Project Formation Study on
Bijeljina Water Supply and Sewerage, Republic of Srpska, Bosnia and Herzegovina

Study Report

March 2009

Engineering and Consulting Firms Association, Japan

UNICO International Corporation

Tokyo Engineering Consultants Co., Ltd.

Ebara Corporation

KEIRIN

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List of Acronyms

AC – Asbestos Cement
BEN – Balkan Endemic Nephritis
BiH – Bosnia and Herzegovina
CI – Cast Iron
CSD – Communal Services Department
DFID – Department for International Development
Dia. – Diameter
EBRD – The European Bank for Reconstruction and Development
EIA – Environment Impact Assessment
Entity – the two highly autonomous political organisations of BiH, FD and RS
EU – European Union
FD – The Federation of BiH, one of the autonomous Entities of BiH
ha. - Hectare
IAS – International Accounting Standard
IEBL – Inter-Entity Boundary Line
IDPs – Internally Displaced Persons
KfW – Kreditanstalt für Wiederaufbau (=German Development Bank)
km – Kilometre
KM – Convertible Marks: 1 KM = US$ 0.67
KM/ m^3 - KM per cubic metre
l/s – Litres per second
m^3 – Cubic metre
MAFWM – Ministry of Agriculture, Forestry and Water Management
MGD – Millennium Development Goals
NGO – Non-Governmental Organisation
NRW – Non Revenue Water
PE – Polyethylene Pipe
PVC - Polyvinyl Chloride
RS – Republic of Srpska, one of the autonomous Entities of BiH
SCADA – Supervisory Control and Data Acquisition
UFW – Unaccounted for Water
UNICEF – United Nations International Children Fund
USGS – United States Geological Survey
VAT- Value Added Tax

Vodoprevreda – Public Enterprise of Water

Vodovod i Kanalizacija – Public Water and Sewerage Company

Vodovod i Kanalizacija Bijeljina = VKB – Bijeljina Public Water and Sewerage Company

WTP – Water Treatment Plant

WWTP – Waste Water Treatment Plant

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EXECUTIVE SUMMARY

Executive Summary

1) Background and objectives of the Study

In Bosnia and Herzegovina (hereinafter referred as "BiH"), restoration and improvement of water supply and sewerage system has been identified as one of the most important programmes in national and regional reconstruction planning after the war.

The current state of water supply and sewerage in BiH leaves a lot to be desired even though it has been improved in cooperation with international organisations and other donor agencies since the Dayton Peace Agreement was concluded. Under such circumstance, the Government of BiH officially requested to the Government of Japan to provide a Japanese grant scheme titled "The Project for Emergency Water Supply Project in part of nephritis suffered areas of Semberia, Republic of Srpska" in 2003.

The Project Formation Study Team for the "Bijeljina Water Supply and Sewerage, Republic of Srpska, BiH" is originally formed to review the aforementioned project. However, due to the change of situation surrounding the project, the Study Team decided to modify a part of study policy that the Study should include the searching for the possibilities to create new projects including sewerage systems in the city.

The main objectives of the Study are as follows.

1. To confirm the current situation of water supply and sewerage systems in Bijeljina city, and a suggestion for the effective and efficient project formation shall be recommended by the Study Team
2. To identify the correlation between nephritis, which maintain an extraordinarily high morbidity ratio in the city, and groundwater
3. To ascertain the ability to operate and maintain the modern water supply facilities in the Bijeljina Water Supply and Sewerage Company (VKB)

2) Current Situation of Water Supply and Sewerage Services in Bijeljina

In Bijeljina, water supply and sewerage system is managed by the VKB under the Municipality of Bijeljina. The VKB became a joint stock company in 2004, which was owned 65% of the total share by the government of the Republic of Srpska. Total population in the city is estimated as 107,000, the VKB surmises the total population as around 200,000 including 50,000 internal displaced persons (IDPs). However, due to sharp fluctuations in the number of IDPs and the in-execution of a census since 1991, it is difficult to estimate the exact figure of

the current population in Bijeljina. The existing water supply and sewerage facilities and their problems are as follows;

(1) Water Supply System

Grmić well-field, which consists of 17 wells (average depth 40 m), is the sole resource for water supply in Bijeljina. Its production capacity is around 475 l/s and is supposed to yield 1,500 to 2,000 l/s at the maximum. However, in order to meet the future water demand in 2030, production capacity should be increased up to 722 l/s.

Around 25 % of the municipality is served by the distribution network. Total length of the pipeline is approximately 400 km, Dia. 50 to 350mm. Age and material of the pipeline varies and the leakage ratio is about 60 %. There is one elevated reservoir (capacity - 1500 m^3, height – 42 m) in the centre of the city, which was used as office of the VKB. Basically, water is supplied 24 hours a day in Bijeljina.

In general, most of water supply facilities were built in former Yugoslavia-era, and are needed to be rehabilitated.

(2) Sewerage System

At present, there is only sewerage collection pipeline in the limited area in the centre of the city. Drainage and other wastewater are discharged into underground or river, naturally, without any treatment. Thus, the construction of sewerage treatment plant is eagerly anticipated.

3) Outline of the Future Projects

The following projects are required to meet the future demand of water supply and sewerage in the city;

(1) Water Supply System

1) Water Intake Facilities
   - New construction of wells and well pumps (50 l/s x 4 sets)
   - Replacement of emergency electrical power generation facilities
   - Replacement of chlorination facilities
   - Installation of SCADA system

2) Water Reservoir
   - New construction of the additional water reservoir with a capacity of 1,000 m^3.

3) Water Transmission Pipeline and Distribution Pipeline
   - Replacement of aged CI and AC pipes

- Rehabilitation of ring mains
- New construction of transmission and distribution pipeline to Northern region
- New construction of transmission and distribution pipeline to South-western region
- Procurement of leakage detector equipment

Total cost is estimated at 49.9 million KM (=3,653 million Japanese Yen).

(2)Sewerage System

1) Wastewater collection system
- New construction of secondary sewer and tertiary sewer pipelines
- New construction of house connections
- New construction of main sewer pipeline from pump station 1 to waste water treatment plant
- Rehabilitation of existing aerated lagoon
- New Wastewater Treatment Plant (SBR w/anaerobic sludge digestion)

2) Replacement of surface water sewer

Total cost is estimated at 60.7 million KM (=4,360 million Japanese Yen).

4) Conclusion and Recommendation

- Conclusion -

The existing water supply and sewerage systems in Bijeljina city face serious situations. There are some old water supply facilities that are so deteriorated in structure, pipes, mechanical and electrical equipment, hence are not able to supply sufficient water to the town. As for the sewerage system, the VKB has just a few collecting pipe lines limited in the centre of the city and Grmić well-field, and the most of wastewater is discharged into neighbouring rivers and underground without any treatment.

In order to solve the problems, expansion and rehabilitation of the water supply and sewerage systems is proposed. Since there is no national plan in the state level, the basic policy of the expansion and rehabilitation of the systems shall be deliberately planned in accordance with the “Development Strategy up until the year 2015” issued by the Bijeljina Municipality.

- Recommendation -

On the basis of the above conclusion, the Study Team made the following recommendations to carry on the development of water supply and sewerage systems in Bijeljina;

(1) Project Implementation

- a) Feasibility Study including site confirmation works and financial design shall be implemented
- b) Detailed Design would be conducted to confirm the design condition before implementation of the Project

(2) General Issues

- a) EIA study shall be carried out by the VKB
- b) Replacement of the aged pipelines should be carried out in consideration of high leakage ratio and public health
- c) As explained in 3, the VKB needs to obtain the skills of pipe leakage detection for the maintenance of pipelines
- d) Since there is no wastewater treatment plant, it is urgent necessary for Bijeljina to establish a new wastewater treatment plant for environmental protection and public health
- e) No correlation between the BEN and groundwater can be identified from the result of water quality inspection conducted by the Study Team, however, more extensive groundwater survey together with other environmental survey should be implemented for the solution of the disease
- f) Human resource development shall be continued to maintain the development of water supply and sewerage management
- g) Water tariff shall be increased in order to improve financial situation of the VKB
- h) Autonomy of the VKB shall be emphasised and be more independent for the proper management of the organisation

CHAPTER 1 INTRODUCTION

1 Introduction

1.1 Background of the Study

In Bosnia and Herzegovina (hereinafter referred as "BiH"), restoration and improvement of water supply and sewerage system has been identified as one of the most important programmes in national and regional reconstruction planning after the war.

The current state of water supply and sewerage in BiH leaves a lot to be desired even though it has been improved in cooperation with international organisations and other donor agencies since the Dayton Peace Agreement was concluded. In fact, there still are many municipalities that can not supply safe water in a stable manner to their residents, and the municipalities need to identify, plan and carry out effective projects to find a way out of this difficulty.

The Government of BiH officially requested to the Government of Japan to provide a Japanese grant scheme titled "The Project for Emergency Water Supply Project in part of nephritis suffered areas of Semberia, Republic of Srpska" in 2003.

The Project Formation Study Team for the "Bijeljina Water Supply and Sewerage, Republic of Srpska (RS), BiH (Study Team)" is originally formed to review the aforementioned project. However, due to the change of situation surrounding the project, the Study Team decided to modify a part of study policy that the Study should include the searching for the possibilities to create new projects including sewerage systems in the city.

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1.2 Objectives of the Study

The main objectives of the Study are as follows.

1. To confirm the current situation of water supply and sewerage systems in Bijeljina city and to discuss with the Bijeljina Waterworks and Sewerage Company (*Vodovod I Kanalizacija Bijeljina* in Bosnian language=VKB) and other concerned organisations about the requested project and other possibilities to create the new projects in the city. Finally, based on the above, a suggestion for the effective and efficient project formation shall be recommended by the Study Team.
2. To identify the correlation between nephritis, which maintain an extraordinarily high morbidity ratio in the city and other areas in the Balkan Peninsula, and the alleged groundwater sources by means of water quality inspection.

3. To ascertain the ability to operate and maintain the modern water supply facilities in the VKB. Since the VKB needs to increase its employees in order to cope with growth in water demand, the possibility of technical assistance on human resource development, enhancement of organisational function, and improvement of organisational operations shall be checked.

1.3 Member of the Study Team

The Study Team consists of three members as follows;

Table 1-1 Member List of the Study Team

Name	Duty	Company
Mr. Kenichiro SUGIYA	Team leader / operation and maintenance specialist	Unico International Corp.
Mr. Isao MASUI	Water Supply Facility Specialist (A)	Tokyo Engineering Consultants Co., Ltd.
Mr. Shigeru KAWAMATSU	Water Supply Facility Specialist (B)	Ebara Densan Ltd.

1.4 Schedule of the Study

Table 1-2 Schedule of the Study

			Contents of Study	
			Mr.Kenichiro SUGIYA	Mr. Isao MASUI/Mr. Shigeru KAWAMATSU
1	Oct/05	Mon	✈JL 407 (Tokyo 13:00 - 18:00 Frankfurt)	(Domestic work)
2	Oct/06	Tue	✈ LH976 (Frankfurt 16:10 – 17:05 Munich) ✈ LH3500 (Munich 19:35 – 21:00 Sarajevo)	(Domestic work)
3	Oct/07	Wed	●Meeting with KfW ●Meeting with the Embassy of Japan ●Meeting with JICA Sarajevo Office	(Domestic work)
4	Oct/08	Thu	(Surface Transfer) Sarajevo ➪ Bijeljina ●Kick-off Meeting with Vodovodo I Kanalizacija	(Domestic work)
5	Oct/09	Fri	●Meeting with Vodoprevreda ●Meeting with EBRD project team ●Meeting with Vodovodo I Kanalizacija	(Domestic work)
6	Oct/10	Sat	-	✈ OS 052 (Tokyo 10:55 - 15:55 Vienna)
7	Oct/11	Sun	(Airport pick up: Mr. Masui and Kawamatsu)	✈ OS 773 (Vienna 13:30 - 14:40 Belgrade) (Surface Transfer) Belgrade ➪ Bijeljina
8	Oct/12	Mon	●Meeting with Vodovodo I Kanalizacija ●(Site Survey: Grmic water source)	
9	Oct/13	Tue	●(Site Survey: Bijeljina city centre, Maintenance factory of Vodovodo I Kanalizacija)	
10	Oct/14	Wed	●(Site Survey: Northern area of Bijeljina city)	
11	Oct/15	Thu	●(Site Survey: Southern area of Bijeljina city)	
12	Oct/16	Fri	●Wrap up meeting with Vodovod I Kanalizacija	(Surface Transfer) Bijeljina ➪ Belgrade
13	Oct/17	Sat	(Surface Transfer) Bijeljina ➪ Sarajevo	✈ OS 7132 (Belgrade 08:10 - 09:45 Vienna) ✈ OS 051 (Vienna 14:05 -
14	Oct/18	Sun	–	- 08:15 Tokyo)
15	Oct/19	Mon	●Meeting with the Embassy of Japan ●Meeting with JICA Sarajevo Office	(Domestic work)
16	Oct/20	Tue	✈ JU 109 (Sarajevo 06:30 - 07:15 Belgrade) ●Meeting with JICA Balkan Office	(Domestic work)
17	Oct/21	Wed	✈ LH 3407 (Belgrade 16:30 - 18:35 Frankfurt) ✈ JL 408 (Frankfurt 21:05 -	(Domestic work)
18	Oct/22	Thu	- 15:20 Tokyo)	(Domestic work)

1.5 List of Interviewees

1) Embassy of Japan in BiH	Mr. Taku ARAMAKI (First Secretary)
2) JICA Balkan Office	Mr. Masao SHIKANO (Office Representative) Mr. Yohei TAKAHASHI (Ass. Resident Representative)
3) JICA BH Contact Office	Ms. Kazuyo HASHIMOTO (Project Formulation Adviser)
4) Vodovod I Kanalizacija Bijeljina (Bijeljina Water and Sewerage Comany)	Mr. Vasilije MIĆIĆ (Director) Mr. Malden MIKOVIĆ (Director of Technical Dept.) Mr. Alexsandra PLJEVALDČIĆ (Civil Engineer) Mr. Milojko TODOROVI Ć (Economist) Ms. Ivana RADONIĆ (PIU Office Manager) Mr. Milorad RUDIĆ (Manager, Water Source Dept.) Mr. Bengt FESSE (Consultant for the EBRD Project)
5) Bijeljina Municipal Assembly	Mr. Vlado SIMEUNOVIĆ (Advisor) Mr. Izet CAMIĆ (Head of Public Utility and Housing Dept.)
6) Ministry of Finance (RS)	Ms. Gordaha PRAŠTAKO (Head, Foreign Aid Dept.)
7) Ministry of Agriculture, Forestry and Water Management (RS)	Mr. Nebojša JAKŠIC (Advisor for Minister)
4) Republic Directorate of Water: (RS)	Mr. Blagojević BRANISLAV (Director) Mr. Ćubrilo SLOBODAR (Technical Advisor) Mr. Miroslav BOSILJČIĆ (Project Manager)
12) KfW	Mr. Gerald KUHNEMUND (Director KfW Office) Ms. Gabriela HUSKIĆ (Project Coordinator)
13) European Bank for Reconstruction and Development (EBRD)	Mr. Josip Polic (Principal Banker)

CHAPTER 2 CURRENT SITUATION OF WATER SUPPLY AND SANITAION IN BIH AND BIJELJINA CITY

2 CURRENT SITUATION OF WATER SUPPLY AND SEWERAGE IN BIH AND BIJELJINA CITY

2.1 Current Situation of Water Supply and Sewerage in BiH

According to a report issued by the EU and the World Bank, before the war about 60 % of the total population in BiH was served by safe water supply systems (95 % in urban areas and 35 % in rural areas). However, due to damage and lack of proper maintenance during the war, most systems are experiencing great loss caused mainly by leakage from network distribution mains. In addition, most of the facilities in the water and wastewater systems were constructed under the former Yugoslavian government, and thus most of them date back more than 25 years, which needs extensive rehabilitation urgently. Due to the lack of demographic survey since 1991, there is no exact numerical data of the latest safe water coverage ratio.

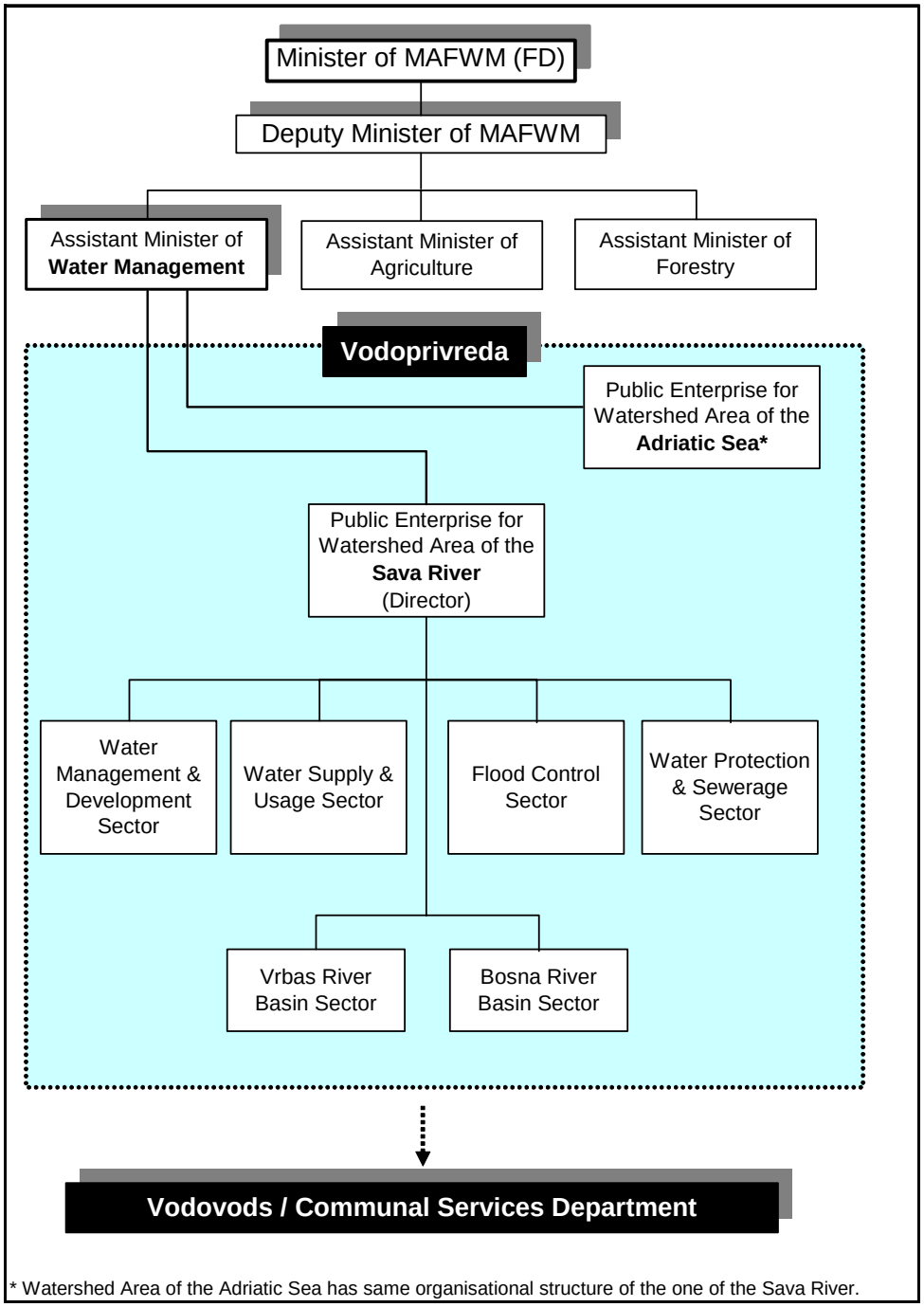
In each Entity, Republic of Srpska (RS) and the Federation of Bosnia and Herzergovina (FD), water supply projects are planned and executed by the Public Enterprise of Water (*Vodoprevreda*), and water supply systems are operated and maintained by the Public Water and Sewerage Company (*Vodovod i Kanalizacija=Vodovod*) in each municipality. In both types of Entity, Vodoprevreda is under the Ministry of Agriculture, Forestry and Water Management (MAFWM), and *Vodovod* which is a part of Municipality and thus *Vodovods* are owned and firmly controlled by the Municipalities. There are a total of about 140 municipalities in the country and in most cases, each has a public water company or other forms of water and wastewater organizations. In the Brčko District, Water and Wastewater Division under the Utilities Department is in charge of water supply activities.

Due to the separation of the two entities, there is no national water master plan which covers the entire country and the only target of the development of water supply and wastewater in all over the country is Millennium Development Goals (MDG). According to the UNICEF, the BiH has already achieved all of the MDGs but also pointed out the pace of reform has slowed due to a complex and fragmented governmental structure that has left gaps in the delivery of social services including water supply and sewerage.

There are three *Vodoprevredas* in BiH; two are in FD, and are based in Sarajevo and Mostar, each covering one of the two watershed areas, Sava River and the Adriatic Sea, and one in the RS, which is based in Bijeljina. The organisation of FD and RS *Vodoprevredas* are shown in the next clause.

2.2 Institution of Management of Water Supply and Sewerage in BiH

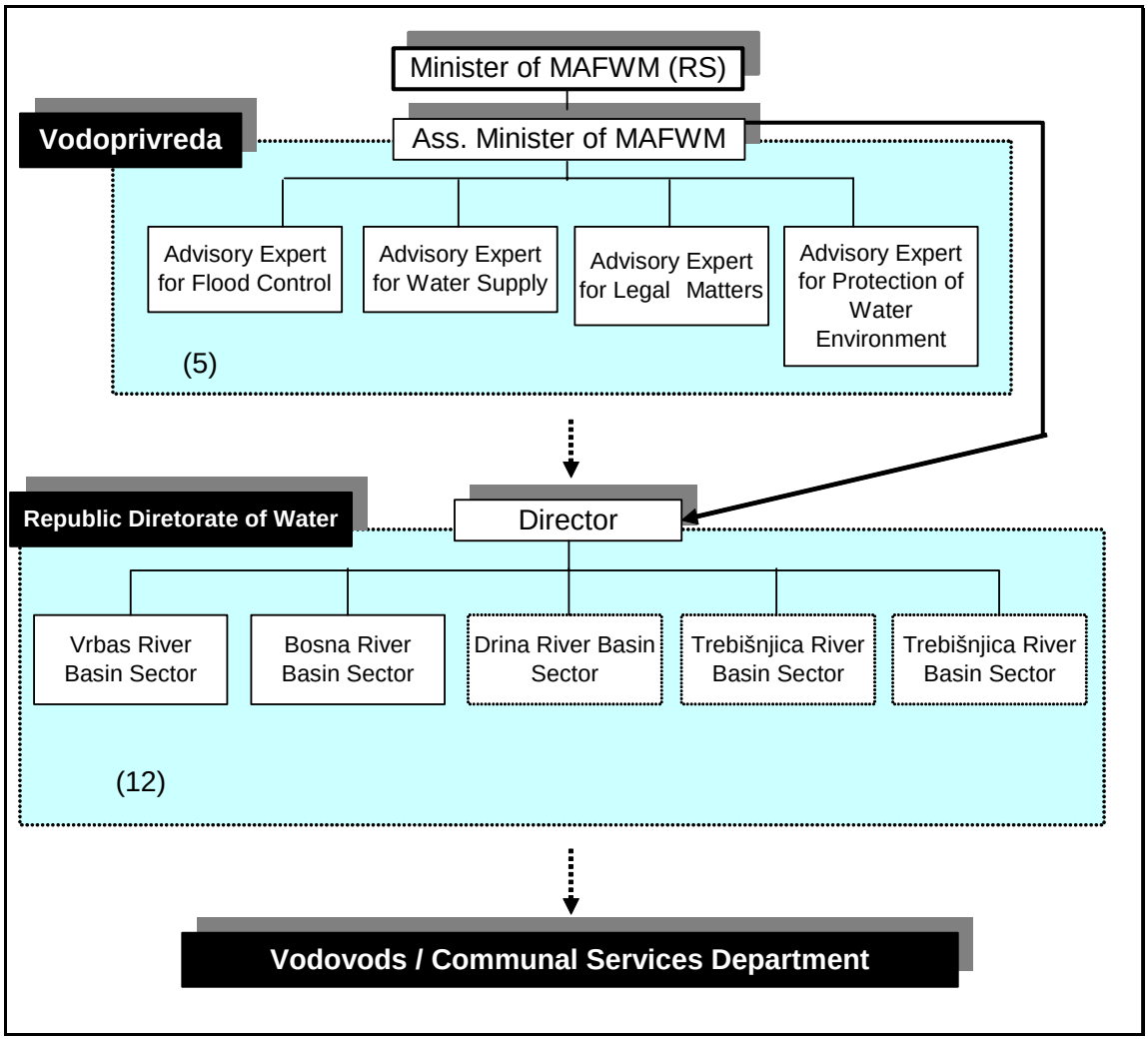
In FD *Vodoprevreda*, there are 50 employees in Sava Watershed group, and 20 in Adriatic Sea. The *Vodoprevreda* consists of four main sectors and two regional sectors. Verbas River Basin Sector and Bosna River Basin Sector are cooperatively worked together with their counterpart of RS. The organisation of FD *Vodoprevreda* is as follows;



(Source: Vodoprevreda)

Figure 2-1 Organizational Chart of *Vodoprevreda* (FD)

In the RS, water supply projects are planned and executed by the Public Enterprise of Water (*Vodoprevreda*), which is also under the Ministry of Agriculture, Forestry and Water Management (MAFWM). The organization chart of the Vodoprevreda is as follows;



(Source: *Vodoprevreda*)

Figure 2-2 Organization of *Vodoprevreda* (RS)

The main task of RS *Vodoprevreda* is an advisory organization for water-related agencies and organization, and is made up of four technical experts.

Republic Directorate of Water, one of the lower organizations in *Vodoprevreda*, is in charge of the administration and protection of water sources. There are 12 employees in the Republic Directorate of Water in the RS and is, conveniently, located in Bijeljina, the targeted area of the Study.

In the meanwhile, as explained in clause 2.1, water supply systems in each urban and rural area are operated and maintained by *Vodovod* in each municipality. As a *Vodovod* is a part of municipality and there is no organizational relationship or subordination with *Vodoprevreda*, which is an organization under the central government of the entity.

Furthermore, there are two types of Vodovod, one that is financially and organisationally independent from its respective municipality even though the director is appointed by municipality. The other is known as a 'Communal Services Department (CSD)', a department of the municipality that usually provides water supply and sewerage services along with many other municipal services such as solid waste collection and street cleaning. Generally in smaller municipalities, water supply is managed by the CSD due to the financial difficulties.

In general, the relationship between Vodoprevreda and Vodovod is vague since there is no organizational hierarchy between them. The concerned international organizations point out that there should be explicit demarcation between the two parties in terms of activities and roles, and an established channel of communication for the effective management of water supply and sewerage systems.

2.3 Current Situation of the Project Site and Major Issues

2.3.1 Outline of the Republic of Srpska and Bijeljina City

(1) Republic of Srpska (RS)

Republic of Srpska (RS), or *Republika Srpska* in Bosnian language, is one of the two political entities which represent a lower level of governance in the state of BiH. Although the official capital is Sarajevo, the *de facto* capital is Banja Luka, which is also the second largest city in BiH with the estimated population of 250,000.

As shown in Figure 2-3, the Inter-Entity Boundary Line (IEBL) that divides BiH into the two entities basically runs along the military front lines as they existed at the end of the war, as defined by the Dayton Agreement. The total length of the IEBL is approximately 1,080km. The IEBL is an administrative and political demarcation between the two entities. The total are of the RS is 24,526km^2, and the under the law of Territorial Organization and Local-Government amended in 1996, the RS is now divided into 63 municipalities including Bijeljina.

(Source: CIA)

Figure 2-3 Inter-Entity Boundary Line

As for the population of the RS, the estimated total population in 2007 is 1,439,673. Although the demographics of the RS changed drastically during and after the war, there has been no census since 1991, hence there is no official population data. However, the changes in population in the last 10 years are estimated in Table 2-1 by the Institute of Statistics, RS. In addition, ethnic composition, including IDPs, in the RS is estimated as; Serbs 88%, Bosnian 8%, and Croats 4%.

Table 2-1 Estimated Population (1998 to 2007)

	Total	Male	Female
1998	1,428,798	679,795	749,003
1999	1,448,537	689,186	759,351
2000*	1,428,899	695,194	733,705
2001	1,447,477	704,197	743,280
2002	1,454,802	708,136	746,666
2003	1,452,351	706,925	745,426
2004	1,449,897	705,731	744,166
2005	1,446,417	704,037	742,380
2006	1,443,709	702,718	740,991
2007	1,439,673	700,754	738,919

(Source: Institute of Statistics, RS)

*Remarks: Since year 2000, Brcko District has not been included in the population estimate.

Table 2-2 indicates the population in employment by sex and activities. According to the table, although the accuracy of the data is questionable, it is understandable that service sector hires the biggest labour forces. In particular, more than 50% of female labour forces engage in the service sector.

Table 2-2 Population in Employment (2006 and 2007)

(in ,000 KM)

	2006			2007		
	Total	Male	Female	Total	Male	Female
TOTAL	298	186	112	340	214	126
Agricultural activities	93	59	(34)	106	66	40
Non-agricultural activities	80	60	20	96	75	21
Service activities	125	68	58	138	73	65
	Structure (%)					
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Agricultural activities	31.2	31.6	(30.4)	31.2	30.9	31.7
Non-agricultural activities	26.8	32.1	17.8	28.2	35.1	16.5
Service activities	42.1	36.2	51.8	40.6	34.0	51.8

(Source: Institute of Statistics, RS)

RS's economy has been improved significantly with the annual real growth rates of GDP in the past three years are 6.5 to 8.6%. In 2007, GDP at current process is 7,357 million KM (=US$ 4,929 million), and GDP per capita is 5,110 KM (=US$ 3,423). Table 2-4 explains the national accounts of the RS.

Table 2-3 GDP in Current Prices (2005 to 2007)

	2005	2006	2007
GDP at current prices (mill. KM)	5,617	6,499	7,357
GDP per capita (KM)	3,883	4,501	5,110
GDP at constant prices (mill. KM)	5,358	6,102	6,918
Annual real growth rates of GDP (%)	7.0	8.6	6.5

(Source: Institute of Statistics, RS)

According to the economic statistical data, service sector such as wholesale and retail trade makes a huge contribution to the RS's economy with the gross value added more than 1,000 million KM (=US$ 670 million) at current prices in 2007. Agriculture (including hunting and forestry) sector follows next with the gross value added of 900 million KM (=US$ 603 million).

Finally, external trade balance of the RS is shown in Table 2-4. Despite of the solid growth rate of the GDP, balance of trade keeps negative growth. Major export commodities are aluminium oxide, non-agglomerated iron ores, and electrical energy, on the other hand, import of principal commodities are oil, hot rolled flat products of iron, medicaments, and so on.

Table 2-4 External Trade Balance (2005 to 2007)

(in ,000 KM)

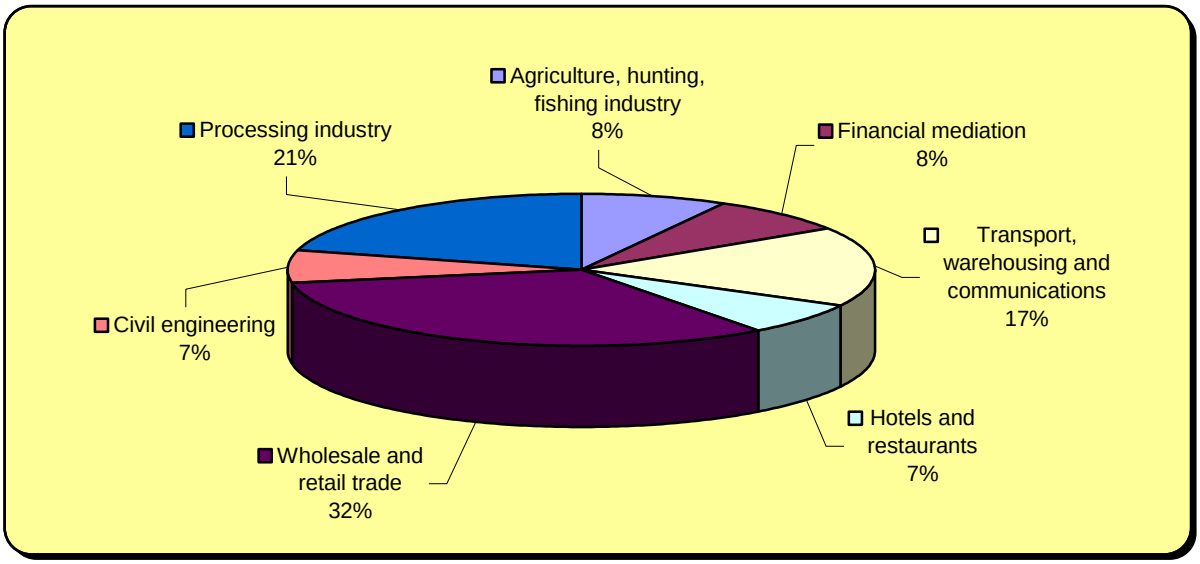
	2005	2006	2007
Export	1,130,518	1,540,236	1,671,601
Import	2,953,177	2,760,163	3,347,925
Volume of trade	4,083,695	4,300,399	5,019,526
Balance of trade	-1,822,659	-1,219,927	-1,676,324
Coverage import/export in %	38.3	55.8	49.9

(Source: Institute of Statistics, RS)

(2) Bijeljina City

Bijeljina is the second largest city in the RS after BanjaLuka, and is situated on the flat rich plains of Semberija region. Bijeljiana is 6 km from the border of Serbia and 40 km from Croatia and 35 km from the FD. Bijeljina municipality consists of 61 subdivisions.

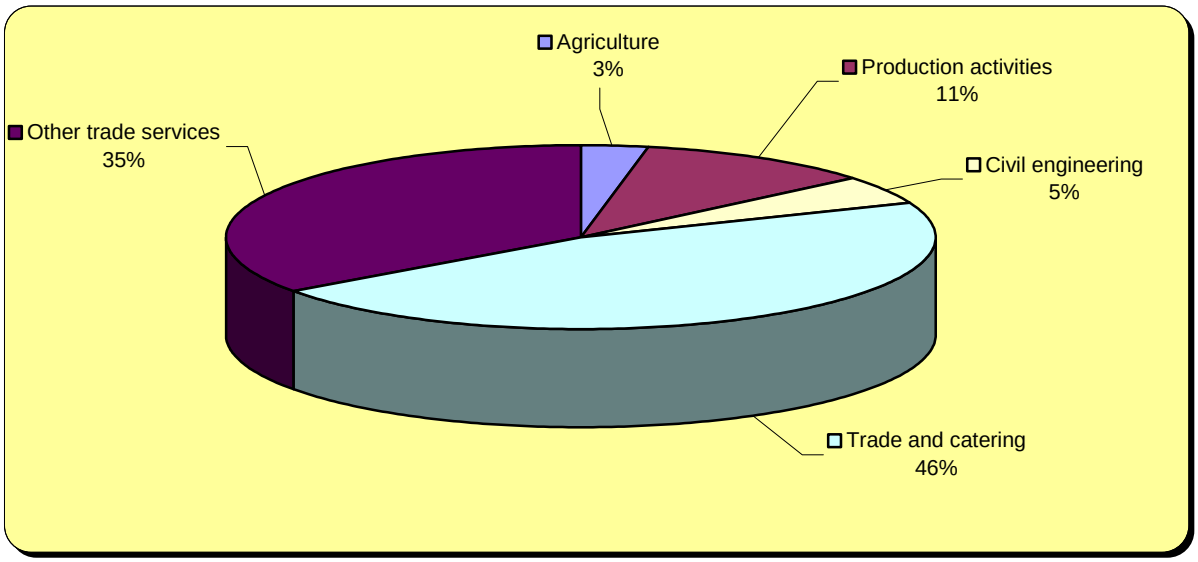
Semberija is a flat region which is surrounded by the rivers Sava, Drina and the Majevica mountains. The entire Semberija area is typically an agricultural area which has fertile land and suitable weather conditions. The main crops are wheat, corn, cabbage, tomato, water-melon and other vegetables. Also, Cattle-breeding of cows and pigs contributes to the local economy. However, as shown in Figure 2-3, agricultural industry shares only 8% of economic structure. The biggest industry in the city is wholesale and retail trade. For reference, GDP of Bijeljina city is around 415 million KM (US$ 278 million) then GDP per capita is 2,730 KM per capita (US$1,829), both of which are lower than the average figures of the RS.



(Source: Bijeljina Municipality)

Figure 2-4 Economic Structure of Bijeljina Municipality

Figure 2-4 below also indicates the structure of legal entities in the city. Trade and catering industry shares almost 50% of the total number. Agricultural entities shares only 3%. However, unemployment ratio in the city is extremely high at 37%. Due to the economic downturn, the ratio is in constant increase.



(Source: Bijeljina Municipality)

Figure 2-5 Structure of Legal Entities of Bijeljina Municipality

As for the demographics data, Urbanism and Planning Department of Bijeljina Municipality estimates its inhabitants at 152,000 in the city (as of 2002). It is, however, estimated on the basis of the last and latest census in 1991 and the drastic demographic change can be seen in the entire country during and after the war, thus the accuracy of the data is questionable. According to the VKB, the current population is around 200,000 including IDPs at 50,000. In the Study, population data given by the Municipality, 159,588 in 2005, is adopted for water demand forecast. For more detailed information, refer to the sub-clause 3.1.1.

Development projects of Bijeljina Municipality are implemented in accordance with "Bijeljina Municipality Development Strategy up until 2015". The development strategy consists of six strategic goals, economic development and employment, agricultural development, human resources development, improvement of education, sport, culture, health and social care conditions, quality of municipal administration services, and urban development including infrastructure. Also, the development strategy is a flexible framework for the future activities linking between vision, objectives, programs, and projects in a wide range of development areas including water supply and sewerage. Monitoring process is conducted by the Municipality annually by evaluating each development projects.

In the development strategy, Bijeljina Municipality conducted self-appraisal on the situation surrounding the Municipality by means of SWOT analysis as follows;

Table 2-5 SWOT Analysis (Strength and Weakness)

STRENGTHS - internal	WEAKNESSES - internal
- Rapid increase in the number of municipality inhabitants - Rapid expansion of Bijeljina town - Many young, educated people - Strong motivation for work and progress - Developed education, especially high education - Developed health care - Medium-size town in insufficiently developed area - Favourable geographic location - Good preconditions for development of tourism - Relatively clean natural environment - Rich natural resources - Dligence, hospitality - Adaptability - Regional identity, recognizability - Cultural resources, heritage, tradition - Enterprising spirit - Good cooperation of institutions at local level - Developed financial institutions - Strong motivation for development of town and municipality - Adopted regulation plans as a basis for adequate construction - Stability of national currency - Closeness of large urban centres - Availability of relatively cheap and qualitative labor - Developed institutional and non-governmental sectors' network	- Insufficiently developed regional functions of the town - Poor degree of natural resources utilization (Drina, - Sava, geothermal water) - Unemployment - Undeveloped utilities infrastructure - Low level of urbanization - High payments' deficit of the municipality - Insufficient planning - Excessive usage of natural resources (agriculture land) - Insufficiently resolved problems of invalids, families of fallen soldiers, impoverished - Insufficient stimulation of talented youth and their retention in the municipality - Insufficient functional and organizational correlation - Unfavourable economic structure - Negative economic and social effects of the privatization process - Insufficient care of the living environment - Insufficient investments into municipality from republic level - Complicated procedures for establishing companies - Termination and reduced capacity of industry - Small sized land plots - Insufficient communication between public services and citizens - Low level of information technologies' use - Low computer literacy - Low percentage of production activities - Under-utilization of thermal waters - Inadequate construction land fees - Inadequate compensation (land rent) for the use of construction land - Lack of database on land and facilities - Lack of awareness on environment protection - Non-implementation of planning documents - Non-existence of sewage system - Aggravated distribution of drinking water (battered pipelines) - Lack of thermal energy capacity - Non-existence of gas pipeline system - Partial resolving of traffic problems - Poor developed public transportation system - Insufficiently developed tourist infrastructure - Insufficient stimulation of youth activities - Insufficient support to new ideas - Non-existence of an "above-party" development strategy - Non-existence of local community priorities Inadequate management of town-owned property - Negative selection of personnel - Repetition of mistakes from the past

(Source: Bijeljina Municipality)

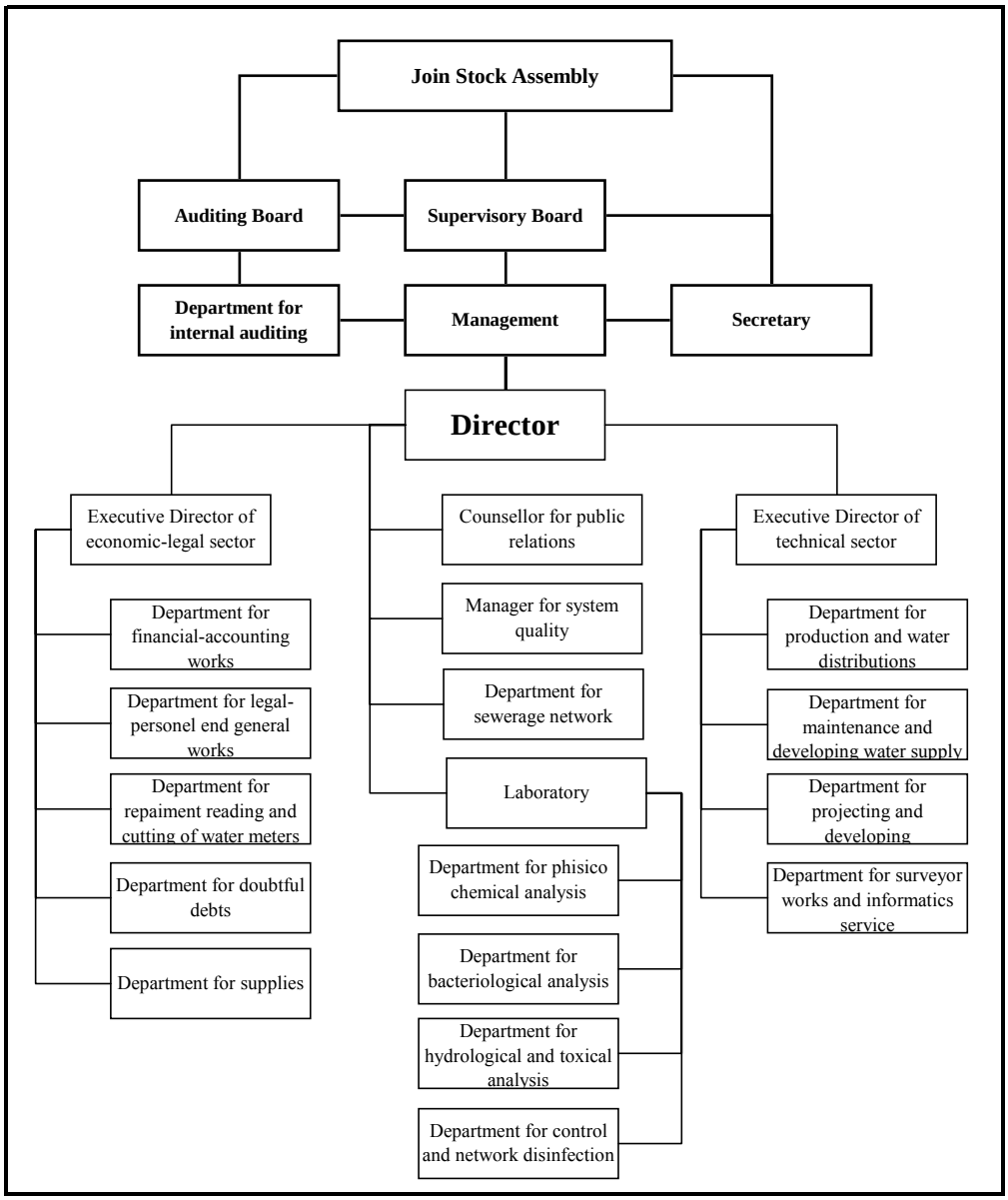
Table 2-6 SWOT Analysis (Opportunities and Threats)

OPPORTUNITIES - external	THREATS - external
- Increase of regional networking (especially trans-border) - Adjustment to EU standards - Utilization of favourable regional location of Bijeljina town (development of regional functions) - Awareness building on sustainable development and environment protection - Awareness building on accepting European standards as a basis for development - Tourism development - Integration, globalization - Joint investments - Concessions - Establishing more favourable climate for trans-border cooperation in the region - Continuous professional and business related development on the concept of life-long learning - More complete legal definition over regional and municipal jurisdiction - Establishment and harmonization of strategic development documents on republic and local community levels - Cooperation between education institutions and economy sector	- Shortcomings in privatization - High tax burden - Departure of educated young people to other countries - Political instability - Undefined regions and their competences - High fiscal centralization - Small participation of municipalities in tax incomes - Undefined role of local communities in economy - Negative effects of the open European market - High external debts - Unrestrained use of natural resources - Ignorance of EU integration advantages - Ignorance of significance of changes coming with - Open European market - Interest of foreign investors for the market and not for production - Grey economy - Slow establishment of new entrepreneurship society - Slow development of the Drina-Sava-Majevica region - Illegal construction - Non-existence of livestock graveyard - High interest rates - Negative birth rate - Slow adjustment of legal regulations to real needs

(Source: Bijeljina Municipality)

2.3.2 Current Situation of Water Supply and Sewerage Services in Bijeljina

In Bijeljina, water supply and sewerage system is managed by *Vodovodo i Kanalizacija* Bijeljina (VKB) under the Municipality of Bijeljina. VKB, established in 1963, plays a key role in the development and maintenance of water supply services in the city, and became a joint stock company in 2004, which was owned 65 percent by the government of the RS, 10 percent by a pension fund and five percent by the restitution fund of the RS at the beginning. The remaining 20 percent was owned by individuals and private investment funds. The organization chart is as follows,



(Source: VKB)

Figure 2-6 Organization Chart of VKB

VKB has now 185 employees (as of February 2008) with the following qualification structure; 27 – University degree, 14 – College degree, 86 – High school degree, and 1 highly skilled worker, 37 skilled workers, and 20 unskilled workers.

The main roles of the director and the two executive directors are;

(a) Director
- Advise for public relations
- Improvement in the quality of water supply and sewerage system across the sector
- Laboratory services

(b) Executive director of economic and legal sector
- Financial and accounting services
- Legal/Human resources and general affairs
- Collection service, meter reading and water supply disconnection
- Procurement services

(c) Executive director of technical sector
- Water production and distribution services
- Maintenance and construction of water supply and sewerage systems
- Design and development services

In addition, the main water supply facilities in Bijeljina are as follows;

(a) Water source

‘ Grmić’, which consists of 17 wells (average depth 40 m), is the sole resource for water supply in Bijeljina. Its production capacity is around 475 l/s and is supposed to yield 1,500 to 2,000 l/s at the maximum. Water quality of the source is so far acceptable for drinking.

At present, the source is well protected by blocking with a barricade within a 4 km radius from the source. In addition, most of the houses surrounding the source have installed a septic tank and are connected to a sewerage pipeline.

(b) Water quality

The VKB checks raw water everyday with respect to residual chlorine, micro-biological characteristics, and visual inspection. In addition, pursuant to their water laws, the VKB sends about 150 samples a month to the authorised regional medical centre. The Ministry of Health also checks chemical, physical and biological characteristics at least twice a year.

(c) Total population and water coverage ratio (2002)

Due to sharp fluctuations in the number of internal displaced persons (IDPs) and the in-execution of a census since 1991, it is difficult to estimate the exact figure of the current population in Bijeljina. Although the total population is estimated as 107,000, the VKB surmises the total population as around 200,000 including 50,000 refugees.

According to VKB, water coverage ration is estimated 70 percent in the city and 50 percent in rural areas.

(d) Water supply facilities

At the source 'Grmić', water from eight wells out of 17 is collected in the reservoir located beneath the pumping station. The other nine wells send water directly to the network by operation of two pumps at each well. All the sources are equipped with a chlorination plant.

Around 25 % of the municipality is served by the distribution network. Total length of the pipeline is approximately 400 km, Dia. 50 to 350mm. Age and material of the pipeline varies and the leakage ratio is about 60 %. Especially in the Janja area, the pipeline is damaged due to aging of the pipes.

There is one elevated reservoir (capacity - 1500 m^3, height – 42 m) in the centre of the city, which was used as office of the VKB.

Basically, water is supplied 24 hours a day in Bijeljina. For the detailed information on water supply facilities in the city, refer to the sub-clause 2.3.3.

(e) Sewerage

At present, there is only sewerage collection pipeline in the limited area in the centre of the city. Drainage and other wastewater are discharged into underground or river, naturally, without any treatment. Thus, the construction of sewerage treatment plant is eagerly anticipated. For the detailed information on sewerage facilities, refer to the sub-clause 2.3.4.

2.3.3 Current Situation of the Existing Water Sources

(1) General

VKB takes ground water from Grmić well-field, disinfects it and supply it as potable water to the towns and villages in the Municipality of Bijeljina.

(2) Water Source

Grmić well-field is situated at the southeast of the town of Bijeljina. The ground water at Grmić well-field is taken by well pumps, disinfected with chlorine gas and transmitted with the water transmission pipeline to the towns and villages in the Municipality of Bijeljina. The quality of ground water and potable water is good and meets the criteria specified in "Regulations on Hygienic Quality of Drinking Water – GRS 40/03", which is issued by the Republic of Srpska. These criteria are higher than water quality standard of the WHO. Typical analysis for water from two boreholes and from locations in the town of Bijeljina and some far villages on two different dates is shown below.

Table 2-7 Analysis of Potable and Borehole Water

	GRS 40/03	Golo Brdo	Glogovac	Janja, Ambul.	Bijeljina. Ul. 27 mart	Borehole/ Bunar B-11'	Bijeljina. AD "Sava	Crnjelovo	Bijeljina, Gimnazija	Bijeljina Ravna Gora	Borehole, Bunar B12
	Fizičko-hemijski, hemijski / Physico-chemical										
Sample No		784	785	786	788	789	913	915	916	917	918
Date		07/08/06	07/08/06	07/08/06	07/08/06	07/08/06	07/09/06	07/09/06	07/09/06	07/09/06	07/09/06
Temp. ˚C		14,5	14,6	14,8	14,9	13,9	15,4	15,2	15,3	15,4	14,5
Colour Co-Pt	5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Smell	bez/no	bez/no	bez/no	bez/no	bez/no	bez/no	bez/no	bez/no	bez/no	bez/no	bez/no
Turbidity NTU	1	0,07	0,11	0,10	0,14	0,07	0,02	0,09	0,02	0,02	0,02
pH	6,8-8,5	7,28	7,43	7,50	7,30	7,45	7,30	7,32	7,29	7,34	7,37
COD ($KMnO_4$)	8	1,58	1,58	1,73	1,26	1,89	2,21	1,89	1,58	1,89	1,58
Ammonium mg/L	0,10	<0,10	< 0,10	< 0,10	< 0,10	<0,10	<0,10	< 0,10	< 0,10	< 0,10	<0,10
Res. Chlorine mg/L	0,50	0,20	0,15	0,14	0,11	0	0,20	0,10	0,20	0,25	0
Chloride mg/L	200	8,47	7,05	7,05	9,52	8,47	9,17	8,47	8,82	8,82	7,76
Nitrite mg/L	0,03	<0,01	< 0,01	< 0,01	< 0,01	<0,01	<0,01	< 0,01	< 0,01	< 0,01	<0,01
Nitrate mg/L	50,0	18,98	18,48	18,18	22,72	21,84	19,18	19,20	19,72	19,54	20,60
Iron mg/L	0,30	< 0,05	< 0,05	< 0,05	< 0,05	<0,05	< 0,05	< 0,05	< 0,05	< 0,05	<0,05
Manganese mg/L	0,05	< 0,05	< 0,05	< 0,05	< 0,05	<0,05	< 0,05	< 0,05	< 0,05	< 0,05	<0,05
Dry Residue mg/l	/	375	343	334	413	396	360	364	368	371	365
Conductivity µS/ cm	1000	560	518	512	598	594	577	569	573	562	559
	Mikrobiološka / Bacteriological										
Res. Chlorine mg/L	0.5	0,20	0,15	0,14	0,11	0	0,20	0,10	0,20	0,25	0
Colony count	10	0	5	3	0	0	0	0	0	10	2
Total coliforms	0	0	0	0	0	0	0	0	0	0	8
Faecal coliforms	0	0	0	0	0	0	0	0	0	0	0
Faecal streptococci	0	0	0	0	0	0	0	0	0	0	0
Sulphite reduc. clostridia	0	0	0	0	0	0	0	0	0	0	0
Proteus organisms	0	0	0	0	0	0	0	0	0	0	0
Pseudomonas aeruginosa	0	0	0	0	0	0	0	0	0	0	0

1. GRS 40/03 – Official Gazette *Republika Srpska*, Regulations on hygienic quality of drinking water

(Source: Feasibility Study for Priority Investment Programme DTM ID 36876)

The ground water was contaminated with wastewater permeated from the residential area situated at the west side of Grmić well-field in a certain period of past time. However, the

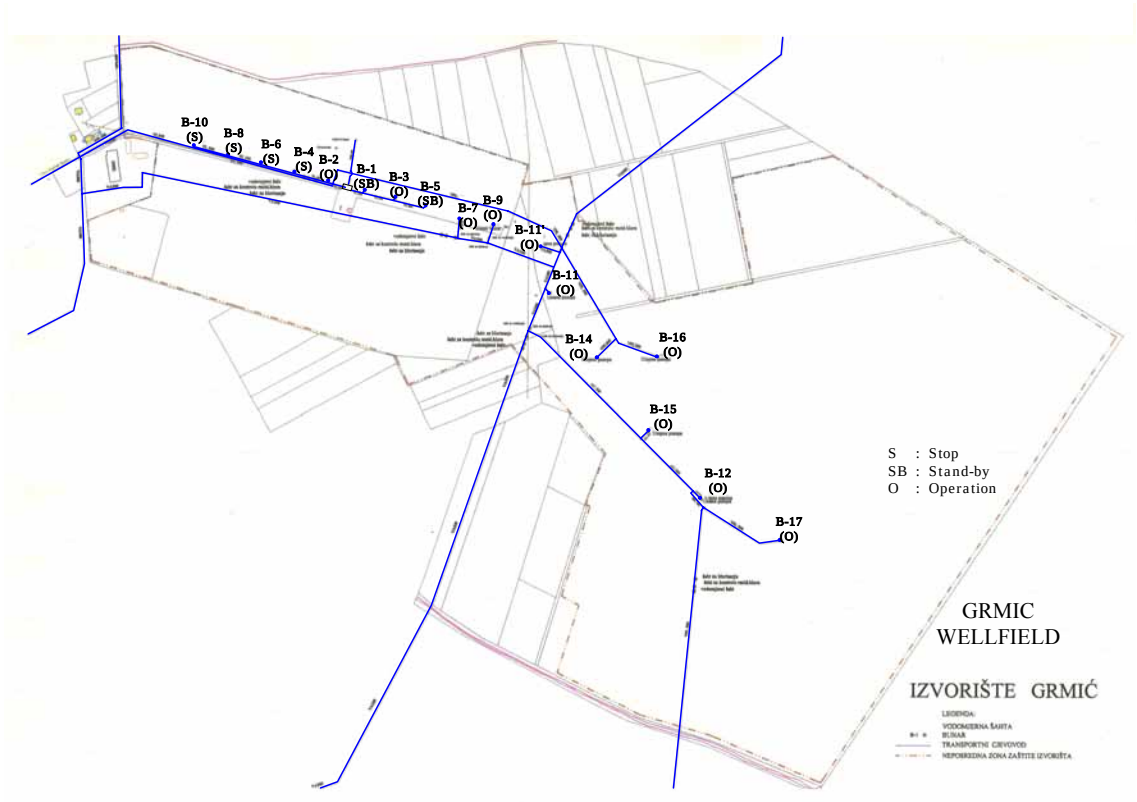
wastewater collection system in this residential area was completed in 1998 under the finance of USAID and the Municipality of Bijeljina. Then this wastewater has been discharged to Dasnica canal which passes through the west side of the town of Bijeljina.

Grmić well-field itself has the capacity sufficient for expected demand up to 2030, and the expected capacity of this source is within wide range from 1,000 – 2,000 l/s.

(3) Water Intake Facilities

Grmić well-field covers an area of 95.06 ha with a perimeter of 4.9 km. The immediate protection zone was extended to 95.06 ha through annexation of municipality property of Municipal decision GOB 6/06 which also defined an additional two protection zone for the well-field. The near protection zone has an area of 118.6 ha at a perimeter of 7.23 km whereas the far protection covers 167.0 ha and a perimeter of 9.04 km.

The water intake facilities in the well-field have seventeen (17) wells (B1 to 17) and each well has one (1) well pump. The depth of well is about 40 m. Four (4) wells and well pumps (B-4, 6, 8 & 10) situated at west side of the well-field are currently stopped in order to avoid contamination due to wastewater from the residential area. Accordingly thirteen (13) wells and well pumps are now ready for operation and two (2) out of them are spare ones. The general arrangement drawing for the water intake facilities is shown below.



(Source: VKB, modified by the Study Team)

Figure 2-7 General Arrangement Drawing for Water Intake Facilities

The number B-1 & 5 well pumps shown in Figure 2-1 are standby ones. The capacity, head, motor capacity and name of manufacturer of the operating pumps are shown below.

Table 2-8 Capacity, Head, Motor Capacity and Manufacturer of Operating Pumps

No	Pump No	Year of Construction	Manufacturer	Capacity x Head	Motor Capacity
1	B2	1962	Litostroj	52 l/s x 70 m	64 kW
2	B3	1963	Litostroj	52 l/s x 70 m	64 kW
3	B7	1996	Jastrebac	26-50 l/s x 112-65 m	63 kW
4	B9		Jastrebac	180 m3/h x 70 m	45.5 kW
5	B11	1984	Jastrebac	30-50 l/s x 90-60 m	75 kW
6	B11'	2000	VOGEL	220 m3/h x 58 m	55 kW
7	B12	1997	Jastrebac	45-85 l/s x 76-51 m	75 kW
8	B14	2000	VOGEL	100 m3/h x 54 m	22 kW
9	B15	2000	VOGEL	220 m3/h x 58 m	55 kW
10	B16	2000	VOGEL	220 m3/h x 58 m	52 kW
11	B17	2004	VOGEL	215 m3/h x 55 m	45 kW

(Source: VKB)

When eleven (11) pumps are operated, it is possible to supply water of 525-615 l/s. The average rate of water supply is estimated as about 400 l/s from the operating data of pumps. However, currently it can not be measured because flow meters are not installed on the water transmission pipeline.

Meanwhile it is difficult to increase water supply rate due to small size of the ring main laid down on the outskirts of the town of Bijeljina, which is a part of water transmission pipeline.

The flow sheet of water intake facilities and water transmission pipeline is shown below.

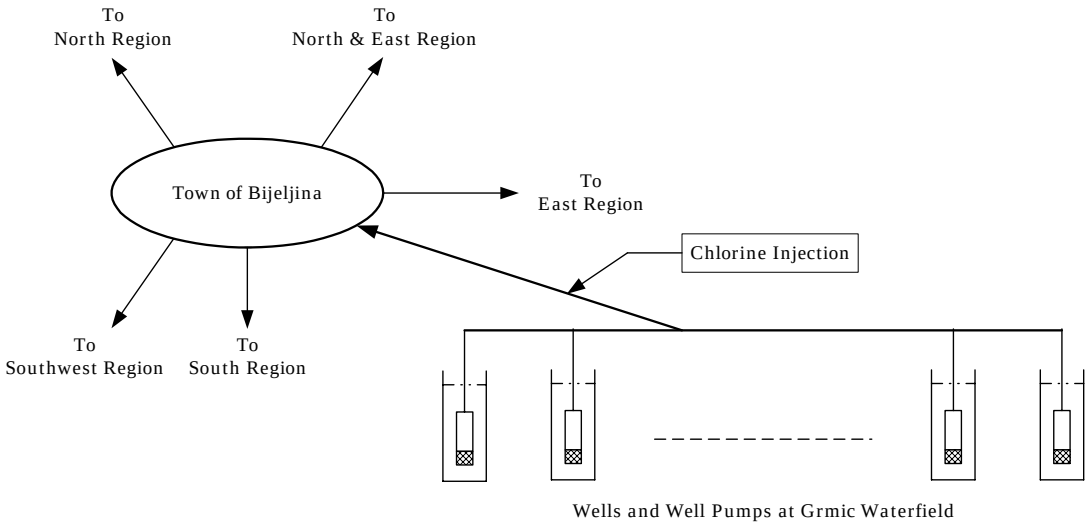


Figure 2-8 Flow Sheet for Water Intake and Water Transmission Pipeline

After water intake by the well pumps, the ground water is disinfected with the chlorination facilities. The chlorination facilities was installed year 1964 and was also replaced with the current chlorination facilities year 1991.

Currently four (4) well pumps (B-7,9,11 & 11') are directly chlorinated on the pump discharge pipeline and the remaining well pumps are chlorinated on the common pipeline. Meanwhile the chlorination facilities are operated manually because of dilapidation of equipment, and irregular and inadequate maintenance. Therefore automatic operation of the chlorine facilities including neutralization unit is put out of use.

The pictures of water intake facilities are shown below.

Grmic Well-field

Well Pump and Chlorine Pump House

Well Pump

Chlorine Injection Pump

Figure 2-9 Pictures of Water Intake Facilities

2.3.4 Current Situation of the Existing Distribution Network

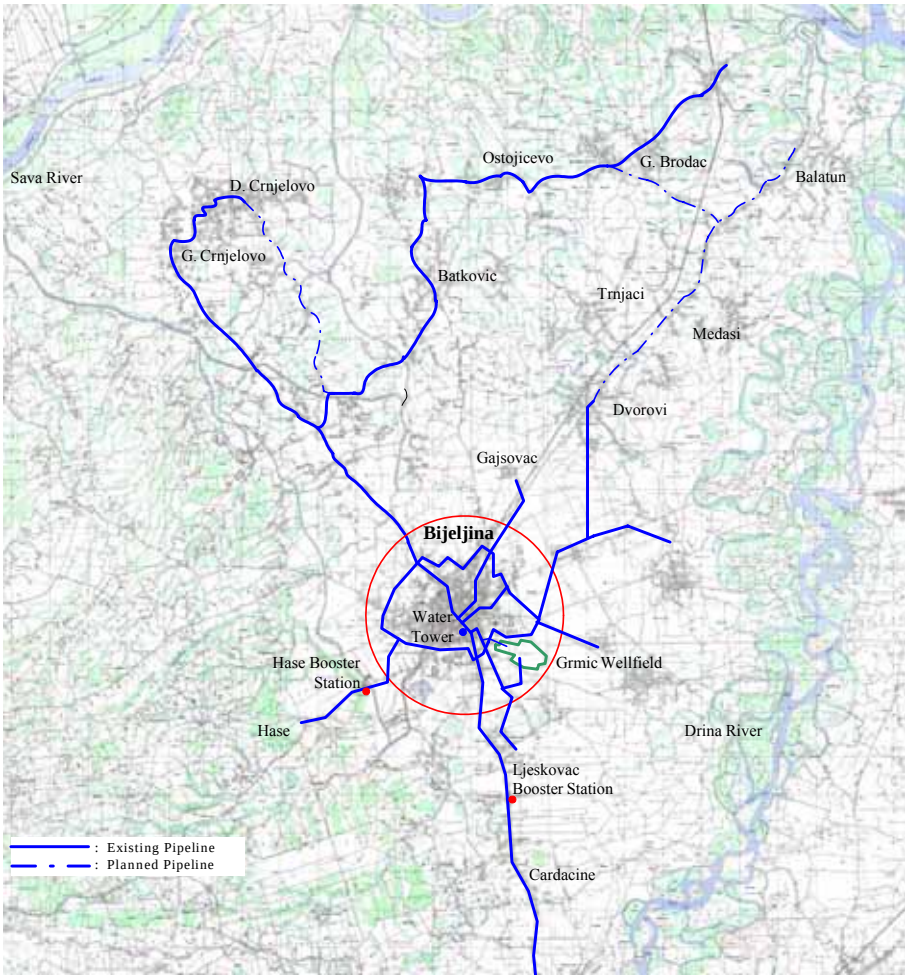
The ground water pumped from the well-field and disinfected by chlorine gas is transmitted as potable water through the water transmission pipeline to the town of Bijeljina and twelve (12) towns/villages out of sixty-one (61) towns/villages in the Municipality of Bijeljina.

Approximately 70 % of total water supply rate from the well-field are supplied to the town of Bijeljina and the remaining 30 % of it are supplied to other twelve (12) towns/villages.

Meanwhile the elevated water reservoir having a capacity of 1,500 m³ is built at the center of the town of Bijeljina and supplies water at peak time of a day.

As the towns/villages situated at the south and southwest side of the town of Bijeljina are higher than the well-field at sea level, two (2) pump stations at Ljeskovac and Hase, both of

which are in the suburbs of the town of Bijeljina, are built to boost water to the said towns/villages. The overall existing water transmission pipeline is shown below.



(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Figure 2-10 Overall Existing Water Transmission Pipeline

Potable water from water intake facilities in the well-field is transmitted to the town of Bijeljina and twelve (12) towns/villages situated at the north, east, south and southwest of Bijeljina town with water transmission pipeline through the ring main pipeline (300 mmφ) on the outskirts of the Bijeljina town. As abovementioned, two booster pump stations are located at the south and southwest suburbs of Bijeljina town.

The water transmission pipeline is laid down under the ground and transmits potable water of 400 l/s in average. Water supply rate of each town and village is shown below.

Table 2-9 Water Supply Rate to Towns/Villages

No.	Name of Town/Village	Rate of Water Supply (%)
1	Bijeljina	68.0
2	Janja	10.0
3	Amajlije	2.5
4	Patkovac	4.0
5	Dvorovi	7.2
6	Velika Obarska	0.8
7	Pucile	1.4
8	Kojcinivac	2.0
9	Popovi	1.8
10	Cojsovac	0.8
11	Glogovac	0.8
12	Crnjalovo	0.3
13	Ljeskovac	1.2

(Source: VKB)

(1) Rate of House Connection at Each Town/Village

As of end year 2005, the rate of house connection at each town/village is shown below:

Table 2-10 Rate of House Connection at Towns/Villages

No	Name of Town/Village	Estimated No. of Household	Households connected	Percentage of Connection	No. of Commercial & Industrial Connections	No. of Administrative Connections	Total
1	Bijeljina	19,244	13,501	70.2%	1,229	367	15,097
2	Janja	4,413	2,653	60.1%	114	28	2,795
3	Amajlije	615	354	57.5%	1	6	361
4	Patkovaca	1,070	566	52.9%	17	6	589
5	Dvorovi	3,803	1,123	29.5%	53	20	1,196
6	V. Obarska	2.258	119	5.3%	4	7	130
7	Pucile	350	240	68.5%	2	2	244
8	Kojcinovac	290	202	69.8%	5	4	211
9	Popovi	608	349	57.4%	2	7	358
10	Gojsovac	160	117	73.1%	24	2	143
11	Glogovac	192	147	76.6		1	148
12	Crnjalovo	1,039	62	6.0%	1	4	67
13	Ljeskovac	179	173	96.6%	1		174
	Total	**34,221**	**19,606**	**57.3%**	**1,453**	**454**	**21,513**

(Source: Feasibility Study for Priority Investment Programme)

(2) Materials of Water Pipes

As of end year 2005, total length of water transmission pipeline and water distribution pipeline are approximately 400 km. The fifty-five (55)%, twenty-two (22)%, sixteen (16)%

and seven (7)% of total length are Polyvinyl Chloride (PVC) Pipe, Asbestos Cement (AC) Pipe, Polyethylene (PE) Pipe and Cast Iron (CI) Pipe, respectively.

The water transmission pipeline and water distribution pipeline built up to mid 1970's are of CI pipe and AC pipe wholly and those built after mid 1970's are of PVC pipe and PE pipe wholly. Currently PE pipe for all of pipeline more than 400mm diameter is used. The length of water pipeline built by age is shown below.

Table 2-11 Length of Pipeline built by Age

	Pre 1978 (m)	1978-1987 (m)	1988-1997 (m)	1998-2005 (m)	**Total (m)**
Bijeljina Town	89,884	41,213	2,327	30,070	**163,494**
Other Towns/villages	48,080	77,050	14,560	92,973	**232,663**
Total	**137,964**	**118,263**	**16,887**	**123,043**	**396,157**

(Source: Feasibility Study for Priority Investment Programme)

The water pipes used up to mid 1970's were mostly made of AC for pipes up to 300 mm diameter. For more than 300 mm diameter, CI pipes were laid down.

It is said that AC pipe had a design life of only 25 years. A large proportion of the water pipeline, especially in the town of Bijeljina, was built with AC pipes between 1963 and 1970 and is therefore already beyond its design life.

The number of repairs on the main water pipeline during 2005 was 516 or about 130 per 100 km of pipeline. This value is high compared to values reported in other countries as shown below.

Table 2-12 Comparison of Bursts Frequency in Water Pipeline

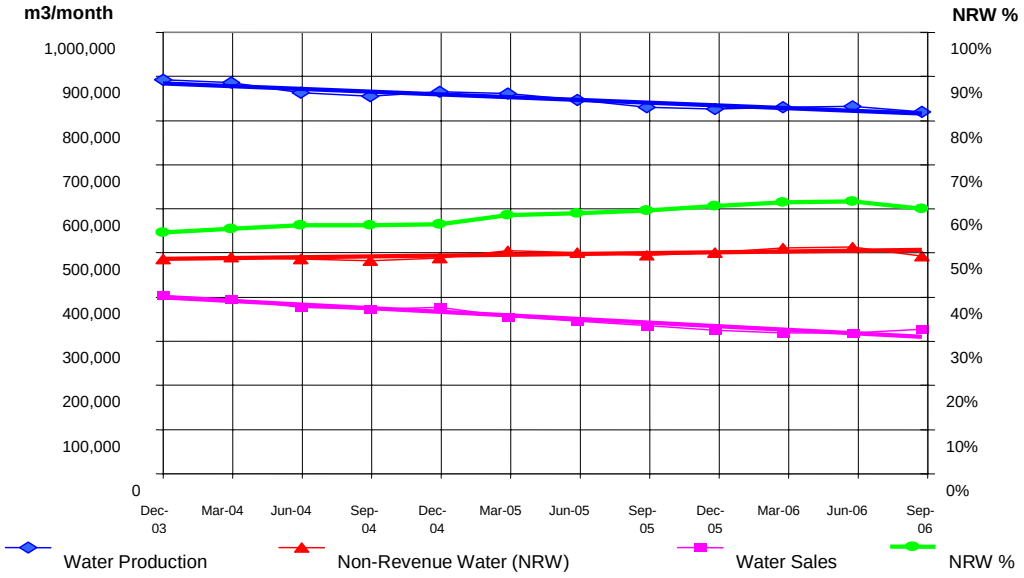
Country	**Repair Frequency No/100km**
Bijeljina	**130**
US	15
UK	22
London, UK – UPVC	15
Australia	30
Canada – Cast Iron	37
Canada – Ductile Iron	9
Canada – Asbestos Cement	6
Russia	121
Ukraine	230

(Source: Feasibility Study for Priority Investment Programme)

This assessment is reinforced by the fact that during the night AC pipeline in Bijeljina cannot tolerate a pressure above 4 bars without an excessive number of bursts, although the original design pressure of AC pipeline was 10 bars.

(3) Non Revenue Water (NRW)

According to Feasibility Study Report, currently VKB can not measure the rate of water production. In absence of any way to measure minimum night flow in the distribution system, a widely used proxy for leakage, NRW was estimated by subtracting billed consumption from synthetic water production based on billed electricity consumption at the well-field. The result of it is shown below.



(Source: Feasibility Study for Priority Investment Programme)

Figure 2-11 Non Revenue Water Estimates

Although the water production rate and the billed consumption decrease month by month, NRW stays constant. The decline in billed consumption means that, although the volume of NRW as stayed constant, it has increased as a percentage of water production volume.

The volume of NRW includes metering error, system usage (main flushing) and unmeasured consumption of all kinds as well as leakage. The stability of NRW for last three years suggests that leakage is the main component and is stable.

(4) Water Meters

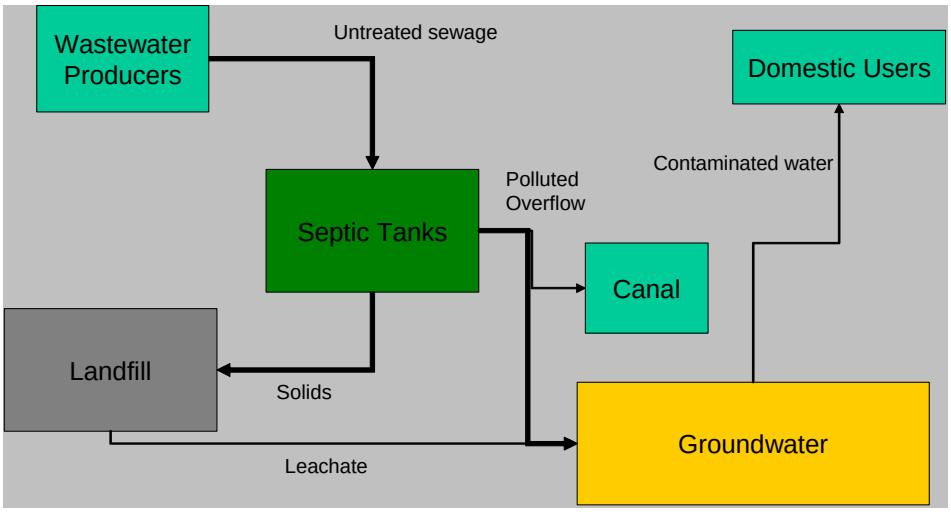
As of year 2008, all of individual houses connected with the water supply pipe have water meters and total number of those is 20,178. Total number of water meters including apartment houses, public buildings and commercial/industrial buildings is 25,591. New apartment houses have water meters for all of households, but old apartment houses have one water meter only for each apartment house. Therefore water tariff for each household of the old apartment houses is shared by number of living persons.

2.3.5 Current Situation of Sewerage Facilities

Currently most towns/villages in the Municipality of Bijeljina have no sewerage system. In case of the town of Bijeljina, which is the largest town in the Municipality of Bijeljina, most wastewater is discharged through the septic tanks or directly to the surface water drainage network or permeated underground through the soak-away pit.

The surface water drainage network of 250-600 mm φ pipelines covers a substantial area of the town of Bijeljina and at first was constructed to reduce the risk of flooding in the town. However presently both surface water and wastewater are discharged to this network and drained into the Dasnica canal running through the western part of the town.

The operation and maintenance of the surface water drainage network is not the responsibility of VKB and has been awarded to a different company by the Municipality.



(Source: Feasibility Study for Priority Investment Programme)

Figure 2-12 Non Revenue Water Estimates

Meanwhile in other towns or villages having no wastewater collection system, most wastewater is permeated underground through the septic tank. Flow sheet of the current sewerage system in the town of Bijeljina is shown in Figure 2-6.

The number of septic tanks as of year 2003 is shown below.

Table 2-13 Numbers of Septic Tanks in Town of Bijeljina for 2003

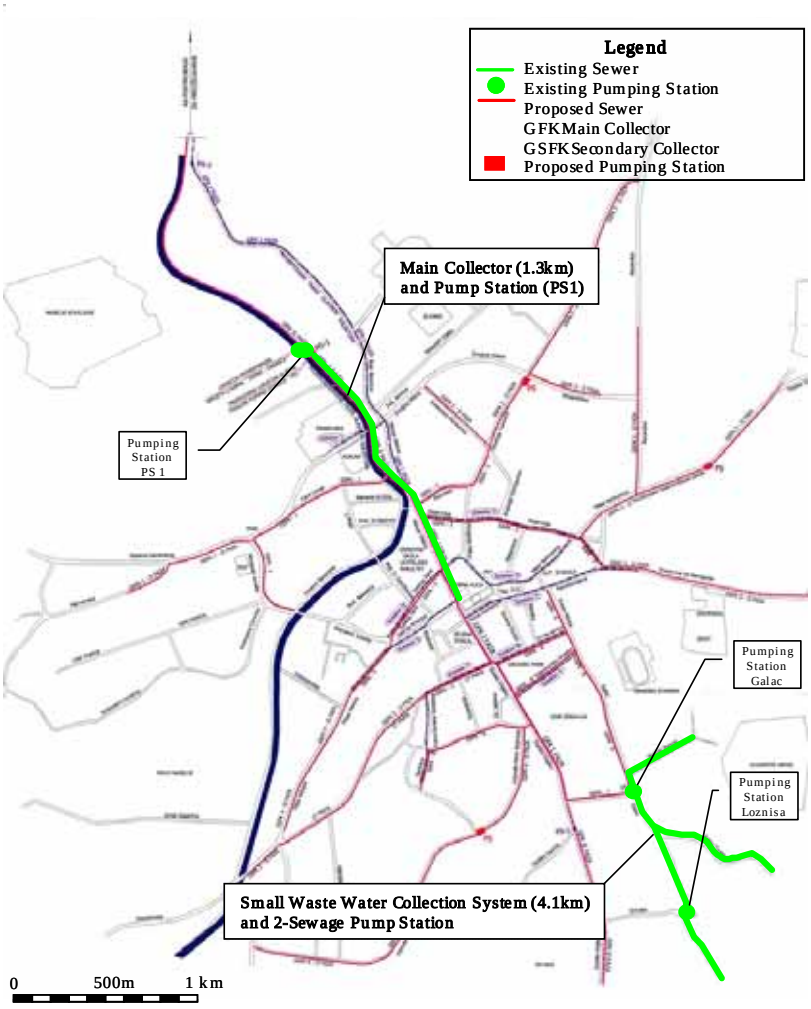
Population	No of Individual Septic Tanks	No of Communal Septic Tanks	No. of Industrial Septic Tanks	Total No. of Septic Tanks
54,600	14,040	265	487	14,792

(Source: Feasibility Study for Priority Investment Programme)

The small wastewater collection system under the responsibility of VKB was constructed at Galac and Loznicka district close to Grmić well-field in 1998 under the finance of USAID and the Municipality of Bijeljina to protect ground water in the well-field. This system consists of about 4.1km of 300 mm φ sewer including 280 house connections, two (2) communal septic tanks and two (2) sewage pump stations. This wastewater is discharged to the existing surface water drainage network from these sewage pump stations.

Meanwhile the Municipality of Bijeljina has already started a programme to provide the town of Bijeljina with a wastewater collection system. The first stage of construction for this wastewater collection system in the town of Bijeljina is almost completed. It consists of about 1.3km of the main collector and the pumping station (PS 1) which transports the wastewater to the wastewater treatment plant in future. Until completion of the wastewater treatment plant, the pumping station (PS 1) will discharge the collected wastewater to the Dasnica canal.

The location of the small wastewater collection system, the main collector and the pumping station (PS 1) is shown below.



(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Figure 2-13 Location of Small Wastewater Collection System, Main Collector and Pumping Station (PS 1)

The characteristics of wastewater discharged into Dasnica canal from the surface water drainage network currently is shown below.

Table 2-14 Characteristics of Wastewater discharged into Dasnica Canal from Surfacewater Drainage Network

Characteristics	Units	Value
Date		25 Aug. 1998
Temperature	ºC	20.5
Colour		Gray
Visible waste material		Floculent
Smell		of feces
pH		6.94
Conductivity	µS/cm	986
Turbidity	NTU	27.0
COD ($KmnO_4$)	mg/l	81.6
r-alkalinity	$mgCaCO_3$/l	0.0
m- alkalinity	$mgCaCO_3$/l	379
Sulfates	mg/l	43.6
Chlorides	mg/l	95.0
Nitrates	mgN/l	0.00
Nitrites	mgN/l	<0.005
Ammonia	mgN/l	21.0
Dissolved oxygen	mgO_2/l	0.1
BOD_5	mgO_2/l	68.6
Orthophosphates	mg/l	2.9
Settled solids	mg/l	0.4
Suspended solids	mg/l	64.0
Dissolved solids	mg/l	661.0
Phenol	mg/l	0.14
Oil and fat	mg/l	3.45
Detergents	mg/l	0.12
Iron	mg/l	0.33
Manganese	mg/l	0.05
Zinc	mg/l	0.07
Sodium	mg/l	65.0
Potassium	mg/l	8.5
Lead	mg/l	<0.02

(Source: Feasibility Study for Priority Investment Programme)

The existing wastewater network and wastewater treatment facilities except for the town of Bijeljina are as follows;

- Wastewater network

  The wastewater network in Koviljuse presently serves about 300 households and is maintained by a outsourcing company. The wastewater network in Slobomir serves the free trade zone, commercial centre and university already constructed by the community. However the residential area has not yet been constructed.

- Wastewater Treatment Facilities

  There are two small-scaled biological wastewater treatment plants, that is; one at the now

closed sugar factory and the other having a capacity of 10,000 persons at the Slobomir community.

2.3.6 Operation and Management of the Water Supply and Sewerage

As explained in sub-clause 2.3.2, the VKB is a joint stock company, and the Shareholders Assembly supervised the internal organization of the VKB. In general, the shareholder meeting is held twice a year, and Supervisory Board, which is a subordinate organization of Shareholders Assembly, met on 13 occasions to discuss financial, business, legal and organizational issues.

In the VKB, there are 15 departments under the director, and so far the departments are operated successfully and smoothly. However, there is no regular monitoring or management information provided for the departments to assess their performance.

According to the VKB, about 50% of employees engage in the technical part of the organization such as maintenance and construction, planning and development, production and distribution, and laboratory. In particular, VKB stresses on the importance of repairing of water meters to be installed in each household. There is a repair shop specialised for water meters in Obrijez pumping station.

As for the capacity building for employees, VKB occasionally holds internal training course for both the engineers and non-engineers in the organization. Some employees are dispatched to the technical seminar and workshops arranged by outer sources such as the central government and international organizations. The salary levels of employees are, in general, higher than local public and private organizations.

The current water tariffs are shown in Table 2-9 below,

Table 2-15 Water and Wastewater Tariffs

Category	Water Tariff (KM/m³)	Wastewater Tariff (KM/m³)	Agriculture Levy Tariff (KM/m³)
Domestic	0.49	0.24	0.01 + 0.04
Industry	2.00	0.91	0.01 + 0.04
Public	1.32		

(Source: VKB)

The water bills are calculated on the basis of the above water and wastewater tariffs. In addition to the charges, rental fee for water meters, which is depends on size of water meter, is also collected by the VKB. The rental fee for the average household is 1.6KM (=US$ 1.1). Value Added Tax (VAT) at 17% is added to all charges. Bills are sent to all customers on a monthly basis.

All water meters to be fit with each household are the property of the VKB and are replaced every five years by the VKB in accordance with the regulation. In the case of apartments, the consumption measured by the water meter is apportioned between inhabitants on the basis of occupation and bills are sent to individual household.

There are three payment methods of the water bills;

- Payment at the accounting section of the VKB headquarters or water tower (former head office of the VKB)
- Payment through the post offices or banks in the city
- Payment to the meter readers

And the above payments shall be completed with in 15 days. In case of the non-payment, the following countermeasures will be put into practice;

- Reminders are posted automatically
- Meter readers may visit to remind
- A letter of warning of disconnection of water supply and wastewater pipelines is posted after three month of non-payment period
- Some worst cases are sent to court

On account of the strict measures towards non-payment customers, water charge collection ratio is high comparing other waterworks and sewerage companies in BiH. According to the VKB, water charge collection ratio reaches around 95% in spite of the lower income of inhabitants in the city.

2.3.7 Financial Information of the VKB

This sub-clause is heavily relied upon the "Business Report 2007" issued by the VKB. However, first of all, financial assessment carried out by the VKB is not quite in accordance with International Accounting Standard (IAS) yet. Some of the financial information do not show the exact figures on the basis of the IAS since some of the account statements are not well-structured to provide such information required in the accounting form. It is, thus,

necessary for the VKB to upgrade the financial knowledge and skills and to increase transparency in the financial statements.

(1) Balance Sheet

Table 210 below shows the balance sheet of the VKB in the year of 2007.

Table 2-16 Balance Sheet (2007)

(Unit : KM)

Assets			Liabilities and Equity		
1)	**Current Assets**	**3,011,994.36**	**1)**	**Liabilities**	**346,157.95**
	Material supplies	443,491.03		Procurers	278,043.58
	Advanced payments	19,037.57		Tax and contribution	68,114.37
	Customer receivables	1,506,717.59			
	Financial investments	304,134.45	**2)**	**Deferred Income**	**3,722,351.51**
	Cash equivalents	731,136.45		(Grants and donations)	
	Other receivables	7,477.27			
			3)	**Capital**	**11,679,392.48**
2)	**Fixed Assets**	**12,735,907.58**		State capital	6,505,996.00
	Lands	1,970,783.80		Restitution fund	500,461.00
	Building facilities	9,947,983.55		PIO fund	1,000,923.00
	Equipment	789,324.30		Small Shareholders	2,001,845.00
	Tools and inventory	5,251.51		Obligatory reserves	1,000,922.54
	Fixed assets in preparation	12,508.48		Revaluation reserves	621,272.80
	Long-term investment	10,055.94		(Previous) Retained revenue	9,778.06
				(Current) Retained revenue	38,194.08
	Total Assets	**15,747,901.94**		**Total Liabilities and Equity**	**15,747,901.94**

(Source: VKB)

As shown in the Table, current assets of the VKB are 3,011, 994.36KM (=US$2,018,036) in 2007. Customer receivable, which shares about a half of the total current assets, consists of receivables from public organization and individual customers.

Regarding the fixed assets, the VKB has now owns lands for water supply facilities such as Grmić well-field zone with 670,964m². The present value of building facilities is 9,947,983.55KM (US$6,665,148), which consists of water supply and sewerage network systems including headquarters (established in 2005) and laboratories. The value of equipment is 789,324.30KM (US$528,847). This includes vehicles, drilling rigs, power transformer, IT equipment, office furniture and laboratory equipment and so on.

Liabilities, mainly for the procured materials amount to 346,157.95KM (US$ 231,925). Deferred income, which means donations from outside of the organization, includes technical

cooperation funded the international organization Caritas. In 2007, Caritas contributes the rehabilitation of Hase booster pump station.

As aforementioned, the VKB has changed its legal status from a public organization into a joint stock company in 2004. In 2007, the biggest shareholder is the government of RS (65% of the total share capital of 10.009,225 KM), which is also the owner of the Restitution fund (5%). In addition, PIO (pension) fund and small shareholders share 10% and 20% respectively.

(2) Profit-Loss Account

Table 2-11 indicates that the total income in 2007 is 5,778,155 KM (=US$ 3,871,363) which is higher than that of 2006 by 10.8%.

Table 2-17 Total Incomes (2007)

No.	DESCRIPTION	2006	2007
1	Incomes from construction & maintenance. of water supply network	559,946	709,347
2	Incomes from connections & machinery	533,421	565,187
3	Incomes from water delivered to companies	516,091	553,120
4	Incomes from water delivered to inhabitants	2,571,075	2,713,419
5	Incomes from sewarage network services	189,490	218,782
6	Incomes from work of special machinery	24,383	23,843
7	Incomes from the calibration room	13,708	2,272
8	Other incomes from operations	34,124	38,733
9	Incomes from donations and refunds	166,267	182,829
10	Incomes from the laboratory	17,098	17,314
11	Incomes from project designing	12,800	11,378
12	Incomes from payments for water spring exp.	220,972	254,152
13	Other business incomes	58,848	294,130
14	Incomes from interest	9,114	37,662
15	Incomes subs. discovered from previous years	105,064	21,098
16	Other incomes	180,798	134,889
Total		**5,213,199**	**5,778,155**

(Source: VKB)

Income from construction and maintenance of water supply networks increases 26% from the previous year. The main reason of the increase is the construction of North ring pipelines and small-scales water facilities in suburban villages. In proportion to the increase of the connection, incomes from water supply and sewerage services also grow up to 5.5% and 15.5% respectively. One of the remarkable features is the proportion of the core and non-core

activities, 50:50. Non-core activities include construction and designing work ordered by external organization.

Meanwhile, total cost in 2007 amounts to 5,739,961 KM (=US$ 3,845,774) which is higher than that of 2006 by 10.8%. The most noteworthy point is that Gross salary costs, which is 2,494,802 KM (=US$ 1,671,517), and other personnel costs shares 55% of the total cost in the VKB.

Table 2-18 Total Costs (2007)

No.	Costs	2006	2007
1	Material costs	605,217	720,748
2	Spare parts costs	17,844	17,818
3	Office material costs	19,827	17,608
4	Vehicle tire costs	5,043	6,626
5	Other material costs	4,438	9,167
6	Small inventory and tool write-off	28,876	32,535
7	Fuel and lubricant costs	85,029	89,131
8	Power costs	190,126	182,569
9	Gross salary costs	2,312,467	2,494,802
10	Other personal costs	541,085	659,120
11	Costs of employee transport	15,636	50,166
12	Postal service costs	19,299	37,847
13	Costs of regular investment maintenance	22,512	53,742
14	Costs of advertising	27,720	53,134
15	Costs of municipal services	3,304	13,505
16	Costs of services of protection at work	1,864	2,189
17	Costs of water analysis	28,056	30,577
18	Costs of other services	49,275	90,773
19	Costs of depreciation	868,622	780,639
20	Costs of allowances for business trips	5,158	46,587
21	Costs of intangible services	72,236	82,907
22	Costs of representation	12,637	48,134
23	Insurance premiums	79,336	4,678
24	Costs of payment operations	8,356	9,013
25	Costs of membership fees in business associations	481	6,520
26	Taxiation costs	9,449	17,860
27	Other intangible costs, humanitarian aid. fees & customs taxes	138,125	159,373
28	Costs of interest	6,512	6,943
29	Claims, stock and small inventory write-off costs	613	9,870
30	Other costs	610	5,380
Total		**5,179,762**	**5,739,961**

(Source: VKB)

Finally, as shown in Table 2-13, gross profit increase 14% from the year of 2006. Profit after tax has not yet calculated due to the delay of payment of taxes.

Table 2-19 Balance between Total Incomes and Costs (2007)

No.	DESCRIPTION	2006	2007
1	Total incomes	5,213,199	5,778,155
2	Total costs	5,179,762	5,739,961
3	Gross profit	33,437	38,194
4	Profit tax	-	-
5	Net profit	33,437	38,194

(Source: VKB)

(3) Cash Flow Statement

Table 2-14 shows the cash inflow from operation increases 6.19% from 2006, and cash from investing was quite insignificant. Total cash inflow in 2007 is higher than that of 2006 by 2.3%. On the other hand, cash outflow also increases 2.3% from 2006, whereas cash outflow from investing lowers by 10%. Total cash out flows in 2007 is higher than that of 2006 by 6.12%. Overall, the balance of the cash flow in 2007 is 107,447 KM (=US$ 71,989) showing the level of liquidity of the VKB.

Table 2-20 Cash Flow Statement

(Unit: KM)

Description	2006	2007
1) Inflow		
Cash infow from operations	6,170,642	6,552,618
Cash infow from investing	284,065	50,410
Cash inflow from financing	-	-
Total Cash Inflow	**6,454,707**	**6,603,028**
2) Outflow		
Cash outfow from operations	5,864,287	6,259,162
Cash outflow from investing	248,805	223,919
Cash outflow from financing	7,971	12,500
Total Cash Outflow	**6,121,063**	**6,495,581**

(Source: VKB)

2.4 Other Donors' Activities

In BiH, the German Development Bank (*Kreditanstalt für Wiederaufbau*=KfW) and the European Bank for Reconstruction and Development (EBRD) play key role in water supply and sewerage field. In general, loan schemes are trend towards the water supply field, except small-scaled water supply systems located in the remote areas, in consideration of sustainability of recipient organisations. The Study Team had some meetings with both the organisations and confirmed the current activities on water supply and sewerage in the country.

2.4.1 KfW

KfW focuses on the rehabilitation of urban water supply and sewerage systems, and also aims at providing reliable and quality water supply for the population at cost-covering and socially affordable tariffs. Besides the financing of infrastructure investments, the programmes also concentrate on management and financial aspects of water utilities. Currently up to €36 million have been allocated for this sector. The following projects are planned, executed or completed by using financing of the KfW.

(1) Rehabilitation of Water and Sewerage Systems in BiH

This is the one of the biggest water supply projects in BiH with amount of €14 million. The rehabilitation programme, which was inaugurated in 2006, includes municipalities in both entities such as Bihac, Derventa, Kankanj and Kostanica.

(2) Water Supply Systems Kakanj

During the project period, 2001 to 2005, the KfW supported the project with total finance of €3.8 million. In the mid of 2005, Kakanj city, for the first ever, 24-hour water supply is provided to the entire population in the city.

(3) Waste Water Treatment Bihac

This project has been agreed upon 2007 between the two governments. Based on the feasibility study conducted by the European Union (EU), this project will be jointly financed by the EU and KfW. KfW will shared €17.5 million of the total budget.

(4) Waste Water Collection for the Tukovi neighbourhood, Prijedor

This project aims for the improvement of living standards of people in Tukovi, a suburban city of Prijedor. KfW supports the new construction of the main wastewater network system.

2.4.2 EBRD

The EBRD is lending €7 million to the VKB to help finance construction of a waste water network that will reduce water pollution and cut health hazards in the city. A further €4.5 million will be provided by the Bijeljina city authorities for the project that also aims to replace dilapidated asbestos cement water pipes.

The new network will address problems of pollution in the underground water systems that is the only source of local drinking water for the most of the entire population in Bijeljina. The project also aims to increase the provision of water services to achieve supply 24 hours a day and 90 percent coverage in the city centre up from 70 percent now.

The loan will also be used to modernise the water network, by replacing rundown water mains to reduce operating costs and increase efficiency. Also envisaged is the gradual upgrading of a water meter scheme, all of which will add to the positive environmental impact of the project.

The EBRD project consists of three phases and is scheduled as follows; Phase 1 (2007 to 2008), Phase 2 (2008 to 2009) and Phase 3 (2010). For the Phase 2, the EBRD is now trying to arrange co-financing with the Swiss government (grant: €5 million), the EU (grant: €2 million), and the rest of €4 million of the EBRD loan. However, the two grant schemes have not yet been approved by the two parties so far.

CHAPTER 3 OUTLINE OF THE FUTURE PROJECTS

3 OUTLINE OF THE FUTURE PROJECT

3.1 Water Supply Projects

3.1.1 Water Demand Forecast

(1) Population of the Municipality of Bijeljina

There is no accurate census data for the Municipality of Bijeljina. The total population of the Municipality of Bijeljina is estimated at about 160,000 in 2005 from the local estimates. Although the Office of Statistics shows the population of the Municipality of Bijeljina to be about 110,000 in 2005 with a general growth of about 0.6%, the growth estimate is based on only records of births and deaths in the Municipality. Other surveys carried out locally showed a large migration component in recent years because of returnees. This explains the difference between the Office of Statistics and local estimates.

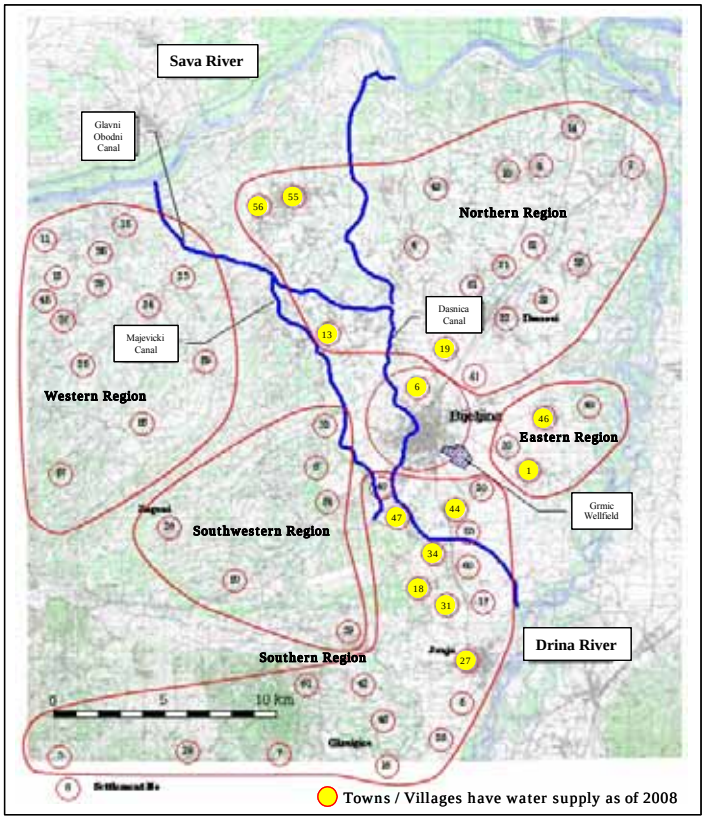
Based on the local estimates, the regional-wise population in the Municipality of Bijeljina up to 2030 is estimated below. The annual increase rate of population is assumed based on the projection provided in the Urban Plan, that is; 1% up to 2015, 0.3% from 2015 to 2025 and 0.2% from 2025 to 2030.

Table 3-1 Regional-wise Population Forecast in Municipality of Bijeljina

No.	Region	Population		
		2005	2015	2030
1	Town of Bijeljina	60,191	66,488	69,199
2	Southern towns/villages from Bijeljina	31,302	34,577	35,986
3	Southwestern towns/villages from Bijelijna	8775	9,693	10,883
4	Northern towns/villages from Bijeljina	40,903	45,182	47,023
5	Eastern towns/villages from Bijeljina	3,797	4,194	4,365
6	Western towns/villages from Bujeljina	14,620	16,149	16,807
	Total	**159,588**	**176,283**	**184,263**

(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Each town/village and region is shown below.



(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Figure 3-1 Location of Town/Village and its Region

Table 3-2 List of Number, Name and Population of Town/Village in 2005

No	Name	Pop.	No	Name	Pop.	No	Name	Pop.
1	Amajlije	1,412	21	Dazdarevo	942	41	Novo Selo	496
2	Balatun	1,624	22	Dvorovi	11,400	42	Obriježˇ	986
3	Banjica	627	23	Dragaljevac Donji	1,389	43	Ostojićevo	600
4	Batković	4,024	24	Dragaljevac Srednji	1,126	44	Patkovača	2,443
5	Batar - Johovac	428	25	Dragaljevac Gornji	1,732	45	Piperci	562
6	Bijeljina	60,191	26	Zagoni	3,035	46	Popovi	1,389
7	Bjeloševac	744	27	Janja	13,680	47	Pučile - Puhare	1,086
8	Brijesnica	550	28	Ruhotina - Johovac	428	48	Ruhotina	496
9	Brodac Donji	1,055	29	Kacevac	627	49	Slobomir	500
10	Brodac Gornji	1,055	30	Kovanluk	496	50	Suho Polje	1,553
11	Bukovica Donja	1,853	31	Kojčinovac	402	51	Triješnica	496
12	Bukovica Gornja	818	32	Kriva Bara	387	52	Trnjaci	1,587
13	Velika Obarska	7,000	33	Ljeljenča	1,571	53	Čipirovine	496
14	Velino Selo	1,279	34	Ljeskovac	555	54	Hase	578
15	Vršani	1,066	35	Magnojević Donji	843	55	Crnjelovo Donje	3,220
16	Glavičice	2,393	36	Magnojević Srednji	990	56	Crnjelovo Gornje	3,488
17	Glavičorak	496	37	Magnojević Gornji	714	57	Čađavica Gornja	1,141
18	Glogovac	595	38	Međaši	1,754	58	Čađavica Srednja	893
19	Gojsovac	496	39	Modran	1,488	59	Čađavica Donja	1,493
20	Golo Brdo	379	40	Novo Naselje	744	60	Čardačine	2,454
						61	Čengić	1,243

(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)
Note: The towns/villages of yellow coloured have water supply service from VKB currently.

(2) Water Supply Population as of 2008

According to VKB's information, water supply population as of year 2008 is about 114,000 and it corresponds to about 70% of total population in the Municipality of Bijeljina. The urban area is over 70% but the rural area is about 55%. The towns/villages to which water is supplied are shown in Figure 3-1 and Table 3-2.

(3) Daily Average Water Demand Forecast

The daily average water demand forecast prepared by VKB is shown below

Table 3-3 VKB's Water Demand Forecast

		Year	2002	2005	2015	2030
		Planned water supply population	82,002	86,836	128,540	174,155
Per Capita		l/p/d	200	200	225	250
Daily Average Water Demand	1. Inhabitant use	l/s	190	201	335	504
	2. Commercial & Industrial use (20% of above 1)	l/s	38	40	67	100
	3. Sub total (1 + 2)	l/s	228	241	401	602
	4. Leakage (20% of above 3)	l/s	46	48	80	120
	Total(3+4)	**l/s**	**273**	**289**	**482**	**722**
		m3/day	**23,587**	**24,970**	**41,645**	**62,381**

(Source: VKB)

However, the actual water demand is more than VKB's water demand forecast. This is because the water supply system in the Municipality of Bijeljina is experiencing rapid extension with about 1,700 new connections during 2005 and the number of house connections has seen consistent growth of over 5% per year for the last 4 year. This growth still continues. Accordingly this water demand forecast is revised based on the water supply population of year 2008. The revised water demand forecast is shown below.

Table 3-4 Revised Water Demand Forecast

		Year	2008	2015	2030
		Planned water supply population	114,000	142,000	174,155
Per Capita		l/p/d	200	225	250
Daily Average Water Demand	1. Inhabitant use	l/s	264	370	504
	2. Commercial & Industrial use（20% of above 1）	l/s	53	74	100
	3. Sub total(1+2)	l/s	317	444	602
	4. Leakage(20% of above 3）	l/s	63	89	120
	Total(3+4)	**l/s**	**380**	**533**	**722**
		m3/day	**32,832**	**46,051**	**62,381**

(Source: Study Team)

3.1.2 Water Intake Facilities

The additional wells and well pumps is required to develop water supply facilities to the towns/villages to which water is not still supplied, and to increase water supply rate due to increase of water supply population.

The existing emergency generator located at the well-field is not used now due to the decrepit conditions. Therefore this shall be replaced with new one in order to provide electric power during ordinary power failure.

The existing well pumps are operated manually and monitored locally. Also as the water transmission pipeline has almost no flow meter, the monitor and control of water transmission rate is made based on operation data of the pumps. Accordingly it is required to install flow meters and pressure instruments on the water transmission pipeline and to build SCADA (Supervisory Control and Data Acquisition) System in the central monitoring/control room in order to control/monitor operation of well pumps, monitor flow rate and pressure, etc.

(1) Additional Wells and Well Pumps

The daily maximum water demand is 1.35 x daily average water demand and becomes about 720 l/s in 2015. The current maximum well pumps capacity is 615 l/s and is insufficient in 2015. Accordingly the wells and well pumps having total capacity of 200 l/s are required. The equipment/materials for them are shown below.

Table 3-5 Equipment/Materials required for Additional Wells and Well Pumps

No	Item	Quantity
1	Well	50 l/s x 4 sets
2	Well Pump	50 l/s x 4 sets
3	Auxiliary Piping and Instruments	1 lot
4	Electrical Facilities for Well Pump	1 lot

(2) Replacement of Emergency Electrical Power Generation Facilities

The existing emergency generator is superannuated and unused now. Taking into account water supply during ordinary power failure, this generator shall be replaced with new one together with the ancillary facilities.

(3) Replacement of Chlorination Facilities

The existing chlorination facilities are withdrawn and the new ones are built to inject chlorine gas into the five (5) outgoing pipelines. The chlorination facilities are operated

automatically. Injection rate of chlorine gas, concentration of residual chlorine, etc are monitored and controlled with SCADA system.

(4) Monitoring and Control System for Water Supply Facilities

The SCADA system is built in the central operation and monitoring room to control and monitor the water intake facilities, chlorination facilities, water reservoirs, water transmission pipeline, booster pumping stations, etc. The major function of SCADA System consists data logging, graphical supervisory display, real/historical trend graph, alarm summary and daily/monthly/annual reporting. The control and monitoring items of SCADA system and the equipment/materials required to build SCADA system are shown below.

Table 3-6 Summary of SCADA System

No	Facilities	Control/Monitoring Item	Equipment required
1	Well Pump	Pump operation/monitoring	SCADA System, Interface Panel, Telecommunication System
2	Chlorination Unit	Monitoring (Pump, Chlorine Concentration)	Instruments, Transmitters, Telecommunication system
3	Transmission Pipeline	Monitoring (Pressure, Flow, Residual Chlorine)	-ditto-
4	Reservoir	Monitoring (Water Level)	-ditto-
5	Booster Pump Station	Pump operation/monitoring (Pump, Pressure, Flow)	-ditto-

3.1.3 Water Reservoir

Currently one (1) water reservoir is built in the town of Bijeljina. Taking into account water supply at the peak time, the water reservoir having a capacity of 1,000m³ is built in the second, third and forth biggest towns, that is; Janja, Dvorovi and Velika Obarska.

3.1.4 Water Transmission Pipeline and Distribution Pipeline

Regarding the water transmission pipeline and distribution pipeline, it is required to replace the superannuated pipes in order to decrease leakage, replace water ring mains in order to solve bottleneck of water transmission pipeline, and construct the new water transmission pipeline and distribution pipeline in order to supply water to the towns/villages having no public water supply service.

(1) Replacement of Superannuated CI Pipe and AC Pipe

As CI pipes are unlined, discoloured water resulting from long residence time of water in the pipes is still a potential problem in long pipelines. The problem usually becomes apparent when operational regimes are changed such as when valves are closed or opened for

maintenance and brown rust deposits are re-suspended in the water and delivered to consumers' taps.

The length 3.3km of CI pipes are replaced with PE pipes in construction of sewerage system (Phase 1 Project, etc.). The remaining 21.7km of CI pipes are replaced with PE pipes in construction of sewerage system (Phase 2 Project).

Meanwhile, AC pipes passed more than 30 years after construction of them and exceeded life of 25 years. Currently AC pipes cannot tolerate a pressure above 4 bars. Most leakages come from AC pipes. Accordingly all of AC pipes (89 km) shall be replaced with PE pipes as soon as possible to reduce the NRW. Now the VKB has plan to replace AC pipes (about 18km) inside the town of Bijeljina together sewer pipes under the wastewater collection system project (Phase 1 Project) and commenced to replace a part of AC pipes already. Therefore the remaining 71km of AC pipes is required to be replaced with PE pipes.

(2) Rehabilitation of Ring Mains on the skirts of the town of Bijeljina

The size of ring mains is 300mmφ and potable water from the water intake facilities is transmitted through ring mains to each town/village of the Municipality of Bijeljina. Although VKB consider increase of water transmission rate accompanying increase of water supply rate to each town/village, it is difficult to increase it due to bottleneck of ring mains. Accordingly the ring main is required to be replaced with bigger size of pipes taking into account future water demand rate. The replacement of ring mains is now done in construction of sewerage system (Phase 1 Project).

(3) Construction of New Water Transmission Pipeline and Distribution Pipeline to Northern Region

As the northern region of the town of Bijeljina has a high incidence of endemic nephritis, it is required to supply water from the Grmić well-field urgently. As shown in Figure 2-1, the transmission pipeline written by real line has been already completed, but it written by dotted line is required to be constructed. In addition it is required to construct water distribution pipeline and house connections for nine(9) towns/villages (V. Obraska, D. Crnjelovo, G. Crnjelovo, Batkovic, Ostojicevo, D. Brodac, G. Brodac, Velino Selo and Jelaz). The length of pipelines and number of house connections are shown below.

Table 3-7 Water Transmission Pipeline, Water Distribution Pipeline and House Connections to Northern Towns/Villages

No	Item	Quantity
1	Un-constructed Transmission Pipeline	160-315 mmϕ x 34,498 m
2	Secondary Distribution Pipeline	63-160 mmϕ x 212,733 m
3	House Connection	4,645 ea

(4) Construction of New Water Transmission Pipeline and Distribution Pipeline to South-western Region

The towns/villages situated at the South-western region of the town of Bijeljina have no public water supply facilities. Each household has its own shallow well and gets water from it. Owing to it VKB has plan to supply potable water from Grmić well-field to the towns/villages such as Hase, Kovacici, Srednji & Gornji Zagoni, Modran, Suho Polje and Ravno Polje by extension of the water transmission pipeline. The length of pipelines and number of house connections are shown below.

Table 3-8 Water Transmission Pipeline, Water Distribution Pipeline and House Connections to Southwestern Towns/Villages

No	Item	Quantity
1	Transmission Pipeline	250-355mmϕ x 18,000m
2	Secondary Distribution Pipeline	63-225mmϕ x 99,000m
3	House Connection	Approximately 2,300ea
4	Water Tower	500m³ x 1set

3.1.5 Leakage Detection Equipment

The current rate of non revenue water (NRW) is about 60%. VKB targets that it decreases up to 20%. Most of NRW is occupied by leakage. It is required to procure the equipment to detect leaks such as correlator, mobile ultra-sound flow meter with pressure logger, etc.

3.1.6 Cost Estimate

The result of cost estimate from the above paragraph 3.1.2 to 3.1.5 is shown below.

Table 3.9 Cost for Future Projects of Water Supply Facilities

No.	Item	Cost in KM millions	Equivalent Japanese million ¥
1	Well-fiield		
1-1	Additional Well and Well Pumps	1.1	81
1-2	Replacement of Emergency Generator	0.4	30
1-3	Replacement of Chlorination Facilities	0.2	15
1-4	SCADA System	5.5	397
2	Additional Water Reservoirs	2.3	169
3	Transmission/Distribution Pipeline		
3-1	Replacement of AC Pipes	8.5	625
3-2	Transmission/Distribution Pipeline to North Villages of Bijeljina City	11.2	824
3-3	Transmission and Distribution Pipeline to Southwest Villages of Bijeljina City	6.1	449
4	Leakage Detection Equipment	0.2	15
5	Engineering & Supervision Fee	3.6	261
6	Physical Contingency	4.0	287
7	Price Escalation	6.8	500
8	VAT	Not included	Not included
	Total	**49.9**	**3,653**

(Source: VKB, modified by the Study Team)

Note: KM is equivalent to 0.51129 Euro.

1 Euro: 140.51 yen (Average of these last six months: From 17 Jul. 2008 to 16 Jan. 2009)

1 KM: 71.84 yen

3.2 Sewerage Projects

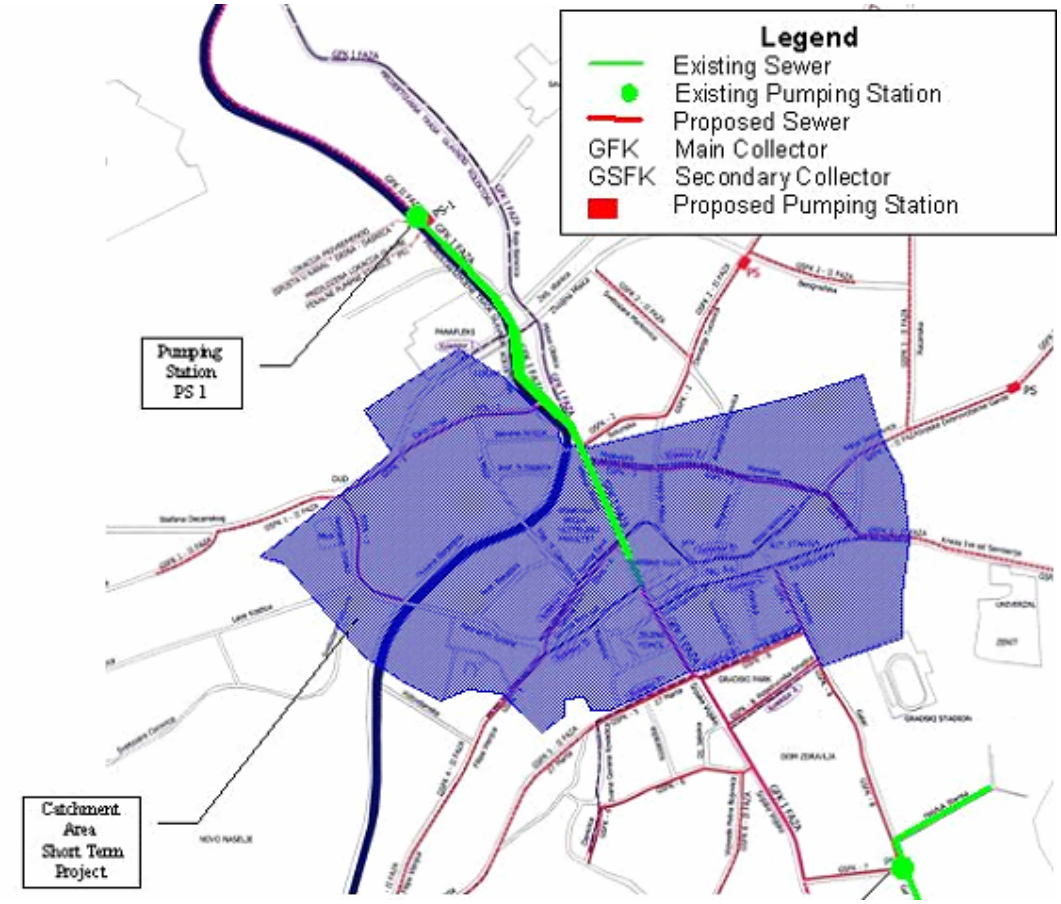
As described in paragraph 2.3.5 in Chapter 2, the small wastewater collection system in the residential area close to Grmić well-field, the main collector between the centre of Bijeljina town and Dasnia canal and the sewage pumping station (PS 1) have almost been completed (Refer to Figure 2-7). Currently the VKB implements Phase 1 Project under the EBRD loan and the Municipality of Bijeljina. The Phase 1 Project consists of sewer pipeline (80 km) and about 5,000 house connections in the town of Bijeljina. Subsequent to this Project, the VKB has a plan to implement Phase 2 Project but has no fund for Phase 2 Project currently. Phase 2 Project consists of the remaining sewer pipeline (80km), about 9,200 house connections and waste water treatment plant.

When Phase 1 & 2 Project are completed, 45,000 inhabitants in the town of Bijeljina can use this sewerage system and are equivalent to about 70% of population in the town of Bijeljina. VKB targets to complete Phase 1 Project up to 2010 and to complete Phase 2 Project up to 2015. Both Projects take priority over other projects.

As other projects, the VKB has a plan to construct sewerage facilities of the towns having more than 2,000 inhabitants in future. Eleven (11) towns except for Bijeljina come under it.

3.2.1 Phase 1 Project

The catchment area of Phase 1 Project is shown below.

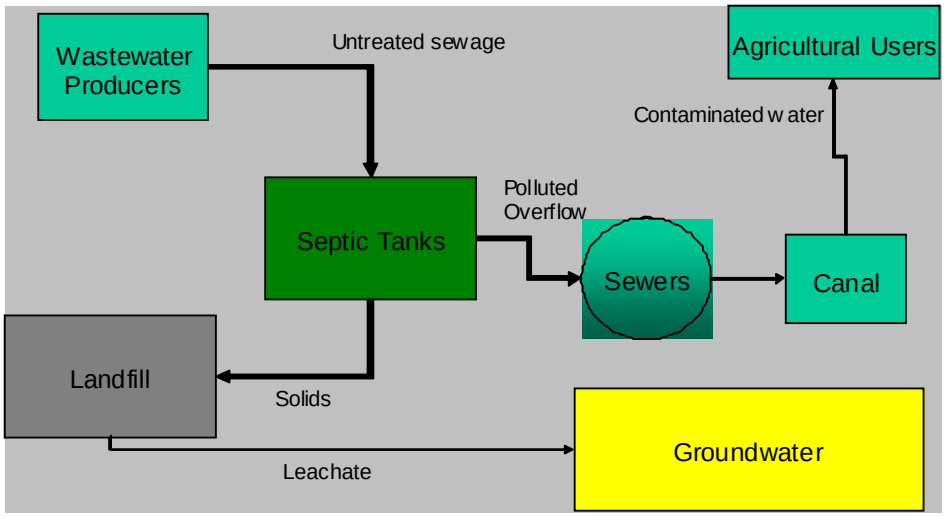


(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Figure 3.2 Catchment Area for Phase 1 Project

This Project covers the construction of a further section of the main collector and the wastewater collection system of the most densely occupied area of the town centre. To avoid unnecessary disruption and minimize investment costs, the Project replaces the existing old asbestos cement water pipes where they occur in the same street as the new sewers. The existing surface water sewers are also replaced as they are exposed for reconnection of septic tank outlets along the sewer routes. This Project was commenced from 2007 and is scheduled to be completed until the end of year 2010. After completion of this Project, sewer of this area

will be discharged into Dasnica canal temporarily until completion of the wastewater treatment plant. The flow sheet of sewerage system after completion of Phase 1 Project is shown below.



(Source: Feasibility Study for Priority Investment Programme)

Figure 3-3 Flow Sheet of Sewerage System after Phase 1 Project

The scope of Phase 1 Project is shown below.

Table 3-10 Scope of Phase 1 Project

No.	Item	Work Quantity
1	Wastewater Collection System	
1-1	Secondary Sewer / Tertiary Sewer Pipeline	Approximately 80km
1-2	House Connection	Approximately 5,000 ea
2	Replacement of Surface Water Sewer	Within Catchment Area
3	Replacement of AC & CI Pipe for Water Supply	Within Catchment Area

EBRD provided €7.0 million sovereign loan for Phase 1 Project and the remaining funds (€4.5 million EURO) were arranged by the Municipality of Bijeljina.

The budgets of Phase 1 Project are shown below.

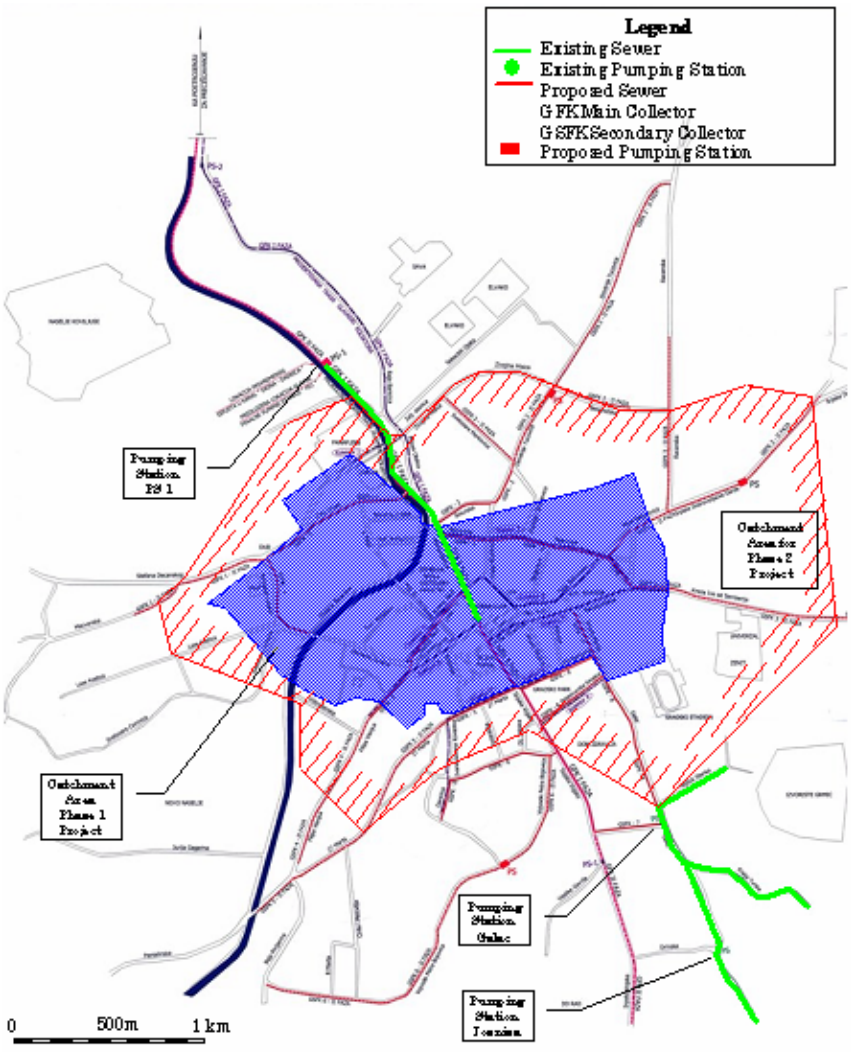
Table 3-11 Budgets of Phase 1 Project

No.	Item	Cost in KM millions	Equivalent Japanese million ¥
1	Wastewater Collection System	14.5	1,042
2	House Connection	3.0	216
3	Replacement of Surface Water Drains	6.0	431
4	Replacement of Asbestos Cement Pipe	2.0	144
	Total	**25.5**	**1,833**

Note: KM means Knvertibilna Marka and is equivalent to 0.51129 Euro.
1 Euro: 140.51 yen (Average of these last six months: From 17 Jul. 2008 to 16 Jan. 2009)
1 KM: 71.84 yen
Budgets include VAT (17%).

3.2.2 Phase 2 Project

The catchment area for Phase 2 Project is shown below.

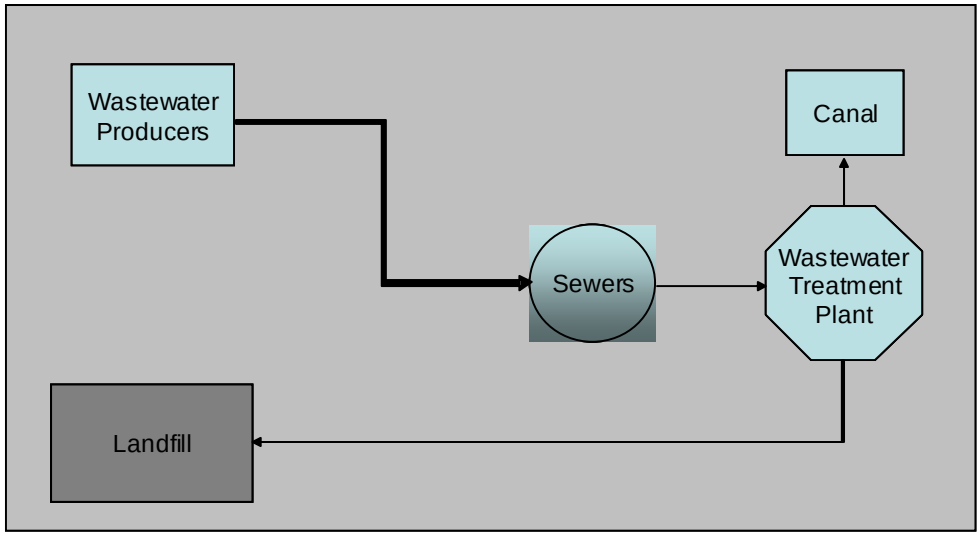


(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Figure 3.4 Catchment Area for Phase 2 Project

The wastewater collection system in the catchment area shown in the above Figure, the wastewater treatment plant (WWTP) and the sewer transmission pipeline from the pump station (PS 1) to WWTP are constructed under Phase 2 Project. In addition of above, Phase 2 Project replaces the existing old AC pipes where they occur in the same street as the new sewers to avoid unnecessary disruption and minimize investment costs. The existing surface water sewers are also replaced as they are exposed for reconnection of septic tank outlets along the sewer routes as well as Phase 1 Project.

WWTP is expected to be constructed in the closed sugar factory situated at a distance of about 6.4km from PS 1 to the southwest direction. Phase 2 Project is scheduled to be completed by 2015. The flow sheet after completion of Phase 2 Project is shown below.



(Source: Feasibility Study for Priority Investment Programme)

Figure 3-5 Flowsheet of Sewerage System after Phase 2 Project

Wastewater Treatment Plant (WWTP)

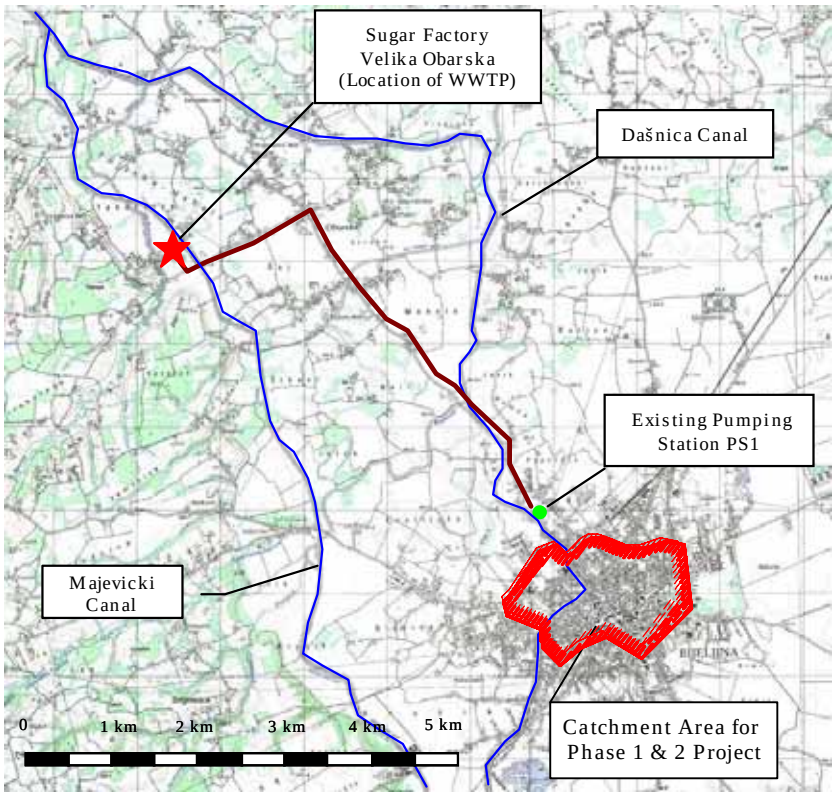
The result studied on WWTP in the feasibility study report prepared by the VKB is summarized below.

- The existing abandoned WWTP in the closed sugar factory is rehabilitated and used to treat sewer from the wastewater collection system constructed under Phase 1 Project(for 30,000 population).
- The least cost option for new WWTP is the Sequential Batch Reactor with Anaerobic Digestion. Accordingly the new WWTP having the said process is used to treat sewer

from the wastewater collection system constructed under Phase 2 Project (for additional 30,000 populations).

- The new WWTP is constructed at the same location as the existing WWTP in the closed sugar factory.
- The effluent from WWTP is discharged to Majevicki canal.

The location of WWTP is shown below.



(Source: Feasibility Study for Priority Investment Programme, modified by the Study Team)

Figure 3-6 Proposed Location for WWTP

The scope of Phase 2 Project is shown below.

Table 3-12 Scope of Phase 2 Project

No.	Item	Work Quantity
1	Wastewater Collection System	
1-1	Secondary Sewer and Tertiary Sewer Pipeline	Approximately 80km
1-2	House Connection	Approximately 9,200 ea
1-3	Main Sewer Pipeline from PS 1 to WWTP	6.400 m
1-4	Rehabilitation of Existing Aerated Lagoon	For 30,000 population
1-5	New WWTP (SBR w/anaerobic sludge digestion)	For 30,000 population
2	Replacement of Surface water Sewer	Within Catchment Area
3	Replacement of CI Pipe for Water Supply	Within Catchment Area

Cost estimate for Phase 2 Project is shown below.

Table 3-13 Cost for Phase 2 Project

No.	Item	Cost in KM millions	Equivalent Japanese million ¥
1	Wastewater Collection System		
1.1	Secondary Sewer and Tertiary Sewer Pipeline	13.2	948
1.2	House Connection	5.5	395
1.3	Main Sewer Pipeline from PS 1 to WWTP	3.3	237
1.4	Rehabilitation of Existing Aerated Lagoon	4.0	287
1.5	New WWTP (SBR w/anaerobic sludge digestion)	9.8	704
2	Replacement of Surface Water Sewer	4.9	352
3	Replacement of CI Pipe for Water Supply	2.6	187
4	Engineering & Supervision Fee	4.3	309
5	Physical Contingency	4.8	345
6	Price Escalation	8.3	596
7	VAT	Not included	Not included
	Total	**60.7**	**4,360**

Note: KM and is equivalent to € 0.51129 Euro.
1 €: 140.51 yen (Average of these last six months: From 17 Jul. 2008 to 16 Jan. 2009)
1 KM: 71.84 yen

The funds for Phase 2 Project are not arranged yet. For the detailed information on the funding arrangement of the Project, refer to sub-clause 2.4.2.

3.2.3 Other Project

The following projects are considered in future:

- Expansion of WWTP and the wastewater collection system for the town of Bijeljina.
- Construction of the sewerage facilities for eleven (11) towns having more than 2,000 inhabitants except for the town of Bijeljina.

3.3 Correlation between the Nephritis and Drinking Water

Balkan Endemic Nephropathy (BEN) is a fatal kidney disease that is known to occur only in geographically limited areas of the Balkan Peninsula. The disease was first and officially described in 1956, but may have existed for many centuries. The disease seems to occur only in rural areas located on alluvial valleys of tributaries of the lower Danube River including the northern part of Bijeljina city. According to the rough estimate conducted by the U.S. Geological Survey (USGS) who surveyed the disease extensively since 1990s, at least 25,000 people are suffering from BEN or are suspected of having the disease and that the total number of people at risk may exceed 100,000.

The environmental hypothesis suggests that the spatial distribution of BEN is related to the biogeochemistry of the environment such as soils, water and food. However, little is known about the hydrochemistry of groundwater from such areas since the precious surveys are mainly focused on soil condition, food chain and genetic trait of the targeted residents.

In Bijeljina city, BEN has also been identified especially in the northern part of the city since 1950s. Most of the residents in the area are taking water from shallow wells with the depth of around 5m. According to the local hospital in the city, about 2,000 people out of 20,000 of the total population in the area are identified as BEN patients. In addition, during and after the war, IDPs of Serbian moved in the areas due to the affordable land price, and the population of the northern areas is still increasing.

Under the such condition, although most of the residents and the concerned organizations in the area suspect that one of the main causes of the water borne disease, namely BEN, could be the ‘contaminated’ groundwater, water quality inspection has not been executed for a long time since the most of shallow wells are located in the private properties.

In response to the request from VKB, the Study Team conducted a water quality inspection with sample water taken from random shallow well that the users of the well are BEN patients. The result of the inspection is shown below just for reference. However, due to the only one sample of the alleged groundwater, it does not nothing is demonstrable.

Table 3-14 Result of Water Quality Inspection

Type of Sample : Groundwater
Place of collection : Northern part of Bijeljina
Date of collection : 15 October 2008
Date of analysis : 30 October 2008

Item	Sample	WHO Guideline (3rd version)	Water Quality Standard in Japan
Turbidity (photoelectric photometry method, degree)	0.1	-	≦2
Chroma (colorimetry method, degree)	1.0	-	≦5
pH(-)	7.3	-	5.8 to 8.6
Total hardness (mg/L as CaCO3)	387	-	≦300
Ca hardness (mg/L as CaCO3)	315	-	-
TOC (mg/L)	1.0	-	≦5
Soluble hydrated cilica (mg/L as SiO2)	19.0	-	-
Aluminum (mg/L as Al)	<0.01	-	**≦0.2**
Iron (mg/L as Fe)	<0.01	-	**≦0.3**
Manganese (mg/L as Mn)	0.008	0.4	**≦0.05**
Arsenic (mg/L as As)	<0.01	0.01	0.01
Boron (mg/L as B)	0.03	0.5	1.0
Barium (mg/L as Ba)	0.07	0.7	0.7
Cadmium (mg/L as Cd)	<0.003	0.003	0.01
Chromium (mg/L as Cr)	<0.05	0.05	0.05
Copper (mg/L as Cu)	<0.01	2	1.0
Lead (mg/L as Pb)	<0.01	0.01	0.01
Molybdenum (mg/L as Mo)	<0.01	0.07	0.07
Nickel (mg/L as Ni)	<0.01	0.02	0.01

Judging from the result of water quality inspection, the sample water is generally acceptable for drinking purposes if chlorine treatment is carried out, thus correlation between BEN and groundwater source can not be identified from the sample water. It is, however, not sufficient to probe the well as safe water source since other data such as seasonal variation of aquifer and other groundwater vein stream nearby have not yet confirmed in the Study. Other comments are as follows;

- Arsenic, which was suspected as a main cause of the disease, is in accordance with the both of WHO and Japanese water quality standard.
- Total hardness is higher than the Japanese standard.

3.4 Environmental and Social Consideration

In general, BiH has made little progress in the environmental field.

Environmental issues are primarily dealt with at Entity level through laws, regulations and standards. Nevertheless, the Ministry of Foreign Trade and Economic Relations has received the authority to deal with issues of natural resources, including environmental protection, at State level. The Ministry's administrative capacity needs to be significantly strengthened to ensure it can carry out these tasks.

As regards the integration of environmental issues into other policies, no particular developments can be reported. The BiH authorities are aware of this basic principle but not yet in a position to implement a policy in this respect. Regarding horizontal legislation, Entity legislation provides for Environmental Impact Assessment (EIA) on the basis of the EIA Directive. Both Entities have adopted by-laws on EIA.

As regards water quality, the collection of data on water quality is not yet functioning well. Poor water quality and insufficient waste water treatment remains a key environment challenge. Water quality is in general poor due to the discharge domestic and industrial waste directly into rivers, the disposal of waste along riverbanks, and run-off from agricultural areas without any treatment. Sewage connection is around 50% in urban areas but does not reach 10% in rural areas.

In December 2004, BiH signed the Danube Convention on the sustainable use of the Danube River. Both Entities and the Brčko District have adopted legislation on nature conservation. However, relevant implementing legislation is still missing. BiH's administrative capacity in the field of environmental protection continues to be insufficient. The institutional structure in this field is complex and there is a lack of central coordination and implementation even for international agreements. Capacity on the State level is particularly weak. There is a gap between attribution of environmental responsibilities and means to fulfil them. The number of vacant posts is significant and administrational development is limited. This is shown in the low number of professional environmental specialists in the subject fields in the country, and the many officials who are multifunctional in order to cover for the lack of specialists. In addition, stronger State-level responsibility for environment is not always accepted by the Entities.

Furthermore, there is an absence of environmental policy and strategy. Although the National Environment Action plan exists, there is no capacity amongst the authorities for deciding on priorities, policy or measures to implement it. A recent operational review of the sector recommended strengthening the capacity of the Ministry of Foreign Trade and Economic Relations and establishing a State Environment Agency. However, so far these recommendations have not been adequately implemented.

To conclude, some legislative steps have been taken by Bosnia and Herzegovina regarding well-field as follows;

- Law on Environmental Protection (Official Gazette of the FD No. 33/03)
- Law on Environmental Protection (Official Gazette of the RS No. 53/2002) plus Amendments (Official Gazette of the RS No. 109/2005)

In the laws, specific provisions related to EIA are set out in the Regulations and Governmental Decrees issued by both entity ministries. The regulations define the following:

- Projects and installations for which EIA is mandatory, and the criteria for determining the obligation and extent of EIA (Official Gazette of the RS No. 7/06)
- Installations and facilities whose operation may be commenced only if the environmental permit has been granted (Official Gazette of the RS No. 7/06, and the FD No. 19/04)
- Specific requirements for submitting an environmental permit application for installations and sections for which environmental permits were issued prior to enacting the Laws on Environmental Protection (Official Gazette of the RS No. 24/06, and the FD No. 68/05)
- Timeframe for applying for an environmental permit for installations issued with an environmental permit before the Laws on Environmental Protection entered into force (Official Gazette of the RS No. 24/06, and the FD No. 68/05)

In addition, regulations on the mandatory requirements and criteria for enterprises and institutions entitled to perform professional activities in environmental protection, such as compiling EIA studies, have been passed in both entities. (Official Gazette of the RS No. 15/07, and the FD No. 68/05)

However, in fact, VKB does not obtain such information on the environmental issues. Thus, the proper implementation of legislation in these areas should be treated as a matter of priority. It is also important that BiH ensures that environmental impact assessments are carried out in compliance with the law and that a functioning environmental monitoring system is in place.

Establishing a well equipped and operational State Environmental Agency would be a significant step forward in this respect. The establishment of a nationwide and harmonised legal framework for environmental protection is also important.

For reference, the Study Team conducted provisional scoping as follows;

(1) Adverse Impacts

Most significant adverse environmental impacts are:

1) Land acquisition for new water treatment plants and distribution facilities such as reservoirs, valve chambers on the pipeline and so on.
2) Hindrance to local populations such as noise, dust, vibration and traffic.
3) Increase of wastewater flow

(2) Envisioned Mitigation Measures

1) With regard to land acquisition, mitigation measures will be considered on the basis of previous Master Plan studies conducted by the VKB and other international organizations. Following mitigation measures will be considered on the site selection. Site selection shall be conducted on the basis whether the candidate sites have inhabitants and existing facilities or not. In case the site has inhabitants, Dialogue with inhabitants and disclosure of the information shall be executed. Priority shall be given to publicly-owned areas and areas with a few inhabitants.
2) With regard to hindrance to local populations, construction method and work execution plan, which mitigate the adverse impacts, will be considered. Following mitigation measures will be considered at the time of construction.
   - to select the construction methods which minimize the noise, dust and cordoning
   - to draw up the construction plan which minimize the cordoning and to explain the plan to inhabitants in advance
   - to adopt the safety measures during construction
3) With regard to increase of wastewater, adverse impact will be continuous. Concerning the increase of wastewater, it is necessary to advocate the counter measure protecting

the natural purification function of wet land and maintaining the natural environment balance. For information, there is no national park or nature preserve area in the targeted area.

4) With regard to sludge from water supply and/or waste water treatment plant(s), it is necessary to consider an appropriate treatment method (s) for the future plan. In case alternative plan for sludge treatment is considered, it is necessary to study in conjunction with the dumping or dealing methods.

So far there could be no alternative plan for the Projects. However, enhancing the capacity of the existing water supply and sewerage systems will be considered as an alternative plan.

CHAPTER 4 CONCLUSION AND RECOMMENDATION

4 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

The existing water supply and sewerage systems in Bijeljina city face serious situations. There are some old water supply facilities that are so deteriorated in structure, pipes, mechanical and electrical equipment, hence are not able to supply sufficient water to the town. As for the sewerage system, the VKB has just a few collecting pipe lines limited in the centre of the city and Grmić well-field, and the most of wastewater is discharged into neighbouring rivers and underground without any treatment. Despite of the efforts the VKB has made in the last decade, ratio of population served still remains low and the water supply and sewerage condition seems worsening due to the increase of population.

In order to solve the problems, expansion and rehabilitation of the water supply and sewerage systems is proposed. Since there is no national plan in the state level, the basic policy of the expansion and rehabilitation of the systems shall be deliberately planned in accordance with the "Development Strategy up until the year 2015" issued by the Bijeljina Municipality.

(1) Water Supply Systems

First, it is imperative for the VKB to increase wells and well pumps in Grmić well-field to fulfil the future water demand 720 l/s (currently 615 l/s). In the existing intake facilities, most of the equipment is severely deteriorated after a long period of use. In particular, replacement of power generators, chlorination facilities is urgently required. In addition, the VKB plans to install SCADA system to control and monitor the entire water supply facilities. Accordingly, it is required to fit with flow meters and pressure instruments on the transmission pipelines.

As for the water transmission and distribution pipelines, replacement of aged AC and CI could be a pressing need since the main case of NRW is stemmed from the leakage of the aged pipelines. Furthermore, replacement of Ring Mains for the outskirts of the city, expansion of water transmission and distribution pipeline to North and South region of the city, and the four new water reservoirs in the four expansion zone in the city are also needed to meet future water demand.

(2) Sewerage Systems

Same as other cities in the BiH, Sewerage system in Bijeljina is now less advanced than that of water supply. So far, the most part of Bijeljina city have no sewerage system, except the centre of the city, Grmić well-field and Koviljuse. It is, however, pointed out that most wastewater is discharged into rivers or underground through septic tanks, soakaway pit or without any treatment.

VKB has already planned a master plan to improve the current situation on waster water treatment. The plan consists of three phases. Phase 1 project, which includes the construction of sewer pipelines (80km) and approximately 5,000 house connection, has been almost competed under the EBRD loan and Municipality fund. Phase 2 project mainly consists of the remaining sewer pipelines (80km) and the construction of a waster water treatment plant. However, so far the fund source for the Phase 2 project is not yet arranged.

At present, the operation and maintenance of water supply and sewerage systems is performed by the VKB under the control of Bijeljina Municipality. So far, major negative effects have not been identified in this institutional structure. It is, however, conceivable that the increase of water tariffs is not easily approved by the Municipality since the Municipality has an authorization to decide it. As for the technical issues, in particular, technological transfer on the wastewater treatment and leakage detection is proposed by means of capacity development.

4.2 Recommendation

(1) Project Implementation

Regarding the project implementation described in Chapter 3, the following Feasibility Study and Detailed Design shall be conducted for the smooth and gradual proceedings of the Project.

(1) –a) Feasibility Study

This Study is to prepare for project formation at the preliminary stage. It is, therefore, necessary to carry out the following Feasibility study, which consists of site confirmation works and financial design as follows;

a) Feasibility Study

<Site confirmation works>

- To review the “Feasibility Study for Priority Investment Programme, Bijeljina Waste Water Collection System”
- To confirm the scope of the project
- To carry out supplementary study such as confirmation of intake water quality and quantity
- To confirm efficient installation of pipelines
- To conduct topographic survey in order to design pipelines
- To confirm the availability of land acquisition
- To confirm environmental and social impact caused by the Project
- To complete facility design at the level of Feasibility Study

<Financial design>
- To review the cost estimation and financial analysis
- To confirm the total budge
- To plan disbursement schedule

(1) –b) Detailed Design

After the Feasibility Study, the Detailed Design would be conducted to confirm the design condition before implementation of the Project. This includes;

- To review Feasibility Study report
- To confirm the project site and to prepare location maps with the scale of 1:5,000
- To examine the most appropriate water supply and wastewater treatment processes in terms of economic efficiency and environmental protection
- To select the suitable pipe material
- To design operation methods of water supply and wastewater treatment systems including instrumentation
- To examine hydrostatic profile and detailed layout plans
- To prepare calculation sheets for hydraulic capacity of systems
- To design the network of electrical incoming lines
- To prepare construction schedule including civil, mechanical, electrical, instrumentation, architect and pipe works
- To determine tender scope and schedule for the construction of the Project
- To prepare pre-qualification tender, if any
- To prepare tender documents including general conditions, general specifications and special specifications

- To support tender procedures
- To make pre-qualification / tender evaluation report
- To supervise construction works
- To carry out capacity development for the concerned organizations

(2) General Issues

In addition to, or in relation to the project implementation above, the following general matters should be dealt with the appropriate means such as;

(2) – a) EIA Study

During the project implementation, the EIA study would be carried out by the VKB and its report should be approved by the concerned organization in the RS. However, since the VKB does not receive any information on the environmental assessment before implementing of projects, they need to confirm the EIA processes defined by the BiH or RS laws and regulations.

(2) – b) Replacement of the aged pipelines

It is urgent necessary for the VKB to replace the superannuated pipelines such as AC and CI pipes. These aged pipes could be the main cause of high leakage ratio in water supply system in Bijeljina. In addition, the aged AC might be suspected of cancer-caused agent. The VKB's high ratio of the NRW, which is estimated around 60%, also arises from leakage of the aged pipelines. In the sense, aside from expansion projects, rehabilitation of existing pipelines shall be absolutely imperative from the point of view of economic efficiency and public health.

(2) – c) Pipe leakage detection

As described in (3), leakage of the aged pipelines is a major issue for the management of water supply and sewerage systems in the city. In order to maintain the pipelines, the VKB shall obtain the skills of pipe leakage detection, and shall establish the specialized department of leakage detection in their technical sector. The Study Team includes the necessary equipment for leakage detection in the cost estimation of the future project.

(2) – d) Improvement of sewerage systems

There is no wastewater treatment plan in Bijeljina, on the contrary, there is a few sewerage systems such as collecting pipes and individual septic tanks in the limited areas in the city. So far, collected sewerage is directly discharges into natural environment including the adjacent rivers and underground. It is recommended to prepare sewerage system urgently.

(2) – e) Nephritis issue

As for the BEN issue, no correlation between the fatal kidney disease and ground water can be identified from the results of water quality inspection conducted by the Study Team. It is, however, not sufficient to probe the wells as safe water source since other data such as seasonal variation of aquifer and other groundwater vein nearby have not yet confirmed in the Study. More extensive groundwater survey together with other environmental survey such as soils, food chain and inheritable trait should be implemented for the resolution of the disease.

(2) – f) Human resource development

In order to develop personnel resources to desire level for sound management, and to keep the work forces required for the proposed future water supply and sewerage systems, both rationalization and capacity development of the organizations would be necessary. At the same time, training and education would be necessary to maintain and develop the water supply and sewerage management. Therefore, continuous training and education programs are strongly recommended for management positions, engineers, and administration staffs to upgrade their skill, knowledge and performance. In particular, the VKB is required to cultivate human resources capable of pipe leakage detection and management of sewerage systems, both of which are the new field to the VKB. In addition, introduction of the SCADA system can upgrade the monitoring techniques of water supply systems.

(2) – g) Financial improvement

The current water tariffs are not high enough to cover overall operational expenses since income from non-core activities shares about half of the total income. In order to allow the VKB to generate higher profit for the management of systems, tariffs should be increased. However, this option must be carefully studied further as increase in water tariffs may cause decline in water charges collection. So further studies including socio-economic survey must be carried out on this issue and variables affecting collection ratio must be identified.

(2) – h) Autonomy of the VKB

Finally, in the near future, the VKB should be more independent and be more autonomous organization. So far, the VKB is organizationally a part of Bijeljina Municipality, in other words, the VKB is one of Municipality's subordinate departments. It is, thus, difficult for the VKB to bring forward objections and to request a tariff increase, as the Municipality has a decision-making authority after all. In addition, considering most of the non-payment of water

charges are attributed to public organizations, which are also under the Municipality, the VKB need to be self-ruling organization.

要 約

ビエリナ市上下水道供給計画,
スルスプカ共和国,
ボスニア・ヘルツェゴビナ

(和文要約)

要約

1) 調査の背景と目的

ボスニア・ヘルツェゴビナでは上下水道システムの復旧・改善が戦後の国家及び地方復興計画の中で、最も重要な分野の一つとされている。

デイトン平和合意締結後、国際機関や援助組織等の協力を基に、同国の上下水道は改善されつつあるが、現状としてまだ多くの問題が残っている。そのような状況下において、ボスニア・ヘルツェゴビナ政府は2003年に日本の無償資金案件として「スルプスカ共和国/センベリア腎炎被害地区緊急上水道計画」を日本政府に公式に要請した。

本「ビエリナ市上下水道/スルプスカ共和国/ボスニア・ヘルツェゴビナ」に対するプロジェクト・フォーメーション調査団は当初、前述の計画を再調査するために結成された。しかし、同計画を取り巻く状況が変化したため、調査団はその調査方針を一部変更し、同市の下水道を含めた新規案件形成の可能性を探る調査に範囲を拡げた。

調査の主な目的は下記の通りである。

1. ビエリナ市の上下水道システムの現況を確認し、効果的且つ効率的なプロジェクト形成を提案する
2. 市内において異常に高い罹患率を示す腎炎と地下水の関係を確認する
3. VKB(ビエリナ上下水道局)の近代水道施設に対する維持管理能力の確認をする

2) ビエリナ市上下水道サービスの現状

ビエリナ市では上下水道システムはビエリナ市庁傘下のVKBが運営している。VKBは2004年に株式組織となり、スルプスカ共和国政府が65%の株式を所有している。同市の総人口は107,000人と統計的に予測されているが、VKBは国内避難民 (IDPs) 50,000人を含む200,000人と推計している。激しく流動するIDPsの推移、そして1991年以来人口調査が実施されていないということもあり、ビエリナ市の現在の人口を正確に把握することは難しい。既存の上下水道施設及びその問題点を下記に記す。

(1) 上水道システム

Grmić 井戸群は17の井戸（深度約40m）から成り、ビエリナ市における唯一の水源である。その生産水量は約475 l/sで、最大1,500から2,000 l/s程度のキャパシティがあるとされている。しかし、2030年の将来的な水需要を満たすには、生産水量を722 l/sまで増やさなければならない。

同市内では約25%の地域を配水管網がカバーしている。パイプラインの総延長は約400 kmで、パイプの口径は50から350mmである。パイプラインの敷設年次や素材は様々であり、漏水率は30%程度と推計されている。街の中心地に高架貯水池（容量：1,500 m³, 高さ：42 m) があり、以前はVKBぼオフィスも兼ねていた。基本的には同市では24時間の水道サービスを実施している。

全体的に、水道施設の多くは旧ユーゴスラビア時代に建設されたものが多く、改修が必要とされている。

(2) 下水道システム

現在、市内では中心部などの限られた地域に下水集水管があるのみである。下水や他の排水は当然、何の処理もされずに地下や近隣の河川に放流される。従って、下水処理場の建設が切望されている。

3) 将来計画の概要

ビエリナ市の将来的な上下水道の需要を満たすためにも下記の様なプロジェクトが必要と考えられる。

(1) 上水道システム

1) 取水施設
- 井戸及び井戸ポンプの新規建設 (50 l/s x 4 sets)
- 非常用発電施設の取替
- 塩素滅菌施設の取替
- 自動制御（SCADA）システムの設置

2) 貯水池
- 追加貯水池の新規建設（キャパシティ： 1,000 m³）

3) 送水管及び配水管
- 老朽化した鋳鉄管及び石綿管の敷設替え
- リングメインの改修
- 北部地域への送・配水管の新規建設
- 南西部地域への送・配水管の新規建設
- 漏水探知器具の購入

以上、総コストは49.9百万KM (=36.5億円)程度になる予定である。

(2) 下水道システム

1) 下水道管きょシステム

- 第二、第三下水管支線の新規建設
- 各戸接続の新規建設
- ポンプステーション1から下水処理場への本管
- 曝気ラグーンの改修
- 下水処理場（Sequencing Batch Reactor）の新規建設

2) 雨水用下水管きょの敷設替え

以上、総コストは60.7百万KM (=43.6億円)程度になる予定である。

4) 結論と提言

- 結論 -

ビエリナ市内の既存上水道施設は深刻な現状に直面している。多くの老朽化が進む上水道施設ではその構造、配管網、機械、電気等、設備の能力が低下し、市内へ十分な水量を送水出来ていない。下水道に関しては、市内中心部、そしてGrmić 井戸郡付近の限られた地域にのみ下水集水管が敷設されているだけで、下水のほとんどは何の処理もなく直接地中か近隣の河川に放流されている。

これらの諸問題を解決するためにも、上下水道施設の拡張及び改修が急務であると判断される。国家レベルでの上下水道計画が存在しないため、上下水道システムの拡張及び改修の方針に関しては、ビエリナ市庁が策定した「Development Strategy up until the year 2015」に従い、慎重に計画すべきである。

- 提言 -

上記の結論より、調査団はビエリナ市の上下水道システムの開発を継続するためにも以下を提言したい。

(1) プロジェクト実施

- a) 現場確認作業や財務計画を含めたフィージビリティ・スタディの実施
- b) プロジェクト実施前に設計条件等の確認するための詳細設計

(2) 一般的な問題点

- a) VKBによる環境アセスメント（EIA）の実施
- b) 高い漏水率及び公衆衛生の観点から老朽化したパイプラインの管路更新
- c) 上記3に関連して、VKBはパイプライン保持のため漏水探知の技術を習得すべき
- d) 現在ビエリナ市には下水処理場がなく、環境保護及び公衆衛生のためにも下水処理場の新規建設が急務である

- e) 調査団が実施した水質検査の結果からはバルカン腎炎と地下水の相関関係は確認出来なかったが、原因の解明のためにも他の環境調査も含めたより広範囲にわたる地下水調査を実施すべきである
- f) 人材育成は上下水道の開発のためにも継続されなければならない
- g) 水道料金はVKBの財務状況を改善するためにも値上げすることが望ましい
- h) VKBは自治を確立すべきである。組織の適正な経営のためにも独立性を高めるべきである