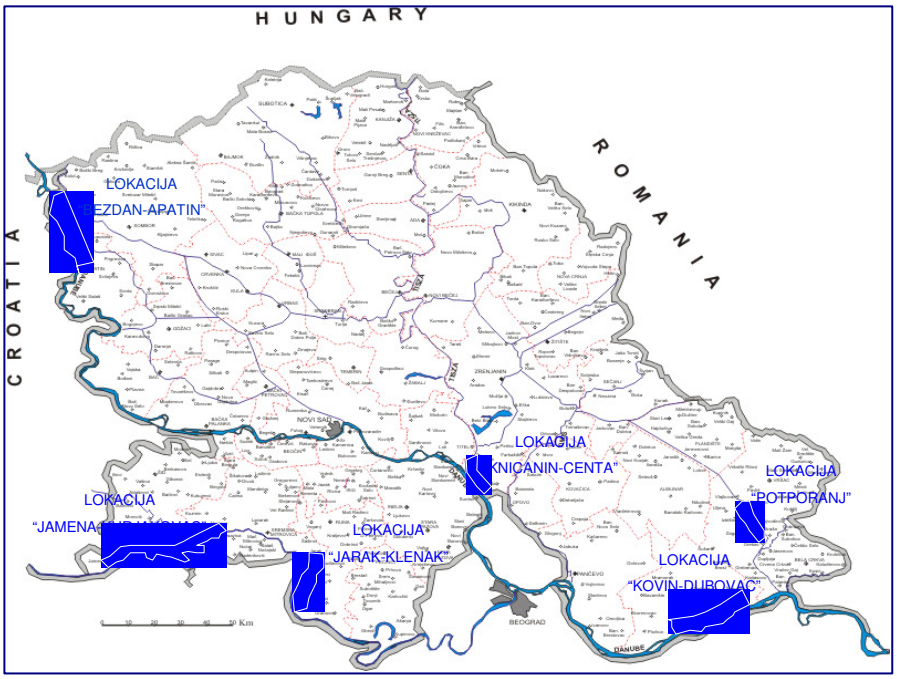
BLUEWATERS
Environmental Consultants



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Project# 353

DRAFT REPORT: SUSTAINABLE SOLUTIONS TO IMPROVE THE QUALITY OF DRINKING WATER AFFECTED BY HIGH ARSENIC CONTENTS IN 3 VOJVODINIAN REGIONS

Book II: Groundwater sources

Stadt Wien MA 31 – Water Management

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2 GROUNDWATER SOURCES

2.1 Introduction

During the 45 years of organized public water supply in Vojvodina, urbanization and rapid economic development were not supported by adequate water supply projects. Today, 464 cities, towns and villages in 45 municipalities of the Autonomous Province of Vojvodina have 307 public water supply systems; 157 of these are managed by public utilities and 150 are managed by local communities. 71 villages (80,000 inhabitants, or 4% of Vojvodina's total population) do not have access to water supply systems.

Public water supply relies solely on ground waters from various water-bearing strata: the shallow ("first") aquifer (well depth up to 50 m), the main aquifer (well depth from 50 to 250 m), and Pliocene subartesian/artesian aquifers (well depth from 200 to 350 m).

The rate of groundwater abstraction surpasses by far that of aquifer recharge, resulting in a permanent lowering of the water table which, in several regions of Vojvodina, amounts to as much as 1.5 m a year. Compared to conditions which existed in the 1960's, a general lowering of the water table of up to 30 m has been recorded.

The continuation of such excessive use of limited water resources will lead to major water supply problems.

In addition to the problem of providing adequate amounts of drinking water to the territory of Vojvodina, the quality of the delivered water constitutes a special problem. The natural quality of the water varies to a great extent, ranging from acceptable quality to the need for a high level of treatment. The chemistry of the shallow aquifer in the regions of Central Bačka and Northern Banat is characterized by an elevated content of organic matter, arsenic, iron, manganese and the ammonium ion.

In the last few years the problem of increased levels of arsenic in groundwater (particularly in Central Banat and Western and Northern Backa) has been addressed; its presence in the water is a consequence of the geochemical characteristics of sediments within water-bearing strata.

Laboratory tests show an unusually high number of physically- and chemically-inadequate samples of the water delivered to the water supply systems in specific regions (even as much as 100%).

Out of the total volume of groundwater water abstracted in Vojvodina, only one-third is being treated at water treatment plants.

Water supply issues in Vojvodina, as well as other parts of Serbia, have been assessed and reviewed in the Water Management Master Plan of Serbia (WMMPS). This strategic document proposes solutions which rely on local water sources (including the use of modern water treatment methods) and the delivery of water from greater distances (Regional Water Supply Systems). As part of these solutions, regional water sources would be developed in near the Danube and Sava rivers (between the locations of Bezdan and Bogojevo; Kovin, Dubovac and Banatska Palanka; Jamena and Laćarak; and Jarak and Klenak, which are presented in the Figure 3.1).

Figure 2.1: Regional groundwater sources

The Ministry of Science and Technology of the Republic of Serbia (today the Ministry of Science and the Environment) originally invited proposals for the funding of water supply projects under a national program titled Development, Protection and Use of Water Resources in Serbia. The program also included a project titled Alternative Water Supply Solutions for Vojvodina, which is currently being prepared. The first phase of the Project was co-funded by the Ministry of Science and the Environment of the Republic of Serbia, and the Executive Council of Vojvodina/Provincial Environmental and Sustainable Development Secretariat and Provincial Agriculture, Forestry and Water Management Secretariat.

The first phase of the Project (completed in 2004), included investigations in the sector of Budžak, Apatin and Mesarske Livade, and provided background information for the definition of regional water source yield and configuration. This water source would be the focal point of water supply for Western Bačka. Complex and state-of-the-art groundwater resource investigations were undertaken, and they indicated that it would be possible to develop a water source with a yield of about 2 cubic meters per second (or about 160 to 240 liters per second per kilometer of riverbank).

In order to arrive at optimal solutions to water supply problems for specific regions, it will be necessary to prepare water supply feasibility studies that address all relevant factors which influence the selection of concepts. The present pre-feasibility study titled Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in Three Vojvodinian Regions (the Study) is being prepared in an attempt to provide solutions to drinking water supply problems in pilot region Western Bačka.

2.2 Summary of available data and background information about groundwater sources addressed in the study

Available data from previous projects, studies and assessments addressing the subject region, as well as dedicated field surveys conducted in order to gain insight into the current water supply situation, were used for the purposes of the Study. These documents include the following:

- Register of water structures and water supplies within the territory of Vojvodina (1982);
- Conceptual design of water supply for Vojvodina, Phase 1 (1996);
- Alternative Water Supply Solutions for Vojvodina, Phase 1 (2004);
- Water supply survey conducted in Western Bačka, Bluewaters (2005).

2.3 Hydrogeological and Hydrodynamic Features of Western Bačka

The region of Western Bačka includes the terrain between the western section of the Danube and the Telečka Loess Plateau and Sivac. To the south its eastern boundary lies between Sivac, Ruski Krstur, Silbaš and Bačka Palanka. It constitutes an erosion and accumulation plain with two geomorpholgical units: an alluvial plain (floodplain and river terrace) and the Upper Terrace. The lower portion of the terrain, up to a depth appropriate for the abstraction of groundwater for public water supply (a depth of about 250 m), is comprised of Pliocene/Upper Paludina silty/clayey deposits alternating with sands and subordinate gravelly sands. Pliocene sediments were detected in the northern slopes of Mt. Fruška Gora and in the stratum underlying the loess in the southeastern slopes of the Neogene horts between Beli Manastir and Batina. From here the Upper Pontian and Paludina deposits gently slope towards the northern and northeastern parts of Bačka. There are polycyclic riverine (or riverine/lacustrine) sandy/gravelly strata discordantly overlying the Pliocene sediments. In the alluvial plain of the Danube and the Upper Terrace these are discordantly overlain by sands (generally fine, and to a lesser extent medium-grain), subordinate gravelly sands, and Upper Quaternary sandy gravels. The ultimate lithologic members of the alluvial plain and the Upper Terrace include silty sands, silts and silty/bog clays, which together function as an overlying semi-pervious stratum.

The water-bearing strata of this litho-stratigraphic build-up include:

- Upper Quaternary sandy/gravelly strata: the shallow aquifer;
- Polycyclic riverine (riverine/lacustrine) sediments including interlayers and lenses comprised of essentially impervious silts and silty clays: main water-bearing complex or main aquifer; and
- Interlayers and strata comprised of fine- and medium-grain sands, and subordinate gravelly sands: Pliocene water-bearing strata containing subartesian/artesian aquifers.

2.3.1 The Quaternary Aquifer in Western Bačka

The Upper and Lower Quaternary water-bearing strata in Western Bačka are vertically interconnected, essentially over the entire terrain. At specific locations (Bezdan, Sombor, Senta, and Srpski Miletić), the Upper Quaternary water-bearing strata and the main water-bearing complex are separated by silty and silty/clayey interlayers and lenses, whose thickness is from 2.5 m (Srpski Miletić) to about 6 m (Sonta), as well as final members comprised of riverine

(riverine/lacustrine) sediments. At these locations the thickness of the Upper Quaternary water-bearing strata is about 30 m.

Despite this local division, the Quaternary sandy and sandy/gravelly strata in Western Bačka generally constitute a single water-bearing medium. The total thickness of this single water-bearing medium is between 20 and 60 m.

The underlying stratum of the water-bearing medium is at a depth of 30-70 m and includes Pliocene sediments, local sands and gravelly sands, and thus the Quaternary and Pliocene water-bearing strata are directly interlinked.

The overlying stratum of this water-bearing medium is comprised of silty sands, silts and silty/bog clays near the Danube, less than 2 m and increasing to about 10 m in the area of the Upper Terrace; occasionally it measures at over 15 m, and at Sonta and Gajdoba it is more than 25 m.

The aquifer created in this single water-bearing medium in Western Bačka is a part of the main aquifer of Bačka and Banat. The western boundary of the aquifer is the Danube, with which the aquifer has either a direct hydraulic link or an incremental-hydraulic-loss link due to clogging of the riverbed. Therefore, the aquifer has a water table elevation in the Danube water table level (about 500 m wide). When river stages are low aquifer act as a unconfined. When river stages are high, the aquifer is artesian/subartesian. In the area of the Upper Terrace, where the thickness of the overlying semi-pervious stratum is greater than 5 m, the aquifer is permanently subartesian.

The water table is at an absolute elevation of about 92 m above sea level in the area near the boundary between the Upper Terrace and the northeastern Telečka Loess Plateau, and decreases to less than 84 m above sea level southwest of the line between Sombor and Stapar. The general gradient of the aquifer's water table is towards the Danube. The piezometric pattern is significantly different in the area of the Sombor and Apatin water sources. There are fewer changes in the piezometric pattern of water sources for other settlements. Hydraulic gradients are low and groundwater flow to the Danube is very slow. Groundwater flow into the Danube occurs at very low river stages in its immediate vicinity, where an exchange of groundwater and river water occurs. In addition to the flow into the Danube, the aquifer drains as a result of flow into the overlying semi-pervious stratum when the water table declines due to evapotranspiration. When the water table is elevated during non-vegetation periods, groundwater flows to the primary canal

network and through the overlying semi-pervious stratum into depressions (oxbows and marshes), from where it is evacuated via the canals and pumped into the Danube. In the area away from the river, the aquifer is primarily recharged by infiltration of precipitation, in essence only during non-vegetation periods, indirectly through the overlying semi-pervious layer. During vegetation periods, when the water table declines, the aquifer is partially recharged from the primary canal network (particularly the canal running from Bezdan to Stapar).

A vertical exchange of groundwater and surface water occurs through the overlying semi-pervious stratum, or an exchange with meteoric water by infiltration and evapotranspiration. The water table in the overlying semi-pervious stratum in the area of the Upper Terrace is 1-4 m higher than the aquifer's water level during the length of the hydrologic year.

2.3.2 Pliocene aquifers in Western Bačka

The Pliocene (Upper Pontian and Paludina) water-bearing strata can be found throughout Vojvodina, and further into the territories of Hungary and Romania, extending to the outer reaches of the Neogene Pannonian Basin. To the west, they stretch continuously into the territory of Croatia. They include subartesian/artesian aquifers (with a depth of up to 250 m), which are used in Western Bačka for the public water supply. They have been found in the northern slopes of Mt. Fruška Gora and, as mentioned earlier, in strata underlying Quaternary sediments in the area of the alluvial plain and the Upper Terrace. They are comprised of fine- and medium-grain sandy deposits, with occasional gravelly sands or sands with gravelly lenses, which alternate laterally and vertically with silty and silty/clayey strata whose thickness is as much as 50 m. The thickness of the water-bearing strata in Western Bačka ranges between 5 and 23 m.

The areal extent and seepage characteristics of these water-bearing strata are known only locally (vicinity of Sombor, area between Mladenovo and Bačka Palanka). No reliable data are available for a more accurate definition of their geometry, especially with regard to the interconnection of the water-bearing strata.

There is no doubt that the Pliocene water-bearing strata hold several aquifers. It can safely be assumed that locally some of these aquifers feature direct hydraulic links, while in the case of others water is exchanged via the thinner silty strata which separate them. In addition, there is a hydraulic link between these strata and the main aquifer, in view of the fact that in some parts of

the ground the Pliocene water-bearing strata and those of the main water-bearing complex are linked directly.

Through the end of the 1970's, at virtually all locations, the aquifers were artesian. However, the water tables declined with the development of major water sources and as a result of intensive abstraction. Today, artesian levels can only be found at a few locations near the Danube. Along the left bank of the Danube (in Srem), artesian levels occur in deeper (115-162 m) water-bearing strata (area between Banoštor and Čerević).

The aquifers are recharged by direct infiltration of meteoric water into the water-bearing strata in the northern slopes of Mt. Fruška Gora, where they were extend to the ground surface. Additionally, the aquifers receive indirect infiltration of precipitation through the loess into the stratum which immediately overlies these water-bearing strata, in the outer reaches of the Neogene horts between Beli Manstir and Batina. A major portion of the recharge is by infiltration from the Danube along the section running from Bački Breg to Monoštor, where the left side of the river channel has incised Pliocene sediments.

The aquifers drain into the Danube at lower river stages, and drain groundwater from Pliocene water-bearing strata into the main aquifer; the rate of drainage is significantly increased as a result of the descent of the water table brought about by the intensive extraction of water for purposes of water supply. However, the majority of the drainage occurs as a result of groundwater abstraction from Pliocene water-bearing strata for municipal and industrial water supply in this region.

At depths greater than 250-300 m in Western Bačka, as well as in other parts of Vojvodina, all Neogene and bedrock water-bearing strata hold thermal and mineral water. In Western Bačka, the most famous spring is found near Prigrevica (Banja Junaković/Junaković Spa), where the groundwater is abstracted by means of bored wells. The thermal and mineral waters reside in Miocene limestones at depths between 600 and 750 m, and their temperatures are between 51 and 59°C. The thermal and mineral waters stored in Tortonian-Messinian and Triassic limestones were identified by drilling at several locations in the northern parts of Western Bačka (Bezdan, Bački Monoštor, Sombor and other).

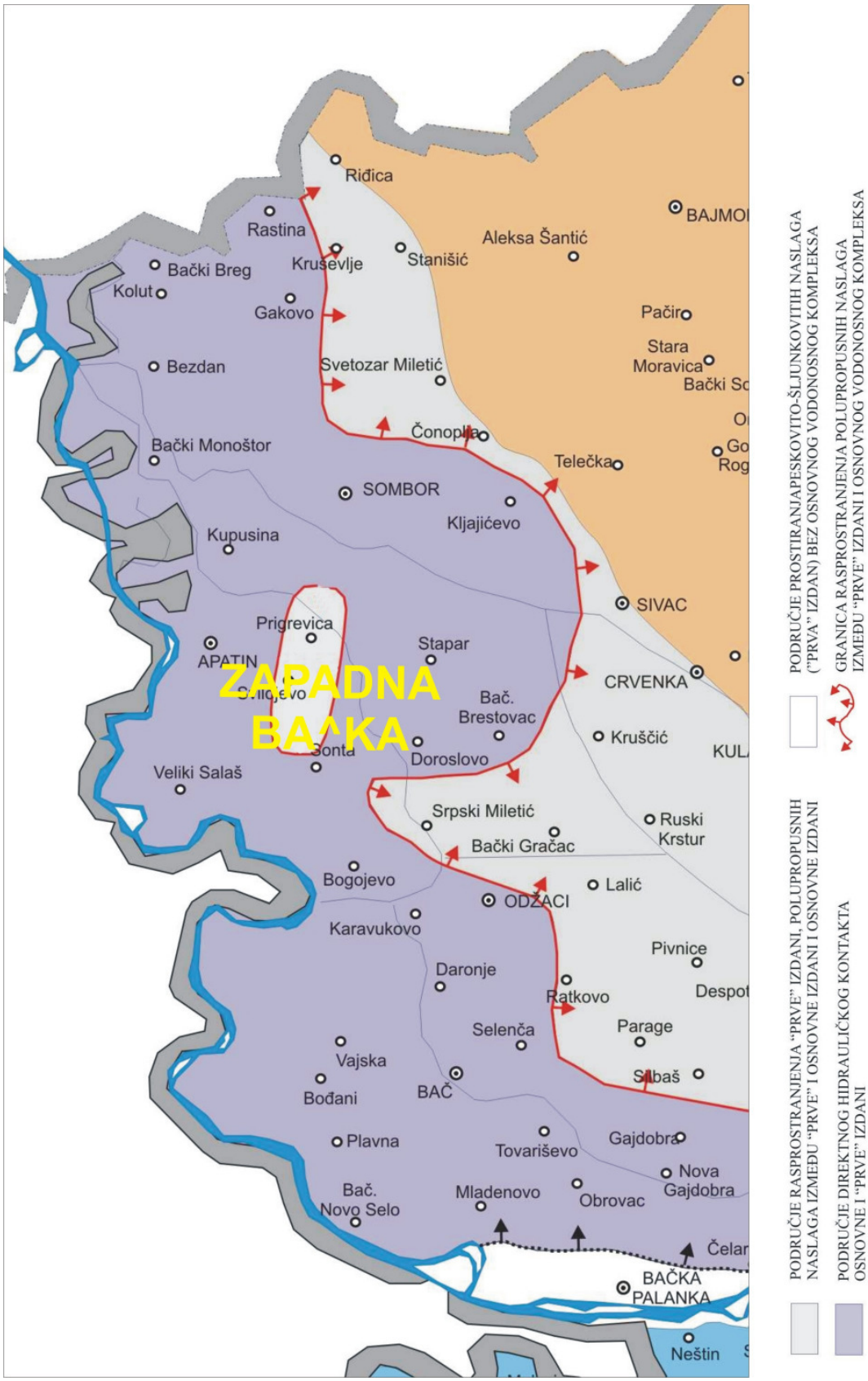
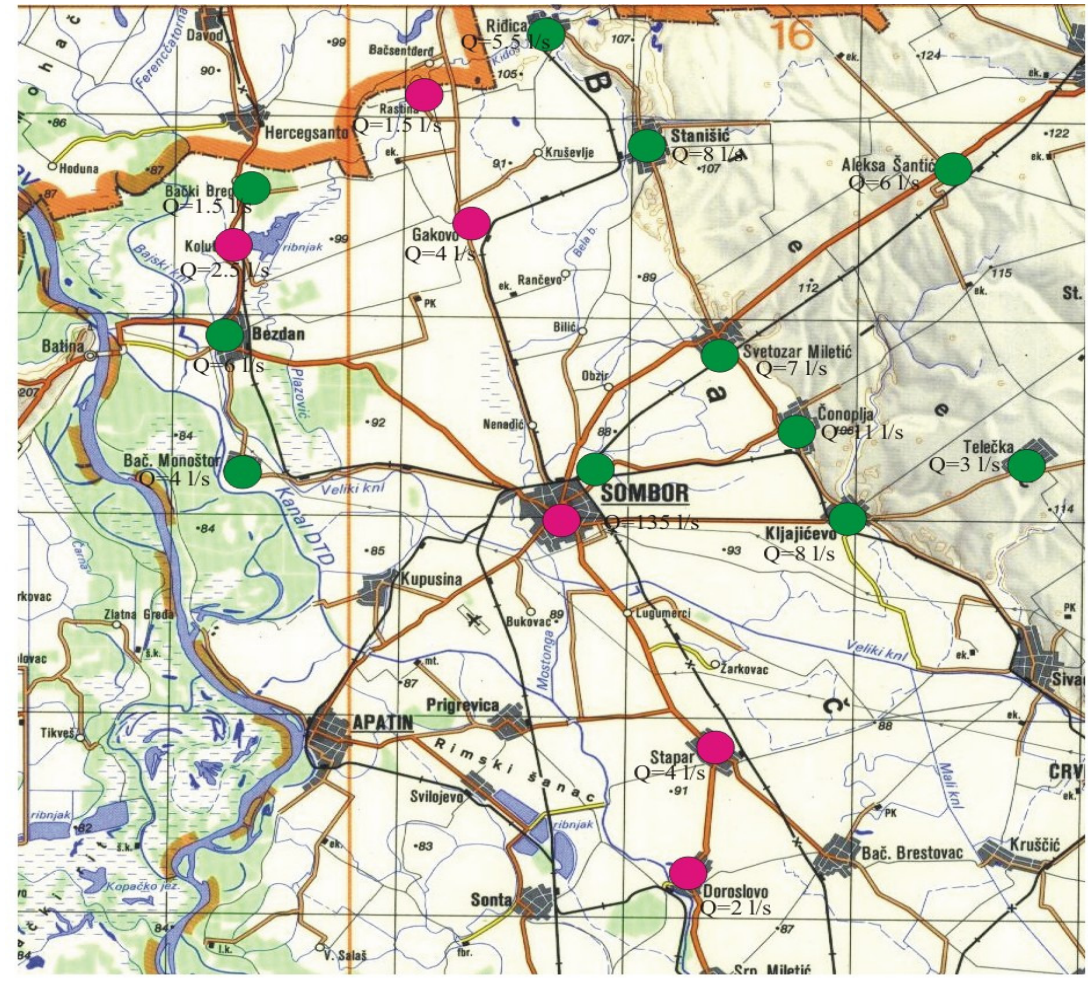


Figure 2.2: ***Areal extent of the main aquifer and shallow aquifer in Western Bačka***

2.4 Overview of the Current Water Source Situation in Western Bačka and Identification of Major Problems

2.4.1 Municipality of Sombor



SOMBOR MUNICIPALITY

POPULATION (2002 SURVEY): 97263

AREA (km^2): 1178

NUMBER OF GROUNDWATER SOURCES FOR PUBLIC SUPPLY:16

ABSTRACTION FROM MAIN AQUIFER

ABSTRACTION FROM PLIOCENE AQUIFER

ABSTRACTION FROM SHALLOW AQUIFER

Figure 2.3: Overview of Groundwater Sources in Sombot Municipality

The municipal territory of Sombor contains one town and 15 villages with a total population of 97263, whose water supply is provided by groundwater abstraction from:

- the subartesian (shallow) aquifer at a depth of up to 30 m;
- the main aquifer at a depth of about 35-65 m; and
- aquifers within Pliocene water-bearing strata at a depth of about 100-170 m.

The total average daily rate of groundwater extraction in this municipal territory is estimated at Q=209 l/s. All water abstraction facilities are bored wells. 160 such wells are active. Water sources for public water supply are serviced by 59 operating wells.

2.4.1.1 Sombor

Water supply for Sombor's population of 51,471 and a portion of the industry is provided from the Jaroš Water Source, located about 3 km northeast of the city center, south of the road connecting Sombor and Čonoplja. The ground elevation of the water source is about 86 m above sea level. Development of the Jaroš Water Source began in 1961, when 6 wells were bored. Five of these were "shallow" (bored to 54-64 m) and one was 142 m deep. The shallow wells abstracted water from Upper Quaternary water-bearing strata (shallow aquifer) and the main water-bearing complex (main aquifer) at a depth of 25-66 m. The deeper well abstracted water from the subartesian/artesian aquifer developed in the Pliocene water-bearing strata at a depth of 128.5-140.4 m (the "deep" aquifer). Later, in 1970, several 144 m-deep wells were bored to abstract water from Pliocene water-bearing strata, primarily because of the quality of this water which did not require the removal of iron and could be delivered directly into the water supply system. Today, 15 wells are operational at this water source. The total average rate of groundwater abstraction is about 135 l/s.

Prior to the development of this water source, water supply was provided by the abstraction of groundwater from Pliocene water-bearing strata. So-called deep wells were bored at several locations within the town. Today, several of the deep wells are occasionally placed on-line and, following chlorination, their water is delivered directly to the system. These wells were developed during the period from 1977 to 1985.

The initial (1961 to 1965) average rate of groundwater abstraction from the Jaroš Water Source is estimated at Q=13-16 l/s (3-6 l/s from Pliocene water-bearing strata and 10 l/s from the subartesian and main aquifers). During subsequent years, the average daily rate of groundwater abstraction

from the Jaroš Water Source continued to grow and today it amounts to Q=11744 m^3/day or 135 l/s (according to the 2005 Bluewaters Survey). The installed capacity of the water source is Q=200 l/s.

Assessment of water source yield and groundwater resources

The current groundwater abstraction capacity of the Jaroš Water Source meets municipal demand and a portion of industrial demand, of those connected to the public water supply system. However, over the last 40 years of operation, the main aquifer's water table has declined by about 9 m. The initial (1961) water tables of the shallow aquifer and the main aquifer were about 1 m below the ground surface, and that of the subartesian/artesian aquifer was 1.7-3 m below the ground surface.

The groundwater quality of the shallow and main aquifers does not meet drinking water standards; iron, manganese, ammonia and organic levels are higher than allowed (Table 1). The quality of the groundwater abstracted from Pliocene water-bearing strata, however, is satisfactory. Treatment at the existing water treatment plant (aeration, sedimentation, filtration and chlorination) produces water which meets most drinking water standards, except those pertaining to organic content (>8 mg/l); such water may not be chlorinated according to the *Drinking Water Code* (Official Gazette of Yugoslavia, Issue 42/98).

Wells / parameters	A1 Jaroš[1]	Bunar Jaroš[2]	A4/78	Bunar Jaroš	NB1/76	Bunar Jaroš	MCL
Sampling date	4.11.1982.		22.4.82		4.11.1982.		
Depth		64		61.6		141	
Y	6 589 530,00		6 589 450,00		6 589 550,00		
X	5 071 570,00		5 071 900,00		5 071 500,00		
Colour (Co-Pt)							5
Turbidity NTU							1

[1] Register of water structures and water supplies within the territory of Vojvodina (1982);

[2] Conceptual design of water supply for Vojvodina, Phase 1 (1996)

Wells / parameters	A1 Jaroš[1]	Bunar Jaroš[2]	A4/78	Bunar Jaroš	NB1/76	Bunar Jaroš	MCL
pH	7.7		8.05		8.1		6.8-8.5
Dry residue (mg/l)	429	615	570	598	514	655	
Nitrites (mg/l NO_2)							0.03
Nitrates (mg/l NO_3)	2.3						50
AmmoniumNH_3 (mg/l)		0.780		1.326		0.390	0.1
Chlorides (mg/l Cl)	32	30.6	32	32.6		34.6	200
Total iron (mg/l Fe)		3.5		1.0			0.3
KMnO4 (mg/l)	12.24	19.60	9.36	11.70	8.62	12.50	8
El.conductivity (µS/cm - 20°C)							1000
Manganese (mg/l Mn)							0.05
Total hardness (°dH)	19.88	15.6	5.04	15.1	5.6	3.9	
Analysis done by	Med.cen. Sombor		Med.cen.Sombor		Med.cen. Sombor		

Table 2-1: Jaroš Wells: Groundwater Quality Test Results

2.4.1.2 Aleksa Šantić

Water supply for the 2172 residents of Aleksa Šantić is provided from a single water source in the northern part of the village. The ground elevation of the water source is about 120 m above sea level. It was developed in 1967 and was comprised of a single bored well. No structural information about this well is available; what is known, however, is that groundwater is abstracted from the main aquifer at a depth of about 80-95 m. Two new bored wells were commissioned in 1987; one was developed in 1984 and was 95 m deep, and the other was developed in 1986 and was 94 m deep. These two wells tap the main aquifer at the above-mentioned depth. Two additional wells were constructed, one in 1995 (101 m deep) and the other in 2001 (98 m deep). These two wells are still operational today. The average daily rate of groundwater abstraction is estimated at Q=550 m^3/day (about 6 l/s), and the maximum rate of abstraction is believed to be 1250 m^3/day (15 l/s). The well drawdowns are 15m and 18 m, respectively.

Assessment of water source yield and groundwater resources

The available groundwater yield of the local water source does not meet municipal demand during peak consumption hours. A lack of reservoirs, which would otherwise even out the differences in consumption, is compensated by a higher rate of abstraction by the wells. To some extent this method can meet water demand, but it reduces the operating life of the wells. An immediate safeguard zone around the abstraction facilities exists, but household septic tanks can be found within a distance of only 100 m from this source.

The groundwater which is abstracted from the main aquifer at the Aleksa Šantić water source does not meet drinking water standards; iron, manganese, ammonia, organic matter and arsenic levels exceed allowed levels (Table 2). The water undergoes no treatment prior to its delivery into the distribution system.

Well	B-2[1]	Bunar izvorište[2]	B-1 (mesna zajednica)[3]	MDK
Sampling date	26.10.1982.			
Depth		100		
Y	6 603 600,00			
X	5 088 050,00			
Colour (Co-Pt)				5
Turbidity NTU			3.46	1
pH	7.4	7.7		6.8-8.5
Dry residue (mg/l)	312	370		
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)		0.234	1.55	0.1
Chlorides (mg/l Cl)	6	9.0	6.25	200
Total iron (mg/l Fe)	0.3	1.2	0.73	0.3
KMnO4 (mg/l)	6.2	22.4	5.9	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)			0.072	0.05
Total hardness (^{0}dH)	18.46	9.9	20.17	
Arsenic (mg/l As)			0.026	0.01
Sulphates (mg/l SO_4)		21.1	10.56	250
Potassium (mg/l K)			0.8	12

Well	B-2[1]	Bunar izvorište[2]	B-1 (mesna zajednica)[3]	MDK
Magnesium (mg/l Mg)		70.2	43.65	50
Calcium (mg/l Ca)		25.9		200
Analysis done by	Med.cen.Sombor			

Table 2-2: ***Aleksa Šantić Wells: Groundwater Quality Test Results***

2.4.1.3 Bački Breg

Water supply for the 1388 residents of Bački Breg is provided from a water source developed in 1971. The ground elevation of the water source is about 96 m above sea level. It is comprised of two wells: one built in 1979 (66 m deep) and the other in 1986 (53.5 m deep). Groundwater is abstracted from a subartesian aquifer and the main aquifer (Lower and Upper Quaternary water-bearing strata are interconnected), respectively, at a depth of 26-66 m. Three additional wells were developed by the year 1986. One of these wells (developed in 1979) abstracted groundwater from Pliocene water-bearing strata at a depth of 107-135 m. All three wells have been abandoned.

According to the 2005 Survey, the average daily rate of groundwater abstraction is Q=120 m^3/day (about 1.5 l/s). The drawdown is about 7 m. The initial depth to water is 6 m.

Assessment of water source yield and groundwater resources

The current groundwater source yield is adequate and can meet the modest demand of the population, except during peak consumption days.

The quality of the groundwater abstracted from the main aquifer at Bački Breg does not meet drinking water standards; iron, manganese and ammonia levels are higher than allowed (Table 3). The water is not treated prior to being delivered into the distribution system.

Well	Bunar [1]	Bunar B-3 izvorište[(2)]	Bunar [3]	MDK
Sampling date	05.05.1982.			
Depth		68		
Y				
X				

Well	Bunar [1]	Bunar B-3 izvorište[(2)]	Bunar [3]	MDK
Colour (Co-Pt)			slabo ž.	5
Turbidity NTU			3.32	1
pH	7.5	8.2	7.2	6.8-8.5
Dry residue (mg/l)	1136	566	668	
Nitrites (mg/l NO_2)			0.005	0.03
Nitrates (mg/l NO_3)			2	50
AmmoniumNH_3 (mg/l)		1.14	0.76	0.1
Chlorides (mg/l Cl)	126	34	52	200
Total iron (mg/l Fe)	0.3	2.1	2.21	0.3
KMnO4 (mg/l)	6.2	11.2	7.20	8
El.conductivity (µS/cm na 20°C)			1057	1000
Manganese (mg/l Mn)			0.1	0.05
Total hardness (°dH)	10.2	19.8		
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)		49		250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)		37.3		50
Calcium (mg/l Ca)				200
Analysis done by				

Table 2-3: ***Bački Breg Wells: Groundwater Quality Test Results***

2.4.1.4 Bački Monoštor

Water supply for the 4205 residents of Bački Monoštor is provided from a water source south of the village. The ground elevation of the water source is about 87 m above sea level. The water source was developed in 1978, when a single 164 m-deep well was bored. Groundwater was abstracted from Pliocene water-bearing strata, 126-128 m and 150-156 m deep. In 1980, another 72 m-deep well was developed to abstract groundwater from the main aquifer at a depth of 45-65 m. A third, 164 m-deep well was developed in 1995. The three wells are still in operation today,

and their total average daily rate of groundwater abstraction is estimated at about 341 m^3/day (4 l/s). The drawdown of the well which taps the main aquifer is about 8 m, and that of the deeper wells is about 25 m.

Assessment of water source yield and groundwater resources

The yield of this groundwater source is adequate and meets the modest demand of the population, except on peak consumption days.

The groundwater abstracted from the main aquifer at Bački Monoštor does not meet drinking water standards; organic matter and chloride levels are higher than allowed. (Table 4). The water undergoes no treatment prior to its delivery into the distribution system.

Well	??? (1)	??? (2)	??? (3)	MDK
Sampling date	04.04.1978.	04.04.1978.		
Depth				
Y				
X				
Colour (Co-Pt)			žuta	5
Turbidity NTU			0.60	1
pH	7.4	8.15	8.3	6.8-8.5
Dry residue (mg/l)	885	748	950	
Nitrites (mg/l NO_2)			0	0.03
Nitrates (mg/l NO_3)	39.83		0	50
AmmoniumNH_3 (mg/l)			0.15	0.1
Chlorides (mg/l Cl)	94	108	272	200
Total iron (mg/l Fe)	0.17		trag	0.3
KMnO4 (mg/l)	9.23	12.4	26.50	8
El.conductivity (µS/cm na 20°C)			1627	1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	34.72	2.24		
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)				250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)				50
Calcium (mg/l Ca)				200
Analysis done by				

Table 2-4: ***Bački Monoštor Wells: Groundwater Quality Test Results***

2.4.1.5 Bezdan

The population of Bezdan is 5263. Until the year 1984 water supply was provided by self-supply works. After the town's water source, which includes two 62 m-deep wells and a groundwater treatment facility (Culligan System, capacity 30l/sec, removes: iron, ammonia, and manganese, also reduces organic content), was developed, the self-supply schemes were abandoned. The ground elevation of this water source is about 88 m above sea level. Groundwater is abstracted from the main aquifer at a depth of 31-56 m.

According to the 2005 Survey, the average daily rate of groundwater abstraction is Q=500 m^3/day (about 6 l/s). The capacity of the water source (wells) is much higher. The water table is at about 3 m from the ground surface.

Assessment of water source yield and groundwater resources

The rate of groundwater abstraction from the Bezdan Water Source is much lower than the available rate, and any future increase in demand can be met using existing wells. Since the system includes a water reservoir (water tower), no excessive abstraction is necessary. An abstraction problem which has been noted is well clogging.

No information is available about the quality of the main aquifer which is tapped by the Bezdan Water Source. Judging from the chemistry of wells of similar depth in the Bezdan area and the Culligan facility treatment process, it is likely that iron, manganese, ammonia and organic levels are higher than allowed.

2.4.1.6 Gakovo

Water supply for the 2201 residents of Gakovo is provided from the village's centrally-located water source. The ground elevation of the water source is about 90 m above sea level. It was developed in 1970, when a single 143 m-deep well was bored. A 147.8 m-deep well was built in 1980 and a 142 m-deep well in 1995. All of these wells abstracted groundwater from Pliocene water-bearing strata, at the following depths: 131.40-143.0, 130.8-138.8 and 128.7-138.8 m. According to the 2005 Survey, only the 1970 well is currently operational; the average daily rate of groundwater abstraction is about Q=350 m^3/day (4 l/s), and the maximum rate of abstraction is about 500 m^3/day. Initially, the water table was 2.30 m from the ground surface. Today, the drawdown amounts to about 18 m.

Assessment of water source yield and groundwater resources

The Gakovo Water Source relies solely on a deep Pliocene aquifer. Future increases in water demand will can likely be met by the development of at least one more well, which would ensure system reliability. Past groundwater abstraction has resulted in a permanent drawdown; it would be opportune to investigate the feasibility of groundwater abstraction from the upper strata of the main water-bearing complex (if the groundwater quality is adequate).

According to available groundwater quality data for this water source, the quality generally meets Code requirements, with the exception of somewhat elevated levels of organic substances and ammonia. However, in view of the modest database, it is not possible to conclude whether any other quality parameters are non-compliant.

Well	**B-1(1)**	**Bunar izvorište(2)**	MDK
Sampling date	12.04.1982.		
Depth	131	131	
Y	6 582 800,00		
X	5 084 750,00		
Colour (Co-Pt)			5
Turbidity NTU			1
pH	8.1	7.2	6.8-8.5
Dry residue (mg/l)		580	
Nitrites (mg/l NO_2)			0.03
Nitrates (mg/l NO_3)			50
AmmoniumNH_3 (mg/l)		0.160	0.1
Chlorides (mg/l Cl)		30.00	200
Total iron (mg/l Fe)		0.2	0.3
KMnO4 (mg/l)	8.81	9.10	8
El.conductivity (µS/cm na 20°C)			1000
Manganese (mg/l Mn)			0.05
Total hardness (^{0}dH)	3.36	4	

Well	B-1(1)	Bunar izvorište(2)	MDK
Arsenic (mg/l As)			0.01
Sulphates (mg/l SO_4)		20	250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by			

Table 2-5: ***Gakovo Well: Groundwater Quality Test Results***

2.4.1.7 Doroslovo

The 1830 residents of Doroslovo have no access to a centralized water supply. Water supply is provided via seven water supply associations which were established around the year 1965. The ground elevation of these self-supply works is about 88 m above sea level. The local community center is in charge of maintenance and quality monitoring. All of the seven operating wells abstract groundwater from Pliocene water-bearing strata at depths of up to 110-130 m, the subartesian level being at a depth of 8 m. The total yield of the seven self-supply works is about 2 l/s.

Assessment of water source yield and groundwater resources

The wells of the seven self-supply works abstract water from the deep Pliocene aquifer at a low rate. Since it is not judicious to provide water supply for fewer than 2000 individuals from seven separate locations, a centralized water supply system comprised of a single water source and a distribution system is the best answer.

According to available data on the quality of the groundwater abstracted via these wells, organic content, ammonia levels and conductivity are high, and the color of the water is markedly yellowish. In addition, the groundwater abstracted from the deep aquifer also contains a high percentage of gasses (methane), and needs to be purified (de-gassed) prior to its delivery into the distribution system in order to avoid gas separation in the piping and consequent explosions which can occur.

Well	B-4(1)	Bunar(3)	MDK
Sampling date	25.06.1982.		
Depth			
Y	6 592 970,00		
X	5 052 150,00		
Colour (Co-Pt)		jako ž.	5
Turbidity NTU		0.71	1
pH	8.5	8.2	6.8-8.5
Dry residue (mg/l)	1536	1363	
Nitrites (mg/l NO_2)	0.18	0	0.03
Nitrates (mg/l NO_3)	3.22	2	50
AmmoniumNH_3 (mg/l)		0.82	0.1
Chlorides (mg/l Cl)	286	160	200
Total iron (mg/l Fe)	2.37	trag	0.3
KMnO4 (mg/l)	14.28	49.30	8
El.conductivity (µS/cm na 20°C)		2047	1000
Manganese (mg/l Mn)			0.05
Total hardness (°dH)	12.6		
Arsenic (mg/l As)	Med.cen.Sombor		0.01
Sulphates (mg/l SO_4)			250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by	Med.cen.Sombor		

Table 2-6: *Doroslovo Wells: Groundwater Quality Test Results*

Note: Gases present!

2.4.1.8 Kljajićevo

All of the 6012 residents of Kljajićevo obtain their water supply from a single water source in the southwestern part of the town, which was developed in 1970. The ground elevation of the water source is about 90 m above sea level. Five wells were built, but only two are currently operational. All of the wells were bored to a depth of 100-110 m and they tap the main water-bearing complex in the interval from 85 to 105 m. The diameter of the well casings is generally 323 mm. The total average daily rate of abstraction is estimated at Q=8 l/s. The extent of the drawdown is unknown. The initial depth to water is 3 m.

Assessment of water source yield and groundwater resources

Analysts had no access to data on the rates of groundwater abstraction and drawdown. Rates of abstraction were estimated based on the number of inhabitants and the average specific consumption. Future water demand can be met by building at least one additional well in the same location or, better yet, in a location outside of town.

Based on available data, the quality of the water provided by this water source does not meet drinking water standards; organic content and iron levels are elevated.

Well	B-1	Bunar izvorište		MDK
Sampling date	16.07.1982.			
Depth	87	87		
Y	6 599 350,00			
X	5 069 850,00			
Colour (Co-Pt)			bez	5
Turbidity NTU			1.33	1
pH	7.45	7.5	7.6	6.8-8.5
Dry residue (mg/l)	475	461	404	
Nitrites (mg/l NO_2)			0.004	0.03
Nitrates (mg/l NO_3)			2	50
AmmoniumNH_3 (mg/l)			trag	0.1
Chlorides (mg/l Cl)	12	8.0	8	200
Total iron (mg/l Fe)	0.23	0.3	0.53	0.3
KMnO4 (mg/l)	5.89	18.10	6.80	8
El.conductivity			761	1000

Well	B-1	Bunar izvorište		MDK
(µS/cm na 20°C)				
Manganese (mg/l Mn)				0.05
Total hardness (°dH)	13.5	11.8		
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)		39.4		250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)				50
Calcium (mg/l Ca)				200
Analysis done by	Med.cen.Sombor			

Table 2-7: ***Kljajićevo Wells: Groundwater Quality Test Results***

2.4.1.9 Kolut

Water supply for the 1710 residents of Kolut is provided from the village's centrally- located water source developed in 1972. The ground elevation of the water source is about 88 m above sea level. By the year 1986, four additional wells were bored at this location. Only two of these are currently operational (those built in 1979 and 1986). The depth of the wells is about 132 m. Groundwater is abstracted by the operating wells from Pliocene water-bearing strata at a depth of 118-128 m.

The average daily rate of groundwater abstraction is estimated at about Q=2.5 l/s. An increasing drawdown is evident. The initial depth to water is 18 m .

Assessment of water source yield and groundwater resources

The available water source data are not adequate for an assessment of the condition of the wells or any problems associated with them. Current capacity seems adequate to meet the demands of Kolut, but water shortages could be experienced during the summer months, mainly as a result of an inadequate configuration of the water supply system (no reservoir, aged distribution system, inadequate diameters, two booster pumps needed to maintain the network pressure).

The quality of the water is characterized by increased dry residue content and conductivity, including occasional, somewhat elevated concentrations of organic substances.

Well	B-1(1)	Bunar izvorište(2)	Bunar izvorište(2)	MDK
Sampling date	5.05.1982.			
Depth	114	138	136	
Y	6 572 250,00			
X	5 083 500,00			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8	8.3	7.2	6.8-8.5
Dry residue (mg/l)	1056	1291	1390	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)		0.470	0.080	0.1
Chlorides (mg/l Cl)	186	108.0	151	200
Total iron (mg/l Fe)	1.13	0.3	0.8	0.3
KMnO4 (mg/l)	6.2	6.0	4.5	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)		7.9	11.5	
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)		118	135	250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)			18	50
Calcium (mg/l Ca)			19	200
Analysis done by	Med.cen.Sombor			

Table 2-8: ***Kolut Wells: Groundwater Quality Test Results***

2.4.1.10 Rastina

The village of Rastina, with its 566 residents living in approximately 150 households (and having the same number of connections) has a centralized water supply system comprised of two bored wells (one developed in 1978). Both are located in the courtyard of the Local Community Center. The ground elevation of the water source is about 94 m above sea level. The depth of the wells is 144 m. Groundwater is abstracted from Pliocene water-bearing strata at a depth of 125.5-132.0 m. Prior to the development of the water source, there were 5-6 public wells and each house also had

its own well. The total average daily rate of groundwater abstraction is Q=1.5 l/s (about 3100 m^3 per month). Drawdown data are not available. The initial depth to water is 5 m.

Assessment of water source yield and groundwater resources

The existing wells meet the current water demand of Rastina. Assuming adequate periodic maintenance is undertaken, there is no need to expand the water source.

The quality of the water meets the requirements of the Drinking Water Code. One of the physical parameters noted, which is typical of Pliocene aquifers, is a slight yellowish color of the water. Organic content is occasionally somewhat higher than the maximum level allowed for water subjected to chlorination.

Well	BP-1(1)	Bunar zvorište(2)	(3)	MDK
Sampling date	5.05.1982.			
Depth	125	144		
Y	6 580 450,00			
X	5 091 000,00			
Colour (Co-Pt)			slabo ž.	5
Turbidity NTU			0.68	1
pH	8.15	8.0	7.9	6.8-8.5
Dry residue (mg/l)	416	468	488	
Nitrites (mg/l NO_2)			0	0.03
Nitrates (mg/l NO_3)			1	50
AmmoniumNH_3 (mg/l)			0	0.1
Chlorides (mg/l Cl)	22	18.0	18	200
Total iron (mg/l Fe)		0.3	0.1	0.3
KMnO4 (mg/l)	10.36	10.30	8.50	8
El.conductivity (µS/cm na 20°C)			766	1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	3.36	5.6		
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)				250
Potassium (mg/l K)				12
Magnesium (mg/l				50

Mg)				
Calcium (mg/l Ca)				200
Analysis done by	Med.cen.Sombor			

Table 2-9: ***Rastina Wells: Groundwater Quality Test Results***

2.4.1.11 Riđica

The 2590 residents of Riđica obtain their water supply from a centrally-located water source. Prior to its development, water supply was provided from shallow dug and bored wells, whose sanitary conditions were poor. The ground elevation of the water source is about 98 m above sea level. It was developed in 1971, when a single 78 m-deep well was bored. Four additional 80 m-deep wells were built at this water source by the year 1987. All of the wells tap the main aquifer at a depth of 59-77 m. Three wells are currently operational (i.e. those built in 1987, 1989 and 1996).

The average daily rate of groundwater abstraction is about Q=5.5 l/s (464 m^3/day). According to the Survey, a permanent annual drawdown amounts to about 30 cm. The initial depth to water is currently 5 m.

Assessment of water source yield and groundwater resources

According to the Survey, the intention is to shut down the old wells and bore a new, vertical tube well. A reduced yield of the old wells could be the result of high iron content (see Table 10). Water shortages during the summer months could be caused by the lack of a reservoir, inadequate pipe diameters, and ageing of the distribution system.

With regard to the quality of the groundwater abstracted via this water source, ammonia, iron, organic matter and hardness levels are higher than allowed.

Well	B-1(1)	bunar izvorište(2)	bunar izvorište(2)	MDK
Sampling date	14.04.1982.			
Depth		85	77	
Y	6 686 500,00			
X	5 094 660,00			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	7.45	7.5	7.5	6.8-8.5

Well	B-1(1)	bunar izvorište(2)	bunar izvorište(2)	MDK
Dry residue (mg/l)		546	478	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)		0.550	0.312	0.1
Chlorides (mg/l Cl)	12	23.0	8.0	200
Total iron (mg/l Fe)	0.62	0.5	0.8	0.3
KMnO4 (mg/l)	15.9	14.5	11.8	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	17.64	18.6	15.0	
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)		36.2	27.9	250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)		38.6	31.2	50
Calcium (mg/l Ca)		69.1	55.9	200
Analysis done by	Med.cen.Sombor			

Table 2-10: ***Riđica Wells: Groundwater Quality Test Results***

2.4.1.12 Svetozar Miletić

The 3169 residents of Svetozar Miletić obtain their water supply from a centrally-located water source. The village lies on the outer reaches of the Telečka Loess Plateau, and the altitude differential is only about 15 m (highest elevation 105 m and lowest elevation 90 m above sea level). The water source was developed in 1969. Its ground elevation is about 91 m above sea level. Several wells were bored, but only two are operational today: the 1984 well and the 1999 well. The depth of both wells is 58 m. Groundwater is probably abstracted from the main aquifer. An attempt was made to bore a 400 m-well, but no source of interest was encountered. In essence, two indirectly connected water-bearing media can be identified. The interval of the first is from the ground surface to a depth of about 28 m, and of the second from 48 m to about 75 m.

According to available data, the total average daily rate of groundwater abstraction is about Q=605 m^3/day (7 l/s). The depth to water is about 5 m.

Assessment of water source yield and groundwater resources

The current well capacity meets the water demand of this village. In view of the age of one of the wells (more than 20 years), it is possible that its replacement will become a necessity in the near future. The quality of the water abstracted via Well B-2/1 does not meet Drinking Water Code requirements with regard to iron, manganese, ammonia (yellowish color) and turbidity. The other well is characterized by elevated iron and manganese, as well as turbidity.

An immediate safeguard zone around the well exists; the closest septic tanks are located about 200 m away.

Well	B-2(1)	B-2/1(3)	MCL
Sampling date	15.04.1982.		
Depth			
Y			
X			
Colour (Co-Pt)		žuta	5
Turbidity NTU		8.8	1
pH	7.6		6.8-8.5
Dry residue (mg/l)			
Nitrites (mg/l NO_2)		0.001	0.03
Nitrates (mg/l NO_3)			50
AmmoniumNH_3 (mg/l)		0.6	0.1
Chlorides (mg/l Cl)	44	56	200
Total iron (mg/l Fe)	0.87	1.5	0.3
KMnO4 (mg/l)	5.27		8
El.conductivity (µS/cm na 20°C)		1118	1000
Manganese (mg/l Mn)		0.43	0.05
Total hardness (^{0}dH)			
Arsenic (mg/l As)			0.01
Sulphates (mg/l SO_4)			250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by	Med.cen.Sombor		

Table 2-11: ***Svetozar Miletić Wells: Groundwater Quality Test Results***

2.4.1.13 Stanišić

In Stanišić, with its 4808 residents, water supply is provided in an organized manner from a centrally-located water source. The water source was developed in 1972, when a single 89 m-deep well was bored. The ground elevation of the water source is 99 m above sea level. Two additional wells, of the same depth as the first, were developed by the year 1987. The well structure is identical: casing diameter 323 mm and screen diameter 219 mm. The three wells tap the main aquifer at a depth of 71-83 m and are operated in turn. Prior to the development of this water source, water supply was obtained from public wells and shallow, dug or bored household wells.

The average daily rate of groundwater abstraction is Q=8 l/s (720 m^3/day). No drawdown data are available.

Assessment of water source yield and groundwater resources

The Stanišić Water Source relies solely on the main aquifer. Any future increases in water demand could be satisfied by the development of at least one more well, which would also provide additional system reliability.

According to the groundwater quality data which are available for this water source, the water is hard and iron/manganese/ammonia levels are elevated. Organic content meets Code requirements, so that the water can be chlorinated.

Well	B-2(1)	bunar izvorište(2)	bunar izvorište(3)	MDK
Sampling date				
Depth		90		
Y				
X				
Colour (Co-Pt)			bez	5
Turbidity NTU			1.10	1
pH	7.6	7.5	7.5	6.8-8.5
Dry residue (mg/l)	389	414	399	
Nitrites (mg/l NO_2)			0.002	0.03
Nitrates (mg/l NO_3)			1	50
AmmoniumNH_3 (mg/l)			0.52	0.1

Well	B-2(1)	bunar izvorište(2)	bunar izvorište(3)	MDK
Chlorides (mg/l Cl)	12	11.0	8	200
Total iron (mg/l Fe)	4.04	0.3	0.59	0.3
KMnO4 (mg/l)	8	17.20	8.00	8
El.conductivity (µS/cm na 20°C)			662	1000
Manganese (mg/l Mn)				0.05
Total hardness (°dH)	18.48	14.9		
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)		29.4		250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)				50
Calcium (mg/l Ca)				200
Analysis done by	Med.cen.Sombor			

Table 2-12: ***Stanišić Wells: Groundwater Quality Test Results***

2.4.1.14 Stapar

Water supply for the 3720 residents of Stapar is provided from a water source located in the northeastern part of the village. The ground elevation of the water source is about 88 m above sea level. The water source was developed in 1969 and was comprised of a single 130 m-deep bored well. Two additional wells were developed by the year 1984: 116 m deep in 1975 and 117 m deep in 1984. The three wells tap Pliocene water-bearing strata at a depth of 100-114 m.

These wells are still in service today and their total average daily rate of groundwater abstraction is about Q=4 l/s. The average depth to water is about 13 m.

Assessment of water source yield and groundwater resources

The capacity of the Stapar wells does not meet the levels of water demand observed during the summer months. According to the groundwater quality data available for this water source, ammonia content is elevated and organic content is high. The development of an additional well might resolve the yield problem, but would not improve the water quality.

Well	B-2	bunar izvorište	MCL
Sampling date	26.05.1982.		

Well	B-2	bunar izvorište	MCL
Depth		117	
Y	6 594 150,00		
X	5 058 550,00		
Colour (Co-Pt)			5
Turbidity NTU			1
pH	8.2	7.5	6.8-8.5
Dry residue (mg/l)	699	854	
Nitrites (mg/l NO_2)			0.03
Nitrates (mg/l NO_3)			50
AmmoniumNH_3 (mg/l)		0.780	0.1
Chlorides (mg/l Cl)	60	50.4	200
Total iron (mg/l Fe)		0.3	0.3
KMnO4 (mg/l)	19.88	30.00	8
El.conductivity (µS/cm na 20°C)			1000
Manganese (mg/l Mn)			0.05
Total hardness (^{0}dH)	5.6	5.6	
Arsenic (mg/l As)			0.01
Sulphates (mg/l SO_4)			250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by	Med.cen.Sombor		

Table 2-13: ***Stapar Wells: Groundwater Quality Test Results***

2.4.1.15 Elečka

Water supply for the 2084 residents of Telečka is provided from two locations containing one well each, in the southwestern part of the village. The ground elevations of these two locations are about 116 m above sea level. The depth of the bored wells is 86-103 m. Screens were incorporated near the very bottom of the wells, from 85 to 103 m.

The average daily rate of groundwater abstraction is estimated at Q=3 l/s. No drawdown data are available. The initial depth to water is 18 m.

Assessment of water source yield and groundwater resources

The current water demand of Telečka does not exceed the capacity of the wells. Most of the time the only non-compliant parameters are iron and turbidity; all other parameters meet the requirements of the Drinking Water Code.

Well	B-1(1)	(3)	MCL
Sampling date	16.07.1982.		
Depth	100		
Y	6 607 950,00		
X	5 073 300,00		
Colour (Co-Pt)		slabo ž.	5
Turbidity NTU		0.90	1
pH	7.5	7.2	6.8-8.5
Dry residue (mg/l)	429	490	
Nitrites (mg/l NO_2)		0.001	0.03
Nitrates (mg/l NO_3)		2	50
AmmoniumNH_3 (mg/l)		0	0.1
Chlorides (mg/l Cl)	8	22	200
Total iron (mg/l Fe)	0.87	1.78	0.3
KMnO4 (mg/l)	9.78	5.70	8
El.conductivity (µS/cm na 20°C)		744	1000
Manganese (mg/l Mn)			0.05
Total hardness (^{0}dH)	19.32		
Arsenic (mg/l As)			0.01
Sulphates (mg/l SO_4)			250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by	Med.cen.Sombor		

Table 2-14: ***Telečka Wells: Groundwater Quality Test Results***

2.4.1.16 Čonoplja

Water supply for the 4359 residents of Čonoplja is provided from a water source located on the eastern edge of the village. The water source was developed in 1972, when a single, 140 m-deep

well was bored. Two additional wells were built by the year 1979. The three wells lie on the Telečka Loess Plateau and tap the main aquifer at a depth of 117-140 m.

According to the 2005 Survey, only one well is operational today. Water is discharged via a 350 m^3 water tower. The average daily rate of groundwater abstraction is about Q=11 l/s (1000 m^3/day). Between 15 and 20% of the water is used for industrial purposes (paint shop and agriculture). No drawdown data are available. The initial depth to water is 14 m.

Assessment of water source yield and groundwater resources

The water storage capability within the water supply system allows the residents and businesses of Čonoplja to obtain their water supply from a single well. A standby well is required to ensure reliable operation in the event of failure of the production well. Since, according to the Survey, all water is provided by a single well, the operating lifespan of the well will be shorter than if two wells were operated in turn. The water quality of this well is characterized by elevated iron.

Well		vodovod izvorište	vodovod izvorište	MCL
Sampling date	30.06.1982.			
Depth		123	140	
Y				
X				
Colour (Co-Pt)				5
Turbidity NTU				1
pH	7.6	7.40	7.50	6.8-8.5
Dry residue (mg/l)	402	1132	491	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)		0.080	0.080	0.1
Chlorides (mg/l Cl)	14		11.0	200
Total iron (mg/l Fe)	0.46	1.00	0.50	0.3
KMnO4 (mg/l)	3.67	5.60	4.20	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	13.16	10.2	12.9	
Arsenic (mg/l As)				0.01

Well		vodovod izvorište	vodovod izvorište	MCL
Sulphates (mg/l SO_4)		3.5	23.7	250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)				50
Calcium (mg/l Ca)				200
Analysis done by				

Table 2-15: ***Čonoplja Well: Groundwater Quality Test Results***

Town/village	Population	Public water supply	Number of wells	Qav/day	WTP	Non-compliant drinking water parameters					
						Fe	Mn	NH3	KMnO4	As	Gases
Sombor	51471	Yes	22	135	Yes	x		x	x	x	
Aleksa Šantić	2172	Yes	2	6	No	x	x	x	x	x	
Bački Breg	1388	Yes	2	1.5	No	x	x	x			
Bački Monoštor	4205	Yes	3	4	No				x		
Bezdan	5263	Yes	2	6	No	NDA	NDA	NDA	NDA	NDA	NDA
Gakovo	2201	Yes	1	4	No			x	x		
Doroslovo	1830	Yes	7	2	No			x	x		x
Kljajićevo	6012	Yes	2	8	No	x			x		
Kolut	1710	Yes	2	2.5	No	x		x			
Rastina	566	Yes	2	1.5	No				x		
Riđica	2590	Yes	3	5.5	No	x		x	x		
Svetozar Miletić	3169	Yes	2	7	No	x	x	x			
Stanišić	4808	Yes	3	8	No	x		x	x		
Stapar	3720	Yes	3	4	No			x	x		
Telečka	2084	Yes	2	3	No	x			x		
Čonoplja	4359	Yes	1	11	No	x					
Total	97548		59	209							

Table 2-16: Summary of the water supply situation within Sombor

2.4.2 Municipality of Apatin

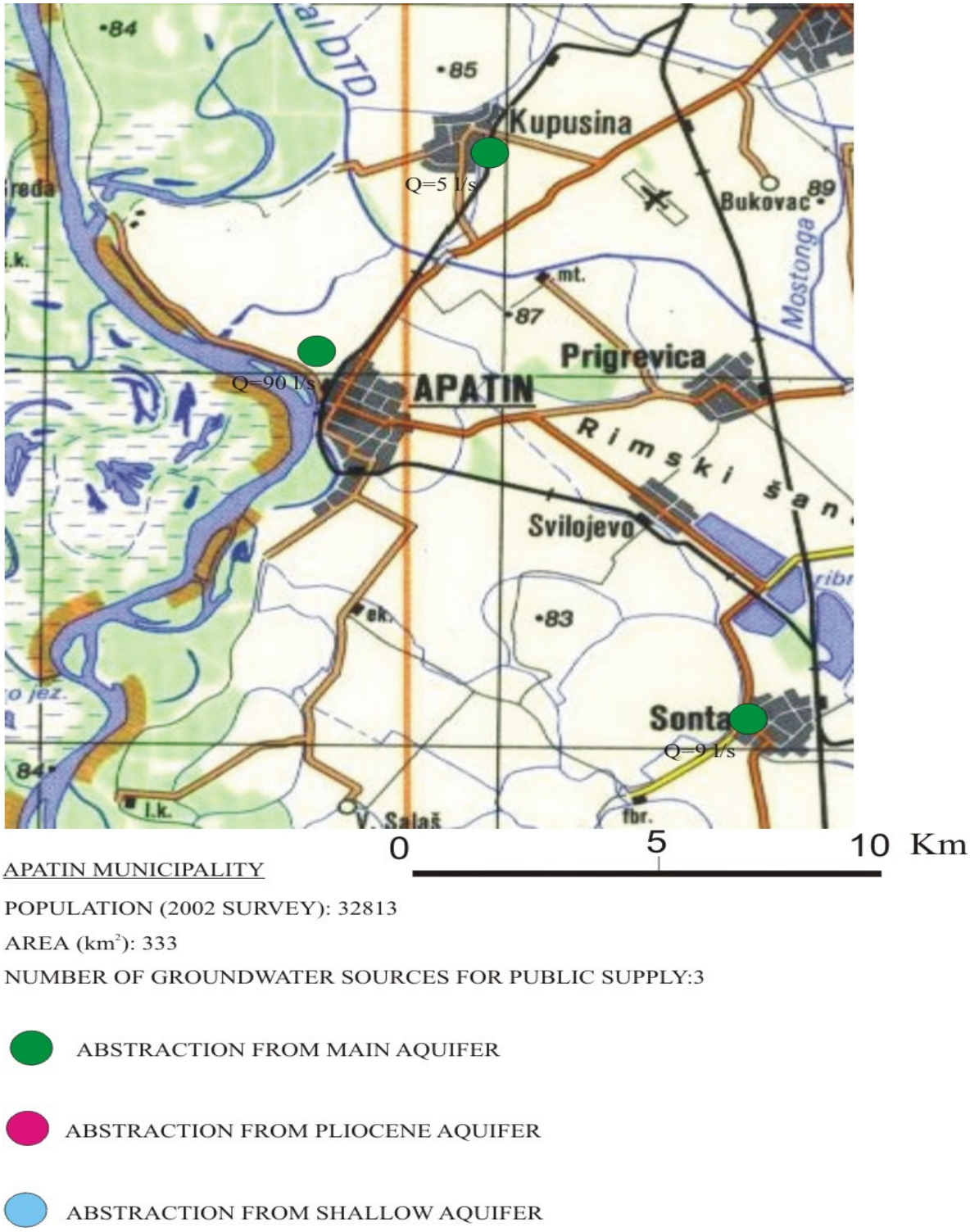


Figure 2.4: ***Overview of groundwater sources in Apatin municipality***

The population of one town and four villages in the municipal territory of Apatin is 32813. Water supply is provided from three groundwater sources whose total capacity is Q=104 l/s. Groundwater is abstracted from the main water-bearing complex near the Danube (Apatin's groundwater source) and a subartesian (shallow) aquifer. Groundwater is abstracted by bored wells whose depth is up to 60 m. Self-supply of a number of industrial plants is provided by groundwater abstraction from Pliocene water-bearing strata at a depth of 125-200 m. No data are available for the village of Svilojevo .

Organized water supply is obtained from 54 bored wells; out of these, 7 wells service public water supply.

2.4.2.1 Apatin

Water supply for the 19,289 residents of Apatin is obtained from a groundwater source in the area of the Danube which is protected from high flow, upstream of the Boris Kidrič Shipyards. The ground elevation of this water source is 83.5 m above sea level. It is comprised of three bored wells (one of them was developed in 1970 and another in 1973). They tap the main aquifer at a depth of about 30-58 m. No data are available on the third well.

The average daily rate of groundwater abstraction from this water source is Q=90 l/s. Since there is a direct hydraulic link between the part of the aquifer which is close to the Danube and the surface water of one of the Danube's arms, drawdown is minor and does not exceed 2-5 m.

Assessment of water source yield and groundwater resources

The Apatin Water Source utilizes only a small portion of the groundwater available in this area. Past groundwater abstraction has had no essential impact, in view of the proximity of available recharge (the Danube River at a distance of 100 m). A potential regional water source in this area will be discussed in the following sections.

The quality of the groundwater provided by the Apatin Water Source is typical of alluvial sources near the Danube; the iron/manganese content is elevated, but so is that of ammonia and organic substances. The existing Culligan-type facility cannot reduce the levels of organic substances. It requires the reconstruction and upgrading of the drinking water conditioning system.

Drilled wells	B-2 i B-3 (mixed sampleorak)	B-4	
Parameters	**value**	**value**	**MCL**
Datum i vreme prijema uzorka	05.03.2003	23.02.2004.	
Izgled	zamućena, žućkaste boje	-	
Ukus	metalan	-	
Temperatura vode ^{o}C	-	12.7	-
Boja ^{o}Co-Pt skale - prividna	-	5	
Boja ^{o}Co-Pt skale - stalna	-	<5	5
Miris	-	na H_2S	bez
Mutnoća NTU jedinice	40	23	1
pH vrednost	6.8	7.5	6.8-8.5
Utrošak $KMnO_4$ mg/l	11	10.1	8
Ostatak isparenja na 105 ^{o}C mg/l	437	521	
El. provodljivost µS/cm na 20^{o}C	494	730	1000
Kiseonik odmah mg/l O2	-	2.4	
Zasićenje kiseonika %	-	22	50
Vodonik sulfid mg/l H_2S	<0.01	0.08	bez
Ugljen dioksid mg/l CO_2	-	71.3	
Cijanid mg/l CN	<0.002	<0.010	0.05
Slob. Hlor RCl mg/l Cl	-	<0.05	0.5
p-alkalitet ml/l 0.1 M HCl	-	0	
m-alkalitet ml/l 0.1 M HCl	-	82.3	
Ukupna tvrdoća ^{0}dH	20.1	16	
Karbonatna tvrdoća ^{o}dH	-	10	
Nekarbonatna tvrdoća ^{o}dH	-	6	
Karbonati mg/l CO_3^{2-}	-	0	
Bikarbonati mg/l HCO_3^{-}	434	502	
Amonijak NH_3 mg/l	2.2	2.34	0.1

Drilled wells	B-2 i B-3 (mixed sampleorak)	B-4	
Parameters	**value**	**value**	**MCL**
Nitriti mg/l NO_2	<0.004	<0.006	0.03
Nitrati mg/l NO_3	<0.5	<2	50
Hloridi mg/l Cl	23	26	200
Sulfati mg/l SO_4	10	18.9	250
Orto fosfati mg/l P	<0.02	<0.02	0.15
Fluoridi mg/l F	0.08	0.34	1.2
Deterdženti (anjonski) mg/l	<0.01	<0.02	0.1
Fenoli mg/l	<0.002	<0.001	0.001
UV ekstincija na 254 nm 1/m	-	9.2	
TOC ukupni organski ugljenik mg/l	-	3.95	
Ukupna ulja i masti mg/l	-	<0.005	0.1
Mineralna ulja mg/l	<0.01	<0.005	0.01
Suspendovane materije mg/l	bez	-	
METALI			
Aluminijum mg/l Al	<0.01	0.017	0.2
Arsen mg/l As	0.012	0.006	0.01
Bakar mg/l Cu	<0.002	0.008	2
Cink mg/l Zn	0.019	<0.010	3
Gvožđe ukupno mg/l Fe	1.6	2.7	0.3
Hrom ukupni mg/l Cr	-	<0.010	0.05
Hrom mg/l Cr^{6+}	<0.001	<0.010	
Kadmijum mg/l Cd	<0.001	<0.002	0.003
Kalcijum mg/l Ca	156	114	200
Kalijum mg/l K	3	2	12
Magnezijum mg/l Mg	15	33	50
Mangan mg/l Mn	0.304	0.09	0.05

Drilled wells	B-2 i B-3 (mixed sampleorak)	B-4	
Parameters	**value**	**value**	**MCL**
Natrijum mg/l Na	22	24.9	150
Nikl mg/l Ni	<0.002	<0.010	0.02
Olovo mg/l Pb	<0.001	<0.010	0.01
Živa mg/l Hg	-	<0.0005	0.001
PESTICIDI g/l			
Ukupno pesticidi	-	<0.01	0.5
Alahlor	-	<0.01	0.1
Aldrin/Dieldrin	-	<0.01	0.03
Atrazin	<0.0005	<0.01	0.1
Bušeni bunar	**B-2 i B-3 (zbirni uzorak)**	**B-4**	
Parametar	**Nađena vrednost**	**Nađena vrednost**	**MDK vode za piće**
Bentazon	-	<0.01	0.1
DDT	-	<0.01	0.1
2,4-D	-	<0.01	0.1
Heksahlor benzol	-	<0.01	0.01
Heptahlor/Heptahlorepoksid	-	<0.01	0.03
Hlorotoluron	-	<0.01	0.1
Izoproturon	-	<0.01	0.1
Karbofuran	-	<0.01	0.1
Lindan	-	<0.01	0.2
MCPA	-	<0.01	0.1
Metolahlor	-	<0.01	0.1
Molinat	-	<0.01	0.1
Pendimentalin	-	<0.01	0.1
Pentahlorfenol	-	<0.01	0.1
Permetrin	-	<0.01	0.1

Drilled wells	B-2 i B-3 (mixed sampleorak)	B-4	
Parameters	**value**	**value**	**MCL**
Piridat	-	<0.01	0.1
Simazin	<0.0005	<0.01	0.1
Trifluralin	-	<0.01	0.1
Hlorofenok.herb drugačiji od2,3-D i MCPA 2,4-D	-	<0.01	0.1
Dihlorprop	-	<0.01	0.1
POLICIKLIČNI AROMATIČNI UGLJOVODONICI (g/l)			
PAU ukupno	-	<0.01	0.2
Fluoranten	-	<0.01	
Benzo 3,4-fluoranten	-	<0.01	
Benzo 11,12-fluoranten	-	<0.01	
Benzo 1,12-perilen	-	<0.01	
Indeno (1,2,3 cd) piren	-	<0.01	
Benzo (a) piren	-	<0.01	0.01
POLIFLOROVANI BIFENILI (g/l)			
PCB ukupni (mg/l)	-	<0.01	0.5
2-hlorobifenil	-	<0.01	
2,3-dihlorobifenil	-	<0.01	
2,4,5-trihlorobifenil	-	<0.01	
2,2,4,4-tetrahlorobifenil	-	<0.01	
2,2,3,4,6-pentahlorobifenil	-	<0.01	
2,2,4,4,5,6-heksahlorobifenil	-	<0.01	
2,2,3,3,4,4,6-heptahlorobifenil	-	<0.01	
2,2,3,3,5,5,6,6-oktahlorobifenil	-	<0.01	
SPOREDNI PROIZVODI DEZINFEKCIJE (g/l)			
Dibromacetonitril	-	<0.01	100
Dihloracetonitril	-	<0.01	90

Drilled wells	B-2 i B-3 (mixed sampleorak)	B-4	
Parameters	**value**	**value**	**MCL**
Trihloracetonitril	-	<0.01	1
Bromohloroacetonitril	-	<0.01	
		Nulto stanje Potencijal	
Hlorpikrin	-	<0.01 0.22	
1,1-dihlor-2-propanon	-	<0.01 1.06	
1,1,1-trihlor-2-propanon	-	<0.01 0.05	
TRIHALOMETANI (g/l)			
Ukupni THM	-	<0.05 146.93	100
Bromoform	-	<0.01 0.36	
Dihlorbrommetan	-	<0.01 17.17	15-25
Dibromhlormetan	-	<0.01 2.70	
Hloroform	-	2.6 126.70	30-40
HLOROVANI ALKANI (g/l)			
1,1 dihloretan	-	<0.01 <0.01	
1,2 dihloretan	-	<0.01 <0.01	3
Dihlormetan	-	<1.00 <1.00	20
1,1,1 trihloretan	-	<0.01 <0.01	2000
Ugljentetrahlorid	-	<0.05 1.27	5
1,2-dibrometan	-	<0.01 <0.01	
1,2-dibrom-3-hlorpropan	-	<0.01 <0.01	
1.1.2.2.-tetrahloretan	-	<0.01 <0.01	
Bušeni bunar	**B-2 i B-3 (zbirni uzorak)**	**B-4**	**MDK vode za piće**
Parametar	**Nađena vrednost**	**Nađena vrednost**	
HLOROVANI ETENI (g/l)		Nulto stanje Potencijal	
1,1 dihloreten	-	<0.01 <0.01	
1,2 dihloreten	-	<0.01 <0.01	

Drilled wells	B-2 i B-3 (mixed sampleorak)	B-4	
Parameters	**value**	**value**	**MCL**
Trihloreten	<0.0001	0.02 0.04	40
Tetrahloreten	<0.0001	0.03 0.05	70
Vinil hlorid	-	<0.01 <0.01	
HLOROVANI BENZOLI (g/l)			
1,2-Dihlorbenzol	-	<0.01 <0.01	1000
1,3-Dihlorbenzol	-	<0.01 <0.01	
1,4-Dihlorbenzol	-	<0.01 <0.01	300
AROMATIČNI UGLJOVODONICI (g/l)			
Benzol	<0.001	<0.10	1
Etibenzol	-	<0.10	2
Ksilol	-	<0.10	50
Stirol	-	<0.10	200
Toluol	<0.005	<0.10	700
Analizu vršio	VMA Beograd	ZZZ Beograd	

Table 2-17: ***Apatin Wells: Groundwater Quality Test Results***

2.4.2.2 Kupusina

Organized water supply for the 2390 residents of this village is provided from a single water source located near its eastern edge. The ground elevation of the water source is about 86 m above sea level. The water source was developed in 1970, when three wells were bored (the boring depth of two of these wells was 67.5 m). Two wells are in service today: one developed in 1995 (60 m deep) and the other in 2001 (about 50 m deep). The drawdown is about 4.5 m.

The average daily rate of groundwater abstraction is about 450 m3/day (Q=5 l/s). A closed Culligan-type water treatment system, whose capacity is 700 m3/day, is currently being reconstructed.

Assessment of water source yield and groundwater resources

Kupusina's water source currently meets the population's demand. Since no significant increase in consumption is expected, this source should continue to provide adequate volumes of water in the future. A major problem is that no safeguard zone exists; groundwater is abstracted from the main aquifer which, in this part of Bačka, is essentially in direct contact with the shallow aquifer. Since there is no sewage system in the village, wastewater is evacuated into septic tanks which are, more often than not, non-compliant (i.e. they are not impervious). As the water source is located virtually inside the village, the distance between it and the septic tanks is relatively short.

The quality of the groundwater provided by this water source is characterized by turbidity and elevated ammonia, iron, manganese and organic content.

Well	B-2		MDK
Sampling date	12.05.1982.		
Depth			
Y			
X			
Colour (Co-Pt)		jako zuta	5
Turbidity NTU		4.12	1
pH	7.4	7.2	6.8-8.5
Dry residue (mg/l)	776	728	
Nitrites (mg/l NO_2)		0.001	0.03
Nitrates (mg/l NO_3)		1	50
AmmoniumNH_3 (mg/l)		0.99	0.1
Chlorides (mg/l Cl)	46	70	200
Total iron (mg/l Fe)	1.84	>4	0.3
KMnO4 (mg/l)	16.43	17.2	8
El.conductivity (µS/cm na 20°C)		1118	1000
Manganese (mg/l Mn)		0.15	0.05
Total hardness (^{0}dH)	33.04		
Arsenic (mg/l As)			0.01
Sulphates (mg/l SO_4)			250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by	Med.cen.Sombor		

Table 2-18: ***Kupusina Wells: Groundwater Quality Test Results***

2.4.2.3 Prigrevica

Prigrevica was connected to Apatin's water supply system in 2004.

2.4.2.4 Sonta

Water supply for the 4994 residents of Sonta is provided from a water source located along the northeastern edge of the town. The ground elevation of the source is 85 m above sea level. The water source was developed in 1981, when two wells (55.6 and 58.5 m deep) were bored. Groundwater is abstracted from the main aquifer at depths of 33-43 m and 48.6-52.6 m (first well) and 33-43 m and 48.7-52.7 m (second well).

The average daily rate of groundwater abstraction is about Q=9 l/s. The drawdown amounts to about 6 m. The initial depth to water is 3.5 m

Assessment of water source yield and groundwater resources

Water provided by Sonta's water source has generally met the residents' water demand and abstraction has had no negative impact. Future demand can be satisfied by expanding the water source and adding another well. The vicinity of septic tanks (150 m to the closest well) is a problem and poses a risk of contamination. The risk will increase with the addition of another well and the subsequent higher rate of abstraction.

The quality of the water does not meet several health standard parameters: turbidity, organic content, iron, manganese, ammonia and arsenic. Occasional nitrites and a higher conductivity are potential indicators of contamination from septic tanks.

Well		well B1	well B3	MCL
Sampling date	10.01.1981.			
Depth	48			
Y	6566750			
X	5051250			
Colour (Co-Pt)				5
Turbidity NTU		17	26	1
pH	7.3			6.8-8.5
Dry residue (mg/l)	620			

Well		well B1	well B3	MCL
Nitrites (mg/l NO_2)	0	0.072	0.161	0.03
Nitrates (mg/l NO_3)	trag			50
AmmoniumNH_3 (mg/l)		1.33	1.5	0.1
Chlorides (mg/l Cl)	82			200
Total iron (mg/l Fe)	1.66	2.9	1.1	0.3
KMnO4 (mg/l)	12	26		8
El.conductivity (µS/cm na 20°C)		1040	1120	1000
Manganese (mg/l Mn)		0.136	0.09	0.05
Total hardness (^{0}dH)	24.08	24.8	27.2	
Arsenic (mg/l As)		0.013	0.24	0.01
Sulphates (mg/l SO_4)				250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)			50.3	50
Calcium (mg/l Ca)				200
Analysis done by	Med.cen.Sombor			

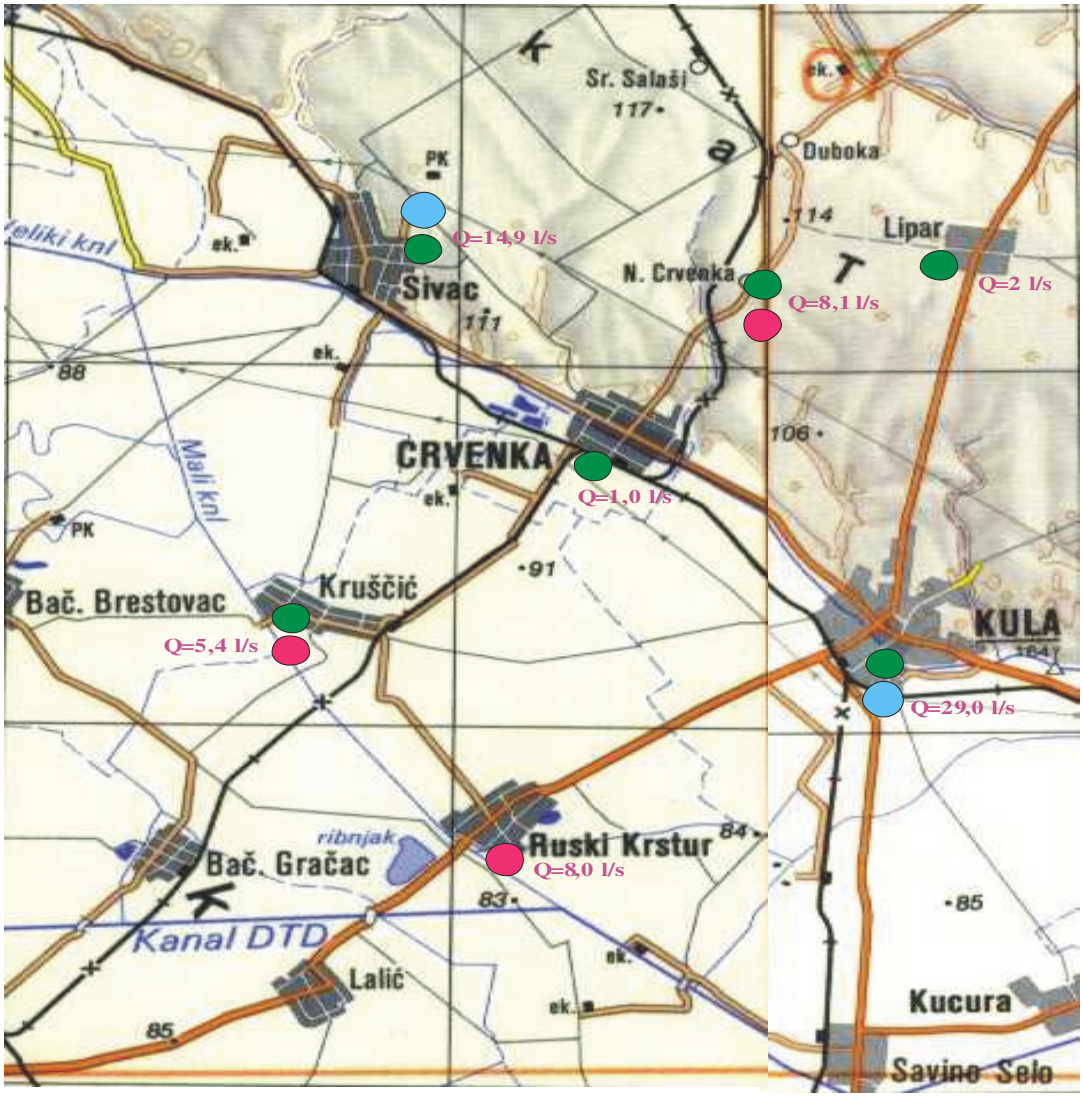
Table 2-19: ***Sonta Wells: Groundwater Quality Test Results***

Town/village	Population	Public water supply	Number of wells	Qav/day	WTP	Non-compliant drinking water parameters					
						Fe	Mn	NH3	KMnO4	As	Gases
Apatin	19289	Yes	3	90	Yes	x	x	x	x	x	
Kupusina	2390	Yes	2	5	Yes	x	x	x	x		
Prigrevica	4786	Conn. to Apatin									
Svilojevo	1354	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA
Sonta	4994	Yes	2	9	Yes	x	x	x	x	x	
	32813		7	104							

Table 2-20: ***Summary of the water supply situation within the municipal territory of Apatin***

NDA: No data available.

2.4.3 The Municipality of Kula



KULA MUNICIPALITY

POPULATION (2002 SURVEY): 48353

AREA (km²): 481,6

NUMBER OF GROUNDWATER SOURCES FOR PUBLIC SUPPLY: 7

ABSTRACTION FROM MAIN AQUIFER

ABSTRACTION FROM PLIOCEN AQUIFER

ABSTRACTION FROM SHALLOW AQUIFER

Figure 2.5: ***Overview of groundwater sources in Kula municipality***

The municipal territory of Kula is host to two towns and five villages. The total population is 48,353. Drinking water supply is being provided by groundwater abstraction from:

- The shallow, subartesian aquifer (Upper Quaternary sediments) at a depth from 42 to 75 m, within the Upper Terrace, and a depth from 65 to 84 m in the area of the Telečka Loess Plateau;
- The main aquifer (Lower Quaternary sediments) at a depth of 92-151 m; and
- Pliocene water-bearing strata at depths greater than 150 m.

The total daily average rate of groundwater abstraction in this municipal territory is currently estimated at Q=72 l/s. Groundwater is being abstracted solely by bored water wells. Public water supply is serviced by about 31 operating water wells.

2.4.3.1 Kula

Water supply for the 19,301 inhabitants and a portion of the industry of Kula is being provided from two water sources:

- The Krsturski Put Water Source within the Upper Terrace near the western edge of the town (ground elevation 83-85 m above sea level), and
- The Štolc Water Source within the outer reaches of the Telečka Loess Plateau (ground elevation 95-105 m above sea level), northeast of the town.

The distance between the two water sources is about 2 km.

The Krsturski Put Water Source is located west of the town. The ground elevation is about 85 m above sea level. The water source was developed in 1970, when three water wells (depths from 67.9 do 73.5 m) were bored to abstract groundwater from the shallow aquifer at a depth from 42 to 73 m. Three „deep“ water wells were built between 1972 and 1977 (bore depths from 108.2 to 117.0) and these abstracted water from the main water-bearing complex at a depth from 88.6 to 111 m. A total of 12 water wells were bored on this location by the year 1995. However, in 1995 only six of these wells were still operational: 3 shallow wells and 3 deep wells. The initial water table of the shallow aquifer was at 1.8 m from the ground surface. Dynamic groundwater levels were registered at depths from 33 to 36 m from the ground surface, for the wells which tapped deeper aquifer.

The Štolc Water Source is located northeast of the town. The ground elevation of the water source is 105 m above sea level. The water source was developed during the period from 1981 to 1983, when six water wells were built (depths from 134 to 152 m). Groundwater was abstracted from the main aquifer at a depth of 100-143 m. Two additional water wells were developed in 1985 (depths 144.5 m and 142 m). Water was abstracted from the same aquifer, at depths between 123 and 136 m. According to 1995 data, six water wells were operational and the drawdown was ~20 m.

These water sources currently deliver about 2500 m^3/day or 29 l/s of water to the town (according to the Bluewaters 2005 Survey). Water is being abstracted via two water wells whose respective depths are 115 and 150 m.

Assessment of waters source yield and groundwater resources

The current rate of abstraction is not adequate to meet the water demand of Kula's population. Since past abstraction has permanently lowered the water table by more than 20 m, and is likely to continue to do so, no expansion is feasible. Water demand is estimated at 47.5 l/s, or ~40 % more than the current daily average rate of consumption.

Groundwater abstracted from the main aquifer does not meet drinking water standards; iron and ammonia levels are higher than allowed (Table 21). The groundwater abstracted via the Krsturski Put Water Source (shallow aquifer) is characterized by an elevated iron content and turbidity. The groundwater provided by the Štolc Water Source is similar to that obtained from the deep water wells of the Krsturski Put Water Source, and this is possibly an indication that groundwater is being abstracted from the same water-bearing medium.

Bunar	Izvorište Krsturski put	Izvorište Krsturski put	Izvorište Štolc	MDK
Samples data	16.03.1983.			
Depth				
Y	7 383 700.00			
X	5 051 800.00			
Colour (Co-Pt)		15		5
Turbidity NTU		1,96		1

Bunar	Izvoričte Krsturski put	Izvorište Krsturski put	Izvorište Štolc	MDK
pH	7,7			6.8-8.5
Dry residue (mg/l)	544			
Nitrites (mg/l NO_2)	0			0.03
Nitrates (mg/l NO_3)	0			50
Ammonium NH_3 (mg/l)	0,6	0,7	0,7	0.1
Chlorides (mg/l Cl)	7,7			200
Total iron (mg/l Fe)	0,51 - Fe^{3+}	0,56		0.3
KMnO4 (mg/l)	6,4			8
El. conductivity (µS/cm na 20°C)				1000
Manganes (mg/l Mn)				0.05
Total hardnes (^{0}dH)	13,3			
Sulphates	23,1			
Analysis done by	Med.cen.Sombor			

Table 2-21: Kula Water Sources: Groundwater Quality Test Results

2.4.3.2 Crvenka

Since 1973, water supply for the 10,163 residents of Crvenka has been provided from a water source in the northwestern part of the town. The ground elevation of the water source is about 87 m above sea level. There are six water wells which tap the Upper Pleistocene main water-bearing complex at a depth between 106 and 150 m. The water wells were bored to a depth of about 150 m.

According to the Bluewaters 2005 Survey, the daily average rate of groundwater abstraction is about Q=11.5 l/s, and groundwater levels are at 30 m from the ground surface. 1995 data indicate a gradual decline of the water table, since at that time the groundwater level was at ~22 m under similar production conditions.

Assessment of water source yield and groundwater resources

The current rate of abstraction does not meet the water demand of Crvenka's population. In view of the fact that past abstraction has permanently increased the drawdown, and will continue to do so, no expansion of water source capacity is feasible. Daily average water demand (estimated at 25 l/s) is double the current production rate.

Groundwater abstracted from the main aquifer generally fails to comply with drinking water standards; organic content ($KMnO_4$ demand can be as high 24 mg/l) and ammonia levels are elevated.

Bunar	Izvoričte Crvenke	Vodovod Crvenke	Izvorište Crvenke	MDK
Sampling date	8.03.1983.			
Depth	B-1 (160 m)	135	140	
Y	7378562			
X	5058971			
Colour (Co-Pt)				5
Turbidity NTU	5			1
pH	7,7	8,7	7,8	6.8-8.5
Dry residue (mg/l)	514	395	390	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)	0,4	0,080		0.1
Chlorides (mg/l Cl)	7,6	6,3	8,0	200
Total iron (mg/l Fe)	0,14 - Fe^{3+}		0,2	0.3
KMnO4 (mg/l)	4,5	4,40	24,10	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	8,8 (prolazana)	8,2	8,4	
Sulphates (mg/l SO_4)	7,7		49,6	250
Analysis done by	Med.cen.Subotica			

Table 2-22: Crvenka Water Wells: Groundwater Quality Test Results

2.4.3.3 Kruščić

Since 1969, organized water supply for the 2,353 residents of Kruščić has been provided from a water source developed in the northern part of the village. The ground elevation is about 85 m above sea level. The water source is comprised of three water wells. The first is 182 m deep and was developed in 1969. It taps Pliocene water-bearing strata at a depth of 170-182 m. A 139m-deep water well was developed in 1975, and it taps the main aquifer at a depth of 92-128 m (the

screen is at 87.7-132.0 m). The third water well was developed in 1996 and it taps the main aquifer.

According to the Bluewaters 2005 Survey, the daily average rate of groundwater abstraction is about Q=5.4 l/s. The same source reports that the depth to water is between 5 and 6 m.

Assessment of water source yield and groundwater resources

Available water source yield meets the water demand of Kruščić's population. Daily average water demand is estimated at 4.7 l/s; according to available consumption data, this is less than the current production rate. If required in the future, this location can provide an additional 2 l/s of water from the main aquifer.

Since elevated iron, organic matter, ammonia and arsenic levels were registered, the groundwater provided by this water source does not meet drinking water standards.

Bunar	Izvorište Kruščić, B-2	Kruščić	Kruščić izvorište	Kruščić B-1	Kruščić B-2	MDK
Sampling date	22.04.1983.					
Depth	(filter 87,7-132,0 m)	182	139			
Y	7373259					
X	5053665					
Colour (Co-Pt)	slabo žućkasta				25	5
Turbidity NTU	15				4,2	1
pH	8,1		8,6	8,69	8,62	6.8-8.5
Dry residue (mg/l)	442	685	542			
Nitrites (mg/l NO_2)						0.03
Nitrates (mg/l NO_3)	0					50
AmmoniumNH_3 (mg/l)	0,2	2,03	0,080			0.1
Chlorides (mg/l Cl)	8,6		6,00			200
Total iron (mg/l Fe)	0,05 Fe2+		0,3		1,19	0.3
KMnO4 (mg/l)	11,1	74,40	18,70	9,1	8,8	8

Bunar	Izvorište Kruščić, B-2	Kruščić	Kruščić izvorište	Kruščić B-1	Kruščić B-2	MDK
El.conductivity (µS/cm na 20°C)						1000
Manganese (mg/l Mn)					0,13	0.05
Total hardness (°dH)	1,2	2,0	1,2			
Sulphates (mg/l SO_4)	11,5		19,90			250
Arsenic (mg/l As)				0,03		0,01
Analysis done by	Med.cen.Subotica					

Table 2-23: Kruščić Water Wells: Groundwater Quality Test Results

2.4.3.4 Lipar

Since 1968, water supply for the 1,807 residents of Lipar has been provided from a centrally-located water source. The ground elevation of the water source is about 112 m above sea level. The first 130 m-deep water well tapped the main aquifer at a depth of 115-128 m (the screen was located between 115.8 and 128.2 m). This water well is no longer operational. Two new water wells were developed, one in 1981 and the other in 1987. Their respective depths are 135 m and 142 m. They abstract groundwater from the main aquifer at the following depths: first well 88-97 m and 112-122 m, and second well 78.8-82.4 m and 110.6-129.2 m.

According to 1995 data, the daily average rate of groundwater abstraction was about Q=2 l/s. The initial water table was at a depth of 25 m, and the 1995 drawdown was about 6 m. It has a permanently declining tendency.

Assessment of water source yield and groundwater resources

Available water source yield does not meet the full demand of Lipar's population. Daily average water demand is estimated at 3.6 l/s. According to available consumption data, the demand is 1.6 l/s higher than the current production rate. The additional water demand can be met by a new water well developed in the same area as the existing water wells.

In view of the fact that elevated iron, ammonia and magnesium levels have been registered, the groundwater obtained from this water source does not meet drinking water standards.

Bunar	Izvorište Lipar B-1	Izvorište Lipar	Izvorište Lipart	Izvorište Lipar	MDK
Sampling date	2.03.1983.				
Depth	filter od 116 do 124 m	130	135	142	
Y	7 387 700.00				
X	5 063 300.00				
Colour (Co-Pt)					5
Turbidity NTU					1
pH	7,5		8,1	7,4	6.8-8.5
Dry residue (mg/l)	422	425	436	412	
Nitrites (mg/l NO_2)					0.03
Nitrates (mg/l NO_3)			2,5		50
AmmoniumNH_3 (mg/l)	0,7	0,390	0,080	0,160	0.1
Chlorides (mg/l Cl)	5,7	10,3	6,0	4,0	200
Total iron (mg/l Fe)	7,83	0,1	0,9	0,1	0.3
KMnO4 (mg/l)	7,4	4,4	7,5	6,3	8
El.conductivity (µS/cm na 20°C)					1000
Manganese (mg/l Mn)					0.05
Total hardness (^{0}dH)	14,5	15,1	15,2	15,9	
Sulphates (mg/l SO_4)	9,6		12,2	1,9	250
Calcium (mg/l Ca)			48,1	78,4	200
Magnesium (mg/l Mg)			65,9	61	50
Analysis done by	Med.cen.Subotic				

Table 2-24: Lipar Water Wells: Groundwater Quality Test Results

2.4.3.5 Nova Crvenka

Since 1976, water supply for the 524 residents of Nova Crvenka has been provided from a centrally-located water source. The ground elevation of the general area is about 113 m above sea level. The water source is comprised of three water wells. The first water well, developed in 1976, whose bore depth was 130 m, is no longer in service. The more recent water wells (130 m and 203 m deep, developed in 1980) were located in the courtyard of an elementary school and first aid station. Groundwater was abstracted from the main aquifer at a depth of 96-127 m (one

water well) and from Pliocene water bearing strata at a depth of 172-200 m (other water well). Both water wells were still in service in 1995.

The daily average rate of groundwater abstraction was about Q=1 l/s, the majority being obtained from the main aquifer.

Assessment of water source yield and groundwater resources

Available water source yield basically meets the water demand of Nova Crvenka. Daily average demand is estimated at 1.1 l/s; according to available consumption data, it is 0.1 l/s higher that the production rate. If required in the future, an additional 1 l/s of water may be abstracted from the main aquifer.

No data are available on the drawdown and groundwater quality for the various aquifers. Since elevated iron has been registered, the mixed water does not fully comply with drinking water standards.

Bunar	Izvorište N.Crvenka	Izvorište N.Crvenka	Izvorište N.Crvenka	MDK
Sampling date	6.01.1983.			
Depth	filter B-1(96-124); B-2(172-203m)	130	151	
Y	7382640			
X	5062320			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	7,5	8,2	7,9	6.8-8.5
Dry residue (mg/l)	412	418	536	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)	0,3	0,624		0.1
Chlorides (mg/l Cl)	4,7	9,0	7,7	200
Total iron (mg/l Fe)	0,73 Fe^{3+}	0,7	0,1	0.3
KMnO4 (mg/l)	6,4	4,70	8,00	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	16,6 (prolazna)	12,7	1,2	
Sulphates (mg/l SO_4)	10,2	30,1	7,7	250
Calcium (mg/l Ca)			2,10	200
Magnesium (mg/l Mg)			3,90	50

Bunar	Izvorište N.Crvenka	Izvorište N.Crvenka	Izvorište N.Crvenka	MDK
Analysis done by	Med.cen.Subotica			

Table 2-25: Nova Crvenka Water Wells: Groundwater Quality Test Results

2.4.3.6 Ruski Krstur

Since 1975, water supply for the 5,213 inhabitants of Ruski Krstur has been provided from a water source located near the western edge of the town. The ground elevation is about 83 m above sea level. Four water wells were developed during the period from 1975 to 1985, and they were still in service in 1995. The depth of the two water wells developed in 1975 was about 227 m. Groundwater was abstracted from Pliocene water-bearing strata at a depth of 192.84-204.7 m (one water well) and 216.6-225.0 m (other water well). The water well developed in 1978 extracted groundwater from the same strata at depths of 169.0-178.0 m and 189-198 m. A similar water well was also developed in 1990.

The daily average rate of groundwater abstraction of Q=8.0 l/s is provided by four water wells (Bluewaters 2005 Survey). The drawdown is about 19 m, and has a declining tendency. The initial depth to water was 3.5 m.

Assessment of water source yield and groundwater resources

Current water source yield does not meet the demand of Ruski Krstur's population. Daily average demand is estimated at 11.3 l/s; according to available consumption data, it is 3.3 l/s higher than the current production rate. Water demand cannot be met by developing new water wells in the same aquifer as the existing wells. Any additional abstraction would lead to a further decline of the tapped aquifer's water table. In addition, it would have a negative impact on groundwater quality, i.e. on organic content and iron/arsenic levels which are already higher than allowed (Table 26).

Bunar	Izvorište R.Krstur	Izvorište R.Krstur, B-1	Izvorište R.Krstur, B-3	Izvorište R.Krstur, B-4	Izvorište R.Krstur, B-5	MDK
Sampling date	8.03.1983.					
Depth	filteri od 169 do 225 m					
Y	7376215					
X	5047050					
Colour (Co-Pt)	žućkaste	25	20	25	35	5

Bunar	Izvoričte R.Krstur	Izvorište R.Krstur, B-1	Izvorište R.Krstur, B-3	Izvorište R.Krstur, B-4	Izvorište R.Krstur, B-5	MDK
	boje, bez mirisa					
Turbidity NTU	5					1
pH	8,1			8,55		6.8-8.5
Dry residue (mg/l)	504					
Nitrites (mg/l NO_2)	0,01					0.03
Nitrates (mg/l NO_3)						50
AmmoniumNH_3 (mg/l)	0,4					0.1
Chlorides (mg/l Cl)	19				214,8	200
Total iron (mg/l Fe)	0,08 - Fe^{2+}				2,06	0.3
KMnO4 (mg/l)	25	30,7	19,4	25,2	35,7	8
El.conductivity (µS/cm na 20°C)	8,1				2530	1000
Manganese (mg/l Mn)						0.05
Total hardness (^{0}dH)	1,8 (prolazna)					
Sulphates (mg/l SO_4)	10,2					250
Arsenic (mg/l As)		0,09	0,13	0,11	0,06	0,01
Analysis done by	Med.cen.Sub otica					

Table 2-26: Ruski Krstur Water Wells: Groundwater Quality Test Results

2.4.3.7 Sivac

Sivac, and its population of 8,992, obtain their water supply from a water source located near the northern edge of the town (an area called Kubeljarsko Polje). The ground elevation is about 88 m above sea level. A total of seven water wells were developed during the period from 1973 to 1987, of which only three were in service in 1995. The water wells were bored to a depth of 102-162.6 m. Groundwater was abstracted from the main aquifer at a depth of about 91-102 m, and in part from the shallow aquifer at 65-75 m.

The daily average rate of groundwater abstraction is Q=14.9 l/s (Bluewaters 2005 Survey). According to the same data source, the water table is at a depth between 5 and 11 m from the ground surface. The initial depth to water was 1.5 m.

Assessment of water source yield and groundwater resources

Available water source yield meets only part of Sivac's demand. Daily average water demand is estimated at 19.5 l/s; according to available consumption data, it is 4.6 l/s higher than the current production rate. The additional demand can be met in part by developing another water well in the same aquifer as the existing wells. In view of the fact that elevated iron/ammonia levels and organic content were registered, the groundwater provided by this water source does not meet drinking water standards.

Bunar	Izvorište Sivact	Izvorište Sivac	Izvorište Sivac	Izvorište Sivac	Izvorište Sivac	Izvorište Sivac	Izvorište Sivac	MDK
Sampling date	1983.							
Depth	filter od 91,5 do 112,5 m	110	118,8	103,6	108	130		
Y	7373990							
X	5065147							
Colour (Co-Pt)	Bez boje							5
Turbidity NTU	5							1
pH	7,6	8,0	8,0		7,5	7,9		6.8-8.5
Dry residue (mg/l)	372	413	413	425		407		
Nitrites (mg/l NO_2)								0.03
Nitrates (mg/l NO_3)					1,00			50
AmmoniumNH_3 (mg/l)		5,460	5,460	0,080	0,080	0,080	0,6	0.1
Chlorides (mg/l Cl)	12			5,00	4,00	5,00		200
Total iron (mg/l Fe)	0,3 Fe^{2+}	0,1	0,1	0,8	0,2	0,08	3,04	0.3
KMnO4 (mg/l)	5,54	7,00	7,00	6,30	4,70	4,40	14,8	8
El.conductivity (µS/cm na 20°C)								1000
Manganese (mg/l Mn)								0.05
Total hardness (^{0}dH)	12,6	6,7	6,7	17,6	15,4	10,3		
Sulphates (mg/l SO_4)		8,30	8,30	14,70	14,70	14,70		250
Calcium (mg/l Ca)					60,10	19,40		200
Magnesium (mg/l Mg)					30,30	32,90		50
Analysis done by	Med.cen. Subotica							

Table 2-27: Sivac Water Wells: Groundwater Quality Test Results

Town/village	**Population**	**Pablic water supply**	**Number of wells**	**Qav/day** (l/s)	**WTP**	**Non-compliant drinking water parameters**					
						Fe	Mn	NH3	KMnO4	As	Gases
Kula (Krstu. Put)	19301	Yes	2	29,00	No	x		x			
Kula (Štolc)		Yes	7								
Crvenka	10163	Yes	5	11,5				x	x		
Kruščić	2353	Yes	3	5,4		x		x	x	x	x
Lipar	1807	Yes	2	2		x		x			
Nova Crvenka	524	Yes	2	1		x		x			
Ruski Krstur	5213	Yes	4	8		x		x	x	x	
Sivac	8992	Yes	6	14,9		x		x	x		

Table 2-28: ***Summary of the water supply situation within the municipal territory of Kula***

2.4.4 The Municipality of Odzaci

ODŽACI MUNICIPALITY

POPULATION (2002 SURVEY): 35582

AREA (km²): 411

NUMBER OF GROUNDWATER SOURCES FOR PUBLIC SUPPLY: 9

ABSTRACTION FROM MAIN AQUIFER

ABSTRACTION FROM PLIOCEN AQUIFER

ABSTRACTION FROM SHALLOW AQUIFER

Figure 2.6: ***Overview of groundwater sources in Odžaci municipality***

The municipal territory of Dace hosts one town and eight villages with a total population of 35,582. Water supply is provided by groundwater abstraction from:

- The shallow aquifer (Upper Quaternary strata) at a depth of up to 40 m;
- The main aquifer (Lower Quaternary strata) at a depth of up to ~100 m; and
- Pliocene water-bearing strata at a depth greater than 100 m.

The total daily average rate of groundwater abstraction within this municipal territory is estimated at Q=60 l/s.

Groundwater is being abstracted solely by bored water wells. Twenty such wells service public water supply systems. Generally speaking, groundwater in this territory is being abstracted from Pliocene water-bearing strata. In view of the fact that yield does not meet current demand, and that past abstraction has resulted in a permanent drawdown at most of the water sources, no significant expansion of water source capacity is likely in this area.

2.4.4.1 Odžaci

Since 1970, public water supply for the 9,940 inhabitants of Odžaci has been provided from the Mostonga Water Source located in the southwester part of the town. The ground elevation is about 85 m above sea level. Initially, groundwater was abstracted by two water wells, about 240 m deep, from Pliocene water-bearing strata at a depth of about 222.5 to 239 m. The water source was expanded in 1977 (two water wells) and 1987 (one water well). These water wells tapped shallower Pliocene water-bearing strata and, in part, the main aquifer at a depth of 106-142 m. A total of 8 water wells were developed by the year 1995. However, in 1995 only five were still in service. In 1977 the water table was at a depth of about 11 m from the ground surface, while in 1981 it was at 18 m. Prior to the development of the water source, the water table of the 200 m-deep water-bearing strata was at about 5 m.

According to the Bluewaters 2005 Survey, the inhabitants of Odžaci obtain their water supply from two water wells which are about 81 m deep. Groundwater is being abstracted from the shallow aquifer at a depth of about 53 m. The daily average rate of groundwater abstraction is 19.1 l/s and the water table is at 4.5 m from the ground surface.

Assessment of water source yield and groundwater resources

Current water source yield only meets a portion of Odžaci's demand. Daily average water demand is estimated at 24.7 l/s; according to available consumption data, it is ~5.5 l/s higher than the current production rate. The additional water demand can be met by developing another water well in the same main aquifer or the shallow aquifer. Water consumption restrictions are being imposed as a result of drinking water shortages during the summer months. The shortages are mitigated, in part, by the use of three reservoirs.

The abstracted groundwater does not meet health standards and is being treated in a closed filtration system. Raw groundwater from the shallow aquifer is characterized by elevated iron and ammonia concentrations (Table 29). Groundwater abstracted from deeper Pliocene water-bearing strata and the main aquifer contains a higher level of arsenic than allowed.

Bunar	Izvoričte Ožaci	Izvorište Odžaci, B-8 i B-9	Odžaci	MDK
Sampling date	19.08.1981.			
Depth	filter: B1,B3(222-239m); B2,B4,B6(106-142)			
Y	7363887			
X	5041206			
Colour (Co-Pt)		30		5
Turbidity NTU		17		1
pH	8,6			6.8-8.5
Dry residue (mg/l)	1336			
Nitrites (mg/l NO_2)	nema			0.03
Nitrates (mg/l NO_3)	nema			50
AmmoniumNH_3 (mg/l)		1,55	0,02	0.1
Chlorides (mg/l Cl)	302	60,8		200
Total iron (mg/l Fe)	Fe^{2+} - trag	1,8	0,21	0.3
KMnO4 (mg/l)	povećana potrošnja	10,32		8
El.conductivity (µS/cm na 20°C)		1102		1000
Manganese (mg/l Mn)		0,11	0,0	0.05
Total hardness (^{0}dH)	6,16 (prolazna)			
Sulphates (mg/l SO_4)		10,0		250

Bunar	Izvoričte Ožaci	Izvorište Odžaci, B-8 i B-9	Odžaci	MDK
Arsenic (mg/l As)			0,21	0,01
Analysis done by	Med.cen.Sombor			

Table 2-29: Odžaci Water Wells: Groundwater Quality Test Results

2.4.4.2 Bački Brestovac

Since 1972, organized water supply for the 3,469 inhabitants of Bački Brestovac has been provided from a water source located in the southern part of the village. The ground elevation of the general area is about 87 m above sea level. Groundwater is being abstracted from the main aquifer and, to a lesser extent, from Pliocene water-bearing strata. Two water wells were developed by the year 1995: 120 m deep in 1972 and 142 m deep in 1983. Groundwater is being abstracted from a depth between 111.5 and 126.0 m. The screen is at a depth of 109.7-125.0 m. The current condition of the water wells is unknown.

The daily average rate of groundwater abstraction is about Q=5 l/s. No drawdown data are available. The initial depth to water was 4.0 m.

Assessment of water source yield and groundwater resources

Available water source yield meets a portion of the demand of Bački Brestovac's population. Daily average water demand is estimated at 7.3 l/s; according to available data, it is ~2 l/s higher the current production rate. Demand can be met by developing another water well within the same aquifer.

Groundwater quality is adequate, except for an elevated organic content. After chlorination, the water is being delivered directly into the distribution network.

Bunar	Izvoričte B.Brestovac, B-n	Izvorište B.Brestovac	Izvorište B.Brestovac	MDK
Sampling date	28.01.1981.			
Depth	filter (89,6-120,6)	140,00	142,00	
Y	7364727			
X	5052984			
Colour (Co-Pt)				5
Turbidity NTU				1

Bunar	Izvoričte B.Brestovac, B-n	Izvorište B.Brestovac	Izvorište B.Brestovac	MDK
pH	8,25	7,70	8,30	6.8-8.5
Dry residue (mg/l)	632	750,00	848,00	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)		0,82	1,25	0.1
Chlorides (mg/l Cl)	34	27,00	40,00	200
Total iron (mg/l Fe)	nema	0,08	0,07	0.3
KMnO4 (mg/l)	29.43	25,40	34,50	8
El.conductivity (µS/cm na 20^oC)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	1,68 (prolazna)	2,30	1,80	
Sulphates (mg/l SO_4)		40,00	45,50	250
Calcium (mg/l Ca)			7,10	200
Magnesium (mg/l Mg)			3,50	50
Analysis done by	Med.cen.Sombor			

Table 2-30: Bački Brestovac Water Wells: Groundwater Quality Test Results

2.4.4.3 Bački Gračac

Since 1972, organized water supply for the 2,913 inhabitants of Bački Gračac has been provided from a single location in the northern part of the village. The ground elevation of the general area is about 85 m above sea level. Initially, a single 120 m-deep water well was used. The water source was expanded in 1981 with the addition of another water well which was about 160 m deep. Groundwater is being abstracted from several Lower Quaternary water-bearing strata and, in part, from Pliocene strata, at depths ranging from 120.0 to 156.0 m. Yet another water well was developed in 1984. All of these water wells were in service in 1995. According to the Bluewaters 2005 Survey, a new 140m-deep water well was built in 1996.

The current rate of groundwater abstraction at this water source is about ~8 l/s; the depth to water is 5 m (Bluewaters, 2005).

Assessment of water source yield and groundwater resources

The available water source yield does not meet the demand of Bački Gračac. Drinking water shortages are being experienced during the summer months and they alter the bacterial content. In part, prolonged daily shortages are mitigated by storage (water tower). Daily average water demand is estimated at 6 l/s; according to available consumption data, it is less than the current production rate. If needed at any future time, the currently tapped water-bearing strata will allow a yield increase of up to 3 l/s.

In view of the elevated iron and organic content, the groundwater provided by this water source does not meet drinking water standards.

Bunar	Izvoričte B.Gračac, B-2	Izvorište B.Gračac, B-2	Izvorište B.Gračac, B-3 i B-4	MDK
Sampling date	27.06.1981.			
Depth	(filter 120-156m)			
Y	7369918			
X	5047285			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8,15			6.8-8.5

Bunar	Izvorište B.Gračac, B-2	Izvorište B.Gračac, B-2	Izvorište B.Gračac, B-3 i B-4	MDK
Dry residue (mg/l)				
Nitrites (mg/l NO_2)	nema			0.03
Nitrates (mg/l NO_3)	nema			50
AmmoniumNH_3 (mg/l)				0.1
Chlorides (mg/l Cl)	14			200
Total iron (mg/l Fe)	Fe^{2+} - 17,13			0.3
KMnO4 (mg/l)	veliko	15,3	17-20	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	1,12			
Analysis done by	Med.cen.Sombor			

Table 2-31: Bački Gračac Water Wells: Groundwater Quality Test Results

2.4.4.4 Bogojevo

The 2,120 inhabitants of Bogojevo obtain their drinking water supply from a water source developed in the southern part of the village. Its ground elevation is about 85 m above sea level. Organized water supply dates back to 1974, when a single, about 126m-deep water well was built. Groundwater was abstracted from Pliocene water-bearing strata at a depth of 84.0-94.65 m. The water source was expanded in 1981 with the addition of a 100m-deep water well. This water well tapped the same aquifer at a depth of 81.0-93.8 m. Both water wells were service in 1995. The daily average rate of groundwater abstraction was about Q=3 l/s. No drawdown data are available. The initial depth to water was 0.3 m.

Assessment of water source yield and groundwater resources

Water source yield does not meet the demand of Bogojevo's population. Daily average water demand is estimated at 4.5 l/s; according to 1995 consumption data, it is ~1,5 l/s higher than the current production rate. The demand cannot be met by developing new water wells in the same aquifer. Any additional abstraction would lead to a further decline of the aquifer's water table. Furthermore, the quality of the groundwater may be threatened since organic content and iron/ammonia levels are already higher than allowed.

Bunar	Izvoričte Bogojevo, B-n	Izvorište Bogojevo	Izvorište Bogojevo	Izvorište Bogojevo	MDK
Sampling date	21.07.1981.				
Depth	(filter 84-94)	145,00	126,00	100,00	
Y	7354481				
X	5043959				
Colour (Co-Pt)					5
Turbidity NTU					1
pH	8,2	7,10	8,30	8,00	6.8-8.5
Dry residue (mg/l)	932	375,00	895,00	943,00	
Nitrites (mg/l NO_2)	nema				0.03
Nitrates (mg/l NO_3)	trag				50
AmmoniumNH_3 (mg/l)			0,23	0,08	0.1
Chlorides (mg/l Cl)	108	10,40	91,00	93,00	200
Total iron (mg/l Fe)	Fe^{3+} - 0,3	0,10	0,30	0,50	0.3
KMnO4 (mg/l)	33,09 velika potrošnja	9,60	45,60	35,00	8
El.conductivity (µS/cm na 20°C)					1000
Manganese (mg/l Mn)					0.05
Total hardness (^{0}dH)	7,28	8,90	5,70	7,20	
Sulphates (mg/l SO_4)		27,80	23,00	119,10	250
Calcium (mg/l Ca)				16,30	200
Magnesium (mg/l Mg)				21,20	50
Analysis done by	Med.cen.Sombor				

Table 2-32: Bogojevo Water Wells: Groundwater Quality Test Results

2.4.4.5 Deronje

Since 1971, organized water supply for the 2,847 inhabitants of Deronje has been provided from two locations. The ground elevation is about 86 m above sea level. The first water well, which is about 310 m deep, was developed in 1971 and is located in the center of the village. The second water well, developed in 1973, is in the northeastern part of the village. The depth of both wells is about 320 m and they tap Pliocene water-bearing strata at the following depths: 293.0-296.0 m and 308.0-320.0 m, respectively.

The current rate of abstraction of ~6 l/s is achieved by means of two 300m-deep water wells, which were developed in 1978 and 1980, respectively (Bluewaters, 2005). They tap the same water-bearing strata as the previous water wells. The depth to water is about 6 m.

Assessment of water source yield and groundwater resources

Current water source capacity, including storage capability provided by a 60 m^3 cistern, essentially meets the demand of Deronje's population. However, frequent pipe bursts are a major problem. Daily average water demand is estimated at 6 l/s; according to available consumption data, it coincides with the current production rate. In view of the fact that groundwater is being abstracted from Pliocene sediments, no increase in yield capacity is recommended. Any additional water wells would lower the water table and degrade the quality of the groundwater.

Few data are available on groundwater quality (Table 33). In view of the registered elevated organic content ($KmnO_4$ ~39), the groundwater does not meet drinking water standards. The water is not being treated.

Bunar	Izvorište Deronje, B-2			MDK
Sampling date	01.07.1981.			
Depth	filter (257-298 i 323-330)			
Y	7361471			
X	5035491			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8,2			6.8-8.5
Dry residue (mg/l)	1207			
Nitrites (mg/l NO_2)	0			0.03
Nitrates (mg/l NO_3)	0			50
AmmoniumNH_3 (mg/l)				0.1
Chlorides (mg/l Cl)	0			200
Total iron (mg/l Fe)	0			0.3
KMnO4 (mg/l)	38,88			8
El.conductivity				1000

Bunar	Izvorište Deronje, B-2			MDK
(µS/cm na 20°C)				
Manganese (mg/l Mn)				0.05
Total hardness (°dH)	3,92			
Analysis done by	Med.cen.Sombor			

Table 2-33: Deronje Water Wells: Groundwater Quality Test Results

2.4.4.6 Karavukovo

Water supply for the 4,991 inhabitants of Karavukovo is provided from a centrally-located water source. Its ground elevation is about 85 m above sea level. It is not known when the original water source was developed. Two water wells were operational in 1995. No construction data is available for the old (first) water well. The second water well was built in 1974, and its depth was ~295.0 m. Groundwater was abstracted from Pliocene water-bearing strata at a depth of 274.0-294.0 m. According to the Bluewaters 2005 Survey, only one 95 m-deep water well is currently in service. It was developed in 1999.

The daily average rate of groundwater abstraction is about 7 l/s. No water table data is available.

Assessment of water source yield and groundwater resources

Current water source yield, including storage, does not meet the full demand of Karavukovo's population. Daily average demand is estimated at 11.3 l/s; according to available consumption data, it is ~25% higher than the production rate. In view of the fact that groundwater is being abstracted from Pliocene sediments, no expansion is recommended. Any new water wells would lower the water table and degrade the quality of the groundwater.

Few data are available on groundwater quality (Table 34). An elevated organic content ($KmnO_4$ ~ 1) has been registered, and thus the quality of the groundwater provided by this water source does not meat drinking water standards. The water is being treated to upgrade its quality.

Bunar	Izvorište Karavukovo, B-2			MDK
Sampling date	02.07.1981.			
Depth	filter (273-300m)			
Y	7359570			
X	5040867			

Bunar	Izvorište Karavukovo, B-2			MDK
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8,2			6.8-8.5
Dry residue (mg/l)	1128			
Nitrites (mg/l NO_2)	0			0.03
Nitrates (mg/l NO_3)	0			50
AmmoniumNH_3 (mg/l)				0.1
Chlorides (mg/l Cl)	212			200
Total iron (mg/l Fe)				0.3
KMnO4 (mg/l)	50,58			8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	5,04 - stalna			
Analysis done by	Med.cen.Sombor			

Table 2-34: Karavukovo Water Wells: Groundwater Quality Test Results

2.4.4.7 Lalić

Water supply for the 1,646 inhabitants of Lalić is being provided from a centrally-located water source. The ground elevation of the general area is about 85.0 m above sea level. The first water well was bored to a depth of about 200.0 m. Another water well was developed in 1984. Groundwater is being abstracted from Pliocene water-bearing strata at a depth of 179.5-203.6 m. In 1995 both water wells were still in service.

In 1995, the daily average rate of groundwater abstraction was about Q=2.0 l/s. No drawdown data are available. The initial depth to water was about 3.20 m. In 1995, the water level in the wells returned to about ~10 m from the ground surface after the pumps were shut down.

Assessment of water source yield and groundwater resources

Available water source yield does not meet the full water demand of Lalić's population. Daily average water demand is estimated at 3.5 l/s; according to 1995 consumption data, it is 1.5 l/s higher than the production rate. In view of the fact that groundwater is being abstracted from

Pliocene sediments, no expansion is recommended. Additional abstraction would intensify the drawdown and degrade the quality of the groundwater.

Few groundwater quality data are available (Table 35).

Bunar	Izvorište Lalić, B-n			MDK
Sampling date	02.07.1981			
Depth	filter (179,5-203,6)			
Y	7372967			
X	5043168			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8,2			6.8-8.5
Dry residue (mg/l)	570			
Nitrites (mg/l NO_2)	nema			0.03
Nitrates (mg/l NO_3)	nema			50
AmmoniumNH_3 (mg/l)				0.1
Chlorides (mg/l Cl)	20			200
Total iron (mg/l Fe)				0.3
KMnO4 (mg/l)	velika potrošnja			8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	2,24 (prolazna)			
Analysis done by	Med.cen.Sombor			

Table 2-35: Lalić Water Wells: Groundwater Quality Test Results

2.4.4.8 Ratkovo

Since 1972, the 4,118 residents of Ratkovo have been obtaining their water supply from a centrally-located water source. Its ground elevation is about 86 m above sea level. Initial water supply relied on a single well, which was about 205.0 m deep. Two additional water wells were developed in 1977 and 1984, respectively. No construction data are available on the 1984 well. Groundwater was abstracted from Pliocene water-bearing strata at the following depths: 81.05-118.0 m and 176.5-198.0 m. According to the Bluewaters 2005 Survey, three more wells were built in 1988, 1994 and 2001, respectively. Four wells are currently in service and the total average rate of abstraction is about 5.8 l/s. The depth to water is about 11.2 m.

Assessment of water source yield and groundwater resources

Available water source yield does not meet the full water demand of Ratkovo's population. Daily average demand is estimated at ~8,5 l/s; according to available consumption data, it is 3.0 l/s higher than the production rate. In view of the fact that groundwater is being abstracted from Pliocene sediments, expansion is not recommended. Additional water wells are likely to intensify the drawdown and degrade the quality of the groundwater. Prolonged daytime water shortages are in part mitigated by storage.

The groundwater provided by this water source is characterized by elevated organic content ($KmnO_4$ 48 to 62 mg/l) and arsenic levels, and thus these two parameters do not comply with drinking water standards. The groundwater is only being chlorinated.

Bunar	Izvorište Ratkovo, B-1 i B-2	Ratkovo, B-5, crkveno dvorište	Ratkovo, B-4	MDK
Sampling date	20.07.1981.			
Depth	filter: B1(177,2-199,5);B2(81-118)			
Y	7370545			
X	5035953			
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8,4			6.8-8.5
Dry residue (mg/l)	1154			
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)	0,6			0.1
Chlorides (mg/l Cl)	217	258	258	200
Total iron (mg/l Fe)	Fe^{2+} - 0,2			0.3
KMnO4 (mg/l)	61,8	48		8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	4,4			
Sulphates (mg/l SO_4)	19,8			
Arsenic (mg/l As)		0,272	0,32	0,01
Analysis done by	Med.cen.Subotica			

Table 2-36: Ratkovo Water Wells: Groundwater Quality Test Results

2.4.4.9 Srpski Miletić

Since 1969, water supply for the 3,538 inhabitants of Srpski Miletić has been provided from a centrally-located water source. Its ground elevation is about 88 m above sea level. The water source was commissioned upon the development of two wells (depths from 35 to 44 m). The water wells were in service for 3 to 5 years. Another, 140m-deep well was built in 1979. Seven additional water wells were developed during the period from 1981 to 1988: 3 shallow wells (up to 40 m deep) and one deep well (204 m) in 1981; a 101m-deep well in 1985; a 126m-deep well in 1987; and a 103m-deep well in 1988. Groundwater was abstracted from the shallow aquifer (19.5-35.4 m and 22.0-40.0 m) and the main aquifer (70.0-80.0 m and 65.0-99.2 m). A minor portion of the groundwater was abstracted from Pliocene sediments (110-130.0 m). Three water wells were still in service in 1995.

According to the Bluewaters 2005 Survey, two water wells, whose intakes are at a depth of about 110 m, are currently operational. The total daily average rate of groundwater abstraction is about 3.5 l/s. The depth to water is 4 m.

Assessment of water source yield and groundwater resources

Available water source yield does not meet the full water demand of Srpski Miletić. Daily average demand is estimated at ~7,5 l/s; according to available consumption data, it is 4,0 l/s higher than the current production rate. Since groundwater is being abstracted from Pliocene sediments, no expansion is recommended. Additional abstraction would intensify the drawdown and degrade the quality of the groundwater. Additional data is required to assess the feasibility of expansion by abstraction from the main aquifer and/or the shallow aquifer, that is, to determine the reason why groundwater is not being abstracted from upper strata (groundwater chemistry or excessive drawdown).

In addition, several chemical parameters of the groundwater are non-compliant, including elevated iron, ammonia, arsenic and organic content. Therefore, the water provided by this water source does not meet drinking water standards. The water is only being chlorinated.

Bunar	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić , B-5,B-6	MDK
Sampling date	26.02.'81							
Depth		40,00	42,00	101,00	126,00	103,00		

Bunar	Izvoričte S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić	Izvorište S.Miletić , B-5,B-6	MDK
Y	7360024							
X	5047655							
Colour (Co-Pt)								5
Turbidity NTU								1
pH	8,4	8,10	8,00	8,40	8,00	8,30		6.8-8.5
Dry residue (mg/l)	2250	721,00	713,00	1421,00	1425,00	1526,00		
Nitrites (mg/l NO_2)	nema							0.03
Nitrates (mg/l NO_3)	trag				0,40	12,00		50
AmmoniumNH_3 (mg/l)		0,31	0,62	0,47	0,39	0,86		0.1
Chlorides (mg/l Cl)	570	40,00	40,00	194,00	190,00	180,00		200
Total iron (mg/l Fe)	Fe^{3+} - 0,12	0,60	0,90	0,30	0,30	0,30		0.3
KMnO4 (mg/l)	132.86	18,20	16,20	121,00	50,60	79,70		8
El.conductivity (µS/cm na 20°C)								1000
Manganese (mg/l Mn)								0.05
Total hardness (^{0}dH)	5,6	21,30	21,50		5,00	2,60		
Sulphates (mg/l SO_4)		32,70	36,50	23,70	51,20	51,20		250
Calcium (mg/l Ca)		64,30	64,30	5,30	8,60	8,60		200
Magnesium (mg/l Mg)		53,30	54,20	7,20	6,10	6,10		50
Arsenic (mg/l As)							0,06-0,095	0,01
Analysis done by	Med.cen .Sombor							

Table 2-37: Srpski Miletić Water Wells: Groundwater Quality Test Results

Town/village	Population	Pablic water supply	Number of wells	Qav/day (l/s)	WTP	Non-compliant drinking water parameters					
						Fe	Mn	NH3	KMnO4	As	Gases
ODŽACI	9940	Yes	2	19,1	Yes	x	x	x	x	x	
Bački Brestovac	3469	Yes	2	5				x	x		
Bački Gračac	2913	Yes	3	8,1	No	x			x		
Bogojevo	2120	Yes	2	3		x		x	x		
Deronje	2847	Yes	2	6	Ne			x	x		
Karavukovo	4991	Yes	1	7,2	Da				x		
Lalić	1646	Yes	2	2					x		
Ratkovo	4118	Yes	4	5,8	No			x	x	x	
Srpski Miletić	3538	Yes	2	3,5	No			x	x	x	

Table 2-38: ***Summary of the water supply situation within the municipal territory of Odžaci***

2.5 OVERVIEW OF GROUNDWATER RESOURCES IN THE MUNICIPALITY OF BAČ, Vrbas, Srbobran, Bečej and Novi Bečej

2.5.1 The municipality of Bač

The municipal territory of Bač is host to one town and five villages; the total population is 16268. Groundwater is their source of water supply. It is abstracted from the subartesian and main aquifers at a depth of 19-60 m and Pliocene water-bearing strata at a depth of 92-230 m.

The total average daily rate of abstraction in this territory is Q=20 l/s. Water is abstracted via about 51 bored wells which are operational in this area. The public water supply system is comprised of 12 operating wells.

The groundwater does not meet drinking water standards; organic content and ammonium ion levels are higher than allowed. In addition, concentrations of gases (hydrogen sulfide and methane) can be found, which also exceed permissible levels.

Well	Selenča	Plavna	B.N.Selo	MCL
Sampling date	28.06.1982.	28.07.1981.	04.02.1975.	
Depth	171.8	88	94	
Y	6 603 500.00	6 588 600.00	6 589 660.00	
X	5 030 500.00	5 023 300.00	5 017 240.00	
Colour (Co-Pt)				5
Turbidity NTU				1
pH	8.18	8.28	8.17	6.8-8.5
Dry residue (mg/l)	1095		380	
Nitrites (mg/l NO_2)		0	0	0.03
Nitrates (mg/l NO_3)		2.5	0	50
AmmoniumNH_3 (mg/l)	2.7			0.1
Chlorides (mg/l Cl)	184	127	9	200
Total iron (mg/l Fe)	0.65	0.05	0.52	0.3
KMnO4 (mg/l)	59.8	22.1	5.6	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05

Well	Selenča	Plavna	B.N.Selo	MCL
Total hardness (^{0}dH)	4.2		7.6	
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)	35.2		12.8	250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)	10.3			50
Calcium (mg/l Ca)	13			200
Analysis done by				

Table 2-39: ***Bač Municipality Wells: Groundwater Quality Test Results***

2.5.2 The municipality of Vrbas

The municipal territory of Vrbas has a population of 458,525 within one town and five villages. The population and most of its industry obtain their water supply by abstraction of groundwater from all water-bearing strata (depths from about 40 to 250 m).

The total average daily rate of groundwater abstraction in this municipal territory is about Q=105 l/s. Groundwater is abstracted solely via bored wells (105 are operational). Public water supply is serviced by 28 wells. The depth to water at Vrbas's water source was measured at 27 m in 1998, and it is likely to decline further.

The quality of the groundwater abstracted from the main water-bearing complex does not fully comply with drinking water standards; excessive levels of manganese and ammonia are present. It has been noted that over time the iron content has declined while the ammonia content has increased. The groundwater from the shallow aquifer does not meet drinking water standards; iron, manganese and organic content are higher than allowed, and bacterial contamination is frequent. In the village of Ravno Selo the water abstracted from Pliocene strata contains gasses and has to be de-gassed.

Well	Vrbas (vodovod B-7)	Kucura (bunar na vodozahvatu)	Savino Selo (bunar na vodozahvatu)	Bačko Dobro Polje (bunar B-3)	Ravno Selo (bunar B-2)	MCL
Sampling date	17.06.1986.	25.04.1985.	17.06.1985.	26.06.1985.	26.06.1985.	
Depth	133.5	185	41	189	158	
Y	7 393 600	7 389 870	7 384 680	7 397 910	7 393 470	
X	5 046 550	5 042 680	5 040 340	5 039 590	5 035 200	

Well	Vrbas (vodovod B-7)	Kucura (bunar na vodozahvatu)	Savino Selo (bunar na vodozahvatu)	Bačko Dobro Polje (bunar B-3)	Ravno Selo (bunar B-2)	MCL
Colour (Co-Pt)						5
Turbidity NTU						1
pH	7.89		7.75	7.95	8.1	6.8-8.5
Dry residue (mg/l)	361.08		428	412	1127	
Nitrites (mg/l NO_2)	0	0	0.079	0	0	0.03
Nitrates (mg/l NO_3)	0	0	0	0	0	50
AmmoniumNH_3 (mg/l)	1.16	0.63	0.58	1.7	4.59	0.1
Chlorides (mg/l Cl)	9.4	24.47	1.19	6.58	77.16	200
Total iron (mg/l Fe)	0.3	0.29		0.2	1.67	0.3
KMnO4 (mg/l)	5.35	6.4	9.28	7.11		8
El.conductivity (µS/cm na 20°C)						1000
Manganese (mg/l Mn)						0.05
Total hardness (°dH)	11.83	3.96	16.63			
Arsenic (mg/l As)						0.01
Sulphates (mg/l SO_4)				8	64	250
Potassium (mg/l K)						12
Magnesium (mg/l Mg)						50
Calcium (mg/l Ca)						200
Analysis done by	M.C.Subotica	M.C.Subotica	M.C.Subotica	M.C.Subotica	M.C.Subotica	

Table 2-40: ***Vrbas Municipality Wells: Groundwater Quality Test Results***

2.5.3 The municipality of Srbobran

According to the 2002 census, the municipal territory of Srbobran hosts a population of 17,855 within one town and two villages. Groundwater is the sole source of drinking water supply. Groundwater for public water supply is abstracted from the main water-bearing complex. The total average rate of groundwater abstraction in this territory is estimated at Q=45 l/s. Water is abstracted via vertical bored wells; 18 such wells service the public water supply. The drawdown at Srbobran's Vašarište I Water Source is about 18.7 m, with a tendency to decline 1 m ever year.

The groundwater does not meet drinking water standards due to elevated iron and ammonia levels.

Well	Srbobran	Turija Izvorište B-2	Nadalj Izvorište B-1	MCL
Sampling date	7.04.1986.	10.08.1981.	7.04.1986.	
Depth		118		
Y		7 411 200.00	7 416 200.00	
X		5 044 200.00	5 041 050.00	
Colour (Co-Pt)				5
Turbidity NTU				1
pH	7.6	8	8.05	6.8-8.5
Dry residue (mg/l)	488	410	510	
Nitrites (mg/l NO_2)				0.03
Nitrates (mg/l NO_3)				50
AmmoniumNH_3 (mg/l)	0.39	1.6	0	0.1
Chlorides (mg/l Cl)	6.58	8.8	31.96	200
Total iron (mg/l Fe)	0.68	2	0.21	0.3
KMnO4 (mg/l)	6.86	5.3	7.24	8
El.conductivity (µS/cm na 20°C)				1000
Manganese (mg/l Mn)				0.05
Total hardness (^{0}dH)	18.24	13.7	9.98	
Arsenic (mg/l As)				0.01
Sulphates (mg/l SO_4)		7		250
Potassium (mg/l K)				12
Magnesium (mg/l Mg)				50
Calcium (mg/l Ca)				200
Analysis done by	Med.cen.Subotica			

Table 2-41: ***Srbobran Municipality Wells: Groundwater Quality Test Results***

2.5.4 The municipality of Bečej

The municipal territory of Bečej hosts one town and four villages. According to the 2002 census, the population is 40,987. Water supply for the population and local industry is provided solely by groundwater abstraction via vertical bored wells. Groundwater for public water supply systems is abstracted from the main water-bearing complex. Self-supply works also tap Pliocene water-bearing media. The average rate of groundwater abstraction by public water supply systems in this territory is about Q=180 l/s. The public water supply is serviced by 37 wells, and there are another nine belonging to self-supply schemes.

Occasional non-compliant drinking water parameters include iron, ammonium ion, organic content and gases (methane and H_2S).

Well	Bečej (izvorište B/I-1	Bačko Gradište Izvorište B-3	Radičević Izvorište B-3	Bačko Petrovo Selo (m.vod. kod ž.stan.)	Mileševo (mikro vodovod H1)	MCL
Sampling date	27.10.1980.	11.06.1980.	13.09.1983.	4.06.1980.	16.01.86.	
Depth	114-126	205	92.53	283	70	
Y	7 421 900	7 424 730	7 416 100	7 427 950	7 408 680	
X	5 051 500	5 042 550	5 049 680	5 063 100	5 066 430	
Colour (Co-Pt)						5
Turbidity NTU						1
pH	7.85	8.1	8.35	8	7.55	6.8-8.5
Dry residue (mg/l)		1322	468	1260	376	
Nitrites (mg/l NO_2)	0		0		0	0.03
Nitrates (mg/l NO_3)	0		0		0	50
AmmoniumNH_3 (mg/l)	0.125	2.2	1.6	14.4	0.56	0.1
Chlorides (mg/l Cl)	5	62.8	10	1.7	2.82	200
Total iron (mg/l Fe)	0.33		0.36	0.3	0.62	0.3
KMnO4 (mg/l)	20.4	88	8.9	88.8	5.33	8
El.conductivity (µS/cm na 20°C)			735			1000
Manganese (mg/l Mn)	0.1					0.05
Total hardness (°dH)	14.6		16	5.3	15.94	
Arsenic (mg/l As)						0.01
Sulphates (mg/l SO_4)	21.1	27.5	16	24.3		250
Potassium (mg/l K)						12
Magnesium (mg/l Mg)	37.1		44.6			50
Calcium (mg/l	43.2		40.9			200

Well	Bečej (izvorište B/I-1	Bačko Gradište Izvorište B-3	Radičević Izvorište B-3	Bačko Petrovo Selo (m.vod. kod ž.stan.)	Mileševo (mikro vodovod H1)	MCL
Ca)						
Analysis done by	Med.fak.N.Sad	M.c.Subotica	M.c N.Sad	M.c.Subotica	M.c.Subot	

Table 2-42: ***Bečej Municipality Wells: Groundwater Quality Test Results***

2.5.5 The municipality of Novi Bečej

According to the 2002 census, the municipal territory of Novi Bečej hosts one town and three villages with a total population of 26,924. Organized supply for the population and a part of its industry is provided by groundwater abstraction from the main water-bearing complex via vertical bored wells. Water sources for public water supply systems in this territory are comprised of 14 operating wells whose total average rate of abstraction is about Q= 55 l/s.

The depth to water of non-operating wells (while the other wells are on line) has a permanent downward tendency. The groundwater does not fully comply with drinking water standards: organic content and ammonia levels are excessive. In 1989, the wells of Novi Bečej were subjected to gas analyses which revealed that methane and hydrocarbons were elevated to the point of being considered an explosion threat. In Kumane's wells, methane in the water was detected in 1997.

Well	Kumane (izvorište B-2)	Bočar	MCL
Sampling date	3.06.1985.	20.12.1984.	
Depth	70		
Y	7 440 50		
X	5 044 970	5 052 150	
Colour (Co-Pt)		7 432 018	5
Turbidity NTU			1
pH	8.2	8.1	6.8-8.5
Dry residue (mg/l)	659	683	
Nitrites (mg/l NO_2)	0		0.03
Nitrates (mg/l NO_3)	0		50
AmmoniumNH_3 (mg/l)		0.94	0.1
Chlorides (mg/l Cl)	6	14	200

Well	Kumane (izvorište B-2)	Bočar	MCL
Total iron (mg/l Fe)	0.33	0.33	0.3
KMnO4 (mg/l)	47.73	23.39	8
El.conductivity (µS/cm na 20°C)			1000
Manganese (mg/l Mn)			0.05
Total hardness (^{0}dH)			
Arsenic (mg/l As)			0.01
Sulphates (mg/l SO_4)			250
Potassium (mg/l K)			12
Magnesium (mg/l Mg)			50
Calcium (mg/l Ca)			200
Analysis done by	Med.cen.Zrenjanin		

Table 2-43: ***Novi Bečej Municipality Wells: Groundwater Quality Test Results***

Town/village	Population	Public water supply	Number of wells	Qav/day	WTP	Non-compliant water quality parameters					
				(l/s)		Fe	Mn	NH_3	$KMnO_4$	As	Other
Bač											
Bač	6087	Yes	4	7	Ne			x	x	NDA	Methane and
Bačko Novo Selo	1228	Yes	1	2	Ne	x				NDA	
Bođani	1113	Yes	2	1.5	Ne					NDA	
Vajska	3169	Yes	2	3	Ne					NDA	
Plavna	1392	Yes	1	2	Ne				x	NDA	Methane and
Selenča	3279	Yes	2	4	Ne	x		x	x	NDA	Methane and
Vrbas											
Vrbas	25907	Yes	13	80	Yes			x		NDA	
Bačko Dobro Polje	3929	Yes	3	14	No			x		NDA	
Zmajevo	4361	Yes	3	12	No	NDA	NDA	NDA	NDA	NDA	
Kosančić	163	Yes	1	0.5	No			x		NDA	
Kucura	4663	Yes	3	9.5	No			x		NDA	
Ravno Selo	3478	Yes	3	11.5	No	x		x	x	NDA	Methane and
Savino Selo	3351	Yes	1	6.5	No	x		x	x		
Srbobran											
Srbobran	13091	Yes	6	20	No	x	x	x		NDA	
Nadalj	2202	Yes	2	3.5	No	x	x	x		NDA	
Turija	2562	Yes	3	5	No	x	x	x		NDA	
Bečej											
Bečej	25774	Yes	13	90	Yes	x		x	x	NDA	Methane and
Bačko Gradište	5445	Yes	2	8	No			x	x	NDA	
Bačko Petrovo Selo	7318	No, 9 self-	9	11	No			x	x	NDA	
Mileševo	1118	Yes	2	2	No	x		x	x	NDA	
Radičević	1332	Yes	3	2	No			x	x	NDA	
Novi Bečej											
Novi Bečej	14452	Yes	6	35	No				x	NDA	Methane and
Bočar	1895	Yes	3	4	No				x	NDA	
Kumane	3814	Yes	4	6	No				x	NDA	Methane and
Novo Miloševo	6763	Yes	2	10	No	NDA	NDA	NDA	NDA	NDA	NDA

Table 2-44: Water Supply within Bač, Vrbas, Srbobran, Bečej and Novi Bečej

2.6 Criteria for the Selection of Optimum Solutions for Drinking Water Supply

Within the territory of Western Bačka, and beyond, groundwater for water supply is abstracted from slowly recharging aquifers (main aquifer and Pliocene water-bearing strata). A rate of abstraction higher than that of natural recharge, on account of the so-called static reserves (known as over-abstraction or mining), has resulted in a permanent drawdown and restricts any further increase in the rate of abstraction.

Another important groundwater resource parameter in connection with the water supply is the natural quality of the groundwater. The quality of the groundwater in Bačka, Banat and Srem varies to a great extent, from acceptable water quality to that requiring a high level of treatment in order to meet the strict requirements of the *Drinking Water Code* (Official Gazette of FRY, Issue 42/98).

The fact that water sources for towns and villages are located either in their centers or in their vicinity poses a special problem and essentially prevents the development of safeguard zones. This is of special significance since most villages and even some towns in Vojvodina have no access to sewage systems and use septic tanks instead. In addition, a large number of abandoned dug wells are used for other purposes (e.g. household septic tanks). In view of the proximity of the water sources to its nearest consumers, it is not possible to apply adequate amounts of disinfectants (primarily sodium hypochlorite), since there is not enough time for there decay.

The above problems relating to water supply in Western Bačka have led to the establishment of solution selection criteria.

First Criterion for the selection of an optimum solution to the water supply (water source) problem was the availability of adequate volumes of groundwater to meet current and future drinking water demand, or to meet such demand with no adverse impacts (drastic drawdown, deterioration of water quality due to contamination from the ground surface, and/or inrush of highly-mineralized water from a deeper aquifer, etc.).

Second Criterion was the natural quality of the groundwater, or the levels of typical groundwater quality parameters in terms of relatively simple (and economically-viable) water treatment processes to raise water quality to drinking standards.

Third Criterion was related to the feasibility of developing safeguard zones around existing and future water sources for water supply, while at the same time not significantly encroaching on other nearby facilities/activities.

According to these criteria, 3 water supply solutions were proposed:

- Development of a regional water source in the sectors between Budžak and Apatin, and Apatin and Mesarske Livade
- development of micro-regional water sources and
- development or expansion of local water sources

For these 3 solutions calculations of costs and their feasibility was made.

2.7 Legal Framework for Development and Management of Water Sources

Serbian and EU laws and directives relevant to the development and mnagement of water sources for public water supply include:

1. The Planning and Construction Law, (Official Journal of the Republic of Serbia (RoS), Issue 47/2003)
2. The Water Law, (Official Journal of the RoS, Issues 46/1991, 53/1993, 67/1993, 48/1994, and 54/1996)
3. The Rules Governing the Content of Technical Documents Submitted with Applications for Water Management Approvals and Water Management Permits, (Official Journal of the RoS, Issue 3/1978)
4. The Geological Research and Investigation Law, (Official Journal of the RoS, Issue 44/1995)
5. The Rules Governing the Content of Geological Investigation Design and Reports, (Official Journal of the RoS, Issue 51/1996)
6. The Law on Uniform Collection and Recording of Data on Mineral and Groundwater Resources and the Balance of These Resources, (Official Gazette of the Socialist Federal Republic of Yugoslavia (SFRY), Issue 53/1977)
7. The Rules Governing Groundwater Resources Classification and Categorization, and Maintenance of Records, (Official Gazette of the SFRY, Issue 34/1979)

8. The Law on the Identification and Classification of Mineral Resources, and the Presentation of Geological Research and Investigation Data, (Official Gazette of the Federal Republic of Yugoslavia (FRY), Issue 12/1998)
9. The Sanitary Oversight Law, (Official Journal of the RoS, Issues 34/1994 and 25/1996)
10. The Strategic Environmental Impact Assessment Law;(Official Journal of the RoS, Issue 135/2004)
11. The Environmental Impact Assessment Law, (Official Journal of the RoS, Issue 135/2004)
12. The Law on Integrated Prevention and Control of Environmental Pollution,(Official Journal of the RoS, Issue 135/2004)
13. The Safety-at-Work Law,(Official Journal of the RoS, Issue 42/1991)
14. The Rules Governing the Delineation and Maintenance of Safeguard Zones and Safeguard Belts Relating to Potable Water Supply Works,(Official Journal of the RoS, Issue 33/78)
15. The Drinking Water Code,(Official Gazette, Issue 42/98)

A new Water Law, which will be fully harmonized with the EU Water Framework Directive (WFD 2000/60 EC), is currently in the process of being enacted.

Draft Rules Governing the Delineation and Maintenance of Safeguard Zones for Water Sources and Public Water Supply Structures and Facilities are currently being developed.

2.8 Cost Estimates for the Proposed Solutions

2.8.1 Development of a regional water source in the sectors between Budžak and Apatin, and Apatin and Mesarske livade

Cost estimates for this solution was based on the Study *Alternative Water Supply Solutions for Vojvodina, Phase 1 (2004)* and field investigations in the region of Apatin. According to these documents, on two sectors near town of Apatin approx. 1,9 m^3/s of groundwater could be abstracted for the purpose of regional water supply of Western Backa and Eastern Backa.

In Table 45 is given a summary of cost estimates for the development of regional groundwater sources . Detailed Bill of Prices is presented in Appendix 7.

INVESTMENT COSTS	SUMMARY PRICE (EUR)	
GROUNDWATER SOURCE	**BUDZAK**	**M. LIVADE**
Water supply wells&piezometers	2302500	1842000
Water mains	1700000	1360000
Main pipeline		2827500
Acess Roads	275000	220000
Security Fence	60000	48000
Electrical works	1090000	914000
Acquisition of land	250000	250000
	5677500	7461500
TOTAL		**13.139.000,00**

Table 2-45: ***Cost Estimates for regional groundwater source on two sectors near Apatin***

Annual Operation and Maintenace costs are presented in Table 46.

OPERATION&MAINTENANCE COSTS	SUMMARY PRICE (EUR)	
(price per year)	**BUDZAK**	**M.LIVADE**
	489774	327076
TOTAL		**816.850,00**

Table 2-46: ***Cost estimates for O & M of groundwater source on two sectors near Apatin***

2.8.2 Development of micro-regional water sources

Micro regional option is yet to be defined.

2.8.3 Development or expansion of local water sources

Cost estimates for development or expansion of local water sources were based on present state of local sources, possibility for expansion of water abstraction (local hydrogeological conditions, water demand, presence of gasses etc). It si important to emphasize that in case of some local groundwater sources (mostly those that are based on pliocene aquifer) it is not possible to expand capacities enough to fulfil the water demands.

Summary of cost estimates for the development of local groundwater sources is given in Table 47 . Detailed Bill of Prices for this option is presented in Appendix 8.

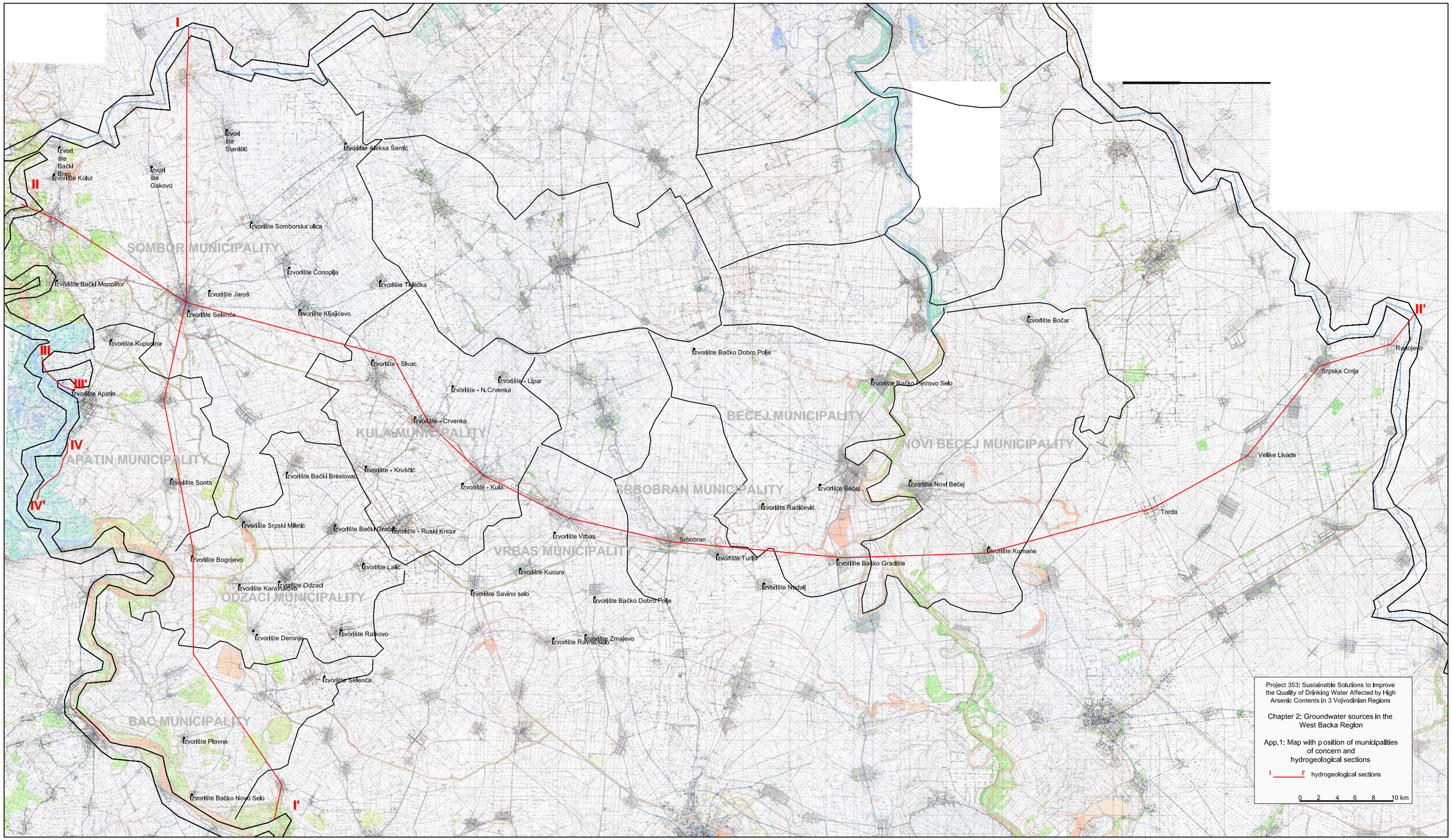
	SUMMARY PRICE (EUR)
TOTAL INVESTMENTS	2.806.530,00
TOTAL O&M PER YEAR	1.316.345,00

Table 2-47: ***Cost Estimates for local groundwater source in Western and Eastern Backa.***

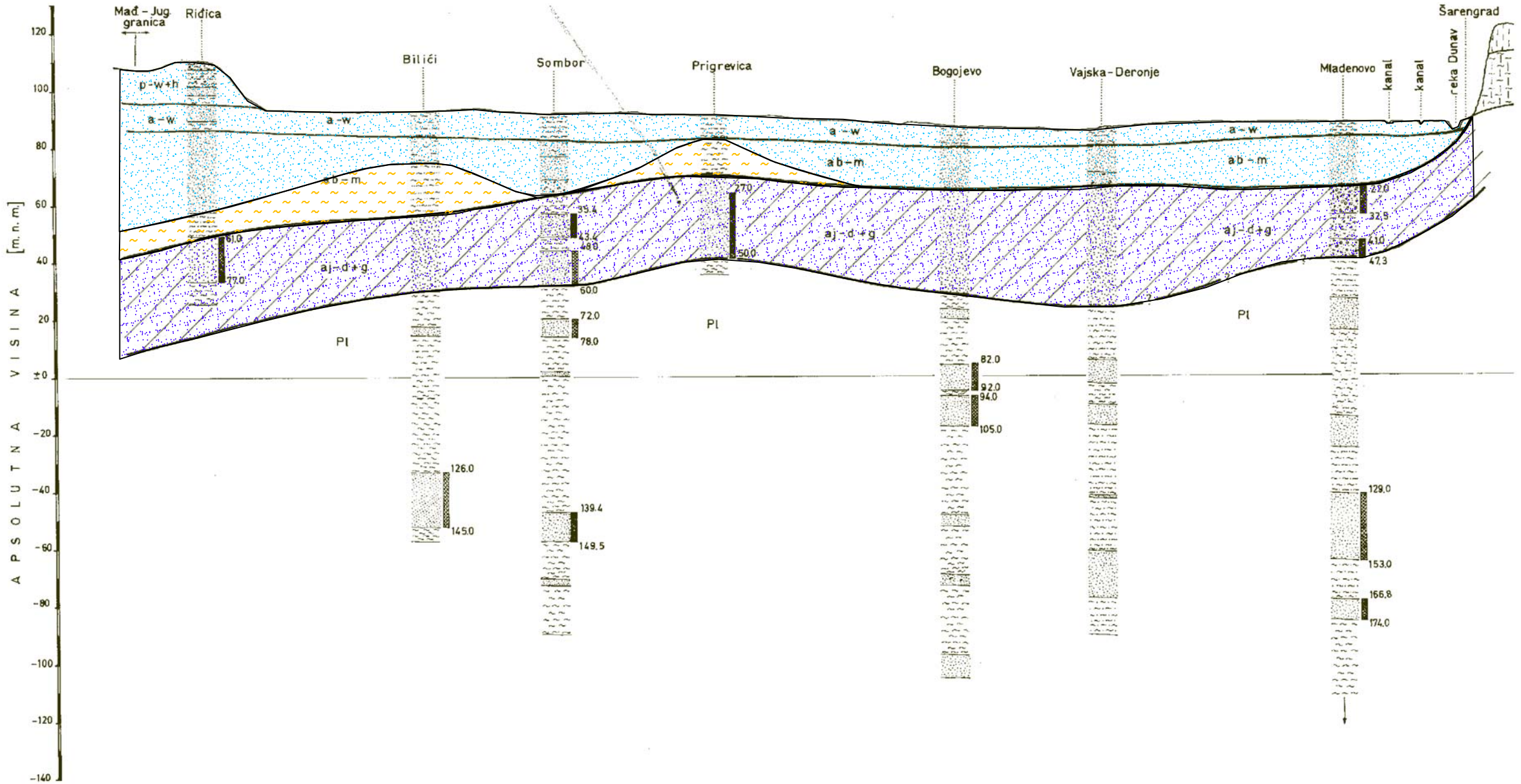
BLUEWATERS
Environmental Consultants

Book II

APPENDICIES


I
II
III
III'
IV
IV'
I'
II'
Izvorište Bački Monoštor
Izvorište Sonta
Izvorište Apatin
Izvorište Kupusina
Izvorište Selenča
Izvorište Jaroš
Izvorište Čonoplja
Izvorište Kljajićevo
Izvorište Telečka
Izvorište Somborska ulica
Izvorište Aleksa Šantić
Izvorište Stanišić
Izvorište Bački Breg
Izvorište Kolut
Izvorište Gakovo
SOMBOR MUNICIPALITY
APATIN MUNICIPALITY
KULA MUNICIPALITY
ODŽACI MUNICIPALITY
BAČ MUNICIPALITY
Izvorište - Slvac
Izvorište - Lipar
Izvorište - N.Crvenka
Izvorište - Crvenka
Izvorište - Kruščić
Izvorište - Kula
Izvorište - Ruski Krstur
Izvorište Bački Brestovac
Izvorište Srpski Miletić
Izvorište Bački Gračac
Izvorište Bogojevo
Izvorište Lalić
Izvorište Karavukovo
Izvorište Odžaci
Izvorište Deronje
Izvorište Ratkovo
Izvorište Selenča
Izvorište Plavna
Izvorište Bačko Novo Selo
Izvorište Bačko Dobro Polje
Izvorište Bačko Petrovo Selo
Izvorište Bočar
BEČEJ MUNICIPALITY
NOVI BEČEJ MUNICIPALITY
SRBOBRAN MUNICIPALITY
VRBAS MUNICIPALITY
Izvorište Bečej
Izvorište Novi Bečej
Izvorište Radičević
Izvorište Vrbas
Srbobran
Izvorište Turija
Izvorište Kucura
Izvorište Savino selo
Izvorište Bačko Dobro Polje
Izvorište Ravno selo
Izvorište Zmajevo
Izvorište Nadalj
Izvorište Bačko Gradište
Izvorište Kumane
Ratkovo
Srpska Crnja
Velike Livade
Torda
Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions
Chapter 2: Groundwater sources in the West Backa Region
App.1: Map with position of municipalities of concern and hydrogeological sections
I I' hydrogeological sections
0 2 4 6 8 10 km

REGIONAL HYDROGEOLOGICAL SECTION I -I'
(Riđica - Mladenovo)



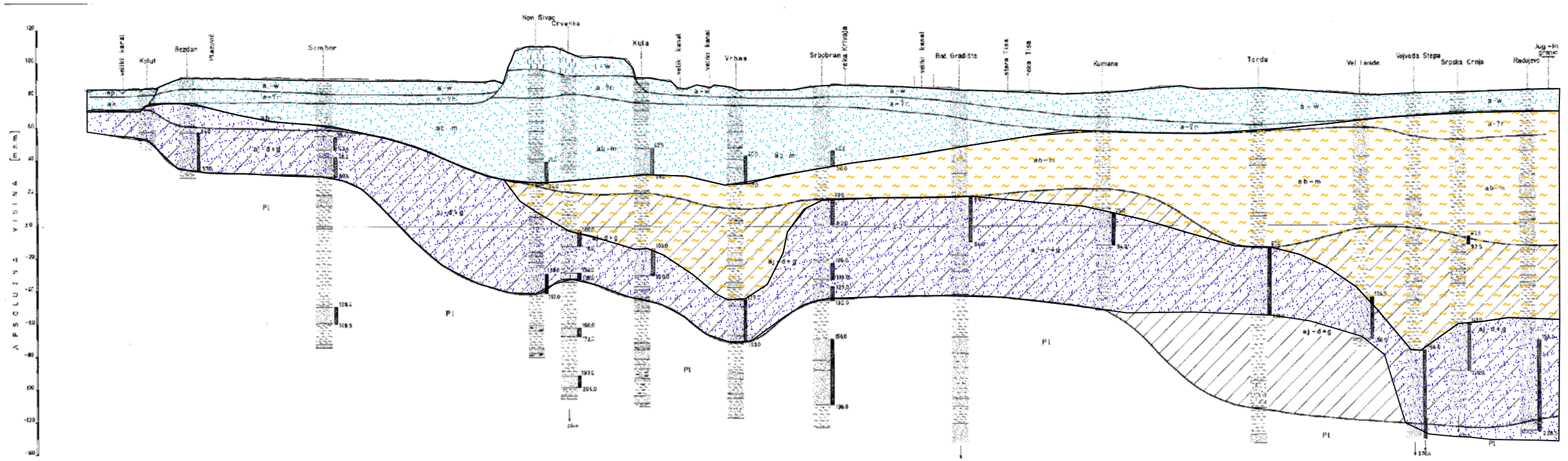
Legend:

shallow aquifer

semi-pervious complex

main aquifer

REGIONAL HYDROGEOLOGICAL SECTION II - II'
(Bezdan - Radojevo)



Legenda:

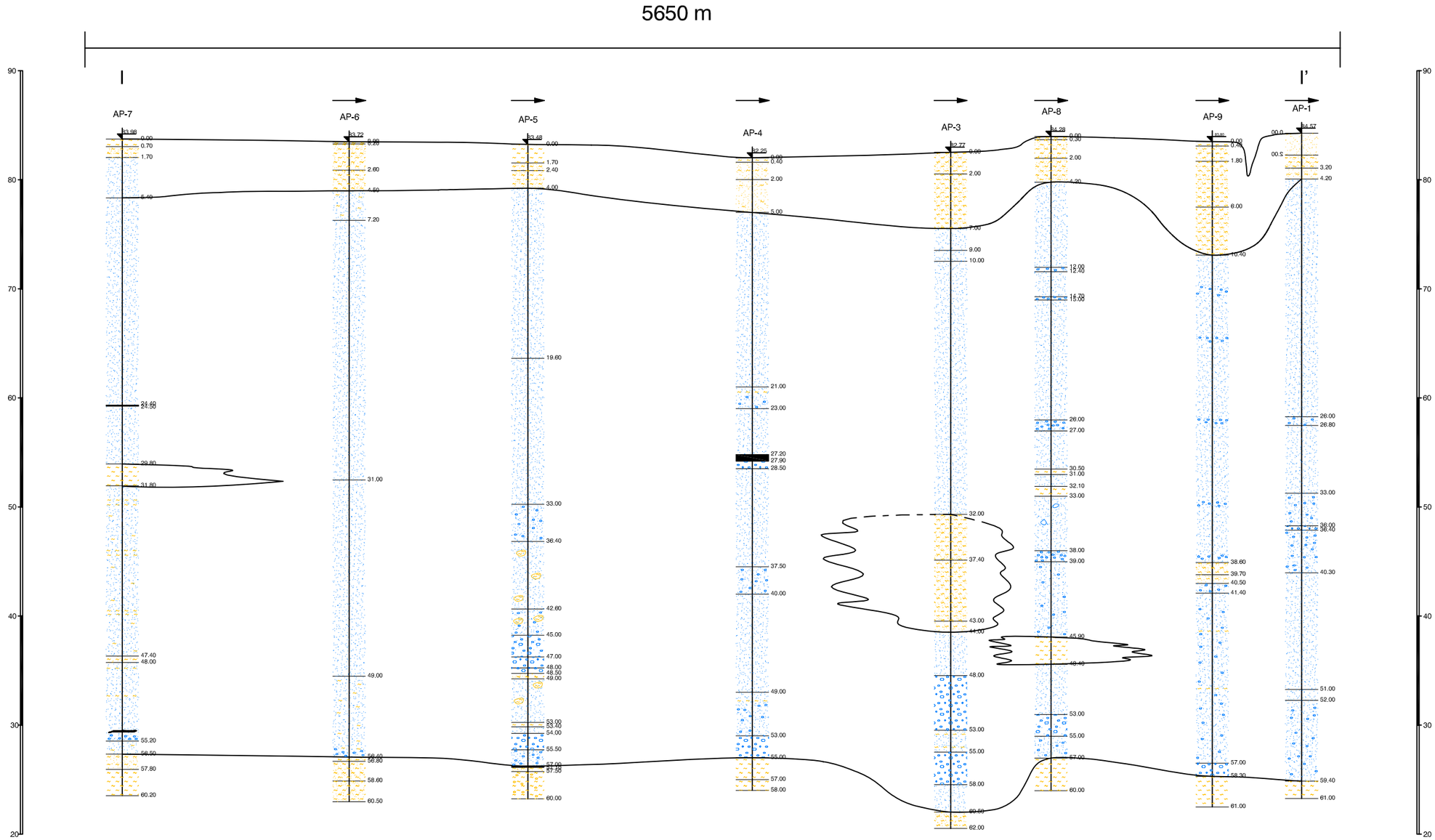
shallow aquifer

semi-pervious complex

main aquifer

App.2.3

REGIONAL HYDROGEOLOGICAL SECTION III -III'
(Apatin - Budzak)

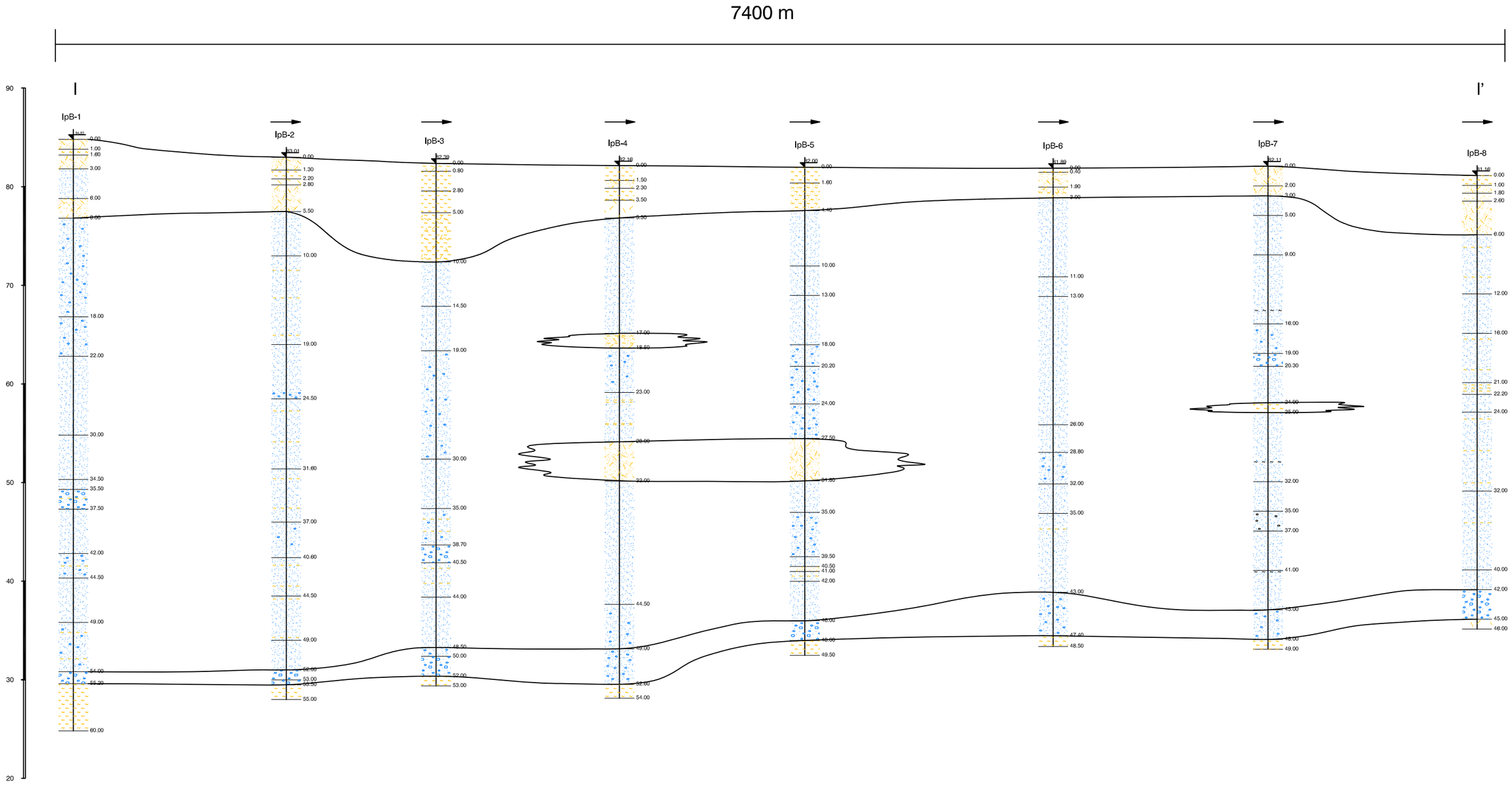


Legend:

water bearing complex (sand and gravel)

semi-pervious complex

REGIONAL HYDROGEOLOGICAL SECTION IV - IV'
(Mesarske livade - Apatin)



Legend:

water bearing complex (sand and gravel)

semi-pervious complex

	RIĐICA
Year of openning of GW source	1971
Number of wells	3
Depths of captured layers (m)	59-77

	RASTINA
Year of openning of GW source	1978
Number of wells	2
Depths of captured layers (m)	125.5-132.0

	B.BREG
Year of openning of GW source	1971
Number of wells	2
Depths of captured layers (m)	20-66

	STANIŠIĆ
Year of openning of GW source	1972
Number of wells	3
Depths of captured layers (m)	71-83

	A.ŠANTIĆ
Year of openning of GW source	1967
Number of wells	2
Depths of captured layers (m)	80-101

	GAKOVO
Year of openning of GW source	1970
Number of wells	1
Depths of captured layers (m)	131.40-138.8

	KOLUT
Year of openning of GW source	1972
Number of wells	2
Depths of captured layers (m)	118-128

	BEZDAN
Year of openning of GW source	1984
Number of wells	2
Depths of captured layers (m)	31-56

	S.MILETIĆ
Year of openning of GW source	1969
Number of wells	2
Depths of captured layers (m)	28 , 48-75

	ČONOPLJA
Year of openning of GW source	1972
Number of wells	1
Depths of captured layers (m)	117-140

	B.MONOŠTOR
Year of openning of GW source	1978
Number of wells	3
Depths of captured layers (m)	45-65,126-128

	SOMBOR
Year of openning of GW source	1961
Number of wells	15
Depths of captured layers (m)	50-140

	TELEČKA
Year of openning of GW source	1972
Number of wells	2
Depths of captured layers (m)	86-103

	KLJAJIĆEVO
Year of openning of GW source	1970
Number of wells	2
Depths of captured layers (m)	85-105

	KUPUSINA
Year of openning of GW source	1970
Number of wells	2
Depths of captured layers (m)	35-50

	SIVAC
Year of openning of GW source	1973
Number of wells	6
Depths of captured layers (m)	91-102 40-93

	LIPAR
Year of openning of GW source	1968
Number of wells	2
Depths of captured layers (m)	79-129

	APATIN
Year of openning of GW source	1973
Number of wells	3
Depths of captured layers (m)	30-58

	STAPAR
Year of openning of GW source	1969
Number of wells	3
Depths of captured layers (m)	100-114

	CRVENKA
Year of openning of GW source	1973
Number of wells	5
Depths of captured layers (m)	oko 106-150

	KRUŠČIĆ
Year of openning of GW source	1969
Number of wells	3
Depths of captured layers (m)	92-128 170-182

	DOROSLOVO
Year of openning of GW source	1965
Number of wells	7 (mikrovod.)
Depths of captured layers (m)	110-130

	BAČKI BRESTOVAC
Year of openning of GW source	1972
Number of wells	2
Depths of captured layers (m)	90-126

	KULA
Year of openning of GW source	1970
Number of wells	2
Depths of captured layers (m)	89-111

	SONTA
Year of openning of GW source	1981
Number of wells	2
Depths of captured layers (m)	33-53

	SRPSKI MILETIĆ
Year of openning of GW source	1969
Number of wells	2
Depths of captured layers (m)	65-99

	BOGOJEVO
Year of openning of GW source	1974
Number of wells	2
Depths of captured layers (m)	81-95

	BAČKI GRAČAC
Year of openning of GW source	1972
Number of wells	3
Depths of captured layers (m)	120-156

	RUSKI KRSTUR
Year of openning of GW source	1975
Number of wells	4
Depths of captured layers (m)	169-225

	LALIĆ
Year of openning of GW source	1972
Number of wells	2
Depths of captured layers (m)	179-204

	ODŽACI
Year of openning of GW source	1970
Number of wells	2
Depths of captured layers (m)	oko 50

	KARAVUKOVO
Year of openning of GW source	
Number of wells	1
Depths of captured layers (m)	oko 75

	DERONJE
Year of openning of GW source	1971
Number of wells	2
Depths of captured layers (m)	293-320

	RATKOVO
Year of openning of GW source	1972
Number of wells	4
Depths of captured layers (m)	81-198

	VAJSKA
Year of openning of GW source	1981
Number of wells	2
Depths of captured layers (m)	

	SELENČA
Year of openning of GW source	1982
Number of wells	2
Depths of captured layers (m)	172-195

	BOĐANI
Year of openning of GW source	1976
Number of wells	2
Depths of captured layers (m)	165-187

	BAČ
Year of openning of GW source	1968
Number of wells	4
Depths of captured layers (m)	171-193

	PLAVNA
Year of openning of GW source	1973
Number of wells	1
Depths of captured layers (m)	160.0-200.0

	BAČ.NOVO SELO
Year of openning of GW source	1979
Number of wells	1
Depths of captured layers (m)	94-115

Groundwater from Pliocene aquifer

Groundwater from the Main aquifer

Groundwater from the shallow aquifer

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.3.1: Map with years of opening of groundwater sources, number of wells and depths of captured layers (West Backa Region)

Scale 1:200.000

	MILEŠEVO
Year of openning of GW source	
Number of wells	2
Depths of captured layers (m)	

	BOČAR
Year of openning of GW source	
Number of wells	3
Depths of captured layers (m)	

	N.MILOŠEVO
Year of openning of GW source	1969
Number of wells	2
Depths of captured layers (m)	83-101

	BAČ.PETROVO SELO
Year of openning of GW source	1982
Number of wells	9 (MIKROVOD)
Depths of captured layers (m)	283-324

	BEČEJ
Year of openning of GW source	1982
Number of wells	13
Depths of captured layers (m)	61-73,80-126

	RADIČEVIĆ
Year of openning of GW source	
Number of wells	3
Depths of captured layers (m)	

	NOVI BEČEJ
Year of openning of GW source	1968
Number of wells	6
Depths of captured layers (m)	71-85

	VRBAS
Year of openning of GW source	1972
Number of wells	13
Depths of captured layers (m)	41-63,133-153

	SRBOBRAN-NOVO VAŠARIŠTE
Year of openning of GW source	1972
Number of wells	4
Depths of captured layers (m)	109-119,123-132

	TURIJA
Year of openning of GW source	1974
Number of wells	3
Depths of captured layers (m)	110-130

	KUCURA
Year of openning of GW source	1968
Number of wells	3
Depths of captured layers (m)	185.0-201.0

	SRBOBRAN-STARO VAŠARIŠTE
Year of openning of GW source	1982
Number of wells	2
Depths of captured layers (m)	109-119

	BAČ.GRADIŠTE
Year of openning of GW source	1971
Number of wells	2
Depths of captured layers (m)	205-222

	KUMANE
Year of openning of GW source	1970
Number of wells	4
Depths of captured layers (m)	79-98,70-97

	NADALJ
Year of openning of GW source	1973
Number of wells	2
Depths of captured layers (m)	

	SAVINO SELO
Year of openning of GW source	1999
Number of wells	1
Depths of captured layers (m)	

	B.DOBRO POLJE
Year of openning of GW source	1978
Number of wells	3
Depths of captured layers (m)	171.2-205.2

	RAVNO SELO
Year of openning of GW source	1977
Number of wells	3
Depths of captured layers (m)	189-236,188-199

	ZMAJEVO
Year of openning of GW source	1973
Number of wells	3
Depths of captured layers (m)	135-200

Groundwater from Pliocene aquifer

Groundwater from the Main aquifer

Groundwater from the shallow aquifer

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.3.2: Map with years of opening of groundwater sources, number of wells and depths of captured layers (East Backa Region)

Scale 1:200.000

	RIĐICA
Q (l/s)	5.5
GWL (m)	5

	RASTINA
Q (l/s)	1.5
GWL (m)	?

	STANIŠIĆ
Q (l/s)	8
GWL (m)	?

	B.BREG
Q (l/s)	1.5
GWL (m)	7

	A.ŠANTIĆ
Q (l/s)	6
GWL (m)	15-18

	GAKOVO
Q (l/s)	4
GWL (m)	18

	KOLUT
Q (l/s)	2.5
GWL (m)	18

	BEZDAN
Q (l/s)	6
GWL (m)	3

	S.MILETIĆ
Q (l/s)	7
GWL (m)	5

SOMBOR MUNICIPALITY

	ČONOPLJA
Q (l/s)	11
GWL (m)	14

	B.MONOŠTOR
Q (l/s)	4
GWL (m)	8-25

	SOMBOR
Q (l/s)	135
GWL (m)	9

	TELEČKA
Q (l/s)	3
GWL (m)	18

	KLJAJIĆEVO
Q (l/s)	8
GWL (m)	?

	KUPUSINA
Q (l/s)	5
GWL (m)	4.5

	SIVAC
Qsr,dn (l/s)	14,9
NPV (m)	5-11

	LIPAR
Qsr,dn (l/s)	2
NPV (m)	31

	NOVA CRVENKA
Qsr,dn (l/s)	1
NPV (m)	

	APATIN
Q (l/s)	90
GWL (m)	2-5

	STAPAR
Q (l/s)	4
GWL (m)	13

	CRVENKA
Qsr,dn (l/s)	11,5
NPV (m)	29

KULA MUNICIPALITY

APATIN MUNICIPALITY

	KRUŠČIĆ
Qsr,dn (l/s)	5,4
NPV (m)	4-6

	BAČKI BRESTOVAC
Q (l/s)	5
GWL (m)	

	KULA
Qsr,dn (l/s)	29
NPV (m)	100

	SONTA
Q (l/s)	9
GWL (m)	6

	DOROSLOVO
Q (l/s)	2
GWL (m)	8

	RUSKI KRSTUR
Qsr,dn (l/s)	8
NPV (m)	19

	SRPSKI MILETIĆ
Q (l/s)	3.5
GWL (m)	4

	BAČKI GRAČAC
Q (l/s)	8.1
GWL (m)	5

VRBAS

	BOGOJEVO
Q (l/s)	3
GWL (m)	

	LALIĆ
Q (l/s)	2
GWL (m)	

	ODŽACI
Q (l/s)	19.1
GWL (m)	4,5

	KARAVUKOVO
Q (l/s)	7.2
GWL (m)	

ODŽACI MUNICIPALITY

	DERONJE
Q (l/s)	6
GWL (m)	6

	RATKOVO
Q (l/s)	5.8
GWL (m)	11,2

	VAJSKA
Q (l/s)	3
GWL (m)	?

	SELENČA
Q (l/s)	4
GWL (m)	?

	BOĐANI
Q (l/s)	1.5
GWL (m)	?

	BAČ
Q (l/s)	7
GWL (m)	?

BAČ MUNICIPALITY

	PLAVNA
Q (l/s)	2
GWL (m)	?

	BA.NOV.SELO
Q (l/s)	2
GWL (m)	?

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.4.1: Map with current average groundwater withdrawal and depths to groundwater level on public water sources (West Backa Region)

Scale 1:200.000

KULA MUNICIPALITY

BECEJ MUNICIPALITY

NOVI BECEJ MUNICIPALITY

SRBOBRAN MUNICIPALITY

VRBAS MUNICIPALITY

	BOČAR
Q (l/s)	4
GWL (m)	>6

	N.MILOŠEVO
Q (l/s)	10
GWL (m)	

	MILEŠEVO
Q (l/s)	2
GWL (m)	?

	B.P.SELO
Q (l/s)	11
GWL (m)	?

	BEČEJ
Q (l/s)	90
GWL (m)	?

	NOVI BEČEJ
Q (l/s)	35
GWL (m)	>10

	RADIČEVIĆ
Q (l/s)	2
GWL (m)	?

	VRBAS
Q (l/s)	80
GWL (m)	>30

	SRBOBRAN
Q (l/s)	20
GWL (m)	>20

	TURIJA
Q (l/s)	5
GWL (m)	?

	B.GRADIŠTE
Q (l/s)	8
GWL (m)	?

	KUMANE
Q (l/s)	6
GWL (m)	>12

	KUCURA
Q (l/s)	9.5
GWL (m)	?

	SAVINO SELO
Q (l/s)	6.5
GWL (m)	?

	B.DOBRO POLJE
Q (l/s)	14
GWL (m)	20

	NADALJ
Q (l/s)	3.5
GWL (m)	?

	RAVNO SELO
Q (l/s)	11.5
GWL (m)	?

	ZMAJEVO
Q (l/s)	12
GWL (m)	18

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.4.2: Map with current average groundwater withdrawal and depths to groundwater level on public water sources (East Backa Region)

Scale 1:200.000

RIĐICA	
Q (l/s)	8.00
Wells	0

RASTINA	
Q (l/s)	3.00
Wells	0

STANIŠIĆ	
Q (l/s)	12.00
Wells	1+

BAČ.BREG	
Q (l/s)	4.00
Wells	1

A.SANTIĆ	
Q (l/s)	9.00
Wells	0

GAKOVO	
Q (l/s)	6.00
Wells	1

KOLUT	
Q (l/s)	4.00
Wells	1+

BEZDAN	
Q (l/s)	300.00
Wells	0

S.MILETIĆ	
Q (l/s)	11.00
Wells	0

SOMBOR MUNICIPALITY

ČONOPLJA	
Q (l/s)	15.00
Wells	1

B.MONOŠTOR	
Q (l/s)	7.00
Wells	1+

TELEČKA	
Q (l/s)	6.00
Wells	1

SOMBOR	
Q (l/s)	400.00
Wells	25

KLJAJIĆEVO	
Q (l/s)	14.00
Wells	2+

KUPUSINA	
Q (l/s)	15.00
Wells	0

SIVAC	
Q (l/s)	18
Wells	1

LIPAR	
Q (l/s)	3
Wells	1

N.CRVENKA	
Q (l/s)	2
Wells	0

APATIN	
Q (l/s)	1990.00
Wells	90

STAPAR	
Q (l/s)	6.00
Wells	1+

CRVENKA	
Q (l/s)	11.5
Wells	0

KULA MUNICIPALITY

APATIN MUNICIPALITY

B.BRESTOVAC	
Q (l/s)	7
Wells	1

KULA	
Q (l/s)	29
Wells	0

DOROSLOVO	
Q (l/s)	7
Wells	2

SONTA	
Q (l/s)	19.00
Wells	1

S.MILETIĆ	
Q (l/s)	3.5
Wells	0

B.GRAČAC	
Q (l/s)	11
Wells	0

R.KRSTUR	
Q (l/s)	8
Wells	0

VRBA

BOGOJEVO	
Q (l/s)	3
Wells	no capacity

ODŽACI	
Q (l/s)	24
Wells	1

LALIĆ	
Q (l/s)	2
Wells	no capacity

KARAVUKOVO	
Q (l/s)	7.2
Wells	no capacity

ODŽACI MUNICIPALITY

DERONJE	
Q (l/s)	6
Wells	no capacity

RATKOVO	
Q (l/s)	5.8
Wells	no capacity

VAJSKA	
Q (l/s)	6.00
Wells	1+

SELENČA	
Q (l/s)	4.00
Wells	no capacity

BOĐANI	
Q (l/s)	2.00
Wells	no capacity

BAČ	
Q (l/s)	7.00
Wells	no capacity

BAČ MUNICIPALITY

PLAVNA	
Q (l/s)	2.00
Wells	no capacity

BAN.NOV.SELO	
Q (l/s)	2.00
Wells	no capacity

Groundwater from Pliocene aquifer

Groundwater from the Main aquifer

Groundwater from the shallow aquifer

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.5.1: Map with maximum available quantities of groundwater and estimated number of additional wells necessary for compensation of water demands (West Backa Region)

Scale 1:200.000

BECEJ MUNICIPALITY

NOVI BECEJ MUNICIPALITY

SRBOBRAN MUNICIPALITY

VRBAS MUNICIPALITY

KULA MUNICIPALITY

	BOSAR
Q (l/s)	6.00
Wells	0

	N.MILOŠEVO
Q (l/s)	12.00
Wells	1+

	MILEŠEVO
Q (l/s)	7.00
Wells	0

	B.P.SELO
Q (l/s)	11.00
Wells	no capacity

	BEČEJ
Q (l/s)	90.00
Wells	0

	NOVI BEČEJ
Q (l/s)	35.00
Wells	no capacity

	RADIČEVIĆ
Q (l/s)	6.00
Wells	0

	VRBAS
Q (l/s)	80.00
Wells	0

	TURIJA
Q (l/s)	20.00
Wells	0

	SRBOBRAN
Q (l/s)	35.00
Wells	3

	KUCURA
Q (l/s)	10.00
Wells	0

	S.GRADISTE
Q (l/s)	8.00
Wells	no capacity

	KUMANE
Q (l/s)	12.00
Wells	1

	SAVINO SELO
Q (l/s)	7.00
Wells	0

	B.DOB. POLJE
Q (l/s)	14.00
Wells	0

	NADALJ
Q (l/s)	24.00
Wells	1

	RAVNO SELO
Q (l/s)	12.00
Wells	0

	ZMAJEVO
Q (l/s)	12.00
Wells	0

Groundwater from Pliocene aquifer

Groundwater from the Main aquifer

Groundwater from the shallow aquifer

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.5.2: Map with maximum available quantities of groundwater and estimated number of additional wells necessary for compensation of water demands (East Backa Region)

Scale 1:200.000

Quality parameters range	RIĐICA
Iron (mg/l)	0.5-0.8
Manganese (mg/l)	
Ammonium ion (mg/l)	0.3-0.6
Organic matters (mg/l)	12-16
Arsenic (mg/l)	

Quality parameters range	RASTINA
Iron (mg/l)	0.1-0.3
Manganese (mg/l)	
Ammonium ion (mg/l)	
Organic matters (mg/l)	8.5-10
Arsenic (mg/l)	

Quality parameters range	B.BREG
Iron (mg/l)	0.3-2.2
Manganese (mg/l)	0.1
Ammonium ion (mg/l)	0.8-1.1
Organic matters (mg/l)	6-11
Arsenic (mg/l)	

Quality parameters range	STANIŠIĆ
Iron (mg/l)	0.3-4
Manganese (mg/l)	
Ammonium ion (mg/l)	0.5
Organic matters (mg/l)	8-17
Arsenic (mg/l)	

Quality parameters range	A.ŠANTIĆ
Iron (mg/l)	0.3-1.2
Manganese (mg/l)	0.08
Ammonium ion (mg/l)	0.2-1.5
Organic matters (mg/l)	6-22
Arsenic (mg/l)	0.026

Quality parameters range	KOLUT
Iron (mg/l)	0.3-1.1
Manganese (mg/l)	
Ammonium ion (mg/l)	0.08-0.5
Organic matters (mg/l)	4.5-6
Arsenic (mg/l)	

Quality parameters range	GAKOVO
Iron (mg/l)	0.2
Manganese (mg/l)	
Ammonium ion (mg/l)	0.16
Organic matters (mg/l)	9
Arsenic (mg/l)	

Quality parameters range	S.MILETIĆ
Iron (mg/l)	0.9-1.5
Manganese (mg/l)	0.4
Ammonium ion (mg/l)	0.6
Organic matters (mg/l)	5
Arsenic (mg/l)	

SOMBOR MUNICIPALITY

Quality parameters range	B.MONOŠTOR
Iron (mg/l)	0.2
Manganese (mg/l)	
Ammonium ion (mg/l)	0.15
Organic matters (mg/l)	9-26
Arsenic (mg/l)	

Quality parameters range	ČONOPLJA
Iron (mg/l)	0.5-1
Manganese (mg/l)	
Ammonium ion (mg/l)	0.08
Organic matters (mg/l)	3.6-5.6
Arsenic (mg/l)	

Quality parameters range	TELEČKA
Iron (mg/l)	0.9-1.8
Manganese (mg/l)	
Ammonium ion (mg/l)	
Organic matters (mg/l)	6-10
Arsenic (mg/l)	

Quality parameters range	SOMBOR
Iron (mg/l)	1-3.5
Manganese (mg/l)	
Ammonium ion (mg/l)	0.4-1.3
Organic matters (mg/l)	9-20
Arsenic (mg/l)	

Quality parameters range	KLJAJIĆEVO
Iron (mg/l)	0.2-0.5
Manganese (mg/l)	
Ammonium ion (mg/l)	
Organic matters (mg/l)	7-18
Arsenic (mg/l)	

Quality parameters range	KUPUSINA
Iron (mg/l)	2-4
Manganese (mg/l)	0.15
Ammonium ion (mg/l)	1
Organic matters (mg/l)	17
Arsenic (mg/l)	

Quality parameters range	LIPAR
Iron (mg/l)	0,1-7,8
Manganese (mg/l)	
Ammonium ion (mg/l)	0,08-0,7
Organic matters (mg/l)	4,4-7,5
Arsenic (mg/l)	

Quality parameters range	SIVAC
Iron (mg/l)	0,1-3
Manganese (mg/l)	
Ammonium ion (mg/l)	0,08-5,4
Organic matters (mg/l)	4,4-14,8
Arsenic (mg/l)	

Quality parameters range	NOVA CRVENKA
Iron (mg/l)	0,1-0,7
Manganese (mg/l)	
Ammonium ion (mg/l)	0,3-0,6
Organic matters (mg/l)	4,7-8
Arsenic (mg/l)	

Quality parameters range	APATIN
Iron (mg/l)	1.6-2.7
Manganese (mg/l)	0.09-0.3
Ammonium ion (mg/l)	2.2
Organic matters (mg/l)	11
Arsenic (mg/l)	0.006-0.012

Quality parameters range	STAPAR
Iron (mg/l)	0.3
Manganese (mg/l)	
Ammonium ion (mg/l)	0.8
Organic matters (mg/l)	20-30
Arsenic (mg/l)	

Quality parameters range	CRVENKA
Iron (mg/l)	0.2
Manganese (mg/l)	
Ammonium ion (mg/l)	0,08-0,4
Organic matters (mg/l)	4,5-24,1
Arsenic (mg/l)	

Quality parameters range	BAČKI BRESTOVAC
Iron (mg/l)	0.08
Manganese (mg/l)	
Ammonium ion (mg/l)	0,8-1,2
Organic matters (mg/l)	25,4-34-5
Arsenic (mg/l)	

APATIN MUNICIPALITY

KULA MUNICIPALITY

Quality parameters range	KULA
Iron (mg/l)	0.6
Manganese (mg/l)	
Ammonium ion (mg/l)	0.7
Organic matters (mg/l)	6.4
Arsenic (mg/l)	

Quality parameters range	SONTA
Iron (mg/l)	1-3
Manganese (mg/l)	0.1-0.13
Ammonium ion (mg/l)	1.5
Organic matters (mg/l)	12-26
Arsenic (mg/l)	0.013-0.24

Quality parameters range	DOROSLOVO
Iron (mg/l)	2
Manganese (mg/l)	
Ammonium ion (mg/l)	0.8
Organic matters (mg/l)	14-50
Arsenic (mg/l)	

Quality parameters range	KRUŠČIĆ
Iron (mg/l)	0,3-1,19
Manganese (mg/l)	0,13
Ammonium ion (mg/l)	0,08-2
Organic matters (mg/l)	8,8-74,4
Arsenic (mg/l)	0.03

Quality parameters range	SRPSKI MILETIĆ
Iron (mg/l)	0,3-0,9
Manganese (mg/l)	
Ammonium ion (mg/l)	0,31-0,86
Organic matters (mg/l)	16,2-132,9
Arsenic (mg/l)	0,06-0,09

Quality parameters range	BAČKI GRAČAC
Iron (mg/l)	
Manganese (mg/l)	
Ammonium ion (mg/l)	
Organic matters (mg/l)	15,3-20
Arsenic (mg/l)	

Quality parameters range	RUSKI KRSTUR
Iron (mg/l)	2.1
Manganese (mg/l)	
Ammonium ion (mg/l)	0.4
Organic matters (mg/l)	19.4-35,7
Arsenic (mg/l)	0,06-0,13

Quality parameters range	BOGOJEVO
Iron (mg/l)	0,1-0,5
Manganese (mg/l)	
Ammonium ion (mg/l)	0,08-0,23
Organic matters (mg/l)	9,6-45,6
Arsenic (mg/l)	

Quality parameters range	ODŽACI
Iron (mg/l)	0,21-1,8
Manganese (mg/l)	0.11
Ammonium ion (mg/l)	0,02-1,55
Organic matters (mg/l)	10.3
Arsenic (mg/l)	0.21

ODŽACI MUNICIPALITY

VRBAS

Quality parameters range	RATKOVO
Iron (mg/l)	
Manganese (mg/l)	
Ammonium ion (mg/l)	0.6
Organic matters (mg/l)	48-61,8
Arsenic (mg/l)	0.3

Quality parameters range	SELENČA
Iron (mg/l)	0.6
Manganese (mg/l)	
Ammonium ion (mg/l)	2.7
Organic matters (mg/l)	60
Arsenic (mg/l)	

Drinking Water Code (Yugoslav Official Gazette, Issue 42/98)	
Iron (mg/l)	0.3
Manganese (mg/l)	0.05
Ammonium ion (mg/l)	0.1
Organic matters (mg/l)	8
Arsenic (mg/l)	0.01

BAC MUNICIPALITY

Quality parameters range	PLAVNA
Iron (mg/l)	0.05
Manganese (mg/l)	
Ammonium ion (mg/l)	
Organic matters (mg/l)	22
Arsenic (mg/l)	

Quality parameters range	BAČ.NOVO SELO
Iron (mg/l)	0.5
Manganese (mg/l)	
Ammonium ion (mg/l)	
Organic matters (mg/l)	5.6
Arsenic (mg/l)	

Groundwater from Pliocene aquifer

Groundwater from the Main aquifer

Groundwater from the shallow aquifer

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.6.1: Map with major groundwater quality parameters of concern (West Backa Region)

Scale 1:200.000

KULA MUNICIPALITY

SRBOBRAN MUNICIPALITY

BECEJ MUNICIPALITY

NOVI BECEJ MUNICIPALITY

VRBAS MUNICIPALITY

Quality parameters range	MILEŠEVO
Iron (mg/l)	0.6
Manganese (mg/l)	
Ammonium ion (mg/l)	0.6
Organic matters (mg/l)	5
Arsenic (mg/l)	

	BAČ.PETROVO SELO
Iron (mg/l)	0.3
Manganese (mg/l)	
Ammonium ion (mg/l)	14.4
Organic matters (mg/l)	85
Arsenic (mg/l)	

Quality parameters range	BEČEJ
Iron (mg/l)	0.3
Manganese (mg/l)	0.1
Ammonium ion (mg/l)	0.12
Organic matters (mg/l)	20
Arsenic (mg/l)	

Quality parameters range	RADIČEVIĆ
Iron (mg/l)	0.4
Manganese (mg/l)	
Ammonium ion (mg/l)	1.6
Organic matters (mg/l)	9
Arsenic (mg/l)	

Quality parameters range	KUMANE
Iron (mg/l)	0.3
Manganese (mg/l)	
Ammonium ion (mg/l)	0.9
Organic matters (mg/l)	48
Arsenic (mg/l)	

Quality parameters range	VRBAS
Iron (mg/l)	0.3
Manganese (mg/l)	
Ammonium ion (mg/l)	1.2
Organic matters (mg/l)	5.3
Arsenic (mg/l)	

	SRBOBRAN-NOVO VAŠARIŠTE
Iron (mg/l)	0.7
Manganese (mg/l)	
Ammonium ion (mg/l)	0.4
Organic matters (mg/l)	7
Arsenic (mg/l)	

Quality parameters range	TURIJA
Iron (mg/l)	2
Manganese (mg/l)	
Ammonium ion (mg/l)	1.6
Organic matters (mg/l)	5
Arsenic (mg/l)	

Quality parameters range	BAČ.GRADIŠTE
Iron (mg/l)	
Manganese (mg/l)	
Ammonium ion (mg/l)	2.2
Organic matters (mg/l)	88
Arsenic (mg/l)	

Quality parameters range	KUCURA
Iron (mg/l)	0.3
Manganese (mg/l)	
Ammonium ion (mg/l)	0.6
Organic matters (mg/l)	6
Arsenic (mg/l)	

Quality parameters range	B.DOBRO POLJE
Iron (mg/l)	0.2
Manganese (mg/l)	
Ammonium ion (mg/l)	1.7
Organic matters (mg/l)	7
Arsenic (mg/l)	

Quality parameters range	RAVNO SELO
Iron (mg/l)	1.7
Manganese (mg/l)	
Ammonium ion (mg/l)	4.5
Organic matters (mg/l)	
Arsenic (mg/l)	

Quality parameters range	SAVINO SELO
Iron (mg/l)	
Manganese (mg/l)	
Ammonium ion (mg/l)	0.6
Organic matters (mg/l)	8
Arsenic (mg/l)	

Drinking Water Code (Yugoslav Official Gazette, Issue 42/98)	
Iron (mg/l)	0.3
Manganese (mg/l)	0.05
Ammonium ion (mg/l)	0.1
Organic matters (mg/l)	8
Arsenic (mg/l)	0.01

Groundwater from Pliocene aquifer

Groundwater from the Main aquifer

Groundwater from the shallow aquifer

Project 353: Sustainable Solutions to Improve the Quality of Drinking Water Affected by High Arsenic Contents in 3 Vojvodinian Regions

Chapter 2: Groundwater sources in the West Backa Region

App.6.2: Map with major groundwater quality parameters of concern (East Backa Region)

Scale 1:200.000

REGIONAL GROUNDWATER SOURCE "BUDZAK"

A	**Water supply wells&piezometers**	**quantity**	**unit price**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of 60 meters			
	Calculation per m'			
	50 piezometers x 60 m	3000	80	240000
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of 60 m, well construction diameter 350 mm, steel or PVC casing			
	Calculation per m'			
	50 wells x 60 m	3000	500	1500000
A3	Construction of concrete well shafts			
	Calculation per well shaft	50	2000	100000
A4	Procurement and installation of mechanical equipement			
	-Submersible pump	50	6300	315000
	-Gate valve	50	300	15000
	-FF piece C19	50	250	12500
	-Back valve	50	600	30000
	Air Valve	50	300	15000
	Flow meter	50	1500	75000
	TOTAL A.:			**2302500**
B	**Water mains**			
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the			
	Calculation per m'			
	5000m	5000	25	125000
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.			
	Calculation per m'	5000	315	1575000
	TOTAL B.:			**1700000**
C	**Acess Roads**			
C1	Leveling of the terrain with removal of surface layer and compacting.			
	Calculation per m2			
	5000m x 5 m	25000	1	25000
C2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.			
	Calculation per m^2			
	5000 m x 5 m	25000	10	250000
	TOTAL C:			**275000**
D	**Security Fence**			
D1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire			
	Calculation per m'			
	50wells x 80 m	4000	15	60000
D2				
	TOTAL D:			**60000**
E	**Electrical works**			
E1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m	5000	50	250000
E2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete	6	40000	240000
	Low voltage cables.	5000	15	75000
E3	Inside and outside well lightning , complete. Calculation per m2. 50 x 40 m^2	2000	40	80000
E4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	5500	40	220000
E5	Electrical distribution cabinet (well complete	50	1500	75000
E6	Command control center (construction of object+ equipement)	1	150000	150000
	TOTAL E:			**1090000**
F	**Acquisition of land**			
	Acquisition of land in the immediate protection zone			
	Calculation per ha			
	50ha	50	5000	250000
	TOTAL F:			**250000**
	TOTAL A-F:			**5677500**
G	**OPERATION&MAINTENANCE (ANNUAL COSTS)**			
G1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	1020	50	51000
G2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	0.1	462500	46250
G3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	0.05	1090000	54500
G4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	200	400	80000
G5	Power consumption costs. Price per kWh. 274kWx24hx365days	2400240	0.1	240024
G6	Labour costs, price per work/month. 3workersx12months	36	500	18000
	TOTAL G:			**489774**

REGIONAL GROUNDWATER SOURCE "MESARSKE LIVADE"

A	**Water supply wells&piezometers**	**quantity**	**unit price**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of 60 meters			
	Calculation per m'			
	40 piezometers x 60 m	2400	80	192000
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of 60 m, well construction diameter 350 mm, steel or PVC casing			
	Calculation per m'			
	40 wells x 60 m	2400	500	1200000
A3	Construction of concrete well shafts			
	Calculation per well shaft	40	2000	80000
A4	Procurement and installation of mechanical equipement			
	-Submersible pump	40	6300	252000
	-Gate valve	40	300	12000
	-FF piece C19	40	250	10000
	-Back valve	40	600	24000
	Air Valve	40	300	12000
	Flow meter	40	1500	60000
	TOTAL A.:			**1842000**
B	**Water mains**			
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the			
	Calculation per m'			
	4000m	4000	25	100000
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.			
	Calculation per m'	4000	315	1260000
	TOTAL B.:			**1360000**
C	**Main pipeline to WTP**			
C1	Excavation of trench with , for laying a main pipeline Ø 800mm , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess earth out of the			
	Calculation per m'			
	L=6500 m	6500	25	162500
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.			
	Ø 800mm	6500	410	2665000
	TOTAL C.:			**2827500**
D	**Acess Roads**			
D1	Leveling of the terrain with removal of surface layer and compacting.			
	Calculation per m2			
	4000m x 5 m	20000	1	20000
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width			
	Calculation per m^2			
	4000 m x 5 m	20000	10	200000
	TOTAL D:			**220000**
E	**Security Fence**			
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire			
	Calculation per m'			
	40bun x 80 m	3200	15	48000
	TOTAL E:			**48000**
F	**Electrical works**			
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m	4000	50	200000
F2	Delivery and installation of Power Station , 2x250 kVA 10(20)/0.4 kV;complete	5	40000	200000
	Low voltage cables,	4000	15	60000
F3	Inside and outside well lightning , complete. Calculation per m2. 40 x 40 m^2	1600	40	64000
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	4500	40	180000
F5	Electrical distribution cabinet (well complete	40	1500	60000
F6	Command control center (construction of object+ equipement)	1	150000	150000
	TOTAL F:			**914000**
G	**Acquisition of land**			
	Acquisition of land in the immediate protection zone			
	Calculation per ha			
	50ha	50	5000	250000
	TOTAL G:			**250000**
	TOTAL A-G:			**7461500**
H	**OPERATION&MAINTENANCE (ANNUAL COSTS)**			
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'. 14wellsx60meters	840	50	42000
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year)	0.1	370000	37000
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year)	0.05	914000	45700
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	200	400	80000
H5	Power consumption costs. Price per kWh. 126kWx24hx365days	1103760	0.1	110376
H6	Labour costs, price per work/month. 2workersx12months	24	500	12000
	TOTAL H:			**327076**

BLUEWATERS
Environmental Consultants

Book II

APPENDIX 8:

COST ESTIMATES FOR LOCAL WATER SOURCES

List of Tables:

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		APATIN MUNICIPALITY														
		APATIN			KUPUSINA			PRIGREVICA(connected to Apatin			SVILOJEVO (no data)			SONTA		
A	Water supply wells&piezometers	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	1	60	4800
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	1	60	30000
A3	Construction of concrete well shafts															
	Calculation per well shaft	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2000
A4	Procurement and installation of mechanical equipement															
	-Submersible pump	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6300
	-Gate valve	0	0	0	0	0	0	0	0	0	0	0	0	1	1	300
	-FF piece	0	0	0	0	0	0	0	0	0	0	0	0	1	1	250
	-Back valve	0	0	0	0	0	0	0	0	0	0	0	0	1	1	600
	Air Valve	0	0	0	0	0	0	0	0	0	0	0	0	1	1	300
	Flow meter	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1500
	TOTAL A.:			**0**			**0**			**0**			**0**			**46050**
B	**Water mains**															
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	1	50	1250
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.															
	Calculation per m'	0	0	0	0	0	0	0	0	0	0	0	0	1	50	6000
	TOTAL B.:			**0**			**0**			**0**			**0**			**7250**
C	**Main pipeline to WTP**															
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.															
	Ø 300mm	0	0	0	0	0	0	0	0	0	0	0	0	1	50	9500
	TOTAL C.:			**0**			**0**			**0**			**0**			**10750**
D	**Acess Roads**															
D1	Leveling of the terrain with removal of surface layer and compacting.															
	Calculation per m2															
				0	0	0	0	0	0	0	0	0	0	1	250	250
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.															
	Calculation per m^2															
				0	0	0	0	0	0	0	0	0	0	1	250	2500
	TOTAL D:			**0**			**0**			**0**			**0**			**2750**
E	**Security Fence**															
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire															
	Calculation per m'															
				0	0	0	0	0	0	0	0	0	0	1	80	1200
E2																
	TOTAL E:			**0**			**0**			**0**			**0**			**1200**
F	**Electrical works**															
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'			0	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete			0	0	0	0	0	0	0	0	0	0	0	0	0
				0	0	0	0	0	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2			0	0	0	0	0	0	0	0	0	0	1	40	1600
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling			0	0	0	0	0	0	0	0	0	0	1	50	2000
F5	Electrical distribution cabinet (well complete)			0	0	0	0	0	0	0	0	0	0	1	1	1500
F6	Command control center (construction of object+ equipement)			0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**0**			**0**			**5100**
G	**Acquisition of land**															
	Acquisition of land in the immediate protection zone															
	Calculation per ha															
				0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**															
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	1	60	3000	0.7	42	2100	0	0	0	0	0	0	1	60	3000
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	3	0.1	2775	2	0.1	1850	0	0	0	0	0	0	3	0.1	2775
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	3	0.05	3750	2	0.05	2500	0	0	0	0	0	0	3	0.05	3750
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	165733	16573.3	1	9207	920.7	0	0	0	0	0	0	1	20256	2025.6
H6	Labour costs, price per work/month	1	12	6000	1	12	6000							1	12	6000
	TOTAL O&M:			**32098.3**			**13370.7**			**0**			**0**			**17550.6**
	TOTAL INVESTMENTS:			**0**			**0**			**0**			**0**			**73100**

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		SOMBOR MUNICIPALITY																																				
		SOMBOR			ALEKSA ŠANTIĆ			BAČKI BREG			BAČKI MONOŠTOR			BEZDAN			GAKOVO			DOROSLOVO(new GW source)			KLJAJIĆEVO			KOLUT			RASTINA			RIĐICA			SVETOZAR MILETIĆ			STANIŠIĆ		
A	Water supply wells&piezometers	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters																																					
	Calculation per m'	0	0	0	0	0	0	1	70	5600	1	75	6000	0	0	0	1	140	11200	2	80	12800	2	100	16000	1	132	10560	0	0	0	0	0	0	0	0	0	1	90	7200
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.																																					
	Calculation per m'	0	0	0	0	0	0	1	70	35000	1	75	37500	0	0	0	1	140	70000	2	80	80000	2	100	100000	1	132	66000	0	0	0	0	0	0	0	0	0	1	90	45000
A3	Construction of concrete well shafts																																					
	Calculation per well shaft	0	0	0	0	0	0	1	1	2000	1	1	2000	0	0	0	1	1	2000	2	1	4000	2	1	4000	1	1	2000	0	0	0	0	0	0	0	0	0	1	1	2000
A4	Procurement and installation of mechanical equipement																																					
	-Submersible pump	0	0	0	0	0	0	1	1	6300	1	1	6300	0	0	0	1	1	6300	2	1	12600	2	1	12600	1	1	6300	0	0	0	0	0	0	0	0	0	1	1	6300
	-Gate valve	0	0	0	0	0	0	1	1	300	1	1	300	0	0	0	1	1	300	2	1	600	2	1	600	1	1	300	0	0	0	0	0	0	0	0	0	1	1	300
	-FF piece	0	0	0	0	0	0	1	1	250	1	1	250	0	0	0	1	1	250	2	1	500	2	1	500	1	1	250	0	0	0	0	0	0	0	0	0	1	1	250
	-Back valve	0	0	0	0	0	0	1	1	600	1	1	600	0	0	0	1	1	600	2	1	1200	2	1	1200	1	1	600	0	0	0	0	0	0	0	0	0	1	1	600
	Air Valve	0	0	0	0	0	0	1	1	300	1	1	300	0	0	0	1	1	300	2	1	600	2	1	600	1	1	300	0	0	0	0	0	0	0	0	0	1	1	300
	Flow meter	0	0	0	0	0	0	1	1	1500	1	1	1500	0	0	0	1	1	1500	2	1	3000	2	1	3000	1	1	1500	0	0	0	0	0	0	0	0	0	1	1	1500
	TOTAL A.:			**0**			**0**			**51850**			**54750**			**0**			**92450**			**115300**			**138500**			**87810**			**0**			**0**			**0**			**63450**
B	**Water mains**																																					
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including																																					
	Calculation per m'	0	0	0	0	0	0	1	50	1250	1	50	1250	0	0	0	1	50	1250	1	150	3750	1	100	2500	1	50	1250	0	0	0	0	1	0	0	0	0	1	50	1250
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																																					
	Calculation per m'	0	0	0	0	0	0	1	50	6000	1	50	6000	0	0	0	1	50	6000	1	150	22500	1	100	15000	1	50	6000	0	0	0	0	0	0	0	0	0	1	50	6000
	TOTAL B.:			**0**			**0**			**7250**			**7250**			**0**			**7250**			**26250**			**17500**			**7250**			**0**			**0**			**0**			**7250**
C	**Main pipeline to WTP**																																					
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e																																					
	Calculation per m'	0	0	0	1	50	1250	1	50	1250	1	50	1250	0	0	0	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																																					
	Ø 300mm	0	0	0	1	50	9500	1	50	9500	1	50	9500	0	0	0	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**0**			**10750**			**10750**			**10750**			**0**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**																																					
D1	Leveling of the terrain with removal of surface layer and compacting.																																					
	Calculation per m2	0	0	0	0	0	0	1	250	250	1	250	250	0	0	0	1	250	250	1	500	500	1	500	500	1	250	250	0	0	0	0	0	0	0	0	0	1	250	250
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.																																					
	Calculation per m^2	0	0	0	0	0	0	1	250	2500	1	250	2500	0	0	0	1	250	2500	1	500	5000	1	500	5000	1	250	2500	0	0	0	0	0	0	0	0	0	1	250	2500
	TOTAL D:			**0**			**0**			**2750**			**2750**			**0**			**2750**			**5500**			**5500**			**2750**			**0**			**0**			**0**			**2750**
E	**Security Fence**																																					
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire																																					
	Calculation per m'	0	0	0	0	0	0	1	80	1200	1	80	1200	0	0	0	1	80	1200	2	80	2400	2	80	2400	1	80	1200	0	0	0	0	0	0	0	0	0	1	80	1200
E2																																						
	TOTAL E:			**0**			**0**			**1200**			**1200**			**0**			**1200**			**2400**			**2400**			**1200**			**0**			**0**			**0**			**1200**
F	**Electrical works**																																					
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	2500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	40000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	750	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	0	0	0	0	0	0	1	40	1600	1	40	1600	0	0	0	1	40	1600	2	40	3200	2	40	3200	1	40	1600	0	0	0	0	0	0	0	0	0	1	40	1600
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	0	0	0	0	0	0	1	50	2000	1	50	2000	0	0	0	1	40	1600	1	50	2000	1	100	4000	1	100	4000	0	0	0	0	0	0	0	0	0	1	100	4000
F5	Electrical distribution cabinet (well complete)	0	0	0	0	0	0	1	1	1500	1	1	1500	0	0	0	1	1	1500	2	1	3000	2	1	3000	1	1	1500	0	0	0	0	0	0	0	0	0	1	1	1500
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	25000	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**5100**			**5100**			**0**			**4700**			**76450**			**10200**			**7100**			**0**			**0**			**0**			**7100**
G	**Acquisition of land**																																					
	Acquisition of land in the immediate protection zone																																					
	Calculation per ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	15000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**			**0**			**15000**			**0**			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**																																					
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	7	80	28000	0.7	95	3325	1	70	3500	1	75	3750	0.7	60	2100	0.7	140	4900	1	80	4000	1	100	5000	1	132	6600	1	144	7200	1	80	4000	1	58	2900	1	90	4500
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	22	0.1	20350	2	0.1	1850	3	0.1	2775	3	0.1	2775	2	0.1	1850	2	0.1	1850	2	0.1	1850	4	0.1	3700	3	0.1	2775	2	0.1	1850	3	0.1	2775	2	0.1	1850	4	0.1	3700
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	22	0.05	27500	2	0.05	2500	3	0.05	3750	3	0.05	3750	2	0.05	2500	2	0.05	2500	1	0.05	3822.5	4	0.05	5000	3	0.05	3750	2	0.01	500	3	0.05	3750	2	0.05	2500	4	0.05	5000
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	252282	25228.2	1	11049	1104.9	1	6629	662.9	1	12890	1289	1	26517	2651.7	1	11050	1105	1	9207	920.7	1	25781	2578.1	1	8287	828.7	1	2762	276.2	1	12338	1233.8	1	14732	1473.2	1	22098	2209.8
H6	Labour costs, price per work/month	2	24	12000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**113078.2**			**14779.9**			**16687.9**			**17564**			**15101.7**			**16355**			**18593.2**			**22278.1**			**19953.7**			**15826.2**			**17758.8**			**14723.2**			**21409.8**
	TOTAL INVESTMENTS:			**0**			**10750**			**78900**			**81800**			**0**			**119100**			**251650**			**184850**			**116860**			**10750**			**10750**			**10750**			**92500**

BLUEWATERS
Environmental Consultants

		STAPAR			TELEČKA			ČONOPLJA		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters									
	Calculation per m'									
		1	120	9600	1	110	8800	1	120	9600
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.									
	Calculation per m'									
		1	120	60000	1	110	55000	1	120	60000
A3	Construction of concrete well shafts									
	Calculation per well shaft	1	1	2000	1	1	2000	1	1	2000
A4	Procurement and installation of mechanical equipement									
	-Submersible pump	1	1	6300	1	1	6300	1	1	6300
	-Gate valve	1	1	300	1	1	300	1	1	300
	-FF piece	1	1	250	1	1	250	1	1	250
	-Back valve	1	1	600	1	1	600	1	1	600
	Air Valve	1	1	300	1	1	300	1	1	300
	Flow meter	1	1	1500	1	1	1500	1	1	1500
	TOTAL A.:			**80850**			**75050**			**80850**
B	**Water mains**									
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including									
	Calculation per m'									
		1	50	1250	1	50	1250	1	50	1250
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.									
	Calculation per m'	1	50	6000	1	50	6000	1	50	6000
	TOTAL B.:			**7250**			**7250**			**7250**
C	**Main pipeline to WTP**									
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e									
	Calculation per m'									
		1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.									
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**
D	**Acess Roads**									
D1	Leveling of the terrain with removal of surface layer and compacting.									
	Calculation per m2									
		1	250	250	1	250	250	1	250	250
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.									
	Calculation per m^2									
		1	250	2500	1	250	2500	1	250	2500
	TOTAL D:			**2750**			**2750**			**2750**
E	**Security Fence**									
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire									
	Calculation per m'									
		1	80	1200	1	80	1200	1	80	1200
E2										
	TOTAL E:			**1200**			**1200**			**1200**
F	**Electrical works**									
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete									
		0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	1	40	1600	1	40	1600	1	40	1600
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	1	100	4000	1	100	4000	1	100	4000
F5	Electrical distribution cabinet (well complete)	1	1	1500	1	1	1500	1	1	1500
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0
	TOTAL F:			**7100**			**7100**			**7100**
G	**Acquisition of land**									
	Acquisition of land in the immediate protection zone									
	Calculation per ha									
		0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**
H	**Operation&maintenance**									
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	1	120	6000	1	110	5500	1	120	6000
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	4	0.1	3700	3	0.1	2775	2	0.1	1850
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	4	0.05	5000	3	0.05	3750	2	0.05	2500
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	11049	1104.9	1	11049	1104.9	1	20256	2025.6
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**21804.9**			**19129.9**			**18375.6**
	TOTAL INVESTMENTS:			**109900**			**104100**			**109900**

BLUEWATERS
Environmental Consultants

		KULA MUNICIPALITY																				
		KULA			CRVENKA			KRUŠČIĆ			LIPAR			NOVA CRVENKA			RUSKI KRSTUR			SIVAC		
A	Water supply wells&piezometers	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)	no.of objects	quantity	total price (eur)
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	1	130	10400	0	0	0	0	0	0	1	100	8000
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	1	130	65000	0	0	0	0	0	0	1	100	50000
A3	Construction of concrete well shafts																					
	Calculation per well shaft	0	0	0	0	0	0	0	0	0	1	1	2000	0	0	0	0	0	0	1	1	2000
A4	Procurement and installation of mechanical equipement																					
	-Submersible pump	0	0	0	0	0	0	0	0	0	1	1	6300	0	0	0	0	0	0	1	1	6300
	-Gate valve	0	0	0	0	0	0	0	0	0	1	1	300	0	0	0	0	0	0	1	1	300
	-FF piece	0	0	0	0	0	0	0	0	0	1	1	250	0	0	0	0	0	0	1	1	250
	-Back valve	0	0	0	0	0	0	0	0	0	1	1	600	0	0	0	0	0	0	1	1	600
	Air Valve	0	0	0	0	0	0	0	0	0	1	1	300	0	0	0	0	0	0	1	1	300
	Flow meter	0	0	0	0	0	0	0	0	0	1	1	1500	0	0	0	0	0	0	1	1	1500
	TOTAL A.:			**0**			**0**			**0**			**86650**			**0**			**0**			**69250**
B	**Water mains**																					
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	1	50	1250	0	0	0	0	0	0	1	50	1250
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																					
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	50	6000	0	0	0	0	0	0	1	50	6000
	TOTAL B.:			**0**			**0**			**0**			**7250**			**0**			**0**			**7250**
C	**Main pipeline to WTP**																					
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e																					
	Calculation per m'	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																					
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**																					
D1	Leveling of the terrain with removal of surface layer and compacting.																					
	Calculation per m2	0	0	0	0	0	0	0	0	0	1	250	250	0	0	0	0	0	0	1	250	250
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.																					
	Calculation per m^2	0	0	0	0	0	0	0	0	0	1	250	2500	0	0	0	0	0	0	1	250	2500
	TOTAL D:			**0**			**0**			**0**			**2750**			**0**			**0**			**2750**
E	**Security Fence**																					
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire																					
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	80	1200	0	0	0	0	0	0	1	80	1200
E2																						
	TOTAL E:			**0**			**0**			**0**			**1200**			**0**			**0**			**1200**
F	**Electrical works**																					
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0
				0			0			0			0			0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	0	0	0	0	0	0	0	0	0	1	40	1600	0	0	0	0	0	0	1	40	1600
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling																					
		0	0	0	0	0	0	0	0	0	1	50	2000	0	0	0	0	0	0	1	50	2000
F5	Electrical distribution cabinet (well complete)	0	0	0	0	0	0			0	1	1	1500	0	0	0			0	1	1	1500
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**0**			**5100**			**0**			**0**			**5100**
G	**Acquisition of land**																					
	Acquisition of land in the immediate protection zone																					
	Calculation per ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**																					
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	1	130	6500	2	130	13000	1	150	7500	1	140	7000	1	160	8000	1	225	11250	2	100	10000
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	2	0.1	1850	5	0.1	4625	3	0.1	2775	3	0.1	2775	2	0.1	1850	4	0.1	3700	7	0.1	6475
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	2	0.05	2500	5	0.05	6250	3	0.05	3750	3	0.05	3750	2	0.05	2500	4	0.05	5000	7	0.05	8750
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	53403	5340.3	1	21177	2117.7	1	9944	994.4	1	6629	662.9	1	2026	202.6	1	14732	1473.2	1	34988	3498.8
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**16190.3**			**25992.7**			**15019.4**			**14187.9**			**12552.6**			**21423.2**			**28723.8**
	TOTAL INVESTMENTS:			**10750**			**10750**			**10750**			**113700**			**10750**			**10750**			**96300**

BLUEWATERS
Environmental Consultants

		VRBAS MUNICIPALITY																				
		VRBAS			BAČKO DOBRO POLJE			ZMAJEVO			KOSANČIĆ			KUCURA			RAVNO SELO			SAVINO SELO		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3	Construction of concrete well shafts																					
	Calculation per well shaft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4	Procurement and installation of mechanical equipement																					
	-Submersible pump	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Gate valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-FF piece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Back valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Air Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flow meter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL A.:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
B	**Water mains**																					
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																					
	Calculation per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL B.:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
C	**Main pipeline to WTP**																					
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e																					
	Calculation per m'																					
		1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																					
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**																					
D1	Leveling of the terrain with removal of surface layer and compacting.																					
	Calculation per m2																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.																					
	Calculation per m^2																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL D:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
E	**Security Fence**																					
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire																					
	Calculation per m'																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2																						
	TOTAL E:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
F	**Electrical works**																					
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F5	Electrical distribution cabinet (well complete)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
G	**Acquisition of land**																					
	Acquisition of land in the immediate protection zone																					
	Calculation per ha																					
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**																					
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	4	120	24000	1	100	5000	1	100	5000	0.3	100	1500	1	100	5000	1	100	5000	0.3	80	1200
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	13	0.1	12025	3	0.1	2775	3	0.1	2775	1	0.1	925	3	0.1	2775	3	0.1	2775	1	0.1	925
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	13	0.05	16250	3	0.05	3750	3	0.05	3750	1	0.05	1250	3	0.05	3750	3	0.05	3750	1	0.05	1250
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	128903	12890.3	1	14732	1473.2	1	15653	1565.3	1	552	55.2	1	16573	1657.3	1	12890	1289	1	12154	1215.4
H6	Labour costs, price per work/month	2	24	12000	1	12	6000	1	12	6000	0	0	0	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**77165.3**			**18998.2**			**19090.3**			**3730.2**			**19182.3**			**18814**			**16590.4**
	TOTAL INVESTMENTS:			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**

BLUEWATERS
Environmental Consultants

ODŽACI MUNICIPALITY

		ODŽACI			BAČKI BRESTOVAC			BAČKI GRAČAC			BOGOJEVO			DERONJE			KARAVUKOVO			LALIĆ			RATKOVO			SRPSKI MILETIĆ		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters																											
	Calculation per m'	1	60	4800	1	130	10400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.																											
	Calculation per m'	1	60	30000	1	130	65000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3	Construction of concrete well shafts																											
	Calculation per well shaft	1	1	2000	1	1	2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4	Procurement and installation of mechanical equipement																											
	-Submersible pump	1	1	6300	1	1	6300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Gate valve	1	1	300	1	1	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-FF piece	1	1	250	1	1	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Back valve	1	1	600	1	1	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Air Valve	1	1	300	1	1	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flow meter	1	1	1500	1	1	1500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL A.:			**46050**			**86650**			**0**			**0**			**0**			**0**			**0**			**0**			**0**
B	**Water mains**																											
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including																											
	Calculation per m'	1	50	1250	1	50	1250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																											
	Calculation per m'	1	50	6000	1	50	6000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL B.:			**7250**			**7250**			**0**			**0**			**0**			**0**			**0**			**0**			**0**
C	**Main pipeline to WTP**																											
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e																											
	Calculation per m'			0	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																											
	Ø 300mm			0	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**0**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**																											
D1	Leveling of the terrain with removal of surface layer and compacting.																											
	Calculation per m2	1	250	250			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.																											
	Calculation per m^2	1	250	2500			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL D:			**2750**			**0**			**0**			**0**			**0**			**0**			**0**			**0**			**0**
E	**Security Fence**																											
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire																											
	Calculation per m'	1	80	1200	1	80	1200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2																												
	TOTAL E:			**1200**			**1200**			**0**			**0**			**0**			**0**			**0**			**0**			**0**
F	**Electrical works**																											
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'			0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete			0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				0			0	0	0	0	0	0	0	0	0	0	0	0	0			0			0			0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	1	40	1600	1	40	1600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	1	50	2000	1	50	2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F5	Electrical distribution cabinet (well complete)	1	1	1500	1	1	1500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F6	Command control center (construction of object+ equipement)			0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**5100**			**5100**			**0**			**0**			**0**			**0**			**0**			**0**			**0**
G	**Acquisition of land**																											
	Acquisition of land in the immediate protection zone																											
	Calculation per ha			0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**																											
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	1	80	4000	1	130	6500	1	140	7000	1	120	6000	1	320	16000	1	95	4750	1	200	10000	1	150	7500	1	110	5500
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	3	0.1	2775	3	0.1	2775	3	0.1	2775	2	0.1	1850	2	0.1	1850	1	0.1	925	2	0.1	1850	4	0.1	3700	2	0.1	1850
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	3	0.05	3750	3	0.05	3750	3	0.05	3750	2	0.05	2500	2	0.05	2500	1	0.05	1250	2	0.05	2500	4	0.05	5000	2	0.05	2500
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.			0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	45484	4548.4	1	13443	1344.3	1	14916	1491.6	1	5524	552.4	1	11049	1104.9	1	13259	1325.9	1	3683	368.3	1	10681	1068.1	1	6445	644.5
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**15073.4**			**14369.3**			**15016.6**			**10902.4**			**21454.9**			**8250.9**			**14718.3**			**17268.1**			**10494.5**
	TOTAL INVESTMENTS:			**62350**			**110950**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**

BLUEWATERS
Environmental Consultants

		BAČ MUNICIPALITY																	
		BAČ			BAČKO NOVO SELO			BODANI			VAJSKA			PLAVNA			SELENČA		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters																		
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	80	6400	0	0	0	0	0	0
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.																		
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	80	40000	0	0	0	0	0	0
A3	Construction of concrete well shafts																		
	Calculation per well shaft	0	0	0	0	0	0	0	0	0	1	1	2000	0	0	0	0	0	0
A4	Procurement and installation of mechanical equipement																		
	-Submersible pump	0	0	0	0	0	0	0	0	0	1	1	6300	0	0	0	0	0	0
	-Gate valve	0	0	0	0	0	0	0	0	0	1	1	300	0	0	0	0	0	0
	-FF piece	0	0	0	0	0	0	0	0	0	1	1	250	0	0	0	0	0	0
	-Back valve	0	0	0	0	0	0	0	0	0	1	1	600	0	0	0	0	0	0
	Air Valve	0	0	0	0	0	0	0	0	0	1	1	300	0	0	0	0	0	0
	Flow meter	0	0	0	0	0	0	0	0	0	1	1	1500	0	0	0	0	0	0
	TOTAL A.:			**0**			**0**			**0**			**57650**			**0**			**0**
B	**Water mains**																		
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including																		
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	50	1250	0	0	0	0	0	0
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																		
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	50	6000	0	0	0	0	0	0
	TOTAL B.:			**0**			**0**			**0**			**7250**			**0**			**0**
C	**Main pipeline to WTP**																		
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e																		
	Calculation per m'	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.																		
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**																		
D1	Leveling of the terrain with removal of surface layer and compacting.																		
	Calculation per m2	0	0	0	0	0	0	0	0	0	1	250	250	0	0	0	0	0	0
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.																		
	Calculation per m^2	0	0	0	0	0	0	0	0	0	1	250	2500	0	0	0	0	0	0
	TOTAL D:			**0**			**0**			**0**			**2750**			**0**			**0**
E	**Security Fence**																		
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire																		
	Calculation per m'	0	0	0	0	0	0	0	0	0	1	80	1200	0	0	0	0	0	0
E2																			
	TOTAL E:			**0**			**0**			**0**			**1200**			**0**			**0**
F	**Electrical works**																		
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	0	0	0	0	0	0	0	0	0	1	1	40	0	0	0	0	0	0
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	0	0	0	0	0	0	0	0	0	1	100	4000	0	0	0	0	0	0
F5	Electrical distribution cabinet (well complete)	0	0	0	0	0	0	0	0	0	1	1	1500	0	0	0	0	0	0
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**0**			**5540**			**0**			**0**
G	**Acquisition of land**																		
	Acquisition of land in the immediate protection zone																		
	Calculation per ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**																		
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	1	200	10000	0.3	120	1800	1	187	9350	1	80	4000	0.3	180	2700	0.7	195	6825
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	4	0.1	3700	1	0.1	925	2	0.1	1850	3	0.1	2775	1	0.1	925	2	0.1	1850
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	4	0.05	5000	1	0.05	1250	2	0.05	2500	3	0.05	3750	1	0.05	1250	2	0.05	2500
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	12890	1289	1	3683	368.3	1	2762	276.2	1	11049	1104.9	1	3683	368.3	1	7366	736.6
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**25989**			**10343.3**			**19976.2**			**17629.9**			**11243.3**			**17911.6**
	TOTAL INVESTMENTS:			**10750**			**10750**			**10750**			**85140**			**10750**			**10750**

BLUEWATERS
Environmental Consultants

		SRBOBRAN MUNICIPALITY								
		SRBOBRAN			NADALJ			TURIJA		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters									
	Calculation per m'									
		3	100	24000	1	150	12000	0	0	0
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.									
	Calculation per m'									
		3	100	150000	1	150	75000	0	0	0
A3	Construction of concrete well shafts									
	Calculation per well shaft	3	1	6000	1	1	2000	0	0	0
A4	Procurement and installation of mechanical equipement									
	-Submersible pump	3	1	18900	1	1	6300	0	0	0
	-Gate valve	3	1	900	1	1	300	0	0	0
	-FF piece	3	1	750	1	1	250	0	0	0
	-Back valve	3	1	1800	1	1	600	0	0	0
	Air Valve	3	1	900	1	1	300	0	0	0
	Flow meter	3	1	4500	1	1	1500	0	0	0
	TOTAL A.:			**207750**			**98250**			**0**
B	**Water mains**									
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including									
	Calculation per m'									
		1	150	3750	1	50	1250	0	0	0
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.									
	Calculation per m'	1	150	18000	1	50	6000	0	0	0
	TOTAL B.:			**21750**			**7250**			**0**
C	**Main pipeline to WTP**									
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e									
	Calculation per m'									
		1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.									
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**
D	**Acess Roads**									
D1	Leveling of the terrain with removal of surface layer and compacting.									
	Calculation per m2									
		1	750	750	1	250	250	0	0	0
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.									
	Calculation per m^2									
		1	750	7500	1	250	2500	0	0	0
	TOTAL D:			**8250**			**2750**			**0**
E	**Security Fence**									
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire									
	Calculation per m'									
		3	80	3600	1	80	1200	0	0	0
E2										
	TOTAL E:			**3600**			**1200**			**0**
F	**Electrical works**									
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete									
		1	1	40000	0	0	0	0	0	0
		1	150	2250	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	3	40	4800	1	40	1600	0	0	0
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	1	150	6000	1	50	2000	0	0	0
F5	Electrical distribution cabinet (well complete)	3	1	4500	1	1	1500	0	0	0
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0
	TOTAL F:			**57550**			**5100**			**0**
G	**Acquisition of land**									
	Acquisition of land in the immediate protection zone									
	Calculation per ha									
		0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**
H	**Operation&maintenanc**									
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	3	100	15000	0.7	150	5250	1	110	5500
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	9	0.1	8325	2	0.1	1850	3	0.1	2775
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	9	0.05	11250	2	0.05	2500	3	0.05	3750
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	60769	6076.9	1	8287	828.7	1	9760	976
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**46651.9**			**16428.7**			**19001**
	TOTAL INVESTMENTS:			**309650**			**125300**			**10750**

BLUEWATERS
Environmental Consultants

		NOVI BEČEJ MUNICIPALITY											
		NOVI BEČEJ			BOČAR			KUMANE			NOVO MILOŠEVO		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters												
	Calculation per m'												
		0	0	0	0	0	0	1	100	8000	1	100	8000
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.												
	Calculation per m'												
		0	0	0	0	0	0	1	100	50000	1	100	50000
A3	Construction of concrete well shafts												
	Calculation per well shaft	0	0	0	0	0	0	1	1	2000	1	1	2000
A4	Procurement and installation of mechanical equipement												
	-Submersible pump	0	0	0	0	0	0	1	1	6300	1	1	6300
	-Gate valve	0	0	0	0	0	0	1	1	300	1	1	300
	-FF piece	0	0	0	0	0	0	1	1	250	1	1	250
	-Back valve	0	0	0	0	0	0	1	1	600	1	1	600
	Air Valve	0	0	0	0	0	0	1	1	300	1	1	300
	Flow meter	0	0	0	0	0	0	1	1	1500	1	1	1500
	TOTAL A.:			**0**			**0**			**69250**			**69250**
B	**Water mains**												
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including												
	Calculation per m'												
		0	0	0	0	0	0	1	50	1250	1	50	1250
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.												
	Calculation per m'	0	0	0	0	0	0	1	50	6000	1	50	6000
	TOTAL B.:			**0**			**0**			**7250**			**7250**
C	**Main pipeline to WTP**												
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e												
	Calculation per m'												
		1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.												
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**												
D1	Leveling of the terrain with removal of surface layer and compacting.												
	Calculation per m2												
		0	0	0	0	0	0	1	250	250	1	250	250
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.												
	Calculation per m^2												
		0	0	0	0	0	0	1	250	2500	1	250	2500
	TOTAL D:			**0**			**0**			**2750**			**2750**
E	**Security Fence**												
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire												
	Calculation per m'												
		0	0	0	0	0	0	1	80	1200	1	80	1200
E2													
	TOTAL E:			**0**			**0**			**1200**			**1200**
F	**Electrical works**												
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete												
		0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	0	0	0	0	0	0	1	1	40	1	1	40
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling												
		0	0	0	0	0	0	1	100	4000	1	100	4000
F5	Electrical distribution cabinet (well complete)	0	0	0	0	0	0	1	1	1500	1	1	1500
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**5540**			**5540**
G	**Acquisition of land**												
	Acquisition of land in the immediate protection zone												
	Calculation per ha												
		0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**
H	**Operation&maintenance**												
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	2	105	10500	1	100	5000	1	100	5000	1	100	5000
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	6	0.1	5550	3	0.1	2775	5	0.1	4625	3	0.1	2775
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	6	0.05	7500	3	0.05	3750	5	0.05	6250	3	0.05	3750
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	68135	6813.5	1	7734	773.4	1	15653	1565.3	1	22098	2209.8
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**36363.5**			**18298.4**			**23440.3**			**19734.8**
	TOTAL INVESTMENTS:			**10750**			**10750**			**96740**			**96740**

BLUEWATERS
Environmental Consultants

		BEČEJ MINICIPALITY														
		BEČEJ			BAČKO GRADIŠTE			BAČKO PETROVO SELO			MILEŠEVO			RADIČEVIĆ		
A	**Water supply wells&piezometers**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**	**no.of objects**	**quantity**	**total price (eur)**
A1	Drilling of piezometer boreholes, with a diameter of 146 mm to a max. depth of (varies) meters															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2	Well drilling, equidistance 100 m, Well drilling with a diameter of 820 mm to a max. depth of (varies) m, well construction diameter 350 mm, steel or PVC casing.															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3	Construction of concrete well shafts															
	Calculation per well shaft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A4	Procurement and installation of mechanical equipement															
	-Submersible pump	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Gate valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-FF piece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Back valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Air Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flow meter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL A.:			**0**			**0**			**0**			**0**			**0**
B	**Water mains**															
B1	Excavation of trench , for laying a pipeline , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including															
	Calculation per m'															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.															
	Calculation per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL B.:			**0**			**0**			**0**			**0**			**0**
C	**Main pipeline to WTP**															
C1	Excavation of trench with , for laying a main pipeline Ø varies , with proper cutting of edges and removal of earth out of the trench.Leveling of bottom of trench in accordance with elevations and slopes given in the design, including removal of excess e															
	Calculation per m'	1	50	1250	1	50	1250	1	50	1250	1	50	1250	1	50	1250
C2	Procurement, transportation, laying alongside trench and installation of steel piping, with couplings and necessary fittings.															
	Ø 300mm	1	50	9500	1	50	9500	1	50	9500	1	50	9500	1	50	9500
	TOTAL C.:			**10750**			**10750**			**10750**			**10750**			**10750**
D	**Acess Roads**															
D1	Leveling of the terrain with removal of surface layer and compacting.															
	Calculation per m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	Procurement, transport and compacting of broken stone, in 20cm layers, 5,00 m width.															
	Calculation per m^2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL D:			**0**			**0**			**0**			**0**			**0**
E	**Security Fence**															
E1	Construction of security fence with concrete pillars at 2,0 m distance, height 2,0 m with chain link fence 1,50m heigh and two rows of barb wire															
	Calculation per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2																
	TOTAL E:			**0**			**0**			**0**			**0**			**0**
F	**Electrical works**															
F1	Delivery and laying of power supply cables 10kV, single direction supply. Price per m'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	Delivery and installation of Power Station , 2x250 kVA, 10(20)/0.4 kV;complete	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
F3	Inside and outside well lightning , complete. Calculation per m2. n x 40 m^2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	Power cables of different sections, with excavation of trenches, cable laying and backfilling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F5	Electrical distribution cabinet (well complete)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F6	Command control center (construction of object+ equipement)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL F:			**0**			**0**			**0**			**0**			**0**
G	**Acquisition of land**															
	Acquisition of land in the immediate protection zone															
	Calculation per ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL G:			**0**			**0**			**0**			**0**			**0**
H	**Operation&maintenance**															
H1	Regeneration of production wells, every 3 years, (30% wells annualy). Price per m'.	4	80	16000	0.7	200	7000	3	100	15000	0.7	80	2800	1	130	6500
H2	Repair expenses for mechanical equipment, calculated as 10% of total equipment value (per year).	13	0.1	12025	2	0.1	1850	9	0.1	8325	2	0.1	1850	3	0.1	2775
H3	Repair expenses for electrical equipment, calculated as 5% of total equipment value (per year).	13	0.05	16250	2	0.05	2500	9	0.05	11250	2	0.05	2500	3	0.05	3750
H4	Compensation for reduction of use of chemicals and fertilizers in the wider protection zone of GW source. Calculated per ha.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H5	Power consumption costs. Price per kWh.	1	128903	12890.3	1	14732	1473.2	1	20256	2025.6	1	4235	423.5	1	4972	497.2
H6	Labour costs, price per work/month	1	12	6000	1	12	6000	1	12	6000	1	12	6000	1	12	6000
	TOTAL O&M:			**63165.3**			**18823.2**			**42600.6**			**13573.5**			**19522.2**
	TOTAL INVESTMENTS:			**10750**			**10750**			**10750**			**10750**			**10750**