the last 5 years		435.324,92			54.484,17			116.467,06	

3.3.2.1 INVESTMENT PLAN FOR PRIORITY PROJECT

Three scenarios have been defined for the Investment Plan

Option 1 – Strong option

Option 2 – Medium option

Option 3 – Weak option

All three options imply that the activities of the Prioritized Plan will be implemented during the first 10 years differing in the length of implementation of certain priority project.

Istočno Sarajevo –Implementation Plan Option 1

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Activity																									
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation																									
Construction of new main distribution transmission pipelines																									
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići																									
Construction of new reservoirs																									
Construction of new pumping stations																									
Opening of new sources																									
Connected Population (capita)	26.021	27.044			28.263					33.144					35.355					37.714					40.230
Average Annual Investment Cost (BAM)	1.251.077	1.434.236	1.376.088	1.416.562	2.444.562	2.538.985	2.423.590	2.423.590	1.165.278	137.278	62.184	62.184	62.184	516.580	516.580	520.743	66.347	66.347	66.347	66.347	70.762	70.763	70.762	70.763	70.763
Operational Cost	0	0	0	60.228	60.228	60.228	65.421	65.421	159.795	236.895	236.895	236.895	236.895	236.895	236.895	236.895	257.342	307.495	307.495	307.495	307.496	307.497	307.498	307.499	307.500
Maintenance Cost (Reinvestment)	0	0	0	150.192	150.255	150.318	167.690	167.753	172.849	182.057	191.265	200.473	209.682	218.890	228.098	237.306	247.605	257.903	268.202	278.501	288.799	299.098	309.397	319.695	329.994
Total Costs of Maintenance and Management	0	7.193	4.286	212.563	212.626	217.410	239.975	240.038	339.508	425.816	431.269	440.477	449.685	458.894	468.102	477.518	508.264	568.715	579.014	589.313	599.833	610.133	620.432	630.732	641.032

Istočno Sarajevo –Implementation Plan OPTION 2

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Activity																									
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation																									
Construction of new main distribution transmission pipelines																									
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići																									
Construction of new reservoirs																									
Construction of new pumping stations																									
Opening of new sources																									
Connected Population (capita)	26.021	27.044			28.263					33.144					35.355					37.714					40.230
Average Annual Investment Cost (BAM)	625.538	808.697	750.549	1.682.582	2.539.248	2.633.671	1.892.738	1.892.738	1.892.738	1.892.738	62.184	62.184	62.184	516.580	516.580	520.743	66.347	66.347	66.347	66.347	70.762	70.763	70.762	70.763	70.763
Operational Cost	0	0	0	3.930	3.930	3.930	18.506	18.506	18.506	18.506	109.088	109.088	109.088	109.088	109.088	109.088	114.280	179.688	179.688	179.688	179.689	179.690	179.691	179.692	179.693
Maintenance Cost (Reinvestment)	0	0	0	63	126	189	42.582	42.645	42.708	42.771	47.665	52.559	57.453	62.347	67.240	72.134	77.305	82.476	87.647	94.256	99.427	104.598	109.768	114.939	120.110
Total Costs of Maintenance and Management	0	7.193	4.286	6.136	6.199	10.983	67.952	68.015	68.078	68.141	159.862	164.756	169.650	174.543	179.437	184.539	194.903	265.481	270.652	277.261	282.654	287.825	292.997	298.169	303.341

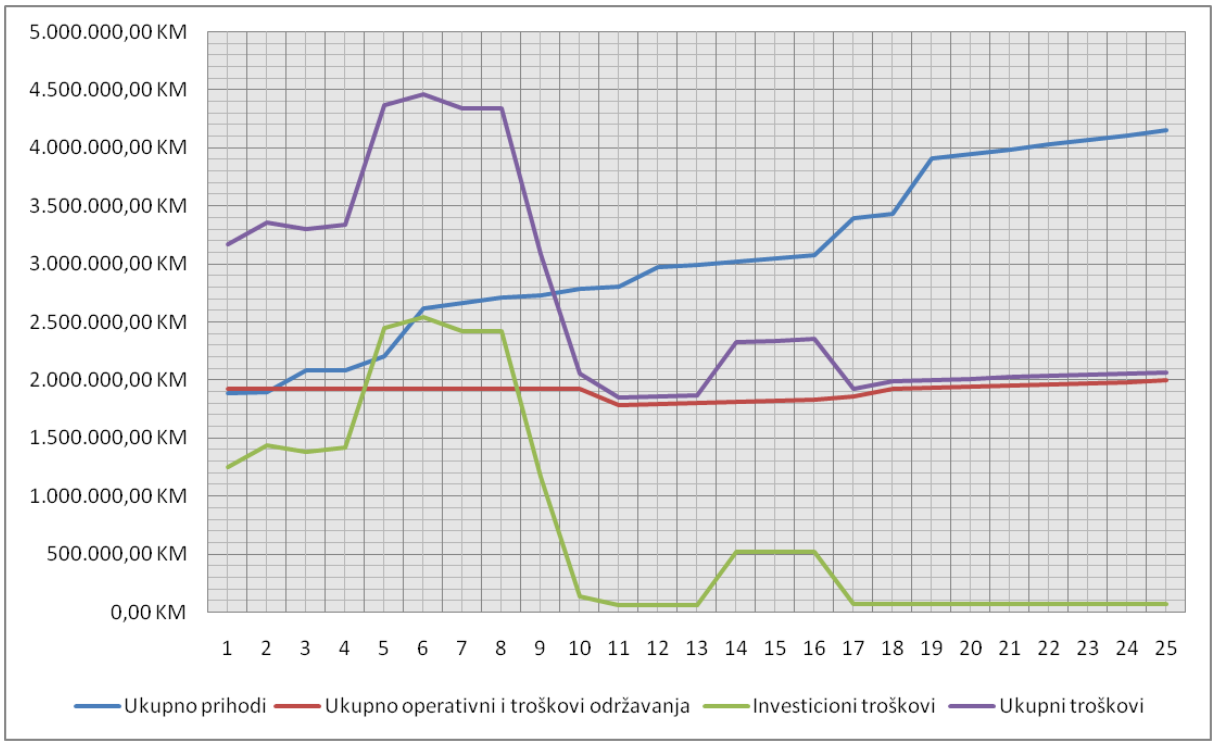
Istočno Sarajevo –Implementation Plan Option 3

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Activity																									
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation																									
Construction of new main distribution transmission pipelines																									
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići																									
Construction of new reservoirs																									
Construction of new pumping stations																									
Opening of new sources																									
Connected Population (capita)	26.021	27.044			28.263					33.144					35.355					37.714					40.230
Average Annual Investment Cost (BAM)	469.154	652.313	594.164	1.526.198	2.382.864	2.477.287	2.361.892	2.361.892	1.892.738	1.892.738	62.184	62.184	62.184	516.580	516.580	520.743	66.347	66.347	66.347	66.347	70.762	70.763	70.762	70.763	70.763
Operational Cost	0	0	0	3.930	3.930	3.930	9.123	9.123	16.160	16.160	106.742	106.742	106.742	106.742	106.742	106.742	111.935	177.342	177.342	177.342	177.343	177.344	177.345	177.346	177.347
Maintenance Cost (Reinvestment)	0	0	0	63	126	189	17.561	17.624	36.453	36.516	41.409	46.303	51.197	56.091	60.985	65.879	71.050	76.221	81.392	88.001	93.171	98.342	103.513	108.684	113.855
Total Costs of Maintenance and Management	0	7.193	4.286	6.136	6.199	10.983	33.547	33.610	59.477	59.540	151.261	156.155	161.048	165.942	170.836	175.938	186.302	256.880	262.051	268.660	274.052	279.224	284.396	289.568	294.740

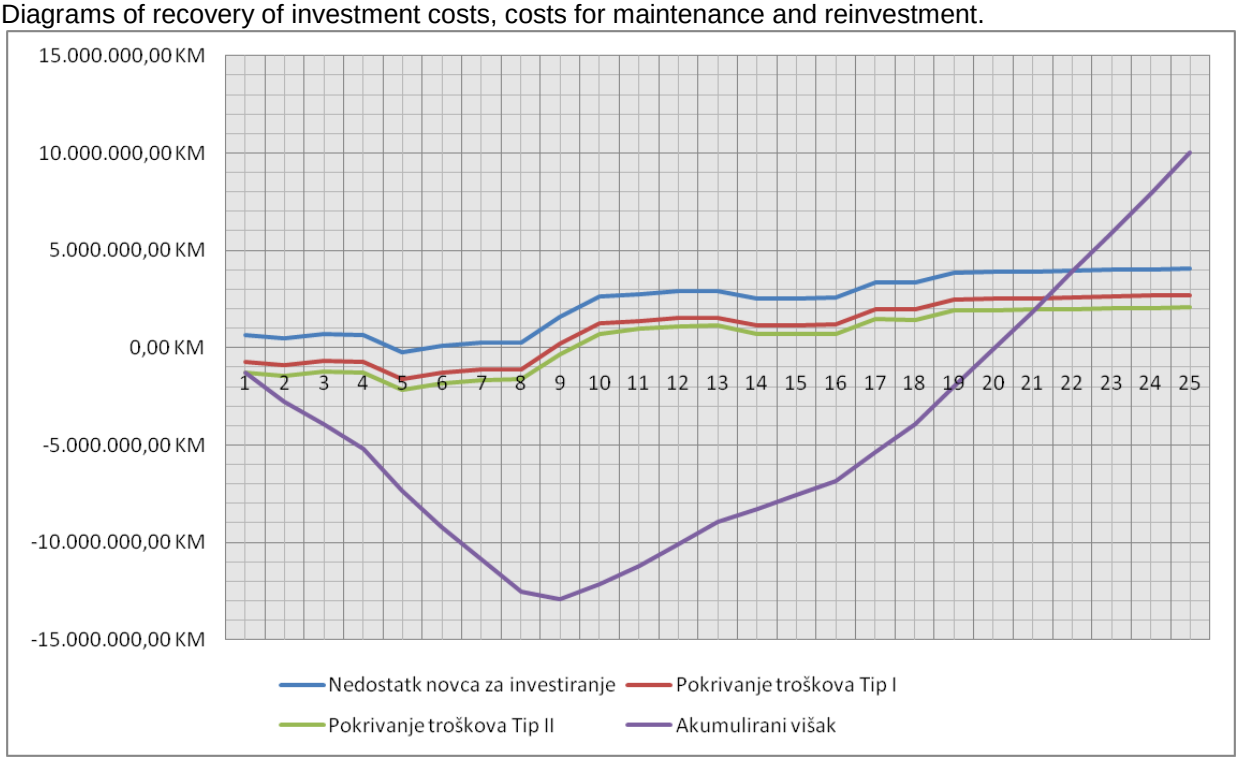
RESULTS OPTION 1

Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*15*	*16*	*17*	*18*	*19*	*20*	*25*
Revenues	All values are expressed in BAM 1000															
Revenues from services to households																
Collected revenue	576	709	905	1.219	1.383	1.762	1.776	1.791	1.809	2.130	2.159	2.479	2.511	2.992	3.030	3.232
Revenues from services to industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	713	736	730	563	520	553	585	618	618	618	618	618	618	618	618	618
Revenues of budgetary institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	1.288	1.445	1.635	1.781	1.903	2.315	2.361	2.409	2.427	2.748	2.776	3.096	3.129	3.610	3.647	3.850
Other revenues	600	450	450	300	300	300	300	300	300	300	300	300	300	300	300	300
Additional funding from the budget	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Revenues	1.888	1.895	2.085	2.081	2.203	2.615	2.661	2.709	2.727	3.048	3.076	3.396	3.429	3.910	3.947	4.150
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational Costs	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376
Maintenance and Reinvestment Costs	544	544	544	544	544	544	544	544	544	446	455	486	546	557	567	619
Operational and Maintenance Costs Before Savings	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.943	1.994
Cost Savings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Operational and Maintenance Costs	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.943	1.994
Investments Costs	1.251	1.434	1.376	1.417	2.445	2.539	2.424	2.424	1.165	517	521	66	66	66	66	71
Total Costs	3.171	3.354	3.296	3.337	4.365	4.459	4.344	4.344	3.085	2.338	2.352	1.928	1.988	1.999	2.009	2.065
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investment Gap	637	460	709	665	-241	76	237	285	1.561	2.531	2.556	3.330	3.362	3.843	3.881	4.079
Cost recovery Type I	-739	-916	-667	-711	-1.617	-1.300	-1.139	-1.090	185	1.155	1.180	1.954	1.986	2.467	2.505	2.703
Cost recovery Type II	-1.283	-1.460	-1.211	-1.256	-2.161	-1.844	-1.683	-1.635	-359	710	725	1.468	1.440	1.911	1.938	2.084
Accumulated Surplus	-1.283	-2.743	-3.954	-5.209	-7.371	-9.215	-10.898	-12.532	-12.891	-7.564	-6.840	-5.371	-3.931	-2.020	-82	10.039

Cost Structure



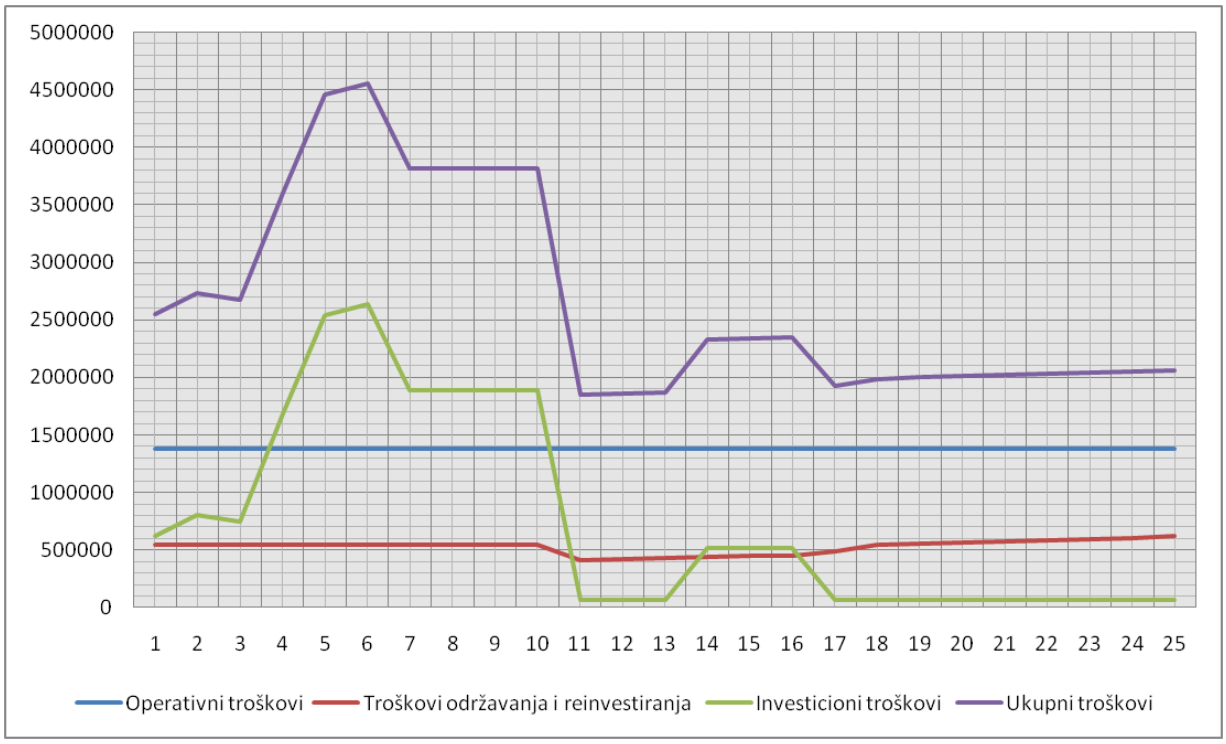
Diagrams of recovery of investment costs, costs for maintenance and reinvestment.



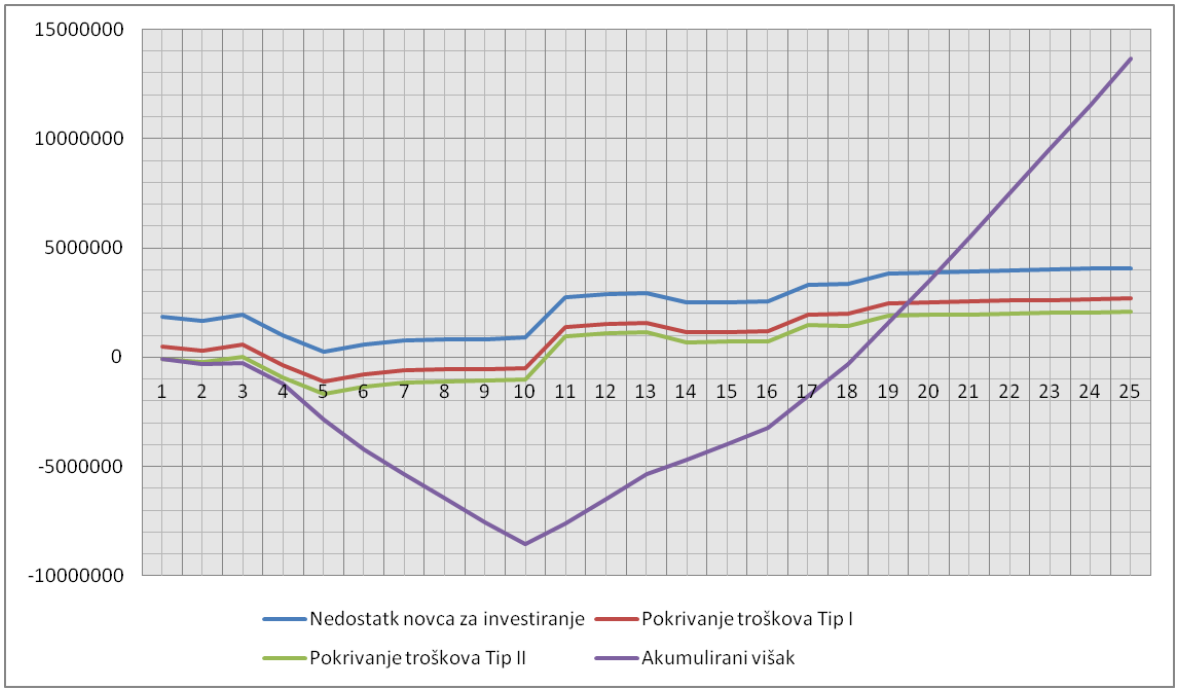
RESULTS OPTION 2

	1	2	3	4	5	6	7	8	9	10	15	16	17	18	19	25
Revenues All values are expressed in BAM 1000																
Revenues from services to households																
Collected revenue	576	709	905	1.219	1.383	1.762	1.776	1.791	1.809	1.864	2.130	2.159	2.479	2.511	2.992	3.232
Revenues from services to industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	713	736	730	563	520	553	585	618	618	618	618	618	618	618	618	618
Revenues of budgetary institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	1.288	1.445	1.635	1.781	1.903	2.315	2.361	2.409	2.427	2.481	2.748	2.776	3.096	3.129	3.610	3.850
Other revenues	600	450	450	300	300	300	300	300	300	300	300	300	300	300	300	300
Additional funding from the budget	600	600	600	600	600	600	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Revenues	2.488	2.495	2.685	2.681	2.803	3.215	2.661	2.709	2.727	2.781	3.048	3.076	3.396	3.429	3.910	4.150
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational Costs	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376
Maintenance and Reinvestment Costs	544	544	544	544	544	544	544	544	544	544	446	455	486	546	557	619
Operational and Maintenance Costs Before Savings	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.994
Cost Savings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Operational and Maintenance Costs	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.994
Investments Costs	626	809	751	1.683	2.539	2.634	1.893	1.893	1.893	1.893	517	521	66	66	66	71
Total Costs	2.546	2.729	2.671	3.603	4.459	4.554	3.813	3.813	3.813	3.813	2.338	2.352	1.928	1.988	1.999	2.065
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investment Gap	1.863	1.686	1.935	999	264	581	768	816	834	889	2.531	2.556	3.330	3.362	3.843	4.079
Cost recovery Type I	487	310	559	-377	-1.112	-795	-608	-560	-542	-487	1.155	1.180	1.954	1.986	2.467	2.703
Cost recovery Type II	-57	-234	15	-922	-1.656	-1.339	-1.152	-1.104	-1.086	-1.031	710	725	1.468	1.440	1.911	2.084
Accumulated Surplus	-57	-292	-277	-1.199	-2.855	-4.193	-5.346	-6.449	-7.536	-8.567	-3.964	-3.240	-1.771	-331	1.580	13.639

Cost Structure



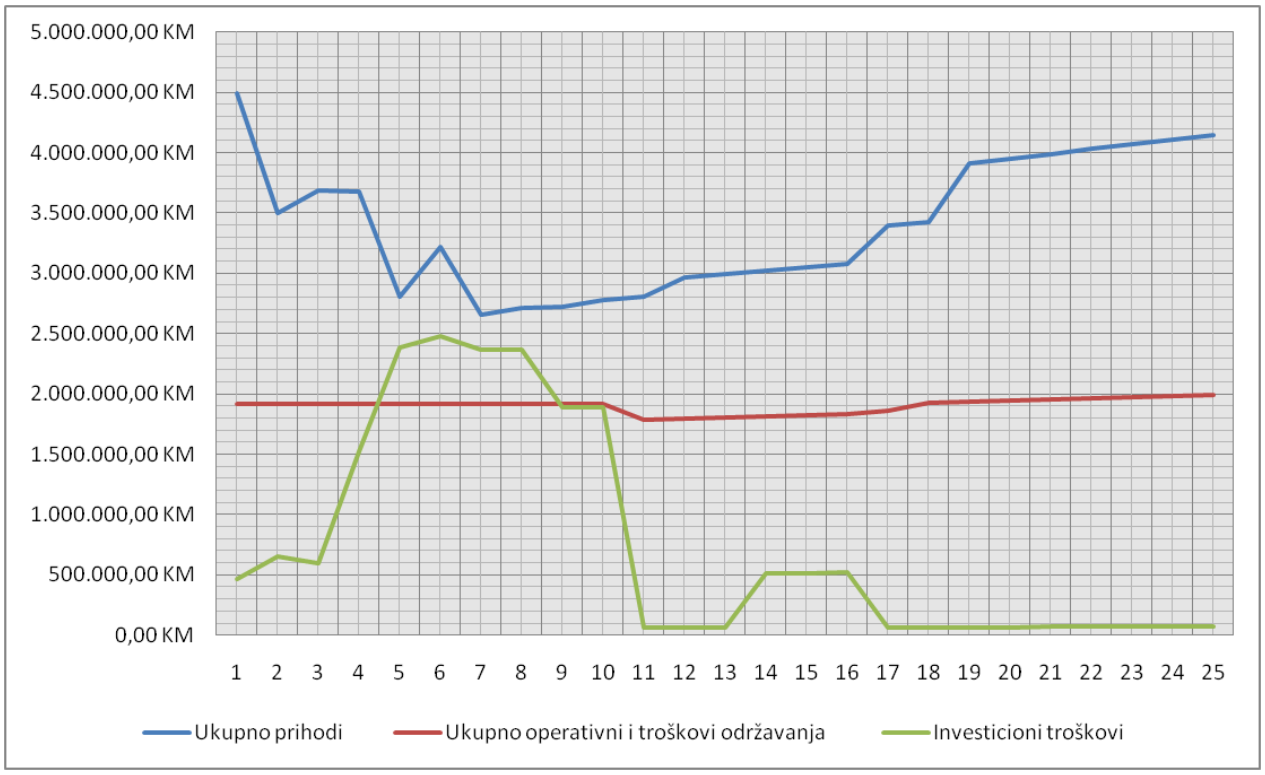
Diagrams of recovery of investment costs, maintenance costs and reinvestments



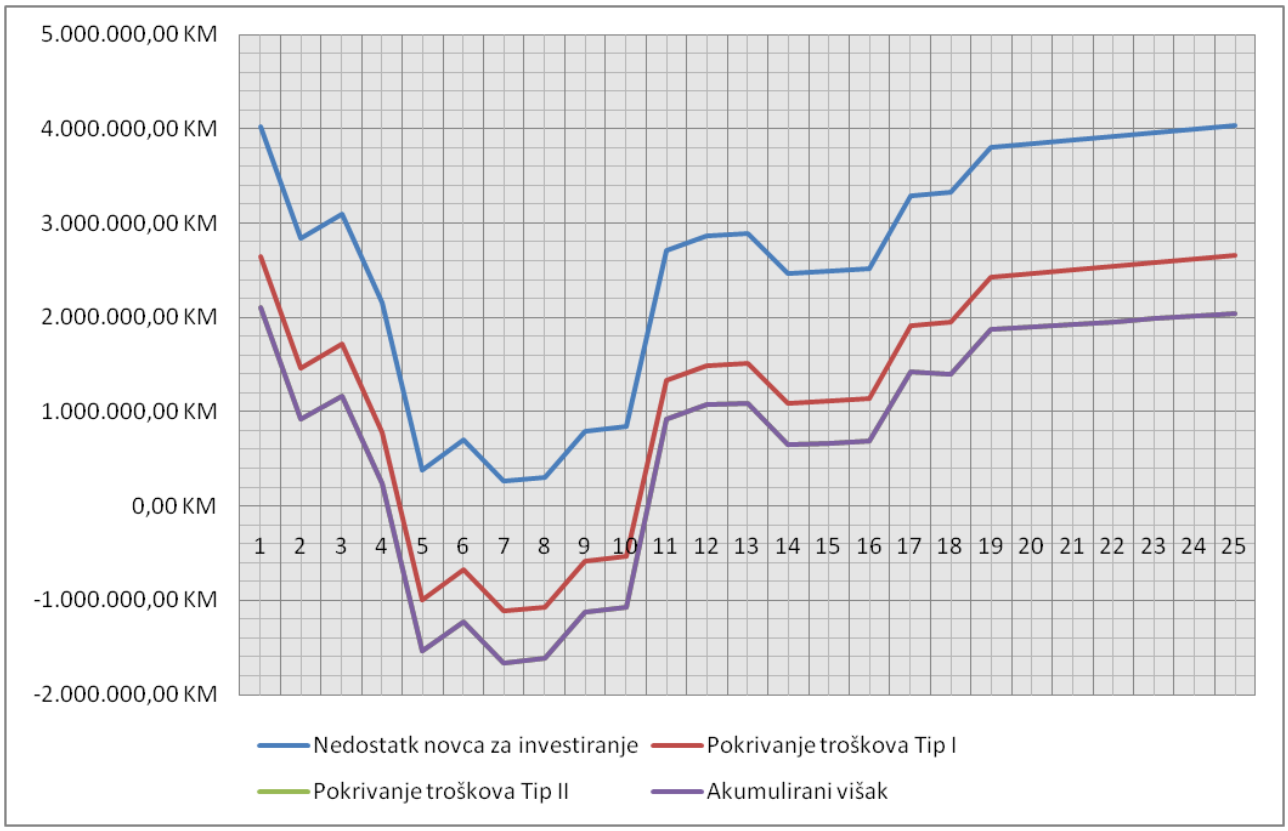
RESULTS OPTION 3

	1	2	3	4	5	6	7	8	9	10	15	16	17	18	19	20	25
All values are expressed in BAM 1000																	
Revenues																	
Revenues from services to households																	
Collected revenue	576	709	905	1.219	1.383	1.762	1.776	1.791	1.809	1.864	2.130	2.159	2.479	2.511	2.992	3.030	3.232
Revenues from services to industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	713	736	730	563	520	553	585	618	618	618	618	618	618	618	618	618	618
Revenues from budget institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	1.288	1.445	1.635	1.781	1.903	2.315	2.361	2.409	2.427	2.481	2.748	2.776	3.096	3.129	3.610	3.647	3.850
Other revenues	600	450	450	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Additional funding from the budget	600	600	600	600	600	600	0	0	0	0	0	0	0	0	0	0	0
Loan	2.000	1.000	1.000	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	4.488	3.495	3.685	3.681	2.803	3.215	2.661	2.709	2.727	2.781	3.048	3.076	3.396	3.429	3.910	3.947	4.150
Costs																	
Operational costs	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376
Maintenance and reinvestment costs	544	544	544	544	544	544	544	544	544	544	446	455	486	546	557	567	619
Costs of Capital	0	0	0	0	40	40	40	40	40	40	40	40	40	40	40	40	40
Operational and maintenance costs before savings	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.943	1.994
Cost savings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total operational and maintenance costs	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.943	1.994
Investment cost	469	652	594	1.526	2.383	2.477	2.362	2.362	1.893	1.893	517	521	66	66	66	66	71
Total costs	2.389	2.572	2.514	3.446	4.343	4.437	4.322	4.322	3.852	3.852	2.378	2.391	1.968	2.028	2.038	2.049	2.105
Investment Gap	4.019	2.842	3.091	2.155	381	698	259	307	794	849	2.492	2.516	3.290	3.323	3.804	3.842	4.039
Cost recovery Type I	2.643	1.466	1.715	779	-995	-678	-1.117	-1.068	-582	-527	1.116	1.140	1.915	1.947	2.428	2.466	2.663
Cost recovery Type II	2.099	922	1.171	235	-1.539	-1.222	-1.661	-1.613	-1.126	-1.071	670	685	1.429	1.401	1.871	1.899	2.045
Accumulated surplus	2.099	922	1.171	235	-1.539	-1.222	-1.661	-1.613	-1.126	-1.071	670	685	1.429	1.401	1.871	1.899	2.045

Cost Structure



Diagrams of recovery of investment costs, maintenance costs and reinvestments



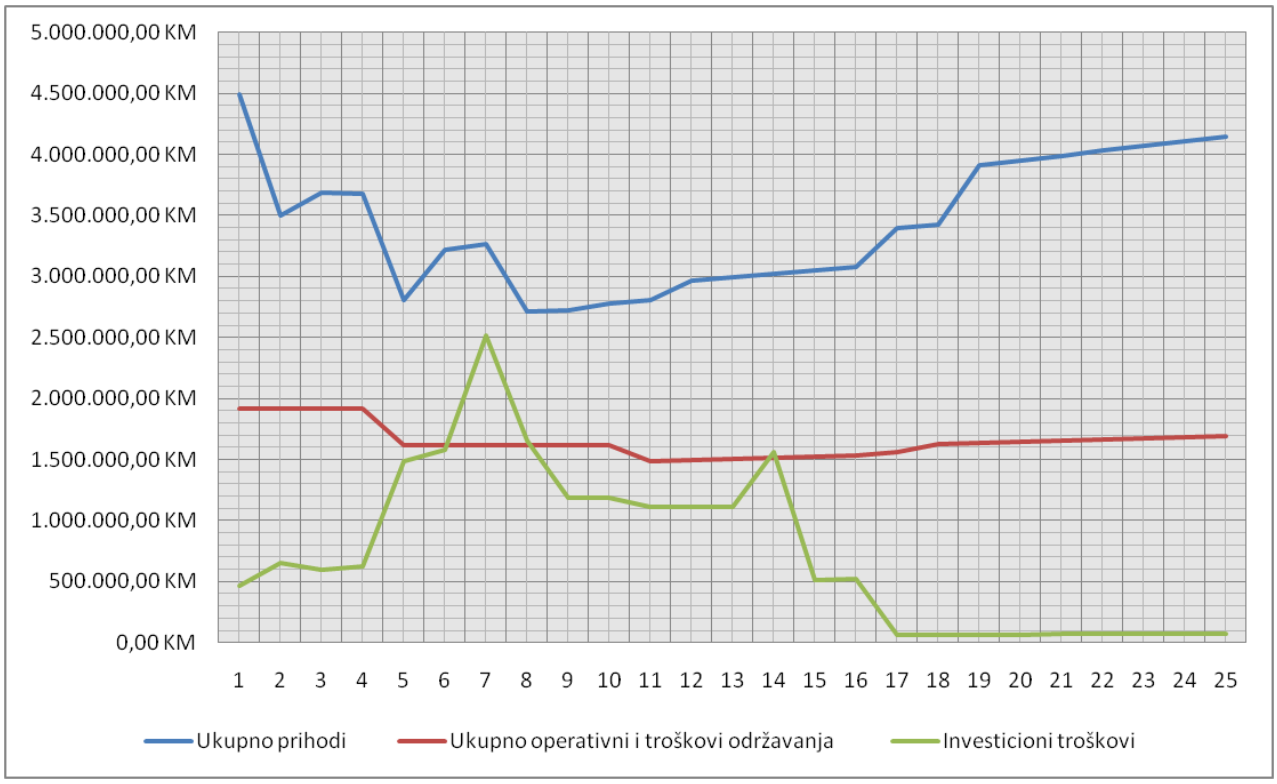
Results OPTION 4

Year	1	2	3	4	5	6	7	8	9	10	15	16	17	18	19	20	25
Revenues																	
All values are expressed in BAM 1000																	
Revenues from services to households																	
Collected revenue	576	709	905	1.219	1.383	1.762	1.776	1.791	1.809	1.864	2.130	2.159	2.479	2.511	2.992	3.030	3.232
Revenues from services to industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	713	736	730	563	520	553	585	618	618	618	618	618	618	618	618	618	618
Revenues of budgetary institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collected revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenue	1.288	1.445	1.635	1.781	1.903	2.315	2.361	2.409	2.427	2.481	2.748	2.776	3.096	3.129	3.610	3.647	3.850
Other revenues	600	450	450	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Additional funding from the budget	600	600	600	600	600	600	600	0	0	0	0	0	0	0	0	0	0
Loan	2.000	1.000	1.000	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	4.488	3.495	3.685	3.681	2.803	3.215	3.261	2.709	2.727	2.781	3.048	3.076	3.396	3.429	3.910	3.947	4.150
Costs																	
Operational Costs	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376
Maintenance and Reinvestments Costs	544	544	544	544	544	544	544	544	544	544	446	455	486	546	557	567	619
Capital Costs	0	0	0	0	40	40	40	40	40	40	40	40	40	40	40	40	40
Operational and Maintenance Costs before savings	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.821	1.831	1.862	1.922	1.932	1.943	1.994
Cost Savings	0	0	0	0	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300
Total operational and maintenance costs	1.920	1.920	1.920	1.920	1.620	1.620	1.620	1.620	1.620	1.620	1.521	1.531	1.562	1.622	1.632	1.643	1.694
Investments Costs	469	652	594	627	1.484	1.578	2.512	1.655	1.186	1.186	517	521	66	66	66	66	71
Total Costs	2.389	2.572	2.514	2.548	3.144	3.238	4.171	3.315	2.846	2.846	2.078	2.091	1.668	1.728	1.738	1.749	1.805
Lack of money for investments	4.019	2.842	3.091	3.054	1.280	1.597	709	1.014	1.501	1.556	2.492	2.516	3.290	3.323	3.804	3.842	4.039
Cost recovery Type I	2.643	1.466	1.715	1.678	-96	221	-666	-361	125	180	1.116	1.140	1.915	1.947	2.428	2.466	2.663
Cost recovery Type II	2.099	922	1.171	1.134	-340	-23	-911	-606	-119	-64	970	985	1.729	1.701	2.171	2.199	2.345
Accumulated Surplus	2.099	3.021	4.192	5.326	4.985	4.962	4.051	3.446	3.327	3.263	4.979	5.964	7.693	9.393	11.564	13.763	25.186

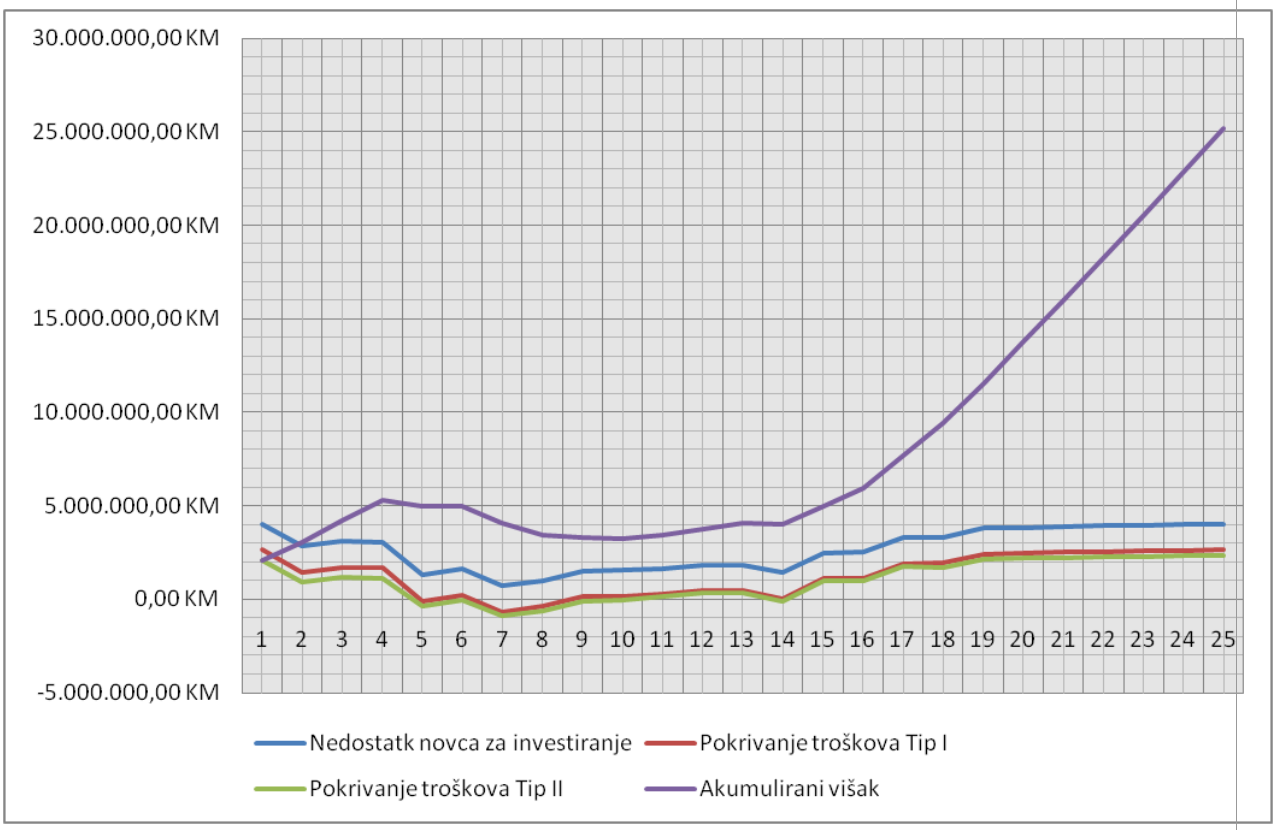
Istočno Sarajevo –Implementation Plan Option 4

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Activity																									
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation																									
Construction of new main distribution transmission pipelines																									
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići																									
Construction of new reservoirs																									
Construction of new pumping stations																									
Opening of new sources																									
Connected population (capita)	26.021	27.044			28.263					33.144					35.355					37.714					40.230
Average annual investment cost (BAM)	469.154	652.313	594.164	627.404	1.484.070	1.578.493	2.511.691	1.655.025	1.185.872	1.185.872	1.110.778	1.108.850	1.108.850	1.563.246	516.580	520.743	66.347	66.347	66.347	66.347	70.762	70.763	70.762	70.763	70.763
Operational Cost	0	0	0	3.930	3.930	3.930	9.123	47.673	103.971	103.971	103.971	103.971	103.971	198.345	198.345	198.345	218.792	218.792	218.792	218.792	218.792	218.792	218.792	218.792	218.792
Maintenance Cost (reinvestment)	0	0	0	63	126	189	17.561	19.680	171.928	174.047	176.165	178.284	180.403	202.655	209.807	216.959	225.202	233.445	241.687	259.996	268.239	276.482	284.725	292.967	301.210
Total maintenance and management Costs	0	7.193	4.286	6.136	6.199	10.983	33.547	74.216	282.763	284.882	283.246	285.365	287.484	404.109	411.261	418.621	447.312	455.554	463.797	482.106	490.570	498.812	507.055	515.298	523.540
Household connection (BAM 450 per household)		143.859	85.711	42.855	42.855	137.278	137.278	137.278	137.278	137.278	62.184	62.184	62.184	62.184	62.184	66.347	66.347	66.347	66.347	66.347	70.762	70.763	70.762	70.763	70.763
Household connection Maintenance and Operational Costs (5% of investment value)		7.193	4.286	2.143	2.143	6.864	6.864	6.864	6.864	6.864	3.109	3.109	3.109	3.109	3.109	3.317	3.317	3.317	3.317	3.317	3.538	3.538	3.538	3.538	3.538

Cost Structure



Diagrams of recovery of investment costs, maintenance costs and reinvestments



CONCLUSION

It is obvious that the initial plan of prioritized investments was over ambitiously created: all three options 1, 2 and 3 proved to be impractical and beyond investment capacity of Utility company. OPTION 3 also implied co-financing from the municipality's budgets and the bank loans amounting to BAM 5 mill.. However, this option also shown that the Utility company would be in a 5 year period on the verge of solvency and that it could not guarantee the realization of the project. The main reason for this lies in the fact that all prioritized project do not directly affect the reduction of costs of operation and the maintenance of the system but rather contribute to improvement of quality of services. It is important to note that Utility company is expected to accumulate app. BAM 4 mill. at the end of the considered period.

If the utility company decided to ambitiously reduce operational costs, especially costs for employees who make up most of the fixed costs, Option 3 could be considered feasible.

Based on the above results, the Prioritized Investment Plan was revised with the aim of reducing investment costs in a first 10 years and their compliance with the influx of revenues. Activities on construction of pipelines and reservoirs are divided into two phases and planned for implementation in the later period.

It was also planned to reduce the costs of employees in the amount of BAM 300,000.00 annually.

This does not refer to physical downsizing of the staff but to keeping better record on various revenues and expenses. In other words, labour savings in the amount of BAM 300,000.00 per year means that these revenues will be achieved through staff performance in other activities that are not connected with water supplying and that those workers will not be considered as employees assigned to water supplying duties. These savings do not imply layoffs but only clear redistribution of income and expenses.

With these conditions OPTION 4 has singled out as the preferred option.

4 FEASIBILITY STUDY FOR PRIORITY INVESTMENTS

4.1 IDENTIFYINGTECHNICAL SCOPE FOR INVESTMENT MEASURES

Basic identified strategic objectives of the plan of priority activities:

- Providing water quality at the Tilava source
- Reducing water losses in the systems managed by Water Utility Company „Vodovod i kanalizacija“ AD Istočno Sarajevo with the aim of providing sufficient water quantities from the existing sources
- Increasing quality of water supplying especially in the hillside areas (II and III pressure zone)
- Proceeding the construction of key facilities in WSS Istočno Sarajevo in order to maintain the achieved level of losses and long-term stability of the system
- Achieving the sustainable operation and business of Utility Company „Vodovod i kanalizacija“ AD Istočno Sarajevo

Plan of priority investment measures was presented in the following table along with the assessment of the value of the investments costs.

Existing project documentation is listed in the enclosure. For investment measures that do not have project documentation, investment costs are assessed based on the experience and knowledge of the Consultant, on the basis of available information, maps of the system and conducted hydraulic analysis.

4.2 COST ASSESSMENT

Detailed cost assessment of the priority project list in accordance with the financial capacity of Istočno Novo Sarajevo Municipality and municipalities on which territory Utility Company Vodovod i kanalizacija“ AD Istočno Sarajevo (Trnovo and Istočno Sarajevo) operates are given in the table below.

Priority Project List

Activities			Cost (BAM)	
GIS, hydraulic model, defect removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation				**2.338.103,42**
Construction of new main distribution transmission pipelines				**5.752.121,40**
	Planned pipelines in the first pressure zone		1.024.437,00	
	Planned pipelines in the second pressure zone		1.145.780,00	
	New pipelines – Kasindo area	*270.000,00*		
	New pipelines – the area of Tilava	*516.980,00*		
	New pipelines – the area of Tešanovo and Prljevo brdo	*358.800,00*		
	Planned pipelines in third pressure zone - R. Kadino brdo zone and higher zones		1.699.674,40	
	New pipelines – area of LC Petrovići and Tvrdimići		500.130,00	
	Planned pipelines – water supply from the system Grabski mlini		1.382.100,00	
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići				**78.600,00**
Construction of new reservoirs				**2.390.000,00**
Construction of new pumping stations				**346.187,13**
Total:				**10.905.011,95**

4.3 FINANCIAL ANALYSIS

Financial analysis will examine under what circumstances the company will have sufficient resources to provide services, maintain the system and implement investments in the future.

Analysis was made on the basis of the following assumptions:

- All of the costs were calculated on the basis of the current costs without inflation, VAT and other fees and taxes
- The discount rate is 8%

Possible income sources are defined as:

- Incomes obtained by providing water supply services with the services costs up to household capability, i.e. 2 % of estimated revenues
- Revenues from other utility services which are reduced for the purpose of this Study from the current app. BAM 550,000 on the real BAM 300,000 in the considered period.
- Investments of Municipalities in water supply systems are taken into consideration as the possible source of funding, the following table gives an overview of investments over the past five years. For the purpose of our analysis it was assumed that municipalities will continue to invest in proposed priority plan in the amount of 60% from the average of investments during the first 6 years of implementation.
- Credit Debt by the Utility company under the following conditions

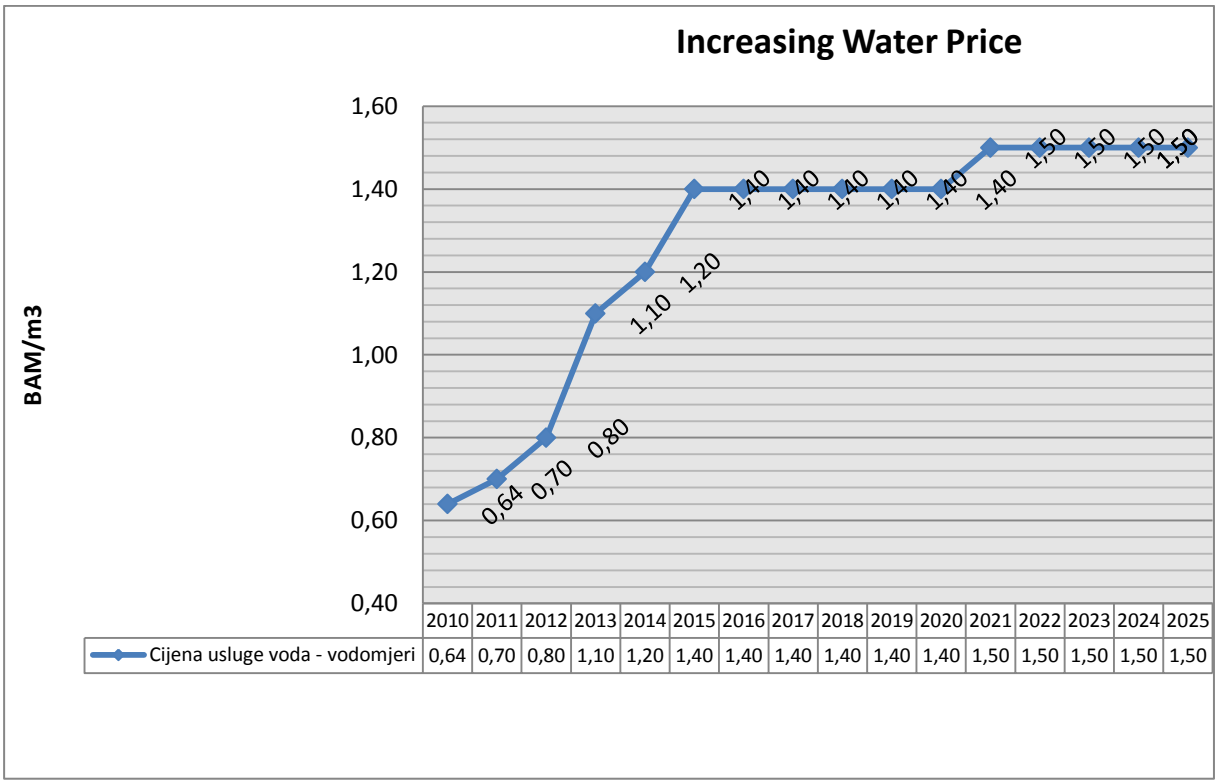
Value of Credit Debt	BAM 5.000.000,00
Annual interest rate	5,00%
Repayment in years	15
Initial date of repayment	2016

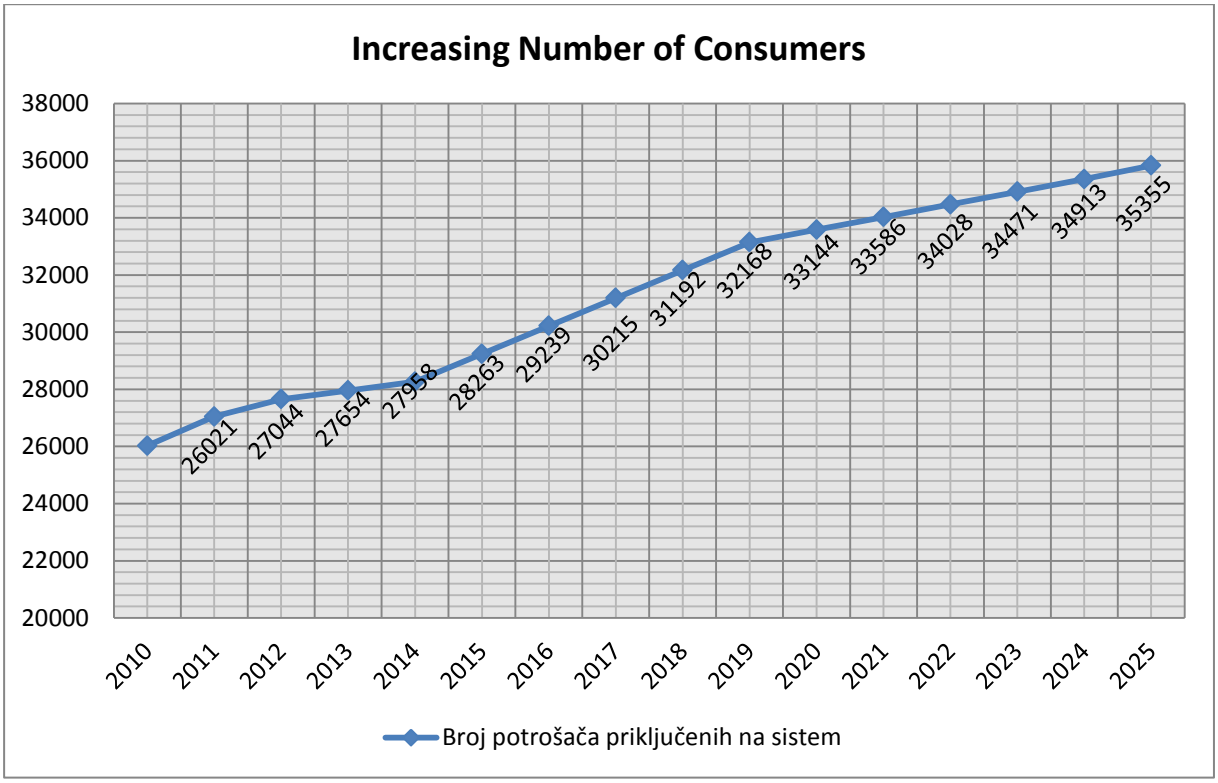
Repayment in equal monthly instalments

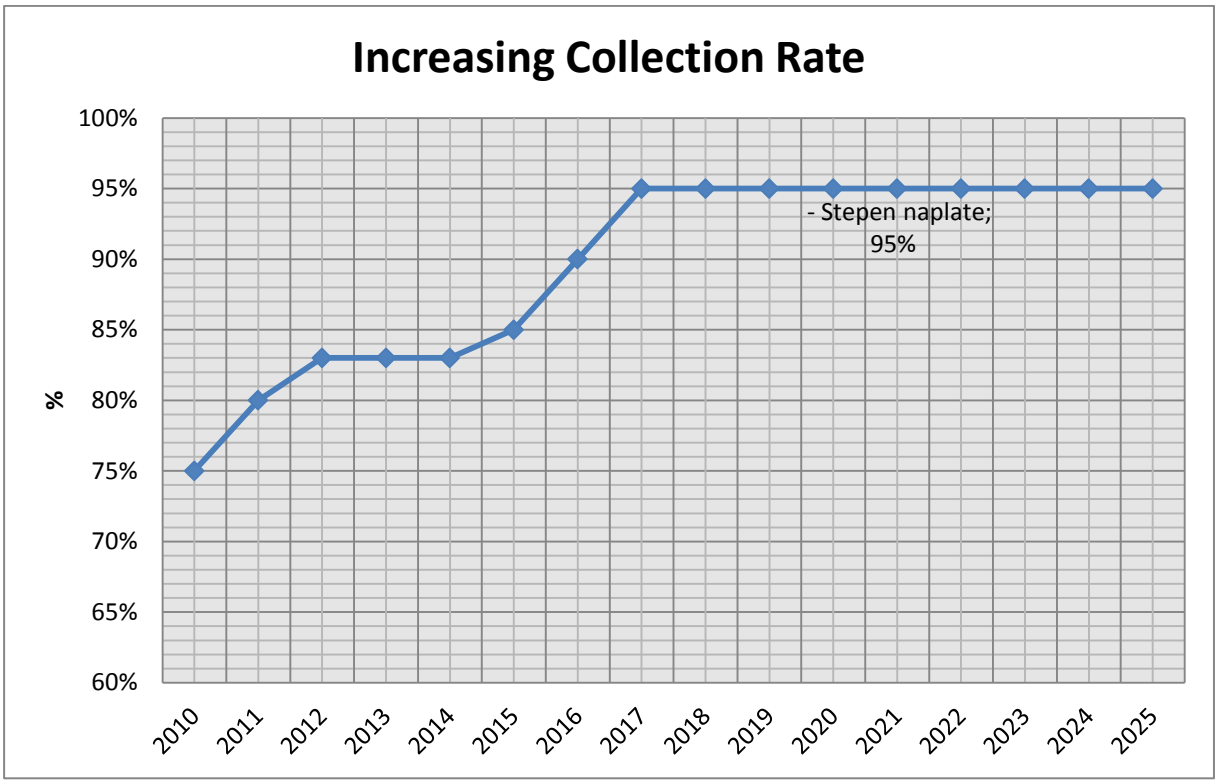
Costs are defined as

- Investment costs
- Capital Costs
- Costs of maintenance and reinvestment
- The costs of company operation, operational costs

Plan to increase the prices, collection rate and number of consumers was presented in the charts below.


Increasing Water Price
BAM/m3
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,64
0,70
0,80
1,10
1,20
1,40
1,40
1,40
1,40
1,40
1,40
1,50
1,50
1,50
1,50
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
Cijena usluge voda - vodomjeri 0,64 0,70 0,80 1,10 1,20 1,40 1,40 1,40 1,40 1,40 1,40 1,50 1,50 1,50 1,50 1,50


Increasing Number of Consumers
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
26021
27044
27654
27958
28263
29239
30215
31192
32168
33144
33586
34028
34471
34913
35355
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
Broj potrošača priključenih na sistem


Increasing Collection Rate
100%
95%
90%
85%
80%
75%
70%
65%
60%
%
- Stepen naplate; 95%
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

Priority Investment Plan

Istočno Sarajevo –Implementation Plan Option 4

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Activity																				
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation																				
Construction of new main distribution transmission pipelines																				
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići																				
Construction of new reservoirs																				
Construction of new pumping stations																				
Opening of new sources																				
Connected population (capita)	26.021	27.044			28.263					33.144					35.355					37.714
Average annual investment cost (BAM)	469.154	652.313	594.164	627.404	1.484.070	1.578.493	2.511.691	1.655.025	1.185.872	1.185.872	1.110.778	1.108.850	1.108.850	1.563.246	516.580	520.743	66.347	66.347	66.347	66.347
Operational Cost	0	0	0	3.930	3.930	3.930	9.123	47.673	103.971	103.971	103.971	103.971	103.971	198.345	198.345	198.345	218.792	218.792	218.792	218.792
Maintenance Cost (reinvestment)	0	0	0	63	126	189	17.561	19.680	171.928	174.047	176.165	178.284	180.403	202.655	209.807	216.959	225.202	233.445	241.687	259.996
Total maintenance and management Costs	0	7.193	4.286	6.136	6.199	10.983	33.547	74.216	282.763	284.882	283.246	285.365	287.484	404.109	411.261	418.621	447.312	455.554	463.797	482.106

Operational and Maintenance Costs

All values are expressed in BAM1000

YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
TOTAL COSTS	**2.389**	**2.572**	**2.514**	**2.548**	**3.404**	**3.499**	**4.432**	**3.575**	**3.106**	**3.106**	**2.895**	**2.903**	**2.912**	**3.375**	**2.338**	**2.352**
Operational and Maintenance Costs																
	2.389	*2.572*	*2.514*	*2.548*	*3.404*	*3.499*	*4.432*	*3.575*	*3.106*	*3.106*	*2.895*	*2.903*	*2.912*	*3.375*	*2.338*	*2.352*
Maintenance	544	544	544	544	544	544	544	544	544	544	409	418	427	436	446	455
Operational costs	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376
Investment costs	469	652	594	627	1.484	1.578	2.512	1.655	1.186	1.186	1.111	1.109	1.109	1.563	517	521
Efficiency Improvement																
Reducing Electricity					300	300	300	300	300	300	300	300	300	300	300	300
Total Savings of Operational Costs	***0***	***0***	***0***	***0***	***300***	***300***	***300***	***300***	***300***	***300***	***300***	***300***	***300***	***300***	***300***	***300***
Savings	*0*	*0*	*0*	*0*	*300*	*300*	*300*	*300*	*300*	*300*	*300*	*300*	*300*	*300*	*300*	*300*
Activity 1 –Labour Costs	0	0	0	0	300	300	300	300	300	300	300	300	300	300	300	300

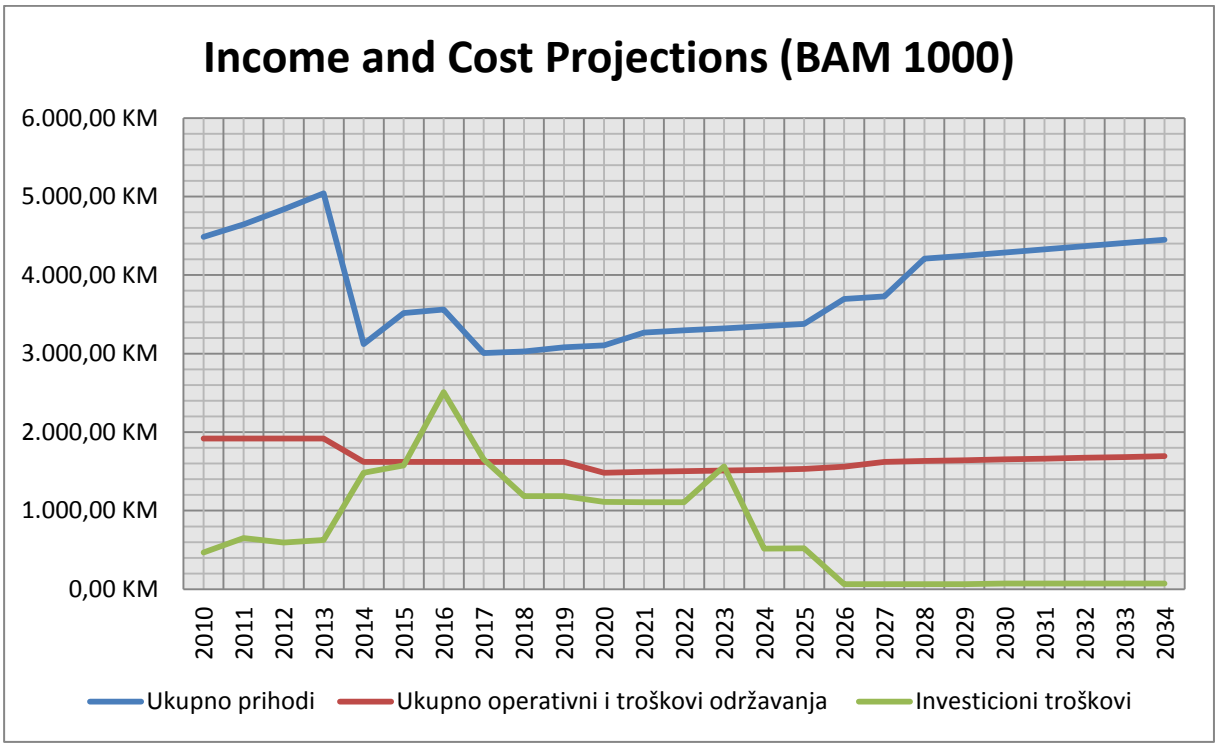
Revenue Projection

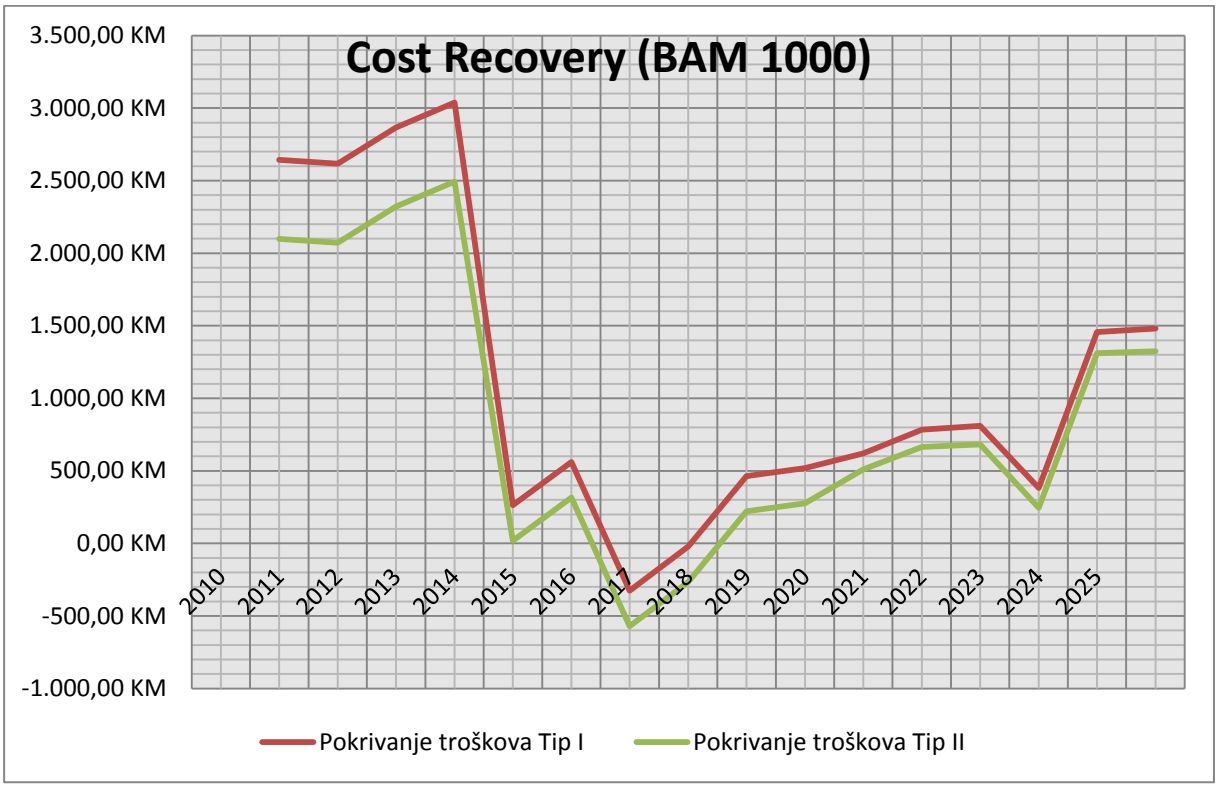
BAM		***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***
Physical indicators																	
Households connected to the system		8132	8451	8642	8737	8832	9137	9442	9747	10052	10358	10496	10634	10772	10910	11048	11196
Consumers connected to the system		26021	27044	27654	27958	28263	29239	30215	31192	32168	33144	33586	34028	34471	34913	35355	35827
Water consumption (liter/capita/day)		140	136,72	131,84	127,72	124,17	124,17	121,06	118,31	115,85	115,85	115,85	115,85	115,85	115,85	115,85	115,85
Water consumption per household (m3/day)		0,45	0,44	0,42	0,41	0,40	0,40	0,39	0,38	0,37	0,37	0,37	0,37	0,37	0,37	0,37	0,37
Households with water meter		8.132	8.451	8.642	8.737	8.832	9.137	9.442	9.747	10.052	10.358	10.496	10.634	10.772	10.910	11.048	11.196
Households without water meter		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price of water service– water meters	(BAM/m3)	0,64	0,70	0,80	1,10	1,20	1,40	1,40	1,40	1,40	1,40	1,40	1,50	1,50	1,50	1,50	1,50
Price of water service – lump sum	(BAM/connect/month)	6,00	6,00	6,00	6,00	6,00	8,00	12,00	14,00	14,00	14,00	14,00	14,00	14,00	14,00	14,00	14,00

Revenue Projection

BAM		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenues from charged services																	
Households																	
- Invoiced consumption	BAM 1000	851	945	1.065	1.434	1.537	1.855	1.869	1.886	1.904	1.962	1.988	2.158	2.186	2.214	2.242	2.272
- Collection rate	%	68%	75%	85%	85%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Households - TOTAL																	
- Invoiced consumption	BAM 1000	851	945	1.065	1.434	1.537	1.855	1.869	1.886	1.904	1.962	1.988	2.158	2.186	2.214	2.242	2.272
- Charged Value	BAM 1000	576	709	905	1.219	1.383	1.762	1.776	1.791	1.809	1.864	1.889	2.050	2.077	2.104	2.130	2.159
Household Income per person per year	BAM	3156	3251	3348	3449	3552	3659	3768	3881	3998	4118	4241	4369	4500	4635	4774	4917
Invoiced service as % of revenue	%	1,04%	1,07%	1,15%	1,49%	1,53%	1,73%	1,64%	1,56%	1,48%	1,44%	1,40%	1,45%	1,41%	1,37%	1,33%	1,29%
Charged service as % of revenue	%	0,70%	0,81%	0,98%	1,26%	1,38%	1,65%	1,56%	1,48%	1,41%	1,37%	1,33%	1,38%	1,34%	1,30%	1,26%	1,23%
Industry and other business consumers		0,95	0,92	0,88	0,75	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
- Invoiced consumption	BAM 1000	950	920	880	750	650	650	650	650	650	650	650	650	650	650	650	650
- Charged Value	%	75%	80%	83%	75%	80%	85%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Funding from Budget and similar sources																	
1.Municipal Budget	BAM 1000	600	600	600	600	600	600										
2. Grant I																	
Total	BAM 1000	600	600	600	600	600	600	0	0	0	0	0	0	0	0	0	0
Other sources of Revenue																	
1. Other Revenues	BAM 1000	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
2.																	
Total	BAM 1000	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600

Scenario Results	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***
Revenues BAM 1.000																
Revenues obtained from the services to the households																
Collected revenues	576	709	905	1.219	1.383	1.762	1.776	1.791	1.809	1.864	1.889	2.050	2.077	2.104	2.130	2.159
Revenues obtained from the services to the industry																
Collected revenues	713	736	730	563	520	553	585	618	618	618	618	618	618	618	618	618
Revenues from the budgetary institutions																
Collected revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	1.288	1.445	1.635	1.781	1.903	2.315	2.361	2.409	2.427	2.481	2.506	2.668	2.695	2.721	2.748	2.776
Other revenues	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Additional financing from the budget	600	600	600	600	600	600	600		0	0	0	0	0	0	0	0
Loan	2.000	2.000	2.000	2.000												
Total revenues	4.488	4.645	4.835	4.981	3.103	3.515	3.561	3.009	3.027	3.081	3.106	3.268	3.295	3.321	3.348	3.376
Costs																
Operational costs	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376	1.376
Maintenance and reinvestment costs	544	544	544	544	544	544	544	544	544	544	409	418	427	436	446	455
Capital Costs					39	39	39	39	39	39	39	39	39	39	39	39
Operational and maintenance costs before savings	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.785	1.794	1.803	1.812	1.821	1.831
Savings of costs	0	0	0	0	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300	-300
Operational and maintenance costs in total	1.920	1.920	1.920	1.920	1.620	1.620	1.620	1.620	1.620	1.620	1.485	1.494	1.503	1.512	1.521	1.531
Investment costs	469	652	594	627	1.484	1.578	2.512	1.655	1.186	1.186	1.111	1.109	1.109	1.563	517	521
Total Costs	2.389	2.572	2.514	2.548	3.143	3.238	4.171	3.314	2.845	2.845	2.634	2.642	2.651	3.114	2.077	2.091
Lack of money for investments	4.019	3.992	4.241	4.354	1.580	1.897	1.010	1.315	1.802	1.857	1.957	2.120	2.147	1.719	2.792	2.817
Cost recovery Type I	2.643	2.616	2.865	2.978	204	522	-366	-61	426	481	581	744	771	343	1.416	1.441
Cost recovery Type II	2.099	2.072	2.321	2.434	-40	277	-610	-305	182	236	472	626	644	207	1.271	1.286
Accumulated surplus	2.099	4.171	6.492	8.926	8.886	9.163	8.553	8.248	8.430	8.666	9.138	9.764	10.408	10.615	11.885	13.171





Recovery costs Type I	Difference between operational costs and total revenues after investments
Recovery costs Type II	Difference between operational and maintenance costs and total revenues after investments

4.4 ECONOMIC ANALYSIS

Quantification of benefits of Priority Investment Measures:

- Reduction of losses at 25 % of total production
- Increasingconsumers' number for 4500 inhabitants
- Obtaining water quantities in accordance with development and water balance projections
- Achieving financial sustainability of the Utility company „Vodovod i kanalizacija“
- Increasing the quality of water supply services
- Creation of opportunities to expand the coverage of water supply system

Estimate of Netpresent value and internal rate of return

	20 YEARS	
	NPV	IRR
	(BAM)	(%)
OPTION 1	-1.171.959,01	6,72%
OPTION 2	-460.005,82	7,42%
OPTION 3	-264.274,69	7,65%
OPTION 4	943.404,12	9,59%

According to all parameters it is obvious that Option 4 is the preferred option.

4.5 PRELIMINARY ASSESSMENT OF ENVIRONMENTAL IMPACT

In Republic of Srpska, Ministry for Spatial Planning, Construction and Ecology is responsible for environmental issues and Ministry for Water Management, Agriculture and Forestry is responsible for issues of water use.

Preliminary Environmental Impact Assessment for the proposed projects are not required to conduct in accordance with Rulebook on plants and facilities that require assessment of its environmental impact and plants and facilities that can be built and operate only if they have the environmental permit.

A proposed project also does not require the issuance of ecological permit because they do not have negative impact on the environment.

4.6 IMPLEMENTATION PLAN AND STRATEGY

The Supervisory Board which has actively participated in the preparation of this Study will be the body responsible for implementation of the Study.

The study is considered to be a "living" document that will at least annually, in accordance with the progress of implementation and in accordance with other planned activities of both Municipality and utility company, be revised and updated in accordance with the needs.

Supervisory Board	City of Istočno Sarajevo	Stojanka Šarović	City of Istočno Sarajevo
		Mile Borovina	City of Istočno Sarajevo
	Istočna Ilidža Municipality	Zoran Avram	Head of Finance
		Nenad Berjan	Head of Urbanism
	Istočno Novo Sarajevo Municipality	Nebojša Džebo	Istočno Novo Sarajevo Municipality
		Nada Ateljević	Istočno Novo Sarajevo Municipality
	Trnovo Municipality	Sonja Klepić	Trnovo Municipality
		Milojka Golijanin	Trnovo Municipality
	Utility Company Vodovod i Kanalizacija Istočno Sarajevo	Siniša Perković	Managing Director
		Vesna Kapetina	Technical Director
		Radmila Vujičić	Financial Director

4.7 DYNAMIC IMPLEMENTATION PLAN

Istočno Sarajevo –Implementation Plan Option 4

Year	1	2	3	4	5	6	7	8	9	10
Activity										
GIS, hydraulic model, defects removal, monitoring of the system and procurement of equipment for defect removal and developing project documentation										
Construction of new main distribution transmission pipelines										
Rehabilitation of capture structure and reservoirs – area of LC Petrovići and Tvrdimići										
Construction of new reservoirs										
Construction of new pumping stations										
Opening of new sources										
Connected population (capita)	26.021	27.044	28.263					33.144		
Average annual investment cost (BAM)	469.154	652.313	594.164	627.404	1.484.070	1.578.493	2.511.691	1.655.025	1.185.872	1.185.872

5 APPENDICES

5.1 APPENDIX 1: GENERAL MAP OF WATER SUPPLY SYSTEM TILAVA - 1:12.500

5.2 APPENDIX 2: GENERAL MAP OF WATER SUPPLY SYSTEM TILAVA - 1:25,000