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STUDY FOR WATER SUPPLY SYSTEM BOSANSKI PETROVAC

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STUDY
FOR WATER SUPPLY SYSTEM BOSANSKI PETROVAC

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STUDY
FOR WATER SUPPLY SYSTEM FOR BOSANSKI PETROVAC MUNICIPALITY

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2.1 INTRODUCTION

2.1.1 INTRODUCTORY EXPLANATIONS

Bosanski Petrovac	
	
Administrative Data	
Country	Bosnia and Herzegovina
Entity	BiH Federation
Geographical Data	
Coordinates	44° 32′ 60" NGW 16° 22′ 00" EGL

As a settlement, Bosanski Petrovac existed even in time of the Romans as road junction. Konstantin Porfirogenit mentions it in 10th century under the name Pset. At Bukovaca locality there are traces of Roman necropolis, where late-antic tomb and roman money was found. Only 16 localities from Medieval period tells us that this geographical widespread area very poorly populous in this period, as well. It is important to mention the Medieval city Bjelaj (old name Bilaj), located at the edge of "Bjelajsko polje" (Bjelaj/Bilaj field). The first time it was mentioned in documents was in 945. Medieval architecture of this city is well preserved. In the written documents, the settlement that was there instead of Bosanski Petrovac is mentioned in 1334, with the name St. Petri de eodem. Osmans conquered this area in the period between 1520 and 1530, and organized Qadi Novosel. Petrovac city was in good condition when occupied by Austro-Hungarian in 1878. It was probably destroyed during the regulation plan implementation, drafted by Austro-Hungarian government.

Area of Bosanski Petrovac Municipality has a continental climate to mountain characteristics, with plenty of hot summers and cold and harsh winters. Average annual temperature is 10,8°C. The highest monthly temperature is in July, and the lowest in January. Average annual rainfall is about 1750 mm which are well spaced, and in this area there is no need for supplementary irrigation during the year. Towards Gračanin, the climate in this area is humid, with tendency to create black soil and brown soil. The mean annual cloudiness in this region is 5.5 of sky coverage. The biggest cloudness is in January with 6.9, and lowest in August with 4.0. This locality has, averagely, 26 days a year with heavy frost, and frosty days in which the minimum temperature is lower than 0 ° C within 24 hours, is even 113. Winds typical for this area are the bora and sirocco.

In Bosanski Petrovac municipality the highest percentage of soil is brown soil (shallow), moderately deep and deep brown soil, which is formed on the limestones, which gives them specific characteristics.

Natural vegetation of these lands is forest of beech and oak, and the land with no forest is covered by meadows and pastures. These soils are characterized by high content of humus and nitrogen. Since adverse chemical properties emphasize the low content of phosphorus and potassium, it makes it necessary to perform melioration fertilization. In Bosanski Petrovac municipality, after applying agro-melioration measures, it is possible to use the land for intensive agricultural production, which is the main productive branch of this region.

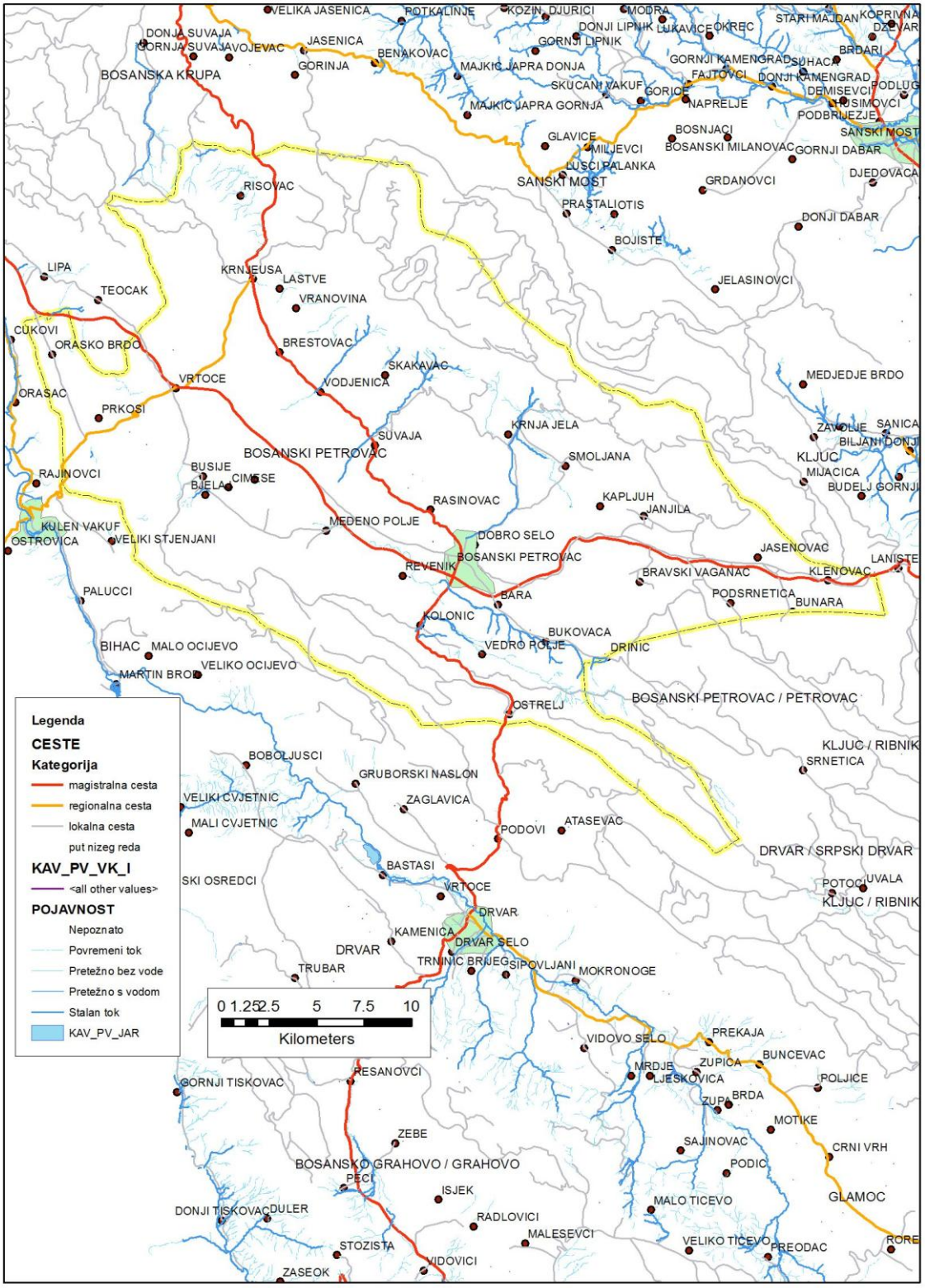


Figure 1: Location of settlements in Bosanski Petrovac Municipality

2.1.2 GEOGRAPHICAL POSITION, INFRASTRUCTURE AND ECONOMY OF BOSANSKI PETROVAC MUNICIPALITY

Bosanski Petrovac is located in northwestern part of Bosnia and Herzegovina and it's a part of the Una-Sana Canton. The municipality is located on the 54th kilometer of Bihac – Sarajevo road. It is located in the Northwestern Bosnia, and closer determinant of the municipal area is belonging to the Bosanska Krajina region. Northern boundary of the municipality, towards Bosanska Krupa and Sanski Most, is presented by Grmec mountain. From the southern side, the municipality is closed by Osječenica and Klekovača mountains and separated from Drvar, and it is only opened, in the sense of relief, towards Bihac and Ključ municipalities. Mountains are rich in forests, which represent the base of economic development of the municipality. Highest plateau is characterized by karst soil. Apart from few minor sources, in the hills lowest area surrounding this plateau there is not a river, not even a bigger stream.

Figure 2: Location of Bosanski Petrovac municipality in RS and BiH

2.1.3 BACKGROUNDS

Backgrounds for draft of the Master plan are as follows:

GEODESIC BACKGROUNDS

For the purpose of drafting the Master plan, geodetic maps of Bosanski Petrovac area were used in scale 1:25 000 and digitalized map of Bosanski Petrovac in scale 1: 1000.

URBANISTIC BACKGROUNDS

Urbanistic planning documentation for Bosanski Petrovac municipality was being made in the last 5 years, and, as such, it can be treated as reliable documentation from development point of view.

Speaking about town, the following documentation is available:

- Zonning plan of Bosanski Petrovac (2007-2027).

- Regulation plan of Gorčani business zone (2010).
- Regulation plan of Industrial zone (2009).
- Regulation plan of sports, tourists, recreational center Oštrelj (2009).
- Regulation plan of the settlement behind the MIA (1999).

2.1.4 PROJECT DOCUMENTATION

MAIN PROJECTS

All of the Main projects drafted since 1961 untill now were, also, available. Especially significant are the following projects:

- The Main catchment project at Sanica river source, 1987,
- The Main project of supply pipeline from the cathcment at Sanica river source to P. „Sanica", 1990,
- The Main project of P.S „Sanica", 1989,
- The Main project of pressure pipeline from P.S. „Sanica" to the breaking chamber „Mijačica", 1985,
- The Main projects of surge tank „Mijhačica", „Jakšići", „Grla", 1985,
- The Main project of reservoir „Bosanski Petrovac, 1985,
- The Main project of supply pipeline from the surge tank „Mijačica" to the reservoir „Bosanski Petrovac", 1985,
- Bosanski Petrovac water usage – Preliminary design – 1982

2.1.5 OBJECTIVE AND ASSIGNMENT OF THE PROJECT

2.1.5.1 TASK 1: INCEPTION REPORT INCLUDING ANALYSIS OF CURRENT SITUATION

As part of the Inception Report, the Consultant will address the following:

a) 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 Organization/Institution 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 Organization/Institution 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.

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

2.1.5.2 TASK 2: WATER SUPPLY MASTER PLAN FOR PARTNER MUNICIPALITIES

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) Analysis of existing water protection measures (documentation on water source protection zones, municipal decision on water source protection zones, as well as current situation regarding protection of the water sources). Report on findings and set of recommendations.

e) 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 Organization/Institution will provide hydraulic modeling or appropriate hydraulic calculations.

f) Macro-available assessment and socio-economic analysis, investment capability to invest into the water supply system. The Organization/Institution should asses the macro-available amount of investment for implementation of measures. This indicative value will lead the Organization/Institution 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.

g) 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 TASK 3: PRIORITIZED PLAN OF INVESTMENTS 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 TASK 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 Organization/Institution should ensure that adequate considerations and alternative solutions are given. The Organization/Institution 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 Organization/Institution 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 Water Utility Company be informed on the progress of the Feasibility Study. The Feasibility Study will be comprised of the following sub-tasks.

Sub-task 1- Identifying technical scope for investment measures

The Organization/Institution should prepare a short summary of the technical scope of work for identification of investment measures and submit it to Project Steering Board for discussion. 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-task 2: Cost assessment

After an appropriate technical solution is made, which will lead to the goals of investment measures, the Organization/Institution 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-task 3: Financial analysis

The Organization/Institution 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 Organization/Institution 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 Organization/Institution 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 Organization/Institution 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-task 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-task 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 Organization/Institution will be obliged to analyze 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 neighboring areas.

Sub-task 6: Implementation plan and strategy

The Organization/Institution 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 PROJECTION

Bosanski Petrovac municipality population is organized in 35 local communities. Municipality settlements are pretty scattered, so the local communities are far away from the municipal center. For instance, the local communities Strgačina and Bijelo Brdo are around 50 km far away from eachother. In municipality area there are 88 settlements of which only Bosanski Petrovac, a municipal center, can be considered as a settlement with urban characteristics. Other settlements in the local communities have a range of villages with local communities group of settlements center.

Table 1: Population in Bosanski Petrovac municipality by settlements in 1991

Population number of Bosanski Petrovac municipality, by settlements, according to the census from 1991		
S.n.	Settlement	Total
1	Bara	166
2	Bjelaj	187
3	Bjelajski Vaganac	141
4	Bosanski Petrovac	5,381
5	Bravski Vaganac	98
6	Brestovac	192
7	Bukovača	298
8	Bunara	106
9	Busije	159
10	Cimeše	139
11	Dobro Selo	901
12	Drinić	363
13	Janjila	354
14	Jasenovac	430
15	Kapljuh	144
16	Klenovac	229
17	Kolunić	521
18	Krnja Jela	475
19	Krnjeuša	958
20	Lastve	279
21	Medeno Polje	92
22	Oraško Brdo	65
23	Oštrelj	50
24	Podsrnetica	131
25	Prkosi	195
26	Rašinovac	627
27	Revenik	145
28	Risovac	379
29	Skakavac	226
30	Smoljana	497
31	Suvaja	315
32	Vedro Polje	113
33	Vođenica	562
34	Vranovina	274
35	Vrtoče	429
	Total	**15,621**

According to the last official census in 1991 Bosanski Petrovac municipality had 15,621 inhabitants in 35 settlements, with an average population density of about 34 per km2. Of the total population the municipality center had a population of 5381 inhabitants or 34.45%. Looking at the results of the census for the period 1971-1981-1991, the demographic trends are as shown in the Table 2.

Table 2: Changes in population number in Bosanski Petrovac municipality for the period 1971-1991.

Bosanski Petrovac municipality population			
Census year	1991.	1981.	1971.
Total	**15,621**	**16,374**	**18,597**

Source: Statistical Yearbooks in B&H, web page of Statistics Agency B&H.

The previous table shows us that the population growth in Bosanski Petrovac Municipality in the period 1971 - 1991 had the same negative growth trend, i.e. it decreased for 16 %.

Before the war, Bosanski Petrovac Municipality (1971-1991) had negative growth rate of around 0,7 % i.e. the population number decreased from 18597 (1971) to 15621 (1991). We need to have in mind that in the mentioned period significant economic development was going on, but the growth was still negative.

2.2.2 CURRENT NUMBER OF INHABITANTS

In Bosnia and Herzegovina and Republic of Srpska no census took place since 1991.

According to data received from Bosanski Petrovac municipality, it is estimated that the municipal center currently has about 6000 inhabitants. According to the list of voters for 2010 in the town area there are 4216 voters and in the other municipality settlements 2834 voters. Approximate population number can be obtained if the number of voters is increased by 25 %. Based on this calculation, there are around 5300 inhabitants in the town, while in the other settlements there are around 3500 inhabitants, i.e. in the entire municipality area there are around 8800 inhabitants.

2.2.3 PROJECTION OF INHABITANTS NUMBER

Projection of inhabitants and households number of certain teritory represents very important starting element in the process of spatial planning. According to the number of inhabitants, other components are dimensioned, as well, such as housing fund, economical capacities, technical and social infrastructure, etc.

Unfortunately, the results of planning projections may be made only to the level of municipalities, or zone of secondary and local centers, as there is not enough information for the projection of the settlements. Basic two components that affect the projection of the natural and mechanical movement.

If we speak only about the natural population growth, the estimation of planned population increase can't be considered as a big mistake. However, which is the number to calculate for the year 2010. Bigger changes can be caused by political conditions which can not be foreseen.

For the needs of this Master plan, we made three population projections for the 20 years planning period. In the tables 11,12 i 13 we made calculations for 2035, as well, with the aim to estimate the water requirements for some longer period and to show the system sensitivity related to the water requirements.

The ***Table 11: Calculation of population and water amounts needed for WSS Bosanski Petrovac – planned system coverage*** shows one pesimistic estimation of the development, with the minimum population growth of 0,1 % but the number of connected inhabitants increased from 77% to 100 %. According to this estimation, the population number will be around 87800.

The table number 4 shows one realistic estimation of development, with the population growth of 0,5 %. The number of connected inhabitants increased from 77% to 100 %. According to this estimation, the population number will be around 8600.

The table number 5 shows one optimistic estimation of development, with the population growth of 1,0 %. The number of connected inhabitants increased from 77% to 100 %. According to this estimation, the population number will be around 9500.

From the economic development aspect, we can not expect some bigger improvements, comparing to the before war situation. It is realistic to expect the renewal of existing economic capacities, which were significant water users.

For the plan coverage area it is foreseen that the mechanical movement will play the main role in the future inhabitants number changes. At the begining of time period horison, the natural population growth will be low, but positive, and moving to the end of time horison it will be gradually increasing untill it reaches the value of average 0,5 % at the level of entire plan coverage area. The main cause of stagnant movements at the beginning of the period will be migratory movements itself, despite the assumption of a positive population growth.

The average annual growth rate at the level of the entire plan coverage is estimated to amount of 0.5%. Due to the large distance of some settlements from the municipal center and the existence of their local watersupply system, it is not realistic to expect that they can be connected to the town watersupply system. According to our estimates, at the end of the planning period, connections which can be expected is entire Bosanski Petrovac and around 70% of settlements in Municipality area or, based on the actual data, around 7800 inhabitants.

Table 3: Population number projection within the plan coverage in the period 2010 – 2035

Settlement	Year						
	2010	2012	2015	2020	2025	2030	2035
Bosanski Petrovac with settlements	7.800	7.878	7.997	8.199	8.406	8.618	8.836

Bosanski Petrovac itself will experience the slight increase in population, while the rural settlements will have a population decline. The assumption is that there will be migration of population from rural areas towards town.

2.2.4 SPATIAL COVERAGE

Spatial coverage of Master Plan relates to WSS Bosanski Petrovac i.e. urban water supply system that covers urban part of the town and few suburban settlements.

The main watersupply system covers the town zone, and the following settlements:

- Rašinovac ;
- Suvaja (part);
- Medeno Polje ;
- Bjelajski Vaganac ;
- Kolunić ;
- Bara;
- Revenik

As well as the part of the settlements located near the transport pipelines:

- Klenovac ;
- Bravsko;
- Smoljana.

System or the system management will expand to the following settlements

- Kapljuh,
- Bjelaj,
- Krnjeuša,

- Vrtoče,
- Vođenica
- Industry zone Gorinčani

Differing from some other town environments in BiH, in Bosanski Petrovac municipal center, the condition is good. At the moment, 6000 inhabitants is connected to the water supply system. All connections, except of the collective residence facilities are equipped by water meters, and the billing percent from population is around 85% and economy around 95%. Concerning the collective residence facilities, there is a lump sum way of billing.

In Bosanski Petrovac Municipality area, besides the town water supply system, there are some smaller local systems at the levels of local communities or settlements.

Water supply quality situation in these and other settlements is mostly worse than in municipal center, although there are no real indicators for that. Water supply systems were constructed in the organization of local communities or the groups of citizens, and the town utility company is not obliged to control their systems, nor it has data that the water is regularly controlled in authorized institutions. Only water supply system „Krnjeuša“ is under the supervision and management of „Utility company“

S.n.	Type of users	2010			2020			2030		
		Number of connections	Number of houses/appartments	Number of inhabitants	Number of connections	Number of houses/appartments	Number of inhabitants	Number of connections	Number of houses/appartments	Number of inhabitants
1	Household connections and individual appartments	1928	1928	5456	2300	2300	6670	2500	2500	7500
2	Households connections and apartment buildings	x	390	566	x	400	640	x	410	902
3	Legal bodies	156			180			200		
4	Public institutions	25			27			30		

As a development plan, the adopted is the realistic approach to the population number estimation and the number of posible users at the end of th eplanning period. According to this estimation, it is planned to develop the water supply system in the planning period to suburban settlements and to connect more inhabitants to the system in the settlements out of the town.

Individual connections number will increased for approximatelly 30 % and the number of collective residence facility will increase for appr. 5%. All of the types of users are increased for appr. 20-25 % at the end of the planning period. The number of individual users will increase mostly thanks to increased level of connections and expansion of water supply distribution network to some sub urban settlements.

2.3 CURRENT WATER SUPPLY SYSTEM

2.3.1 THE OVERVIEW OF WATER SUPPLY SYSTEM IN BOSANSKI PETROVAC

Watersupply of Bosanski Petrovac by sanitary regular water is based in 1906 by impoundment of Smoljani source at the south sides of Grmeč. Reconstruction and impoundment took place in the period 1962-1963. During 1999 the additional water abstraction was performed at source Smoljani 2, (Sedra 2). Observing technically functional parts of Water Utility in Bosanski Petrovac municipal center, and based on the data collected from the local utility company, the following can be stated:

- groundwaters natural resources, Source „Smoljane“ and „Sanica“ River Source, were estimated to provide over 200 l/s of good quality water, so these sources were determined as longterm water resources of Bosanski Petrovac municipal center.
- (2) existing intake structures and transport objects to the town reservoirs are mostly in a good condition, and talking about capacities they satisfy nowadays needs of consumers.
- (3) two town reservoirs, total capacity 2200 m3, enable enough nonlinearity balance of water consumption in town.
- (4) town distribution network is mostly reconstructed (75 %).

Bosanski Petrovac watersupply system managment is obligation of company „Komunalno“ Ltd. According to the data of this company, the town's watersupply system is equipped by appr. 2600 registered connections with water-gauges, of which around 2311 are individual households and 180 working organizations and private companies.

The existing watersupply system (Main system) is water supplied from two sorces capacities (systems):

I Group of sources"SMOLJANA":

- Smoljana 1 – (Osoline 1);
- Smoljana 2 – (Osoline 2);
- Pećina – (Pećina 1 and Pećina 2);
- Crno Vrelo.

Total available minimum capacity of all impounded sources, during the extremelly low water levels, is measured in 2007 and doesn't go over 5,0 lit/sec. Maximum capacity of transport pipeline DN 250 mm (ACC) with one main collection chamber of capacity 40,0 m3 and surge tank "Novakovići" is 50 lit/sec, (designed), and 45 lit/sec, (measured at the reservoir entrance). Transport pipeline lenght is 12 kilometers to the reservoir "Novakovići", with 30 manholes with fittings and i valves for sludgy and air vents, section caps and connections for settlements Smoljani. The system is completely gravitational.

Source „Smoljana“ with constructed by - pass from reservoir "Novakovići" to reservoir "BURSAĆI" (system "Sanica"), lenght 1440 meters - ACC DN 200 mm, which serves as transport for water surplus from the system Smoljani, and it is able, in its full capacity with the water inflow of 25,0 lit/sec, to cover the entire Main system (upper and lower supply zone).

Smoljana system is telemetrically connected with the dispatch center – reservoir Novakovići, with installed electro-magnetic flow meter and chlorine station type "ALLDOS".

Surge tank PK "Novakovići" has the cap chamber and mini chlorination station type "Drop by drop" for chlotination of the part that goes to Rašinovac settlement.

When the water inflow from this sourceses group is lower than needed in the drought period, than the other supply source is activated – „Sanica“ source.

II Source ”SANICA”

Watersupply system „Sanica“ is consisted of the following objects:

- Catchment
- Supply pipeline from the intake to the PS Sanica AC pipes profile 500 mm - l= 600 m;
- PS “Sanica“ of total designed capacity of 183 l/sek, (three pumps) – currently 2 * 61 l/sec, (two pumps – one operating, the other spare), at the cote PS = 211,84 msl
- Pressure pipline from PS to PK Mijačica - l = 3.125 meters, steel pipes – outside diameter 335,6 mm - DN 300 - NP 80 bar;
- Surge tank PK “Mijačica” – volume 2 * 100 m^3 at the cote 909,15 (895,50 m) msl
- Gravitational supply pipeline to reservoir B. Petrovac has total lenght of 27.647,5 m, made of:

  AC – pipes - 400 mm 16.554,20 m1
  350 mm 10.667,70 m1
  300 mm 425,60 m1

- Surge tank at the supply pipeline PK “Jakšići“ V = 2 * 100 m^3 ; cote 846,94 m.n.v. chainage 12 + 930,40 km.
- Surge tank at the supply pipeline PK “Grla“ V = 2 * 100 m^3, cote 792,30 m.n.v. – chainage 20 + 341,70 km.
- reservoir “Bursaći“ - Bosanski Petrovac, V = 1 * 2.000 m^3 with cap chamber within the chlorination system chamber, type “ALLDOS“, flow meter – electromagnetic DN 300 with complete telemetric observation and managing system, connected to the dispatch center – bottom cote: 719,00 msl

Existing project documentation in this I phase covers supplying of the settlements with transport pipeline: Klenovac ; Bunara; Jasenovac; Podsrnetica; Janjila; Bravski Vaganac; Kapljuh; Bukovača i Drinić; Bara and Vedro Polje; Kolunić; Oštrelj; Bosanski Petrovac – town with sub-urban local communities.

Upper supplying zone of LC Kolunić is resolved by the construction of pump stations with installation of pumps for rising the pressure directly on the pipeline - “Buster Station“:

- right side - “ GRUNDFOS “ type CR 5-22 - 4 KW with installed expansion bowl V= 500 liters and panel setting– cote 654,85 msl
- left side – “GRUNDFOS“ type CR 5-15-2,2 KW with installed expansion bowl V= 500 liters and panel setting– cote 654,83 msl.

2.3.1.1 DATA ON THE SOURCES IN WSS BOSANSKI PETROVAC

As already stated, the town watersupply system relies on two water resources: groundwater from the fractured karst areas, which occur at the surface in the form of springs (captured spring Smoljani) and groundwater from fractured karst areas captured from the source „Sanica“. Considering the estimated yield and good quality of underground water resources of Smoljani and Sanice, these sorces are especially significant for Bosanski Petrovac, since it was determined as the main reliance for the future watersupply development of this area. Due to mentioned, the special attention has to be paid to the water quality of this resource.

Besides, sources protection is legal obligation, defined by the Book of Rules1, according which the three zones of sanitary protection were established:

(1) immediate protection zone,

(2) narrow protection zone, and

(3) wider protection zone.

The Book of Rules, also, regulates the protection measures at certain zones, as well as the draft of Sanitary water protection measures, which is, also, consisted of Elaborates on quality and groundwater reserves. For „Sanica“ source, the „Project on Potable Water Sources Protection of Bosanski Petrovac and Ključ Municipality “ was drafted by “ Rudarski institut “ (Mining Institute) d.d. Tuzla in May, 2005. Untill now, the planned measures operative realization of mentioned did not take place.

For SMOLJANA source, the project “Potable water sources protection of Smoljana – Bosanski Petrovac Municipality“ was drafted by “Institute for hydrotechniques of Civil Engineering Faculty“ Sarajevo in 2004. According to this project in the period 2006 – 2010, the following planned actiities were performed:

- construction of the capturing facilities protection fance - I A - zone;
- marking of IB, II and III protection zones ;
- drainage of precipitation waste and faecal waters from the I zone ;
- construction and setting the tables with information on IA, IB, II and III zone.
- Draft of “ Elaborate on the protection zones marking ”

- **Intake Smoljana**

Smoljani intake facility is consisted of the captures at the very sources and the main collection chamber in Smoaljani. „Smoljani“ source is of minimum yield 5,0 l/sec.

The source altitude, (based on the topographic map 1: 25000):

- Smoljana 1 – (Osoline 1) - 930 MSL
- Smoljana 2 – (Osoline 2) - 895 MSL
- Pećina 1 & 2 - 910 MSL
- Crno Vrelo - 875 MSL

Figure 3: Collection chamber „Smoljani“, WSS Bosanski Petrovac

- **Sanica intake**

After it was established that SMOLJANI source with it's capacity does not satisfy the population needs, during eightees of the last century, the design and work performance based regarding the project realization took place.

"Watersupply of Bosanski Petrovac Wider Area With the Sanica Source Intake". Preliminary design of water use in Bosanski Petrovac area ("Water Managemnt Institute" Sarajevo, 1982), was the base for further system design in the period 1984 – 1990, and the number of system's I phase main projects was drafted. Unitll 1991, a lot of work were performed at the facilities of the I stage I phase of watersupply system:

Coordinates of Sanica source intake are:

X – 4 941 200

Y – 6 390 700

Z – 221

Sanica source capture was constructed in 1985. The source's uield is Qmin, =0,80 m^3/sec and Qmax, =40,0 m^3/sec. Q av.=8,9 m^3/sec. At the distance of appr. 600 m from th ecapture location, there is P.S. „Sanica".

PS „Sanica"has two pumping agregates installed (one is operative, and the other one spare), with the capacity of Q = 61 lit/sec. Sanica river source is a typical "karst source"

Constant monitoring system of the capacity and levels is not established, and based on the available data, Sanica source's yield is as follows:

Q – min = 0,8 m^3/ sec

Q – max = 40,0 m^3/sec

Q – av. = 8,9 m^3/sec

„Sanica" intake is used exclusively in the period of drought when Smoljani capacity isn't sufficient.

Table 4: Data of Smoljani source

Source description	Unit	Amount	Comments
Type of source		5 intakes	Sources group
Year of construction	god.	1904-1906	
Abstracted amount of water	l/s	Min. 5,0	
Bottom level of the source	mn.m.	875,0 – 930,0	
Minimum source yield	l/s	5,0	
Maximum source yield	l/s	>100	
Water quality		dobar	dezinfekcija

Table 5: Data of "Sanica" source

Source description	Unit	Amount	Comments
Type of source			Rasuto
Year of construction	god.	1985	
Abstracted amount of water	l/s	61,0	
Bottom level of the source	mn.m.	221	

Minimum source yield	l/s	800	
Maximum source yield	l/s	40 000	
Water quality		dobar	dezinfekcija

2.3.1.2 DATA ON RESERVOIRS AND SURGE TANKS

Figures 4 and 5 show the reservoirs in Bosanski Petrovac.

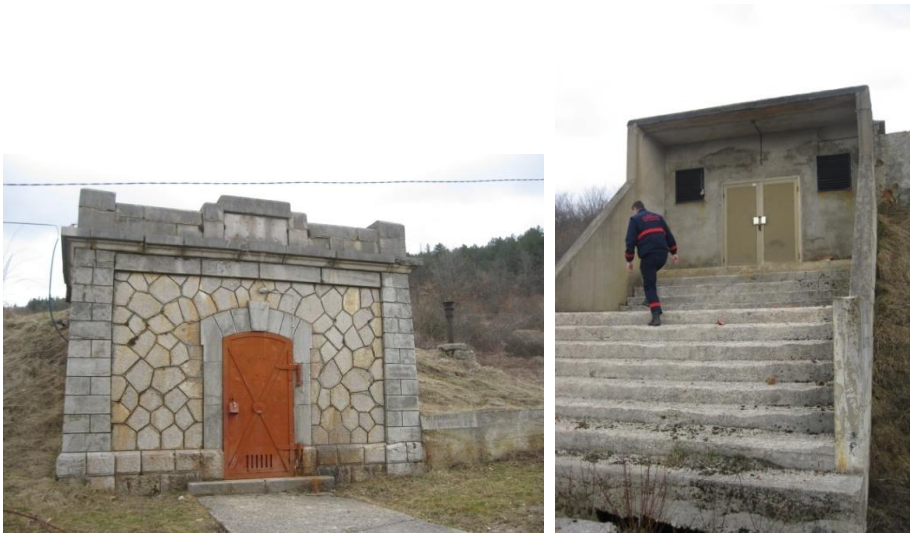


Figure 4 and Figure 5: Reservoirs *„Novakovići“(V=200 m^3) and „Bursaći“(V=2000 m^3)*

Table 6: Data of reservoir „ Novakovići“

Project description	Units	Amount	Comments
Reservoir type			Semi-buried (underground)
Material			Concrete
Reservoir capacity	m^3	200	
Construction year	year	1900.	
Reservoir shape			Rectangular
No. of chambers	piece	2	
Reservoir bottom cote	mn.m.	728,85	
Overflow cote	mn.m.	-	
Water depth	m	-	

Table 7: Data of reservoir „Bursaći“

Project description	Units	Amount	Comments
Reservoir type			Semi-buried (underground)
Material			Concrete
Reservoir capacity	m^3	2000	

Construction year	year	1985	
Reservoir shape			Rectangular
No. of chambers	piece	1	
Reservoir bottom cote	mn.m.	719	
Overflow cote	mn.m.	-	
Water depth	m	-	

2.3.1.3 DATA ON THE PUMPING STATIONS

Table 8: Data of PS „Sanica“

Facility description	Unit	Amount	Comments
PS type	Well pump station		
Construction year	god	1985	
PS capacity	l/s	122	
PS installed power	kW	2*719	
Total number of pumps	piece	2	
Number of operating pumps	piece	1	
Pumps type			Horisontal centrifugal pump
Pumps operating average time	hour/day	8	

Manufacturer	Pump type mark	Nominal capacity (l/s)	Pump power (kW)	Manufacturer	Pump type mark	Nominal capacity (l/s)	Pump power (kW)
„Jugoturbina “ Karlovac Engine „Sever Subotica“	31,5-12/6	61-632	2x710	700	Summer period 2–8 hours day	1985 (26 years)	Good – Spare pump

2.3.1.4 DISTRIBUTION NETWORK

Reconstructing Bosanski Petrovac watersupply network in the period 1999-2000, finenced by European Comission within “ PHARE “ program, the following results were achieved:

- Construction of two distributive rings of town zone;
- Construction of nodes, (connections for secondary ducts);
- Removal of discovered part of physical losses and illegal connections;
- Transport pipeline rehabilitation of Smoljani source – reservoir NOVAKOVIĆI.
- kaptirano izvorište “ Smoljana 2 “ (Sedra 2), te priključeno na sistem;
- Installation of equipment in chlorination stations;
- Construction of telemetric monitoring and management system;

- Construction of inlet and pressure duct, and pumping station and reservoir in RAŠINOVAC settlement;
- supply of the part of equipment for regular system maintanance;
- training the staff for system maintanance.

In the period of 2000- 2007, the expansion of the Main system coverage was performed for the following settlements:

- LC Kolunić, (inlet duct), two pre-pumping stations and secondary network with home connections;
- LC Suvaja, hamlets Šipke, Šumari, Medeno Polje and Bjelajski Vaganac;

The zone of coverage and supply of the new business, manufacturing and industrial zones is expanded, as well.

Distribution network is consisted of the following pipe material types:

a/ asbest – concrete pipes:

- DN 150 – 200 mm m1 1.900
- DN 200 – 250 mm m1 1.850
- DN 300 – 350 mm m1 4.500
- DN 400 – 450 mm m1 500

b/ molten – iron pipes + ductile:

- DN 80 mm i manje m1 2.800
- DN 80 – 100 mm m1 1.100
- DN 150 – 200 mm m1 950
- DN 200 – 250 mm m1 2.500
- DN 300 – 350 mm m1 800
- DN 400 mm m1 500

c/ PVC (plastic) watersupply pipes:

- DN 150 mm m1 1.250
- DN 225 mm m1 750

d/ polyethylene water pipes:

- do DN 80 mm m1 26.000
- DN 80 – 100 mm m1 35.000
- DN 150 – 200 mm m1 600

2.3.1.5 WATER LOSSES

After the reconstruction of distribution network bigger part, the water losses from the system are significantly reduced. Now they are estimated to around 30 %. The biggest part of these losses is related to the so called technical losses, as a result of pipes and coonestions condition at unreplaced pipelines. To these losses, we should add the commercial losses, as well, of around 15 % due to the lump sum billing in the appartment buildings and illegal connections.

Previous experiences and attitudes of study documentation in BH and RS indicate that one can not determine the minimum acceptable percentage of losses uniformly for all water supply systems. It is necessary, for each water system analysis, to determine the minimum technical and especially economic, acceptable percentage losses. That means that the determination of losses and its elimination bellow the acceptable minimum is non-profitable, i.e. gained profit is far less than invested means for losses reducing. Therefore, the key role is in abtsracting costs and water delivery itno to distribution network. It is obvious that the water supply systems with simple absraction, without water treatment (except of dissinfection) and gravitational transport to the water supply network (in most of the part of water supply network in Bosanski Petrovac) have higher, economically acceptable, percent of losses than the system with expensive abstractions, necessary conditioning and pump transport to the distribution network. However, the water supply network in Bosanski Petrovac is such that, even without performing the mentioned analysis, network reconstruction and gradual losses reduction can take place.

It is very important to emphasize the necessity of water supply network continuance reconstruction in Bosanski Petrovac. It has to be continious, multi annual activity. By the campaign works, we can obtain only the short term results, so after few years of being passive, the condition would be same as it was at the first place. This is especially important for the areas having no problems with water resources capacity, nor with the raw water quality. That means that they do not have special stimulans to perform the hard work, regarding the network reconstruction and losses reduction, which are expenxive, last long and the results are obtained slowly and gradually. Future period will lead to the necessity of economical water price implementation.

2.3.1.6 WATER QUALITY

At the consumption locations, the periodical regular water quality control is performed. Physical-Chemical and bacteriological water analysis are performed twice a month. Water sampling and analysis are performed in authorised laboratories of Public Health Institute of Bihac canton. All the results so far indicate that the water samples (sampling is done at different consumption locations in distribution network) met the prescribed requirements of the Rules on hygienic quality of drinking water. Very rarely it happens that some of the samples does not satisfy regulated standards, but with 1 to 2 analyzed parameters. Most often, it is about the bacterioligally irregular water and lack of residual chlorine in water. By rehabilitation of the chlorine equipment, these problems will go to minimum. Analyses results are shown in enclosure number 3.

According to the water analysis of distribution network, it can be concluded that the water quality is good. Reasons for this good water quality have to be searched in raw water of good quality at the intakes, good condition of transport and storage facilities, and, despite of everything, rare reductions in certain network parts. In other words, distribution network is always under the pressure, which prevents the outside waters inflow itno the water supply pipes.

Water disinfection is performed in reservoirs, by gas chlorine devices application. The devices are of such type and in such condition which can enable regular dosing and mixing chlorine solution with raw water. Equipment manipulation is done manually and if it's planned to operate automatically and managed telemetrically.

2.3.2 WATER SUPPLY SYSTEM VRTOČE

Water supply of the settlement Vrtoče and side users is performed from the source „Pećina" in Vođenica which is constructed in 1979. There is a capture facility at the source at the elevation appr. 890 msl. Minimum source yield is 4,0 l/sec. Transport pipeline is gravitational, out of PVC (plastic) pipes DN 125 mm and with the total lenght of 13,5 km. Reservoir capacity is 2 * 125 m^3 and it is constructed above the settlement LC Vrtoče at the elevation of

appr. 755 msl. Data on distribution network are unknown. Around 100 households are connected to the system, and they are mostly agricultural. Water quality at this source is satisfying.

2.3.3 WATER SUPPLY SYSTEM VOĐENICA

Water supply system for inhabitants of the LC Vođenica uses the gravitational system consisted of the facility constructed at the source at the elevation appr. 928 MSL., of gravitational pipeline made of PVC (plastic) pipe (estimated lenght from the map is 748 m), surge tank at th eelevation of appr. 865 msl, gravitational line (estimated lenght is 3.364 m), reservoir "Gradina" at the elevation of appr.755 MSL, nearby Vođenica settlement center and supply pipeline which leads water to the users.

By checking the site, we realized that all water was captured from few sources.

The capture facility is consisted of the water tank and surge tank with the fittings and reinforcements. On the day without some significant precipitations, we estimated that appr. 2,0-3,0 l/sec of water enters to the capture facility from several sources.

The water is directed by a plastic hose from the capture to the surge tank because of lowering the pressure which would represent the difficulties to the lower users. This pipeline is connected to several users in the highest zone of the settlement. Further,from the surge tank, the water is gravitationally directed to the reservoir "Gradina". The allignment itself was not shown to the designer, nor the data on users which are directly connected to this part of the pipeline.

While at the site, the reservoir "Gradina" was in a good condition, with appr. 1,0-1,5 l/sec of water flowing into it.

2.3.4 WATER SUPPLY SYSTEM KRNJEUŠA

Water supply system supplies the settlement Krnjeuša, and it was constructed in 1978. The source „Kula" in Krnjeuša was captured which minimum capacity is 0,5 l/sec. From the capture to the reservoir, the supply gravitational pressure pipeline was constructed. From the capture to the pumping station there is a pipeline 1,0 km long made of AC pipes DN 80 mm, and from the pumping station to the reservoir there is a pressure pipeline made of PE DN 50 mm, 700 m long. Reservoir's volume is 75 m3. There is no data about distribution network.

2.3.5 WATER SUPPLY SYSTEM BRAVSKO

Water supply system Bravsko was constructed in 1914, and reconstructed in 1950. For the needs of this system, the following sources are captured:

- Perjanovac Qmin=0,317 l/sec
- Čemerovac Qmin=0,190 l/sec
- Veliki pločevac Qmin=0,428 l/sec

Which makes the total quantity of 0,935 l/sec. The system is gravitational and the transport pipeline lenght is 7,0 km, DN 50 mm. 1,8 km is made out of steel pipes, and the rest of PE pipes. Connection pipeline from the capture Čemerovac to the main pipeline is 180 m long, with diameter of 25 mm, while the connection pipeline from the capture Veliki Pločevac to the main pipeline is 800 m long with diameter of 32 mm. Reservoir's volume is 120 m3 and it is constructed in 1978. There is no project documentation about this system.

2.3.6 OTHER SMALL WATER SUPPLY SYSTEMS

Other small water supply systems are:

- Bjelaj Qmin=0,70 l/sec
- Bukovača Qmin=0,90 l/sec

2.4 PRODUCTION, CONSUMPTION AND WATER REQUIREMENTS

2.4.1 PRODUCTION AND CONSUMPTION OF WATER IN WSS BOSANSKI PETROVAC

It can be concluded that the water amount entering Novakovići reservoir of Qpros=25,0 l/s is sufficient during the bigger part of the year, i.e. that only during the summer months droughts, the Sanica source is activated. According to the utility company data, abstracted water amount at the sources is cca 556603.00 m3.

Considering the water consumption in 2010, it is shown separately for population as total monthly consumption and average monthly consumption of industry. The following table shows mentioned consumptions.

Table 9: Review of water consumption in WSS Bosanski Petrovac

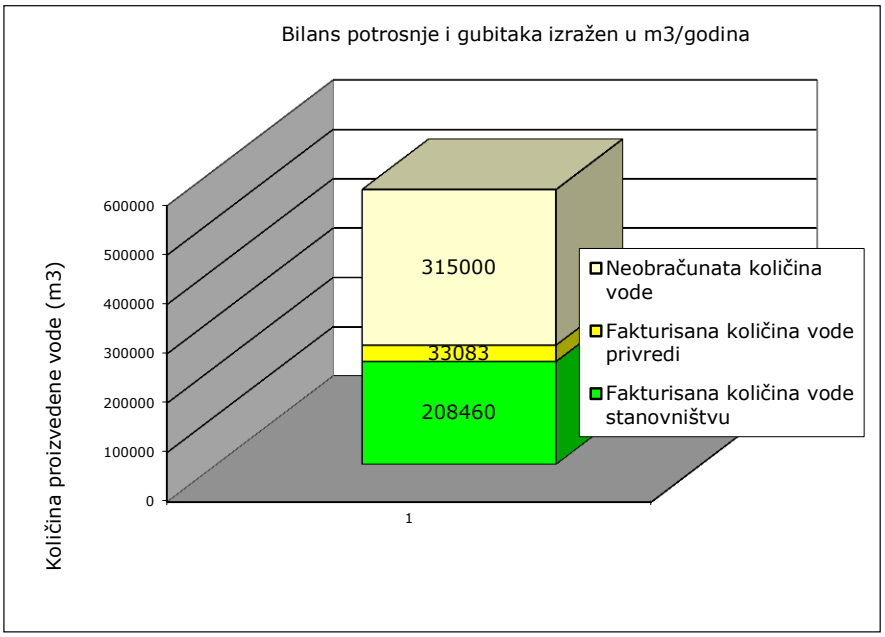
month	Water consumption		Water production
	Population	Industry	
	m3/month	m3/month	m3/month
1	14578,00	2422,00	45000
2	17089,00	2309,00	42000
3	18312,00	2570,00	46500
4	14905,00	2898,00	45000
5	15961,00	2580,00	46500
6	18021,00	4468,00	52528
7	22208,00	2868,00	44743
8	21135,00	2786,00	37531
9	16797,00	2473,00	38025
10	18737,00	2763,00	53568
11	15689,00	2268,00	51840
12	15028,00	2678,00	53368
total	208460,00	33083,00	**556603,00**
total	**241543,00**		

Also, based on the water utility data, the invoiced water amount during 2010 is 241 543,00 m3 of water. According to these data, we get that the total non-revenue water amount is cca 315 000,00 m3 of water. This data can not be taken as reliable for indicating water losses in water supply system, due to the reservoir water overflow, and those amounts are not measured. As stated by staff from utility company, the losses are in between 30 and 35 %.

The total number of waer gauges in the system is 2311 for households connections and 180 for legal bodies. There is a lump sum amount reading in the system, and connected to the system are around 95 % population and economy. The existing water gauges are working properly and are regularly calibrated, so the reading can be taken with high precent of accuracy.

- According to th edata obtained from „Vodovod i kanalizacija“ Bosanski Petrovac, appr. 556 600,00 m^3 of water was captured in 2010.
- 241543,00 m^3 of water was invoiced.
- Non-revenue water was appr. 315 000,00 m^3.

Chart 1: Relation chart of invoiced and non-revenue water amount – December 2010



2.5 ANALYSIS OF WATER SUPPLY SYSTEM OPERATION IN BOSANSKI PTROVAC

2.5.1 WATER SUPPLY SYSTEM OPERATION

The basic water supply system problem is the system control. The company that manages this system, as well as the most companies in BiH, doesn't have the team operating with GIS and measurements and water balances in the system. GIS database doesn't exist. Underground installation cadastre is only partial.

There is no hydraulic model of water supply system which would be connected to the GIS database. It is necessary to have hydraulic model. Only with the hydraulic model development can control the entire system. Hydraulic model provides a lot of posisbilities in the system operation control, as well as in the future plans for system development.

Losses control is very modest, but without hydraulic model, detail plans measurement programs and losses detection we will not have any significant improvements in this branch. Water losses are the biggest problem in all water companies in BiH. Physical losses, as a part of non-revenue water, make the biggest part. However, we should not ignore other parts of non-revenue water, which make the system non-rentabile. For the company, the financial loss is the same, no matter what is the way of water losses. It is necessary to develop the non-revenue water control plans urgently, at the same time with development of GIS and hydraulic model of water supply system, work on reduction of this water quantity. GIS and hydraulic model are the main solutions for losses in the system.

There is enough water in the system at the end of the planning period.

2.5.2 WATER REQUIREMENTS

Having in mind that no census was conducted, it is not possible to give a precise number of residents in the town and the regional plan is outdated, at this moment is not possible to give accurate information on actual water demands in this area. For the purpose of this Master plan, the calculation table of population growth was drafted: Table 10: where addopted population growth coefficient is 0,5, and this calculation relates to the current system coverage. Having in mind the need for system expansion to some other municipality settlements which are not currently covered by the system, the population number calculation was done for the future planned system coverage. This calculation is shown in the Table no. 11. We think that population growth of 0,5 % is realistic and safe talking about the planned water consumption in WSS Bosanski Petrovac. According to this calculation, it is planned to connect cca 8850 inhabitants to the WSS Bosanski Petrovac, untill the end of the planning period in 2030.

Water needs projection was performed by using usual and controlled methods, using specific consumption normatives and its' variations, as well as demographic spatial projection for the planning period till 2030.

Addopted values of specific consumption and its nonlinearity covered the suitable water losses, as well, but it was planned to keep their values within allowed quantities.

At the end of the planning period, the specific consumption is increased from Specifišna appr. 110 l/capita/day to 200 l/capita/day. It is very likely that this consumption will be lower.

Industrial consumption from the current average of 1.25 l / sec increased to 6.28 l / sec Sanitized water. In the town Bosanski Petrovac it is not realistic to expect the development of some food industry that would require a larger quantity of sanitary water.

Before the war Livestock was one of the major industries of the area but during the eighties the number of animals was significantly reduced. Currently there are no data on the number

of cattle, but we can conclude that it is much lower than during the eighties and as such it is meaningless in terms of water consumption.

While calculating, the coefficients of daily nonlinearity which were adopted are 1,5 for population and 1,25 for industry.

The thing we have to mention is that it was planned to reduce the losses from currently estimated 30 % to 20 – 25 %. The biggest part of the works will be planned by a Master plan, concerning water losses reduction in the system.

Total necessary water quantity at the end of the planning period is 49,05l/sec of water.

2.5.3 WATER BALANCE

2.5.3.1 EXISTING SOURCES

Balance of available and needed water amounts is shown in the Table no. 14. Based on the mentioned review, it was concluded that during the planning period till 2030, for the development of this spatial unity there is around 78 l/s of potable water surplus, under the condition of lowering water losses to the reasonable level, i.e. not to exceed 20-25 % of producted water. Since there are no precise measurements of the water entering the system after the reservoir, it is not posible to give the precise water losses data inside of the transport and distribution network. Currently, those losses are estimated to be around 30 %.

Current water amount balances are shown in the Chart 1: Relation chart of invoiced and non-revenue water amount – December 2010 . This Chart shows the balances of producted and lost annual water amounts. The water losses in this Chart are related to the reservoir water overflow.

The conclussion is following:

The table number 14 shows us that the main water supply source in Bosanski Petrovac is „Sanica“ source and during the minimum yield period it can provide 120 l/sec. During the bigger part of the year the water is taken from the source „Smoljana“. It can happen that in hydrogeologically favourable years there is no need for the source „Sanica“, but all water is provided from the sources „Smoljana“

Process water for future industry can only provide the water supply system according to the hydrological situation at the source.

According to the data obtained from the water company, appr. 6000 inhabitants will be connected to the water supply system. Specific water consumption of the population and industry is around 110 l/capita/day.

The percentage of actual physical losses in transport and distribution systems, which are part of the non-revenue water can only be estimated, because of research and data on the quantity of water there. According to current estimates of water company staff, the physical water losses are about 30% since the entire network is not reconstructed.

2.5.3.2 POSIBILITY OF PROVIDING THE ADDITIONAL WATER QUANTITIES GRAVITATIONALLY

One of the problems of the Utility company that manages water supply system are high energy expences whuch is used for the water pumping from the source „Sanica” in the period of „Smoljana” source minimum yield.

During the eightees, the posibilty for water supply from Bosanski Petrovac plateau was analyzed and the complete documentation was made by The Institute for Water Management Sarajevo. Within that project, four posible options were analyzed for providing the required water quantity for entire plateau, as follows :

- Source „Sanica”,

- Source „Skakavac”
- Source „Crno vrelo”
- Source”Ostrovica”

Based on all of these analysis, the option „Sanica” was choosen, which was constructed and currently operating.

The only source which could be used gravitationally is the source „Skakavac”. At the preliminary design level, in 1982 the documentation was made about the usage of this source. The failure in this design is that minimum yield is only 4,0 l/sec and to use this source, we would have to construct the artifical accumulation in the source’s zone, i.e. Suvaja river. It is, also, necessary to construct the water conditioning plant.

Complete construction of the system (dam, conditioning installation, pipeline) would be very expensive in comparison to the effects that could be achieved, so consider this variant as a potential for providing additional Quantity of water for the entire water supply system of Bosanski Petrovac.

Only remains the possibility to capture this source and use it without the construction of reservoirs and water conditioning plants. In this case, the source can be taken with a capacity of approximately 4.0 l / sec in the minimum yield period. Together with the source "Smoljana” total capacity would be approximately 9.0 l / sec which is not enough to supply the entire area, which means the usage of the system „Sanica”.

Table 10: Calculation of population and water amounts needed for WSS Bosanski Petrovac – current system coverage

Population growth percent**: 0,5 %**

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	**2015**	**2020**	**2025**	**2030**	**2035**
Number of inhabitants in the town	inh.	**6.000**	**6.152**	**6.307**	**6.466**	**6.629**	**6.797**
Population connected to the system	inh.	**4.620**	**5.229**	**5.676**	**6.143**	**6.629**	**6.797**
Average specific water consumption of the population	l/capita/day	120	140	160	180	190	200
Percentage of population connected to the system	%	77,00	85,00	90,00	95,00	100,00	100,00
Average water consumption of population	l/s	6,42	8,47	10,51	12,80	14,58	15,73
Share of economy in water consumption	%	15,00	17,00	20,00	25,00	30,00	35,00
Average water consumption of economy	l/s	0,96	1,44	2,10	3,20	4,37	5,51
Total average water consumption of population+ economy	**l/s**	**7,38**	**9,91**	**12,61**	**16,00**	**18,95**	**21,24**
Specific consumption of population + economy	l/capita/day	**138,00**	**163,80**	**192,00**	**225,00**	**247,00**	**270,00**
Total daily average water consumption of population + economy	**m^3/day**	**638**	**856**	**1.090**	**1.382**	**1.637**	**1.835**
Total monthly average water consumption population +economy	**m^3/month**	**19.392**	**26.051**	**33.149**	**42.040**	**49.806**	**55.819**
Total average annual water consumption population+ economy	**m^3/year**	**232.709**	**312.613**	**397.785**	**504.477**	**597.671**	**669.822**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	l/s	9,63	12,71	15,77	19,20	21,87	23,60
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	1,20	1,80	2,63	4,00	5,47	6,88
Maximum daily water consumption in total(population+economy)	**l/s**	**10,83**	**14,51**	**18,39**	**23,20**	**27,33**	**30,48**
Average losses of water in the system in total	%	30,00	25,00	25,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	**l/s**	**10,54**	**13,22**	**16,82**	**20,00**	**23,69**	**26,55**
Average daily water amount needs with losses in total	m^3/month	27.704	34.735	44.198	52.550	62.257	69.773
Specific population consumption + economy with losses	l/capita/day	**197,14**	**218,40**	**256,00**	**281,25**	**308,75**	**337,50**
Maximum daily water amount needs with losses in total	**l/s**	**15,47**	**19,35**	**24,53**	**28,99**	**34,17**	**38,10**

Table 11: Calculation of population and water amounts needed for WSS Bosanski Petrovac – planned system coverage

Pesimistic estimation - population growth percent: 0,1%

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	inh.	7.800	7.839	7.878	7.918	7.957	7.997
Population connected to the system	inh.	6.006	6.663	7.091	7.522	7.957	7.997
Average specific water consumption of the population	l/capita/day	120	140	160	180	190	200
Percentage of population connected to the system	%	77,00	85,00	90,00	95,00	100,00	100,00
Average water consumption of population	l/s	8,34	10,80	13,13	15,67	17,50	18,51
Share of economy in water consumption	%	15,00	17,00	20,00	25,00	30,00	35,00
Average water consumption of economy	l/s	1,25	1,84	2,63	3,92	5,25	6,48
Total average water consumption of population+ economy	**l/s**	**9,59**	**12,63**	**15,76**	**19,59**	**22,75**	**24,99**
Specific consumption of population + economy	l/capita/day	**138,00**	**163,80**	**192,00**	**225,00**	**247,00**	**270,00**
Total daily average water consumption of population + economy	**m^3/day**	**829**	**1.091**	**1.361**	**1.692**	**1.966**	**2.159**
Total monthly average water consumption population +economy	**m^3/month**	**25.210**	**33.198**	**41.409**	**51.478**	**59.784**	**65.678**
Total average annual water consumption population+ economy	**m^3/year**	**302.522**	**398.374**	**496.903**	**617.739**	**717.408**	**788.140**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	l/s	12,51	16,20	19,70	23,51	26,25	27,77
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	1,56	2,29	3,28	4,90	6,56	8,10
Maximum daily water consumption in total(population+economy)	**l/s**	**14,08**	**18,49**	**22,98**	**28,40**	**32,81**	**35,87**
Average losses of water in the system in total	%	30,00	25,00	25,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	**l/s**	**13,70**	**16,84**	**21,01**	**24,49**	**28,44**	**31,24**
Average daily water amount needs with losses in total	m^3/month	36.015	44.264	55.211	64.348	74.730	82.098
Specific population consumption + economy with losses	l/capita/day	**197,14**	**218,40**	**256,00**	**281,25**	**308,75**	**337,50**
Maximum daily water amount needs with losses in total	**l/s**	**20,11**	**24,65**	**30,64**	**35,50**	**41,01**	**44,83**

Table 12: Calculation of population and water amounts needed for WSS Bosanski Petrovac – planned system coverage

Realistic estimation - population growth percent: 0,5%

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	inh.	7.800	7.997	8.199	8.406	8.618	8.836
Population connected to the system	inh.	6.006	6.797	7.379	7.986	8.618	8.836
Average specific water consumption of the population	l/capita/day	120	140	160	180	190	200
Percentage of population connected to the system	%	77,00	85,00	90,00	95,00	100,00	100,00
Average water consumption of population	l/s	8,34	11,01	13,66	16,64	18,95	20,45
Share of economy in water consumption	%	15,00	17,00	20,00	25,00	30,00	35,00
Average water consumption of economy	l/s	1,25	1,87	2,73	4,16	5,69	7,16
Total average water consumption of population+ economy	**l/s**	**9,59**	**12,89**	**16,40**	**20,80**	**24,64**	**27,61**
Specific consumption of population + economy	l/capita/day	**138,00**	**163,80**	**192,00**	**225,00**	**247,00**	**270,00**
Total daily average water consumption of population + economy	**m^3/day**	**829**	**1.113**	**1.417**	**1.797**	**2.129**	**2.386**
Total monthly average water consumption population +economy	**m^3/month**	**25.210**	**33.866**	**43.093**	**54.652**	**64.748**	**72.564**
Total average annual water consumption population+ economy	**m^3/year**	**302.522**	**406.397**	**517.121**	**655.820**	**776.973**	**870.769**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	l/s	12,51	16,52	20,50	24,96	28,43	30,68
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	1,56	2,34	3,42	5,20	7,11	8,95
Maximum daily water consumption in total(population+economy)	**l/s**	**14,08**	**18,86**	**23,91**	**30,15**	**35,54**	**39,63**
Average losses of water in the system in total	%	30,00	25,00	25,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	**l/s**	**13,70**	**17,18**	**21,86**	**25,99**	**30,80**	**34,51**
Average daily water amount needs with losses in total	m^3/month	36.015	45.155	57.458	68.315	80.935	90.705
Specific population consumption + economy with losses	l/capita/day	**197,14**	**218,40**	**256,00**	**281,25**	**308,75**	**337,50**
Maximum daily water amount needs with losses in total	**l/s**	**20,11**	**25,15**	**31,88**	**37,69**	**44,42**	**49,54**

Table 13: Calculation of population and water amounts needed for WSS Bosanski Petrovac – planned system coverage

Optimistic estimation - population growth percent: 1,0%

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	inh.	7.800	8.198	8.616	9.056	9.517	10.003
Population connected to the system	inh.	6.006	6.968	7.754	8.603	9.517	10.003
Average specific water consumption of the population	l/capita/day	120	140	160	180	190	200
Percentage of population connected to the system	%	77,00	85,00	90,00	95,00	100,00	100,00
Average water consumption of population	l/s	8,34	11,29	14,36	17,92	20,93	23,16
Share of economy in water consumption	%	15,00	17,00	20,00	25,00	30,00	35,00
Average water consumption of economy	l/s	1,25	1,92	2,87	4,48	6,28	8,10
Total average water consumption of population+ economy	**l/s**	**9,59**	**13,21**	**17,23**	**22,40**	**27,21**	**31,26**
Specific consumption of population + economy	l/capita/day	**138,00**	**163,80**	**192,00**	**225,00**	**247,00**	**270,00**
Total daily average water consumption of population + economy	**m^3/day**	**829**	**1.141**	**1.489**	**1.936**	**2.351**	**2.701**
Total monthly average water consumption population +economy	**m^3/month**	**25.210**	**34.717**	**45.286**	**58.875**	**71.504**	**82.149**
Total average annual water consumption population+ economy	**m^3/year**	**302.522**	**416.608**	**543.432**	**706.503**	**858.049**	**985.793**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	l/s	12,51	16,94	21,54	26,88	31,39	34,73
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	1,56	2,40	3,59	5,60	7,85	10,13
Maximum daily water consumption in total(population+economy)	**l/s**	**14,08**	**19,34**	**25,13**	**32,48**	**39,24**	**44,86**
Average losses of water in the system in total	%	30,00	25,00	25,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	**l/s**	**13,70**	**17,61**	**22,98**	**28,00**	**34,01**	**39,07**
Average daily water amount needs with losses in total	m^3/month	36.015	46.290	60.381	73.594	89.380	102.687
Specific population consumption + economy with losses	l/capita/day	**197,14**	**218,40**	**256,00**	**281,25**	**308,75**	**337,50**
Maximum daily water amount needs with losses in total	**l/s**	**20,11**	**25,78**	**33,51**	**40,61**	**49,05**	**56,08**

Table 14: Calculation of population and water amounts needed for the settlements Skakavac, Suvaja, Medeno polje, Bjelajski Vaganac and Bjelaj

– planned system coverage – Population growth percent: 1,0%

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	inh.	1.000	1.051	1.105	1.161	1.220	1.282
Population connected to the system	inh.	700	893	994	1.103	1.159	1.218
Average specific water consumption of the population	l/capita/day	120	130	140	150	160	180
Percentage of population connected to the system	%	70,00	85,00	90,00	95,00	95,00	95,00
Average water consumption of population	l/s	0,97	1,34	1,61	1,91	2,15	2,54
Share of economy in water consumption	%	15,00	15,00	15,00	15,00	15,00	15,00
Average water consumption of economy	l/s	0,15	0,20	0,24	0,29	0,32	0,38
Total average water consumption of population+ economy	**l/s**	**1,12**	**1,55**	**1,85**	**2,20**	**2,47**	**2,92**
Specific consumption of population + economy	l/capita/day	**138,00**	**149,50**	**161,00**	**172,50**	**184,00**	**207,00**
Coefficient of seasonal consumption variation of population		1,50	1,50	1,50	1,50	1,50	1,50
Maximum daily water consumption of the population	l/s	1,46	2,02	2,42	2,87	3,22	3,81
Coefficient of seasonal variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	0,18	0,25	0,30	0,36	0,40	0,48
Maximum daily water consumption in total(population+economy)	**l/s**	**1,64**	**2,27**	**2,72**	**3,23**	**3,62**	**4,28**
Average losses of water in the system in total	%	30,00	25,00	20,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	**l/s**	**1,60**	**2,06**	**2,32**	**2,75**	**3,09**	**3,65**
Specific population consumption + economy with losses	l/capita/day	**197,14**	**199,33**	**201,25**	**215,63**	**230,00**	**258,75**
Maximum daily water amount needs with losses in total	**l/s**	**2,34**	**3,02**	**3,40**	**4,04**	**4,53**	**5,35**

Table 15: Water balance in the area of WSS Bosanski Petrovac

Water supply system	Neds (maximum daily) (l/s)				Provided from the source min. (l/s)					Surplus water quantity (l/s)			
	2011	2020	2030	2035	Source	2011	2020	2030	2035	2011	2020	2030	2035
WSS Bosanski Petrovac	20,11	33,51	49,05	56,08	Smoljana	5,00	5,00	5,00	5,00	106,89	93,49	77,95	70,92
					Sanica	122,00	122,00	122,00	122,00				
Total	**20,11**	**33,51**	**49,05**	**56,08**	***Total***	**127,00**	**127,00**	**127,00**	**127,00**	**106,89**	**93,49**	**77,95**	**70,92**

Table 16: Water balance in the area of WSS Bosanski Petrovac after including the „Skakavac“ source in the system

Water supply system	Neds (maximum daily) (l/s)				Provided from the source min. (l/s)					Surplus water quantity (l/s)			
	2011	2020	2030	2035	Izvorište	2011	2020	2030	2035	2010	1	2030	2035
WSS Bosanski Petrovac	20,11	33,51	49,05	56,08	Smoljana	5,00	5,00	5,00	5,00	110,89	97,49	81,95	74,92
					Skakavac	4,00	4,00	4,00	4,00				
					Sanica	122,00	122,00	122,00	122,00				
WSS Bosanski Petrovac	**20,11**	**33,51**	**49,05**	**56,08**	***Total***	**131,00**	**131,00**	**131,00**	**131,00**	**110,89**	**97,49**	**81,95**	**74,92**

2.5.4 RESERVOIR SPACE BALANCE

The following table shows the needs for reservoir space in the planning period, as currently constructed reservoir spaces. The calculation was based on 30 % of daily consumed water in the system. Based on this calculation, the surplus of reservoir space is expressed as cca 900 m3 of water. When the needed reservoir space is observed from the power spending aspect (water pumping is performed in the time of low power tariff), then this reservoir space surplus is economically cost effective.

WSS Bosanski Petrovac

Table 17: An overview of required and available reservoir space in WSS Bosanski Petrovac

2010			
Required Water Amount (lps)	**Required reservoir volume (m3)**	**Existing reservoir space (m3)**	**Needs/ Surplus**
23,50	676,93	2.200,00	+1.523,07
2015			
Required Water Amount (lps)	**Required reservoir volume (m3)**	**Existing reservoir space (m3)**	**Needs/ Surplus**
27,81	800,99	2.200,00	+1.399,01
2035			
Required Water Amount (lps)	**Required reservoir volume (m3)**	**Existing reservoir space (m3)**	**Needs/ Surplus**
44,74	1.288,55	2.200,00	+911,45

Existing reservoirs

Reservoir	**Pressure zone**	**Bottom level (m a.s.l.)**	**Volume (m3)**
Bursaći	I altitude zone	719,00	2.000,00
Novakovići	II altitude zone	750,00	200,00
	Total:		**2.200,00**

2.5.5 WATER SUPPLY SYSTEM MODELLING

For the purposes of the Master Plan an initial model of Bosanski Petrovac water supply system was developped to verify the functionality of the system, the capacity of pipelines and other facilities of the system.

The system geometry which was available at this moment was inserted into the system, so there are probably some minor failures concerning the altitude positions of some facilities, but those failures do not have some significant impact to the results obtained by a model. We need to emphasize that the model was set only on the basis of theoretical data on consumption, consumption schedule by nodes, daily and hourly nonlinearity and that it is not

calibrated. In the future period, the model needs to be upgraded, perform some certain measurements in the system and based on those measurements, perform the model calibration, to provide us with more accurate data on the system functioning.

In this inicial model, two options were made, the first for conditions in 2010 and the second for 2030, i.e. the end of the planning period. Within these two options, we made several sub-options, but these document will contain only two basic options.

2.5.5.1 INPUT DATA FOR HYDRAULIC MODEL

Hydraulic model was done in EPANET.

As a baseline info we took the following data:

- The system geometry with the mapped sources, reservoirs, pressure release chambers, pumping stations, pipelines, caps – system's map taken from GIS
- Data on water consumption and water production for each part of the system,

  For the model needs, we took the water production in 2010 and in 2030.
- Data on revenue and non-revenue water. Non-revenue water is divided proportianally according to the water consumption in the system.

The calculation results are shown in the enclosures.

Hydraulic model was used for system development for the period untill 2030.

The following parameters were determined for hydraulic model:

- **Nodal load** is calculated based on measurements of the solar system in certain parts of the system. The position of objects and consumers in the supply system was, also, taken into account. The specific nodal load was determined in this way.
- The model shows **charts of daily consumption nonlinearity - Demand Patterns**. Determining the nonlinearity of consumption is very important because, based on the maximum hourly consumption, the distribution system can be dimensioned. Multiplying the base nodal consumption and nonlinearity consumption, we get the energy in each node, depending on the weather. So we get the diagram of consumption in node during the one day or more depending on what is assigned in the model.
- Pipelines were determined by its lenght and diameter. The first and the last node were given. Roughness coefficients are given according to the Darcy - Waisbach. For PE and PVC pipelines we took the coefficient 0,1 and for steel, cast iron and asbestos cement the coefficient 0,4. The coefficiens for the other group of materials can be even up to 1.
- Besides the geometry x,y,z the sources were, also, determined based on the water quantity givning to the system.
- For the reservoirs there are reservoir position (x,y), bottom elevation, početna water depth in reservoir and maximum water depth in reservoir.
- Pumping stations are determined by the pumping curve, which determines the pumped water quantity and th eheight of water pumping.
- The caps are determined according to the function in the system.
- The model, also, shows the regulations for the operation of pumping stations, reservoirs and caps.

Non-revenue wsater was allocated proportionally to the consumption, because we do not know the point of the losses in the system. It is necessary to calibrate the hydraulic model which would indicate the point of the real losses in the system.

The following scheme shows the model for WSS Bosanski Petrovac with pipelines diameters.

Enclosures show the schemes with bigger ratio.

Pipelines in WSS Bosanski Petrovac are shown in the following table.

Table 18: Pipelines in WSS Bosanski Petrovac

Section	Pipeline diameter (mm)	Pipeline length (m)
Pipe P128	32	0,49
Pipe P138	100	33,09
Pipe P108	150	115,76
Pipe P118	80	169,67
Pipe P168	25	347,56
Pipe P178	100	169,65
Pipe P28	250	60,61
Pipe P29	250	84,15
Pipe P195	300	3.303,32
Pipe P22	200	101,79
Pipe P23	200	42,35
Pipe P6	100	9,98
Pipe P20	200	71,90
Pipe P24	300	26,19
Pipe P25	200	141,45
Pipe P27	150	420,78
Pipe P242	200	468,35
Pipe P122	25	2,10
Pipe P40	100	56,77
Pipe P112	100	136,54
Pipe P47	50	101,75
Pipe P142	250	45,11
Pipe P152	200	136,75
Pipe P86	200	51,86
Pipe P84	200	79,93
Pipe P18	80	1,24
Pipe P19	40	163,66
Pipe P97	250	117,80
Pipe P243	100	123,08
Pipe P12	80	228,49
Pipe P13	40	223,70
Pipe P5	100	9,12

Pipe P11	200	19,15
Pipe P16	300	39,06
Pipe P17	100	1,36
Pipe P14	300	29,04
Pipe P206	50	870,01
Pipe P237	25	525,53
Pipe P125	25	49,84
Pipe P135	100	98,50
Pipe P115	100	89,17
Pipe P145	38	99,98
Pipe P3	300	736,81
Pipe P234	400	286,98
Pipe P204	60	1.135,58
Pipe P214	200	1,30
Pipe P171	200	13,23
Pipe P224	400	60,82
Pipe P221	400	74,34
Pipe P123	32	128,63
Pipe P201	400	4.130,14
Pipe P99	300	76,44
Pipe P143	200	1,17
Pipe P153	200	100,94
Pipe P148	200	87,51
Pipe P158	100	182,41
Pipe P92	150	4,15
Pipe P93	50	29,96
Pipe P90	150	69,29
Pipe P91	150	140,91
Pipe P96	150	79,94
Pipe P4	200	668,10
Pipe P94	150	116,51
Pipe P95	50	14,94
Pipe P197	400	2.608,58
Pipe P244	250	763,78
Pipe P127	32	22,13
Pipe P137	100	29,21
Pipe P107	150	94,78
Pipe P117	150	1,06
Pipe P167	80	244,00
Pipe P177	32	1,49
Pipe P147	38	33,51
Pipe P157	100	213,81
Pipe P183	200	14,13
Pipe P215	400	112,12

Pipe P124	25	2,39
Pipe P134	100	97,64
Pipe P114	150	39,16
Pipe P164	150	945,73
Pipe P144	38	4,02
Pipe P121	100	400,90
Pipe P131	200	1.440,00
Pipe P101	300	49,31
Pipe P111	100	152,44
Pipe P80	200	39,08
Pipe P72	200	26,29
Pipe P76	200	19,87
Pipe P2	300	2,12
Pipe P74	200	49,31
Pipe P229	400	69,08
Pipe P239	38	110,89
Pipe P209	150	2.393,09
Pipe P219	400	109,68
Pipe P132	25	163,27
Pipe P205	400	439,43
Pipe P10	200	353,24
Pipe P216	400	161,82
Pipe P50	38	313,12
Pipe P68	40	430,84
Pipe P69	200	39,06
Pipe P233	300	1.337,21
Pipe P203	400	4.095,68
Pipe P207	400	2.951,78
Pipe P62	25	255,22
Pipe P60	38	316,34
Pipe P1	450	471,07
Pipe P64	38	268,61
Pipe P65	40	48,85
Pipe P230	400	72,45
Pipe P200	60	648,62
Pipe P210	400	40,48
Pipe P199	400	269,30
Pipe P129	32	3,08
Pipe P139	100	29,15
Pipe P109	150	120,30
Pipe P169	40	422,89
Pipe P179	32	88,54
Pipe P159	38	157,23
Pipe P196	400	5.238,47

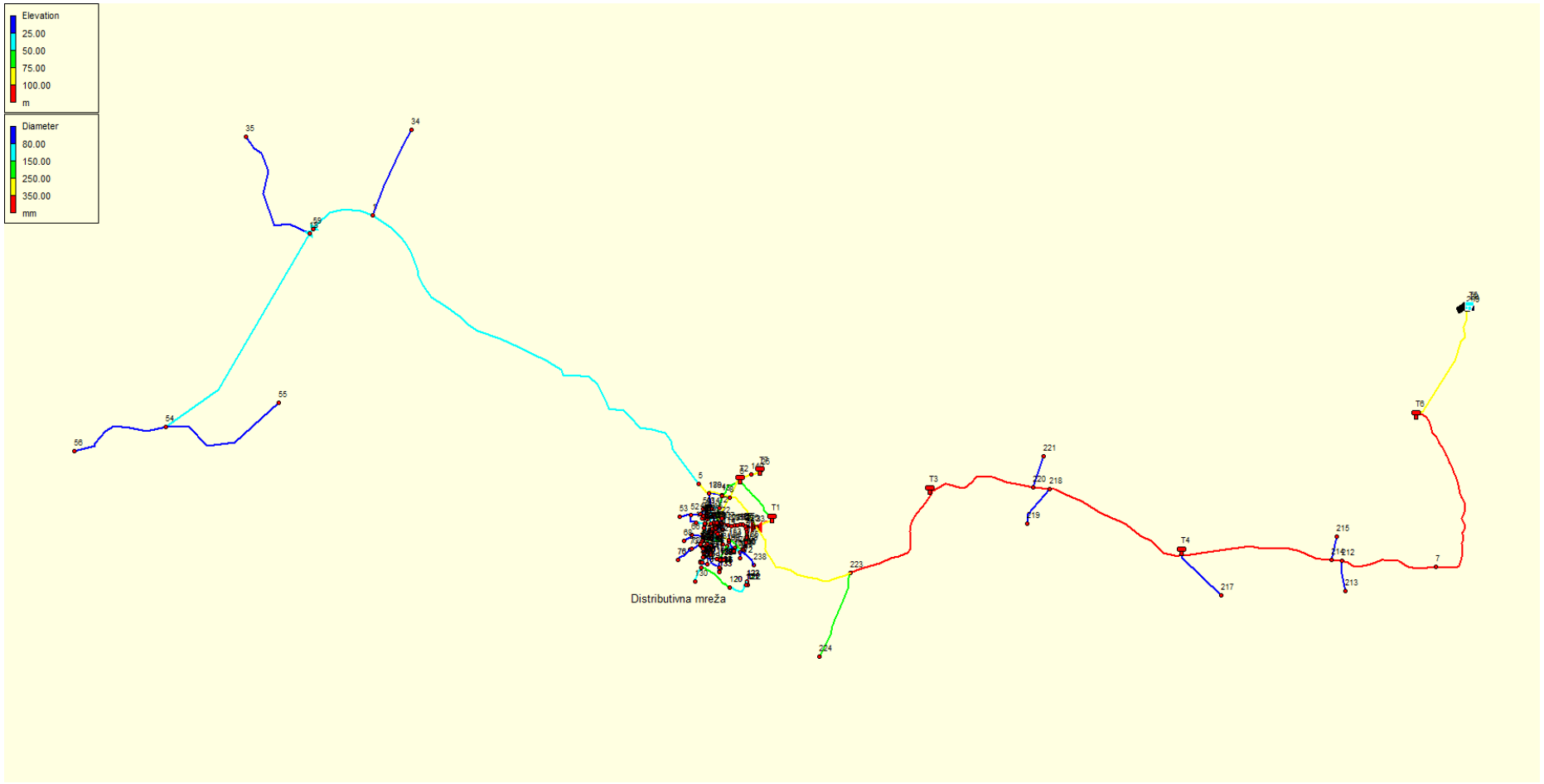
Pipe P126	32	192,11
Pipe P136	50	25,50
Pipe P106	38	178,09
Pipe P166	50	299,83
Pipe P176	32	14,08
Pipe P146	38	106,76
Pipe P156	50	296,64
Pipe P235	400	84,59
Pipe P133	100	0,49
Pipe P103	300	127,00
Pipe P113	100	614,17
Pipe P53	300	25,43
Pipe P56	200	220,06
Pipe P120	50	144,11
Pipe P130	250	325,12
Pipe P100	300	244,40
Pipe P110	80	13,11
Pipe P160	100	118,46
Pipe P170	200	0,29
Pipe P140	40	65,02
Pipe P150	200	57,76
Pipe P182	200	429,31
Pipe P38	80	182,37
Pipe P39	32	83,72
Pipe P33	200	117,57
Pipe P36	100	7,54
Pipe P37	32	69,90
Pipe P34	80	216,73
Pipe P35	100	111,85
Pipe P231	50	12,38
Pipe P184	300	471,42
Pipe P238	250	255,83
Pipe P208	400	3.523,71
Pipe P48	40	186,99
Pipe P49	38	370,74
Pipe P42	100	7,11
Pipe P43	50	51,65
Pipe P8	200	2,53
Pipe P41	40	195,74
Pipe P46	40	78,22
Pipe P7	300	572,71
Pipe P44	50	5,50
Pipe P45	40	65,31
Pipe P245	200	401,80

Pipe P232	50	521,24
Pipe P202	60	1.583,48
Pipe P180	32	98,32
Pipe P241	300	3.321,29
Pipe P213	200	114,01
Pipe P198	60	808,34
Pipe P-1	200	63,38
Pipe P-2	200	51,94
Pipe P-3	38	1,85
Pipe 1	250	10,00
Pipe 2	250	11.675,00
Pipe 3	100	5,00
Pipe 4	500	10,00
Pipe 6	100	6.651,00
Pipe 7	63	1.394,00
Pipe 8	80	770,00
Pipe 9	63	2.224,00
Pipe 10	80	3.984,00
Pipe 11	63	2.468,00
Pipe 12	63	1.571,00
Total:		**93.731,88**

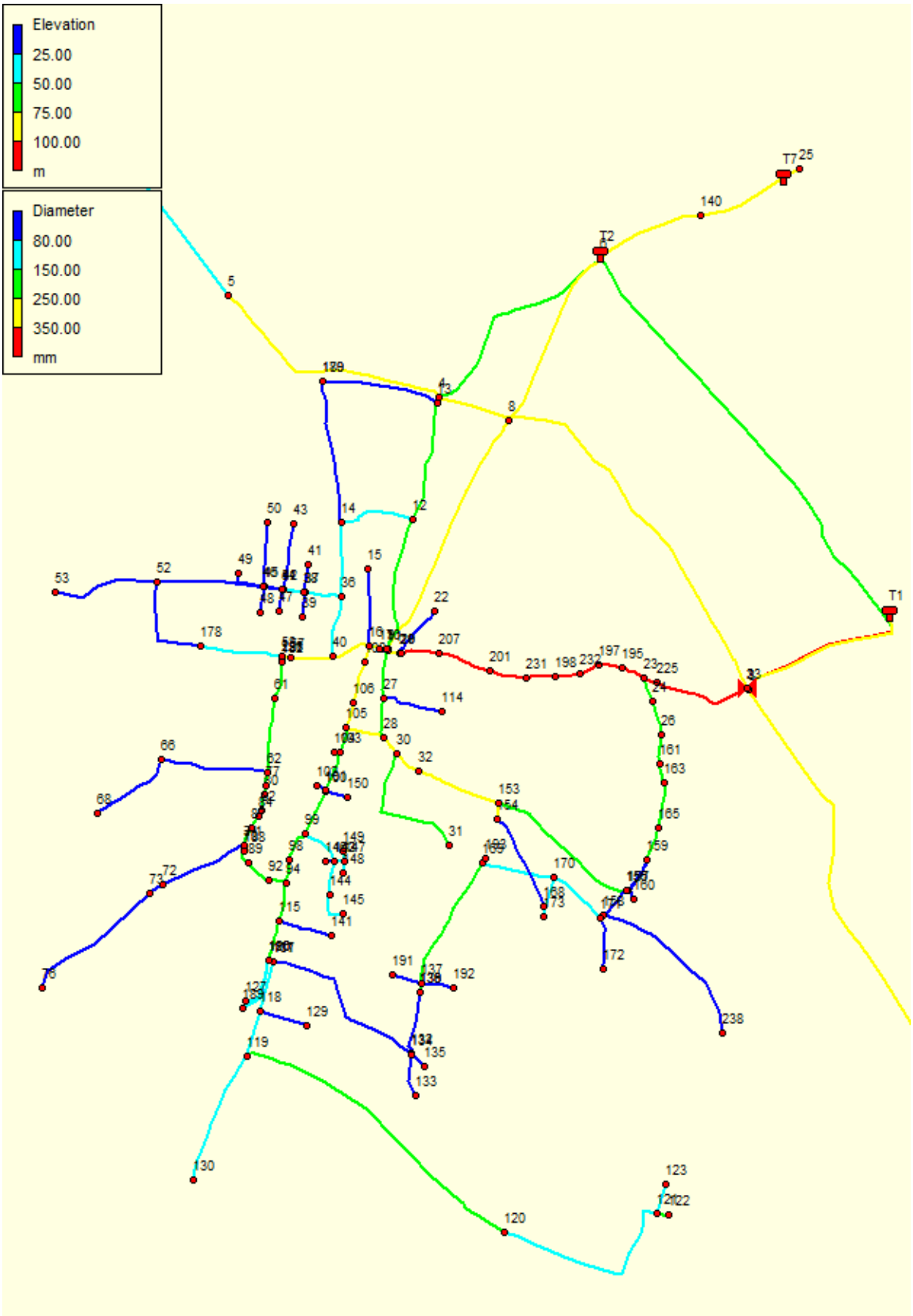
Table 19: Pipelines in WSS Bosanski Petrovac by profiles and percentage

Pipeline diameter	Pipeline lenght	Percentage	Pipelines with diameter smaller than 80 mm	
(mm)	(m)	(%)	(%)	(m)
25	1.345,91	1,44%		
32	702,49	0,75%		
38	1.961,13	2,09%		
40	1.881,22	2,01%	**21,44%**	**20.097,27**
50	2.373,50	2,53%		
60	4.176,02	4,46%		
63	7.657,00	8,17%		
80	5.809,61	6,20%		
100	9.348,44	9,97%		
150	4.541,46	4,85%		
200	5.425,41	5,79%		
250	13.337,40	14,23%	**78,56%**	**73.634,61**
300	10.361,75	11,05%		
400	24.329,46	25,96%		
450	471,07	0,50%		
500	10,00	0,01%		
	93.731,88	**100,0%**	**100,0%**	**93.731,88**

Scheme 1: Scheme of WSS Bosanski Petrovac with the pipelines profiles



Scheme 2: Scheme of WSS Bosanski Petrovac – distribution network



2.5.5.2 THE RESULTS OF HYDRAULIC CALCULATIONS – CONDITION IN 2010 WITH Q= 30,68 L/SEC

After the hydraulic model preparation, the simulation of water supply system operation was made. Operation simulation can be done for different time period intervals. The minimum time period interval can be 24 hours.

The calculation results in hydraulic model can practically be seen in every moment. The most interesting condition for us is, certainlly, the condition in the moment of the maximum consumption, because we can see the system fucntionality.

The Scheme 3: Error! Reference source not found. and Scheme 4: Error! Reference source not found. show the calculation results for the maximum hourly consumption of the existing water supply system. The calculation results details are given in enclosures.

The Scheme 5: Error! Reference source not found. and Scheme 6: Error! Reference source not found. show show the pressure values, water speed and flow during the minimum hourly consumption in the system.

According to the mathematical model, the following can be concluded:

Pressures in the system are very high. It is obvious that in distribution network all of the nodes during the maximum hourly consumption have the pressures higher than 1,5 bar. At the same time, during the maximum hourly consumption, the pressures in most of the nodes are higher than 5 bar, - Scheme 7: Error! Reference source not found.. Althought there is a high percent of the pipelines with diameter smaller than Ø 80 mm in the system - Scheme 9: Error! Reference source not found., due to the highly positioned reservoirs and and proper diameters of the main distribution pipelines, the pressures in the system are even higher than allowed ones.

Hydraulic model showed that the velocities in all pipelines are in the allowed scope, i.e. it is not more than v=1,2 m/s - Scheme 8: Error! Reference source not found.. That means that all of the pipelines are big enough, and they don't represent the bottlenecks in the system. Jedan dio cjevovoda je malog prečnika i predlaže se zamjena ovih cjevovoda jer ne zadovoljavaju tehničke propise. Cjevovodi koji su manjeg prečnika od Ø 80 mm, su dati i potrebno je zamjeniti kako zbog zadovoljavanja osnovnih tehničkih uslova (hidrantska mreža) tako i zbog starosti i dotrajalosti tih cjevovoda.

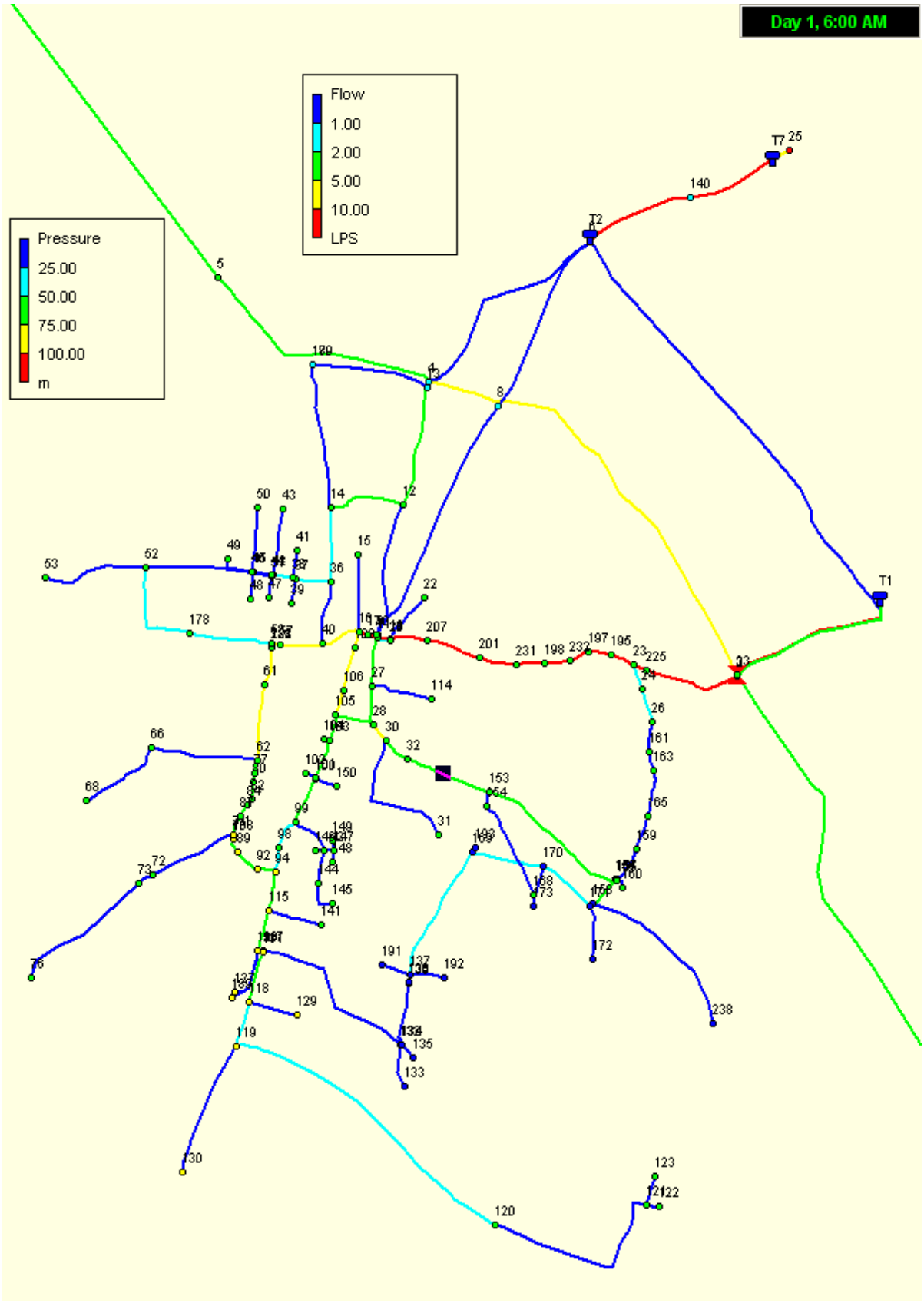
The Chart 2: Water level in Bursaći shows the operation of the main reservoir in the system - Bursaći.

Based on the calculation results, we can conclude that the system is overdimensioned and that the reservoirs operate in the optimum. Bursać reservoir position is lower than the Novaković reservoir, so the reservoir is not charging and emptying during the maximum consumption.

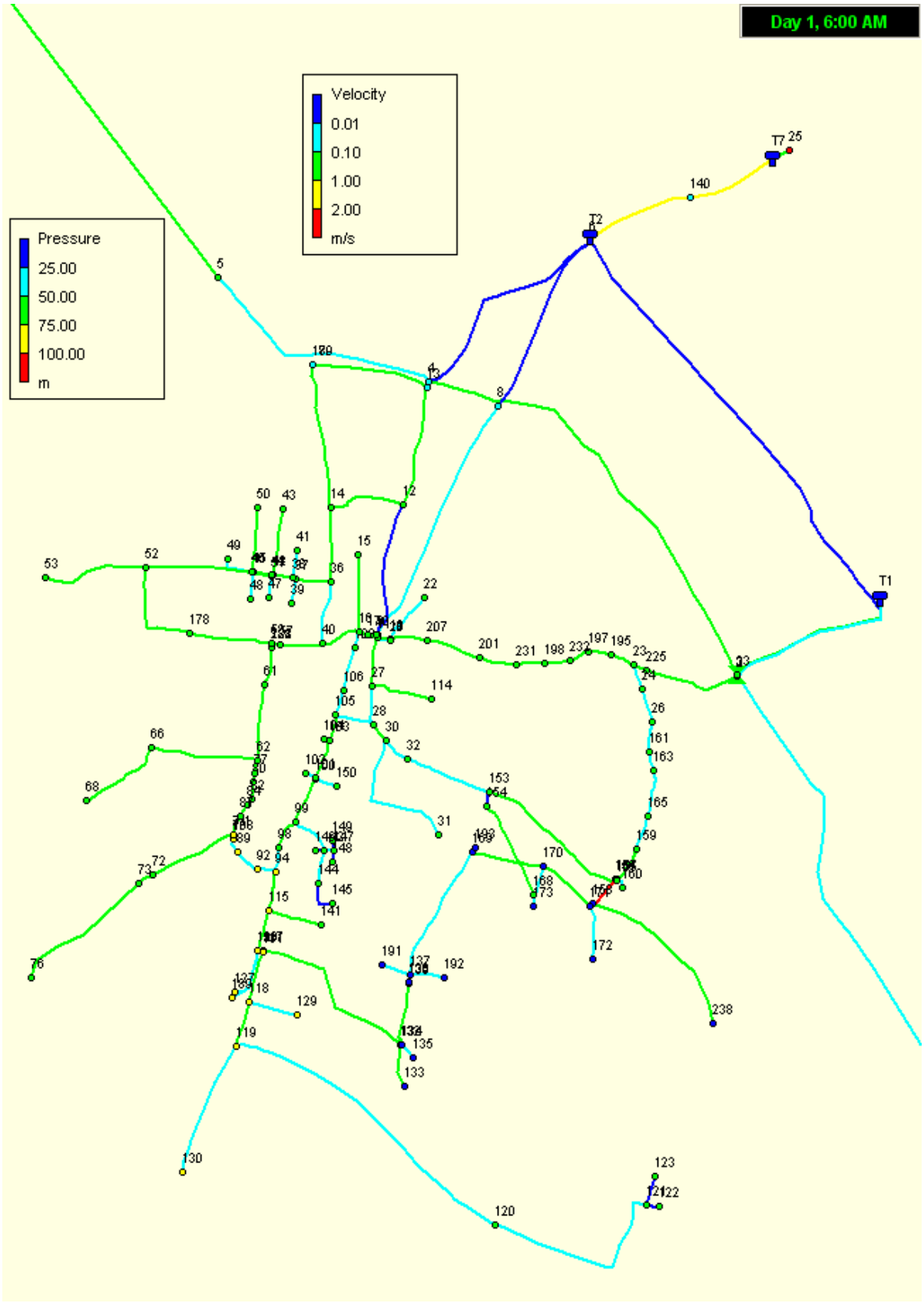
Transport pipelines are overdimensioned, so, at some certain moment, a lot of water quantity is taken, so the Bursać reservoir gets full.

Distribution network is under the high pressures, so it needs the zonning in the future period.

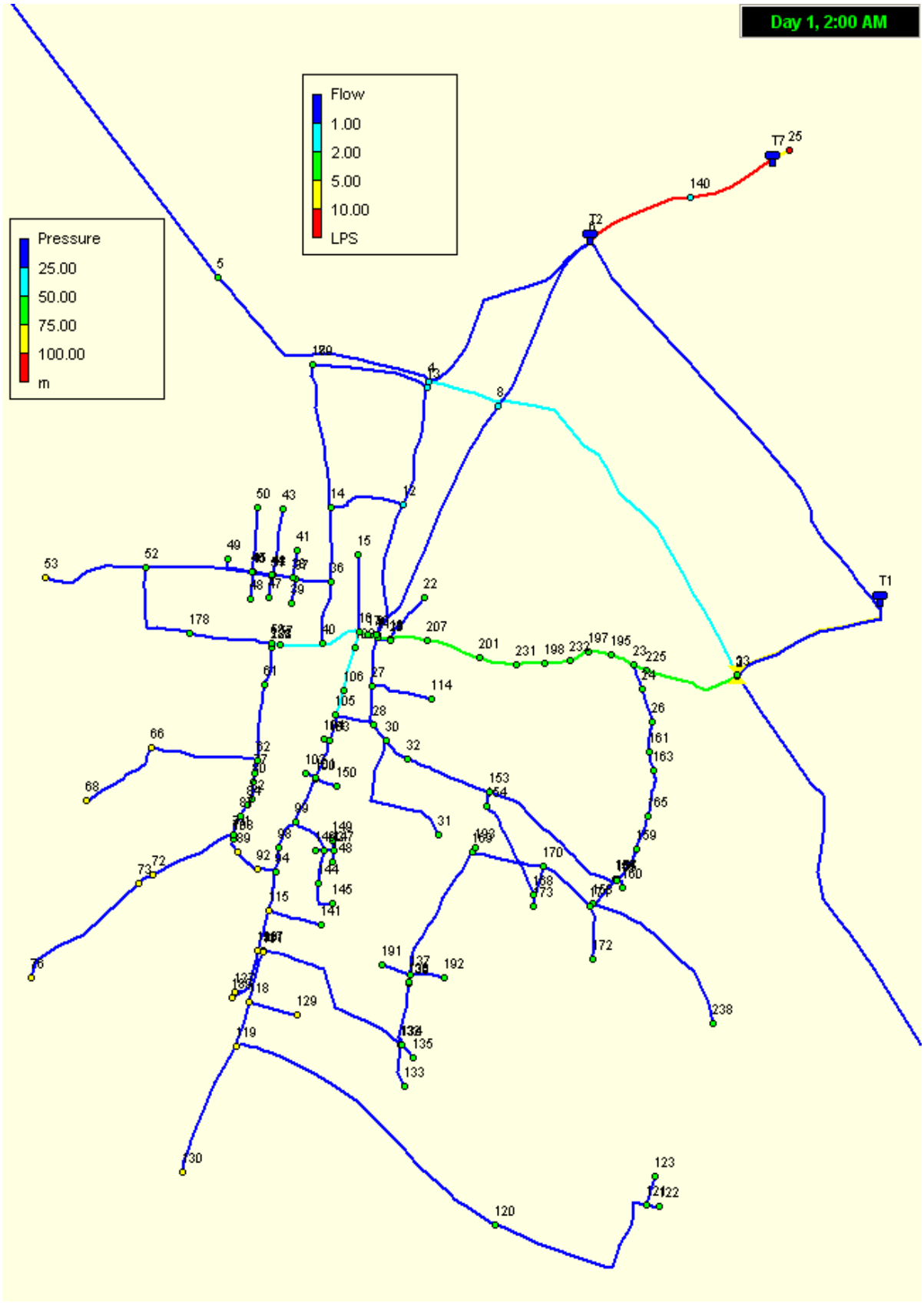
The Chart 3: and water consumption chart shows water balance in the system, which indicates that there is a water surplus in the system at the moments, as well as the occurance of the overflow at the reservoirs



Scheme 3: Error! Reference source not found.



Scheme 4: Error! Reference source not found.



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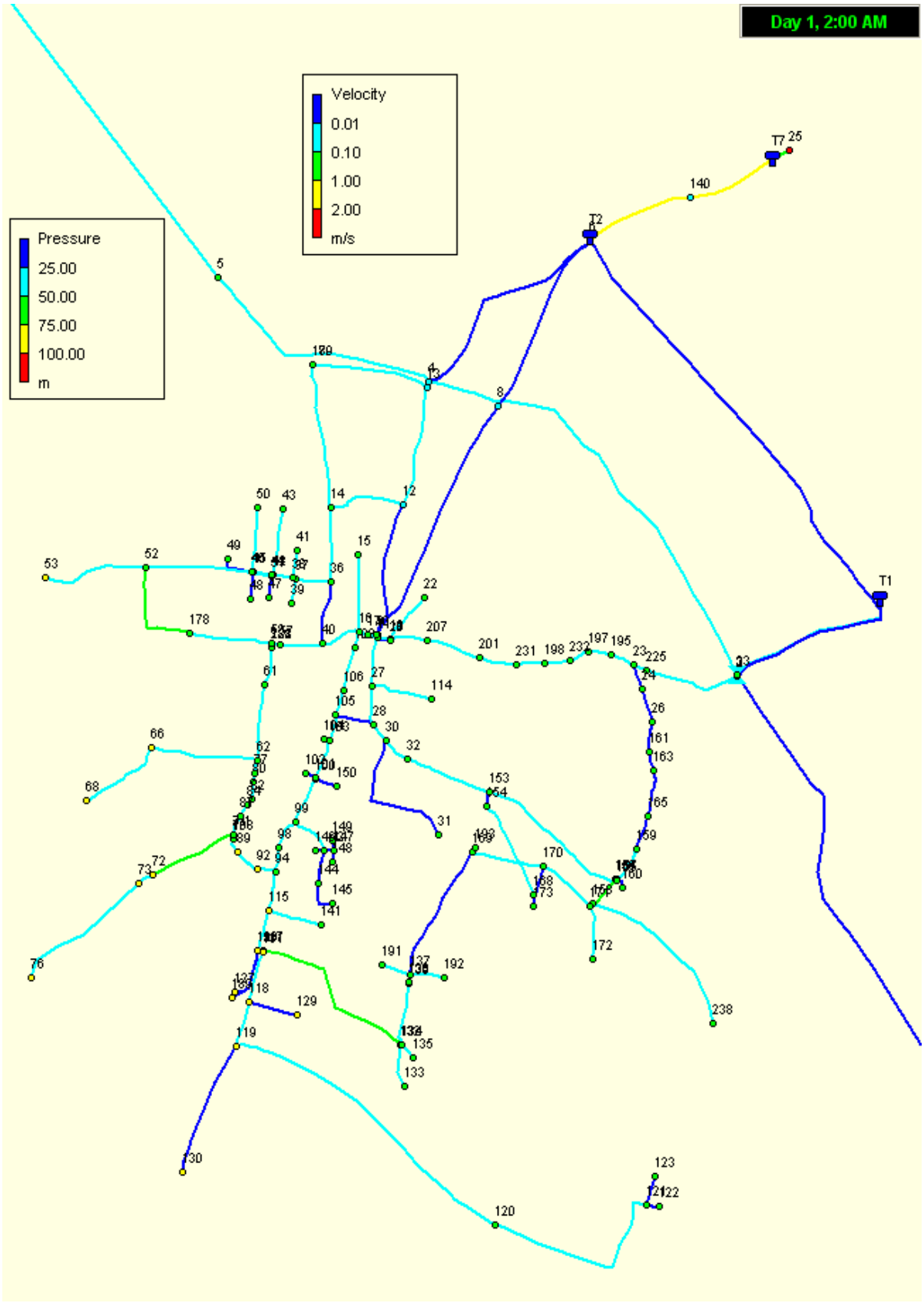
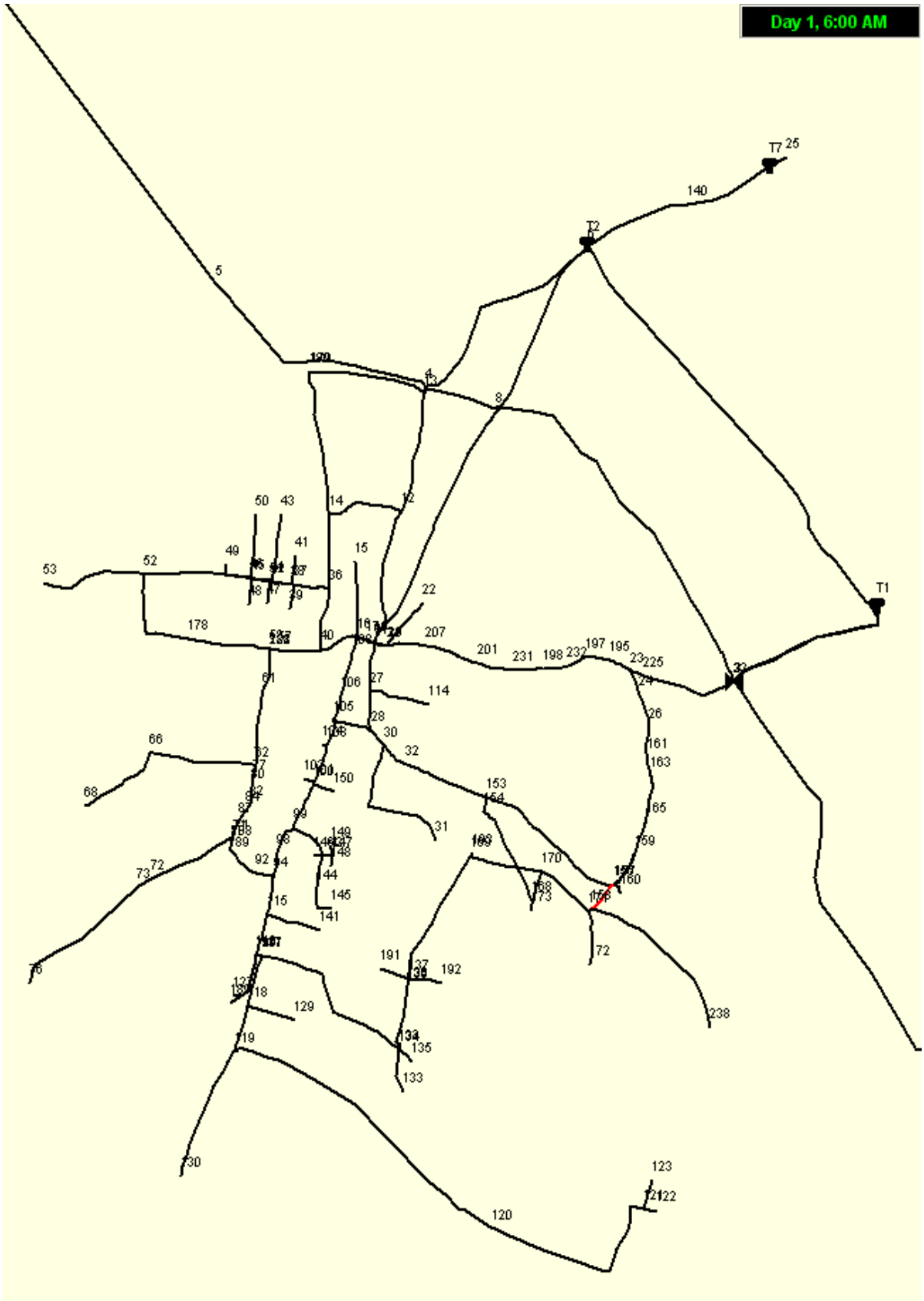
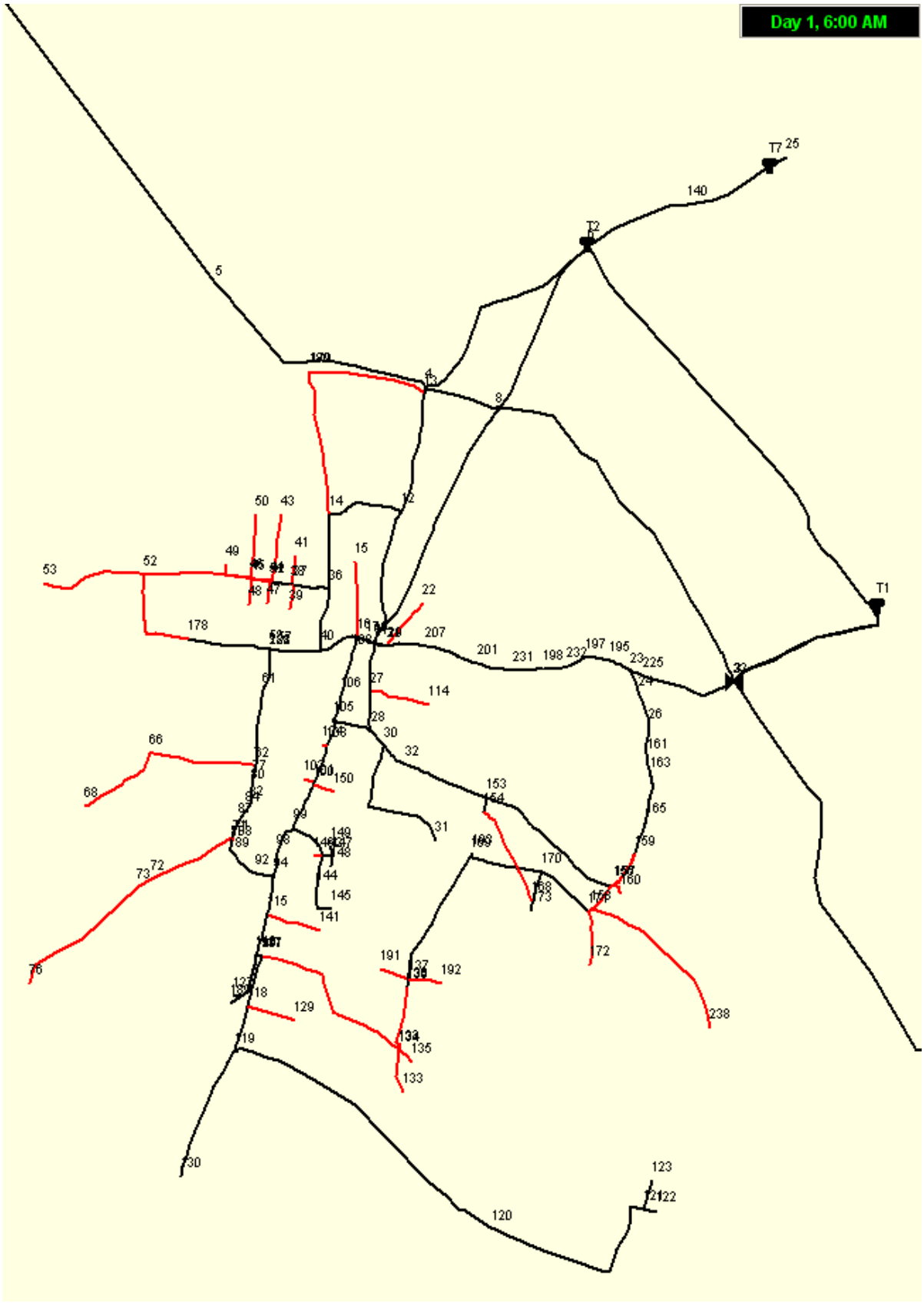


Scheme 6: Error! Reference source not found.

Scheme 7: Error! Reference source not found.



Scheme 8: Error! Reference source not found.



Scheme 9: Error! Reference source not found.

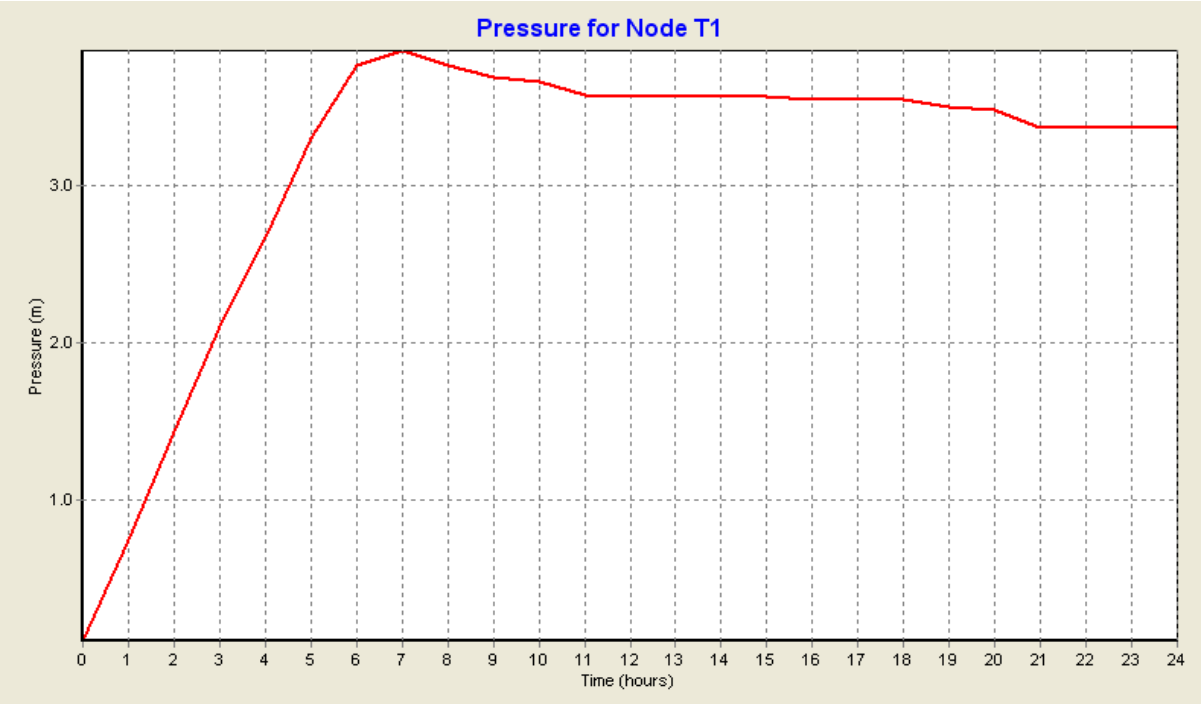


Chart 2: Water level in Bursaći reservoir

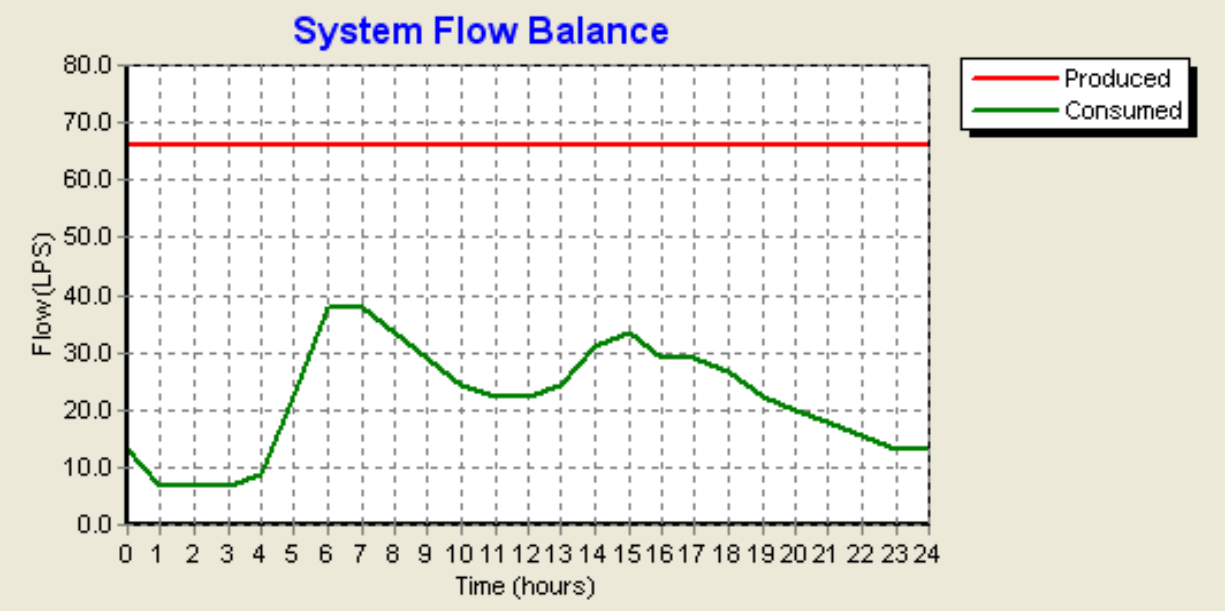
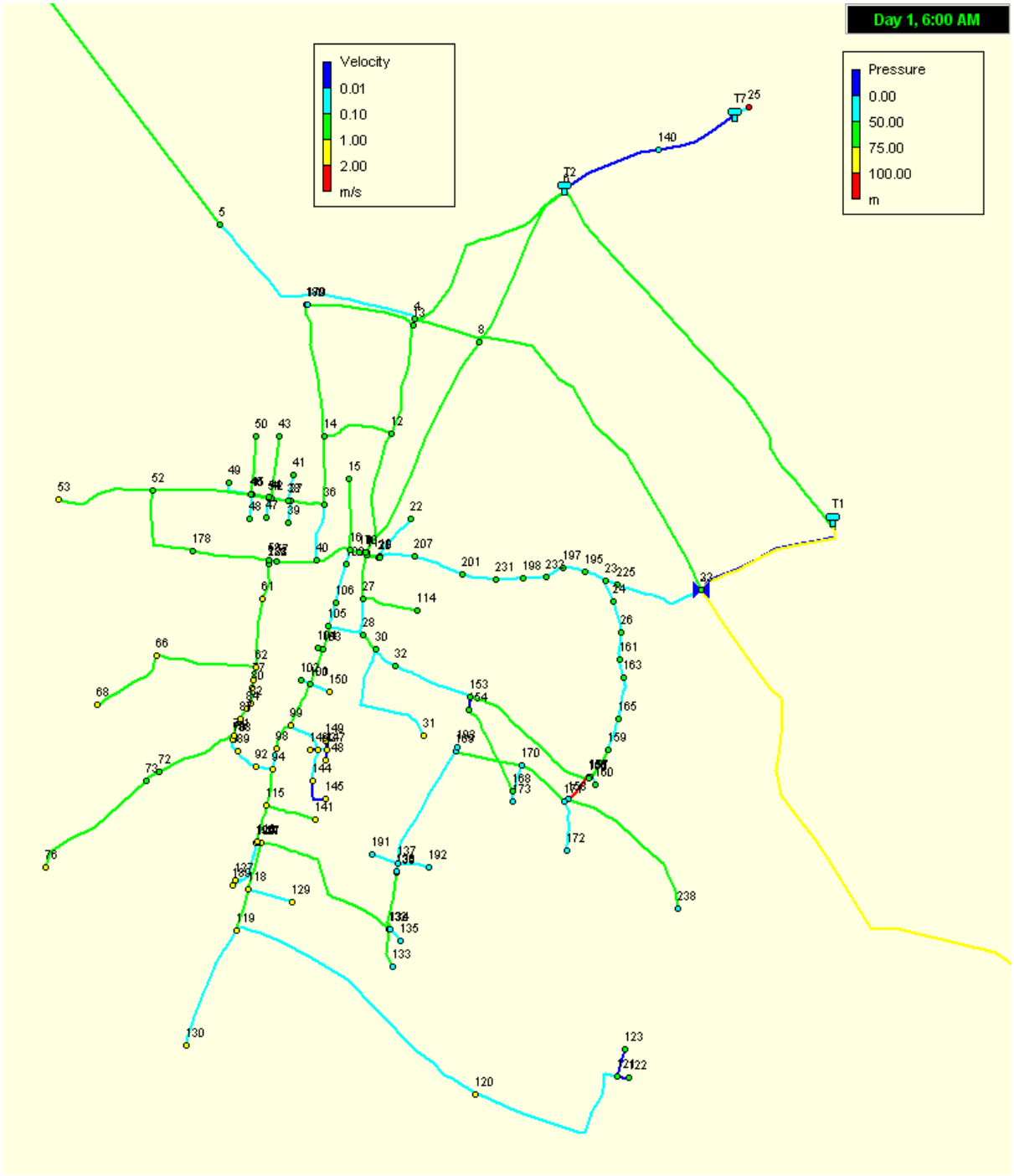


Chart 3: Water production and consumption chart

2.5.5.3 RESULTS OF HYDRAULIC CALCULATIONS – CONDITION IN 2030 WITH Q= 53,85 L/SEC

No significant changes were planned in WSS Bosanski Petrovac concerning the inserting new water quantities, reservoirs construction, etc. The planned changes are related to the distribution network construction mreže, i.e. replacement of the pipelines with th eprofile smaller than Ø 80 mm. We, also, planned to do the water supply system zonning due to the high pressures.

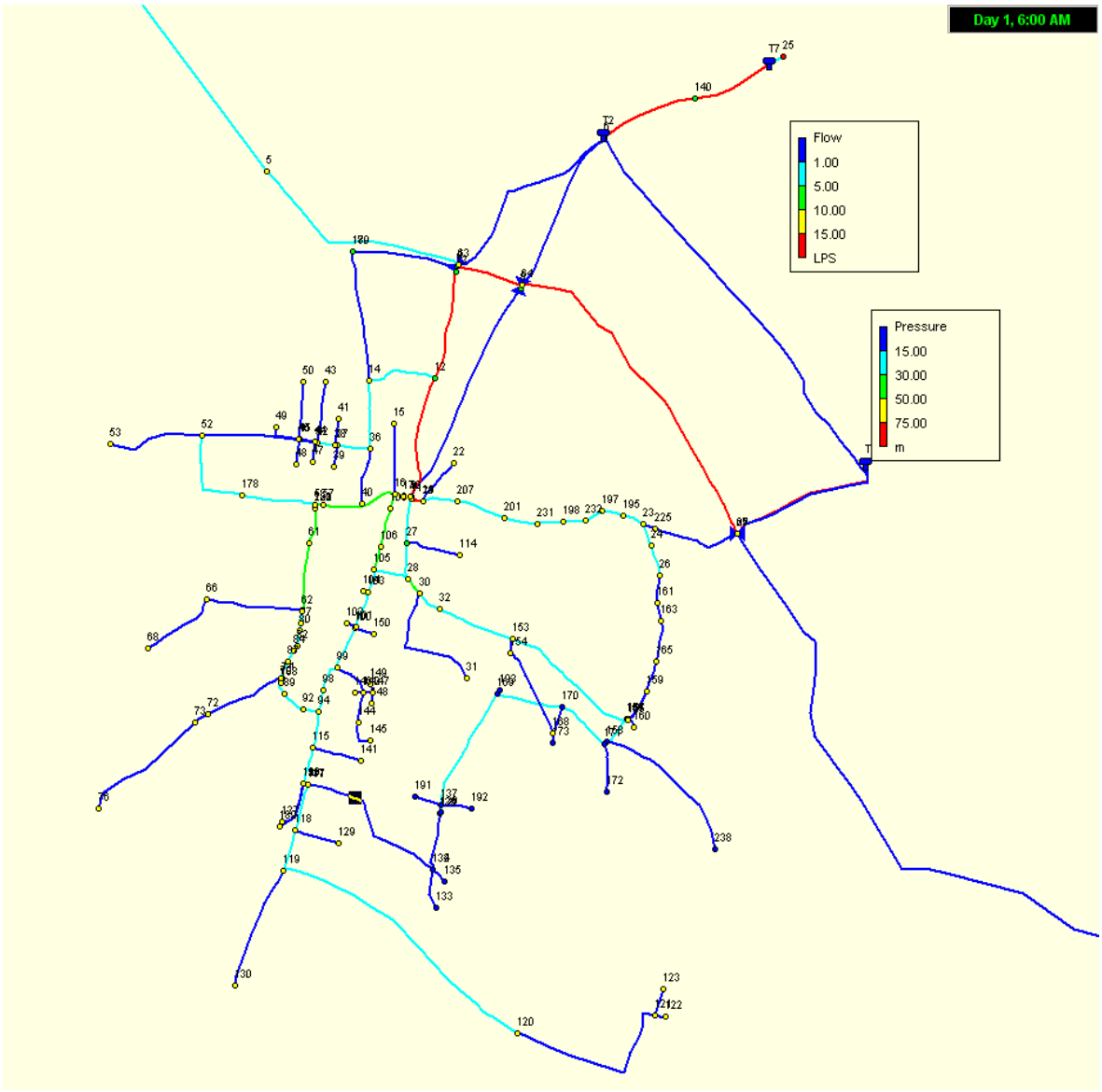
The calculations relate to the future water supply system without the pipeline replacement and zonning, and than the calculations with the pipeline replacement and distribution system zonning.



Scheme 10: Error! Reference source not found.

Scheme 11: Error! Reference source not found.

Scheme 12: Error! Reference source not found.



Scheme 13: Error! Reference source not found.

2.5.6 DISTRIBUTION NETWORK EFFICIENCY

Operation efficiency of one system can be expressed over the proportion. In case of WSS Bosanski Petrovac, the system efficiency proportion can be given.

System efficiency is:

$$\textbf{System efficiency} = 1 - \frac{\text{Water losses}}{\text{Inserted water}} = 1 - \frac{315000}{556603} = \mathbf{0.434}$$

System efficiency is 0.434, which is satisfying coefficient. However, in European Union countries this coefficient is from **0,80** to **0,85**. Nevertheless, comparing to some other watersupply systems in Bosnia and Herzegovina, where this coefficient is lower (around 0.4), this coefficient is a bit above the average.

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 consumers water gauges,
- water invoicing for final users.

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

- visible, i.e. those that can easily be noticed without some complexed researches,
- and invisible, i.e. those for which detection it is necessary to perform different measurements, research analysis, 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-gauges,
- losses due to illegal connections,
- losses in household installations.

2.5.7 NON-REVENUE WATER

The following text presents issues often encountered in the operation of the water supply systems related to non-revenue water amounts, as well as the principles related to the reduction of non-revenue water, with regard to water supply system Bosanski Petrovac. Namely, it has already been noted that water utility with existing water price and non-revenue water amounts 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.

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
- Reservoir leakage
- Other technical losses

II Unmeasured delivered water free of charge:

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

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

- insufficient measurement by water gauges with poorly functioning or not functioning at all
- inaccurate routine water gauge reading
- consumers that cheat by breaking or destroying the water gauges
- illegal unmeasured consumers 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.

Water calculation 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, nor 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 it's 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 ″.

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 Višegrad, 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 Bosanski Petrovac with the development of hydraulic model. In order to prepare a detailed plan for effective reduction of non-revenue water quantity at least these following procedures should 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.

Measuring the water inserted into the network

One of the first tasks is certainly establishing a measurement system. It is necessary to install water gauges at the sources, at the reservoir outlet, as well as at some certain system sections. Larger water gauges should be installed at some certain points in distribution

network, to enable the calculation of NRW in every part that could be considered as a separated whole. It is, also, necessary to install missing water gauges for the final users, or calibrate the existing once.

Ratio calculation

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

Using the calculation ratio from the same process, we can calculate the third ratio which is the **Calculation ratio**, and by further use of payment data it can be developed into the **Payment ratio**.

Speaking about water supply system Bosanski Petrovac, the **Efficiency payment ratio** can be obtained**.** Other ratios cannot be calculated at this point, due to lack of water gauges at the sources and reservoirs. Only by establishing measurements, we will be able to talk about all the necessary ratios.

2.6 WATER SUPPLY SYSTEM CONDITION

Based on the operation analysis of WSS Bosanski Petrovac, the following can be concluded:

- Current amounts of water at the sources are sufficient.
- It is necessary to determine the alternative water sources or the sources which need lower energy amount to send the water to the consuming center, in the aim of avoiding high energy expenses during the use of “Sanica” source.
- Losses in water supply system need to be lowered to the reasonable level (for our current condition 20 – 30 %).
- The water quality is satisfactory, but the adequate chlorination needs to be perfomed at all sources (reservoirs).
- Existing **reservoir space** is enough.
- All transmission pipelines have sufficient capacity. Still, replacement of these pipelines is necessary due to significant losses at Sanica source and unsatisfactory pipe material (AC pipes).
- The distribution network, i.e. the reconstructed part is in good condition and requires only routine maintenance. Non-reconstrukted part of the distribution network needs tobe well maintained, in order to reduce losses.
- According to the measurement data, the system water losses are around 35 % of total production (defects are hard to detect due to the KARST terrain – missing equipment for defects detection);
- It is necessary to carry out measurements at water sources, reservoirs, as well as at the control measuring points and at the end users. In recent years, by installing water gauges for end users, the situation, concerning the amounts of Revenue Water and reducing the amounts of Non-Revenue Water, has significantly improved.
- Commercial losses – relates to unmeasured and NRW in the appartment houses with the lump-sum calculations. Based on the founder decission, determined was 4 m3 per household member. Within mentione, the bigest problem is with population migration and karge number of socially jeopardized inhabitants.
- System maintanace is expensive related to the system size, consumers number and municipality development level;
- High power expenses at PS SANICA, (installed agregates 2 X 719 KW), pre-pumping station and all other equipment necassary for normal system functioning;
- Construction defects and non-functioning distribution network in certain areas (Ploče, Dževar, Bahići, Revenik) not covered by the I reconstruction phase (parts of secondary and distribution network were constructed in 1963-1964), low bandwidth compared to the level of prevalence and number of consumers;

2.7 ANALYSIS AND ESTIMATION OF THE CAPACITY FOR PARTNER MUNICIPALITY BOSANSKI PETROVAC AND UTILITY COMPANY

2.7.1 ANALYSIS AND ESTIMATION OF THE CAPACITY FOR PARTNER MUNICIPALITY BOSANSKI PETROVAC AND UTILITY COMPANY

According to the data obtained from the Federal Institute for Statistics untill 31/12/2009, in Bosanski Petrovac Municipality there is a total of 474 legal subjects: 57 in the agricultural, hunting and forestry branches, 51 in processing industry, 2 in production and supply with the electricity and water, 11 in civil engineering, 152 trading/repairament of the motor vehicles, 57 in catering industry, 13 in transport, storaging and connections branch, 8 in financial branch, 12 in business with immovables, renting and business branches, 19 state management and defence /social security, 11 in education branch, 12 in health and social work branch and 69 in other public, utility social and other private business branches.

According to the data obtained from the Federal Institute for Statistics BiH, the average number of employed persons in 2009 is 1.104 with the average net sallary of 606,07 KM.

The vision of Bosanski Petrovac Municipality development was given through the following development strategies:

2.7.2 DEVELOPMENT STRATEGY OF BOSANSKI PETROVAC MUNICIPALITY 2006 - 2015

The strategy was established in April, 2006 with the vision that: „Bosanski Petrovac Municipality is developped local community oppened for all citizens with natural favourables and ecologically healthy environment “. This strategy is a work result of a Commision for Municipality development planning, OSCE, non-government organizations, local government and other relevant factors.

Strategy defined the following Strategic directions of the municipal development:

1. Agricultural production development

2. Business development

3. Village and mountaineous tourism development

4. Local infrastructure development

5. Efficient local self-government

6. Cultural and sports activities development

7. Position improvement of young people and non-government organizations

8. Social protection and health improvement

Based on the delivered data, the development of the integrated development strategy for Bosanski Petrovac Municipality 2010 – 2020 is in process.

Partnership strategy with Bosanski Petrovac Municipality citizens 2007-2011.

Communication strategy with Bosanski Petrovac Municipality public.

Bosanski Petrovac Municipality budget for the last and this year is shown in the following table:

Table 20: Bosanski Petrovac Municipality budget

DESCRIPTION	BUDGET (KM) FOR 2010	BUDGET (KM) FOR 2011
REVENUE	2.718.180,00	2.890.750,00
EXPENDITURES	2.718.180,00	2.890.750,00

During the last 5 years, the municipality used investments for water supplying of appr.. 200.000,00 KM

Water supply services in Bosanski Petrovac Municipality are under the control of utility company JP "Komunalno" d.d.. The utility company is organized and operates in accordance with the "Law on utility activities" USK SG 11/2005, relevant decisions of Bosanski Petrovac Municipality, utility company statute and other legal acts".

There is a Study on sources protection, but it is only partially applied.

Concerning some other planning documentation JP "Komunalno" regularly prepares annual financial plans and reports. There is no other documentation, especially that one relating to the regular maintanance of water supply systems.

At the moment, the company has 33 employees: 3 with the faculty education, 1 with the highschool education, 26 with the secondary school education and 3 with the primary school education.

2.7.3 UTILITY COMPANY FINANCIAL ESTIMATION

In the past "Komunalno" could cover the basic work expences, but on the account of the water supply and sewerage system. The basic problem was the low water billing, average water billing was around 60%. This problem was caused by high migrations of the local population during the war. The significant number of refugees and displaced persons temporarily residing in Bosanski Petrovac, made this situation much worse.

Bosanski Petrovac Municipality and Utility Company "Komunalno" recognized the financial sustainability as a pre-condition for water supply and utility sector development and begun the activity for business restructure of Public Company "Komunalno".

The action plan for the work of utility company, as well as financial recovery, is based on the three paralel activities:

- Investments for expansion and reconstruction of the water supply system with the aim of increasing the number of users and service quality
- Activities for water supply system improvement include:
    - Finding and fixing the leakage in water supply system
    - Finding the illegal connections
    - Installation of water meters at all water connections
- Increasing the price and billing percent

In 2006 the water supply prices were increased to 1 KM /m^3 and during the period 2006-2010 the billing increased from 60% to 80% of the invoiced water quantity.

Water prices in 2010 in Bosanski Petrovac Municipality are given in the following table.

Table 21: Bosanski Petrovac water price

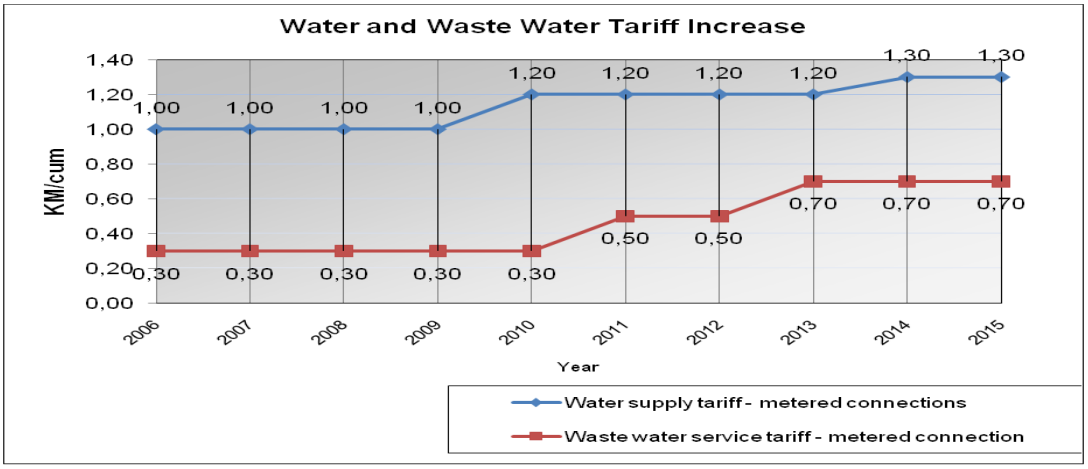
Town	Water price for		
	Population	Public institutions	Industry
	(KM)	(KM)	(KM)
Bosanski Petrovac	1,00	1,25	2,00

According to the Utility Company "Komunalno" data which manages the system, the current delivered water billing for the households is appr. 85 % and for th eindustry appr. 95 %.

Concerning the material sources, the company has old mechanization, as well as other material means, so it is necessary to renew the mentioned .

Bosanski Petrovac Municipality has intension to finance the construction of seweragenetwork, as well as cleaners for 300 ES. For that purpose, the price increasing policy was suggested, as shown at the following figure.

Chart 4: Price increasing plan



2.8 REHABILITATION OF WSS BOSANSKI PTROVAC

2.8.1 NECESSARY MEASURES FOR REHABILITATION AND RECONSTRUCTION

The previous chapter shows the basic problems in the water supply system. As one of the main problem, we have losses in the water supply system. Losses have to be set to some reasonable limit because of the water company operation efficiency, as well as the financial losses that company faces with. The losses reduction in water supply system is the first measure which needs to be implemented in the aim of providing sufficient water in the system.

The basic acticities which need to be impemented in the aim of WSS reconstruction can be batched as follows:

- **Establishment of GIS and development of water supply system Hydraulic model in the aim of improved system control and better water supply system monitoring,**
- **Measurements and defects detections in the system,**
- **Defects removal at the water distribution network,**
- **Replacement of the pipelines sections with the losses and, and those with the constant losses occurances,**
- **Defects removal in houses installations – this has to be performed in coordination with the owners of facilities and housing companies,**
- **Procurement of equipment for defects removal and train th eteam for it's detection, because this has to be continious activity in the future,**
- **Make record of all connections,**
- **Removal of the bottlenecks in the system by constructing the new pipelines, replacement of the pipelines with the profile smaller than 80 mm.**
- **System zoning due to the high pressures in distribution system, by installing the reducer valve at the main distribution pipelines.**
- **Reconstruction of distribution water supply network in the settlement Dževar – Dobro selo, Revenik, Bahići, 29th November Street and settlements Ploče.**
- **Rehabilitation and upgrade of telemetric system,**
- **Replace defective valves on the joints and construct shafts on those joints.**

Necessary measures for water supply system monitoring

To establish the monitoring of water supply system it is necessary to divide the water network into sectors and establish a process of measuring flow, pressure and water quality parameters that are not subject to this project. That means:

- **Constant measurements of the flow and pressures at the source,**
- **Constant measurements of the flow and level of water in reservoirs,**
- **Constant measurements of the flow and pressures at characteristic locations in the network.**

In addition to these measurements, it implies that the system of water meters is correct and that their regular reading and monitoring of consumption trends is performed. Constant monitoring and analysis of the measured values provide the control over the production and

consumption in the system. By monitoring the values of flow and pressure in some branches, especially the values of the flow in the period of minimum night flow it is possible to conclude the emergence of new failures and quickly respond with repairs.

Priorities in solving th eproblems are:

In the first phase it is necessary to do the rehabilitation and reconstruction of the transport and distribution pipelines to reduce losses in the system. Rehabilitation is consisted of following works:

- Establishment of GIS and development of water supply system Hydraulic model,
- Finding and removal the losses which has to be the constant process (the expences of emergency activities are estimated, but this is the proces that needs to be performed constantly, so it is necessary to leave the part of the budget every year for this kind of work),
- Reconstruction of distribution water supply network in the settlement Dževar – Dobro selo,
- Establishment of measurements in the system by installing the flow meters at the system facilities and end users, calibrate the existing flow meters, replace old ones, and install the meters where missing,
- Rehabilitation and upgrade of telemetric system,
- Regulation of pressure in distribution network by installing the pressure regulators
- Replacement of th epipelines due to reduction of losses in the system.

2.8.1.1 DETECTION AND ELIMINATION THE LOSSES IN WATER SUPPLY NETWORK

Detection and elimination of losses in the water supply network is work which must be done consistently and systematically. Through this Master plan it is intended to purchase the equipment to detect malfunctions and training of personnel which will then together with the managers from the water company make short-term plans for monitoring and detecting faults in the transport and distribution network. Bearing in mind that a significant portion of the distribution network has been reconstructed and that it is in good condition, the attention paid to the old pipes that have not been reconstructed in the distribution network and transmission pipelines from the source to reservoir.

Establishing or restoring the measurement at the sources, reservoirs, end users and performing the current measurements on individual networks in equities, shall detect the possible losses in certain sections and then will make the correlator finding the precise location of defects.

The complete detection and rehabilitation work should be under the management of the company that manages the water supply system.

2.8.1.2 RECONSTRUCTION OF WATER SUPPLY NETWORK IN THE SETTLEMENT DŽEVAR – DOBRO SELO

Bosanski Petrovac town water supply network was reconstructed in 1999-2000, so two distribution rings were constructed and points for connections for some certain streets and sttlements not included in the project were planned. One of those settlements – streets is the settlement Dževar- Dobro Selo for which the connection is left at the main pipeline DN 200 with the outlet profile DN 80/100 mm. The existing distribution pipeline of 6/4 col is connected at the same pipeline. The complete settlement with around 800 users is supplied with the pipeline profile of 6/4 col – DN 40 mm. Due to the not planned development and illegal constructions of individual residence facilities, the number of consumers significantly increased. At the main pipeline lenght of 1600 meters, with th eprofile of 6/4 col, over 200

facilities are connected. Bigger part of the assembling works was performed with a lot of improvisations and physical losses. The constructed pipeline with the profile of 6/4 col, with it's permeable profile, does not satisfy the mentioned number of users, not even in the ideal conditions, without any losses.

There are no sludge or air outlets at constructed distribution pipeline, nor the section caps and the caps for some certain sections, so in the case of the slightest defect must water supply system needs to be shut off the for a complete settlement.

At the subjected pipeline, there are no large consumers, such as industry. There are only individual residence facilities with some cattle.

Based on the recorded condition of users and connections number, and considering the base for the 20 years planning period, the calculation for water requirements of the settlement is made, as follows:

Q daily= 960 inhabitant x 190 l/daily = 182.400 l/ daily

Q daily = 182,40 m3 = 2,11 l/sec.

For the planned daily needs of 182,00 m3, i.e. averagelly 2,11 lit/sec. In the maximum secund consumption and during the biggest coefficient, it will not go over 3,5 lit/sec. Based on the estimated water quantity, the main connection pipeline profile was determined for the settlement, considering the hydrant street network, so it's profile is 100 mm, i.e. PE- 100 water supply pipe profile 110 mm for NP- 10 bar. For the secondary pipelines the profiles are 63 and 32 mm, and for the house connections 25 mm, all of them PE- 100 of water supply pipes for NP 10 bar.

The main connection is set to the prepared connectionat the pipeline distribution ring DN 200 mm. GGG-pipeline. It was planned to put three air outlets and two sludge outlets at the main pipeline, as well as eight underground hydrants against the fire of a profile DN 50 mm.

It is necessary to prepare the main project for water supply network reconstruction for this settlement.

2.8.1.3 RECONSTRUCTION OF WATER SUPPLY NETWORK IN THE STREET "14 SEPTEMBAR" AND THE SETTLEMENT PLOČE

During the reconstruction of the town water supply network in 1999 and 2000 the street „14.Septembra" and the settlement Ploča were not reconstructed, as it was planned in the II phase. Based on the measurements and visual check at the existing network, the significant losses were determined. Existing profiles of the main pipelines are inappropriate for population needs, and there is lack of water very often in th emoments of maximum consumption. This occures very often, and the most in the sttlement part Ploča, with the small profiles and a lot leakages. Several defects of that kind are discovered annualy and removed, but while eliminating the defects that often, the asphalt surfaces are damaged, which can be noticed at the traffic roads.

The main pipeline inception profile (the junction towards the basin) is DN 80 mm, made of the cast iron material with the lead seals, while the secondary pipelines are made of the same material wtih the exception in some cases when the pipelines are made of the lead pipes. Big number of users is using this supply pipeline, while the biggest consumer is settlement Novo Naselje, which is directly connected to this pipeline. Complete subjected settlement and the street does not have hydrant network (protection against fire), nor the posibility of sectioned shutting the certain sections.

According to the planned technical solution, the new connection would be connected to the main pipeline DN 300 mm with the section cap and flow meter. The pipeline would be made of PE- water supply pipes of a good quality with the profile of 160 mm (main pipeline), with the secondary pipelines profile 110 and 63 mm and the house connections of the same material type with the profile of 25 mm. The main section caps wold be set for the street near the PTT office, Novo Naselje, Jaramaze and sections in the settlement Ploča. At the main pipeline plan is to install the underground hydrants DN 80 mm at the legally determined distance. Supply profiles of a good quality would make posible the undisturbed supplying of all users, as well as the necessary function of protection against fire. The lenght of the main pipeline is app. 850 meters with the secondary pipelines app.1150 meters long and house connections app. 1050 meters long.

2.8.1.4 RECONSTRUCTION OF WATER SUPPLY NETWORK BIŠĆANI - BOSNAPLAST

According to the planned technical solution, the new connection would be connected to the main pipeline DN 200 mm with the section cap. The pipeline would be made of PE- water supply pipes of a good quality with the profile of 160 mm (main pipeline) and the house connections of the same material type with the profile of 25 mm. The main section caps and underground hydrants would be set at the main pipeline DN 80 mm at the legally determined distance. Supply profiles of a good quality would make posible the undisturbed supplying of all users, as well as the necessary function of protection against fire. The lenght of the main pipeline is app600 meters and house connections app. 400 meters.

2.8.1.5 RECONSTRUCTION OF WATER SUPPLY NETWORK BIŠĆANI - BOSNAPLAST

Water supply network for the settlement Revenik is connected to Bosanski Petrovac town water supply system in front of the Musk in the settlement Bišćani – srednji. During the reconstruction of Bosanski Petrovac town water supply network, existing connection, DN 40 mm, it was connected to the existing newly constructed pipeline DN 200 mm of ductile pipes, by the system DN 200 mm /DN 40 mm.

In the period 2002 – 2003 humanitarian organisation " IOCC " Banja Luka replaced the pipeline part made of zinc pipes at the joint from Medeno Polje to the joints for secondary pipelines, (Tubići, Krajinovići, Šepe). The part ov th ejoints and house connections was rehabilitated. The mentioned pipeline supplies around 350 users, gas station "ENERGOPETROL" and several small craft shops. The quality and permeability of th epipeline do not satisfy users needs, neither the posibilities of the users increase. Also, the existing pipelines profiles hinder the development of economic activities, agriculture and livestock for which all conditions at the subject area exist.

Based on the recorded condition of users and connections number, and considering the base for the 20 years planning period, the calculation for water requirements of the settlement is made, as follows:

Q daily = 420 inhabitants X 190 l/ daily = 79.800 l/ daily

Q daily = 79,8 m3 = 0,92 l/sec.

The planned daily needs of 80,0 m3, i.e. average of 0,92 l/sec during the maximum secund consumption will not exceed 2,0 l/sec. Replaced network part is in a good condition, so it does not need to be replaced. The basic problem at the part of the pipeline from the connection point to the main road M-5, i.e. joint for the gas station and side houses, as well as the secondary pipeline for the settlement ŠEPE-KRAJINOVIĆI, whish is very long, but of a small profile – DN 25 mm.

According to the planned technical solution, it is necessary to replace the main pipeline and the main connection at the section from the Musk Srednji Bišćani to the main road for the settlement ŠEPE_KRAJINOVIĆI with appropriate profiles. The old connections and secondary pipelines should be connected to the new pipeline, and replace th ereinforcements and fittings, and construct the shafts. It is, also, necessary to install the sludge and air outlets.

2.8.2 NECESSARY MEASURES FOR REHABILITATION AND RECONSTRUCTION OF THE LOCAL WATER SUPPLY SYSTEMS IN MUNICIPALITY AREA

Smaller settlements, which are supplied from local sources will also remain in these sources during some period with the possible inclusion of new sources and rehabilitation of existing facilities in the system and expansion of those facilities that do not meet capacity. A particular problem is the lack of existing sources yield. One of the basic parameters with which we do the calculations regarding water supply systems, is certainly the source yield.

If rehabilitation and reconstruction is conducted, the water company ViK Bosanski Petrovac can take the system under the control. Within the rehabilitation measures for the local water supply system, the following needs to be done:

- Rehabilitatation of existing captures,
- Investigation of the sources yield by monitoring it in the future several years,
- Rehabilitation of the protection fence around the source,
- Rehabilitation of the existing reservoirs,
- Record the existing pipelines in the system and eliminate all of the defects at the pipelines,
- Installation of the water meters at the sources and reservoirs,
- Installation of the water meters at the users.

2.9 DEVELOPMENT OF WSS BOSANSKI PTROVAC

2.9.1 BASES FOR THE CALCULATION

The item **Error! Reference source not found.** ***Water quanitites balance*****Error! Reference urce not found.**, shows estimation of development and required water quantities. The end of the planning period is 2030. Based on these calculations, water quantity at the sources is sufficient for the end of the planning period.

While calculation, we took the population growth of 1.00 % and the data about existing population number are obtained from the water company and were made based on estimations.

Specific population consumption is 120 l/capita/day and untill the end of the planning period 2030 this consumption is increased to 190 l/ capita/day.

Estimation of industry consumption is 25-30 % of population consumption.

Daily nonlinearity coefficient is 1,50 for population and industry.

Losses are decreased from existing 30-35 % to 20 % at the end of the planning period. The biggest improvement in losses reduction needs to be done in the first few years and later the process will be lot slower, what is understandable, because after the reduction of certain process of losses, it will be much harder finding them, and with the losses reduction the pressures in the system increase, which leads to the new losses. The process of detection and elimination of losses is a constant process.

Water supply system development relates to the including the new water quantities gravitationally from the source „Skakavac“ into the existing system, what would reduce the time of water pumping from the source „Sanica“

The other development direction relates to distribution networks development towards the smaller settlements in municipality area.

2.9.2 USING THE SOURCE “SKAKAVAC”

Water supply system development relates to the including the new water quantities gravitationally from the source „Skakavac“ into the existing system, what would reduce the time of water pumping from the source „Sanica“

The other development direction relates to distribution networks development towards the smaller settlements in municipality area.

2.9.2.1 BASES FOR THE CALCULATION

The item **Error! Reference source not found.** ***The balance of water quantities and water equirements in tthe area of municipalities and water supply system***, shows estimation of development and required water quantities. The end of the planning period is 2030. Based on these calculations, water quantity at the sources is sufficient, but the problem is huge expences of the electrical energy during the water pumping from the source „Sanica“. This is the reason for finding more cost effective way for providing the additional water quantities, which can be gravitationally included into the system.

While calculation, we took the population growth of 1.00 % and the data about existing population number are obtained from the water company and were made based on estimations.

Specific population consumption is 120-140 l/capita/day and untill the end of the planning period 2030 this consumption is increased to 200 l/ capita/day.

Estimation of industry consumption is 25-30 % of population consumption.

Daily nonlinearity coefficient is 1,50 for population and industry.

Losses are decreased from existing 30 % to 20 % at the end of the planning period.

2.9.2.2 THE SOURCE

For the planning period 2030, the required **maximum daily water quantities are Q=49,05l/s.** If we consider the minimum yield of the source „Smoljana", it doesn't satisfy the needs, so that is the reason for „Sanica" system construction which can provide enough drinking water quantity. The source „Sanica is annualy used around 45 days in the period of droughts. To reduce the necessity of „Sanica" source operation and reduce the electricity expences, we can include the source „Skakavac" into the system, and gravitationally insert water into the existing water supply system.

For the needs of Preliminary design preparation „Water usage of Bosansko Petrovačke plateu" we did the monitoring of the source „Skakavac" (940 MSL) and determined the following flows:

Q_{min}=4,0 l/sec

Q_{mean}=100,0 l/sec

Q_{max}=6,5 m^3/sec

This indicates the significant fluctuations, i.e. high coefficient of outflow at this terrain.

Minimum water quantity which can be captured is low, but it still represents the important water quantity, considering the need for water supply system development towards the settlements Medeno polje, Bjelaj, Vrtoče, etc.

During the minimum source yield, the water that can be provided is app. 350 m3 daily, what is enough for around 1400 inhabitants, i.e. app. 400 households.

By capturing this source during the minimum sources yields, the usage of „Sanica" source would be reduced for app. 1,5 hrs daily, i.e. saving of around 1000 kw electrical energy daily.

Based on the current data, the water quality at this source is mostly satisfying, except of the appereance of short term turbidity during precipitations.

It is, also, necessary to begin with monitoring this source, in a quality and quantity sense, to collect more data before the final decission about connecting this source with the system.

2.9.2.3 RESERVOIRS

The item **Error! Reference source not found. Error! Reference source not found.** shows gnificant surplus of reservoir space in the system at the moment, as well as at the end of the planning period 2030.

In case of including the „Skakavac" source into the system, it would be necessary to construct one more reservoir to take water from this source during the minimum consumption period (night hours).

The volume of this reservoir is app. 50 % of minimum daily source's yield, i.e. V= 200,00 m3. New reservoir would be constructed just before the settlement Suvaja at the elevation of app. 720 MSL, and the exact elevation of this reservoir would be additionally determined by main project development.

2.9.2.4 PIPELINES AND THE PRESSURE RELEASE CHAMBERS

From the capture facility „Skakavac" to the reservoir „Suvaja" it is necessary to construct the transport pipeline DN 110 mm of the total lenght L= 8000 m. Considering the fact that the source is located at the elevation 940 MSL and that the reservoir is at the elevation 720 MSL,

it is necessary to construct 2-3 pressure release chambers, as well, so the pipeline can be protected against the high pressures.

From reservoir „Skakavac" to the existing pipeline DN 110 mm towards the settlement ***Medeno polje*** it is necessary to construct the distribution pipeline DN 110 mm lenght L=400 m.

2.9.3 DISTRIBUTION NETWORK DEVELOPMENT

2.9.3.1 BUSINESS ZONE „GORIČANI"

According to the planning documentation, it is planned to construct the business zone at „Gorinčani „ location. Municipality allready started with the number of activities, and one of them is the project documentation at the level of the main project, for providing the water for this zone.

Based on the project, the pipeline will be connected to the existing shaft near the business facility "HRM", and the pipeline allignment will go out of the protected main road traffic belt.

The average pressure in the connection shaft is app. 4,5-5,0 bar. Water quantity which needs to be transported to the business zone is max. 7,0 l/s.

Gravitation pipeline „Gorinčani" is designed to transport the water from connection shaft (node 0005) to the business zone at Gorinčani location (node 0119).

The total allignment lenght is L=2.341,72 m.

From the connection shaft, the allignment goes over the connection road for business facility "HRM" and goes over the part of a meadow, following the main road direction (out of a road protection belt), all the way to th enode SC75 where the shaft construction is planned, due to storring the fittings and reinforcements for the connections towards the future users.

From the node SC58, the allignment is getting far away from the main road, due to constructed and it goes along the abondoned macadam road all the way to the node SC79, and then to the node SC86. From this road, the allignment cuts the asphatlt road for Drinić and follows the main road direction untill the point of the planned concrete shaft construction.

Alignment of pipelines is adapted to the terrain with the corrections due to local terrain and longitudinal fractures. Considering the fact that the route is planned over the meadow, and because of the extreme terrain (full of local low elevations, valleys, etc.) on the route, it was impossible to avoid all negative slopes, which conditioned the construction of a number of sludge and air outlets.

Due to the terrain configuration, four air outlets and three sludg outlets are designed, and put into the concrete shafts.

Based on the project, the construction of pipelines is planned with PEHD pipes DN 125 mm

Necessary pipe diameter is obtained by hydraulic calculation, licenced program «HYDRA» developped by the software company Studio-Ars from Rijeka.

The quantity of water transported through the pipeline is obtained by hydraulic calculation and it is 7,0l/s. Based on hydraulic calculatiob, the water velocity in the pipeline is 0,6-0,7 m/s.

2.9.3.2 WATER SUPPLY SYSTEM OF THE SETTLEMENTS SELIŠTE,TARBUČKI DO AND ZAPOLJAK (LC KRNJEUŠA)

By developping the project documentation, the Municipality took over the activities regarding the water supply issue of LC Krnjeuša parts, i.e. the settlements Selišta,Tarbučki Do and Zapoljak (all in LC Krnjeuša) because other inhabitants of LC Krnjeuša have drinking water.

The total number of users in this settlement is around 200 inhabitants, i.e. around 40 households of agricultural character.

Posible water supply sources are “Šljivinovac“in Mrakića Dolini and “Salati“ which used to be the water supply source technological water for the factory nearby.

All of the three mentioned settlements are located at the left side of the road Vrtoče-Krnjeuša and they spread high into the Grmeča mountain.

Households in the settlement Selište are pretty widespread and located between isohipsis 570-630 MSL, while the households in the settlement Tarbučki Do is located between the elevations 590-730 MSL, and in Zapoljak between 660 and 770 MSL.

The source “Šljivinovac“elevation 620 MSL is located 4-5 m under the surrounding terrain surface and it can be reached vertically through the natural hole. At that depth, there is a water accumulation level. During the rain period, the accumulation level rises and the source freely flows out from the mentioned hole.

At the source “Salati“,558 MSL, which is located under the settlement Salati, the pumping station is constructed, so the water is pumped into the reservoir through the pressure pipeline, above the former factory. Water from the reservoir was used for the factory, for technological work process (not as drinking water).

Since we’re talking about the new water supply system, two posible supply sources, and two reservoirs locations, we are recommanding the solutions depending on the mentioned sources, which oone of them is of a better quality, i.e.which option is more cost effective (reservoir Brda or Vranovača).

A-source“Šljivinovac“

In case that we choose this source for drinking water supply of the mentioned settlements, as well as the location, the system would operate in the following way:

Option I

At the source, there would be pumping station constructed (620 MSL) with the pump which would pump the water to the new reservoir “Vranovača“(V=50 m3). Pump would have to raise the water untill th elevation 785 MSL (Hgeod=165 m) through the pressure pipeline app. 3.882 m long.

From the new reservoir “Vranovača“ water would be gravitationally distributed to the users over the surge tanks to the settlements Selišta, Tarbučki Do and Zapoljak and it would be app.7.337 m.

Option II

At the source, there would be pumping station constructed (620 MSL) with the pump which would pump the water to the new reservoir “Brda“(V=50 m3). Pump would have to raise the water untill th elevation 795 MSL (Hgeod=175 m) through the pressure pipeline app.977 m long.

From the new reservoir “Brda“ the water would be distributed by gravitational pipeline app. 4.008 m long to the node 1 and then to the surge tanks 1 and 3 (lenghts 770 and 560 m). From the mentioned chambers, the water would be gravitationally distributed over the allignments from the Option I to the users (app.6.737 m).

B-source “Salati“

If this source is of better yield and quality than the previous one, it would be similar, i.e.:

From the newly constructed pumping station, the water would be pumped into the new reservoir “Vranovača“ which would supply the users of the mentioned settlements, but the lenght of the pressure pipeline in this case would be app. 2.243 m, and the pump would have to operate at the altitude difference of 227 m.

2.10 PRICED BILL OF QUANTITY FOR REHABILITATION OF WSS BOSANSKI PETROVAC

2.10.1 LOSSES REHABILITATION AND DOCUMENTATION DEVELOPMENT

No.	Description	Price (KM)
1	Development of GIS	150.000,00
2	Development of water supply system hydraulic model	80.000,00
3	Distribution network zoning	100.000,00
4	Sources protection Study	40.000,00
5	Procurement of equipment and water supply system monitoring	80.000,00
6	Project documentation development at the level of the main projects	70.000,00
7	Investigation of the network and rehabilitation of the defects in the first 10 years	200.000,00
8	Investigation of the network and rehabilitation of the defects in the period 2021 - 2035	300.000,00
Total:		**1.020.000,00**

2.10.2 REHABILITATION OF FACILITIES IN THE SYSTEM

2.10.2.1 REHABILITATION OF THE CAPTURE FACILITIES, RESERVOIRS AND PUMPING STATIONS

Rehabilitation of the source "Smoljana"

No.	Description	Price (KM)
1	Terrain rehabilitation around the sources	2000,00
2	Replacemnt of hydro-mechanical equipment	2000,00
3	Rehabilitation of fence around the facility	1000,00
	Total:	**5000,00**

Rehabilitation of the source "Novakovići"

No.	Description	Price (KM)
1	Construction works for reservoir rehabilitation	1000,00
2	Replacement of hydro-mechanical equipment	2000,00
3	Procurement and installation of the chlorine equipment	6000,00
4	Rehabilitation of fence around the facility	500,00
	Total:	**9500,00**

Rehabilitation of the source "Bursaći"

No.	Description	Price (KM)
1	Construction works for reservoir rehabilitation	2000,00
2	Replacement of hydro-mechanical equipment	3000,00
3	Procurement and installation of the chlorine equipment	6000,00
4	Rehabilitation of fence around the facility	1000,00
	Total:	**12000,00**

Pumping station "Sanica"

No.	Description	Price (KM)
1	General maintenance of the pump and engine	100000,00
2	Rehabilitation of hydro-mechanical equipment	5000,00
3	Rehabilitation of the constructed facility at "Sanica" pumping station which relates to the roof construction maintenance, façade maintenance, joinery works maintenance, painting, fence maintenance, etc.	15000,00
	Total:	**120000,00**

Recapitulation		
1	Rehabilitation of the source "Smoljana"	5000,00
2	Rehabilitation of the reservoir "Novakovići"	9500,00
3	Rehabilitation of the reservoir "Bursaći"	12000,00
4	Pumping station "Sanica"	120000,00
	TOTAL:	**146500,00**

2.10.2.2 REHABILITATION OF MEASURING-REGULATION EQUIPMENT

Rehabilitation of telemetric measuring and regulation equipment

No.	Description	Price (KM)
1	Reconstruction of " TELEMETRIC SYSTEM FOR MONITORING AND MANAGEMENT " of water supply system with repairs and replacement of defective elements, and transferring to GSM communication system with the dispatch center and increasing th eposibilities for connection all parameters and facilities. (P.S. Sanica, PK Mijačica, reservoir Bursaći, reservoir Novakovići). Revenue value based on the data obtained from equipment delivery staff "ENA " Ltd. Karlovac	20000,00
2	Procurement and installation of electro-magnetic flow meter in reservoir "Bursaći"	11000,00
3	Procurement and installation of electro-magnetic flow meter in PS "Sanica"	12000,00
4	Procurement and installation of sector flow meters at the main distribution pipelines. It is necessary to install 6 water meters with diameter 150 and 200 mm. Procurement and installation of 5 pressure regulation valves with diameter 150, 200 and 300 mm. At the points of installation of water meters and pressure regulators it is necessary to construct the shafts with appropriate dimensions, as well as to install necessary hydro-mechanical equipment (valves, MDK, etc.)	140000,00
5	Procurement and installation of water meters at end users in the apartment buildings. It is necessary to install 55 water meters of which 15 need to have diameter from 50 to 100 mm and around 40 with diameters from 50 to 25 mm.	30000,00
	Total:	**213000,00**

2.10.2.3 RECONSTRUCTION OF DISTRIBUTION NETWORK

Replacement of distribution pipelines

No.	Description	Price (KM)
1	Pipeline in the settlement Dževar - Dobro selo. New pipeline would be made of PE pipe, type 100, internal diameter DN 110 mm app. 1300 m long, DN 63 mm app. 1100 m long and house connections with the pipeline DN 32, 25 and 20 mm app. 1000 m long. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	150000,00
2	Pipelines in the street "14. Septembar" and settlement Ploče. New pipeline would be made of PE pipe, type 100, internal diameter DN 160 mm app. 850 m long, DN 110 and 63 mm app. 1150 m long and house connections with the pipeline with smaller diameter app. 1100 m long. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	220000,00
3	Pipeline Bišćani - Bosnaplast. New pipeline would be made of PE pipe, type 100, internal diameter DN 160 mm app 600 m long, and house connections with the pipeline with smaller diameter app. 400 m. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	130000,00
4	Pipeline in the settlement Revenik and side settlements. New pipeline would be made of PE pipe, type 100, internal diameter DN 110 mm app 90 and 63 app. 2500 long and house connections with the pipeline with smaller diameter app. 200 m long. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	100000,00
	Total:	**600000,00**

Replacement of distribution pipelines with diameter smaller than 80 mm					
Section	**Pipeline diameter (mm)**	**Pipeline length (m)**	**New pipeline diameter (mm)**	**Unit price (KM/m)**	**Total price (KM)**
Pipe P168	25	348	80 - 100	65,88	22.897,19
Pipe P122	25	2	80 - 100	65,88	138,26
Pipe P237	25	526	80 - 100	65,88	34.621,78
Pipe P125	25	50	80 - 100	65,88	3.283,27
Pipe P124	25	2	80 - 100	65,88	157,73
Pipe P132	25	163	80 - 100	65,88	10.756,36
Pipe P62	25	255	80 - 100	65,88	16.813,96
Pipe P128	32	0	80 - 100	65,88	32,26
Pipe P123	32	129	80 - 100	65,88	8.473,88
Pipe P127	32	22	80 - 100	65,88	1.457,85
Pipe P177	32	1	80 - 100	65,88	97,87
Pipe P129	32	3	80 - 100	65,88	202,66
Pipe P179	32	89	80 - 100	65,88	5.833,30

Pipe P126	32	192	80 - 100	65,88	12.656,40
Pipe P176	32	14	80 - 100	65,88	927,69
Pipe P39	32	84	80 - 100	65,88	5.515,37
Pipe P37	32	70	80 - 100	65,88	4.604,93
Pipe P180	32	98	80 - 100	65,88	6.477,62
Pipe P145	38	100	80 - 100	65,88	6.586,48
Pipe P147	38	34	80 - 100	65,88	2.207,74
Pipe P144	38	4	80 - 100	65,88	264,96
Pipe P239	38	111	80 - 100	65,88	7.305,17
Pipe P50	38	313	80 - 100	65,88	20.628,21
Pipe P60	38	316	80 - 100	65,88	20.840,61
Pipe P64	38	269	80 - 100	65,88	17.696,22
Pipe P159	38	157	80 - 100	65,88	10.358,11
Pipe P106	38	178	80 - 100	65,88	11.732,57
Pipe P146	38	107	80 - 100	65,88	7.033,48
Pipe P49	38	371	80 - 100	65,88	24.424,22
Pipe P-3	38	2	80 - 100	65,88	121,76
Pipe P19	40	164	80 - 100	65,88	10.781,92
Pipe P13	40	224	80 - 100	65,88	14.737,22
Pipe P68	40	431	80 - 100	65,88	28.383,41
Pipe P65	40	49	80 - 100	65,88	3.218,05
Pipe P169	40	423	80 - 100	65,88	27.860,12
Pipe P140	40	65	80 - 100	65,88	4.283,66
Pipe P48	40	187	80 - 100	65,88	12.319,16
Pipe P41	40	196	80 - 100	65,88	12.895,42
Pipe P46	40	78	80 - 100	65,88	5.153,23
Pipe P45	40	65	80 - 100	65,88	4.302,85
Pipe P47	50	102	80 - 100	65,88	6.703,42
Pipe P206	50	870	80 - 100	65,88	57.315,93
Pipe P93	50	30	80 - 100	65,88	1.973,79
Pipe P95	50	15	80 - 100	65,88	984,28
Pipe P136	50	25	80 - 100	65,88	1.679,73
Pipe P166	50	300	80 - 100	65,88	19.752,73
Pipe P156	50	297	80 - 100	65,88	19.542,31
Pipe P120	50	144	80 - 100	65,88	9.494,16
Pipe P231	50	12	80 - 100	65,88	815,37
Pipe P43	50	52	80 - 100	65,88	3.402,80
Pipe P44	50	5	80 - 100	65,88	362,15
Pipe P232	50	521	80 - 100	65,88	34.339,36
Pipe P204	60	1.136	80 - 100	65,88	74.812,01
Pipe P200	60	649	80 - 100	65,88	42.730,89
Pipe P202	60	1.583	80 - 100	65,88	104.319,66
Pipe P198	60	808	80 - 100	65,88	53.253,64
Pipe 7	63	1.394	80 - 100	65,88	91.836,72

Pipe 9	63	2.224	80 - 100	65,88	146.517,12
Pipe 11	63	2.468	80 - 100	65,88	162.591,84
Pipe 12	63	1.571	80 - 100	65,88	103.497,48
Total:		**20.097,27**		**Total:**	**1.324.008,37**

2.10.2.4 RECAPITULATION OF REHABILITATION THE WSS BOSANSKI PETROVAC

No.	Description of activities	Price (KM)
1	Sources protection, GIS, hydraulic model, defects elimination, monitoring over the system and procurement of equipment for defects elimination and development of project documentation	1.020.000,00
2	Recapitulation of sources and PS rehabilitation	146.500,00
3	Rehabilitation of telemetric measuring and regulation equipment	213.000,00
4	Replacement of distribution pipelines	600.000,00
5	Replacement of the pipelines with diameter smaller than 80 mm	1.324.008,37
	In total:	**3.303.508,37**

2.11 BILL OF QUANTITIES FOR REHABILITATION OF LOCAL WSS

2.11.1 WSS OF LC VRTOČE

Rehabilitation of WSS Vrtoče

No.	Description of activities	Price (KM)
1	Capture, continuance of the broken hose and introduction of the source, which used to be the part of the system, into the existing capture (estimated water quantity is 0,5-1,5 l/sec.),	4000,00
2	Capture, gravitation line construction (app.350 m), and introduction of the new captured source (940 MSL) into the existing capture (estimated water quantity is 1,5-2,5 l/sec.),	7000,00
3	Detail check, eventual rehabilitation and cleaning the source (water and cap chamber), procurement and installation of water meters with the fittings and reinforcement into the cap chamber of the capture at the outlet pipeline,	4000,00
4	Detail check of the gravitation line section from the capture "Pećina" to the reservoir "Duliba", and then rehabilitate all eventual leakages curenja,otkopčati sve potrošače koji se nalaze na tom potezu, perform th econtrol of all air valves operation, sludge outlets, section caps, etc.	8000,00
5	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber), procurement and installation of water meters in the cap chamber.	4000,00
	Total:	**27000,00**

2.11.2 WSS OF LC VOĐENICA

Rehabilitation of WSS Vođenica

No.	Description of activities	Price (KM)
1	Capture, gravitation line construction (app.250 m), and introduction of the new captured source (975 MSL) into the existing capture (estimated water quantity is 1,0-2,0 l/sec.),	8000,00
2	Detail check, eventual rehabilitation and cleaning the source (water and cap chamber),	1000,00
3	Detail check of the gravitation line section from the capture to the surge tank and then disconnect unnecessary users, and for remaining users (higher elevations) establish the consumption control,	3000,00
4	Detail check, eventual rehabilitation and cleaning the surge tank facility,	500,00
5	Detail check of the gravitation line section from the surge tank to the reservoir "Gradina"and then disconnect unnecessary users, and for remaining users establish the consumption control,	2000,00
6	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	1000,00
	Total:	**15500,00**

2.11.3 WSS OF LC KRNJEUŠA

Rehabilitation of WSS Krnjeuša

No.	Description of activities	Price (KM)
1	Detail check, eventual rehabilitation and cleaning the source (water and cap chamber),	15000,00
2	Detail check of the gravitation line section from the capture to the Pumping station and pressure pipeline from the Pumping station to the reservoir with rehabilitation of all found defects	35000,00
3	Rehabilitation of the pumping station	2000,00
4	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	5000,00
	Total:	**57000,00**

2.11.4 WSS OF LC BRAVSKO

Rehabilitation of WSS Bravsko

No.	Description of activities	Price (KM)
1	Detail check, eventual rehabilitation and cleaning the capture (water and cap chamber),	1000,00
2	Detail check of the gravitation pipeline with rehabilitation of all found defects	4000,00
3	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	2000,00
	Total:	**7000,00**

2.11.5 WSS OF LC BJELAJ

Rehabilitation of WSS Bjelaj

No.	Description of activities	Price (KM)
1	Detail check, eventual rehabilitation and cleaning the capture (water and cap chamber),	10000,00
2	Detail check of the gravitation pipeline with rehabilitation of all found defects	80000,00
3	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	10000,00
	Total:	**100000,00**

2.11.6 RECAPITULATION OF REHABILITATION THE SMALL LOCAL WSS

Recapitulation of rehabilitation the small local WSS

No.	Description of activities	Price (KM)
1	Rehabilitation of WSS Vrtoče	27000,00
2	Rehabilitation of WSS Vođenica	15500,00
3	Rehabilitation of WSS Krnjeuša	57000,00
4	Rehabilitation of WSS Bravsko	7000,00
5	Rehabilitation of WSS Bjelaj	100000,00
	In total:	**206500,00**

2.12 BILL OF QUANTITIES FOR SYSTEM DEVELOPMENT

2.12.1 USING THE SOURCE "SKAKAVAC"

Using the source "Skakavac"

No.	Description of activities	Price (KM)
1	Project documentation	24000,00
2	Construction of the capture facility at the source	10000,00
3	Construction of the transport pipeline from the capture to the reservoir, total length app. 8000 m of PEHD pipes DN 110 mm	320000,00
4	Construction of the reservoir "Suvaja"	150000,00
5	Construction of the distribution pipeline from the reservoir to the existing distribution network L=400 m of PEHD pipes DN 110 mm.	16000,00
	Total for the Option 2:	**520000,00**

2.12.2 WSS "KRNJEUŠA" SETTLEMENTS SELIŠTA, TARBUČKI DO AND ZAPOLJAK

Option 1

No.	Description of activities	Price (KM)
1	Preparatory works	14000,00
2	Construction of PS "Šljivinovac"	23000,00
3	Construction of the pressure line PS "Šljivinovac"-res."Vranovača"	100000,00
4	Construction of the reservoir "Vranovača"	32000,00
5	Construction of the surge tanks 1,2 i 3	10000,00
6	Construction of the secondary line from res."Vranovača" to the users	83000,00
	Total for the Option 1:	**262000,00**

Option 2

No.	Description of activities	Price (KM)
1	Preparatory works	15000,00
2	Construction of PS "Šljivinovac"	23000,00
3	Construction of the pressure line PS"Šljivinovac"rezervoar"Brda"	17000,00
4	Construction of the reservoir "Brda"	32000,00
5	Construction of the gravitation line from res."Brda" to the surge tanks 1 and 3	121000,00
6	Construction of the surge tanks 1,2 i 3	10000,00
7	Construction of the secondary line from the surge tanks 1 and 3 to the users	78000,00
	Total for the Option 2:	**296000,00**

2.12.3 RECAPITULATION FOR SYSTEM DEVELOPMENT

Recapitulation of WSS Bosanski Petrovac development

No.	Description of activities	Price (KM)
1	Connecting the source "Skakavac"	520000,00
2	Water supply system Krnjeuša village Selišta, Tabački do and Zapoljak - Option I	262000,00
	In total:	**782000,00**

2.13 TOTAL INVESTEMNTS IN WSS BOSANSKI PETROVAC

No	Description of activities	Price (KM)
1	Sources protection, GIS, hydraulic model, defects removal, monitoring the system and procurement of equipment for defects removal and project documentation development	1.020.000,00
2	Recapitulation of rehabilitation the sources and PS	146.500,00
3	Rehabilitation of telemetric measuring and regulation equipment	213.000,00
4	Replacements of distribution pipelines	600.000,00
5	Replacement of the pipelines with diameter smaller than 80 mm	1.324.008,37
6	Recapitulation of rehabilitation the small local WSS	42.500,00
7	Recapitulation of WSS Bosanski Petrovac development	782.000,00
	In total:	**4.128.008,37**

3 PRIORITY PLAN OF INVESTMENT MEASURES FOR THE PERIOD OF 10 YEARS

3.1 INTRODUCTION

Based on criteria developped in the longterm water supply plan, and taking into the consideration the macro-available estimation and investment capability, the priority tasks are defined as follows:

- Priority list of the projects,
- Dynamic plan of realization;

3.2 PRIORITY LIST OF THE PROJECTS

In the previous chapters, we analyzed the water supply system operation in Bosanski Petrovac and emphasized the problems, as well as measures for solving those problems. Priority measures that need to be undertaken in the future 10 years are as folows:

- Establishment of GIS and development of water supply system hydraulic model,
- Finding and removal the losses which has to be the constant process (the expences of emergency activities are estimated, but this is the proces that needs to be performed constantly, so it is necessary to leave the part of the budget every year for this kind of work),
- Establishment of the measurements in the system by installing the flow meters at the system facilities, certain zones of distribution network and at end users,
- Replacement of distribution network pipeline due to reduction of losses in the system.
- Rehabilitation of facilities in the system,
- Replacement of the transport pipeline.
- Distribution system zoning.

3.2.1 BILLS OF QUANTITIES

Sources protection, GIS, hydraulic model, defects elimination, monitoring the system and procurement of the equipment for defects elimination and project documentation development

No.	Description	Price (KM)
1	GIS development	150.000,00
2	WSS hydraulic model development	80.000,00
3	Distribution network zonning	100.000,00
4	Sources protection study	40.000,00
5	Equipment procurement and WSS monitoring	80.000,00
6	Development of project documentation at the main projects level	70.000,00
7	Network investigation anddefects rehabilitation during the first 10 years	200.000,00
In total:		**720.000,00**

Rehabilitation of telemetric measuring and regulation equipment

No.	Description	Price (KM)
1	Reconstruction of " TELEMETRIC SYSTEM FOR MONITORING AND MANAGEMENT " of water supply system with repairs and replacement of defective elements, and transferring to GSM communication system with the dispatch center and increasing th eposibilities for connection all parameters and facilities. (P.S. Sanica, PK Mijačica, reservoir Bursaći, reservoir Novakovići). Revenue value based on the data obtained from equipment delivery staff "ENA " Ltd. Karlovac	20000,00
2	Procurement and installation of electro-magnetic flow meter in reservoir "Bursaći"	11000,00
3	Procurement and installation of electro-magnetic flow meter in PS "Sanica"	12000,00
4	Procurement and installation of sector flow meters at the main distribution pipelines. It is necessary to install 6 water meters with diameter 150 and 200 mm. Procurement and installation of 5 pressure regulation valves with diameter 150, 200 and 300 mm. At the points of installation of water meters and pressure regulators it is necessary to construct the shafts with appropriate dimensions, as well as to install necessary hydro-mechanical equipment (valves, MDK, etc.)	140000,00
5	Procurement and installation of water meters at end users in the apartment buildings. It is necessary to install 55 water meters of which 15 need to have diameter from 50 to 100 mm and around 40 with diameters from 50 to 25 mm.	30000,00
	Total:	**213000,00**

Replacement of distribution pipelines

No.	Description	Price (KM)
1	Pipeline in the settlement Dževar - Dobro selo. New pipeline would be made of PE pipe, type 100, internal diameter DN 110 mm app. 1300 m long, DN 63 mm app. 1100 m long and house connections with the pipeline DN 32, 25 and 20 mm app. 1000 m long. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	150000,00
2	Pipelines in the street “14. Septembar” and settlement Ploče. New pipeline would be made of PE pipe, type 100, internal diameter DN 160 mm app. 850 m long, DN 110 and 63 mm app. 1150 m long and house connections with the pipeline with smaller diameter app. 1100 m long. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	220000,00
3	Pipeline Bišćani - Bosnaplast. New pipeline would be made of PE pipe, type 100, internal diameter DN 160 mm app 600 m long, and house connections with the pipeline with smaller diameter app. 400 m. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	130000,00
4	Pipeline in the settlement Revenik and side settlements. New pipeline would be made of PE pipe, type 100, internal diameter DN 110 mm app 90 and 63 app. 2500 long and house connections with the pipeline with smaller diameter app. 200 m long. There will be sector pipes at the pipeline, sludge outlets, air valves and hydrants.	100000,00
	Total:	**600000,00**

PS "Sanica"

No.	Description	Price (KM)
1	General maintenance of the pump and engine	100000,00
2	Rehabilitation of hydro-mechanical equipment	5000,00
3	Rehabilitation of the constructed facility at "Sanica" pumping station which relates to the roof construction maintenance, façade maintenance, joinery works maintenance, painting, fence maintenance, etc.	15000,00
	Total:	**120000,00**

Rehabilitation of the source "Smoljana"

No.	Description	Price (KM)
1	Rehabilitation of terrain around the capture facilities	2000,00
2	Replacement of hydro-mechanical equipment	2000,00
3	Rehabilitation of the fence around the facility	1000,00
	Total:	**5000,00**

Rehabilitation of the reservoir "Novakovići"

No.	Description	Price (KM)
1	Reservoir rehabilitation construction works.	1000,00
2	Replacement of hydro-mechanical equipment	2000,00

3	Procurement and installation of chlorine equipment	6000,00
4	Rehabilitation of the fence around the facility	500,00
	Total:	**9500,00**

Rehabilitation of the reservoir "Bursaći"

No.	Description	Price (KM)
1	Reservoir rehabilitation construction works.	2000,00
2	Replacement of hydro-mechanical equipment	3000,00
3	Procurement and installation of chlorine equipment	6000,00
4	Rehabilitation of the fence around the facility	1000,00
	Total:	**12000,00**

Rehabilitation of WSS Vrtoče

No.	Description of activities	Price (KM)
1	Capture, continuance of the broken hose and introduction of the source, which used to be the part of the system, into the existing capture (estimated water quantity is 0,5-1,5 l/sec.),	4000,00
2	Capture, gravitation line construction (app.350 m), and introduction of the new captured source (940 MSL) into the existing capture (estimated water quantity is 1,5-2,5 l/sec.),	7000,00
3	Detail check, eventual rehabilitation and cleaning the source (water and cap chamber), procurement and installation of water meters with the fittings and reinforcement into the cap chamber of the capture at the outlet pipeline,	4000,00
4	Detail check of the gravitation line section from the capture “Pećina“ to the reservoir “Duliba“, and then rehabilitate all eventual leakages,disconnect all users which are not in that direction, perform the control of all air valves operation, sludge outlets, section caps, etc.	8000,00
5	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber), procurement and installation of water meters in the cap chamber.	4000,00
	Total:	**27000,00**

Rehabilitation of WSS Vođenica

No.	Description of activities	Price (KM)
1	Capture, gravitation line construction (app.250 m), and introduction of the new captured source (975 MSL) into the existing capture (estimated water quantity is 1,0-2,0 l/sec.),	5000,00
2	Detail check, eventual rehabilitation and cleaning the source (water and cap chamber),	1000,00
3	Detail check of the gravitation line section from the capture to the surge tank and then disconnect unnecessary users, and for remaining users (higher elevations) establish the consumption control,	3000,00

4	Detail check, eventual rehabilitation and cleaning the surge tank facility,	500,00
5	Detail check of the gravitation line section from the surge tank to the reservoir "Gradina"and then disconnect unnecessary users, and for remaining users establish the consumption control,	2000,00
6	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	1000,00
	Total:	**12500,00**

Rehabilitation of WSS Krnjeuša

No.	Description of activities	Price (KM)
1	Detail check, eventual rehabilitation and cleaning the source (water and cap chamber),	15000,00
2	Detail check of the gravitation line section from the capture to the Pumping station and pressure pipeline from the Pumping station to the reservoir with rehabilitation of all found defects	35000,00
3	Rehabilitation of the pumping station	2000,00
4	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	5000,00
	Total:	**57000,00**

Rehabilitation of WSS Bravsko

No.	Description of activities	Price (KM)
1	Detail check, eventual rehabilitation and cleaning the capture (water and cap chamber),	1000,00
2	Detail check of the gravitation pipeline with rehabilitation of all found defects	4000,00
3	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	2000,00
	Total:	**7000,00**

Rehabilitation of WSS Bjelaj

No.	Description of activities	Price (KM)
1	Detail check, eventual rehabilitation and cleaning the capture (water and cap chamber),	10000,00
2	Detail check of the gravitation pipeline with rehabilitation of all found defects	80000,00
3	Detail check, eventual rehabilitation and cleaning the reservoir (water and cap chamber).	10000,00
	Total:	**100000,00**

Priority measures recapitulation in total for WSS Bosanski Petrovac

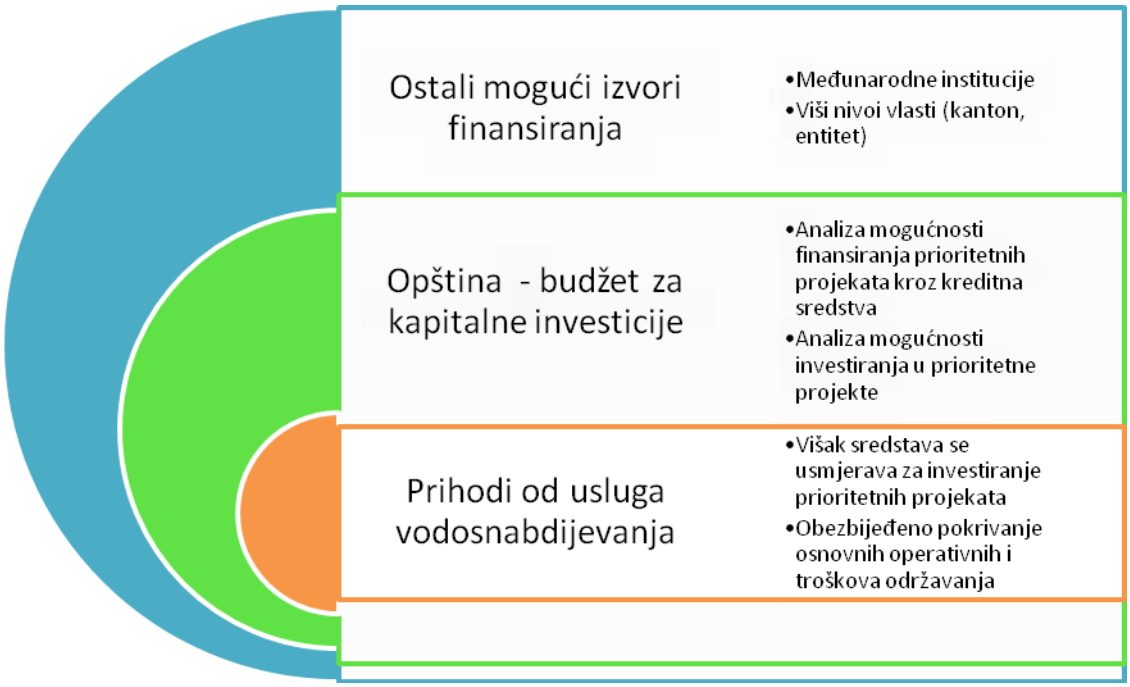
No.	Description	Price (KM)
1	Development of GIS	150.000,00
2	Development of water supply system hydraulic model	80.000,00
3	Distribution network zoning	100.000,00
4	Sources protection Study	40.000,00
5	Procurement of equipment and water supply network monitoring	80.000,00
6	Development of project documentation at the level of the main projects	70.000,00
7	Investigation of the network and rehabilitation of defects in the first 10 years	200.000,00
8	Rehabilitation of telemetric measuring and regulation equipment	213.000,00
9	Replacement of distribution pipelines	600.000,00
10	PS "Sanica"	120.000,00
11	Rehabilitation of the source "Smoljana"	5.000,00
12	Rehabilitation of the reservoir "Novakovići"	9.500,00
13	Rehabilitation of the reservoir "Bursaći"	12.000,00
14	Rehabilitation of the WSS Vrtoče	27.000,00
15	Rehabilitation of the Vođenica	12.500,00
16	Rehabilitation of the Krnjeuša	57.000,00
17	Rehabilitation of the Bravsko	7.000,00
18	Rehabilitation of the Bjelaj	100.000,00
	In total:	**1.883.000,00**

3.3 FUNDING SOURCES

Analysis of possible sources of funding will be carried out in several steps which are described below. This will define the possible sources of funding according to their availability and importance.

The primary funding source will be the incomes obtained by water supply services. The next analyzed funding source will be possible municipality investments into WSS development from budget, and the last possible funding source is grants of higher government levels (cantons and entities), as well as the grants of international organizations.

Chart 5: Funding sources according to the engagement priority



3.3.1 MACROECONOMIC AVAILABILITY AND SOCIO-ECONOMIC ANALYSIS

The analysis of macroeconomic availability of funds will be based on an analysis of primary sources of funding, and that the revenue generated from providing services through:

- Increasing the services cost
- Increasing the number of users
- Savings in operation – increasing the efficiency

3.3.1.1 INCREASING THE NUMBER OF USERS

The following table shows that WSS Bosnaski Petrovac is a complete system that already covers most of the population and the expansion of services includes a limited number of

population projections. This means that the growth of revenues by increasing the number of users will be extremely limited and negligible.

Table 22: Increasing the number of users

No.	Type of users	2010			2020			2030		
1	House connections and individual housing	1928	1928	5456	2300	2300	6670	2500	2500	7500
2	House connections and collective housing	x	390	566	x	400	640	x	410	902
3	Legal entities	156			180			200		

3.3.1.2 INCREASING THE WATER SUPPLY SERVICE COST

Current water supply services cost is given in the following table

Table 23: Current water supply and sewerage services cost

Component	Cost KM/m^3
Water component	1,00
Sewerage component	0,30
Water capture fee	0,05
Waste water fee	0,04
VAT	0,24
TOTAL COMBINED COST	1,63

Multilateral financial institutions dealing with the financing of infrastructure projects have established limits on the cost of water supply and sewerage services which are expressed as a percentage of household, i.e. users income. According to the generally accepted standards as a socially acceptable load is considered a separation of up to 5% of average income.

It is, therefore, of interest to analyze the consumers purchasing power, creating the current costs of water supply services and to see if there are opportunities to increase the reserve of the mentioned.

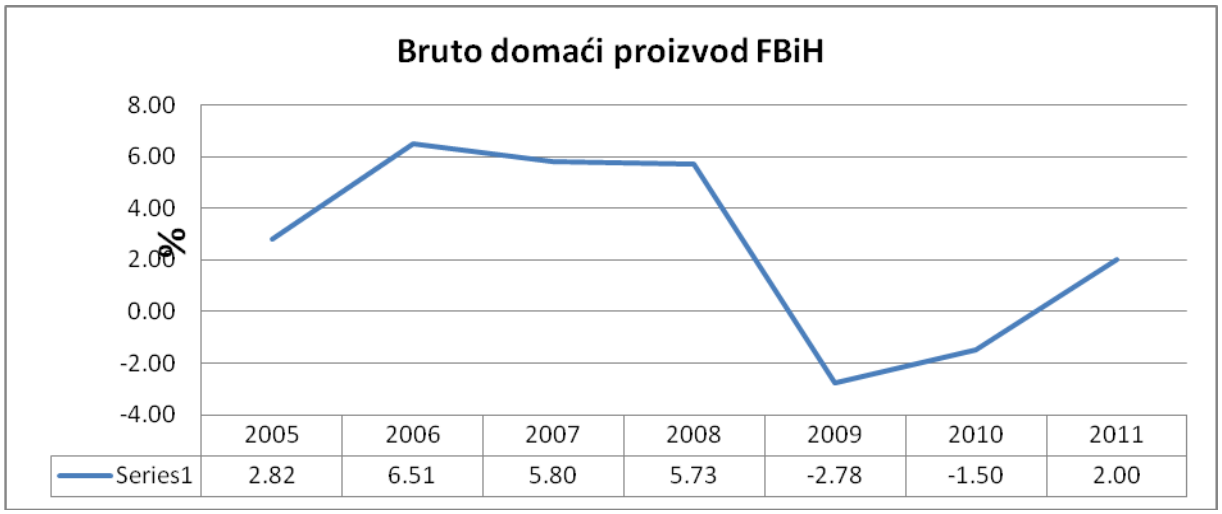
In order to be able to assess, it is necessary to analyze the macroeconomic situation in the Federation BIH, as well as at the local community level.

It is common to use Gross Domestic Product (GDP) as an indicator of economic progress, but in BiH this ratio is not very reliable for several reasons:

- Development of statistic system and data collection
- WAT implementation
- Significant proportion of informal economy
- Financial incomes from abroad

The following diagram shows significant fluctuations of GDP, so in the absence of reliable analysis, the macroeconomic availability projections were made for three projections of GDP growth.

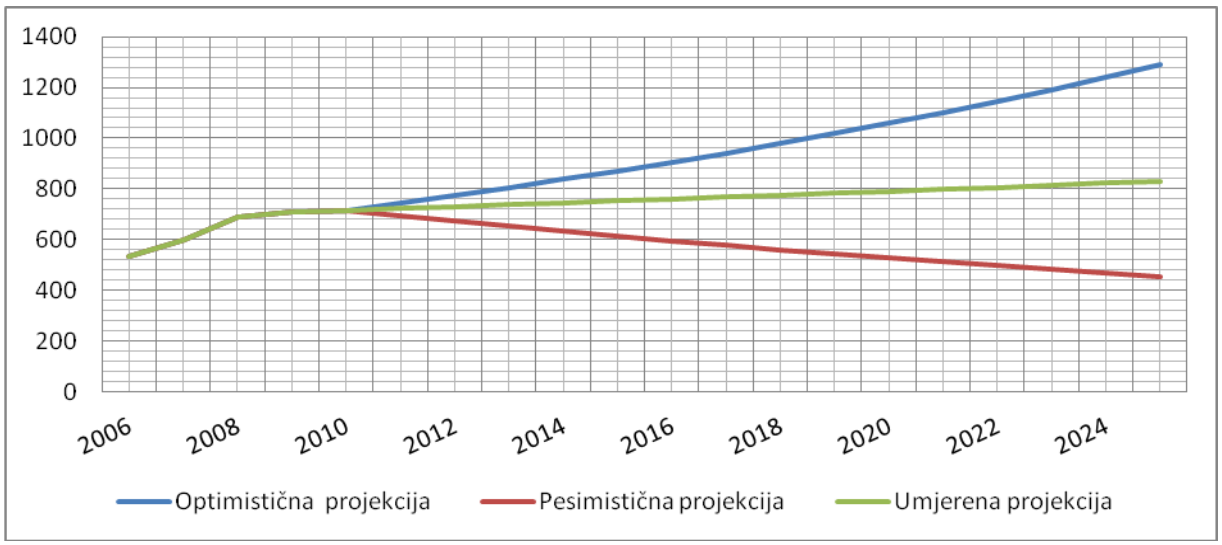
Chart 6: GDP in FBiH



- Moderate projection anticipates a minimal increase in GDP for the analyzed period of 20 years at a rate of 1% per year
- optimistic projection that predicts GDP growth of 4% per year
- The pessimistic variant that predicts negative GDP growth by an annual rate of - 3% per year

The Chart no. 7 shows the results for above mentioned three options and the establishment of income limit which can be considerated in the future by utility company, so it is obvious that the economic development is the key factor for improvement of services quality.

Chart 7: Growth projections of average incomes in Bosanski Petrovac



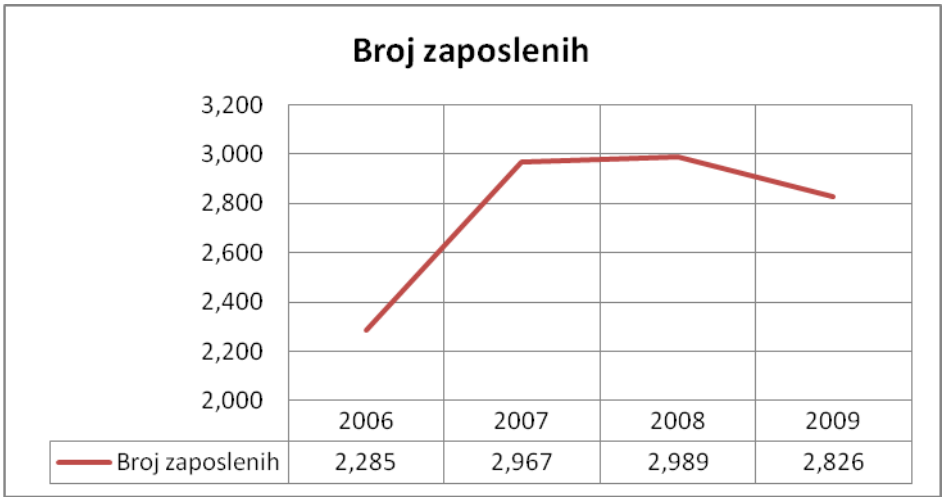
For the purposes of further analysis we will adopt "moderate projection" which provides a minimal real (no inflation) GDP growth and a parallel income at a rate of 1% per year. This is

a very conservative assumption, but we expect to achieve it with a large percentage of probability.

However, the above analysis refers to the statistical average earnings at the municipal level, and for the purpose of analyzing the real possibility that consumers pay for services it is of interest to us to estimate the average household income or household member.

Since these kinds of statistics do not exist in cooperation with the authorized services at the municipal level, and in accordance with the data obtained from Federal Bureau of Statistics FBiH, http://www.fzs.ba/, it is estimated that average household has three people, with 1 or 2 working.
This estimate is consistent with the statistical movement of employees in Bosanski Petrovac Municipality.

Chart 8: Number of employees in Bosanski Petrovac Municipality



Based on these assumptions we are able to assess the real possibilities of consumers to pay for water supply in accordance with different projections of revenue growth.

The current price of water supply of 1.0 KM/m^3 with the specific water consumption of 120 liters per capita per day is 1.25% of average income of a household which constitutes for BiH at really high percentage, and if we add to this water abstraction fee and wastewater fee and VAT, it will be possible to share the costs of water supply of 1.57% of income of a household member.
If we assume that the costs of water supply is 2% of the average income of a household we will come up with the water supply service cost of 1.61 KM/m3 which can be considered to comply with the ability of consumers to pay without fear of endangering their social status. It is obvious that despite the relatively high cost of water supply in Bosanski Petrovac there is still considerable scope for increasing revenue by increasing prices.

Table 24: Water supply expenses expressed as a household oncome percent

Specific consumption	l/cap/day	120
	m3/month	3,6
Service cost	KM/m3	1,00
Water supply expenses	KM	3,6
As a percent of the current incomes	(%)	1,25%
Specific consumption	l/cap/day	120
	m3/month	3,6
Service cost	KM/m3	1,61
Water supply expenses	KM	5,78
As a percent of the current incomes	(%)	2,00%

Elasticity of demand for services and willingness to pay the same

Price elasticity of demand for water is the change in demand divided by the change in the price of water at any point in the curve of demand. Usually the demand for water is considered "inelastic" because the elasticity is less than + / - 1, indicating that one percent increase in void rates to lower (or higher) than one percent change in demand. Usually the elasticity calculations go in natural logarithms as the coefficient of elasticity of return as a percentage change, and because they are easier to interpret. Elasticity is calculated for the average cost and consumption variable.

Price elasticity of demand for water is increasing the amount consumed per unit, increase in income or consumption. Although the demand may decline in response to price increases, the demand will increase as a result of increase in real household income.

Such analysis is not done in Bosnia and the only attempt to estimate the demand elasticity is given in the project of the European Commission's water quality management at the level of river basins in Bosnia and Herzegovina Europe Aid/119168/C/SV/BA

This attempt is based on data of ISMS Study on household consumption in 2007, the Federal Bureau of Statistics FBiH, http://www.fzs.ba/. The document estimated that the elasticity of water prices increase by one percent will lead to 0.5 percent volume decline in water consumption, and one percent increase in real household income will lead to 0.8 percentage volume increase of water consumption.

Potentially increased consumption due to the increase of household income is not taken into account because it is considered that the real growth of income will be sufficient to amortize the expected increase in price. Only with a significant absolute increase in income and reduction of water supply cost below 1.2% for the economic cost of water, one can expect growth in demand as a result of revenue growth.

Willingness to pay services and consumer surplus

Assessment of willingness to pay for services is one of the most controversial issues when it comes to preparing financial and economic plans for utility companies development.

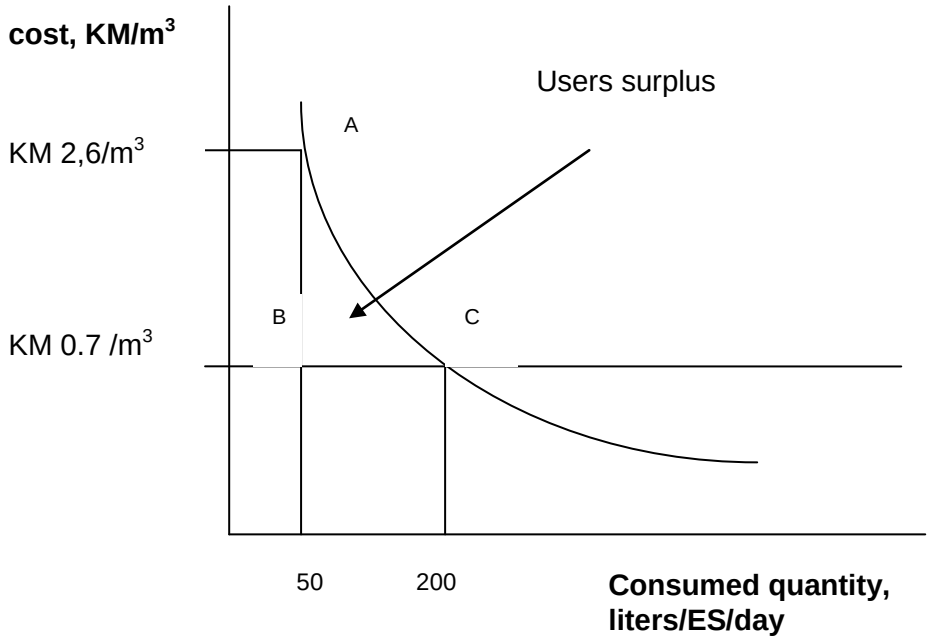
Analysis to assess the readiness of users to pay for a particular service are designed and used primarily for the economic evaluation of investments that can not be evaluated in money market and, therefore, this analysis became very popular when it comes to environmental projects that will have consequences for the environment and improving conditions of life.

The application of such analysis in cases where a monopoly on services under the customs of state regulation has proved to be less flourishing because they do not take into account other financial mechanisms that do not affect the willingness to pay for certain services.

Experience in all transition countries shows that, when it comes to water supply services a lot bigger problem is "unwillingness to service charge" comparing to the "Consumer willingness to pay ".

The method which is much more common when it comes to assessing willingness to pay for services is the consumer surplus estimates.

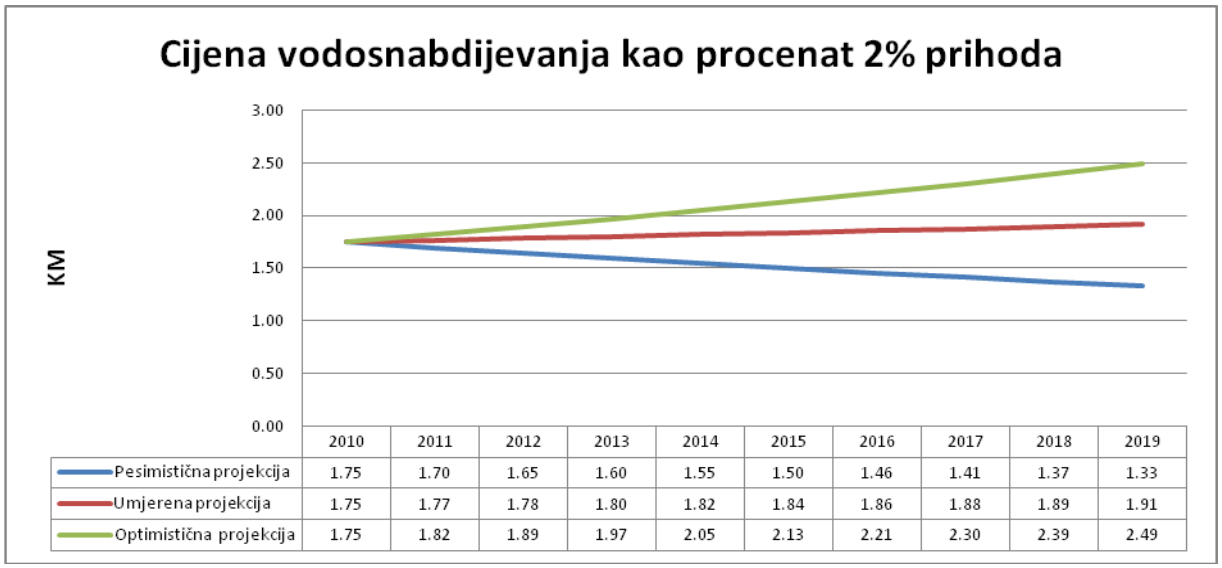
Consumers surplus concept is briefly presented by the following chart



As in the municipality of Bosanski Petrovac cost of service water supply is already relatively high and represents 1.25% of average household income statistics with relatively low specific consumption of 120 l/capita/day, elasticity of demand will not be taken into account when making projections of covering the costs of utility companies operation.

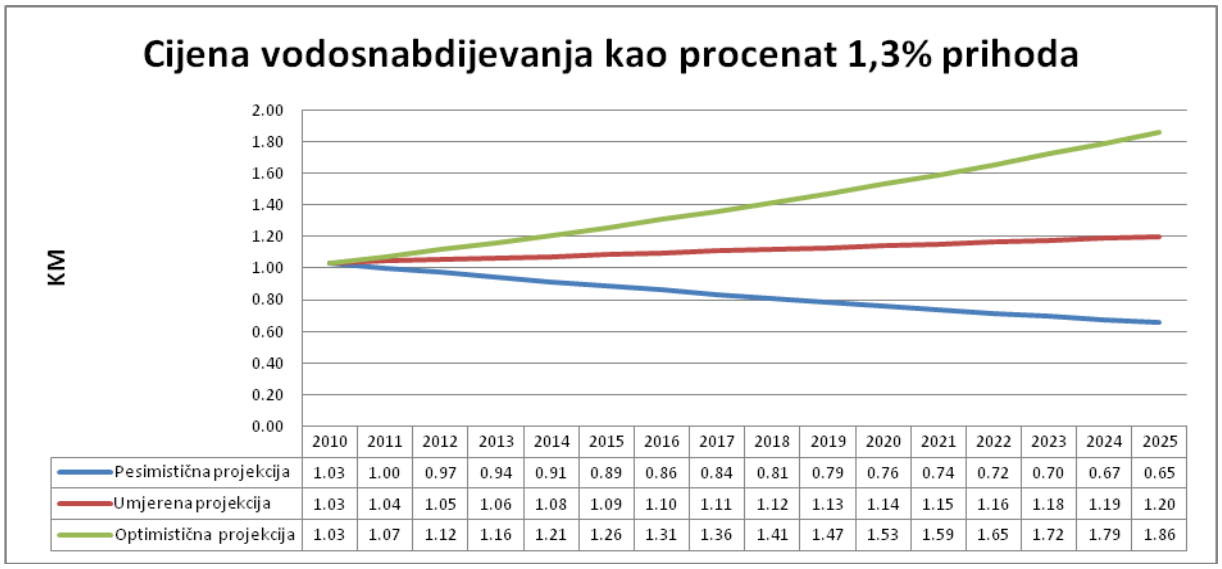
Finally, we are able to define the projections of utility company revenue growth, depending upon the consumer's ability to pay for water supply services.

Chart 9: Projection of potential growth rate 2%



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Pesimistična projekcija	1.75	1.70	1.65	1.60	1.55	1.50	1.46	1.41	1.37	1.33
Umjerena projekcija	1.75	1.77	1.78	1.80	1.82	1.84	1.86	1.88	1.89	1.91
Optimistična projekcija	1.75	1.82	1.89	1.97	2.05	2.13	2.21	2.30	2.39	2.49

Chart 10: Projection of potential growth rate 1,3%



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Pesimistična projekcija	1.03	1.00	0.97	0.94	0.91	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72	0.70	0.67	0.65
Umjerena projekcija	1.03	1.04	1.05	1.06	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.18	1.19	1.20
Optimistična projekcija	1.03	1.07	1.12	1.16	1.21	1.26	1.31	1.36	1.41	1.47	1.53	1.59	1.65	1.72	1.79	1.86

Conclussion

Ability to increase revenues by rising prices of water supply services in further analysis will be considered as a primary source of income. Ability to finance priority projects of this income will depend on:

- The current level of coverage of labor costs the utility revenues generated from providing services
- The structures and types of investment measures
- The cost of investment measures

3.3.1.3 SAVINGS IN UTILITY COMPANIES WORK

PE "Komunalno" Inc. with the support of Bosanski Petrovac Municipality during the past 6 years made significant investments in the reconstruction of the existing water supply system, with the main aim of reducing losses and operating costs (electricity). The results of these activities are evident, through the reduction of losses are currently estimated at 35% of the amount of water delivered which is one of the lowest losses in Bosnia and limiting the operation of pumping plant Sanica for the period of 3 - 4 months depending on weather conditions.

These activities make possible the savings in utility company operation by increasing the efficiency of pumping and do not represent a real source of revenue for financing investment projects.

3.3.1.4 SOCIAL ASPECTS OF INCREASING THE COST OF WATER SUPPLY SERVICES

Household consumption Survey for 2007 (APD) for Bosnia and Herzegovina (BiH) is implemented in partnership of the Agency for Statistics of Bosnia and Herzegovina (BHAS), Federal Bureau of Statistics (FOS) and the Republic Statistical Office of the Republic of Sr pska (RSIS).

Material well-being should be measured in a manner that indicates the living standard. However, as it is difficult to measure, it is usually assumed that the material welfare is the result of joint products and services that people use. Given the fact that different people use different products and services in varying quantities, it is assumed that the monetary value of goods and services indicates the level of welfare, which is a result of these values. Therefore, if two different groups of products and services have different monetary values, it is assumed that the most expensive group will be the one that gives a higher level of material well-being. Products and services are bought to be consumed: the price of consumer products and services group, therefore, according to financial criteria, is the indicator value (monetary measures). The amount that an individual spends is considered as an indicator of the amount consumed by the individual, ie. indicator of the level of prosperity that will result from the consumption / use. In this way, the material well-being, ie. Living standard, can be expressed in convertible marks (KM), U.S. Dollars, Euros or any other currency.

In this sense, poverty is measured as a level of consumption that does not reach a certain level of consumption which is sufficient to produce a minimum acceptable level of material well-being.

The survey results show that household consumption statistically registered is greater than the revenue which is explained by the high participation of the "informal economy" and other official statistics and unregistered cash flows.

It is interesting to see that the share of costs for water and sanitation services is 13.7% of the total household costs for utilities and energy. That is the obvious proof of more than ten years when water and sanitation services were considered primarily social rather than economic categories.

Percentage of el. energy and utility services consumption	(KM)	(%)
Total monthly consumption	1.623,86	
El. energy, gas, water, other	113,67	
Water supply	15,58	13,71%
Water and sewerage in total	19,63	17,27%

The table below explains why the entire utilities sector that specializes in providing water supply services in a very difficult economic situation, and unable to to cover the basic costs of operation and maintenance.

It is obvious that the policy of services cost was based and adopted to the capabilities of app. 15% of relatively poor population and that the rest of the population was amnested in paying the real water supply services.

Relative poverty		
Relative poverty line per adjusted member per month	350,22	(KM)
Poverty percent per adjusted member	15,64	(%)
Water supplying	6,32	1,80%
Water and sewerage in total	7,58	2,16%

One possibility to overcome this situation is the introduction of block tariffs that would allow "relatively poor" part of the population to have the ability to use water services at affordable prices with rational behavior and consumption, while at the same time the rest of the consumers could use the same services in accordance with their ability to pay the true cost of services.

Regarding the registered poor people which are included into the group of „real poverty“, there is a Study “Action plan for socialy included into the system of social/children protection, related to the branch of water supplying in Bosanski Petrovac Municipality for 2011-2012” drafted, which consists the recommandations and directions for solving the problems of socialy jeopardized persons.

3.3.1.5 BOSANSKI PETROVAC MUNICIPALITY CAPABILITIES TO FINANCE THE WATER SUPPLY PROJECTS

During the last 5 years, the Municipality allocated appr. 200.000,00 KM in the branch of water supplying for the period 2011 – 2015; priority in investing in development of infrastructure is the construction of sewerage network and cleaners of 3000 ES capacity. Bosanski Petrovac Municipality is planning to implement this project throug the following:

- The loan from European Investment Bank (EIB) through the project WatSan FBiH
- Grants through the IPA 2008 and 2009 grants
- Own participation

Given the relatively small budget of the Municipality possibility of investing in water infrastructure development, it will be reduced and it is expected that the average of 200,000.00 KM-year period will fall to the app. 50.000,00 KM or for a period of 10 years app. 500.000,00 Km

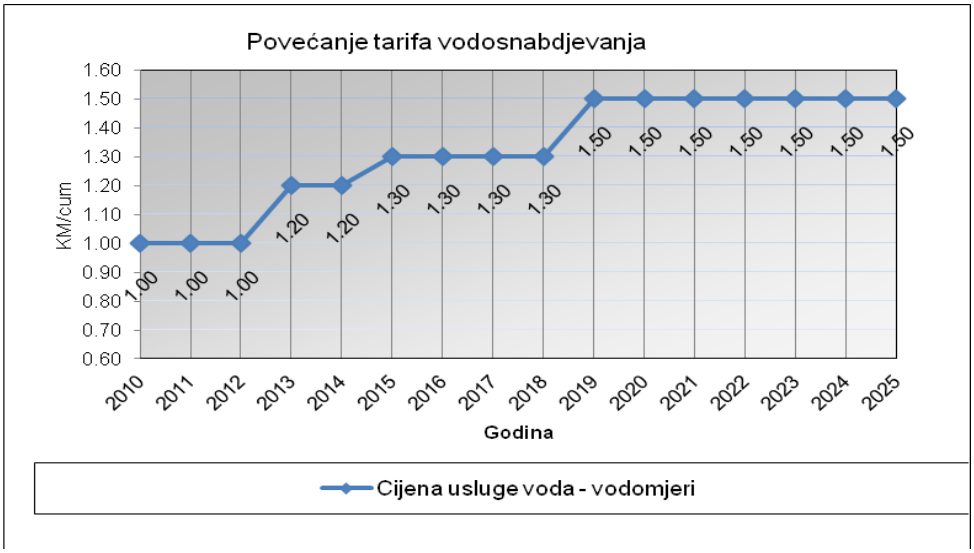
DESCRIPTION	BUDŽET (KM)	BUDŽET (KM)
	ZA 2010.GOD.	ZA 2011.GOD.
INCOMES	2.718.180,00	2.890.750,00
EXPENSES	2.718.180,00	2.890.750,00

3.3.2 ANALYSIS FOR POSIBILITY TO INVEST IN ACCORDANCE WITH THE DEFINED PRIORITY PROJECTS

Previous chapters show that the defined priority projects can be financed by only two finencing sources

- Increasing the price of water supply service
- Financing the infrastructure projects

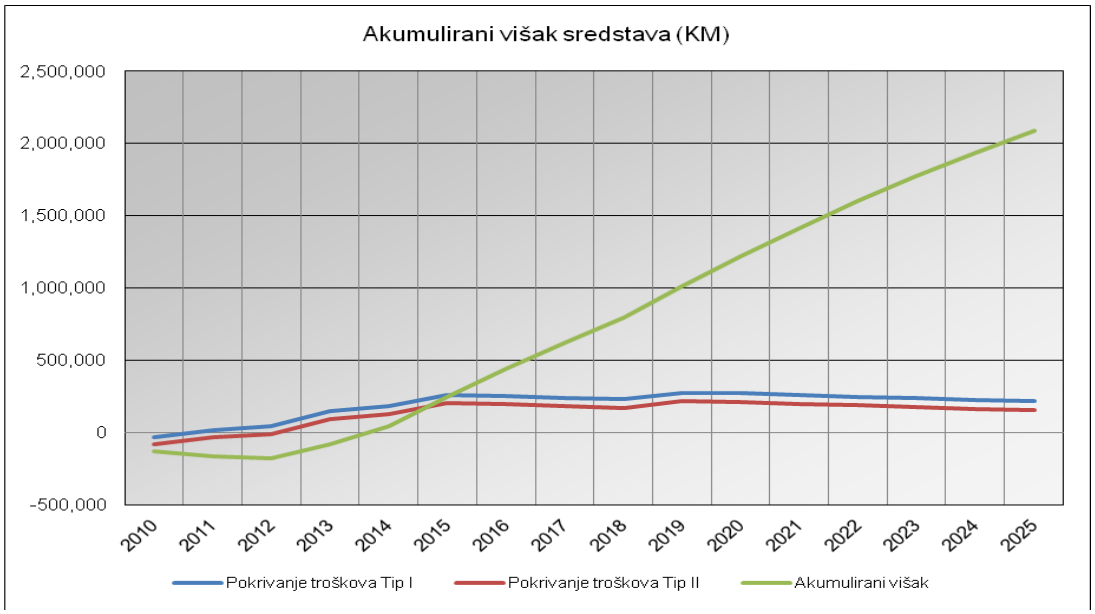
Chart 11: Plan of increasing the price of water supply services



Based on a possible plan for price increases, we are able to assess that the utility company, after covering fixed costs of operation, would be able to accumulate a surplus of funds in the amount of app. 1.5 million for the financing of priority projects.

With co-financing of infrastructure projects from the Municipality budget in the amount of app. 500,000 KM, we can conclude that the priority investment plan of measures for Bosanski Petrovac Municipality is realistic and financially feasible.

Chart 12: Financial capability of utility company



4 FEASIBILITY STUDY FOR PRIORITY INVESTMENTS

4.1 IDENTIFYING THE TECHNICAL CONDITIONS FOR INVESTMENT MEASURES

Based on the analysis of WSS Bosanski Petrovac operation and projections of development for the future 25 years, we can conclude the following:

- Current water quantities at the sources are sufficient
- Alternative gravitational sources or sources that require less energy to deliver water to the center of consumption in order to avoid the high costs of energy sources when using the "Sanica" do not exist or they are not feasible financially, nor technically
- Non-revenue water in the system is app. 50%, but big part of this water relates to the reservoirs overflows of gravitational sources.
- Water quality is good, but requires adequate chlorination in all of the sources (reservoirs).
- Existing **reservoir space** is sufficient.
- All transmission pipelines have sufficient capacity. Still, replacement of these pipelines is necessary due to significant losses at Sanica source and unsatisfactory pipe material (AC pipes).
- The distribution network, i.e. the reconstructed part is in good condition and requires only routine maintenance. Non-reconstrukted part of the distribution network needs tobe well maintained, in order to reduce losses.
- According to the measurement data, the system water losses are around 35 % of total production (defects are hard to detect due to the KARST terrain – missing equipment for defects detection);
- It is necessary to carry out measurements at water sources, reservoirs, as well as at the control measuring points and at the end users. In recent years, by installing water gauges for end users, the situation, concerning the amounts of Revenue Water and reducing the amounts of Non-Revenue Water, has significantly improved.
- Commercial losses – relates to unmeasured and NRW in the appartment houses with the lump-sum calculations. Based on the founder decission, determined was 4 m3 per household member. Within mentione, the bigest problem is with population migration and karge number of socially jeopardized inhabitants.
- System maintanace is expensive related to the system size, consumers number and municipality development level;
- High power expenses at PS SANICA, (installed agregates 2 X 719 KW), pre-pumping station and all other equipment necassary for normal system functioning;
- Construction defects and non-functioning distribution network in certain areas (Ploče, Dževar, Bahići, Revenik) not covered by the I reconstruction phase (parts of secondary and distribution network were constructed in 1963-1964), low bandwidth compared to the level of prevalence and number of consumers;

CONCLUSSION

WSS Bosanski Petrovac is well developed and complete system of water supply that provides quality service to consumers. The disadvantaged hydromorphological position of Bosanski Petrovac is conditioned what makes the system quite complicated and complex compared to the number of consumers which results in high unit costs of operation and maintenance.

The analysis showed that all the main elements of the system are well set and even oversized, the system covers most of the consumers and expansion of the system and increasing the number of consumers is limited, alternative water supply solutions are not technically feasible.

Therefore, the proposed plan of priority investment measures does not go beyond the regular water system maintenance plan.

4.2 COST ESTIMATION

Recapitulation of priority measures in WSS Bosanski Petrovac

No.	Description	Price (KM)
1	GIS development	150.000,00
2	Development of water supply system hydraulic model	80.000,00
3	Distribution network zonning	100.000,00
4	Sources protection study	40.000,00
5	Procurement of equipment and water supply system monitoring	80.000,00
6	Development of project documentation at the level of the main projects	70.000,00
7	Investigation of the network and rehabilitation of defects during the first 10 years	200.000,00
8	Rehabilitation of telemetric measuring and regulation equipment	213.000,00
9	Replacement of distribution pipelines	600.000,00
10	Pumping station "Sanica"	120.000,00
11	Rehabilitation of the source "Smoljana"	5.000,00
12	Rehabilitation of the reservoir "Novakovići"	9.500,00
13	Rehabilitation of the reservoir "Bursaći"	12.000,00
14	Rehabilitation of WSS Vrtoče	27.000,00
15	Rehabilitation of WSS Vođenica	12.500,00
16	Rehabilitation of WSS Krnjeuša	57.000,00
17	Rehabilitation of WSS Bravsko	7.000,00
18	Rehabilitation of WSS Bjelaj	100.000,00
	In total:	**1.883.000,00**

4.3 FINANCIAL ANALYSIS

Analysis was made based on the following assumptions

All of the costs were taken based on the current costs without inflation, VAT and other 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 incomes
- Increasing the number of users
- Municipality investments into water supply system were, also, taken into consideration as a possible finincing resource amounting appr. 600.000,00 KM during the ten years period

4.3.1 OPERATION EXPENSES OF UTILITY COMPANY

20 employees at the water supply system

Total fixed costs – water supply component

Salaries and other payments	250.000,00 KM
Other	35.000,00 KM
El. energy	170.000,00 KM
TOTAL	455.000,00 KM

VARIABLE COSTS (including the regular maintanance costs)

AVERAGE COST (20 KM/year connection)(2300 x 20)=46.000,00 KM

VARIABLE EXPENSES IN TOTAL	46.000,00 KM

«KOMUNALNO» IN TOTAL	501.000,00 KM

4.3.2 EXPENSES RECOVERY PLAN - OPTION 1

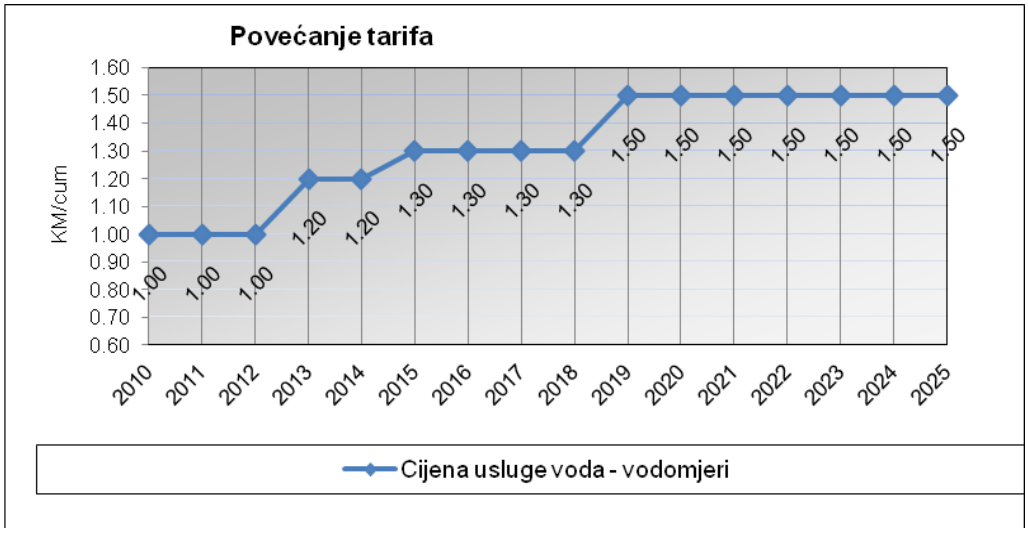
All of the costs were taken based on the current costs without inflation, VAT and other taxes

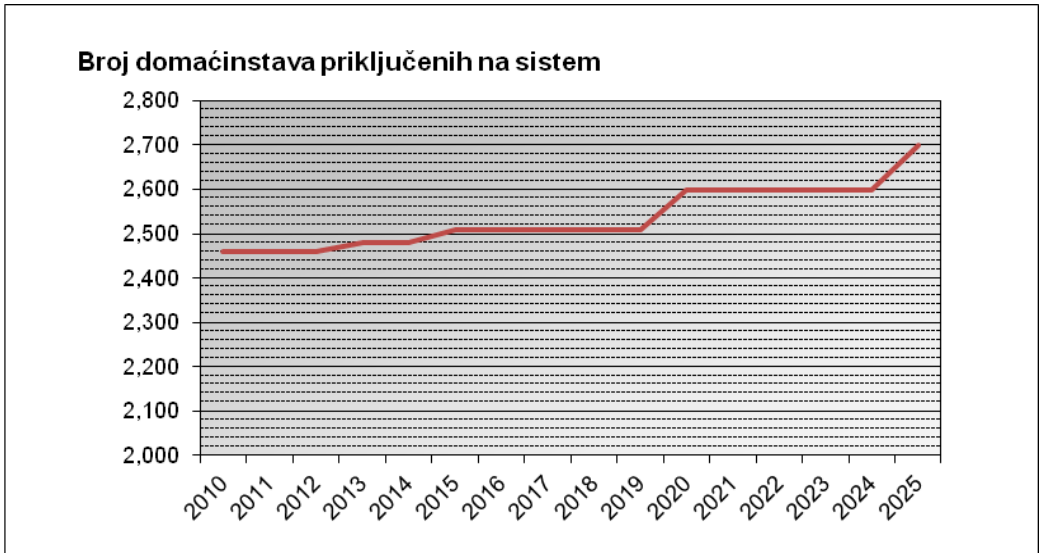
The discount rate is 8%

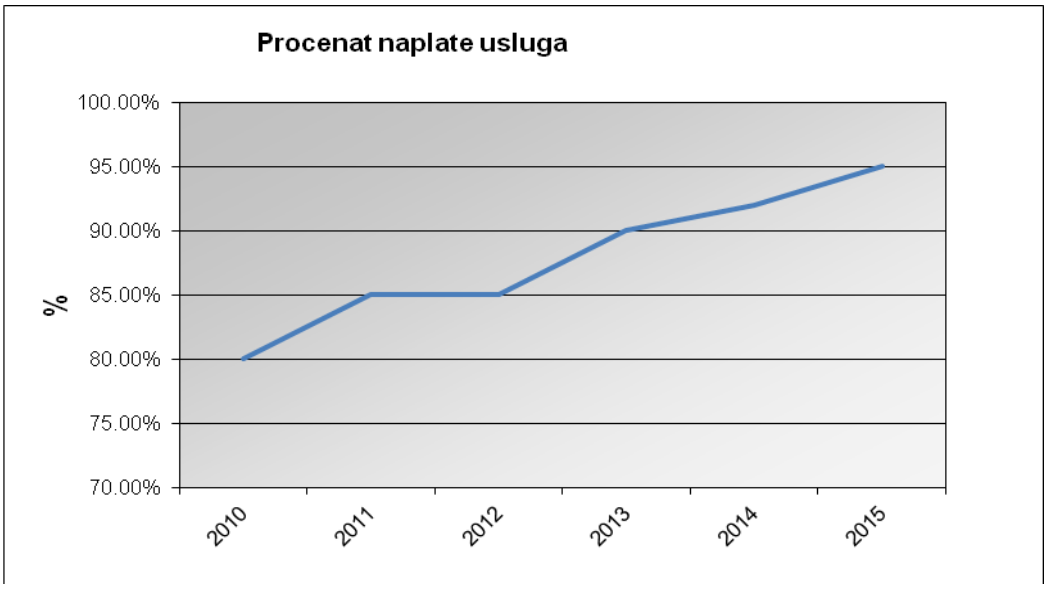
Possible income sources are defined as:

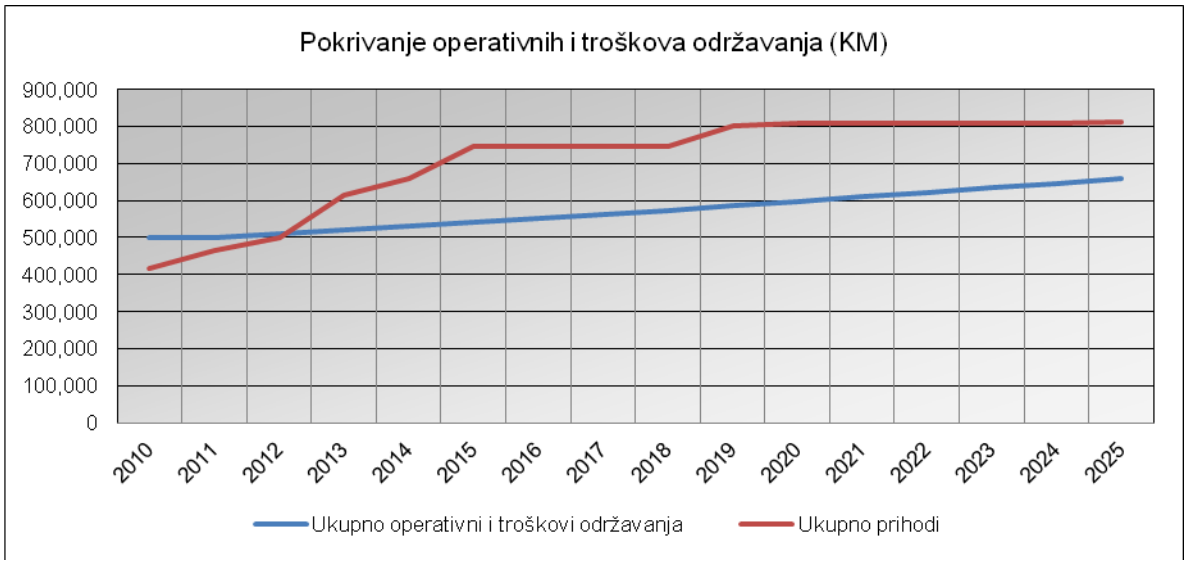
- Incomes obtained by providing water supply services with the services costs up to household capability, i.e. 2% of estimated incomes
- Increasing the number of users

The following charts show projection of increasing the water supply services prices, number of consumers and paying level.









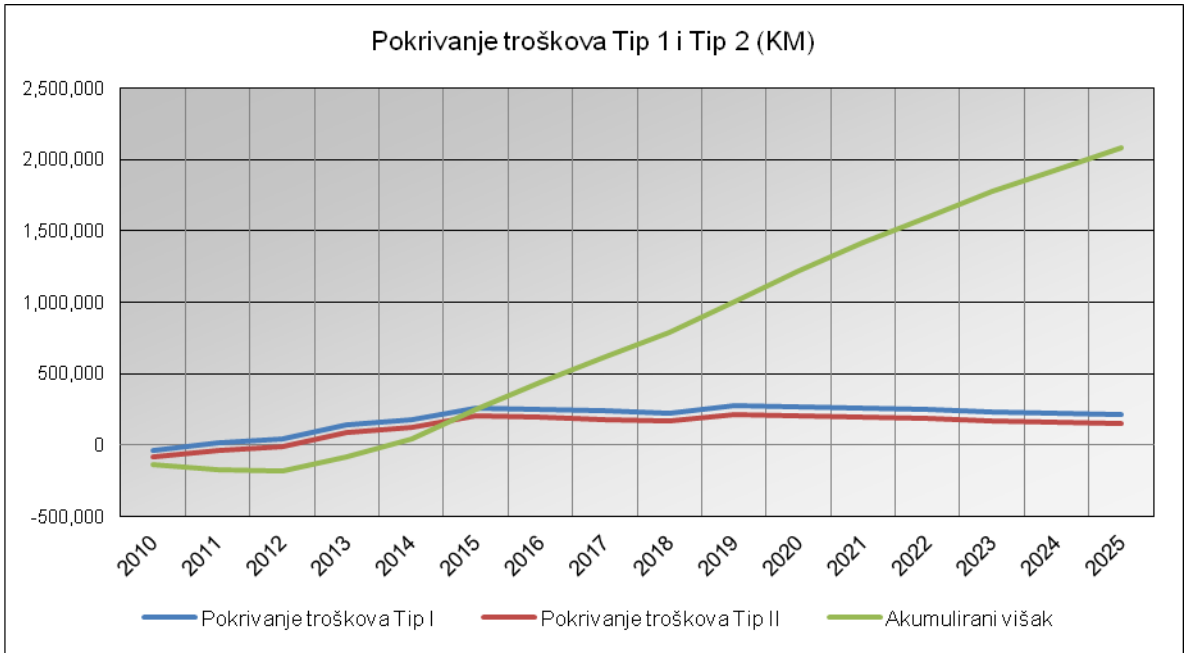
With these projections we see that the utility company would cover basic operating costs and accumulate surplus funds which would be used for system maintenance and financing of priority actions and measures.

According to their priorities, the expenses recovery can be divided into

Expenses recovery Type I	Difference between operational expenses and total incomes after investing
Expenses recovery Type II	Difference between operational and maintenance expenses and total incomes after investing

If we assume that the annual investment is zero, there is nothing to invest in the development and maintenance of the system, for each year or cumulatively for the period considered, investment income may be financial capacity of utility company.

The results of this analysis are shown in the following chart:



It is obvious that, with the assumed scenario, the utility company needs a couple of years to replace part of income that currently subsidize or cover the profitable activities pursued by the utility, or activities not related to water supply services (construction works, management of markets, etc.). Only from 2015, one can expect the accumulation of surplus funds for investment in priority projects. By the year 2022 at the end of ten years period accumulated surplus of the investment would be app. 1.5 million KM.

The above analysis was performed assuming the constant price level of 2010, inflation was not taken into account. This means that the above-defined plan is to cover the costs is feasible only if the planned water supply price increase is adjusted for inflation in the value of the considered period.

4.3.3 EXPENSES RECOVERY PLAN - OPTION 2

As mentioned above, the priority infrastructure investment project for Bosanski Petrovac Municipality for the period 2011 – 2015 is the construction of sewerage network and cleaners of 3000 ES capacity. Bosanski Petrovac Municipality is planning to implement this project througt the following:

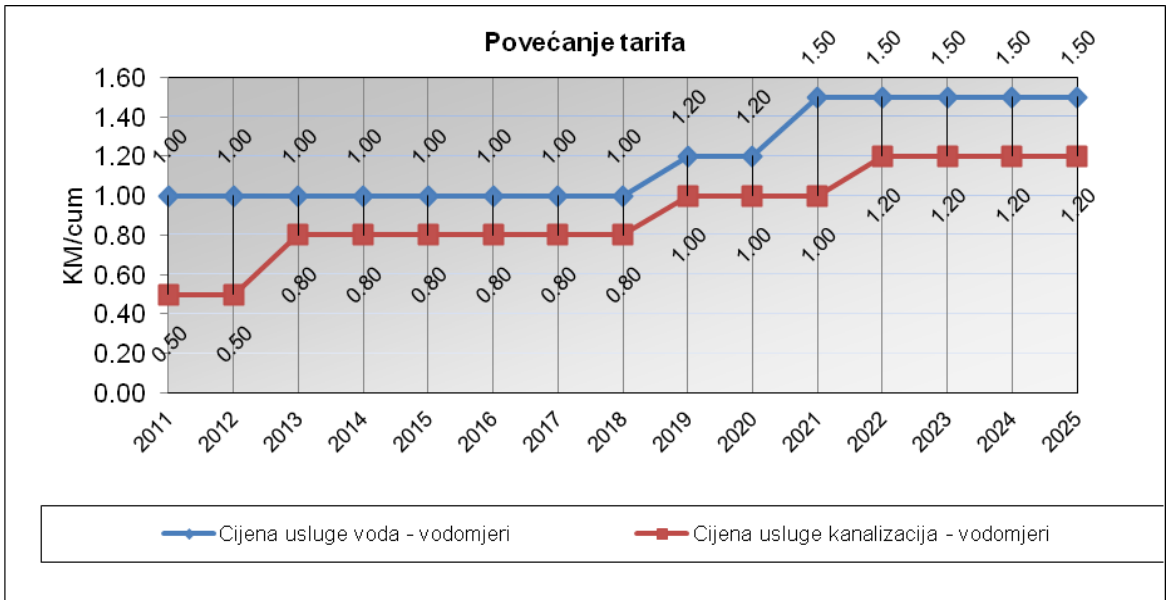
- The loan from European Investment Bank (EIB) through the project WatSan FBiH
- Grants through the IPA 2008 and 2009 grants

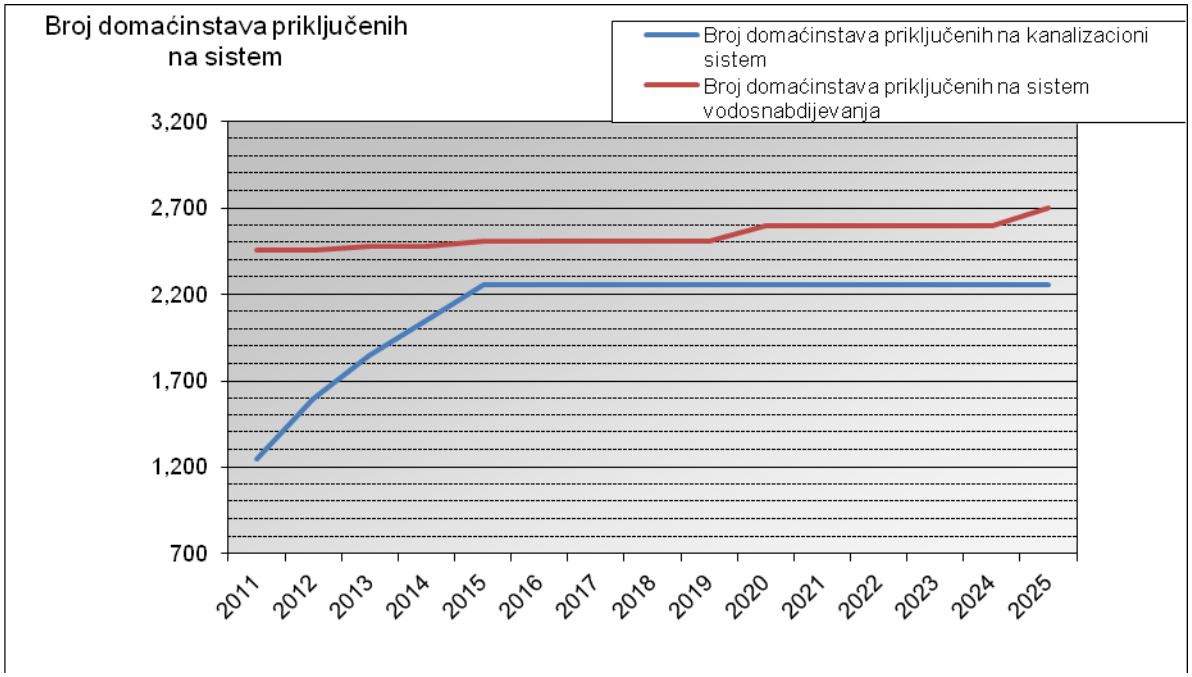
As estimated, the implementation of this project will, besides loans and available grants, represent significant financial burden for both, Municipality and utility company.

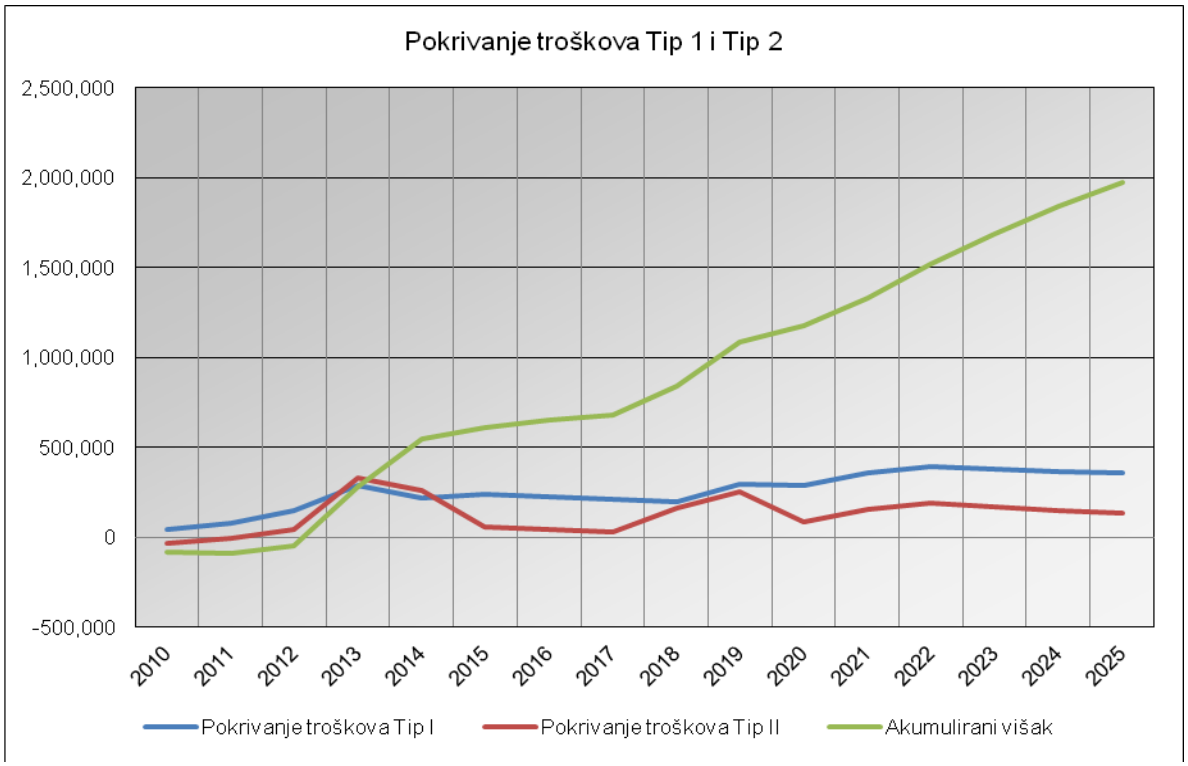
Implementation of the construction project of sewerage network and filters entails sewerage services price increases, or collection, drainage and waste water treatment in order to achieve coverage of basic operating costs of the planned sewage systems and purifiers.

However, it is of interest to consider the option of paralel implementation of investments into the water supplying and sewerage.

Analysis were made based on the following assumptions







At the cart of expenses recovery we can se that when the sewerage investment projects are included into the analysis, the planned means surplus realized through the price increse are a bit lower, but still at the satisfying level.

However, there is a problem with the real posibilities of the utility company and municipality, whether they can implement this kind of ambicious price increase plan of water supply and sewerage services. Based on the above presented price increase projection of water supply and sewerage services would be 2,0 KM/m^3 of consumed water in 2015, i.e. with VAT the real expense per m3 of consumed water would be 2,45KM, i.e. monthly app. 8,8 KM per household member (assumed specific water consumption is 120 l/capita/day), i.e. for the thre members household the invoice for water supply and sewerage services would be 26,4 KM monthly.

The conclussion is that the above presented scenarion is too ambicious and most probably not feasible.

4.3.4 EXPENSES RECOVERY PLAN - OPTION 3

Based on the above analyzed scenarios, and in cooperation with representatives of utility company and municipality, we came with the final scenario of expenses recovery for the future 15 years for Bosanski Petrovac Municipality, taking into consideration the investment programs for water supply and sewerage system.

Analysis was made based on the following assumptions

All of the costs were taken based on the current costs without inflation, VAT and other 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 incomes
- Increasing the number of users
- Investing in infrastructure projects for water supply from the Municipal budget of 600.000,00KM
- Implementation program period of 15 years

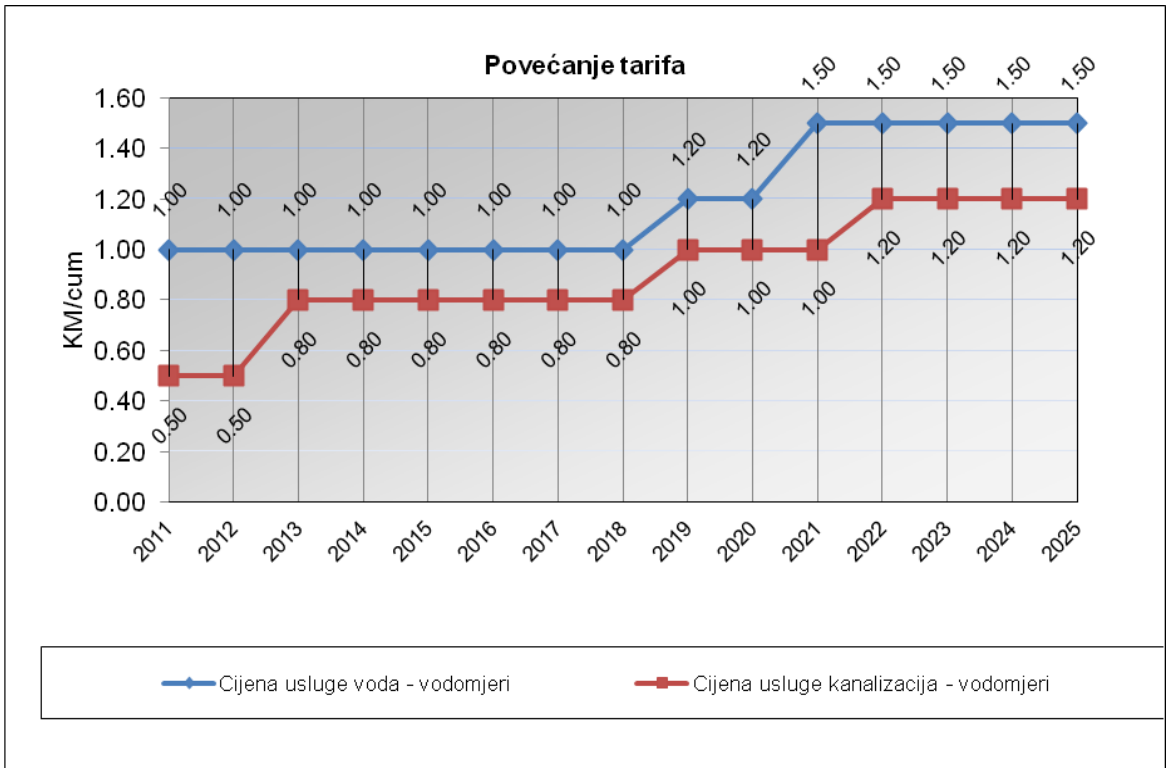
It is obvious that this kind of scenarion is much more acceptable from the consumer's aspect and it represents the continuance of Bosanski Petrovac Municipality succesful policy regarding the water supply system development.

Achieving the complete sustainability will be prolonged for the period after the implementation of the construction project for sewerage network and purifiers and in the meantime:

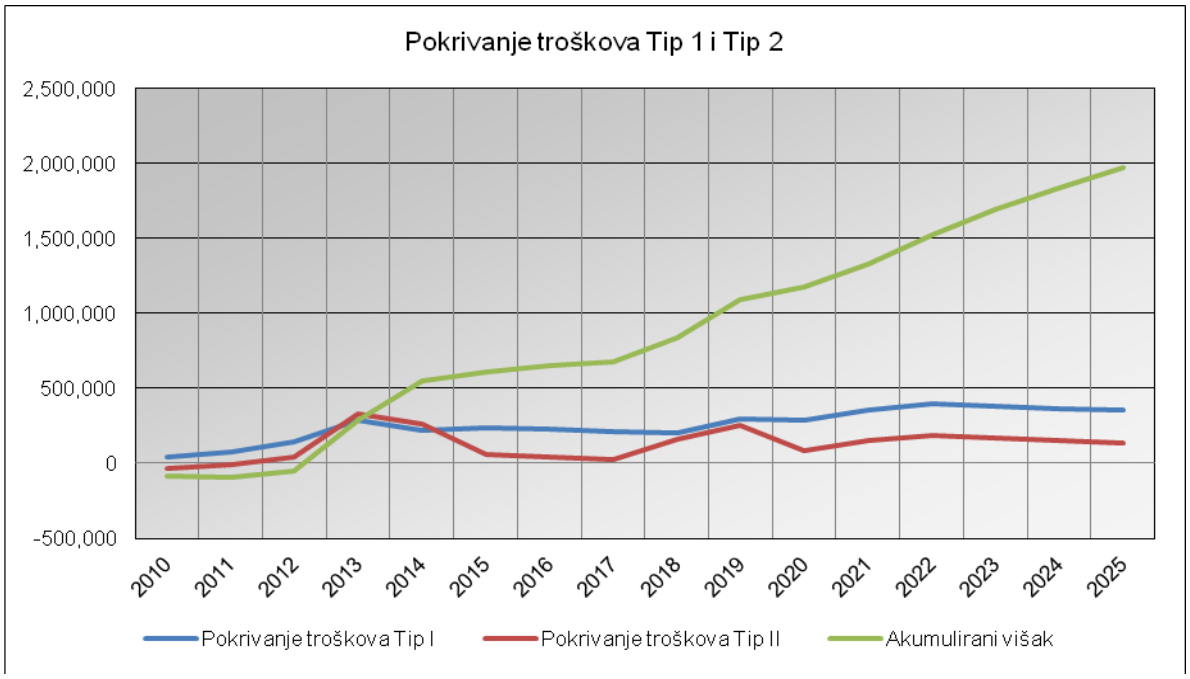
- Bosanski Petrovac Municipality will finance priority projects of 600.000,00 KM during the 5 years period
- Part of the missing means for the needs of utility company operation will be provided from more profitable company activities
- Water supply services price increase will be moved further to the period of implementation of construction project for sewerage network and purifiers (2018), so in that way the overlapping of services significant increase of water supply and sewerage services will be avoided.
- Period of priority investment measures implementation will happen in 3 years.

Expenses increase and expenses recoery plan are shown in the following charts

Chart 13: Financial capability of utility company



Expenses recovery Type I	Difference between operational expenses and total incomes after investing
Expenses recovery Type II	Difference between operational and maintenance expenses and total incomes after investing



Economic – financial analysis EXPENSES RECOVERY PLAN

All in KM															
YEAR	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***
TOTAL EXPENSES	***559.765***	***578.262***	***578.262***	***706.662***	***830.000***	***846.600***	***863.532***	***880.803***	***898.419***	***916.387***	***934.715***	***953.409***	***972.477***	***991.927***	***1.011.765***
Operational and maintenance expenses	*559.765*	*578.262*	*578.262*	*706.662*	*830.000*	*846.600*	*863.532*	*880.803*	*898.419*	*916.387*	*934.715*	*953.409*	*972.477*	*991.927*	*1.011.765*
Maintenance	86.559	105.056	105.056	105.056	180.000	183.600	187.272	191.017	194.838	198.735	202.709	206.763	210.899	215.117	219.419
Operational expenses	473.206	473.206	473.206	601.606	650.000	663.000	676.260	689.785	703.581	717.653	732.006	746.646	761.579	776.810	792.346

Incomes projection															
YEAR	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***
All in KM															
Physical indicators															
Households connected to water supply system	2.460	2.460	2.480	2.480	2.510	2.510	2.510	2.510	2.510	2.600	2.600	2.600	2.600	2.600	2.700
Consumers connected to the system	7.380	7.380	7.440	7.440	7.530	7.530	7.530	7.530	7.530	7.800	7.800	7.800	7.800	7.800	8.100
Water consumption (liter/capita/day)	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
Water consumption per houshold (m3/day)	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,33
Households with the water meter	2.134	2.215	2.292	2.400	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490
Households without the water meter	185	150	120	60	20	20	20	20	20	20	20	20	20	20	20

YEAR		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Physical indicator																
Households connected to sewerage system		1.250	1.600	1.850	2.050	2.260	2.260	2.260	2.260	2.260	2.260	2.260	2.260	2.260	2.260	2.260
Persons connected to sewerage system		3.800	4.200	4.800	5.900	6.525	6.525	6.525	6.525	6.525	6.525	6.525	6.525	6.525	6.525	6.525
Water services prices – water meters	(KM/m3)	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,20	1,20	1,50	1,50	1,50	1,50	1,50
Sewerage services prices – water meters	(KM/m3)	0,50	0,50	0,80	0,80	0,80	0,80	0,80	0,80	1,00	1,00	1,00	1,20	1,20	1,20	1,20
Other incomes	(KM/conn/month)	**7,50**	**7,50**	**7,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**	**10,50**
Tax 2	(KM/conn/month)	3,00	3,50	3,50	4,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00
Tax 3	(KM/conn/month)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tax 3	(KM/conn/month)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Charged services incomes

YEAR		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Households																
- Invoiced consumption	KM	476.382	511.477	594.497	630.858	676.694	676.694	676.694	676.694	791.122	796.522	886.498	940.941	940.941	940.941	946.941
- Charging level	%	80,00%	85,00%	90,00%	92,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%
Households – IN TOTAL																
- Invoiced consumption	KM	476.382	511.477	594.497	630.858	676.694	676.694	676.694	676.694	791.122	796.522	886.498	940.941	940.941	940.941	946.941
- Charging level	KM	381.105	434.755	535.048	580.389	642.859	642.859	642.859	642.859	751.566	756.696	842.173	893.894	893.894	893.894	899.594
		289	292	295	298	301	304	307	310	313	316	319	322	326	329	332
Incomes from households per person per year	KM	3.469	3.503	3.538	3.574	3.610	3.646	3.682	3.719	3.756	3.794	3.832	3.870	3.909	3.948	3.987
Invoiced service as % of the income	%	1,86%	1,98%	2,26%	2,37%	2,49%	2,47%	2,44%	2,42%	2,80%	2,69%	2,97%	3,12%	3,09%	3,06%	2,93%
Charged service as % of the income	%	1,49%	1,68%	2,03%	2,18%	2,37%	2,34%	2,32%	2,30%	2,66%	2,56%	2,82%	2,96%	2,93%	2,90%	2,79%

Charged services incomes

YEAR		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Industry and other business consumers																
- Invoiced consumption	KM	115.053	122.176	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000
- Charging level	%	85,00%	88,00%	90,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%
IN TOTAL - Industry and other business consumers																
- Invoiced consumption	KM	115.053	122.176	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000	158.000
- Charging value	KM	97.795	107.515	142.200	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100
Budget organization and public institutions																
- Invoiced consumption	KM	76.702	81.451	86.484	91.818	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470
- Charging level	%	95,00%	95,00%	98,00%	98,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
IN TOTAL - Budget organization and public institutions																
- Invoiced consumption	KM	76.702	81.451	86.484	91.818	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470
- Charging value	KM	72.867	77.378	84.754	89.982	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Financing from budget and similar resources															
1.Municipal budget			150.000	150.000				150.000	150.000						
2. Grant I															
3. Grant II															
Total	0	0	150.000	150.000	0	0	0	150.000	150.000	0	0	0	0	0	0

YEAR		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Incomes (KM)																	
Incomes of the services to the households																	
Collected incomes		342.976	381.105	434.755	535.048	580.389	642.859	642.859	642.859	642.859	751.566	756.696	842.173	893.894	893.894	893.894	899.594
Incomes from services to the industry																	
Collected incomes		82.710	97.795	107.515	142.200	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100	150.100
Incomes from budget institutions																	
Collected incomes		59.681	72.867	77.378	84.754	89.982	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470	97.470
Total incomes		485.368	551.767	619.649	762.002	820.471	890.429	890.429	890.429	890.429	999.136	1.004.266	1.089.743	1.141.464	1.141.464	1.141.464	1.147.164
Other incomes		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional financing from budget			0	0	150.000	150.000	0	0	0	150.000	150.000	0	0	0	0	0	0
Loan																	
Total incomes		485.368	551.767	619.649	912.002	970.471	890.429	890.429	890.429	1.040.429	1.149.136	1.004.266	1.089.743	1.141.464	1.141.464	1.141.464	1.147.164
Expenses																	
Operational expenses		443.500	473.206	473.206	473.206	601.606	650.000	663.000	676.260	689.785	703.581	717.653	732.006	746.646	761.579	776.810	792.346
Maintanance and reinvestment expenses		76.077	86.559	105.056	105.056	105.056	180.000	183.600	187.272	191.017	194.838	198.735	202.709	206.763	210.899	215.117	219.419
Operational and maintenance expenses before savings		519.577	559.765	578.262	578.262	706.662	830.000	846.600	863.532	880.803	898.419	916.387	934.715	953.409	972.477	991.927	1.011.765
Expenses savings		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational and maintenance expenses in total		519.577	559.765	578.262	578.262	706.662	830.000	846.600	863.532	880.803	898.419	916.387	934.715	953.409	972.477	991.927	1.011.765
Investment expenses		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total expenses		519.577	559.765	578.262	578.262	706.662	830.000	846.600	863.532	880.803	898.419	916.387	934.715	953.409	972.477	991.927	1.011.765
Expenses recovery Type I		41.868	78.561	146.443	288.796	218.865	240.429	227.429	214.169	200.644	295.555	286.613	357.737	394.818	379.885	364.654	354.818
Expenses recovery Type II		-34.209	-7.998	41.387	333.740	263.809	60.429	43.829	26.897	159.627	250.717	87.878	155.028	188.055	168.987	149.537	135.399
Accumulated surplus		-83.944	-91.942	-50.555	283.185	546.994	607.423	651.253	678.150	837.777	1.088.494	1.176.372	1.331.400	1.519.455	1.688.442	1.837.979	1.973.378

4.4 PRELIMINARY ASSESMENT FOR IMPACT TO THE ENVIRONMENT

For all projects that are the subject of this study is not necessary to do a preliminary assessment of environmental impacts in accordance with the laws of FBiH, and Una-Sana Canton.

4.5 IMPLEMENTATION PLAN AND IMPLEMENTATION STRATEGY

The Supervisory Board of Bosanski Petrovac Municipality, 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 "living" document that will at least annually, in accordance with the progress of implementation and in accordance with other planned activities to municipalities and municipal enterprises, be revised, regarding the data given in the study in accordance with the needs.

The Supervisory Board of Bosanski Petrovac Municipality

Bosanski Petrovac Municipality	Ermin Hajder	Bosanski Petrovac Municipality
	Merima Kahrić	Bosanski Petrovac Municipality
	Senada Mehdin	Bosanski Petrovac Municipality
ViK Bosanski Petrovac	Duško Bosnić	"ViK" Bosanski Petrovac
	Huse Jukić	"ViK" Bosanski Petrovac
	Jasmin Hamzić	"ViK" Bosanski Petrovac

Plan of priority investments, as well as other findings will form the basis for the development of utility planning documents and the basis for planning of infrastructure projects to be funded from the budget of Bosanski Petrovac Municipality.

Special attention will be devoted to awareness of the public with the findings and recommendations of the Study.

4.6 DYNAMIC REALIZATION PLAN OF PRIORITY INVESTMENTS

No.	Type of works	Year									
		2011	2012	2013	2014	2015	2016	2017	2018	219	2020
1	Sources protection										
2	Development of GIS and hydraulic model of water supply system and distribution system zoning										
3	Procurement of equipment and water supply system monitoring										
4	Development of project documentation at the level of the main projects										
5	Investigation of the network and rehabilitation of defects in the first 10 years										
6	Rehabilitation of telemetric measuring and regulation equipment										
7	Replacement of distribution pipelines										
8	PS "Sanica"										
9	Rehabilitation of the source "Smoljana"										
10	Rehabilitation of the reservoir "Novakovići"										
11	Rehabilitation of the reservoir "Bursaći"										
12	Business zone "Goričani"										
13	Rehabilitation of the WSS Vrtoče										
14	Rehabilitation of the WSS Vođenica										
15	Rehabilitation of the WSS Krnjeuša										
16	Rehabilitation of the WSS Bravsko										
17	Rehabilitation of the WSS Bjelaj										

5 ENCLOSURES

5.1 ENCLOSURE NO.1: GENERAL SITUATION OF WSS BOSANSKI PETROVAC MUNICIPALITY R= 1:50000

5.2 GENERAL SITUATION OF THE TOWN WATER SUPPLY SYSTEM R= 1:25000

5.3 EXTRACTS FROM HYDRAULIC MODEL

5.4 WATER ANALYSIS