MDG ACHIEVEMENT FUND

INVESTOR:
MDG- F DEMOCRATIC ECONOMIC GOVERNANCE OF WATER ACCESS

PROJECT: WATER SUPPLY STUDY FOR PARTNER MUNICIPALITIES

WATER SUPPLY STUDY
FOR RUDO MUNICIPALITY

Voding-92 d.o.o.

2011

Voding-92 d.o.o.

Engineering, Design and Consulting Company
Bijeljina

INVESTOR:
UNDP BIH / MDG-F DEMOCRATIC ECONOMIC GOVERNANCE

WATER SUPPLY STUDY
FOR RUDO MUNICIPALITY

Project Team			Responsibility for the project
UNDP BiH		Slobodan Tadić	Program Manager UNDP/MDG-F DEG
		Haris Fejzibegović	Technical Coordinator UNDP/MDG-F DEG
Voding 92 doo		Zdravko Stevanović	Team Leader
		Vladimir Potparević	Technical Expert
		Alen Robović	Financial Expert
Supervisory board	Rudo Municipality	Milko Čolaković	Rudo Municipal Assembly –
		Vera Furtula	Rudo Municipal Assembly – Coordinator for Economy and Finance
		Mirko Mijušković	Rudo Municipal Assembly – Coordinator for Utility Services
	Vodovod i Kanalizacija Rudo (Water and Sewerage Utility Company Rudo)	Milemko Novaković	"Usluge" Rudo - Managing Director
		Jovan Savić	"Usluge" Rudo – Manager for Economic Stimulus
		Slobodan Miković	"Usluge" Rudo - Technical Manager
Voding 92 doo		Nebojša Budović	Technical Expert
		Branislav Erić	Technical Expert
		Andreas Stoisits	Technical Expert
		Mirjana Blagovčanin	Financial Expert
		Željko Ivanović	Financial Expert
		Milutin Petrović	GIS Expert
		Željka Ivanović	Translator
		Bobana Pejčić	Translator

Project Leader:

Zdravko Stevanović, Civ. Eng.

Managing Director:

Vladimir Potparević, Civ. Eng.

WATER SUPPLY STUDY

FOR RUDO MUNICIPALITY

TABLE OF CONTENTS:

TABLES:

CHARTS:

SCHEMES:

1 REGISTRATION

1.1 COMPANY LICENSE

1.2 COMPANY REGISTRATION

2 MASTER PLAN

2.1 INTRODUCTION

2.1.1 INTRODUCTORY EXPLANATIONS

Rudo	
	
Administrative Data	
Country	Bosnia and Herzegovina
Entity	Republic of Srpska
Geographical Data	
Geographical Coordinate	43° 37′ 00" N 19° 22′ 00" E

Rudo Municipality is situated in the far east part of Republic of Srpska and it covers an area of 344 km². Municipality is situated on the border triangle of Bosnia and Herzegovina, The Republic of Serbia and the Republic of Montenegro and with its major part it is bordering with two neighbouring states. Within Bosnia and Herzegovina it shares its border with Municipality Rudo, Istočno Goražde, Čajniče and Rogatica.

Rudo municipality centre is located in hilly and mountainous region of the lower course of the river Lim, about 20 km before it flows into the river Drina as its right tributary, i.e. the accumulation of dam Rudo making it flooded by a backwater of accumulation in the lower course in the length of around 20 km. Total length of the river Lim in BiH is 42.5 km and on its flow through the municipality of Rudo receives tributaries, rivers: Uvac, Poblačnica, Radojna, Sutjeska and left tributary of the very short course – Krupica. Catchment area of the river Lim in BiH is 391 km2 (6.8% of total catchment area 5 717 km2). The whole course of the river Lim in BiH is in the deep and inaccessible canyon.

Municipality Rudo is also rich in groundwater resources. Decision of the Rudo Municipal Assembly classifies the following groundwater sources under particularly valuable waters: Krupica and Zova (which are used for water supply of the town), Mokronozi, Kula, Štrpci, Bijelo Brdo, Budimlja, Majdan, Jabučnica, Strgačina, Gaočići, Pazaljame, Ustibor, Šibenik as well as waters of the river Uvac and Pribidolski potok(stream). In the territory of Rudo municipality, over the course of the river Lim, stretches the part of Rudo Hydropower accumulation lake, with maximum storage altitude, 336 m a.s.l. Municipal centre is situated at the average altitude of around 400 m a.s.l. Mountains Varda and Tmor, 1389 and 1280 m a.s.l. are located in the close vicinity.

The municipality has a strong continental climate, with occasional mild influence of the Mediterranean climate. Winters have average temperature of -8 °C while summers' average temperature is around 26 °C.

Rudo Municipality is connected with its surrounding, generally, only via road traffic. At the Beograd-Bar railway, which runs through the territory of Rudo municipality in length of 9 km, there are two railway stops for passenger trains, Štrpca and Goleš, used mainly by local population.

In terms of traffic, the area of municipality is located on the margin of major traffic flows of Republic of Srpska, Republic of Serbia and Republic of Montenegro, but it's on the corridor of one of the most significant republic longitudinal roads of the M-5 Sarajevo-Rudo-Užice main road and further to the

Bulgarian border. In this way, the access to all important neighbouring centres of Republic of Srpska, Federation BiH, Serbia and Montenegro is provided.

Figure 1: Location of settlements in Rudo Municipality

2.1.2 GEOGRAPHICAL POSITION, INFRASTRUCTURE AND ECONOMY OF RUDO MUNICIPALITY

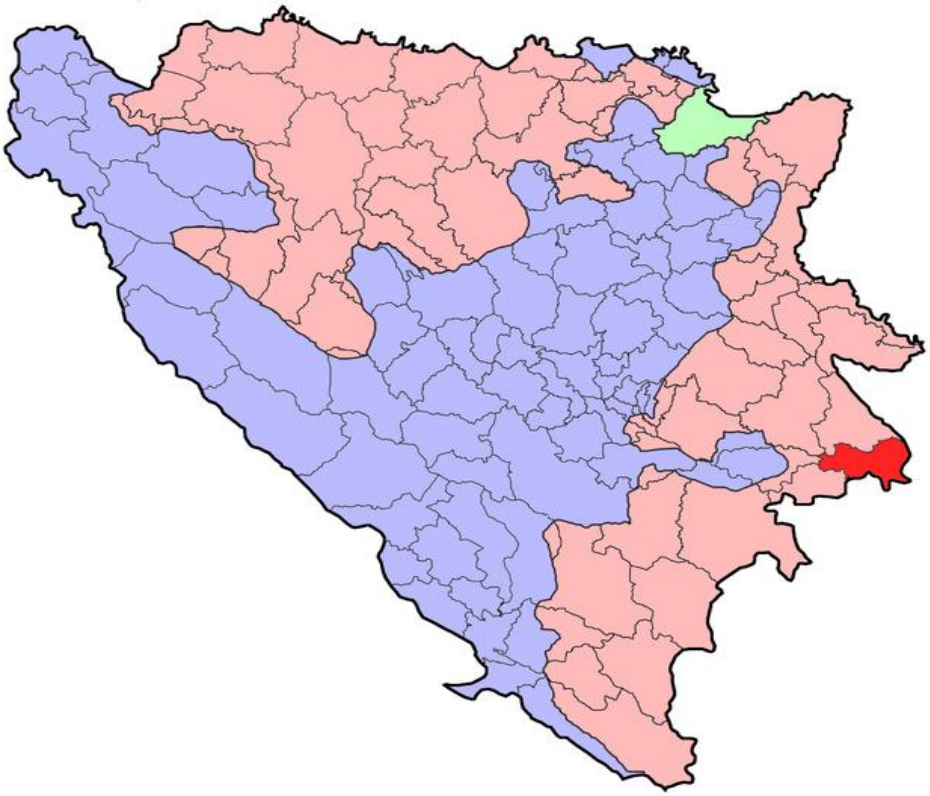


Figure 2: Location of Rudo Municipality in RS and BiH

The most significant road in the area of Rudo Municipality is the R449 Brodar-Rudo-Uvac-Dobrun Regional road, where this road (in Dobrun and Brodar) intersects with the M-5 main road. Regional road network in the area of municipality is 65 km long and it is covered with lower quality asphalt, with the roadway width of 6 m.

Business entities that were in 90's leaders of municipal development, ODP „Autodijelovi", ODP „Rudoplast" and ZDP „Polimka" today work with the capacity below 10%, and ODP „Rudoplast" is not working for several years.

- Production facility „Polimka" within the company „ŠIPAD-MAGLIĆ" from Foča, employs about 120 workers and produces saw timber, semi-finished products for manufacturing of furniture, wood joinery, flooring and other wood products.
- Production facility „Autodijelovi" operates with the capital from Serbia, which is why the privatization process has not started yet. The company employs about 170 workers and manufactures components for automotive industry, garbage containers and various tin and iron wares.
- Production facilities „Rudoplast" and „Dekorplast" who were engaged before the war in manufacturing plastics and employed 178 workers, after the war the production process has completely died out.

General feedback for the other businesses is that they are in the state of stagnation, insolvency, load obligations and in anticipation of privatization process.

In the area of craft activity, more or less successfully, operates 40 individual product or service craft shops.

There are two primary schools on the territory of municipality Rudo, Primary school ' Rudo' in Rudo and Primary school 'Boško Buha' in Štrpci, as well as one high school centre with several profiles.

In the area of trade, there are 44 sole proprietorship businesses, offering consumer goods. In the last two years, the border crossing Uvac has developed into a little shopping centre that is daily visited by a great number of costumers from Prijepolje, Pljevlja, Užice, Nova Varoš, and Priboj. State trading company „Proleter" Rudo, which was successful in business before the war, today only leases its office space.

As for the hotels and restaurants, the Hotel „Rudo" offers its services with 42 beds in single and double rooms, and a café and restaurant with 200 seats with tables. The hotel has a covered terrace which can accommodate 80 guests. Besides the hotel there are also 23 sole catering businesses – buffets, bars and restaurants.

The area of Rudo Municipality is very hilly and mountainous except for the lowland part near the rivers Lim, Uvac and Ustibarska rijeka. Forests cover an area of 3,665 hectares, grasslands cover an area of 2,598 hectares, orchards 557 hectares, arable land and gardens 2,625 hectares and non-arable land 442 hectares.

2.1.3 BACKGROUNDS

Backgrounds for the Master Plan development consist of the following:

GEODETIC SURVEYING MAPS

Geodetic maps of the area of Rudo were used for the development of Master Plan with a scale of 1:25 000 and the digitalized map of Rudo, scale 1 : 1000.

URBANISTIC BACKGROUNDS

Urban planning documents for the municipality Rudo are mainly out-dated. Spatial plan of Rudo municipality was developed before the war in 1986 with a validity period until 2011. That plan is obsolete and it is necessary to develop a new spatial plan.

Speaking about town, the following documentation was available:

- Rudo Urbanistic plan (1981).
- Regulatory plan of Rudo centre (1990).
- Regulatory plan of Rosulje (2006).
- Regulatory plan of MZ Strgačina (1985).
- Regulatory plan of MZ Setihovo (1985).

2.1.4 PROJECT DOCUMENTATION

MASTER PLAN

During 1996, The Master plan of Water supply system Rudo was developed by the Institute for Water Management– Pale.

MAIN PROJECTS

All Main Projects that were designed in the period from 1961 until recent years were also at our disposal. The following projects are especially important:

- Water Supply System of Rudo Municipality, JNA, (1961);
- Proposal for reconstruction of urban network, (1970);
- Construction of the city reservoir – First phase, (1988);
- Reservoir and pipeline for improvement of water supply in Municipality of Rudo, 1998-2000,
- Main project for reconstruction of distribution water network of Rudo (2007),
- Reconstruction of city water network (2008),
- Local Environmental Action Plan (LEAP) for the Rudo Municipality (2009).

2.1.5 OBJECTIVE AND ASSIGNMENT OF THE PROJECT

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

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

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, i.e. households in individual residential units, households in collective residential units, industry, public institutions, businesses, farms for raising cattle, chickens…
- **analysis of consumption, or needs for water**; overview of current situation by user category, average consumption per inhabitant, needs of industry and cattle-raising, public consumption; analysis of the quantities of captured water at the sources and assessment of total losses.
- **description of existing network**, including sources and water supply zones, measure of protection of sources, water treatment, water quality, length, diameter and material of main water pipes, reservoir space, pumping and re-pumping stations, including installed equipment and any other technical characteristics of the water supply network;
- **map** of existing systems, facilities and assets;
- **assessment of system components** in terms of capacities, efficiency, performance, reliability, adequacy, maintenance practices, age and quality of material and equipment, quality and quantity of raw water at the sources and treated water at the sources and in the network, source protection measures…
- **description and assessment of the management system**, assessment of losses by water supply zones;
- **assessment of the functioning of the water supply network;**
- **analysis and assessment of the capacities of the partner municipality and associated Water Utility Company** in terms of management and running the existing and future infrastructural facilities, considering technical capacities, human and financial resources. The Consultant should make a critical assessment of the current management of the system, human resources, organization, and availability of technical equipment, operation

and maintenance concept. Where necessary, the Consultant should identify a need for future reforms, capacity building and propose concepts for future management (organization, needs for human resources, needs for equipment, enhancement of operation and maintenance...);

- **socio-economic situation, financial analysis of the company's operation, analysis of current tariff system;**

analysis of institutional and legal regulatory framework – laws, regulations, rule books, standards, norms and directives which will be applied during the drafting of the Study and with which the Study will be aligned.

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

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

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

include the cost of investment and reinvestment, cost of functioning and maintenance and cost of general management.

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

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

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

f) **Long-term water supply development plan**. The plan will be based on the adopted concept – conceptual solution with defined water management facilities, water supply delineated by systems, zones and subzones, calculated maximum needs for water, defined water treatment at source locations, locations and capacities of reservoirs, pumping and re-pumping stations, main pipelines, hydraulic calculations, management system and other technical elements. The long-term development plan will identify facilities and costs and provide criteria for prioritization of the project, including risk assessment and mitigation of consequences for realization of full efficiency of the project.

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

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

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

2.1.5.4 ASSIGNMENT 4: FEASIBILITY STUDY FOR PRIORITY INVESTMENT MEASURES

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

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

Subassignment 1- Identifying technical scope for investment measures

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

Subassignment 2 - Cost assessment

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

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

Subassignment 3- Financial analysis

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

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

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

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

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

The financial analysis will show sustainability of the proposed investment measures(s) in different scenarios. It should also contain an assessment of work of the Water Utility Company in charge of rendering services of water supply and the burden the proposed investment measure(s) can cause with their financial adjustment. This assessment should contain a projection of cash flow which is

based on a sensible assumption of cost recovery, examine under which circumstances the Water Utility Company will have sufficient resources to render services, maintain the system and realize investments in the future.

Subassignment 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.

Subassignment 5 - Preliminary assessment of environmental impact

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

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

Subassignment 6 - Implementation plan and strategy

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

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

2.2 POPULATION AND SPATIAL COVERAGE

2.2.1 POPULATION IN PREVIOUS PERIOD

For the purposes of this Study, Expert assessments of inhabitants' number for this municipality was given, as well as, projected population growth for the planned period of 20 to 25 years. It is difficult to estimate fluctuation in number of inhabitants and foreseen the development of this area for a given period. There are no any statistical data series we can rely on, because the data up to 1991 cannot be considered relevant due to changes in population structure. On the other hand, from 1991

– 2010, due to war activities, huge demographic changes occurred and they are not usual pattern for the period of peace ahead.

Population of Rudo municipality is organized in ten local communities, as follows: Rudo, Staro Rudo, Mioče, Mokronozi, Uvac, Štrpca, Bijelo Brdo, Mrsovo, Strgačina and Setihovo. Municipal settlements are quite scattered, which, consequently, make the local communities distant from municipal centre. For example, local communities Strgačina and Bijelo Brdo have a mutual distance of about 55 km. There are 88 settlements in the municipality, of which only the settlement Rudo, as a municipal centre has urban characteristics. Other settlements in local communities have a rank of rural settlements with local communities as centres of a group of settlements.

Table 1: Overview of population in the municipality Rudo by settlement

Municipality **1991**	**Municipality 2002**	**Entity**	**Settlement**	**Population According to the 1991Census**
Rudo	Rudo	RS	Radoželje	6
Rudo	Rudo	RS	Ljutava	6
Rudo	Rudo	RS	Pohare	7
Rudo	Rudo	RS	Gornji Ravanci	8
Rudo	Rudo	RS	Donji Ravanci	9
Rudo	Rudo	RS	Zarbovina	10
Rudo	Rudo	RS	Budalice	12
Rudo	Rudo	RS	Pazalje	14
Rudo	Rudo	RS	Šahdani	14
Rudo	Rudo	RS	Zagrađe	18
Rudo	Rudo	RS	Petačine	21
Rudo	Rudo	RS	Stankovača	21
Rudo	Rudo	RS	Rupavci	24
Rudo	Rudo	RS	Peljevići	25
Rudo	Rudo	RS	Trbosilje	26
Rudo	Rudo	RS	Popov Do	26
Rudo	Rudo	RS	Džihanići	28
Rudo	Rudo	RS	Bjeljevine	35
Rudo	Rudo	RS	Viti Grab	36
Rudo	Rudo	RS	Bjelugovina	36
Rudo	Rudo	RS	Zubanj	36
Rudo	Rudo	RS	Kosovići	36
Rudo	Rudo	RS	Ravne Njive	38
Rudo	Rudo	RS	Pribišići	40
Rudo	Rudo	RS	Blizna	41
Rudo	Rudo	RS	Oputnica	42
Rudo	Rudo	RS	Omačina	42
Rudo	Rudo	RS	Kovači	43
Rudo	Rudo	RS	Čavdari	43
Rudo	Rudo	RS	Dolovi	43
Rudo	Rudo	RS	Dubac	46
Rudo	Rudo	RS	Bare	47
Rudo	Rudo	RS	Orah	47
Rudo	Rudo	RS	Sokolovići	49
Rudo	Rudo	RS	Gornje Cikote	52
Rudo	Rudo	RS	Trnavci	56
Rudo	Rudo	RS	Gornja Strmica	56
Rudo	Rudo	RS	Bijelo Brdo	56
Rudo	Rudo	RS	Cvrkote	57
Rudo	Rudo	RS	Božovići	58
Rudo	Rudo	RS	Rakovići	58
Rudo	Rudo	RS	Strgačina	59
Rudo	Rudo	RS	Arbanasi	61
Rudo	Rudo	RS	Past	65
Rudo	Rudo	RS	Dugovječ	69
Rudo	Rudo	RS	Strgači	71
Rudo	Rudo	RS	Dorići	73
Rudo	Rudo	RS	Donja Strmica	74

Rudo	Rudo	RS	Vagan	75
Rudo	Rudo	RS	Polimlje	81
Rudo	Rudo	RS	Prijevorac	85
Rudo	Rudo	RS	Zlatari	92
Rudo	Rudo	RS	Knjeginja	98
Rudo	Rudo	RS	Nikolići	99
Rudo	Rudo	RS	Danilovići	101
Rudo	Rudo	RS	Bišević	102
Rudo	Rudo	RS	Gaočići	104
Rudo	Rudo	RS	Setihovo	106
Rudo	Rudo	RS	Misajlovina	111
Rudo	Rudo	RS	Mikavice	111
Rudo	Rudo	RS	Donja Rijeka	111
Rudo	Rudo	RS	Grabovik	116
Rudo	Rudo	RS	Grivin	121
Rudo	Rudo	RS	Oskoruša	125
Rudo	Rudo	RS	Mrsovo	126
Rudo	Rudo	RS	Donje Cikote	129
Rudo	Rudo	RS	Arsići	140
Rudo	Rudo	RS	Janjići	140
Rudo	Rudo	RS	Gornja Rijeka	143
Rudo	Rudo	RS	Prebidoli	159
Rudo	Rudo	RS	Omarine	165
Rudo	Rudo	RS	Plema	176
Rudo	Rudo	RS	Zubač	198
Rudo	Rudo	RS	Gojava	199
Rudo	Rudo	RS	Obrvena	209
Rudo	Rudo	RS	Kula	223
Rudo	Rudo	RS	Trnavci	232
Rudo	Rudo	RS	Bovan	239
Rudo	Rudo	RS	Bjelušine	245
Rudo	Rudo	RS	Staro Rudo	247
Rudo	Rudo	RS	Međurečje	265
Rudo	Rudo	RS	Resići	270
Rudo	Rudo	RS	Boranovići	272
Rudo	Rudo	RS	Štrpci	308
Rudo	Rudo	RS	Ustibar	336
Rudo	Rudo	RS	Mioče	469
Rudo	Rudo	RS	Uvac	515
Rudo	Rudo	RS	Mokronozi	611
Rudo	**Rudo**	**RS**	**Rudo**	**2.077**
			Total for Rudo Municipality	**11.571**

According to the latest official population census from 1991, in the area of municipality Rudo lived 11, 571 inhabitants residing in 89 settlements, with average population density of approximately 34 inhabitant per square kilometre. Of the total number of inhabitants, in municipal centre lived 2077 inhabitants, or 17.9%. Looking at the results of the census for the period 1971-1981-1991, we can get a picture of demographic trends as shown in Table 2.

Table 2: Population Trend in Rudo Municipality for the period 1971-1991

Subject Area:	Conducted Population Censuses by Year		
	Year1971	Year1981	Year1991
Municipal Centre Rudo	1258	1760	2077
Other Settlements	14724	11841	9494
Total:	15982	13601	11571

Source: Statistical Yearbook in BiH, Web page of Statistics Agency BiH.

Before the war (1971-1991), Rudo Municipality had negative growth rate of around 1.3 % i.e. population declined from 15,982 (1971) to 11,571 (1991). We should bear in mind that in this period municipality experiences significant economic growth, while the population growth was still negative.
The current economic growth in municipality is far worse than in the period 1971 – 1991 and it will be unrealistic to expect that there will be a significant increase in population.
The population census has not been conducted in Bosnia and Herzegovina and Republic of Srpska since 1991. Institute for statistics of Republic of Srpska, Banja Luka, gives estimates on number of inhabitants by municipality. According to these estimates population trends for the municipality Rudo in the period 2000-2006 are shown in Table 3.

Table 3: Population Trend in Rudo Municipality for Period 2000-2006

Municipality:	Changes in municipal population numbers by year						
	2000	2001	2002	2003	2004	2005	2006
Rudo:	9456	9626	9684	9742	9801	9860	9920

Source: Institute for Statistics, Banja Luka, 19/7/2007

The previous table shows that in the period from 2000 to 2006 population increased from 9,456 to 9,920 i.e. annual population growth rate was 0.2 %.

According to data obtained from Rudo Municipality it is estimated that in the area of municipal centre currently lives about 2,000 inhabitants.

Population and household projections of the specific territory represent an important initial element in the process of spatial planning. According to population numbers, other spatial components are being dimensioned, such as housing funds, commercial facilities, technical and social infrastructure, etc.

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

2.2.2 CURRENT POPULATION

For the purposes of this Study, Expert assessments of inhabitants' number for this municipality was given, as well as, projected population growth for the planned period of 20 to 25 years. It is difficult to estimate fluctuation in number of inhabitants and foreseen the development of this area for a given period. There are no any statistical data series we can rely on, because the data up to 1991 cannot be considered relevant due to changes in population structure. On the other hand, from 1991 – 2010, due to war activities, huge demographic changes occurred and they are not usual pattern for the period of peace ahead.

Current population is estimated at about 10,000 inhabitants in Rudo municipality and around 2,000 inhabitants in the city itself.

2.2.3 PROJECTED POPULATION

For the purposes of this Master Plan, three variants of population projections were made for planning period of 20 years. In tables 18,19 and 20 calculations were also given for the year 2035 in order to assess the water requirements for a longer period and demonstrate the sensitivity of the system in relation to the increase of water requirements.

In Table 20 was given a pessimistic development projection by minimum growth rate of 0.1 % but the population connected to the system has increased from 90% to 100 %. According to this projection, there will be 2,040 inhabitants at the end of planning period by 2030.

In Table 19 was given a realistic development projection by minimum growth rate of around 0.5 % . Population connected to the system has increased from 90% to 100 %. According to this projection, there will be 2,210 inhabitants at the end of planning period by 2030.

In Table 18 was given an optimistic development projection by minimum growth rate of 1.0 % . Population connected to the system has increased from 90% to 100 %. According to this projection, there will be 2,440 inhabitants at the end of planning period by 2030.

For the plan coverage area, it is anticipated that mechanical movement will play a major role in future population trends. Natural population increase at the beginning of the time horizon will be small, but positive, but moving toward the end of time horizon it will be gradually increasing until it reaches the value of average 1.0% at the level of entire plan coverage area. Migration will represent the underlying cause of stagnating trends at the beginning of the period, despite the assumption of positive growth. The average annual growth rate at the level of coverage of the entire plan will amount to 1.0 %.

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

Table 4: Projected population within the plan coverage for the period 2010 – 2035

	Year						
Settlement	2010	2012	2015	2020	2025	2030	2035
Rudo	2.000	2.040	2.102	2.209	2.322	2.440	2.565
Mokronozi	600	612	631	663	697	732	769
Uvac	500	510	526	552	580	610	641

The town of Rudo will experience a slight increase in population while the rural settlements will record a population decline. The assumption is that it will be a migration of population from the rural areas to the town.

2.2.4 SPATIAL COVERAGE

Spatial coverage of Master Plan relates to WSS Rudo i.e. urban water supply system that covers urban part of the town. The Master Plan also covers some other settlements in the area of municipality and these are Uvac and Mokronozi. There are also several small independent water supply systems in the area of municipality which supply with water from 5-6 homes to several dozens homes. Taking into account that all these systems are far from WSS Rudo it is not realistic to expect that they will be connected to central system in the next ten years.

In the water supply system there are currently total of 562 households and collective residential units connected at household connections and 67 water meters at legal entities. The system has not got lump sum reading and around 95 % inhabitants and businesses are connected to it.

Table 1 gives the current number of consumers by type of consumer as well as the estimate of number of users at the end of planning period which makes according to Terms of Reference 20 years.

Table 5: Consumers Specification by Category – Rudo, 2010 – 2030

S.n.	Consumer Type	2010			2020			2030		
		Number of Connections	Number of Households	Population	Number of Connections	Number of Households	Population	Number of Connections	Number of Households	Population
1	Household Connections Individual Residential Units	533	533	1439	550	555	1499	560	575	1553
2	Household Connections Collective Residential Units	29	226	588	32	250	649	35	273	710
3	Industrial Consumers	19			22			25		
4	Public Institutions	17			18			20		
5	Businesses	31			35			40		

Bearing in mind that there is no planning documents (zoning map of the city) it is not possible to give a more detailed development plan of water supply system in terms of consumer type specification.

The least favourable variant from the hydraulic point of view was adopted for development plan (the largest number of potential consumers at the end of planning period). This projection envisages that central part of the city will develop within the planning period, i.e. a small number of apartment buildings in central city area will be constructed which will consequently increase the number of connections in individual housing by approx. 10 %. All other types of consumers are increased in number for 20% at the end of planning period. Number of individual users will generally grow due to the increase in connection level and extension of water distribution network.

2.3 EXISTING WATER SUPPLY SYSTEM

2.3.1 INTRODUCTION

Survey on the state of the environment in the municipality Rudo, which was conducted for the purposes of LEAP, pointed out that residents consider the issue of drinking water quality as a priority issue, ahead of poor condition of road network, waste management problems and quality of wastewater management. As in many smaller urban environments in Bosnia and Herzegovina (BiH) and Republic of Srpska (RS), in municipal centre Rudo the state of water supply network is poor, with severe losses, frequent repairs and given the branched type network each repair causes

exclusion of one part of the town. This is the main reason why a drinking water issue, which any intervention on the network makes temporarily worse, the citizens declare as a major. Water supply network that services about 2,400 inhabitants is equipped with approximately 600 connections, most of which are households. Price of 1 m3 of water for households is BAM 0.60 and for industry 1.50 BAM / m3. Price for wastewater disposal is 50 % of the water price. All connections are equipped with water meters and the collection rate for population is around 85%.

In addition to city water supply system, in the area of municipality Rudo, there are also some smaller local water supply systems in local communities and settlements. Situation concerning the quality of water supply in these other settlements is mainly worse than in the municipal centre, although we lack the real indicators. Water supply systems were built in organization of local communities or groups of citizens and city utility company has no obligation to control their operation nor does it have the data on the regular control of water quality in responsible legal institution.

Looking at the technical and functional parts of water network of municipal centre Rudo, based on the data collected by local utility company and by virtue of field visits, we can conclude the following: (1) natural resources of underground water, Krupica along with Zova 1 and 2, according to estimate can provide around 26.0 lps of good quality water, so these sources are designated as long-term water resources of the municipal centre Rudo. (2) existing water intake and transmission facilities to the city reservoir are generally in good condition and their capacity meets the current needs of consumers. (3) three city reservoir, with total volume of 550 m3, provide sufficient water to balance an uneven consumption in the town. (4) city distribution network is largely (95 %) reconstructed and has total length of around 4,800 m.

Management, use and maintenance of public water network in Rudo is responsibility of Communal company JODKP „Usluga". According to data provided by this company, public water network is being equipped with approximately 828 registered connections with water meters, of which about 523 individual households, 226 residential units, 36 business organization and 31 private companies.

2.3.2 SUMMARY OF THE STATE OF WATER SUPPLY IN RUDO

Organized approach in solving the water supply problem of the city of Rudo was adopted at the very beginning of twentieth century with the construction of the first regulated urban water supply network. This water supply system was in use until 1961 when the new one was built by tapping the spring Zova I, capacity of 4.5 lps. After that and after the implementation of hydrogeological research work a new, long-term groundwater source have been selected, situated in the spring area of the river Krupica, with the total estimated yield of around 250 lps of good quality water. One exploitation well capacity of 17 lps was built during 1982. Growth in requirements for water, with the desire to avoid the costs of pumping water from the well Krupica, resulted in 1999 in introducing new quantities of water, by gravity, from the source Zova II , in quantities of 5 lps, and in 2011, „Jelovik" capacity of 6.0 lps (Cross-border Cooperation Project with Priboj Municipality).

The current situation of water supply system of the city of Rudo is such that it can fully satisfy the needs of population and economy. Unsolved problems still remained on junctions of transmission pipelines DN 300 mm from reservoir „Gradina" to the town and reconstruction of network in industrial zone.

Capacities of city water supply facilities (facilities of water intake, transmission and reservoirs) and quantitative features of good quality water resources, undoubtedly create positive perspective of the water supply system development of both the city of Rudo and the suburbs. The problems that arise in the distribution of water to consumers can be solved with the reconstruction of network. First steps in this direction have already been made, by creating a design solution which is on the level of the main project. It must be noted that one important step was skipped. Namely, reconstruction of distribution network should be approached by developing a Conceptual Solution,

which would be made on the basis of data on development plans for urban area. Lack of financial resources is, as in many other cases, one of the main reasons why the comprehensive resolution of problems of water supply has not been addressed before. Extension of water supply with a new resource Zova II was conducted with a help of donation from the UN project VeeP, but further investments are no longer able to rely on donation.

2.3.2.1 DATA ON SOURCES – WATER INTAKES

As already stated, city water supply system relies on two water resources: groundwater from the fractured karst areas, which in the form of springs occur on the surface (tapped springs Zova I and II) and groundwater from the fractured karst areas which are reached by an exploitation well Krupica. Water resource of groundwater Krupica is, given the estimated yield and good quality, especially important for the town of Rudo, since the Long-term programme denotes it as a main pillar of future water supply development of this area. Therefore, special attention should be devoted to the protection of water quality of this source, which is located in the close vicinity of the town, on the left bank of the river Lim. Tapped springs Zova I and II, given the altitude related to the consumption area and excellent water quality, also need measures for quality protection that will, in the long run, these water resources keep on the current level. In addition, protection of the source is a legal obligation, as defined in the Regulations, under which a three zones of sanitary protection are being established: (1) immediate protection zone, whose size corresponds to a 7-days flow time of groundwater to the water intake facility, but not less than 50m; (2) narrow protection zone, which corresponds grounwater flow time of 90 days to the water intake facility, but not less than 250m, and (3) the wider protection zone, which corresponds to groundwater flow time of 180 days to the water intake facility, but not less than 200 m. The Regulation also prescribes protective measures in certain zones as well as the Program of sanitary protection of water, which consists of the Study on quality and reserves of groundwater and is being approved by the municipal assembly of the town, which in the case of Rudo has not been done yet. Currently, the protection of these three sources is reduced to a fence in the immediate area of water intake.

- **Krupica Water Intake**

Krupica water intake facility is consists of a drilled well, depth of 16 m, with the final inner diameter of 110 mm. Current and projected yield of the well is 17 lps. Over time, the originally installed well pump in 1998 was replaced with a new one, power of 45 kW, with water rising level to the reservoir Gradina of 120m. The facility for accommodation of hydro mechanical equipment and the equipment for chlorination of water in the pressure pipeline by chlorine solution was built above the well. Operational control of well pump is conducted by the signals of water level in the reservoir Gradina and in the well itself.

Water is transported by the well pump to Gradina reservoir through pressure pipeline with diameter of 200 mm, length of 120m, made of cast iron pipe material. The Figure 3 presents the facility of Krupica exploitation well.

Figure 3: Facility of exploitation well Krupica, Rudo Water Supply System

- **Water Intake Zova I and Begova voda**

In 1961, the source Zova I was tapped. The yield of the source of 4.5 lps of good quality drinking water ensured a good water supply for the then city water supply system. The source is with parallel gravity pipeline with diameter of 50 and 75mm connected with reservoir Zova I, volume of 50 m3, with bottom level of 450 m a.s.l.

The subsequent growth of water requirements and the intention to reduce high costs of electrical power consumption at the source Krupica have led to the construction of water intake on the spring Zova II in 1999, with minimum yield of 5 lps. As part of this extension of water supply system for Rudo, a gravity supply pipeline was laid (⍰110 mm, L=3500 m made of polyethylene pipe material), to reservoir „Begova voda", with single-chamber volume V=250 m3, bottom level 495 m a.s.l. Two break-pressure chambers were constructed on the transmission pipeline, the first at the elevation of 639 m a.s.l. and the other one at 511 m a.s.l.. An overflow from this reservoir is connected to the reservoir Zova I via gravity pipeline. Disinfection of water is carried out in reservoirs, using primitive devices, so called 'droppers', with a chlorine solution. The devices are of such type and condition that they can not ensure proper dosing and mixing of chlorine solution and raw water. Figures 5 present the reservoirs Zova I and Begova voda.

Figure 4*: Reservoirs Zova I (V=50 m^3) and Begova voda (V=250 m^3)*

- **Jelovik Water Intake**

Capacity of the source Jelovik is Q=12 l/s in minimum. Water supply systems Rudo and Sjeverin, according to data provided from the Water Utility Company of Rudo withdraw from this source total of Q=8 l/s.

This amount is shared between WSS Rudo and WSS Sjeverin in the way that Rudo takes Q=6 l/s while Sjeverin Q=2 l/s.

Source is located at the elevation of 822.94 m a.s.l.. Elevation of the existing reservoir Rudo is 474.88 m a.s.l. and planned reservoir Sjeverin 450.79 m a.s.l..

Joint transmission pipeline conveys water from the capture to the break-pressure chamber No. 3. Total length of this pipeline is 2,070 m. On this transmission pipeline due to altitude difference of 286.5 m between the capture structure „Jelovik" and break-pressure chamber No. 3 where pipeline branches for settlements Sjevorin and Rudo, two more break-pressure chambers were built. From break-pressure chamber No. 3 two separate pipeline lead to reservoirs Rudo and Sjeverin. The new transmission pipeline was built length of 2,039.0m made of PEHD DN 110 mm from the break-pressure chamber No. 3 to reservoir „Gradina" in Rudo.

Table 6: Data on source " Zova 1"

Source Description	Unit	Amount	Comments
Spring Type			Spreaded
Year of construction	year	1961	
Abstracted amount of water	l/s	4,5	
Bottom level of the capture	m.a.s.l.	-	
Overflow level of the capture structure	m.a.s.l.	-	
Minimum yield of the spring	l/s	4,5	
Maximum yield of the spring	l/s	-	
Water quality		Good	Disinfection

Table 7: Data on source " Begova voda"

Source Description	Unit	Amount	Comments
Spring Type			Spreaded
Year of construction	year	1999	
Abstracted amount of water	l/s	5,0	
Bottom level of the capture	m.a.s.l.	712	
Overflow level of the capture structure	m.a.s.l.	-	
Minimum yield of the spring	l/s	5,0	
Maximum yield of the spring	l/s	-	
Water quality		good	Disinfection

Table 8: Data on source " Jelovik"

Source Description	Unit	Amount	Comments
Spring Type			Spreaded
Year of construction	year	1999	
Abstracted amount of water	l/s	8,0	
Bottom level of the capture	m.a.s.l.	822,94	
Overflow level of the capture structure	m.a.s.l.	-	
Minimum yield of the spring	l/s	12,0	
Maximum yield of the spring	l/s	-	

Water quality		Good	Disinfection

Table 9: Data on source " Krupica"

Source Description	Unit	Amount	Comments
Spring Type	Well DN 110 mm, depth 16 m		
Year of construction	year	1982	
Abstracted amount of water	l/s	17	
Well Elevation	m.a.s.l.	350	
Minimum yield of the spring for return period 1/20 years	l/s	-	
Estimated Well Yield	l/s	240	
Water quality		Good	Disinfection

2.3.2.2 DATA ON RESERVOIRS AND BREAK - PRESSURE CHAMBERS

Table 10: Data on Reservoir „Zova 1"

Facility Description	Unit	Amount	Comments
Reservoir Type			Semi-buried (underground)
Material			Concrete
Reservoir Storage Volume	m3	50	
Year of construction	year	1961	
Reservoir Shape			Round
Number of Chambers	Pc.	1	
Reservoir Bottom Level	m.a.s.l.	450,00	
Overflow Level	m.a.s.l.	453,00	
Water Depth	m	3	

Table 11: Data on Reservoir „Begova voda"

Facility Description	Unit	Amount	Comments
Reservoir Type			Semi-buried (underground)
Material			Concrete
Reservoir Storage Volume	m3	250	
Year of construction	year	1999	
Reservoir Shape			Round
Number of Chambers	Pc.	1	
Reservoir Bottom Level	m.a.s.l.	495,00	
Overflow Level	m.a.s.l.	499,00	

Water Depth	m	4	

Table 12: Data on Reservoir „Gradina"

Facility Description	Unit	Amount	Comments
Reservoir Type			Semi-buried (underground)
Material			Concrete
Reservoir Storage Volume	m3	250	
Year of construction	year	1982	
Reservoir Shape			Round
Number of Chambers	Pc.	1	
Reservoir Bottom Level	m.a.s.l.	464	
Overflow Level	m.a.s.l.	467	
Water Depth	m	4	

2.3.2.3 DATA ON PUMPING STATIONS

Table 13: Data on Pumping Station „Krupica"

Facility Description				Unit	Amount	Comments	
PS Type				Well Pumping Station			
Year of construction				Year	1982		
PS Capacity				l/s	17		
Installed power of Pumping Station				kW	45		
Total number of pumps				Pc.	1		
Number of operating pumps				Pc.	1		
Pump Type						Vertical submersible pump „Jastrebac" Niš	
Pump average operating time				hours per day	8		
Manufacturer	Pump Label	Nominal capacity (l/s)	Pump Power (kW)	Nominal rising height (m)	Operation time (hour per day)	Pump age (year)	Pump Condition
Jastrebac	-	17	45	120	In summer period 2 – 8 hours a day	20	Obsolete – There is a spare pump

2.3.2.4 DISTRIBUTION NETWORK

The original distribution network was formed from the early 60's, without clearly defined development strategy, but the expansion of the network was performed by partial introduction of new lines in accordance with urban development of some parts of the urban area. This way of development has led to diverse distribution network pipe material, with the presence of asbestos cement, insufficient hydraulic capacity and very high percentage of water loss. In percent, the most

prevailing pipe material is polyethylene (PE) 56% and asbestos cement (AC) 26%, however there are also galvanized steel pipes, with diameters below 100 mm.

Stated condition of the network caused very frequent failures which urban utility company often encountered.

All this has led to the need for reconstruction of complete distributive network.

There are no precise data on current losses in the network, because of the lack of measurements of abstracted water. At the end of 2010 the flow meters have been installed at the outflow pipe of the reservoir while on the water intake Krupica has been set an electromagnetic flow meter.

After the reconstruction of transmission pipeline and much of the distribution network, water losses in the system are significantly reduced. Now, they are estimated at approximately 30 %. Most of these losses relate to so-called technical losses, as a result of the condition of pipes and fittings on unsubstituted pipelines in industrial area and on the pipeline that leads from the spring Krupica to the town. Particular problems of the network represent an uneven position of reservoir Begova voda (bottom level 495 m a.s.l.) and Gradina (bottom level 464 m a.s.l.). This significantly reduces the influence zone of reservoir Gradina, which is currently regulated by manually manipulating valve on the network.

Previous experiences and attitudes of study documentation in BiH and RS say that one can not determine minimum acceptable percentage of losses uniformly for all water supply systems. It is necessary for each water supply system to determine using analysis a minimum of technical and, especially economically, acceptable percentage of losses. This means that the search for losses and their removal below the acceptable minimum is unprofitable, i.e. gained benefits are far smaller than the investments for loss reduction. The costs of abstraction and water delivery to the distribution network play a key role. Water systems with a simple water intake, without water treatment (except disinfection) and gravity transmission to the water supply network (as in much of the case with water supply of Rudo) will certainly have a higher, economically acceptable, percentage of losses than the systems with expensive water intakes, necessary conditioning and usage of pumps for transmission of water to the distribution network. In any case, water supply network in Rudo is such, that without conducting the above-stated analysis, one can access the reconstruction of the network and gradual reduction of losses. One should know that the additional quantities of water need not to be pursued in extension of capacities at sources, because the reserves exist in the network itself.

To this end, specific activities are carried out in recent years. During 2010, a partial reconstruction of water supply network was carried out, about 2/3 of its length, which somewhat mitigated the bad conditions. In 2005, the water supply network was extended into suburb area of Staro Rudo, in the immediate vicinity of the town on the left bank of the river Lim, as well as in the settlement Obrvena, around 1.5 km downstream from municipal center. There is a geodetic survey of the position of current state of distribution network in Rudo, which certainly greatly facilitates activities related to maintenance and repair of failures.

It is very important to stress the necessity of the continuation of the reconstruction of water supply network in Rudo, and subsequently, a gradual reduction of water losses. It must be sustained, multi-year activity. Occasional activities provide only short-term results, and the state after several years of inactivity is coming back to the original. This is particularly important to stress for the environments that have no problem with the capacities of water resources, nor the quality of raw water, and, thus, have no special reasons /incentives to engage in the arduous tasks related to reconstruction of network and loss reduction, which are expensive and last a long time with the results that come slowly and gradually. Future period will lead to the necessity of introducing the economic cost of water.

2.3.2.5 WATER QUALITY

At the consumption locations, the regular periodical water quality control is performed. Physic-chemical analyses are conducted twice a year and bacteriological once a month. Water sampling and analysis are performed in accredited laboratories of the Public Health Institute of Republika Srpska, Banja Luka, the Regional Public Health Institute, and Foča. All the results so far indicate that the water samples (sampling is done at various consumption sites in the distribution network) satisfy the prescribed criteria of the Drinking Water Hygienic Regulations.

In addition to these water quality controls, Rudo Health Centre conducts daily analysis of the concentration of residual chorine in city water network. All the results so far indicate that the concentration of residual chlorine is within permissible limits.

Analysis of water from distribution network (Appendix 3) shows that the quality of water is good. Reasons for this, still a favourable state of water quality, can be found in good quality of raw water at water intakes, good condition of facilities for transmission and storage and, in spite of everything, rare reductions in certain parts of the network. In other words, the distribution network is constantly under pressure thus preventing insertion of external water into the water supply pipes.

Analysis of physical and chemical results showed that happens quite often that presence of residual chlorine is not detected in the water sample, which indicates that this kind of chlorination (manual) is not reliable and it should be reconstructed and modernize.

2.3.3 WATER SUPPLYING IN OTHER SETTLEMENTS OF RUDO MUNICIPALITY

In the area of Rudo Municipality city water supply network represents the largest facility equipped for this purpose with regular maintenance and quality control of delivered water. Other municipal settlements resolved the issue of water supply by building smaller, so-called rural water supply systems whose maintenance is entrusted to either local communities or groups of citizens. Water resources are groundwaters that are being abstracted via captured springs. The competent municipal authorities have no data on these water supply systems except for information that some local communities organize the occasional performing of water quality control. The following Table 14 gives the review of basic data for some water supply systems of settlements in the area of Municipality Rudo:

Table 14: An overview of basic data on some rural water supply systems of Rudo municipality

Settlement:	Captured Source:	Source Capacity (l/s):
Mioče	Vrelo I	2.0
	Vrelo II	0.4
Sokolovići	Vrelo	0.17
Cikotsko polje	Suvodol	0.5
Izbište	Izbište	0.17
Olandići	Gradac	0.12
Mokronozi	Maksimovo vrelo	4.0
Orašje	Vrelo	0.3

Source: Spatial plan of Rudo municipality – Extract from the plan. Urban Institute of BiH, Sarajevo 1986

According to the competent authorities of Rudo municipality, in the last 10 years, funds from donations have been used for construction of water supply systems in local communities Bijelo Brdo, Štrpci and Strgačina. It is worth mentioning that the most of the local community Uvac use

water from water supply system Priboj, from the neighbouring Republic of Serbia. Unfortunately, municipal authorities do not have technical data on these water supply systems or the information on implementation of water quality control.

2.3.3.1 UVAC WATER SUPPLY SYSTEM

About 250 households and small commercial properties are currently water supplied in the settlement Uvac.Water for the settlement Uvac is provided from water supply system Priboj. Utility company from Priboj performs metering of delivered water at the location where pipeline crosses the river Uvac and 80% of the metered amount of water is invoiced to residents. Water supply system for the settlement Uvac was built in 1989 and its main drawback is that the distribution network was made of galvanized pipes with diameter from DN 50 mm to 150 mm total length of around 4.0 km and it has around 200 connections. Water supply system „Plema" was constructed in 2003 and it's made of PEHD pipes DN 63 mm and it has length of around 2.0 km, servicing approx. 50 connections. Around 20 households of Donji Uvac use water from the source „Subašina voda" from the settlement Mokronozi. Utility company from Rudo manages the system and performs water meter readings, billing and repairing of failures. Water quality control is performed in water supply network of Priboj while on the side of Uvac there are no such activities. According to findings from Priboj water supply system, water quality is satisfactory.

2.3.3.2 MOKRONOZI WATER SUPPLY SYSTEM

The settlement Mokronozi has ca 180 households and most household have resolved issue of water supply. Water supply has been solved with several small independent water supply systems which supply with water several homes to several dozen homes.

The largest is the old water supply system which once water supplied the part of Priboj. Now this system uses around 1,200 homes of the settlement Mokronozi. Total of four springs are being tapped, as follows:

„Dobra voda" and „Badovina" for one pressure zone, and „Jorgovan" and „Crno vrelo" for Second pressure zone.

Length of transmission line is approx. 5.0 km with steel and AC pipes with inner pipe diameter of DN 100mm and DN 160 mm.

The system does not have enough water during hydrological minimum of the source which leads to irregular water supply. There are no measurements in the system nor does the population pay water. This is the reason for the excessive consumption by some number of citizens.

This complete system is out-dated and requires reconstruction of all parts of the system. It is necessary to rehabilitate the sources, to built two reservoirs, volume of approximately 50 m3 each, and built a new distribution network of total length of approximately cca 5-6 km. Systems for chlorination of water should be installed on the reservoirs.

In addition to this system, water supply system „Jasen" built in 1972 is also in function and it services with water 32 households. Pipeline length is approx. 2.0 km and it is made of PE pipes diameter of 20 and 25 mm.

Source „Subašina voda" supplies with water 43 households out of which 20 households belongs to settlement Uvac.

Water supply system was built at the beginning of the 20th century, made of cast iron pipes with diameter of transmission pipeline of 100 mm total length of around 500 m. In 2004, pipeline is completely reconstructed so that the losses are minimal but it is necessary to reconstruct the reservoir „Subašina voda" volume of 20 m3.

Water supply system „Nikitovića vrelo" is also in function and it supplies 20 households, of which 10 households near the spring and 10 households in settlements Jelići and Mioče.

There are no technical data on sources' yield, elevation of capture structures and reservoirs, length of distribution network, etc.

Quality of water at these sources is unknown because of the lack of analyses.

2.3.3.3 STARO RUDO WATER SUPPLY SYSTEM

Even though the central water supply system crosses through the settlement, not a single household is connected to it. Population provides water from the small individual water supply systems. The biggest water supply system has around 20 households and it receives water from the source „Strgačina". In order to provide additional water quantities, in 1998 the spring „Zagorica" was connected to this system and currently this system has no problems with the amounts of water. Still, capacity of these springs is neither unknown nor their water quality.

2.3.3.4 MIOČE WATER SUPPLY SYSTEM

Water supply system for settlement Mioče consists of captures "Grablja voda" and „Nijemčev do" whose capacity is around 2.4 l/s, and 3.5 km of distribution water network diameter of DN 63 mm and reservoir storage volume of 64 m3. Reservoir is located in „Nijemčev potok". This system supplies around 60 households, the Primary School, the clinic and the church. Metering of abstracted water quantities is not performed nor is the consumption at end users, so there no data on water quality or the amount of water. It is necessary to replace existing pipeline DN 63 mm from reservoir to the settlement „Kula" with pipeline diameter of DN 90 mm in length of around 1,000 m.

2.3.3.5 ŠTRPCI WATER SUPPLY SYSTEM

There are two small water supply systems in the area of MZ Štrpci. Capture and reservoir „Zapoda" has capacity of around 1.0 l/s and storage volume of 30 m3. Reservoir is connected with distribution network via PVC transmission pipeline DN 90 mm total length of 2,300 m. This pipeline is constructed in 1999 and it was connected to the old pipeline made of AC pipes DN 80 mm length of approx. 900 m that was built in the sixties. Around 40 households are connected to this system. Connections are not equipped with water meters which cause extensive consumption which further leads to the occurrence of water shortages.

Water shortage can be solved by introducing additional water quantities from the source near railway station „Štrpci" by construction of capture structure and transmission pipeline DN 63 mm length of around 800 m. It is also necessary to replace the existing asbestos cement transmission pipeline DN 100mm length of approx. 900 m and install water meters at consumers.

The second system is „Andžići" which have reservoir with volume of 10 m3 (2*5). One chamber supplies 15 households of Donja Rijeka village, primary school, school building with 10 apartments and the church with two apartments. School building and church are connected to the system via pipeline DN 50 mm length of around 1,000 m. Water supply network for households was built in sixties and its length is unknown. Water shortages occur occasionally. There are losses in the distribution water supply network and it needs reconstruction in order to provide regular water supply for consumers.

2.4 WATER PRODUCTION, WATER CONSUMPTION AND WATER REQUIREMENTS

2.4.1 WATER PRODUCTION IN WSS RUDO

Data on water production does not exist due to lack of measurement at the water intakes.

It can be concluded that the amount of water entering the reservoirs Zova 1 and Begova voda Qmin=9.5 l/s. When using the pump at the source Krupica this capacity increases to Qmin=26.5 l/s. Only during two summer months minimum yield of springs Zova 1 and Begova voda, before the reconstruction of the network, was not sufficient for water supply so the source Krupica was used i.e. the pump was used with the capacity of 17.0 lps during 2 – 8 hours a day. Now, after the reconstruction of distribution network and connection of water supply system „Jelovik" the usage of the pump will probably not be needed but one will be able to say that with confidence only after conducting the measurements.

2.4.2 WATER CONSUMPTION IN WSS RUDO

As for the consumption of water, for the year 2010 it is displayed separately for the population as total average monthly consumption and average monthly consumption of industry. The table below shows these consumptions.

Table 15: Summary of water consumption in WSS Rudo

	Population	Industry
month	m3/month	m3/month
1	6850,00	833,00
2	6686,00	1026,00
3	6172,00	988,00
4	6409,00	807,00
5	7075,00	900,00
6	9343,00	838,00
7	9331,00	750,00
8	9394,00	761,00
9	8252,00	839,00
10	7157,00	841,00
11	6809,00	914,00
12	6748,00	779,00
total	**90226,00**	**10276,00**
total	**100502,00**	

Additionally, according to data provided by water supply company, the amount of revenue water during 2010 is 100502 m3 of water. Amount of non-revenue water is unknown due to lack of measurements at the source.

Table 16: Summary of produced water and revenue water quantity in WSS Rudo

Water Production	Amount of Revenue Water	Amount of Non-Revenue Water

	Population	Economy	Total	m3	%
	90226,00	10276,00	100502,00	-	-

The system has total of 761 water meters installed at household connections and 72 water meters at legal entities. There are no lump sum readings and around 95 % of population and economy is connected to the system. The existing water meters are working properly and are regularly calibrated, so the readings can be taken with high degree of certainty.

2.4.3 PRODUCTION AND CONSUMPTION OF WATER IN WSS UVAC

As stated earlier Uvac is supplied by water from the water supply system Priboj. Utility company from Priboj conducts measurements of quantity of water delivered, reduces that quantity by 20 % for recognized losses of water in the distribution network and the remaining 80 % is charged from the citizens of Uvac. Table 17 depicts total amount of delivered and revenue water for the year 2010.

Table 17: Summary of the amount of delivered and revenue water for the settlement Uvac in 2010

Month	Year 2010		Year 2009	
	Delivered	Charged by "ViK" Priboj	Delivered	Charged by "ViK" Priboj
	m3/month	m3/month	m3/month	m3/month
1	3968,00	3174,40	1620,00	1296,00
2	2923,00	2338,40	1822,00	1457,60
3	3782,00	3025,60	2683,00	2146,40
4	2441,00	1952,80	2239,00	1791,20
5	2914,00	2331,20	2310,00	1848,00
6	1298,00	1038,40	5525,00	4420,00
7	2585,00	2068,00	2489,00	1991,20
8	4766,00	3812,80	5129,00	4103,20
9	3491,00	2792,80	3440,00	2752,00
10	3513,00	2810,40	2819,00	2255,20
11	3189,00	2551,20	3688,00	2950,40
12	3076,00	2460,80	1582,00	1265,60
Total	**37946,00**	**30356,80**	**35346,00**	**28276,80**

Total amount of Revenue Water accounted by Water Utility Company „Rudo" for the year 2010 is 24, 446.00 m3 of water. The actual number of inhabitants in Uvac that use water from water supply system is currently unknown. It is estimated that there are about 500 but this number does not include the people staying there only on weekends. If we divide the total mount of accounted for water with the approximately 500 current inhabitants we will get the specific water consumption of approximately 134 l/capita/day. Bearing in mind that specific consumption in our country is ranging in the average around 120-140 l/capita/day it can be concluded that estimated number of inhabitants is realistic and that there is around 33 % of losses in distribution network. Some of the households in settlement Uvac have its own water system.

2.4.4 PRODUCTION AND WATER CONSUMPTION IN WSS MOKRONOZI

These data can not be given since there is no metering of neither the production nor the consumption of water in this settlement.

2.5 ANALYSIS OF WATER SUPPLY SYSTEM OPERATION

2.5.1 RUDO WATER SUPPLY SYSTEM

2.5.1.1 WATER SUPPLY SYSTEM FUNCTIONING

The main problem of water supply system is control over the system. Company that manages the system like most of companies in BiH, does not have the team that deals with GIS, measurements and water balance in the system. GIS database does not exist. Cadastre of underground installations is only partial.

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

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

There are sufficient quantities of water in the system at the end of planning period.

2.5.1.2 AVAILABLE WATER QUANTITY

The balance of available and required quantity of water is shown in Table 26, i.e. the least favourable option in terms of water consumption. Based on the mentioned review, it was concluded that for the 2030 planning period, for the development of this spatial unity there is around 12,80 l/s of potable water surplus, under the condition of lowering water losses to the reasonable level, i.e. not to exceed 20 % of produced water.

According to available data current capacity of all sources is approx. 32.5 l/s i.e. there is a water surplus of around 19.70 l/s at the end of planning period. It should be also noted that at the end of planning period there is enough water from the three springs which deliver water by gravity into distribution network under the condition that water losses range around 20 - 25%. Capacity of these three springs is 15.50 l/s.

Since there are no precise measurements of the water entering the system after the reservoir, currently, it is not possible to give precise water losses data inside of the transmission and distribution network. Currently, these losses are estimated at about 30 %.

According to data provided by Water Utility Company, there are approximately 2,000 inhabitants connected to the system. Specific consumption of population and economy without losses according to these balances is around 140 l per inhabitant per day. Specific consumption of population is, according to these data, 120 l per inhabitant per day.

The percentage of actual physical losses in transmission and distribution system, which are part of non-revenue amount of water can only be estimated, due to lack of research and data on these water quantities. According to estimates of Water Company's employees current physical losses are

around 30 % because not the entire network was reconstructed. Administrative losses are around 20 %.

2.5.1.3 WATER REQUIREMENTS

Bearing in mind that Spatial Plan does not exist and that population census was not conducted, it is not possible to give exact number of population in the city area. Three variants of population growth estimates were done for purposes of this Master Plan.

The first variant is optimistic approach when the population growth rate is 1.0 % , calculation showed in Table 18:Estimates of population and required water quantities for WSS Rudo. We think that this coefficient of growth is realistic and that it is on the safe side when it comes to planned water consumption in water supply system Rudo. According to these estimates, it is envisaged that in Rudo settlement will reside ca 2,440 inhabitants at the end of 2030 planning period. In the same table it was adopted the consumption of economy of 25 % in relation to population, connectivity 100 % and specific consumption of 200 l/capita/day. According to these adopted parameters the required water quantity at the end of planning period by 2030 is 12.80 l/s, providing the losses in the system reduces to approx. 20 %.

In **Table 19** it was adopted growth rate which is reasonable to expect of 0.50 %. With this coefficient of population growth (2,210 inhabitants at the end of planning period) and other parameters the same as in the previous table the required water quantity at the end of planning period is 11.59 l/s.

In **Table 20** it was adopted a pessimistic approach of city development i.e. population growth rate is 0.10 % and consumption of economy 20 % in relation to population consumption. According to this estimates required water quantity is 10.33 l/s at the end of planning period.

The projection of water requirements was performed using usual and proven methods, using of specific consumption normative and its variations as well as demographic projections for this area for the 2030 planning period.

Adopted values of specific consumption and its variations covered also the corresponding water losses, but it was planned to keep their values within a range of permissible values.

After analysis of the previous variants it can be concluded that water supply system Rudo is not sensitive to required water quantity in terms of population trends, thus, the demographic impact is not crucial for the required water quantity in the system. System maintenance (losses) and development of economy will have the crucial impact.

Table 18:Estimates of population and required water quantities for WSS Rudo

Optimistic Development Projection – Population Growth Rate: 1.00 %

Consumption Description	Measurement Unit	Projected population in the area of the system					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	capita	2.000	2.102	2.209	2.322	2.440	2.565
Population connected to the system	capita	1.800	1.976	2.165	2.322	2.440	2.565
Average specific water consumption of the population	l/capita/day	120	150	190	190	200	200
Percentage of population connected to the system	%	90,00	94,00	98,00	100,00	100,00	100,00
Average water consumption of population	l/s	2,50	3,43	4,76	5,11	5,65	5,94
Share of economy in water consumption	%	15,00	17,00	20,00	22,00	25,00	25,00
Average water consumption of economy	l/s	0,38	0,58	0,95	1,12	1,41	1,48
Total average water consumption of population+ economy	l/s	2,88	4,01	5,71	6,23	7,06	7,42
Specific consumption of population + economy	l/capita/day	138,00	120,50	120,50	96,40	96,40	96,40
Total daily average water consumption of population + economy	m3/day	248	347	494	538	610	641
Total monthly average water consumption population +economy	m3/month	7.556	10.548	15.015	16.371	18.557	19.504
Total average annual water consumption population+ economy	m3/year	90.666	126.571	180.176	196.452	222.685	234.044
Coefficient of daily 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	3,75	5,15	7,14	7,66	8,47	8,91
Coefficient of daily variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	0,47	0,73	1,19	1,40	1,77	1,86
Maximum daily water consumption in total(population+economy)	l/s	4,22	5,87	8,33	9,06	10,24	10,76
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	4,11	5,35	7,62	7,79	8,83	9,28
Average daily water amount needs with losses in total	m3/month	10.794	14.063	20.020	20.464	23.196	24.380
Specific population consumption + economy with losses	l/capita/day	197,14	234,00	304,00	289,75	312,50	312,50
Maximum daily water amount needs with losses in total	l/s	6,03	7,83	11,11	11,33	12,80	13,45

Table 19: Estimates of population and required water quantities for WSS Rudo

Realistic Development Projection – Population Growth Rate: 0,50 %

Consumption Description	Measurement Unit	Projected population in the area of the system					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	capita	2.000	2.051	2.102	2.155	2.210	2.266
Population connected to the system	capita	1.800	1.927	2.060	2.155	2.210	2.266
Average specific water consumption of the population	l/capita/day	120	150	190	190	200	200
Percentage of population connected to the system	%	90,00	94,00	98,00	100,00	100,00	100,00
Average water consumption of population	l/s	2,50	3,35	4,53	4,74	5,12	5,24
Share of economy in water consumption	%	15,00	17,00	20,00	22,00	25,00	25,00
Average water consumption of economy	l/s	0,38	0,57	0,91	1,04	1,28	1,31
Total average water consumption of population+ economy	l/s	2,88	3,92	5,44	5,78	6,39	6,56
Specific consumption of population + economy	l/capita/day	138,00	120,50	120,50	96,40	96,40	96,40
Total daily average water consumption of population + economy	m3/day	248	338	470	500	552	566
Total monthly average water consumption population +economy	m3/month	7.556	10.289	14.288	15.197	16.804	17.228
Total average annual water consumption population+ economy	m3/year	90.666	123.469	171.453	182.359	201.643	206.735
Coefficient of daily 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	3,75	5,02	6,80	7,11	7,67	7,87
Coefficient of daily variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	0,47	0,71	1,13	1,30	1,60	1,64
Maximum daily water consumption in total(population+economy)	l/s	4,22	5,73	7,93	8,41	9,27	9,51
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	4,11	5,22	7,25	7,23	7,99	8,19
Average daily water amount needs with losses in total	m3/month	10.794	13.719	19.050	18.996	21.005	21.535
Specific population consumption + economy with losses	l/capita/day	197,14	234,00	304,00	289,75	312,50	312,50
Maximum daily water amount needs with losses in total	l/s	6,03	7,64	10,57	10,52	11,59	11,88

Table 20: Estimates of population and required water quantities for WSS Rudo

Pessimistic Development Projection – Population Growth Rate: 0,10 %

Consumption Description	Measurement Unit	Projected population in the area of the system					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	capita	2.000	2.010	2.020	2.030	2.040	2.051
Population connected to the system	capita	1.800	1.889	1.980	2.030	2.040	2.051
Average specific water consumption of the population	l/capita/day	120	150	190	190	200	200
Percentage of population connected to the system	%	90,00	94,00	98,00	100,00	100,00	100,00
Average water consumption of population	l/s	2,50	3,28	4,35	4,46	4,72	4,75
Share of economy in water consumption	%	15,00	17,00	20,00	20,00	20,00	20,00
Average water consumption of economy	l/s	0,38	0,56	0,87	0,89	0,94	0,95
Total average water consumption of population+ economy	l/s	2,88	3,84	5,22	5,36	5,67	5,70
Specific consumption of population + economy	l/capita/day	138,00	120,50	120,50	96,40	96,40	96,40
Total daily average water consumption of population + economy	m3/day	248	332	451	463	490	492
Total monthly average water consumption population +economy	m3/month	7.556	10.086	13.729	14.080	14.895	14.969
Total average annual water consumption population+ economy	m3/year	90.666	121.031	164.750	168.954	178.737	179.633
Coefficient of daily 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	3,75	4,92	6,53	6,70	7,08	7,12
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	0,47	0,70	1,09	1,12	1,18	1,19
Maximum daily water consumption in total(population+economy)	l/s	4,22	5,62	7,62	7,81	8,27	8,31
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	4,11	5,12	6,97	6,70	7,08	7,12
Average daily water amount needs with losses in total	m3/month	10.794	13.448	18.306	17.599	18.618	18.712
Specific population consumption + economy with losses	l/capita/day	197,14	234,00	304,00	285,00	300,00	300,00
Maximum daily water amount needs with losses in total	l/s	6,03	7,49	10,16	9,77	10,33	10,38

Table 21: Water balance in the area of water supply system Rudo

Water Supply System	Requirements (Maximum Daily) (l/s)				Provided from the Source (l/s)					Surplus Water Amount (l/s)			
	2010	2020	2030	2035	Source	2010	2020	2030	2035	2010	2020	2030	2035
WSS Rudo	6,03	11,11	12,80	13,45	Zova 1	4,50	4,50	4,50	4,50	26,47	21,39	19,70	19,05
					Begova voda	5,00	5,00	5,00	5,00				
					Jelovik	6,00	6,00	6,00	6,00				
					Krupica	17,00	17,00	17,00	17,00				
Total	**6,03**	**11,11**	**12,80**	**13,45**	***Total***	**32,50**	**32,50**	**32,50**	**32,50**	**26,47**	**21,39**	**19,70**	**19,05**

2.5.1.4 RESERVOIR SPACE BALANCE

The table below depicts the requirements for reservoir space in the planning period, as currently constructed reservoir spaces. From the provided data we can conclude that there is a sufficient reservoir space in the water supply system Rudo for planned system.

Table 22: An overview of required and available reservoir space in WSS Rudo

2010			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs/Surplus**
6,03	173,57	550,00	-376,43
2020			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs/Surplus**
11,11	319,95	550,00	-230,05
2030			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs/Surplus**
12,80	368,60	550,00	-181,40

Existing Reservoirs

Reservoir	Pressure Zone	Bottom Level (m.a.s.l.)	Storage Volume (m^3)
Zova 1	I Pressure Zone	450,00	50,00
Begova voda	II Pressure Zone	495,00	250,00
Gradina	I Pressure Zone	475,00	250,00
	Total:		**550,00**

2.5.1.5 MODELLING OF WSS RUDO

The initial model of the Rudo water supply system was developed in order to verify the functionality of the system, pipelines' capacity and other system facilities.

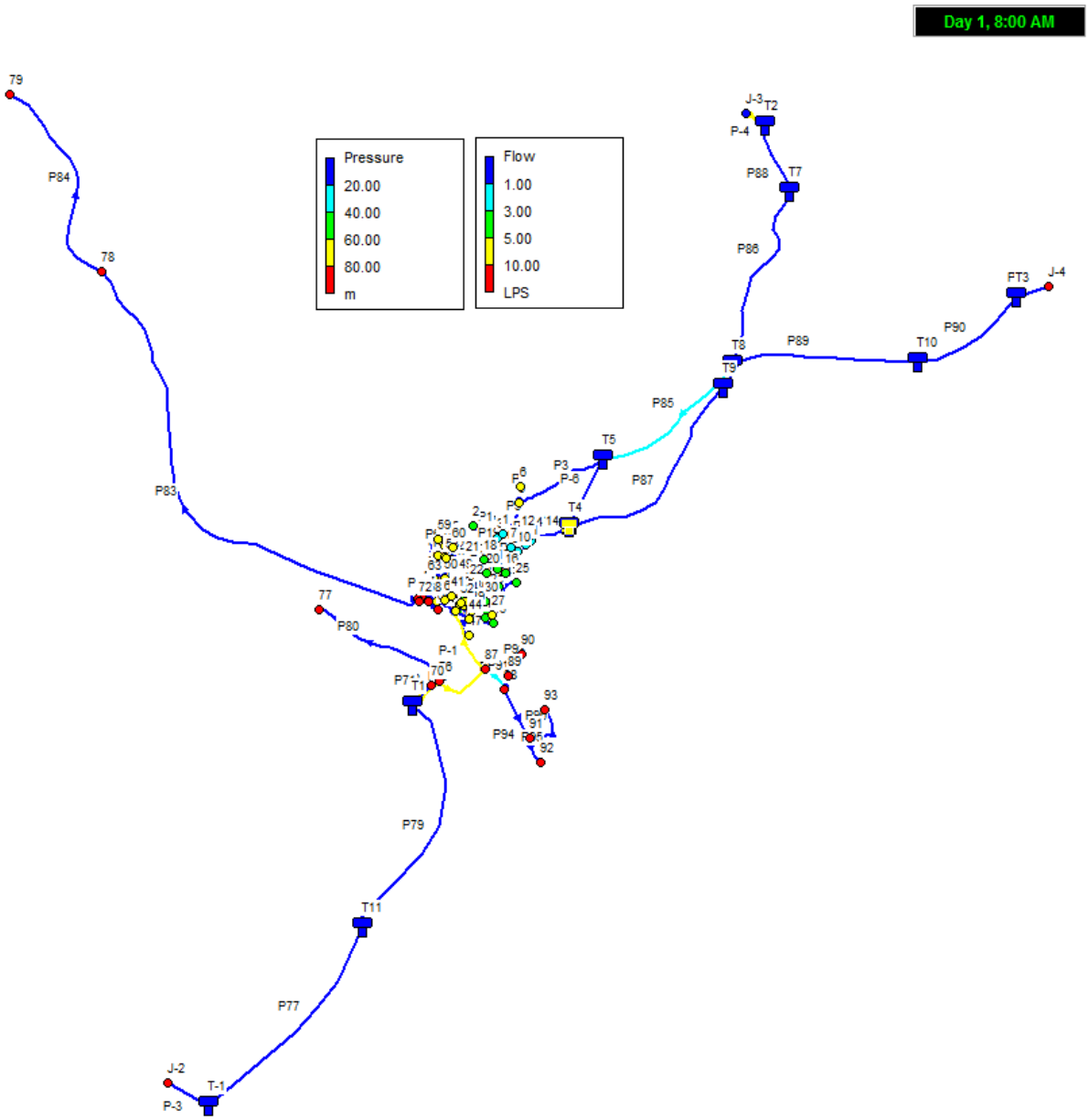
The geometry of the system that was on the disposal at the moment has been entered into the model and it probably have minor flows in terms of altitude of some facilities, but these errors do not substantially affect the results obtained by the model. It should be noted that the model is set only on the basis of theoretical data on consumption, distribution of consumption per nodes, daily and hourly consumption unevenness and that it is not calibrated. Upgrading the model should be continued in the future period just as well as to perform certain system measurements and based on those measurements make the calibration of the model in order to give as accurate information on the functioning of the system.

Two variants were made in this initial model, first for the conditions in 2010 and second for the conditions in the year 2030 i.e. for the end of planning period. Several other sub variants were made within these two variants but only two basic variants will be presented in this document.

VARIANT I – CONDITIONS IN 2010

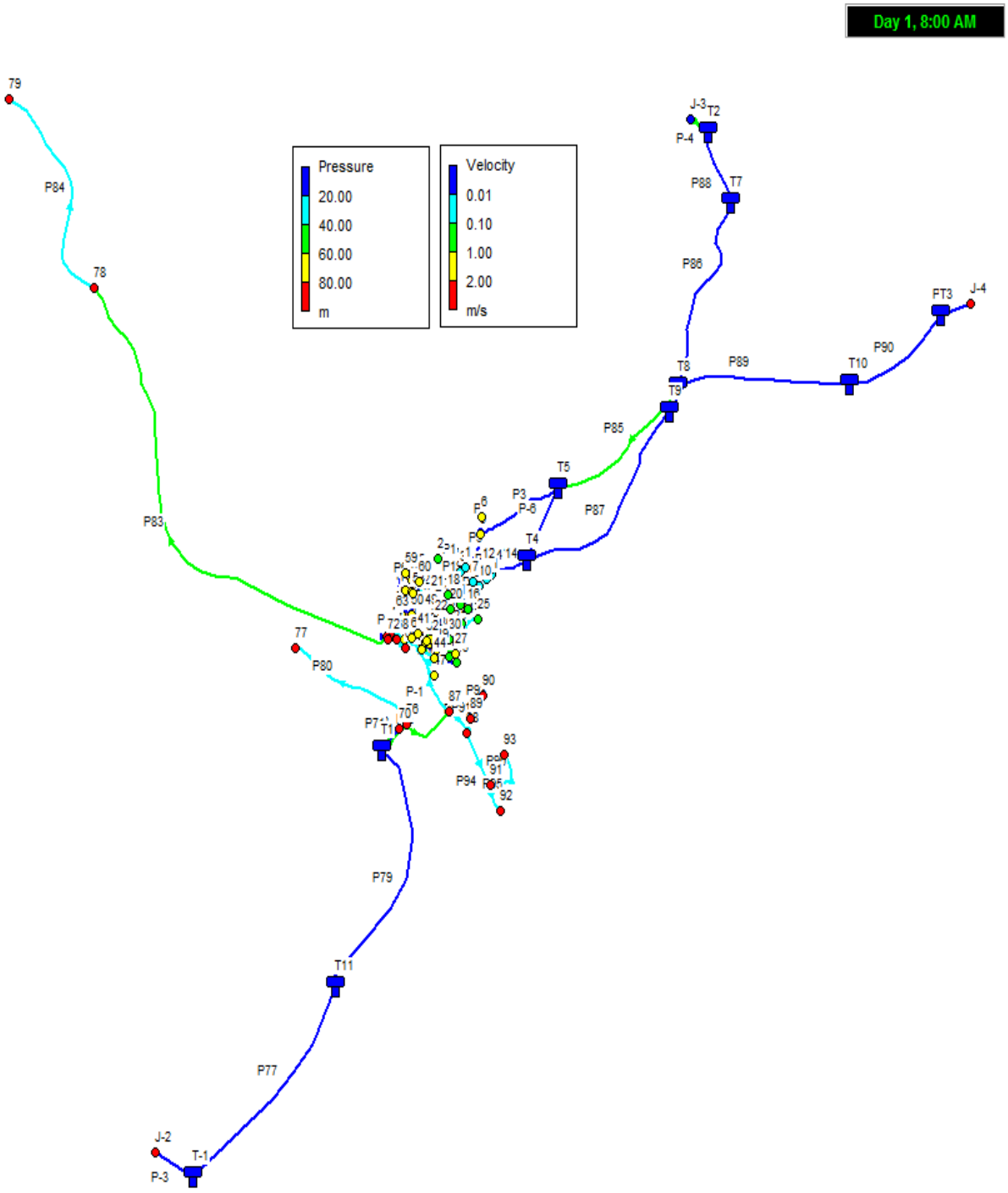
In the first variant the current consumption of 6.03 l/s was included in the calculation and distributed to nodes as well as other parameters from the Table 18.

The scheme below depicts flows in pipelines and pressures in nodes during peak daily consumption i.e. at 8 o'clock in the morning.



Scheme 1: Pressures in Nodes and Flows in Pipes during Peak Water Consumption

All pipelines are well dimensioned and there are no bottlenecks in the system. Some pipelines are even over dimensioned but there is no excessive water retention in them so it does not affect water quality.



Scheme 2: Pressures in Nodes and Velocities in Pipes during Peak Consumption without Pressure Reduction

It can be noted that velocity of water in all pipelines is within permissible range and that there are no bottlenecks in the system i.e. major pressure losses. Pressures in nodes in lower parts of the city are higher than 6 bar.

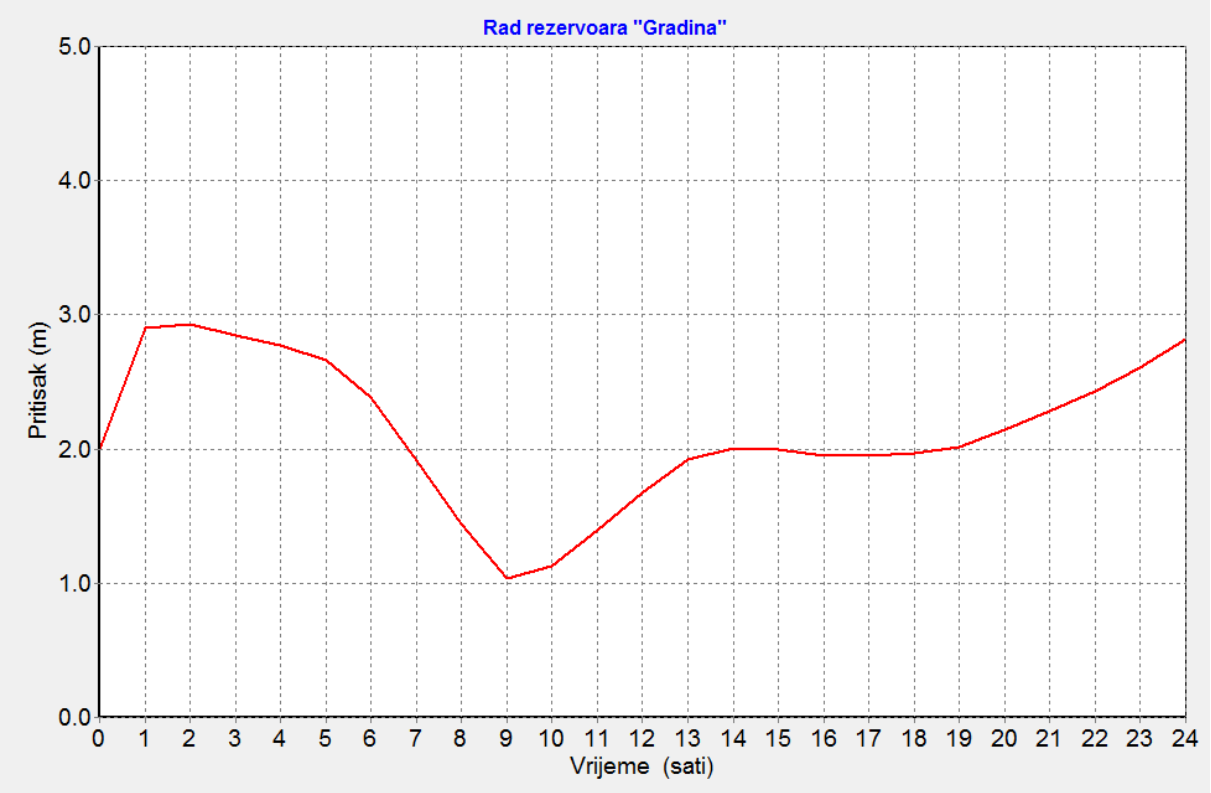


Chart 1: Functioning of "Gradina" Reservoir

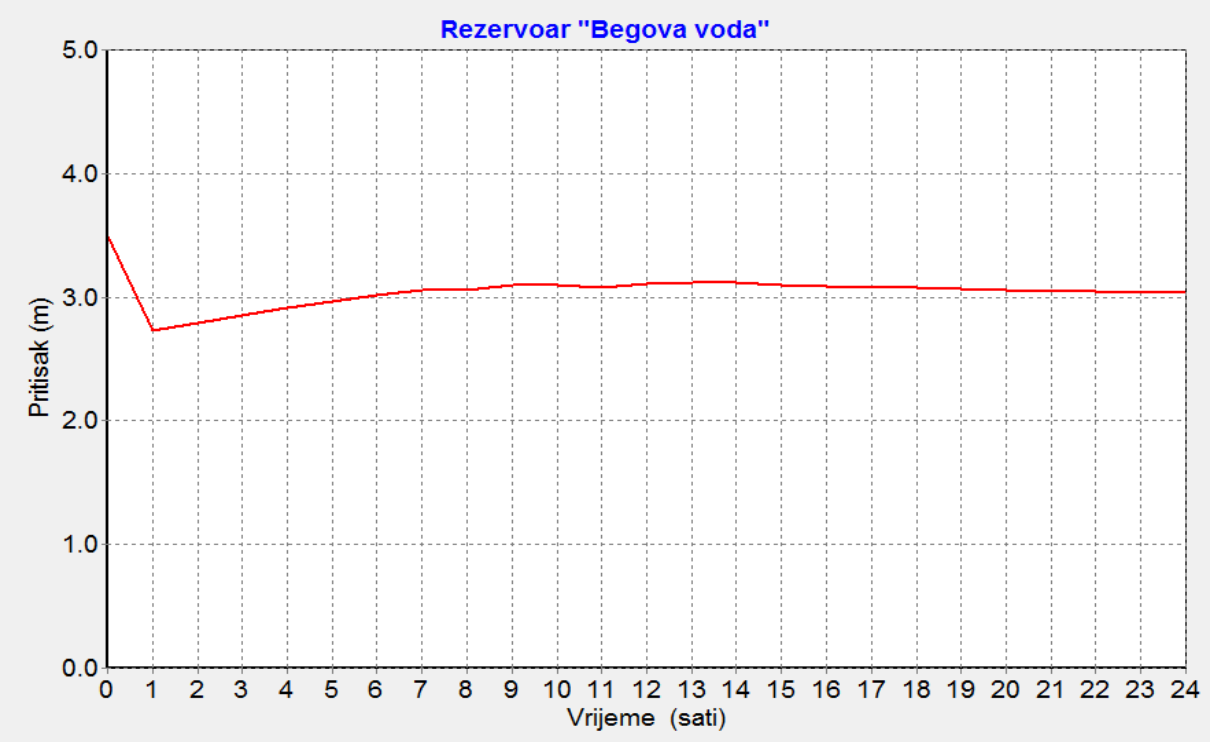


Chart 2: Functioning of "Begova voda" Reservoir

The two main reservoirs are now operating normally and they are rarely emptied completely.

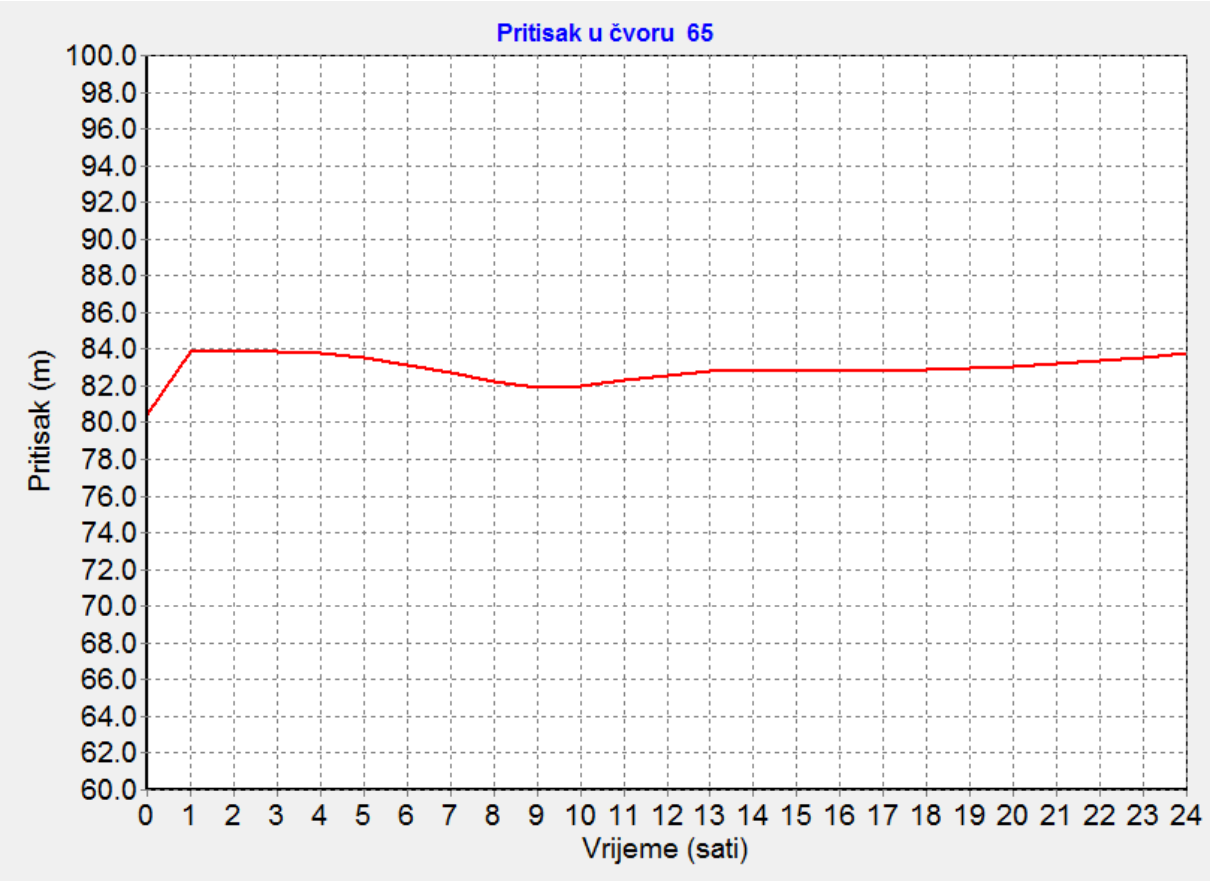


Chart 3: Typical Node with Pressures Higher than 8 bar

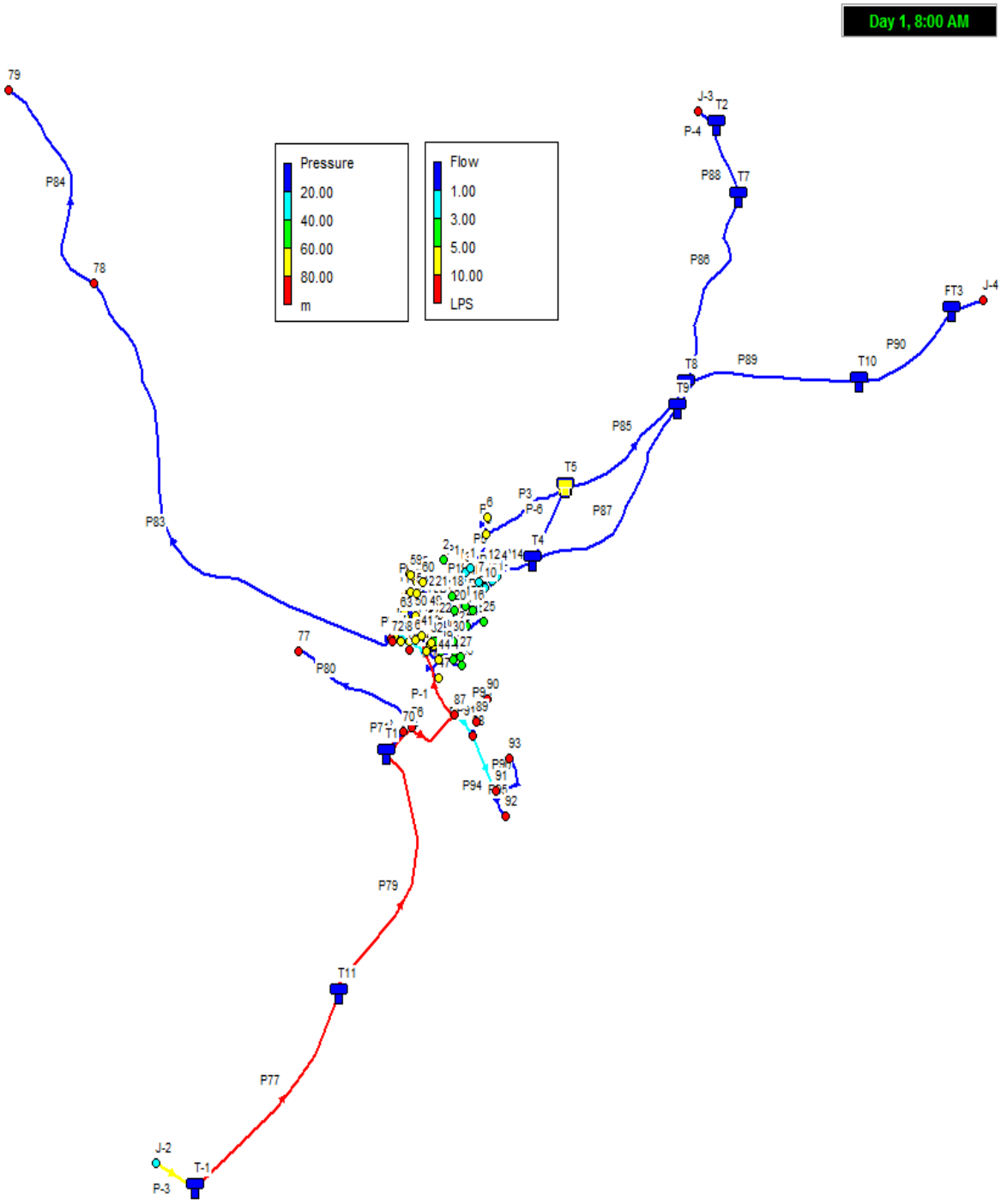
In a considerable part of distribution network pressures are too high which increases the losses in the system, affects the occurrence of a number of faults on installations at end users and increases the consumption of water.

Reservoirs are set quite high and in lower parts of network occurrence if high pressures is common i.e. pressures higher than 6 bar. In some nodes these pressures are up to 10 bar. This indicates the need of network zoning and at some nodes requires the installation of pressure regulating valves. At this point it is not possible to determine with certainty the points on which valves should be set because the calibration of the model has not been done yet. Project of network zoning should be developed in the coming period as well as defining precisely the positions of pressure reducing valve.

VARIANT II – CONDITIONS IN 2030

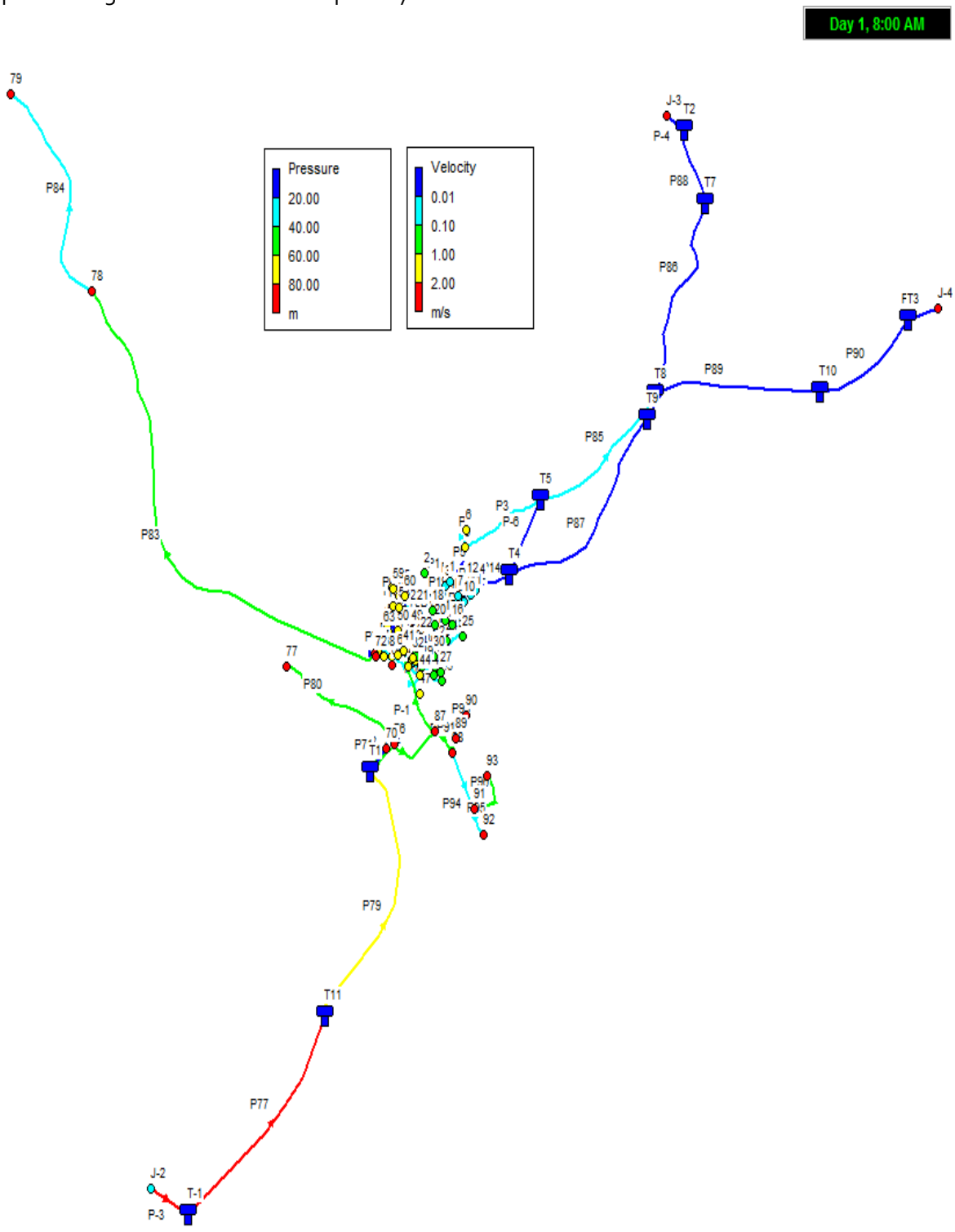
In the second variant consumption at the end of planning period of 12.80 l/s was included in calculation and distributed by nodes as well as all the other parameters from the Table 18.

The scheme below depicts flows in pipelines and pressures in nodes during peak daily consumption i.e. at 8 o'clock in the morning.



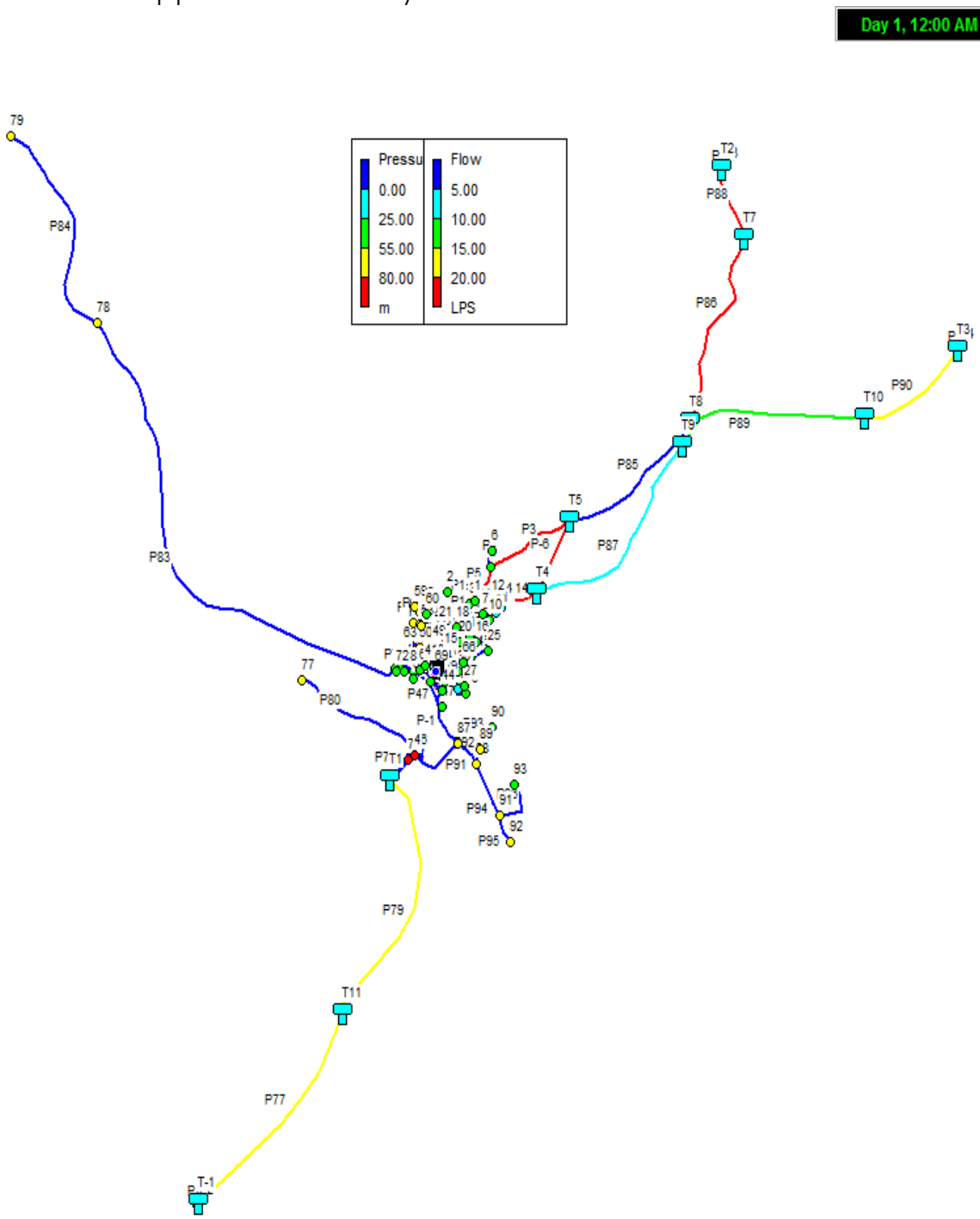
Scheme 3: Pressures in Nodes and Flows in Pipes during Peak Water Consumption without Pressure Reduction

All distribution network pipelines are well dimensioned and it is not necessary to increase pipe diameter. Transmission pipelines from the source to reservoir are also well dimensioned and they can pass through the available water quantity.



Scheme 4: Pressures in Nodes and Velocities in Pipes during Peak Consumption without Pressure Reduction

Water velocities in pipelines are satisfactory.



Scheme 5: Pressures in Nodes and Velocities in Pipes during Peak Consumption with Pressure Reduction

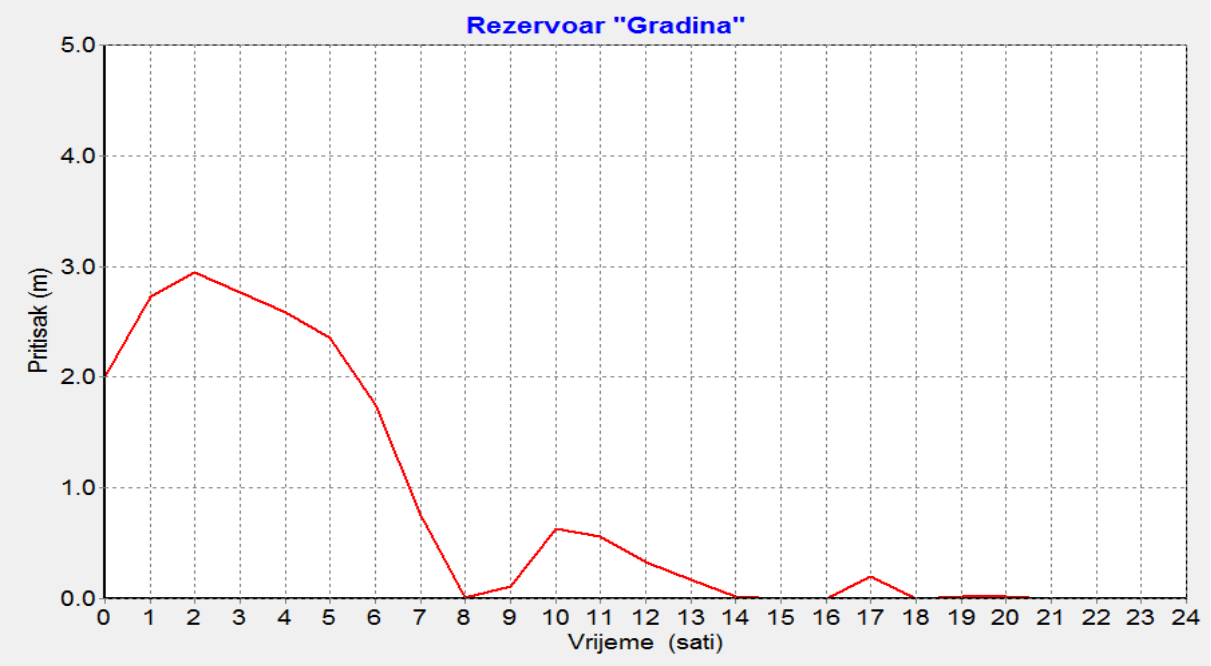


Chart 4: Functioning of "Gradina"Reservoir, Year 2030

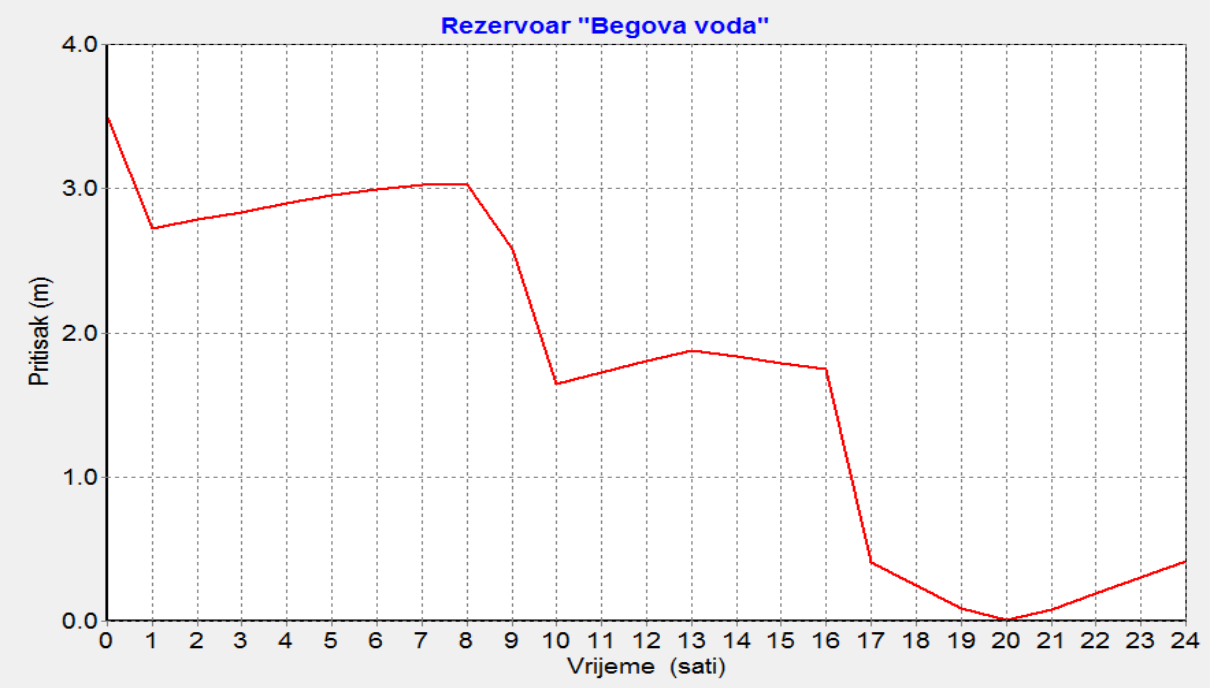


Chart 5: Functioning of "Begova voda" Reservoir, Year 2030

Reservoirs are being emptied during hours of peak water consumption due to lack of water in the system and the system will provide the water deficit by pumping additional amounts from the source "Krupica".

2.5.1.6 DISTRIBUTION NETWORK EFFICIENCY

Operation efficiency of the system can be expressed with the ratio. In the case of water supply system Rudo, the Network efficiency ratio can be given.

Network Efficiency is, as follows:

$$\textbf{Network Efficiency} = 1 - \frac{\text{Water Losses}}{\text{Inserted Water}} =$$

It is not possible to express the system efficiency for the Rudo municipality since there are no measurements of the amount of abstracted water at the sources.

Namely, in the European Union countries this coefficient ranges from **0.80** to **0.85**.

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 Meters,
- water invoicing for end users.

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

- visible, i.e. those easily detected without any complex research,
- and invisible, i.e. those whose detection requires various measurements, 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 meter,
- losses due to illegal connections,
- losses in household installations.

2.5.1.7 NON-REVENUE WATER QUANTITY

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

Definitions

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

I Physical water losses:

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

II Unmeasured delivered water free of charge:

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

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

- Insufficient water metering with poorly operating water meters or deficient water meters
- Inaccurate or routine water meter reading
- Users that cheat by breaking and destroying the water meters
- Illegal unmetered 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 m3/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 Rudo we can not speak about this efficiency, since no measurement of the source capacity, or the abstracted water amounts is taking place. The rest of the four ratios can be measured at any water supply distribution system. That system can be the entire municipal network or its smaller part, such as the pilot zone. All four ratios are expressed since the water amount volume inserted into the system is the same. The inserted water is measured by a large flow meter or estimated (for instance, based on the prescribed pumping amount). Inserted water can be lost in the following way:

Inserted water = Consumed water + Water losses

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

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

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

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

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

$$\text{Abstracted water}$$

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

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

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

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

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

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

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

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

Payment ratio will depend on the payment lag taken into account. For instance, calculating form the moment when all invoices are delivered, some invoices will be paid until the end of the first month, additional invoices will be paid until the end of the second month, and some invoices can be paid a year later. That is why it is necessary to determine the payment ratio period, such as "payment ratio within two months" or "payment ratio within one year ".

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 Rudo, 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 Rudo with the development of hydraulic model. In order to prepare a detailed plan for effective reduction of non-revenue water quantity the following procedure should at least be performed:

1. Metering of inserted water in the network (investments)
2. Study, training and loss detection plan

3. Active consumption metering policy and service management plan

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

Metering of water inserted in the network

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

Calculating ratios

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

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

In the case of water supply system Rudo, it can be calculated the **Efficiency payment ratio.** Other ratios cannot be calculated at this point, due to lack of water meters at sources and reservoirs. Only by establishing measurements, we will be able to talk about all the necessary ratios.

2.5.1.8 PUMPING STATIONS

Water supply system Rudo operates as a gravity system during most of the year. Pumping station Krupica is being used only at times of minimum yield of captured springs but it is not rare that during the rainy years is not being used at all. By inclusion of the spring „Jelovik" into the system needs for usage of pumping station „Krupica" will be reduced even more.

It is necessary to rehabilitate the pumping station and keep in reserve.

2.5.1.9 TRANSMISSION AND DISTRIBUTION PIPELINES

All transmission pipelines have sufficient capacity but the transmission pipeline from reservoir „Gradina" and capture structure „Zova 1" have a lot of losses and material (steel pipe with lead joints) is inadequate and it requires replacement of these pipelines.

Distribution network is in good condition and it requires only regular maintenance. Unreconstructed part of distribution network also needs to be restored.

Losses in water supply system should be reduced to a reasonable level (in our current situation 20 – 30 %).

2.5.1.10 MEASUREMENTS IN THE SYSTEM

It is necessary to perform system measurements at the sources, reservoirs, but also at the control measuring points and by end consumers. By installing water meters by end users in the last few years, situation has improved significantly concerning the quantities of Revenue water and reduction of the amount of Non-revenue water. Due to lack of water consumption measurements by end consumers and lump sum water charging the substantial amounts of water are being lost and spent without control.

One of the main reasons for more measurements in the system is certainly the control over system which is impossible without required measurements and this will be one of the priorities in the future.

2.5.1.11 WATER QUALITY

Water quality is satisfactory except for some occasional turbidity of some smaller springs. The problem of turbidity is solved by temporary exclusion of those springs from the system because they usually appear when there is enough water at the main source. In order to ensure safe drinking water it is necessary to provide adequate chlorination of all sources.

2.5.2 UVAC WATER SUPPLY SYSTEM

2.5.2.1 AVAILABLE WATER QUANTITY

Current amounts of water which are provided from the water supply system Priboj are sufficient. Balance of available water quantities is showed in Table 26 while the balance of required water quantities is shown in Table 23, i.e. the least favourable variant in terms of water consumption.

The plan envisages provision of water quantities for this settlement from the area of Rudo municipality in the way of capturing new springs „Zminica" and „Grozničava voda". It is evident from the mentioned review that for the planning period by 2030 for the development of this spatial unity there is a water surplus of around 2.01 l/s of drinking water provided that water losses reduce to a reasonable level i.e. not to exceed 20 % of produced water.

According to available data current capacity of all sources is ca. 4.5 l/s i.e. there is a water surplus of around 1.5 l/s at the end of planning period by 2030.

2.5.2.2 WATER REQUIREMENTS

Currently, the settlement Uvac has approximately 240 connections at individual households and 10 commercial properties (trade and catering facilities). The settlement is situated in a narrow strip of the river Uvac and Lim. Complete settlement belongs to one pressure zone.

Three variants of settlement development were done for Uvac settlement. Assessment of required water quantities and population projections for settlement Uvac were done and presented in Tables 23, 24 and 25 depending on the percentage of population growth and consumption of economy. According to the least favourable scenario in terms of water consumption when the percentage of population growth is the largest and when the share of economy is the largest, required water quantity according to those calculations is ca. 2.98 l/s. Total number of inhabitants is 610 at the end of planning period.

System is very sensitive in terms of water consumption in economy since the entire system is small. Water requirements of larger commercial properties should be solved by abstraction of water from the Uvac River and that will be solved by future commercial facilities on their own expense.

Table 23: Estimates of population and required water quantities for WSS Uvac

Optimistic Development Projection – Population Growth Rate: 1.00 %

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	capita	500	526	552	580	610	641
Population connected to the system	capita	450	499	552	580	610	641
Average specific water consumption of the population	l/capita/day	150	170	190	190	200	200
Percentage of population connected to the system	%	90,00	95,00	100,00	100,00	100,00	100,00
Average water consumption of population	l/s	0,78	0,98	1,21	1,28	1,41	1,48
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	0,12	0,15	0,18	0,19	0,21	0,22
Total average water consumption of population+ economy	l/s	0,90	1,13	1,40	1,47	1,62	1,71
Specific consumption of population + economy	l/capita/day	172,50	72,30	96,40	96,40	96,40	96,40
Total daily average water consumption of population + economy	m3/day	78	98	121	127	140	147
Total monthly average water consumption population +economy	m3/month	2.361	2.969	3.671	3.858	4.268	4.486
Total average annual water consumption population+ economy	m3/year	28.333	35.624	44.048	46.295	51.217	53.830
Coefficient of daily 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	1,17	1,47	1,82	1,91	2,12	2,23
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	0,15	0,18	0,23	0,24	0,26	0,28
Maximum daily water consumption in total(population+economy)	l/s	1,32	1,66	2,05	2,15	2,38	2,50
Average losses of water in the system in total	%	10,00	15,00	20,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	l/s	1,00	1,33	1,75	1,84	2,03	2,13
Average daily water amount needs with losses in total	m3/month	2.623	3.493	4.588	4.822	5.335	5.607
Specific population consumption + economy with losses	l/capita/day	191,67	230,00	273,13	273,13	287,50	287,50
Maximum daily water amount needs with losses in total	l/s	1,46	1,95	2,56	2,69	2,98	3,13

Table 24: Estimates of population and required water quantities for WSS Uvac

Realistic Development Projection – Population Growth Rate: 0.50 %

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	capita	500	513	526	539	552	566
Population connected to the system	capita	450	487	526	539	552	566
Average specific water consumption of the population	l/capita/day	150	170	190	190	200	200
Percentage of population connected to the system	%	90,00	95,00	100,00	100,00	100,00	100,00
Average water consumption of population	l/s	0,78	0,96	1,16	1,18	1,28	1,31
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	0,12	0,14	0,17	0,18	0,19	0,20
Total average water consumption of population+ economy	l/s	0,90	1,10	1,33	1,36	1,47	1,51
Specific consumption of population + economy	l/capita/day	172,50	72,30	96,40	96,40	96,40	96,40
Total daily average water consumption of population + economy	m3/day	78	95	115	118	127	130
Total monthly average water consumption population +economy	m3/month	2.361	2.896	3.493	3.581	3.865	3.962
Total average annual water consumption population+ economy	m3/year	28.333	34.751	41.916	42.974	46.378	47.549
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	1,17	1,44	1,73	1,78	1,92	1,97
Coefficient of daily variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	0,15	0,18	0,22	0,22	0,24	0,25
Maximum daily water consumption in total(population+economy)	l/s	1,32	1,62	1,95	2,00	2,16	2,21
Average losses of water in the system in total	%	10,00	15,00	20,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	l/s	1,00	1,30	1,66	1,70	1,84	1,88
Average daily water amount needs with losses in total	m3/month	2.623	3.407	4.366	4.476	4.831	4.953
Specific population consumption + economy with losses	l/capita/day	191,67	230,00	273,13	273,13	287,50	287,50
Maximum daily water amount needs with losses in total	l/s	1,46	1,90	2,44	2,50	2,70	2,77

Table 25: Estimates of population and required water quantities for WSS Uvac

Pessimistic Development Projection – Population Growth Rate: 0.10 %

Description of consumption	Measurement unit	Perspective population number at the system area					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the town	capita	500	503	505	508	510	513
Population connected to the system	capita	450	477	505	508	510	513
Average specific water consumption of the population	l/capita/day	150	170	190	190	200	200
Percentage of population connected to the system	%	90,00	95,00	100,00	100,00	100,00	100,00
Average water consumption of population	l/s	0,78	0,94	1,11	1,12	1,18	1,19
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	0,12	0,14	0,17	0,17	0,18	0,18
Total average water consumption of population+ economy	l/s	0,90	1,08	1,28	1,28	1,36	1,36
Specific consumption of population + economy	l/capita/day	172,50	72,30	96,40	96,40	96,40	96,40
Total daily average water consumption of population + economy	m3/day	78	93	110	111	117	118
Total monthly average water consumption population +economy	m3/month	2.361	2.839	3.356	3.373	3.569	3.586
Total average annual water consumption population+ economy	m3/year	28.333	34.065	40.277	40.479	42.823	43.037
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	1,17	1,41	1,67	1,67	1,77	1,78
Coefficient of daily variation of economy		1,25	1,25	1,25	1,25	1,25	1,25
Maximum daily water consumption of economy	l/s	0,15	0,18	0,21	0,21	0,22	0,22
Maximum daily water consumption in total(population+economy)	l/s	1,32	1,59	1,87	1,88	1,99	2,00
Average losses of water in the system in total	%	10,00	15,00	20,00	20,00	20,00	20,00
Average daily water amount needs with losses in total	l/s	1,00	1,27	1,60	1,60	1,70	1,71
Average daily water amount needs with losses in total	m3/month	2.623	3.340	4.196	4.217	4.461	4.483
Specific population consumption + economy with losses	l/capita/day	191,67	230,00	273,13	273,13	287,50	287,50
Maximum daily water amount needs with losses in total	l/s	1,46	1,86	2,34	2,35	2,49	2,50

Table 26: Water Balance in the Area of Uvac Water Supply System

Water Supply System	Requirements (Maximum Daily) (l/s)				Provided from the Source (l/s)					Surplus Water Quantity (l/s)			
	2010	2020	2030	2035	Source	2010	2020	2030	2035	2010	2020	2030	2035
WSS Uvac	1,46	2,56	2,98	3,13	Zminica	3,50	3,50	3,50	3,50	3,04	1,94	1,52	1,37
					Grozničava voda	1,00	1,00	1,00	1,00				
Total	**1,46**	**2,56**	**2,98**	**3,13**	**Total**	**4,50**	**4,50**	**4,50**	**4,50**	**3,04**	**1,94**	**1,52**	**1,37**

2.5.2.3 RESERVOIR SPACE BALANCE

The table below depicts the requirements for reservoir space in the planning period. Water supply system currently does not have the constructed reservoir space.

It is necessary to plan and built one reservoir storage volume of c.150 m3 for water supply system „Uvac" .

Table 27: An overview of required and available reservoir space in WSS Uvac

Required Reservoir Space for Uvac			
2010			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs**
1,46	63,28	0,00	63,28
2015			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs**
1,95	84,25	0,00	84,25
2035			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs**
2,69	116,32	0,00	116,32
Existing Reservoirs			
Reservoir	**Pressure Zone**	**Bottom Level (m.a.s.l.)**	**Storage Volume (m^3)**
X	X	X	0,00
	Total:		**0,00**

2.5.2.4 TRANSMISSION AND DISTRIBUTION PIPELINES

Transmission and distribution pipelines are made of galvanized pipes which are currently in a very poor condition. It is necessary to replace all pipelines.

Losses in the water supply system should be reduced to a reasonable level (in our situation 20 – 30 %).

2.5.2.5 MEASUREMENTS IN THE SYSTEM

Measurements in the system are conducted at the point of water delivery by Utility Company Priboj and by installing water meters by end users, situation is significantly improving in terms of determining quantities of Revenue Water and reduction of Non-revenue water quantities.

One of the main reasons for more measurements in the system is certainly the control over system which is impossible without required measurements and this will be one of the priorities in the future.

2.5.2.6 WATER QUALITY

Quality of water that is being currently used (Priboj Water Supply System) is good and regular controls of quality are performed as well as chlorination of water.

2.5.3 MOKRONOZI WATER SUPPLY SYSTEM

2.5.3.1 AVAILABLE WATER QUANTITY

Balance of available water quantities is presented in Table 31 while the balance of required water quantities is shown in Table 28 i.e. the least favourable variant in terms of water consumption. It is evident from the mentioned review that for the planning period by 2030 for the development of this spatial unity there is a water surplus of around 2.64 l/s of drinking water provided that water losses reduce to a reasonable level i.e. not to exceed 20 % of produced water.

According to available data current capacity of all sources is c. 4.2 l/s i.e. there is a water surplus of around 2.64 l/s at the end of planning period.

2.5.3.2 WATER REQUIREMENTS

The settlement Mokronozi has approximately 180 households. Due to the position of settlement in terms of altitude and enormous complexity of the village, it is not possible to fully integrate the entire settlement into one water supply system. In the future, the similar concept of water supply will be maintained which is currently organized through a number of smaller separate systems. Assessment of required water quantities and projected number of inhabitants was done for the largest system in Mokronozi i.e. the old water supply system of Priboj and it is shown in **Table 28**. According to these estimates total number of inhabitants at the end of planning period is approximately 390 inhabitants, and required water amount is around 1.68 l/sec.

Table 28: Estimates of population and required water quantities for WSS Mokronozi

Optimistic Development Projection – Population Growth Rate: 0.50 %

Consumption Description	Unit	Projected population in the area of the system					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the settlement	capita	**350**	**359**	**368**	**377**	**387**	**396**
Population connected to the system	capita	**315**	**341**	**368**	**377**	**387**	**396**
Average specific water consumption of the population	l/capita/day	150	170	190	190	200	200
Percentage of population connected to the system	%	90,00	95,00	100,00	100,00	100,00	100,00
Average water consumption of population	l/s	0,55	0,67	0,81	0,83	0,90	0,92
Total daily average water consumption of population + economy	**m^3/day**	**47**	**58**	**70**	**72**	**77**	**79**
Total monthly average water consumption population +economy	**m^3/month**	**1.437**	**1.763**	**2.126**	**2.180**	**2.353**	**2.412**
Total monthly average water consumption population +economy	**m^3/year**	**17.246**	**21.153**	**25.514**	**26.158**	**28.230**	**28.943**
Coefficient of daily 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	0,82	1,01	1,21	1,24	1,34	1,38
Total average water losses in the system	%	10,00	15,00	20,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	**l/s**	**0,61**	**0,79**	**1,01**	**1,04**	**1,12**	**1,15**
Total of needed average daily water quantity with losses	m^3/month	1.597	2.074	2.658	2.725	2.941	3.015
Specific water consumption population	l/capita/day	**166,67**	**200,00**	**237,50**	**237,50**	**250,00**	**250,00**
Total of needed maximum daily water quantity with losses	**l/s**	**0,91**	**1,18**	**1,52**	**1,56**	**1,68**	**1,72**

Table 29: Estimates of population and required water quantities for WSS Mokronozi

Realistic Development Projection – Population Growth Rate: 0.10 %

Consumption Description	Unit	Projected population in the area of the system					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the settlement	capita	350	352	354	355	357	359
Population connected to the system	capita	315	334	354	355	357	359
Average specific water consumption of the population	l/capita/day	150	170	190	190	200	200
Percentage of population connected to the system	%	90,00	95,00	100,00	100,00	100,00	100,00
Average water consumption of population	l/s	0,55	0,66	0,78	0,78	0,83	0,83
Total daily average water consumption of population + economy	**m^3/day**	**47**	**57**	**67**	**68**	**71**	**72**
Total monthly average water consumption population +economy	**m^3/month**	**1.437**	**1.728**	**2.043**	**2.053**	**2.172**	**2.183**
Total monthly average water consumption population +economy	**m^3/year**	**17.246**	**20.735**	**24.516**	**24.639**	**26.066**	**26.196**
Coefficient of daily 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	0,82	0,99	1,17	1,17	1,24	1,25
Total average water losses in the system	%	10,00	15,00	20,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	**l/s**	**0,61**	**0,77**	**0,97**	**0,98**	**1,03**	**1,04**
Total of needed average daily water quantity with losses	m^3/month	1.597	2.033	2.554	2.567	2.715	2.729
Specific water consumption population	l/capita/day	**166,67**	**200,00**	**237,50**	**237,50**	**250,00**	**250,00**
Total of needed maximum daily water quantity with losses	**l/s**	**0,91**	**1,16**	**1,46**	**1,46**	**1,55**	**1,56**

Table 30: Estimates of population and required water quantities for WSS Mokronozi

Pessimistic Development Projection – Negative Population Growth Rate: -0.50 %

Consumption Description	Unit	Projected population in the area of the system					
		2010	2015	2020	2025	2030	2035
Number of inhabitants in the settlement	capita	350	341	333	325	317	309
Population connected to the system	capita	315	324	333	325	317	309
Average specific water consumption of the population	l/capita/day	150	170	190	190	200	200
Percentage of population connected to the system	%	90,00	95,00	100,00	100,00	100,00	100,00
Average water consumption of population	l/s	0,55	0,64	0,73	0,71	0,73	0,71
Total daily average water consumption of population + economy	**m^3/day**	**47**	**55**	**63**	**62**	**63**	**62**
Total monthly average water consumption population +economy	**m^3/month**	**1.437**	**1.677**	**1.924**	**1.876**	**1.926**	**1.878**
Total monthly average water consumption population +economy	**m^3/year**	**17.246**	**20.121**	**23.086**	**22.514**	**23.113**	**22.541**
Coefficient of daily 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	0,82	0,96	1,10	1,07	1,10	1,07
Total average water losses in the system	%	10,00	15,00	20,00	20,00	20,00	20,00
Total of needed average daily water quantity with losses	**l/s**	**0,61**	**0,75**	**0,92**	**0,89**	**0,92**	**0,89**
Total of needed average daily water quantity with losses	m^3/month	1.597	1.973	2.405	2.345	2.408	2.348
Specific water consumption population	l/capita/day	**166,67**	**200,00**	**237,50**	**237,50**	**250,00**	**250,00**
Total of needed maximum daily water quantity with losses	**l/s**	**0,91**	**1,13**	**1,37**	**1,34**	**1,37**	**1,34**

Table 31: Water Balance in the Area of Mokronozi Water Supply System

Water Supply System	Requirements (maximum daily) (l/s)				Provided from the source (l/s)					Surplus Water Amount (l/s)			
	2010	2020	2030	2035	Source	2010	2020	2030	2035	2010	2020	2030	2035
WSS Mokronozi	0,91	1,52	1,68	1,72	Dobra voda	1,10	1,10	1,10	1,10	3,29	2,68	2,52	2,48
					Jorgovan	1,00	1,00	1,00	1,00				
					Crno vrelo	0,90	0,90	0,90	0,90				
					Badovina	1,20	1,20	1,20	1,20				
Total	**0,91**	**1,52**	**1,68**	**1,72**	***Total***	**4,20**	**4,20**	**4,20**	**4,20**	**3,29**	**2,68**	**2,52**	**2,48**

2.5.3.3 RESERVOIR SPACE BALANCE

The table below depicts the requirements for reservoir space in the planning period, as currently constructed reservoir spaces. Water supply system Mokronozi does not have the constructed reservoir space.

For the water supply system „Mokronozi", it is necessary to plan and built two reservoirs (for two pressure zones) with total volume of approximately 2 * 40.0 m^3.

Table 32: An overview of required and available reservoir space in WSS Mokronozi

Required reservoir space for Mokronozi			
2010			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs**
0,91	39,38	0,00	39,38
2015			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs**
1,18	51,13	0,00	51,13
2035			
Required Water Quantity (l/s)	**Required Reservoir Storage Volume (m3)**	**Existing Reservoir Space (m3)**	**Needs**
1,56	67,19	0,00	67,19
Existing Reservoirs			
Reservoir	**Pressure Zone**	**Bottom Level (m a.s.l.)**	**Storage Volume (m3)**
X	X	X	0,00
Total:			**0,00**

2.5.3.4 TRANSMISSION AND DISTRIBUTION PIPELINES

All transmission pipelines have sufficient capacity but transmission pipelines have a lot of losses from capture structure to consumers and material (asbestos cement) of pipes is inadequate which requires replacement of these pipelines.

Distribution network is old and worn out and it requires rehabilitation. The largest part of network was constructed during fifties of the last century. It is necessary to replace all pipelines.

Losses in the water supply system should be reduced to a reasonable level (in our situation 20 – 30 %).

2.5.3.5 MEASUREMENTS IN THE SYSTEM

It is necessary to perform system measurements at the sources, reservoirs, but also at the control measuring points and by end consumers. Due to lack of water consumption measurements by end

consumers and lump sum water charging the substantial amounts of water are being lost and spent without control.

One of the main reasons for more measurements in the system is certainly the control over system which is impossible without required measurements and this will be one of the priorities in the future.

2.5.3.6 WATER QUALITY

Water quality is satisfactory except for occasional turbidity of some springs. It is necessary to provide adequate chlorination at all sources to ensure safe drinking water.

2.5.4 OTHER SMALL WATER SUPPLY SYSTEMS IN THE MUNICIPALITY

2.5.4.1 LOCAL COMMUNITY MIOČE

There are several small water supply systems in this local comunity.

Source Mlakva

The system services seventeen households. In the summer months, when there is not enough water, the population is supplied from other systems.

Source Podbić

The system services sixteen households. Nine households use gravity system while five households use small pumps for pumping water.

Source Blatine

The system services four households, small pumps are in use and the amount of water is sufficient.

Source Saračev Do

The system services five households, the system is gravitational and the amount of water is sufficient.

Source Zavoda

The system services six households, the system is gravitational and the amount of water is sufficient.

Source Grabovi

The system services three households. The system is gravitational and water shortage occurs during the summer months.

Generally, around 40 households in Mioče settlement has a problem with water supplying i.e. there is not enough water in the summer period.

One possible way of solving this problem is to connect these households to water supply system Mokronozi, and/or taking surplus water from the system „Dobra voda" from the territory of Mokronozi.

2.5.4.2 LOCAL COMMUNITY ŠTRPCI

Local Community Štrpci has two independent water supply systems.

Source Zapoda

The system supplies with water around 50 households. Water supply system consists of capture structure „Zapoda" capacity cca 50 l/min, reservoir with storage volume 40.0 m3, transmission

pipeline length of 500 m and distribution network length of around 500 m . Transmission pipeline is made of PVC pipes DN 90/80 mm while distribution pipeline is made of AC pipes.

Water meters have not been installed in end users' homes and water is free of charge which makes maintenance of the system difficult. The system has also some illegal connections. It is presumed that distribution network has a lot of losses.

Source Andžići

The system supplies with water around 50 households, the school, the residential building and the church. Water supply system consists of capture structure capacity of cca 30 l/min, transmission pipeline of the unknown length leading to the reservoir and reservoir storage volume 20 m3. Two independent distribution pipelines branch from the reservoir. Pipeline made from PE DN 63/50 mm total length of around 1,200 m supplies the school, residential building and the church. The second pipeline made from AC pipes length of around 100 m supplies households with water.

Water meters have not been installed in end users' homes and water is free of charge which makes maintainance of the system difficult. The system has also some illegal connections. It is presumed that distribution network has a lot of losses which requires its replacement. Capture structure is also worn out, with the occurrence of leakage and it requires repair.

2.5.4.3 LOCAL COMMUNITY BIJELO BRDO

Water supply system is consists of two independent systems.

Source Laništa

Capacity of this source is around 8 l/min. It consists of capture structure, reservoir divided into 4 chambers of the unknown storage volume, distribution pipeline total length of around 1,500 m diameter of DN 50 mm. The system supplies motel, post office, rural ambulance, 14 households and three public drinking fountains.

There is not enough water in the summer months and one possible solution could be disconnection of illegal consumers from the network which have its own independent water supply systems.

Source Josipov Do

This system consists of capture structure, reservoir storage volume 5.0 m3 and pipeline of total length cca 4,500m. Pipeline has diameter of 30 mm and the system services with water the church and four households. This system has sufficient water quantities for consumers currently connected the system.

2.5.4.4 LOCAL COMMUNITY MRSOVO

Source Jabučnica

Capacity of the source is cca 47 l/min but it currently abstracts around 7 l/min. Transmission pipeline from capture structure to reservoir is made from PE pipes DN 40 mm total length of around 1,250 m. Twenty one households are connected to the system. Currently, the system has sufficient amounts of water.

This system does not require any repairs.

2.6 ANALYSIS AND CAPACITY ASSESSMENT OF PARTNER MUNICIPALITIES AND ASSOCIATED WATER UTILITY COMPANIES

2.6.1 ANALYSIS AND ASSESSMENT OF PARTNER MUNICIPALITY RUDO AND ASSOCIATED UTILITY COMPANY

Conditions of water supplying in the territory of Rudo Municipality is primarily determined by geographical location and properties of the terrain on which the Municipality lies.

Rudo Municipality covers the area of 344 km2, while the town of Rudo is situated in a hilly and mountainous region of lower course of the Lim River, about twenty kilometres before its confluence with the Drina River. It is surrounded by mountain peaks height of approx. 1,300 m.a.s.l.

Population of Rudo Municipality is predominantly rural and it's unevenly distributed over the territory of the Municipality with a relatively low population density of 29 inhabitants per square kilometre.

Rudo Municipality belongs to underdeveloped municipalities within Republic of Srpska with poorly developed industry and some smaller capacities of wood processing, metal and chemical industry. There is a steady decrease of industrial activities as a result of privatization process and transition, as well as the overall economic stagnation.

This situation is reflected on the structure of employees in the territory of Rudo Municipality, thus, approx. 700 people works in a state/public sector and 3,500 are in agriculture. It is estimated that there are approx. 1,490 people who are unemployed.

The company ODJKP „Usluga" a.d. Rudo is responsible for providing utilities in the territory of Rudo Municipality. The company is engaged in providing of services of water supply, collection and disposal of waste water, maintenance and cleaning of green and public areas, collection and disposal of solid waste.

According to data provided by the ODJKP „Usluga" a.d. Rudo company which manages the system, current collection rate for delivered water is approximately 65 %. The current costs of these services are, as follows:

- Water supply services
  - Households 0.60 BAM/m^3
  - Economy 1.50 BAM/m^3

2.6.2 FINANCIAL ASSESSMENT OF UTILITY COMPANY

According to data from ODJKP „Usluga" a.d. Rudo, in 2010 it was produced c. 1, 889,000.00 m3 of water. Out of which the Revenue water makes 345,100.00 m3 of water or 18 %. Non-revenue water quantity makes 1, 554, 900.00 m3 of water or 82 %.

The thing that raises attention is the unevenness in cost of services and its share in total revenues depends on the type of consumer.

Current value of water supply services is, as follows:

- Households 0.60 BAM/m3
- Economy 1.50 BAM/m3

Total (accounted for) income from water supply services amounts to BAM 157,089.28, out of which cash income with collection rate of 65% at the annual level makes approx. BAM 102107 i.e. BAM 8,500 per month.

It is obvious that existing revenues of utility company are not sufficient to cover not even the basic operating costs. However, as the utility company is engaged in providing some other utility services, there is a spilling over of funding resources from more profitable towards less profitable activities. The exact direction of this spilling over of funds is not possible to determine for the lack of separate bookkeeping for different activities.

According to its size, diversity of the system and consumers ODJKP „Usluga" a.d. Rudo would be struggling to achieve the economic sustainability of water supply system even in the much better economic environment/background. Lack of investments in water supply system over the many years as well as the lack of secure funding sources resulted in extremely high level of Non-revenue water which is estimated to 82% of the total produced water quantities.

Material equipment of ODJKP „Usluga" a.d. Rudo is also insufficient and it requires procurement of new equipment as well as the reorganization of work with clearly defined objectives to be achieved in the future.

2.7 REHABILITATION AND EXTENSION OF WATER SUPPLY SYSTEMS

2.7.1 WSS RUDO – REQUIRED MEASURES FOR REHABILITATION AND RECONSTRUCTION

The previous chapters showed the main problems in water supply system. Losses in the water supply system are indicated as one of the main problems. Losses must be reduced to a reasonable level in order to improve efficiency of water utility company operation and to reduce company's financial losses but primarily to solve the problem of deficit of available water quantities delivered by gravity system and reduction of costs for water pumping from the spring „Krupica". Loss reduction is the first measure which should be implemented with the aim of providing sufficient water quantities in the system.

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

- **Establishing GIS and developing a Hydraulic model of WSS for better control of the system and better insight into the state of water supply system,**
- **Measurements and fault detection in the system,**
- **Defects removal on the water distribution network,**
- **Replacement of pipeline sections with observed major losses of water and continuously occurring losses,**
- **Defects removal in the household installations – this must be carried out in coordination with owners of the facilities and Housing companies,**
- **Obtain equipment for detection of defects (correlator and mobile ultrasonic flow meter) and train a team for their detection for this must become regular future activity,**
- **Existing water meters calibrate, defective water meters replace and install water meters on the connections where there are no any,**
- **Make record of all connections,**
- **Replacement of pipelines in industrial zone,**

- **Replacement of defective valves at nodes and construct inspection chambers on those nodes,**
- **Replacement of transmission pipelines from captures to reservoirs,**
- **Rehabilitation of existing reservoirs and break-pressure chambers,**
- **Rehabilitation of captures,**
- **Rehabilitation of chlorination equipment**.

Necessary measures for water supply system monitoring

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

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

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

Priorities in solving problems are, as follows::

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

2.7.2 WSS UVAC – NECESSARY MEASURES FOR REHABILITATION AND RECONSTRUCTION

The previous chapter shows the main problems in water supply system. Losses in the water supply system and providing water for this settlement form the territory of Rudo Municipality are indicated as one of the main problems. Losses must be reduced to a reasonable level in order to improve efficiency of water utility company operation and to reduce company's financial losses.

Basic activities that should be implemented can be grouped into the following steps:

- Project documentation development for capturing new sources, construction of transmission pipelines, reservoir construction as a replacement for distribution network,
- Replacement of pipeline sections with observed major losses of water and continuously occurring losses,

- Defects removal in the household installations – this must be carried out in coordination with owners of the facilities and Housing companies,
- Existing water meters calibrate, defective water meters replace and install water meters on the connections where there are no any,
- Make record of all connections,
- Capturing of the new sources,
- Construction of transmission pipeline from capture structure to reservoir,
- Construction of reservoir,
- Installation of chlorine equipment,
- Development of a study on new source protection zones.

Priorities in solving problems are, as follows:

- Source capturing,
- Transmission pipeline construction,
- Reservoir construction,
- Distribution network construction,
- Establishing metering in the system by installing the flow meters at system facilities and at end user.

2.7.3 WSS MOKRONOZI – REQUIRED MEASURES FOR REHABILITATION AND RECONSTRUCTION

The previous chapter shows the main problems in water supply system. Losses and providing reservoir space in the water supply system are indicated as one of the main problems. Certainly, losses must be reduced to a reasonable level in order to improve efficiency of water supply system, but most of all to address the problem of insufficient amounts of available water.

Basic activities that should be implemented can be grouped into the following steps:

- Project documentation development for construction of reservoir as a replacement for distribution network,
- Replacement of pipeline sections with observed major losses of water and continuously occurring losses,
- Defects removal in the household installations – this must be carried out in coordination with owners of the facilities and Housing companies,
- Establishing metering at sources and reservoirs and by end users,
- Make record of all connections,
- Construction of reservoir,
- Installation of chlorine equipment,
- Development of a study on new source protection zones.

Priorities in solving problems are, as follows:

- Construction of reservoirs,
- Reconstruction of distribution network,

- Establishing metering in the system by installing the flow meters at sources and at end users.

2.8 PRICED BILL OF QUANTITIES FOR REHABILITATION AND EXTENSION OF THE SYSTEM

2.8.1 WSS RUDO

2.8.1.1 LOSS REHABILITATION AND DOCUMENTATION DEVELOPMENT

S.n.	Source Protection, GIS, Hydraulic Model, Defect Removal, System Monitoring and Procurement of Equipment for Defect Removal and Project Documentation Development	Total Cost (BAM)
1	Source Protection Study Development	60.000,00
2	Development of hydraulic model of water supply system	35.000,00
3	Equipment Procurement and Water Supply System Monitoring	80.000,00
4	Project Documentation Development at the Level of the Main Projects	30.000,00
5	Network Research and Failure Repair in the First 10 Years	100.000,00
6	Network Research and Failure Repair in the period 2021 - 2035	150.000,00
	Total:	455.000,00

2.8.1.2 REHABILITATION OF RESERVOIRS

Rehabilitation of "Zova 1" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the reservoir.	9000,00
2	Replacement of hydro mechanical equipment	5000,00
3	Procurement and installation of chlorination equipment	2000,00
4	Building the fence around the facility	2000,00
	Total:	**18000,00**

Rehabilitation of "Begova voda" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the reservoir	2000,00
2	Replacement of hydro mechanical equipment	2000,00
3	Procurement and installation of chlorination equipment	2000,00
4	Building the fence around the facility	1000,00
	Total:	**7000,00**

Rehabilitation of "Gradina" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the reservoir	2000,00
2	Replacement of hydro mechanical equipment	2000,00
4	Rehabilitation the fence around the facility	1000,00
	Total:	**5000,00**

Rehabilitation of System Break-Pressure Chambers

S.n.	Description	Cost (BAM)
1	Construction works for break –pressure chambers Rehabilitation in terms of manhole covers' replacement and some minor concrete works on facilities. Total of 4 break-pressure chambers need rehabilitation	4000,00
2	Rehabilitation the fence around the facility	1500,00
	Total:	**5500,00**

Recapitulation		
1	Rehabilitation of "Zova 1" Reservoir	18000,00
2	Rehabilitation of "Zova 2" Reservoir	7000,00
3	Rehabilitation of "Gradina" Reservoir	5000,00
5	Rehabilitation of System Break-Pressure Chambers	5500,00
	TOTAL FOR RESERVOIRS:	**35500,00**

2.8.1.3 REHABILITATION OF THE SOURCES

Rehabilitation of "Zova 1"Source

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the capture	2000,00
3	Rehabilitation of terrain around the capture	500,00
4	Replacement of hydro mechanical equipment	1000,00
5	Rehabilitation the fence around the facility	1000,00
	Total:	**4500,00**

Rehabilitation of "Begova voda" Source

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the capture	2000,00
2	Rehabilitation of terrain around the capture	500,00
3	Replacement of hydro mechanical equipment	1000,00
4	Rehabilitation the fence around the facility	1000,00
	Total:	**4500,00**

Recapitulation		
1	Rehabilitation of "Zova 1" Source	4500,00
2	Rehabilitation of "Begova voda" Source	4500,00
	TOTAL FOR SOURCES:	**9000,00**

2.8.1.4 REHABILITATION OF PIPELINES

Rehabilitation of transmission pipelines

S.n.	Description	Cost (BAM)
1	Pipeline from the reservoir "Gradina" to the town. Current pipeline is made of cast iron pipes DN 300 mm with total length of around 400 m. Pipelines needs replacement with the pipeline of the same diameter DN 300 mm and possible material is a PE class 100. The pipeline runs in soil of IV, V and VI category. The route of the pipeline crosses the bridge and goes along Rudo-Priboj main road. 400m * 400 BAM/m	160000,00
2	Pipeline from the capture structure "Zova 1" to the reservoir "Zova1". Current pipeline is made of AC pipes DN 80 mm. New pipeline would be made of a PE 100 pipe with inner diameter DN 80 mm. It is possible to partially modify the existing route in order to shorten the pipeline, easier terrain and better land for excavation. There are a lot of air valves, sludge discharge pipes and break-pressure chambers on the pipeline. Estimated length of pipeline is around 1000 m.	50000,00
3	Pipeline from capture "Begova voda" to reservoir "Begova voda". Current pipeline is made of AC pipes DN 100 mm. New pipeline would be made of a PE 100 pipe with inner diameter DN 100 mm. It is possible to partially modify the existing route in order to shorten the pipeline, easier terrain and better land for excavation. Estimated length of pipeline is around 1500 m.	75000,00
	Total:	**285000,00**

Replacement of Distribution Network Pipelines and Pressure Regulation

S.n.	Description	Cost (BAM)
1	Rehabilitation of water supply network in industrial zone. It is necessary to replace Cast iron pipeline DN 150 mm in length of around 500 m and AC pipeline DN 50 mm in length of around 800 m.	52000,00
2	Manhole construction for installation of pressure converters. Two regulatory manholes need to be constructed.	30000,00
	Total:	**82000,00**

Recapitulation		
1	Replacement of Transmission Pipelines	285000,00
2	Replacement of distribution network pipelines	82000,00
	TOTAL FOR PIPELINES REPLACEMENT:	**367000,00**

OVERALL RECAPITULATION

1	Source Protection, GIS, Hydraulic Model, Defect Removal, System Monitoring and Procurement of Equipment for Defect Removal and Project Documentation Development	455000,00
2	"Krupica" Pumping Station	29000,00
3	Rehabilitation of Reservoir and Break-Pressure Chambers	35500,00
4	Source Rehabilitation	9000,00
5	Replacement of Transmission Pipelines	285000,00
6	Replacement of Distribution Network Replacement and Pressure Regulation	82000,00
	TOTAL :	**895500,00**

2.8.2 WSS UVAC

Construction of captures "Zminica" and "Grozničava voda"

S.n.	Description	Cost (BAM)
1	Construction works on building the captures	16500,00
3	Rehabilitation of terrain around the capture	2000,00
4	Installation of Hydro mechanical equipment	4000,00
5	Building the fence around the facility	2500,00
	Total:	**25000,00**

Construction of "Zminica" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on building the reservoir storage volume of 150 m3.	90000,00
2	Installation of Hydro mechanical equipment	3500,00
3	Procurement and installation of chlorination equipment	1000,00
4	Building the fence around the facility	1500,00
	Total:	**96000,00**

Construction of transmission and distribution pipelines

S.n.	Description	Cost (BAM)
1	Construction of transmission pipeline from the capture "Zminica" to Reservoir. Pipeline has diameter of DN 90 mm and possible material is PE Class 100. The pipeline runs in soil of III and IV category, total length of 500 m.	25000,00
2	Construction of transmission pipeline from capture "Grozničava voda" to Reservoir. Pipeline has diameter of DN 63 mm and possible material is PE Class 100. Pipeline runs in the soil of III and IV category, total length of 2000 m.	50000,00
3	Construction of transmission distribution pipeline from reservoir "Zminica" to Uvac settlement. The pipeline has diameter of DN 110, 90, 63 mm and possible material is PE Class 100. Pipeline runs in a soil of III and IV category and total length of pipeline is around 10,000 m. On the part of the system where the reconstruction of the existing water network is under way, new pipeline runs the rout of the existing one in order to the reconstruction of connections.	500000,00
	Total:	**575000,00**

RECAPITULATION FOR WSS UVAC		
1	Construction of "Zminica" Reservoir	25000,00
2	Construction of captures "Zminica" and "Grozničava voda"	96000,00
3	Construction of transmission and distribution pipelines	575000,00
	TOTAL :	**696000,00**

2.8.3 WSS MOKRONOZI

Construction of "Badovine" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on building the reservoir storage volume of 40 m3.	24000,00
2	Installation of Hydro mechanical equipment	3000,00
3	Procurement and installation of chlorination equipment	1000,00
4	Building the fence around the facility	1000,00
	Total:	**29000,00**

Construction of "Badovine" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on building the reservoir storage volume 40 m3.	30000,00
2	Installation of Hydro mechanical equipment	3000,00
3	Procurement and installation of chlorination equipment	1000,00
4	Building the fence around the facility	1000,00
	Total:	**35000,00**

Construction of "Jorgovan" Reservoir

S.n.	Description	Cost (BAM)
1	Construction works on building the reservoir storage volume 40 m3.	30000,00
2	Installation of Hydro mechanical equipment	3000,00
3	Procurement and installation of chlorination equipment	1000,00
4	Building the fence around the facility	1000,00
	Total:	**35000,00**

Rehabilitation of captures "Dobra voda" , "Badovine" , "Jorgovan" and "Crno vrelo"

S.n.	Description	Cost (BAM)
1	Construction works on rehabilitation of captures	6000,00
3	Rehabilitation of terrain around capture	1000,00
4	Replacement of Hydro mechanical equipment	1000,00
5	Building the fence around the facility	2000,00
	Total:	**10000,00**

Replacement of transmission and distribution pipelines

S.n.	Description	Cost (BAM)

1	Pipeline from capture structure "Dobra voda" to capture "Badovina" and then from capture "Jorgovan" to capture "Crno vrelo". Existing pipeline is made of cast iron pipes DN 100 and 160 mm total length of around 5,000 m. Pipeline needs to be replaced with pipeline diameter of DN 140 and 90 mm and possible material is PE Class 100. Pipeline runs in a soil of III and IV category. Cost includes the replacement of one part of connective pipelines as well as the installation of water meters by end users.	350000,00
	Total:	**350000,00**

RECAPITULATION FOR WSS MOKRONOZI		
1	Construction of "Badovine" Reservoir	35000,00
2	Construction of "Jorgovan" Reservoir	35000,00
3	Construction of "Subašina voda" Reservoir	11000,00
	Rehabilitation of capture structures "Dobra voda" , "Badovine" , "Jorgovan" and "Crno vrelo"	10000,00
	Replacement of transmission and distribution pipelines	350000,00
	TOTAL :	**441000,00**

2.8.4 OTHER SMALL WATER SUPPLY SYSTEMS

Seq. Num.	**Description**	**Total (BAM)**
1	Rehabilitation and extension of WSS Mioče	100000,00
2	Rehabilitation and extension of WSS Štrpci	25000,00
3	Rehabilitation of WSS Bijelo brdo	5000,00
	TOTAL:	**130000,00**

2.8.5 OVERALL RECAPITULATION FOR RUDO MUNICIPALITY

Seq. Num.	Water Supply System	Total (BAM)
1	WSS Rudo	895.500,00
2	WSS Uvac	696.000,00
3	WSS Mokronozi	441.000,00
4	Small water supply systems	130.000,00
	TOTAL FOR MUNICIPALITY:	**2.162.500,00**

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

3.1 INTRODUCTION

On the basis of the criteria developed in the long-term water supply plan and taking into consideration macro-available assessment and investment capability, the priority tasks are defined as follows:

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

3.2 PRIORITIZED PROJECT LIST WITH DYNAMIC IMPLEMENTATION PLAN

3.2.1 PRIORITIZED PROJECT LIST

3.2.1.1 RUDO WATER SUPPLY SYSTEM

As priority investments in rehabilitation and expansion of water supply system the following activities are proposed:

S.n.	Source Protection, GIS, Hydraulic Model, Fault Removal, System Monitoring, Procurement of equipment for Defect Removal and Project Documentation Development	Total Cost (BAM)
1	Study on Source Protection	60.000,00
2	Developing Hydraulic Model of Water Supply System	35.000,00
3	Equipment Procurement and Water Supply System Monitoring	80.000,00
4	Development of Project Documentation on the Level of Main Projects	30.000,00
5	Network Research and Fault Removal in the first 10 Years	100.000,00
	Total:	305.000,00

Pumping Station "Krupica"

S.n.	Description	Cost (BAM)
1	Reconstruction of pumping station facility, Replacement of roof structure, Building façade, Reconstruction of electrical installation, Building a fence around the facility, Replacement of doors and windows, Indoor wall treatment. The facility covers an area of 12 m2	8000,00
2	Replacement of Pumps	12000,00
3	Replacement of hydro mechanical equipment	4000,00
4	Installation of signalling system between reservoir "Gradina" and pumping station "Krupica" for pumping station automaton operation.	5000,00
	Total:	**29000,00**

Rehabilitation of reservoir "Zova 1"

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the reservoir.	9000,00
2	Replacement of hydro mechanical equipment	5000,00
3	Procurement and installation of the chlorination equipment	2000,00
4	Building the fence around the facility	2000,00
	Total:	**18000,00**

Rehabilitation of reservoir "Gradina"

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the reservoir	2000,00
2	Replacement of hydro mechanical equipment	2000,00
4	Rehabilitation of the fence around the facility	1000,00
	Total:	**5000,00**

Rehabilitation of System Break - Pressure Chambers

S.n.	Description	Cost (BAM)
1	Construction works on restoration of pressure relief chambers which relates to replacement of manhole covers and some minor concrete works on the facilities. It is necessary to restore total of approx. four pressure relief chambers.	4000,00
2	Rehabilitation of the fence around the facility	1500,00
	Total:	**5500,00**

Rehabilitation of the Source "Zova 1"

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the capture structure	2000,00
3	Rehabilitation of terrain around capture structure	500,00
4	Replacement of hydro mechanical equipment	1000,00
5	Rehabilitation of the fence around the facility	1000,00
	Total:	**4500,00**

Rehabilitation of the Source "Begova voda"

S.n.	Description	Cost (BAM)
1	Construction works on the rehabilitation of the capture structure	2000,00
2	Rehabilitation of terrain around capture structure	500,00
3	Replacement of hydro mechanical equipment	1000,00
4	Rehabilitation of the fence around the facility	1000,00
	Total:	**4500,00**

Replacement of Transmission Pipelines

S.n.	Description	Cost (BAM)
1	Pipeline from the reservoir "Gradina" to the town. Current pipeline is made of steel pipes DN 300 mm with total length of around 400 m. Pipelines needs replacement with the pipeline of the same diameter DN 300 mm and possible material is a PE class 100. The pipeline runs in soil of IV, V and VI category. The route of the pipeline crosses the bridge and goes along Rudo-Priboj main road. 400m * 400 BAM/m	160000,00
2	Pipeline from the capture structure "Zova 1" to the reservoir "Zova1". Current pipeline is made of AC pipes DN 80 mm. New pipeline would be made of a PE 100 pipe with inner diameter DN 80 mm. It is possible to partially modify the existing route in order to shorten the pipeline, easier terrain and better land for excavation. There are a lot of air valves, sludge discharge pipes and pressure relief chambers on the pipeline. Estimated length of pipeline is around 1000 m.	50000,00
3	Pipeline from the capture structure "Begova voda" to reservoir Begova voda. Current pipeline is made of AC pipes DN 100 mm. New pipeline would be made of a PE 100 pipe with inner diameter DN 100 mm. It is possible to partially modify the existing route in order to shorten the pipeline, easier terrain and better land for excavation. Estimated length of pipeline is around 1500 m.	75000,00
	Total:	**285000,00**

Replacement of Distribution Network Pipelines

S.n.	Description	Cost (BAM)
1	Reconstruction of water supply network in industrial zone. It is necessary to replace cast iron pipeline DN 150 mm in length of around 500 m and AC pipeline DN 50 mm in length of approx. 800 m.	50000,00
2	Construction of manholes for installation of pressure converter for distribution network zoning. It is necessary to construct two regulation manholes.	30000,00
	Total:	**80000,00**

OVERALL RECAPITULATION

1	Source Protection, GIS, Hydraulic Model, Fault Removal, System Monitoring, Procurement of equipment for Defect Removal and Project Documentation Development	305000,00
2	Pumping Station "Krupica"	29000,00
3	Rehabilitation of Reservoir "Zova 1"	18000,00
4	Rehabilitation of Reservoir "Begova voda"	7000,00
5	Rehabilitation of Reservoir "Gradina"	5000,00
6	Rehabilitation of System Break-Pressure Chambers	5500,00
7	Rehabilitation of Source "Zova 1"	4500,00
8	Rehabilitation of Source "Begova voda"	4500,00
9	Replacement of Transmission Pipelines	285000,00

10	Distribution Network Pipelines Replacement	80000,00
	TOTAL :	**743500,00**

3.2.1.2 UVAC WATER SUPPLY SYSTEM

PRIORITIES FOR WSS UVAC		
1	Construction of reservoir "Zminica"	96000
2	Construction of captures "Zminica" and "Grozničava voda"	25000
3	Construction of Transmission and Distribution Pipelines	575000
	TOTAL:	**696000**

3.2.1.3 MOKRONOZI WATER SUPPLY SYSTEM

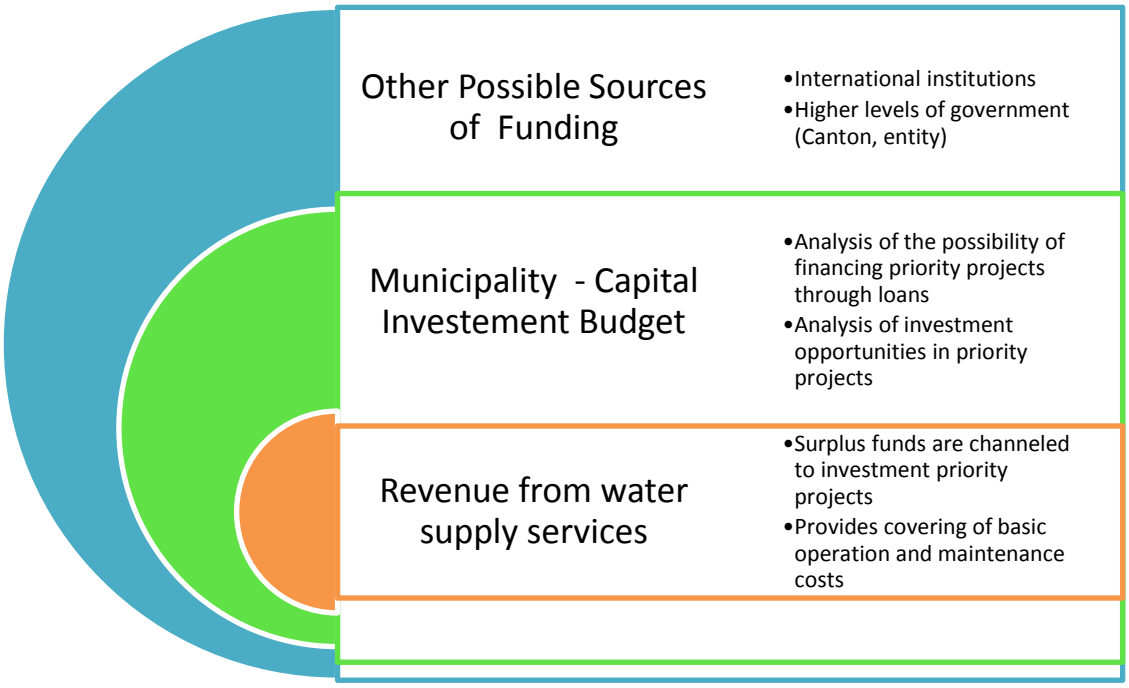
PRIORITIES FOR WSS MOKRONOZI		
1	Construction of reservoir "Badovine"	35000,00
2	Construction of reservoir "Jorgovan"	35000,00
3	Rehabilitation of reservoir "Subašina voda"	11000,00
	Rehabilitation of Captures "Dobra voda" , "Badovine" , "Jorgovan" and "Crno vrelo"	10000,00
	Replacement of Transmission and Distribution Pipelines	350000,00
	TOTAL:	**441000,00**

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 providing water supply services. The next analysed funding source will be the potential municipality investments into WSS development from the budget, and the last possible funding source are grants of higher government levels (cantons and entities), as well as the grants of international organizations.

Chart 6: 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 the analysis of the primary source of funding, and that is the revenue generated from provision of services through:

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

3.3.1.1 INCREASING THE NUMBER OF USERS

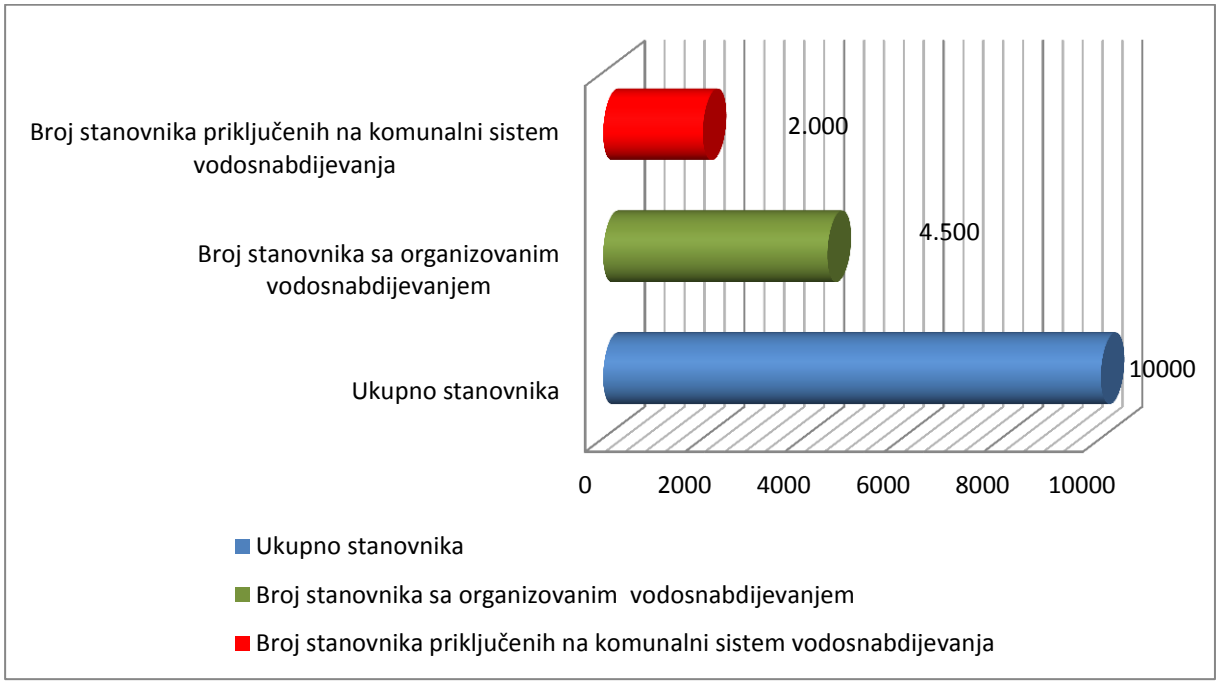
The following table shows that WSS Rudo is a complete system that already covers most of the population. However, the Uvac settlement is supplied with water from the WSS Priboj, The Republic of Serbia, and in the long run such solution can prove to be uncertain in terms of providing the required water quantities. Additionally, possible administrative and legal disputes that also may arise in regulation of relations between vendor and purchaser of water, which are in this case located in two different countries, must also be taken into consideration. Bearing in mind that WSS Rudo has sufficient quantities of good quality potable water the long term development strategy is to connect the settlement Uvac to the water supply system of Rudo Municipality. In this way the number of consumers would be significantly increased for app. 2,000 consumers. From the aspect of financial repercussions of increasing the number of users we can conclude that they will beneficial for Utility Company in a long run. Still, in the short run, with the high level of losses in this part of the system and relatively low cost of water these financial benefits will be minimal.

Increase in number of consumers as a result of the increase in population is minimal and is given in the table below.

Table 33: Increasing the number of users

Settlement	Year						
	2010	2012	2015	2020	2025	2030	2035
Rudo	2.000	2.040	2.102	2.209	2.322	2.440	2.565
Mokronozi	600	612	631	663	697	732	769
Uvac	500	510	526	552	580	610	641

Population with organized water supply and population connected to municipal water supply system Rudo is given in the following chart:



3.3.1.2 INCREASING THE WATER SUPPLY SERVICE COST

Current cost of water supply services is given in the following table

Table 34: Current costs of water supply and sewerage services

Component	Cost
Water Component	0.60 BAM/m^3
Water Abstraction Taxes	0.05 BAM/m^3
Pollution Taxes	0.04 BAM/m^3
VAT	0.10 BAM/m^3
TOTAL COMBINED COST	**0.79 BAM/m^3**

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 income, i.e. user's income. According to these generally accepted standards as a socially acceptable load is considered allowance of up to 5% of average income.

It is, therefore, of interest to analyse to which extent the current costs of water supply services burden the consumers' budget and their purchasing power and to see if there are opportunities and room for the further increase of the aforementioned prices.

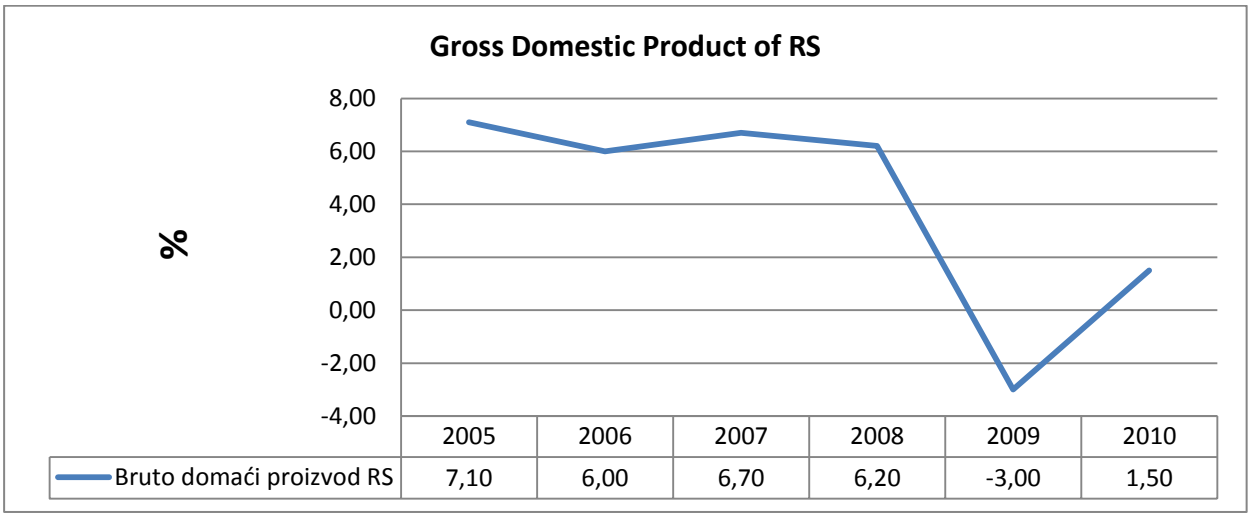
In order to be able to assess, it is necessary to analyse the macroeconomic situation in the Federation BIH and the Republic of Srpska, as well as at the local community level.

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:

- Development of statistic system and data collection
- Implementation of Value Added Tax (VAT)
- Significant proportion of informal economy
- Cash inflow from abroad

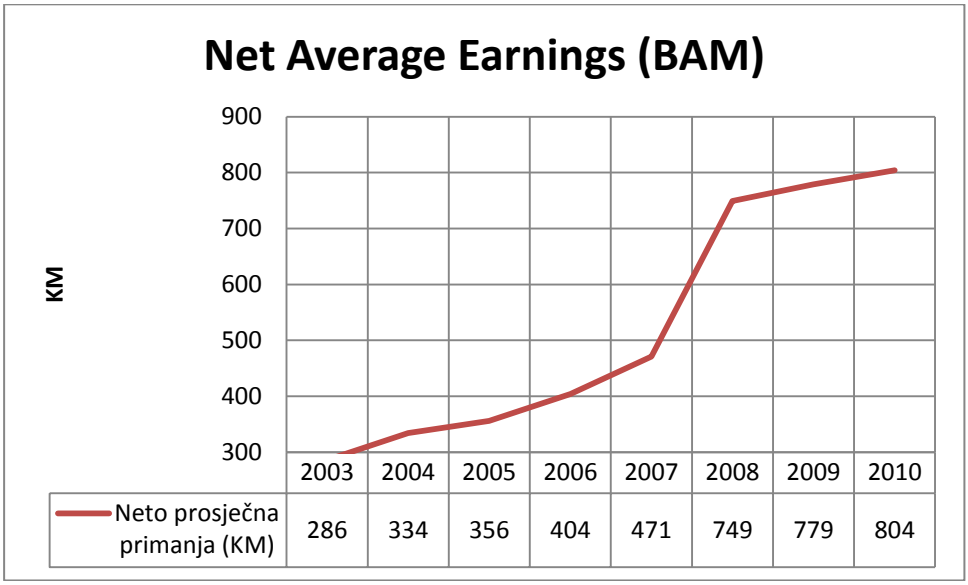
The following diagram shows significant fluctuations of GDP, so in the absence of the more reliable projections, the macroeconomic availability analyses were made for three GDP growth projections.

Chart 7: Gross Domestic Product in Republic of Srpska



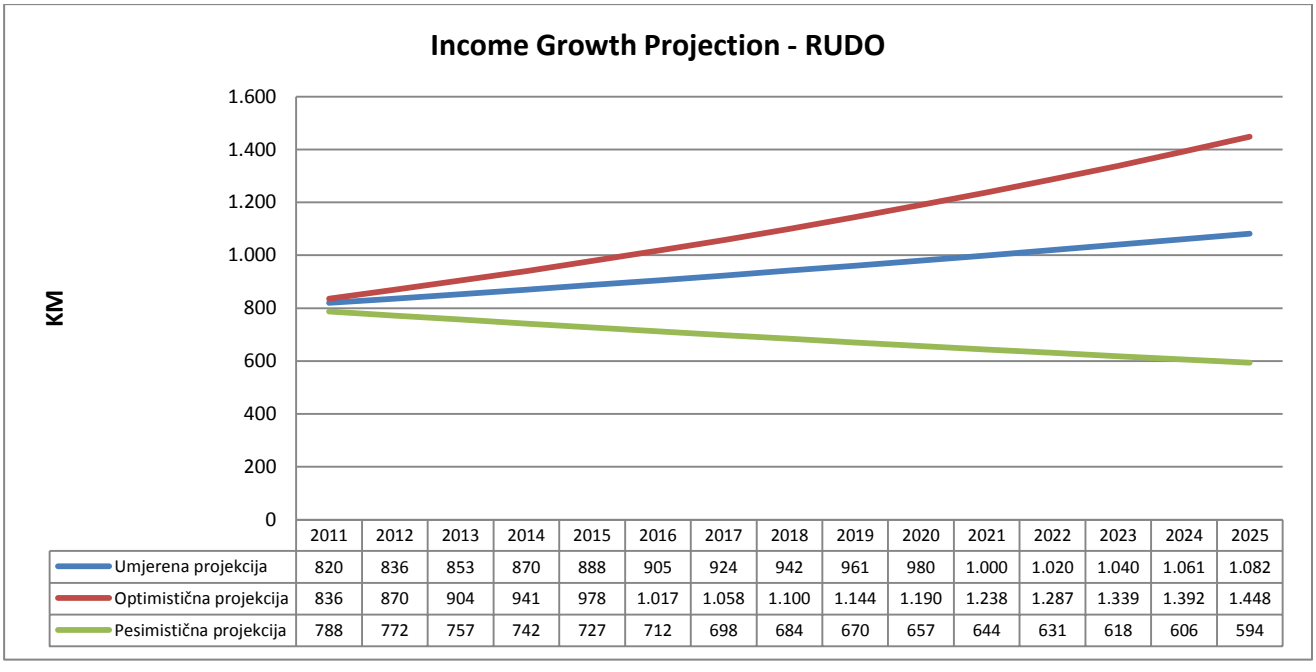
- Moderate projection anticipates a minimal increase in GDP for the analysed period of 20 years at a rate of 2% per year
- Optimistic projection that predicts GDP growth by an annual rate of 4%
- The pessimistic variant that predicts negative GDP growth by an annual rate of – 2% per year

Chart 8: Net Average Earnings in Rudo Municipality



The Chart 9 shows the results for the above mentioned three options and the establishment of income limits on which utility company can count on in the future, so it is obvious that the economic development and welfare are the key factors for improvement of quality of services.

Chart 9: Growth projections of average net earnings in Rudo Municipality



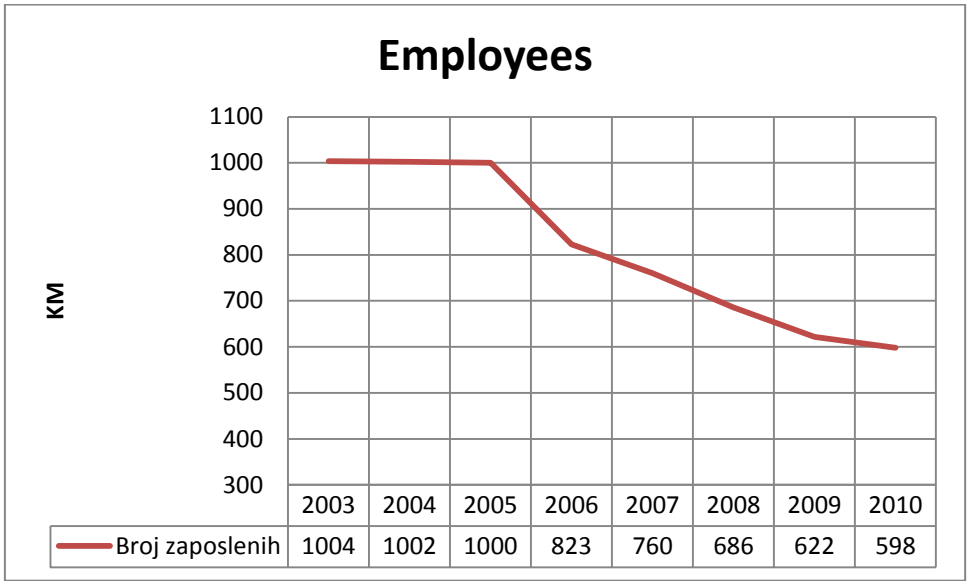
For the purposes of further analysis we will adopt the "moderate projection" which provides a minimal real (no inflation) GDP growth and an income at a rate of 2% per year. This is a very conservative assumption, but we expect to achieve it with a large percentage of probability.

However, the above analysis refers to the statistical average earnings at the municipal level, and for the purpose of analysing the real possibility of consumers to pay for the services it is in our best interest to estimate the average household income, i.e. the average income of household member.

Since these kinds of statistics do not exist at the municipal level, in cooperation with the authorized services and in accordance with the data published regularly by the Republika Srpska Institute of Statistics, www.rzs.rs.ba. (Household Budget Survey 2007), it is estimated that average household represents a three-person household, of which 1.2 persons credits to income (contributes to household budget).

This estimate is adjusted for the Municipality of Rudo due to small number of employees that is below statistical average for the Republic of Srpska. Therefore, for further analysis it is adopted that statistical family in the territory of Rudo Municipality has three members of which 0.7 works (contributes to household budget).

Chart 10: Number of employees in Rudo Municipality



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

The current price of water supply services of 0.6 BAM/m3 with the specific water consumption of 130 litres per capita per day makes 1.23% of the average income of a household member which presents a really high percentage for BiH. If we add to this the water abstraction fee, wastewater fee and VAT, share of the allowances for water supply services will amount to 1.57% of the income of household member.

If we assume that the costs of water supply is 2% of the average income of a household member we will come up with the water supply service cost of 0.98 BAM/m3 which can be considered to comply with the ability of consumers to pay those services without fear of endangering their social status. It is obvious that despite the relatively high cost of water supply in Rudo there is still considerable scope for increasing revenue through price increase.

Table 35: Water supply expenses expressed as the percent of household income

Specific consumption	l/capita/day	130
	m3/month	3,9
Service cost	BAM/m3	0,6
Water supply expenses	BAM	2,34
As a percent of the current revenues	(%)	1,23%
Specific consumption	l/capita/day	130
	m3/month	3,9
Service cost	BAM/m3	0,98
Water supply expenses	BAM	3,82
As a percent of the current revenues	(%)	2,00%

Elasticity of Demand for Services and Willingness to Pay Them

Price elasticity of demand for water is the change in demand divided by the change in the price of water at any point on the curve of demand. Usually, the demand for water is considered 'inelastic' because the elasticity is less than +/- one, indicating that one percent increase in price leads to lesser (or higher) change in demand of one percent. The calculations of elasticity are usually being done in natural logarithms as the coefficients of elasticity are returned as a percentage change making them easier to interpret. Elasticity is calculated for an average price and consumption variable.

Price elasticity of demand for water is the increase of consumed quantity per unit of increase in income or consumption. Although demand can drop in a response to price increase, demand will respectively increase as a result of real growth of household income.

Such analysis have not been conducted in BiH and the a single attempt to estimate elasticity of demand has been given within the European Commission's project: Water Quality Management at River Basins Level in Bosnia and Herzegovina, Europe Aid/119168/C/SV/BA.

This attempt was based on data of ISMS Household Budget Study drafted in 2007, the Republika Srpska Institute of Statistics, www.rzs.rs.ba. The document estimated elasticity that the one-percent water price increase will lead to 0.5 percent decline in volume of water consumption, and one-percent increase in real household income will lead to 0.8 percent increase in quantity of water consumption.

Potential consumption increase due to increase in household income has not been taken into account, because it is considered that the real income growth will be sufficient to amortize expected price increase. Only with a significant absolute increase in income and reduction of water supply

cost share below 1.2% for the economic cost of water, one can expect the increase in consumption, as a result of revenue growth.

Willingness to pay services and consumer surplus

Assessment of willingness to pay services is one of the most controversial issues when it is about preparation of financial and economic plans for the development of Utility companies.

Analysis to assess the readiness of user to pay for a particular service are designed and primarily used for economic evaluation of investments that cannot be evaluated in market or money. Therefore, these analyses became very popular when it comes to environmental projects that will have the consequence in improving environment and life conditions.

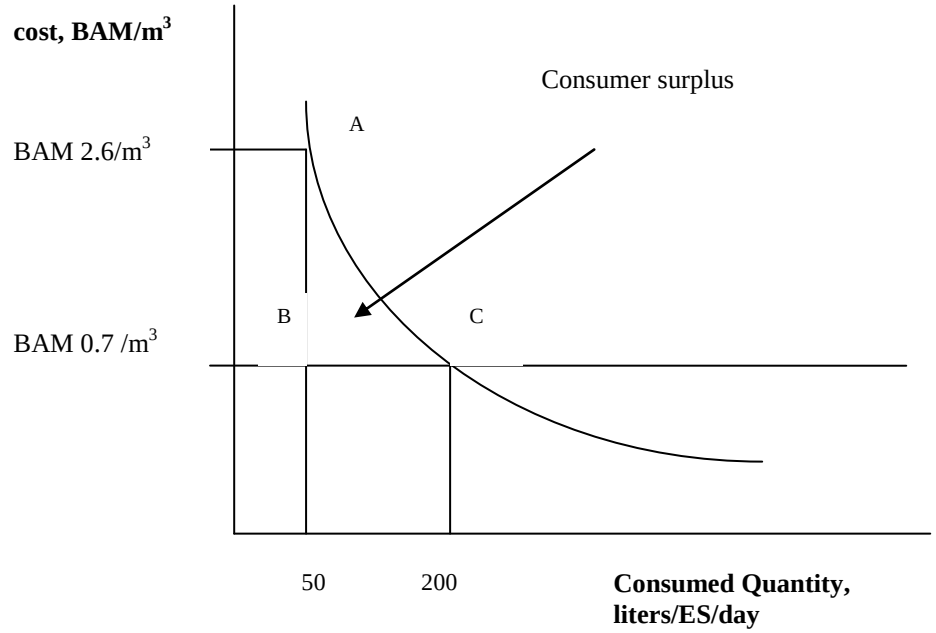
The implementation of such analysis in cases when it comes to monopoly services under the mores of state regulations has proved to be less successful because they do not take into account other non-financial mechanisms that affect the willingness to pay for certain services.

The experience of all transition countries shows that, when it comes to water supply service, a key issue is 'unwillingness to charge services' while a lot less problem is 'the willingness of consumers to pay'.

Municipality of Rudo is a typical example where the long-term indecisiveness of Utility company and Municipality of Rudo to move more aggressively in charging of water supply services resulted in the relatively low collection rate for services which for a long time was app. 50% but in the last few year it reached a value of 65% of collected invoiced bills.

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

Consumer surplus concept is briefly presented by the following chart

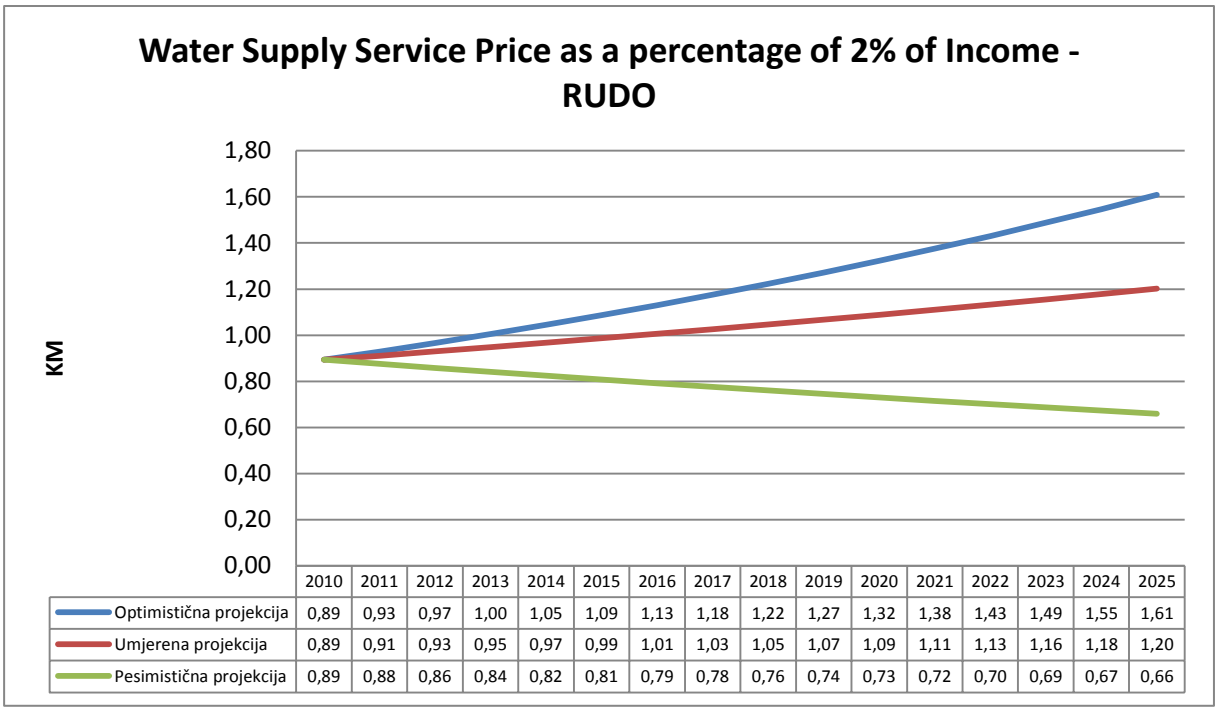


As in the municipality of Rudo cost of water supply service is already relatively high and represents 1.25% of average statistics income of the household with relatively low specific consumption of 130

l/capita/day, elasticity of demand will not be taken into account when making projections of covering the costs of utility companies operation.

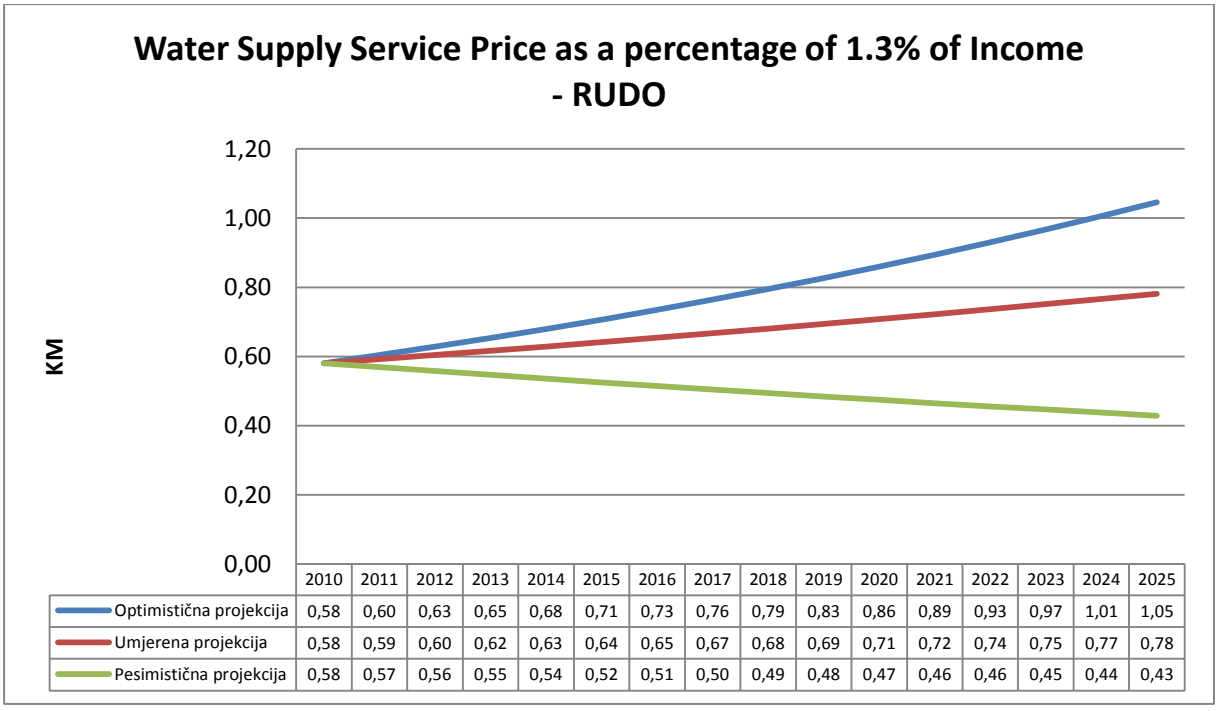
Finally, we are able to define the projections of utility company revenue growth, depending upon the consumers' ability to pay for water supply services.

Chart 11: Projection of potential growth of price of services 2%



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Optimistična projekcija	0,89	0,93	0,97	1,00	1,05	1,09	1,13	1,18	1,22	1,27	1,32	1,38	1,43	1,49	1,55	1,61
Umjerena projekcija	0,89	0,91	0,93	0,95	0,97	0,99	1,01	1,03	1,05	1,07	1,09	1,11	1,13	1,16	1,18	1,20
Pesimistična projekcija	0,89	0,88	0,86	0,84	0,82	0,81	0,79	0,78	0,76	0,74	0,73	0,72	0,70	0,69	0,67	0,66

Chart 12: Projection of potential growth of price of services 1.3%



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Optimistična projekcija	0,58	0,60	0,63	0,65	0,68	0,71	0,73	0,76	0,79	0,83	0,86	0,89	0,93	0,97	1,01	1,05
Umjerena projekcija	0,58	0,59	0,60	0,62	0,63	0,64	0,65	0,67	0,68	0,69	0,71	0,72	0,74	0,75	0,77	0,78
Pesimistična projekcija	0,58	0,57	0,56	0,55	0,54	0,52	0,51	0,50	0,49	0,48	0,47	0,46	0,46	0,45	0,44	0,43

Conclusion
There is a possibility to increase revenues by rising prices of water supply services and in further analysis this will be considered as a primary source of income. Possibility to finance priority projects out of this income will depend on:

- The current level of coverage of utility company's operating costs by revenues generated from providing services
- The structure and types of investment measures
- The cost of investment measures

3.3.1.3 SAVINGS IN UTILITY COMPANY OPERATION

Municipality Rudo and Utility Company ODJKP „Usluga" a.d. Rudo are with the support of the Government and funds of Republic of Srpska have made significant investments in reconstruction and rehabilitation of water supply system. 75% of distribution network was reconstructed during 2010.

Also in late 2010 and early 2011 flow meters were installed at the outlet of the reservoir while at the Krupica water intake an electro magnetic flow meter was installed.

During most of the year water supply system Rudo functions as gravitational system. Pumping station Krupica is being used only at the time of minimum yield of the captured springs but during rainy years it is not used.

After reconstruction of transmission pipelines and most of the distribution network water losses from the system are significantly reduced and they are now estimated at about 30 %. Most of those losses are related to so-called technical losses, as a result of poor condition of pipes and fittings at unreplaced pipelines in industrial area and at the pipeline from the source Krupica to the city.

Implementation of these activities puts an end to the possibilities of savings in utility company's operation through increasing efficiency and they do not present the real source of income for financing investment projects.

It is important to stress that Utility company „Usluga" a.d. has very little to no room for further savings in operation given the size of Rudo Municipality and a small number of consumers. However, since utility company also deals with providing other utility services, it manages to provide at least the minimum of financial resources to cover the basic costs of the enterprise. In other words, large portion of operational costs of the company ODJKP „Usluga" a.d. incurred by providing water and sanitation services are covered by spilling the funds from more profitable activities of the utility company.

3.3.2 SOCIAL ASPECTS OF INCREASING THE COST OF WATER SUPPLY SERVICES

The 2007 Household Budget Survey (HBS) for Bosnia and Herzegovina (BiH) was implemented in partnership by the Agency for Statistics of Bosnia and Herzegovina (BHAS), The Federal Office of Statistics (FOS) and the Republika Srpska Institute for Statistics (RSIS).

Material well-being should be measured in a way that indicates the standard of living that people experience. And yet, as we know, this is difficult to measure and it is generally assumed that a material well-being is a function of the goods and services that people consume. As different individuals consume different goods and services in different quantities, it is assumed that the monetary value of goods and services indicates the level of well-being ("utility") they produce.

Therefore, if two different bundles of goods and services have different monetary values, it is assumed that the most expensive will give a higher level of material well-being to the consumer. Goods and services are bought to be consumed: the cost of a consumption bundle is therefore an indicator of utility according to a money metric (a monetary measure). How much an individual spent is thus considered an indicator of how much that individual consumes, i.e. what level of well-being is going to be attained from that consumption. This way material well-being, i.e. the standard of living, can be expressed in Convertible Marks [BAM], Euros, US Dollars or any other currency.

In this sense, poverty is measured as that level of consumption (expenditure) that does not reach a certain level under which the consumption bundle is insufficient to produce a minimum and acceptable level of material well-being.

The survey results show that household consumption statistically registered is greater than the statistically registered revenue which is explained by the high participation of the "informal economy" and other statistically and officially 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 expenditures. That is the obvious proof of over the decades-long policy which considered water and sanitation services as primarily social rather than economic categories.

Percentage share in consumption of energy and utilities	(BAM)	(%)
Total monthly consumption	1.623,86	
Electricity, Gas, Water, other energy resources	113,67	
Water Supplying	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 is in a very difficult economic situation, and unable to cover the basic costs of operation and maintenance from the revenues generated by providing services.

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

Relative Poverty		
The Relative Poverty Line per Adjusted Member per month	350,22	(BAM)
Percentage of the Poor 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 behaviour 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.

However, when it comes to social aspects of increasing the costs of water supply services in Rudo Municipality, the above data should be interpreted with caution because Rudo Municipality is one of the underdeveloped municipalities in both Republic of Srpska and Federation of BiH. This is confirmed by the findings of the Study called "Regional Disparities in BiH" conducted by the UNDP of BiH in 2010 in which Municipality of Rudo is listed as "extremely underdeveloped" municipality and by the development criteria occupies 118 position of 142 municipalities in BiH.

Regarding the registered poor people which are included into the group of „real poverty", there is a Study "Action plan for social inclusion into the system of social/children protection, related to the branch of water supplying in Rudo Municipality for 2011-2012" drafted, which provides the recommendations and guidelines for solving the problems of socially jeopardized persons.

For all the foregoing reasons when performing economic and financial analysis the Consultant used moderate and conservative assumptions of both revenue growth and estimates of the current revenues and financial abilities of households.

3.3.3 RUDO MUNICIPALITY CAPABILITIES TO FINANCE THE WATER SUPPLY PROJECTS

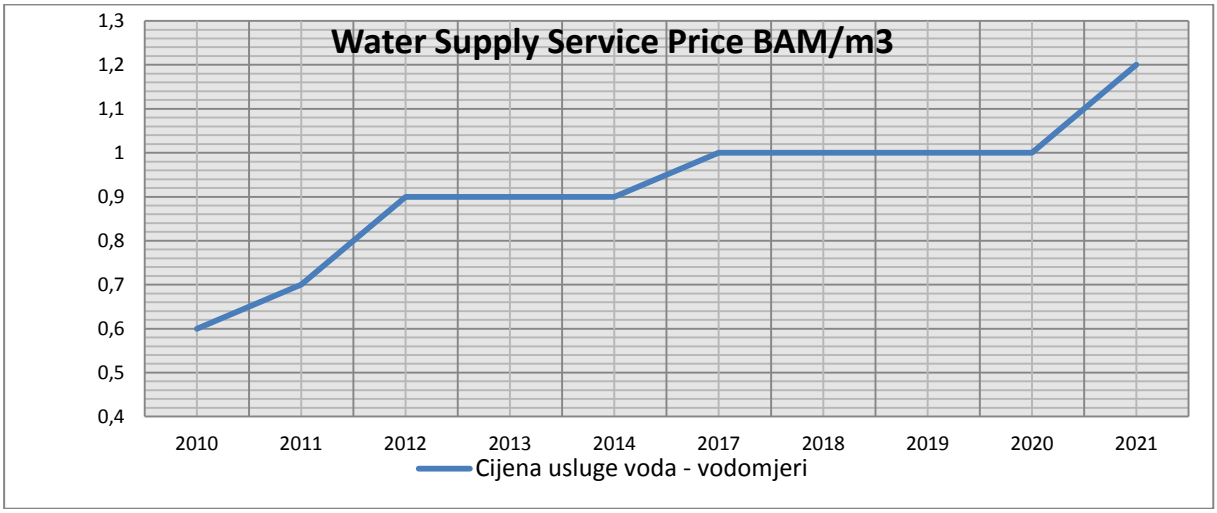
Abilities of Rudo Municipality to finance the reconstruction projects and the construction of water supplying infrastructure are extremely limited due to small budgetary revenues. The current strategy of Rudo Municipality as the underdeveloped municipality has been focused on the finding the additional sources of funding through higher levels of government (the Government of Republic of Srpska) or through the international organizations.

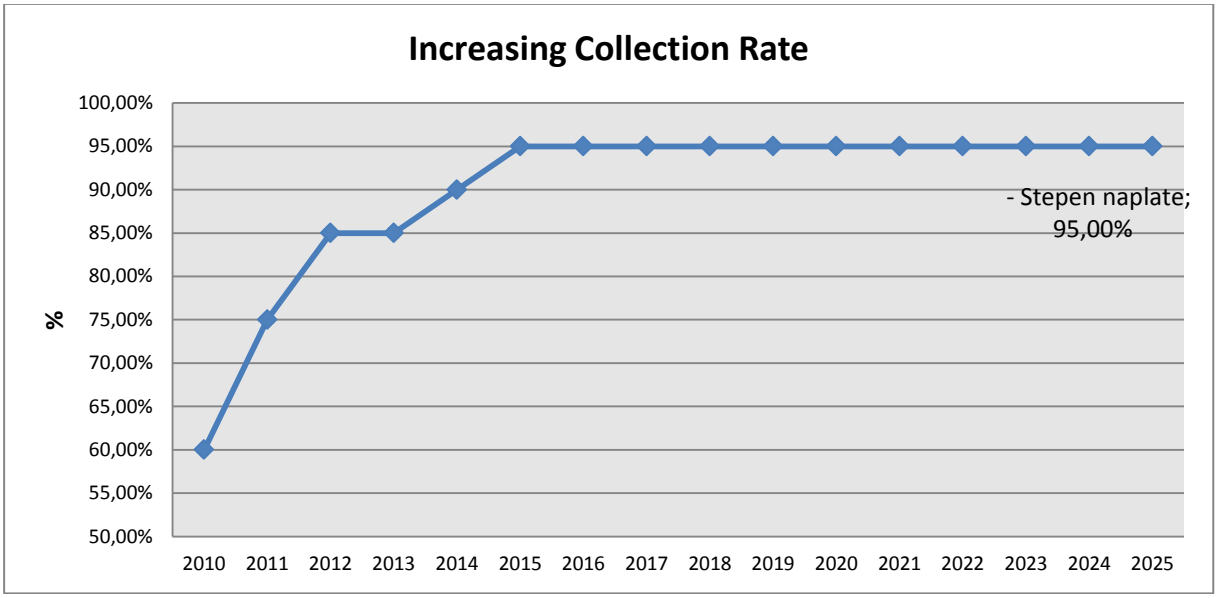
3.4 ANALYSIS OF INVESTMENT OPPORTUNITIES IN ACCORDANCE WITH DEFINED PRIORITY PROJECTS

Previous chapters show that the defined priority projects can be financed only from the following funding sources

- Increasing the price of water supply services
- Increasing the collection rate
- Financing the infrastructure projects from the additional funding sources at the level of Republic of Srpska or through international organisations' grants

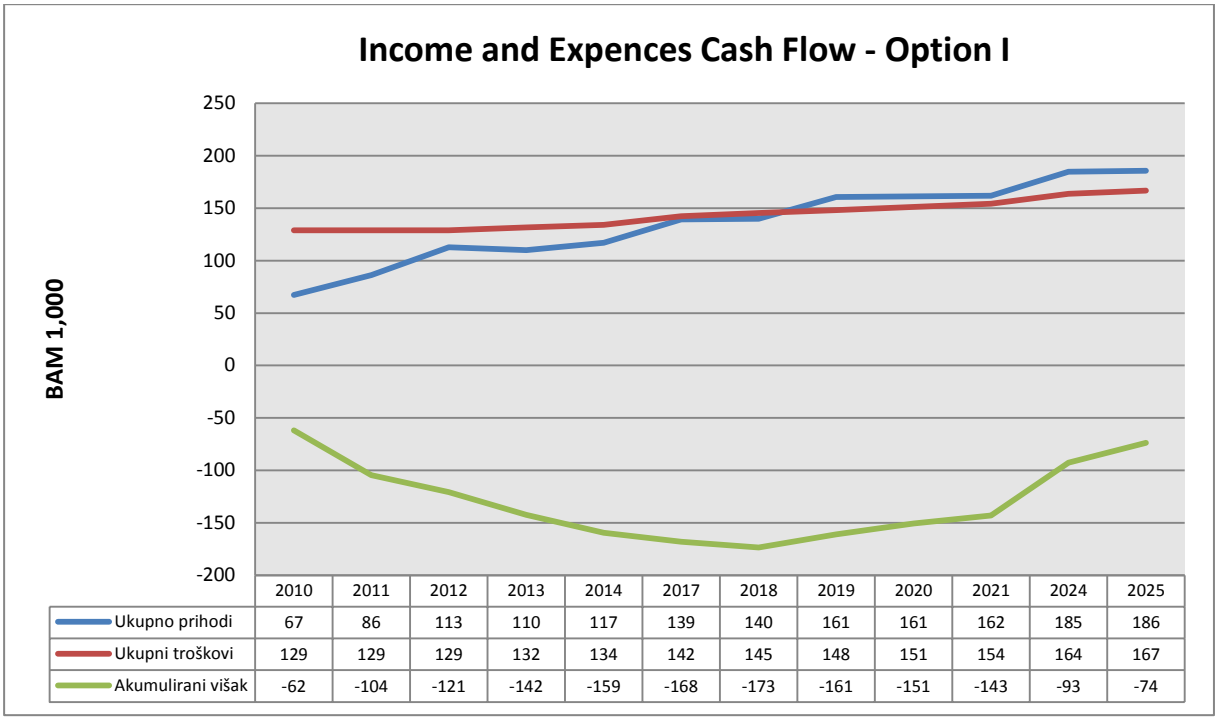
Chart 13: Plan of increasing the price of water supply services





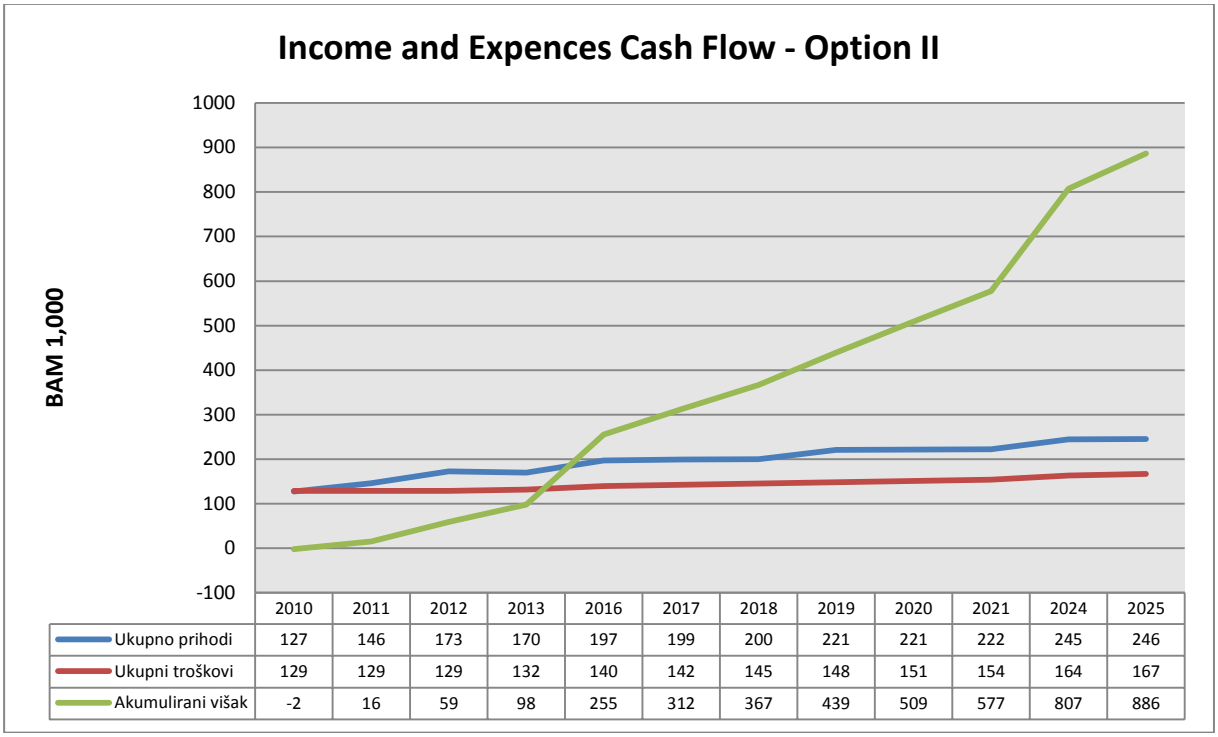
Based on a possible plan for price increase, we are able to assess that the utility company ODJKP „Usluga" a.d. Rudo, after covering fixed costs of operation, would not be able to accumulate a surplus of funds for the purpose of the financing the priority projects from the revenues provided by the water supply services. Despite the significant increase in prices of services, the utility company will be able become a sustainable and to cover basic costs of its operation only after the year 2015. Obviously, relying solely on revenues from water supplying cannot provide any financial means.

Chart 14: Financial capability of utility company



	2010	2011	2012	2013	2014	2017	2018	2019	2020	2021	2024	2025
Ukupno prihodi	67	86	113	110	117	139	140	161	161	162	185	186
Ukupni troškovi	129	129	129	132	134	142	145	148	151	154	164	167
Akumulirani višak	-62	-104	-121	-142	-159	-168	-173	-161	-151	-143	-93	-74

In the next approximation, taking into account that ODJKP „Usluga" a.d. Rudo also deals with some other utility services and that these activities provide the part of revenues particularly for salaries and other fixed expenses ODJKP „Usluga" a.d. in the amount of app. BAM 60,000.00 per year. Revenues on the basis of the „other" revenues are increased by the amount specified.



	2010	2011	2012	2013	2016	2017	2018	2019	2020	2021	2024	2025
Ukupno prihodi	127	146	173	170	197	199	200	221	221	222	245	246
Ukupni troškovi	129	129	129	132	140	142	145	148	151	154	164	167
Akumulirani višak	-2	16	59	98	255	312	367	439	509	577	807	886

The above chart shows that Option II is more favourable and that at the end of the 10-year planning period in 2021 one can expect the total accumulated surplus of funds in the amount of app. BAM 577,000 so this sum can be considered as the estimated financial capacity of ODJKP „Usluga" a.d. Rudo.

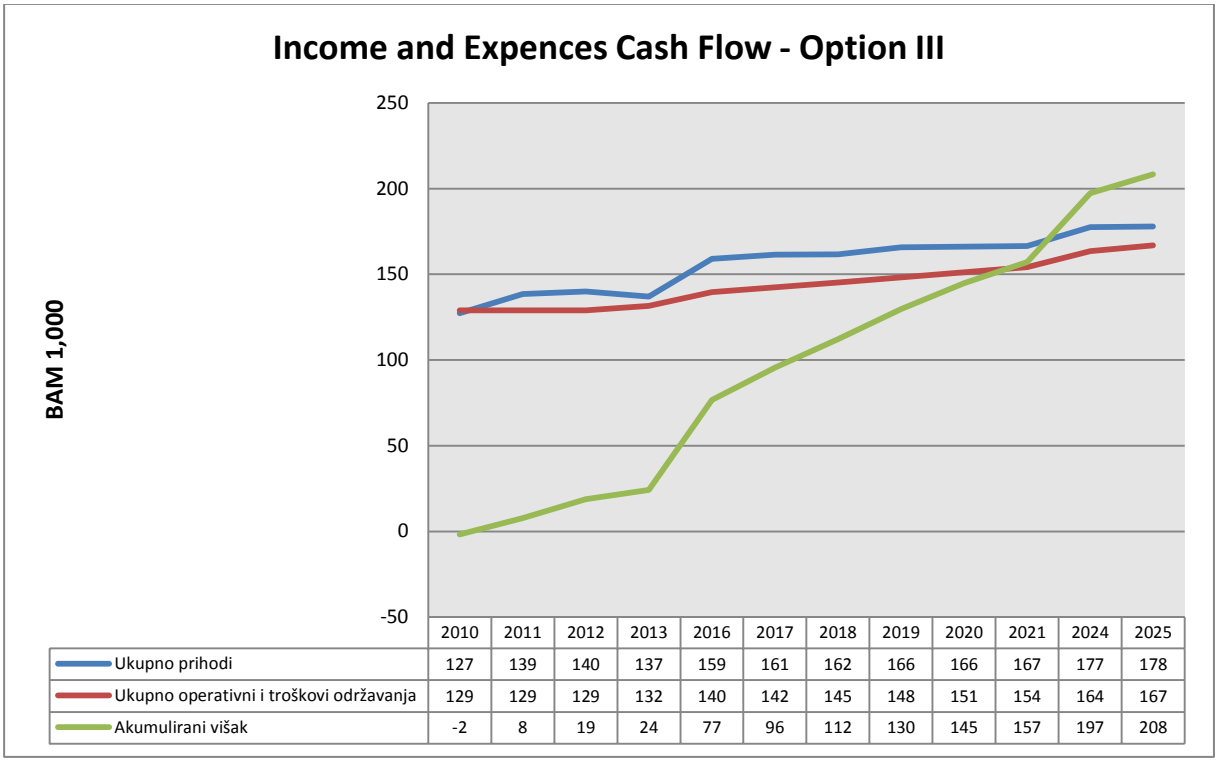
However, Option II was analysed with a costs growth of water supply services

- Which in the net amount exceeds 2% of household income
- The cash flows do not include inflation
- Achieving the collection rate of 95% in a relatively short time frame
- The revenues of utility company also include revenues from other activities in the amount of BAM 60,000 per year

Since it is about very strict conditions for Rudo Municipality and its development level, it was of interest to analyse also the Option III, which is based on the following assumptions

- Net cost of water supply services shall not exceed 1.30% of the household income
- The cash flows do not include inflation
- Collection rate of 90% at the end of planning period
- The revenues of utility company also include revenues from other activities in the amount of BAM 60,000 per year

The results are presented in the Chart below.



	2010	2011	2012	2013	2016	2017	2018	2019	2020	2021	2024	2025
Ukupno prihodi	127	139	140	137	159	161	162	166	166	167	177	178
Ukupno operativni i troškovi održavanja	129	129	129	132	140	142	145	148	151	154	164	167
Akumulirani višak	-2	8	19	24	77	96	112	130	145	157	197	208

It is obvious that Option III with much more relaxed conditions provides the covering of the basic costs of operation and ensures app. BAM 150,000 of accumulated surplus for investment in priority measures.

CONCLUSION

Financial capacity for investing in priority projects is based on the two possible sources of funds

- Increasing revenues from the provision of water supply services

  These revenues are defined with Option II and Option III and they range from app. BAM 577,000 which is a very optimistic estimate of the actual BAM 150,000

- Funding from donations and grants at the level of the Republic of Srpska or through international organizations

4 FEASIBILITY STUDY FOR PRIORITY INVESTMENTS

4.1 IDENTIFYING TECHNICAL SCOPE FOR INVESTMENT MEASURES

Based on the analysis of WSS Rudo 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 PS Krupica
- Due to lack of measurements it is not possible to access the amount of non-revenue water in the system, however, majority of this amount relates to the overflows on reservoirs of gravitational springs.
- 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 but transmission pipeline from the spring has a lot of losses and material (asbestos cement pipeline) is unsatisfactory, thus, this pipeline requires rehabilitation. This action is not a priority and will not significantly affect the quality of water supply in the next 10 years. However, the implementation of priority activities, especially activities related to measurements in the system will create conditions to elaborate on this issue more precisely and to define priority sections for replacement and reconstruction.
- Distribution network i.e. its reconstructed part is in good condition and only requires regular maintenance. Unreconstructed part of the distribution network requires a higher level of investments through regular maintenance with the aim of loss reduction.
- Water losses in the system according to estimates amount to around 30 % of total production;
- 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 meters for end users, the situation, concerning the amounts of Revenue Water and reducing the amounts of Non-Revenue Water, has significantly improved.
- Unit labor costs and maintenance of the system are relatively high considering the system size, number of users and the municipality's development level.
- Solving the problem of deterioration and dysfunction of the distribution network in settlements Uvac and Mokronozi represent one of the priorities for the development of WSS Rudo

CONCLUSION

Water supply system Rudo is well developed and complete system of water supply that provides quality service to consumers. Insufficient numbers of consumers and hydro morphological conditions have caused that despite relatively simple system of supply there are rather high unit labor costs and maintenance costs.

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 to the larger surrounding settlements Uvac and Mokronozi.

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

4.2 COST ESTIMATION

PLAN OF PRIORITY PROJECTS – Financing from utility revenues

Overall recapitulation of WSS Rudo rehabilitation

1	Source Protection, GIS, Hydraulic Model, Fault Removal, System Monitoring, Procurement of equipment for Defect Removal and Project Documentation Development	150000,00
2	Pumping station "Krupica"	29000,00
3	Rehabilitation of the reservoir "Zova 1"	18000,00
4	Rehabilitation of the reservoir "Begova voda"	7000,00
5	Rehabilitation of the reservoir "Gradina"	5000,00
6	Rehabilitation of the break-pressure chambers in the system	5500,00
7	Rehabilitation of the source "Zova 1"	4500,00
8	Rehabilitation of the source "Begova voda"	4500,00
9	Replacement of distribution network pipelines	80000,00
	TOTAL:	**303500,00**

PLAN OF PRIORITY PROJECTS– Financing from other sources of funding (Grants, Donations, Rudo Municipality Budget)

Rehabilitation of WSS Rudo

1	Source Protection, GIS, Hydraulic Model, Fault Removal, System Monitoring, Procurement of equipment for Defect Removal and Project Documentation Development	200000,00
2	Replacement of transmission pipelines	285000,00
	Total:	**485000,00**

Water supply system Uvac

PRIORITIES FOR WSS UVAC		
1	Construction of reservoir "Zminica"	96000
2	Construction of capture facilities "Zminica" and "Grozničava voda"	25000
3	Construction of transmission and distribution pipelines	575000
	TOTAL:	**696000**

Water supply system Mokronozi

PRIORITIES FOR WSS MOKRONOZI		
1	Construction of reservoir "Badovine"	35000,00
2	Construction of reservoir "Jorgovan"	35000,00
3	Rehabilitation of the reservoir "Subašina voda"	11000,00
4	Construction of capture facilities "Dobra voda", "Badovine", "Jorgovan" and "Crno vrelo"	10000,00
5	Replacement of transmission and distribution pipelines	350000,00

	TOTAL:	**441000,00**

4.3 FINANCIAL ECONOMIC ANALYSIS

Analysis was made on the basis of the following assumptions

All of the costs were calculated on the basis of the current costs without inflation, VAT and other fees and taxes

The discount rate is 8%

Possible income sources are defined as:

- Revenues obtained by providing water supply services with the services costs up to household capability i.e. 1.3 % of the estimated revenues
- Increasing the number of consumers

4.3.1 OPERATION EXPENSES OF UTILITY COMPANY

Total fixed expenses

Salaries and other payments BAM 75,000.00

Other BAM 25,000.00

TOTAL BAM 100,000.00

WATER SUPPLYING (75%) BAM 75,000

VARIABLE COSTS (including the regular maintenance costs)

Average cost (BAM 6 per connection per month)

VARIABLE EXPENSES IN TOTAL BAM 54,000.00

ODJKP „USLUGA" IN TOTAL BAM 129,000.00

4.3.2 EXPENSES RECOVERY PLAN

Analysis was made on the basis of the following assumptions.

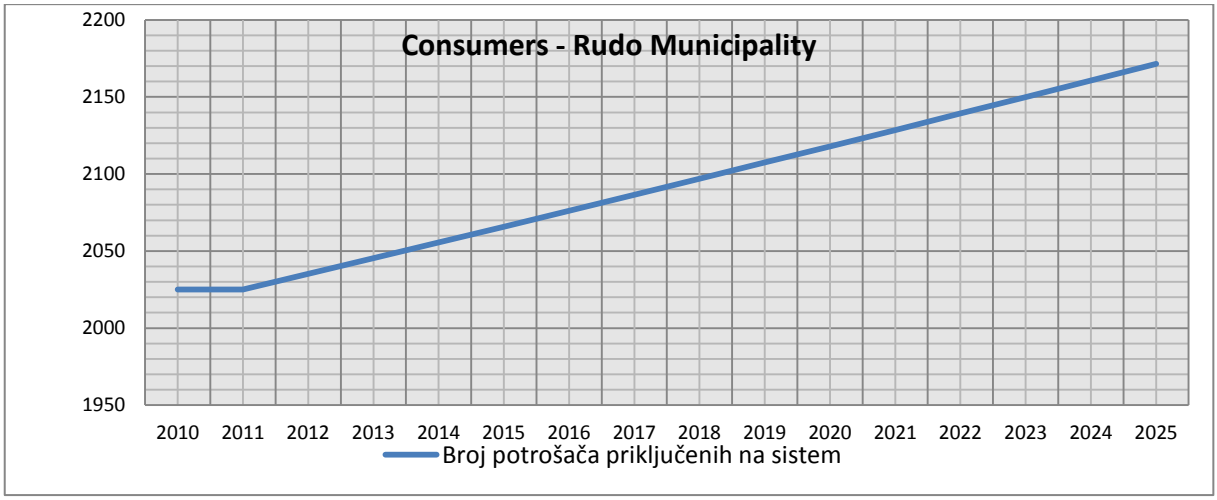
All of the costs were calculated on the basis of the current costs without inflation, VAT and other fees and taxes.

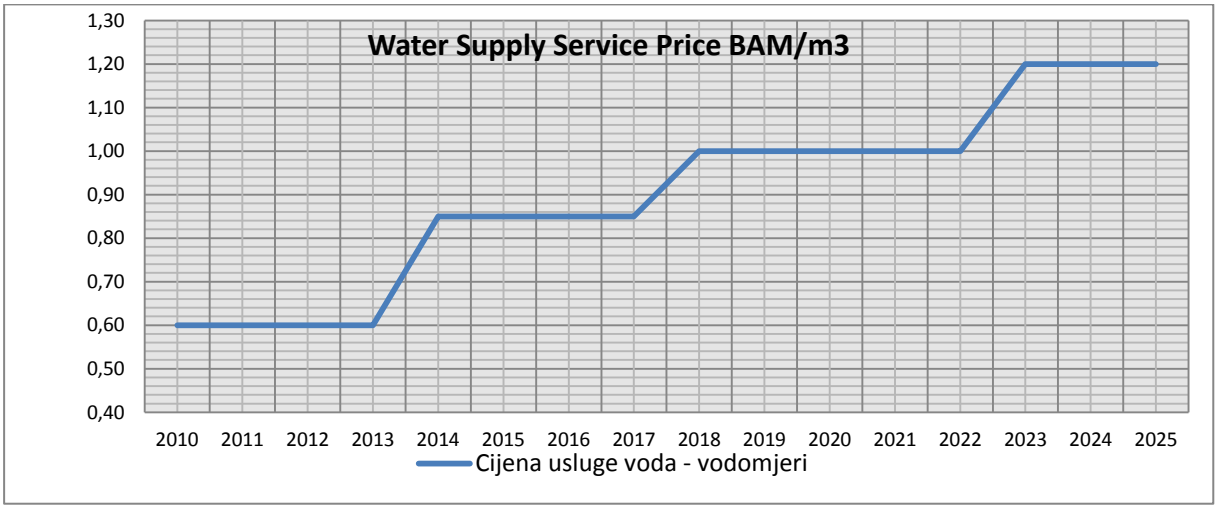
The discount rate is 8%

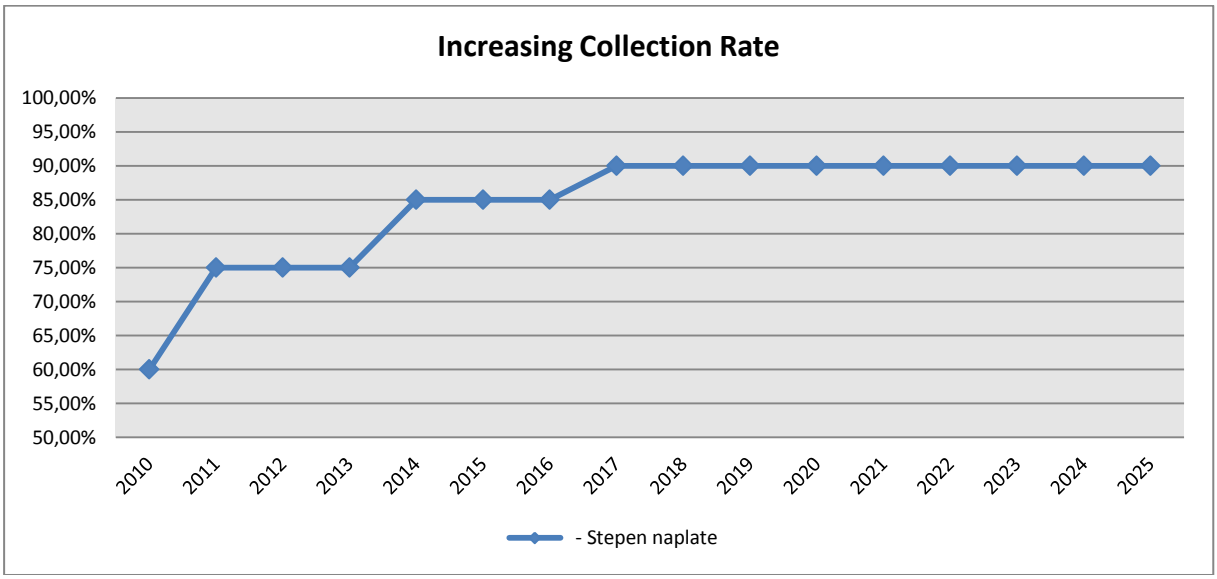
Possible income sources are defined as:

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

The following charts show projections of increasing the water supply services' prices, number of consumers and collection rate.


Consumers - Rudo Municipality
2200
2150
2100
2050
2000
1950
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
Broj potrošača priključenih na sistem


Water Supply Service Price BAM/m3
1,30
1,20
1,10
1,00
0,90
0,80
0,70
0,60
0,50
0,40
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
Cijena usluge voda - vodomjeri


Increasing Collection Rate
100,00%
95,00%
90,00%
85,00%
80,00%
75,00%
70,00%
65,00%
60,00%
55,00%
50,00%
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
- Stepen naplate

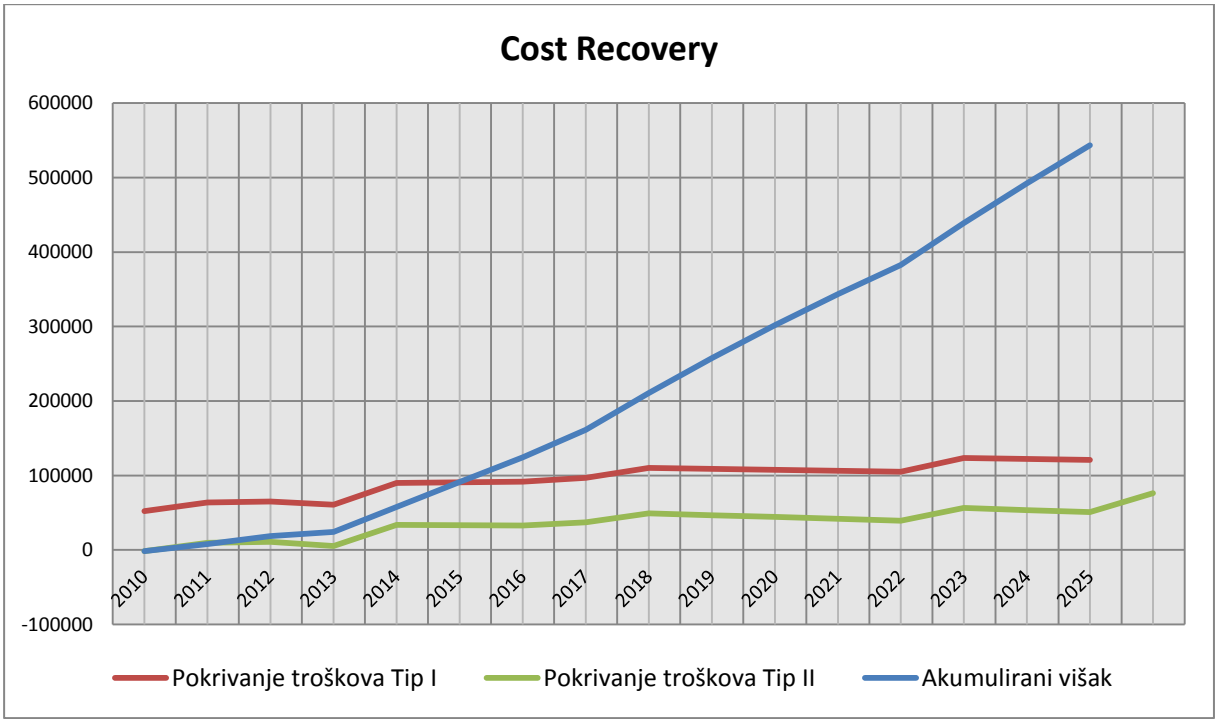
With these projections we see that the utility company could cover basic operating costs and accumulate surplus funds which would be used for system maintenance and financing of priority actions and measures.

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

Expenses recovery Type I	Difference between operational costs and total revenues after investments
Expenses recovery Type II	Difference between operational and maintenance costs and total revenues after investments

If we assume that the annual investment is zero, i.e. that there are no investments in the development and maintenance of the system, for each year or cumulatively for the period considered, we will get financial investment capacity of the 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 compensate for the part of income that is currently not funded. Only with the year 2015 one can expect accumulation of surplus funds for investing in priority projects. By the year 2022, at the end of 10-year period, accumulated investment surplus would be app. BAM 380,000.

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 of covering the costs is feasible only if the planned water supply price increase is adjusted for inflation value in the considered period.

Economic-financial analysis EXPENSES RECOVERY PLAN

All values are expressed in BAM															
YEAR	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***
TOTAL EXPENSES	***129.000***	***129.000***	***131.580***	***134.212***	***136.896***	***139.634***	***142.426***	***145.275***	***148.180***	***151.144***	***154.167***	***157.250***	***160.395***	***163.603***	***166.875***
Operational and Maintenance Costs	*129.000*	*129.000*	*131.580*	*134.212*	*136.896*	*139.634*	*142.426*	*145.275*	*148.180*	*151.144*	*154.167*	*157.250*	*160.395*	*163.603*	*166.875*
Maintenance	54.000	54.000	55.080	56.182	57.305	58.451	59.620	60.813	62.029	63.270	64.535	65.826	67.142	68.485	69.855
Operational Expenses	75.000	75.000	76.500	78.030	79.591	81.182	82.806	84.462	86.151	87.874	89.632	91.425	93.253	95.118	97.020

Revenues' Projections															
Year	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***
All values are expressed in BAM															
Physical indicators															
Households connected to water supply system	750	754	758	761	765	769	773	777	781	784	788	792	796	800	804
Consumers connected to the system	2025	2035	2045	2056	2066	2076	2087	2097	2107	2118	2129	2139	2150	2161	2171
Water consumption (litre/capita/day)	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
Water consumption per household (m3/day)	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
Households with the water meter	750	754	758	761	765	769	773	777	781	784	788	792	796	800	804
Households without the water meter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

YEAR		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Physical indicators																
Price of water services– water meters	(BAM/m3)	0,60	0,60	0,60	0,85	0,85	0,85	0,85	1,00	1,00	1,00	1,00	1,00	1,2	1,2	1,2

Income from collected services

YEAR		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Household																
- Invoiced consumption	BAM	62.087	62.397	62.709	89.282	89.728	90.177	90.628	107.154	107.690	108.228	108.769	109.313	131.832	132.491	133.153
- Collection rate	%	75,00%	75,00%	75,00%	85,00%	85,00%	85,00%	90,00%	90,00%	90,00%	90,00%	90,00%	90,00%	90,00%	90,00%	90,00%
Households - TOTAL																
- Invoiced consumption	BAM	62.087	62.397	62.709	89.282	89.728	90.177	90.628	107.154	107.690	108.228	108.769	109.313	131.832	132.491	133.153
- Charged value	BAM	46.565	46.798	47.032	75.890	76.269	76.650	81.565	96.439	96.921	97.405	97.892	98.382	118.649	119.242	119.838
		289	292	295	298	301	304	307	310	313	316	319	322	326	329	332
Household Revenues per person per year	BAM	2338	2385	2432	2481	2531	2581	2633	2685	2739	2794	2850	2907	2965	3024	3085
Invoiced service as % of revenue	%	1,31%	1,29%	1,26%	1,75%	1,72%	1,68%	1,65%	1,90%	1,87%	1,83%	1,79%	1,76%	2,07%	2,03%	1,99%
Charged service as % of revenue	%	0,98%	0,96%	0,95%	1,49%	1,46%	1,43%	1,48%	1,71%	1,68%	1,65%	1,61%	1,58%	1,86%	1,82%	1,79%

Income from collected services

YEAR		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Industry and other business consumers																
- Invoiced consumption	BAM	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000
- Collection rate	%	80,00%	83,00%	75,00%	80,00%	85,00%	90,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%	95,00%
TOTAL - Industry and other business consumers																
- Invoiced consumption	BAM	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000
- Charged value	BAM	32.000	33.200	30.000	32.000	34.000	36.000	38.000	38.000	38.000	38.000	38.000	38.000	38.000	38.000	38.000

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Other revenues															
1. Other revenues	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
2.															
3.															
Total	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000

YEAR		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenues (BAM)																	
Revenues obtained from the services to the households																	
Collected revenues		37.252	46.565	46.798	47.032	75.890	76.269	76.650	81.565	96.439	96.921	97.405	97.892	98.382	118.649	119.242	119.838
Revenues obtained from the services to the industry																	
Collected revenues		30.000	32.000	33.200	30.000	32.000	34.000	36.000	38.000	38.000	38.000	38.000	38.000	38.000	38.000	38.000	38.000
Revenues obtained from the services to the budgetary institutions																	
Collected revenues		0	0	0	0	0	0	0	0	0	0						
Total revenues		67.252	78.565	79.998	77.032	107.890	110.269	112.650	119.565	134.439	134.921	135.405	135.892	136.382	156.649	157.242	157.838
Other revenues		60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
Additional financing from the budget		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan																	
Total revenues		127.252	138.565	139.998	137.032	167.890	170.269	172.650	179.565	194.439	194.921	195.405	195.892	196.382	216.649	217.242	217.838
Expenses																	
Operational expenses		75.000	75.000	75.000	76.500	78.030	79.591	81.182	82.806	84.462	86.151	87.874	89.632	91.425	93.253	95.118	97.020
Maintenance and reinvestment expenses		54.000	54.000	54.000	54.000	55.080	56.182	57.305	58.451	59.620	60.813	62.029	63.270	64.535	65.826	67.142	68.485
Operational and maintenance expenses before savings		129.000	129.000	129.000	129.000	131.580	134.212	136.896	139.634	142.426	145.275	148.180	151.144	154.167	157.250	160.395	163.603
Savings of expenses		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational and maintenance expenses in total		129.000	129.000	129.000	129.000	131.580	134.212	136.896	139.634	142.426	145.275	148.180	151.144	154.167	157.250	160.395	163.603
Investment expenses		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total expenses		129.000	129.000	129.000	131.580	134.212	136.896	139.634	142.426	145.275	148.180	151.144	154.167	157.250	160.395	163.603	166.875
Expenses recovery Type I		52.252	63.565	64.998	60.532	89.860	90.678	91.468	96.759	109.976	108.769	107.531	106.260	104.957	123.395	122.124	120.818
Expenses recovery Type II		-1.748	9.565	10.998	5.452	33.678	33.373	33.017	37.139	49.164	46.740	44.261	41.725	39.132	56.253	53.639	50.963
Accumulated surplus		-1.748	7.817	18.814	24.266	57.944	91.317	124.334	161.472	210.636	257.376	301.638	343.363	382.495	438.748	492.387	543.349

4.4 PRELIMINARY ASSESSMENT OF THE IMPACT ON 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 the Republic of Srpska.

4.5 IMPLEMENTATION PLAN AND IMPLEMENTATION STRATEGY

The Supervisory Board of Rudo 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 a "living" document that will at least annually, in accordance with the progress of implementation and in accordance with other planned activities of both Municipality and utility company, be revised and updated in accordance with the needs.

The Supervisory Board of Rudo Municipality

Rudo Municipality	Milko Čolaković	Rudo Municipal Assembly–
	Vera Furtula	Rudo Municipal Assembly – Coordinator for Economy and Finance
	Mirko Mijušković	Rudo Municipal Assembly – Coordinator for Utility Services
Vodovod i Kanalizacija Rudo	Milenko Novaković	"Usluge" Rudo – Managing Director
	Jovan Savić	"Usluge" Rudo – Manager for Economic Stimulus
	Slobodan Miković	"Usluge" Rudo – Technical Manager

Plan of priority investments, as well as other findings of the Study will form the basis for the development of utility planning documents and the basis for planning of infrastructure projects.

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

4.6 DYNAMIC PLAN

S.n.	Type of works	Years									
		2011	2012	2013	2014	2015	2016	2017	2018	219	2020
1	Development of Water Source Protection Study										
2	Development of water supply system hydraulic model										
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	Pumping station "Krupica"										
7	Rehabilitation of the reservoir "Zova 1"										
8	Rehabilitation of the reservoir "Begova voda"										
9	Rehabilitation of the reservoir "Gradina"										
10	Rehabilitation of break pressure chambers in the system										
11	Rehabilitation of the source "Zova 1"										
12	Rehabilitation of the source "Begova voda"										
13	Replacement of transmission pipelines										
14	Replacement of distribution network pipelines										
15	WSS Uvac										
16	WSS Mokronozi										

5 APPENDICES

5.1 APPENDIX 1: GENERAL MAP OF WATER SUPPLY SYSTEM RUDO - 1:25000

5.2 APPENDIX 2: GENERAL MAP OF WATER SUPPLY SYSTEM RUDO - 1:2500

5.3 APPENDIX 3: WATER QUALITY TESTING RESULTS