REPUBLIC OF SERBIA
THE CITY OF BELGRADE
BELGRADE LAND DEVELOPMENT PUBLIC AGENCY (LDA)
BELGRADE WATERWORKS AND SEWERAGE (BVK)

PREPARATORY SURVEY REPORT
ON
THE SEWERAGE SYSTEM IMPROVEMENT PROJECT
FOR
THE CITY OF BELGRADE
IN
REPUBLIC OF SERBIA

VOLUME III
APPENDIX-II
(PRE EIA & LARAP)

MAY 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

TEC INTERNATIONAL CO., LTD.

7R
CR(5)
13-018

REPUBLIC OF SERBIA
THE CITY OF BELGRADE
BELGRADE LAND DEVELOPMENT PUBLIC AGENCY (LDA)
BELGRADE WATERWORKS AND SEWERAGE (BVK)

PREPARATORY SURVEY REPORT
ON
THE SEWERAGE SYSTEM IMPROVEMENT PROJECT
FOR
THE CITY OF BELGRADE
IN
REPUBLIC OF SERBIA

VOLUME III
APPENDIX-II
(PRE EIA & LARAP)

MAY 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

TEC INTERNATIONAL CO., LTD.

EXCHANGE RATE

1 Euro	**115.00**	**Serbian Dinar**
1 Euro	**105.00**	**Japanese Yen**

as of January 2013

VOLUME I

SUMMARY & MAIN REPORT

VOLUME II

APPENDIX-I

VOLUME III

APPENDIX-II

(PRE EIA & LARAP)

VOLUME IV

DRAWINGS

Preparatory Survey Report
on the Sewerage System Improvement Project for the City of Belgrade
in Republic of Serbia

Table of Contents

1. Preliminary Environmental Impact Assessment Study Report

   Pumping Stations and the Interceptors

2. Preliminary Environmental Impact Assessment Study Report

   Veliko Selo Wastewater Treatment Plant

3. Land Acquisition and Resettlement Action Plan

INSTITUTE FOR HYDRAULIC AND ENVIRONMENTAL ENGINEERING

Telephone (011) 33-70-206
(011) 32-18-530
Fax (011) 33-70-206
E-mail: office@hikom.grf.bg.ac.rs

UNIVERSITY OF BELGRADE FACULTY OF CIVIL ENGINEERING

Bulevar kralja Aleksandra 73, Belgrade
Telephone (011) 32-18-553
Fax (011) 33-70-223

Client: TEC International Co., Ltd.

PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PREPARATORY SURVEY ON THE SEWERAGE SYSTEM IMPROVEMENT FOR THE CITY OF BELGRADE PUMPING STATIONS AND THE INTERCEPTORS

Belgrade, March 2013

Client:	**TEC International Co., Ltd.** 3-7-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013 Japan
Facility:	Belgrade Sewerage System
Location of the Facility:	Belgrade, Serbia
Work Assignment:	**PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PREPARATORY SURVEY ON THE SEWERAGE SYSTEM IMPROVEMENT FOR THE CITY OF BELGRADE IN THE REPUBLIC OF SERBIA**
Assignment Manager:	Assist. Prof. Dr. Zorana Naunović
Authors:	Assist. Prof. Dr. Zorana Naunović, Environmental Engineer Assist. Prof. Dr. Nenad Jaćimović, Civil (Hydraulic) Engineer
Assignment Code:	43970
Date of completion:	March 2013

DIRECTOR OF THE INSTITUTE OF HYDRAULIC AND ENVIRONMENTAL ENGINEERING

Prof. Dr. Dušan Prodanović, CE

DEAN OF THE FACULTY OF CIVIL ENGINEERING

Prof. Dr. Dušan Najdanović, CE

Contents

List of Abbreviations iv
1 Executive Summary 1
2 Project Description 3
2.1 Pumping Stations 11
2.2 Interceptors 13
3 Legal and Administrative Framework 17
3.1 Legal Framework 17
3.2 Administrative Framework 18
3.3 Environmental Impact Analysis Procedures 18
4 Baseline Data 20
4.1 Population, Topography, Bio-Geographical and Landscape Features 20
4.2 Land Cover in the Project Area 25
4.3 Geology 27
4.4 Soil Types and Quality 29
4.5 Soil Erosion 31
4.6 Meteorology 31
4.6.1 Air Temperature 32
4.6.2 Precipitation 32
4.6.3 Relative Humidity 33
4.6.4 Wind Speed 34
4.6.5 Insolation 35
4.7 Air Quality 35
4.8 Noise and Vibrations 39
4.9 Solid Waste Management 41
4.10 Wastewater Discharge 44
4.11 Surface Water and Sediment Quality 50
4.12 Hydrogeological situation 58
4.12.1 Characteristics of the Usce Area 60
4.12.2 Groundwater quality 62
4.13 Hydrological Situation 64
4.13.1 River Regimes 64
4.13.2 The Danube River 64
4.13.3 The Sava River 66

4.13.4 Frequency Analysis of Flood Levels 67
4.14 Coastal Zone 68
4.15 Natural Environment 69
4.15.1 Protected Areas 69
4.15.1.1 Natural Monument – Marine Neogene Sandbank at Kalemegdan 71
4.15.1.2 Landscape of Outstanding Features – Great War Island 72
4.15.2 Flora, Fauna and Biodiversity 74
4.16 Cultural Heritage 77
5 Analysis of With and Without the Project Scenario 84
6 Environmental Impacts 85
6.1 Construction Phase Impacts 85
6.1.1 Soil and Geographical Features (Landscape) 85
6.1.2 Microclimate Parameters 85
6.1.3 Global Warming 86
6.1.4 Air Pollution and Offensive Odors 86
6.1.5 Noise and Vibrations 86
6.1.6 Ground Subsidence 88
6.1.7 Solid Waste Management 88
6.1.8 Water Resources and River Sediments 88
6.1.9 Natural Environment 91
6.1.10 Cultural Heritage 91
6.1.11 Existing social infrastructures and services 92
6.2 Operation Phase Impacts 92
6.2.1 Soil and Geographical Features (Landscape) 92
6.2.2 Microclimate Parameters 92
6.2.3 Global Warming 92
6.2.4 Air Pollution and Offensive Odors 92
6.2.5 Noise and Vibrations 93
6.2.6 Ground Subsidence 93
6.2.7 Solid Waste Management 93
6.2.8 Water Resources and River Sediment 93
6.2.9 Natural Environment 95
6.2.10 Cultural Heritage 95
6.2.11 Existing social infrastructures and services 95
7 Environmental Management Plan 96

8 List of References 99
8.1 Legislation 99
8.2 Guidelines 100
8.3 Plans and Strategies 100
8.4 General References 101

List of Abbreviations

BOD_5	Five Day Biological Oxygen Demand
cfu	colony forming unit
CLC	CORINE Land Cover
COD	Chemical Oxygen Demand
CORINE	Coordination of Information on the Environment
CSMP	Construction Site Management Plan
CSO	Combined Sewer Overflow
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EU	European Union
HPP	Hydro Power Plant
ICM	Immovable Cultural Monument
JICA	Japan International Cooperation Agency
LV	Limit Value
m. a.s.l.	meters above sea level
MAC	Maximum Allowable Concentration
PAHs	Polycyclic Aromatic Hydrocarbons
PEIA	Preliminary Environmental Impact Assessment
PM	Particulate matter
PS	Pumping Station
PUC	Public Utility Company
RHSS	Republic Hydrometeorological Service of Serbia
SRB	Sava River Basin
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

1 Executive Summary

The current situation in Belgrade is that all wastewater generated in the city, domestic and industrial, is discharged into the Sava and Danube Rivers without prior treatment. The Sava and the Danube rivers represent the "heart" of the City, along whose riverbanks the City was founded and grew. The "riverside" life-style that Belgrade and its inhabitants are known for is becoming increasingly an unsustainable way of life, as the rivers are polluted. Moreover, the discharge of untreated wastewater from the city influences the water quality far downstream of Belgrade and consequently impacts aquatic life – the biodiversity and functionality of aquatic ecosystems.

In order to solve this problem, a "Master Plan of the Belgrade Sewerage System" was prepared in 2011 that is in conformity with "Master Plan of Belgrade 2021". The Sewerage System Master Plan elaborates on the sewerage system infrastructure defined in the "Master Plan of Belgrade 2021" and develops the detailed sewer system network and options for wastewater treatment.

The Government of Serbia requested the Japanese Government to extend a Japan International Cooperation Agency (JICA) Loan for a Sewerage System Improvement Project for the City of Belgrade. The scope of works of the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade" (hereinafter referred to as "the Project") is to implement a part of the Sewerage Master Plan and includes the analysis of the following facilities:

- Usce (Ušće in Serbian) and Mostar Pumping Stations (PS);
- Interceptors;
- Veliko Selo Wastewater Treatment Plant (WWTP);
- Sludge Treatment Facilities.

This Preliminary Environmental Impact Analysis (PEIA) Study Report will focus on the Pumping Stations and the Interceptors, while another PEIA Study is also prepared for the Veliko Selo WWTP and the Sludge Treatment Facilities.

This document summarizes analysis on several aspects of the PEIA:

- Description of the Proposed Project;
- Analysis of the Legal and Administrative Framework;
- Collection and Analysis of Baseline Environmental Data;
- Analysis of With and Without the Project Scenario;
- Identification and Prediction of Impacts;
- Mitigation Measures and Monitoring Plan.

The Republic of Serbia acceded to the International Commission for the Protection of the Danube River in August 2003 and promoted sewerage system development. The majority of measuring results indicated that the Belgrade waters do not satisfy the Class II requirements (good ecological status) and have a poor ecological status. The River Danube does not comply with the Class II requirements due to microbial pollution, which can infer to fecal contamination from raw wastewater discharges.

Among the natural protected areas in Belgrade, only the Great War Island (Veliko ratno ostrvo in Serbian) and the Neocene sandbank at Kalemegdan are within the narrow zone of planned works, but will not be influenced by the planned works.

In addition, the location of the Usce PS is in the inner protection zone of the Belgrade wellhead area. Analysis of groundwater regime in this area reveals that it lies in the recharge area of the Belgrade Waterworks and Sewerage Public Utility Company wells RB-2 and RB-4. The capacity of these wells is significant, especially RB-4, which produces about 130 L/s.

Interceptor No. 2 will be installed around the Belgrade Fortress, which is of important cultural heritage. The planned works will be carried out with the Decision on Technical Protection Measures that will be issued by the Belgrade City Institute for Protection of Cultural Monuments and/or the Republic Institute for Protection of Cultural Monuments at the Preliminary Design Phase of the Project.

It is foreseen that proper functioning of WWTP and reduction of pollution from Belgrade will have positive effects to all groups of aquatic biota.

With the implementation of the proposed Project works, the Republic of Serbia and the City of Belgrade will achieve a number of very important goals:

- The Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012-Amendments) will be satisfied, which is a dual great benefit to Serbia – it will improve its water quality status in Belgrade and it will fulfill an environmental requirement set forward by the European Union. The Project will also lead to faster compliance with the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012).

- With the construction of the interceptors and the Veliko Selo WWTP, Belgrade's industries will be forced to comply with the wastewater effluent standards for discharge into the communal sewer system. These waters are currently discharged into the river waters untreated.

- Belgrade's drinking water sources (both surface and groundwater resources) are under the direct influence of the surface water quality; the improvement of the surface water quality will enhance the safety of the drinking water sources for the future.

- The further accumulation of pollutants in river bed sediments will be delayed.

- The City of Belgrade's waters will be healthier and this will improve the general standard of living for the city's inhabitants. The City beaches and bating waters will be safer to use due to the discontinuance of raw wastewater discharges in their vicinity. Aquatic habitats will also be improved.

- The tourist potential will be increased by developing different kinds of entertainment venues and tours on the rivers.

- The construction of the interceptors will free up large areas along the Sava and Danube River banks that outlets (e.g. at the location of Ada Huja). This will have a positive effect on surface water quality, riparian flora and the landscape in general. The rehabilitated spaces will be available for recreational and other activities.

2 Project Description

Due to negative anthropogenic impact, watercourses in Serbia are under the influence of three most significant pollution sources: communal wastewater, industrial wastewater and water runoff from agricultural areas. The most significant municipal pollution sources in Serbia include the Cities of Belgrade, Novi Sad and Nis (Niš in Serbian).

The area influenced by the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade" (hereinafter referred to as "the Project") includes the City of Belgrade and its wider metropolitan area (Figure 1). Belgrade (Beograd in Serbian) has a population of around 1.6 million (Census in Serbia 2011) and it is situated on the confluence of the Danube and Sava Rivers.

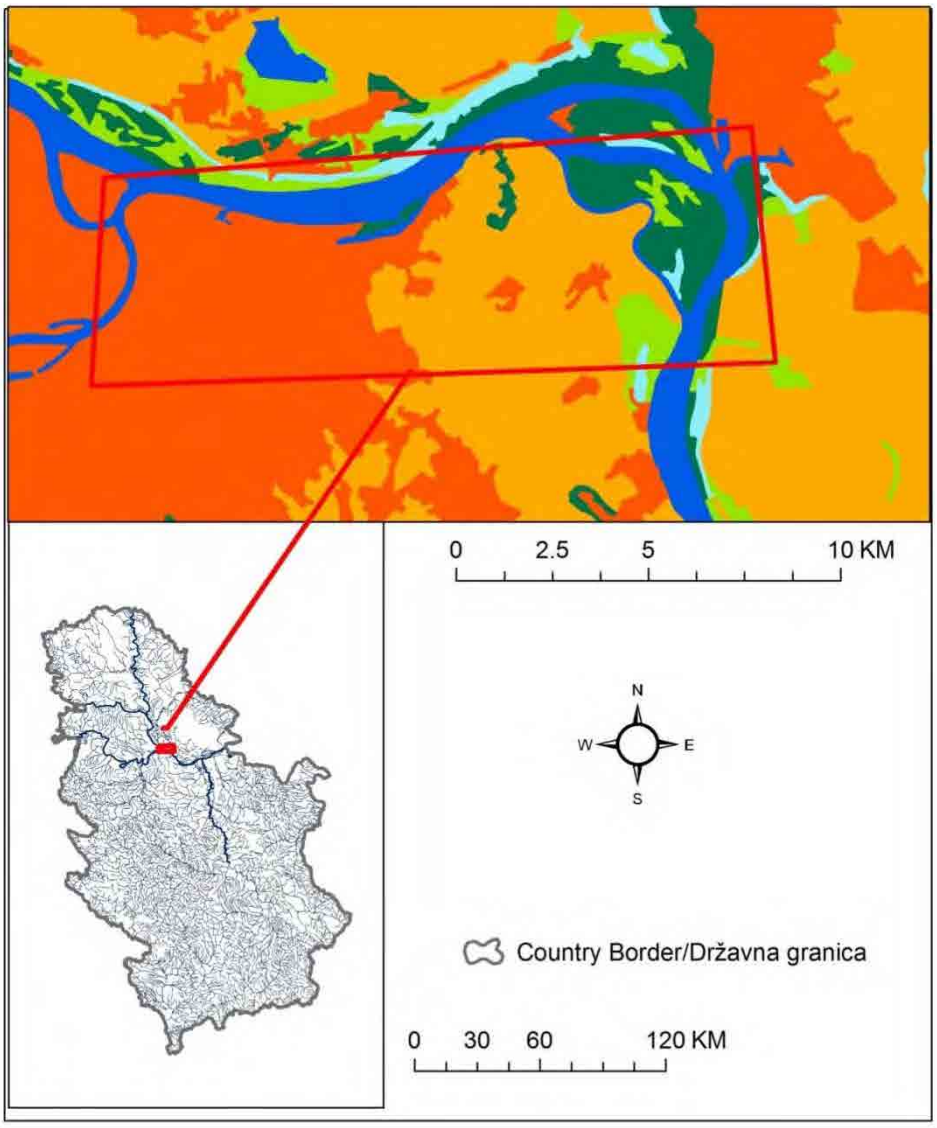


Figure 1. The area of project influence

The sewage system of the city does not have treatment facilities and the wastewater collected through the collection system is discharged directly to the Danube and Sava Rivers. The discharge of untreated wastewater significantly deteriorates the status of the two rivers. In addition, since the drinking water

supply services for the City of Belgrade depend on surface water and groundwater sources, the discharge of untreated sewage may cause not only an increase in operation cost of the water treatment plants but also safety problems in terms of water quality of the drinking water in future.

The area that is the subject of this Preliminary Environmental Impact Assessment (PEIA) Study Report (hereinafter referred to as "the Report") includes urban areas.

The planned construction of Waste Water Treatment Plant (WWTP) and the interceptors will primarily contribute to the improvement of the status of the Danube and the Sava Rivers, not only in the narrow zone of Belgrade, but also in the downstream stretch. The improved river water quality will also influence the quality of drinking water, as the drinking water supply services for the City of Belgrade depend in part on surface water sources. The Vinca (Vinča in Serbian) surface water intake (from the River Danube) for drinking water production is located about 7 km downstream of the locality of building of WWTP.

The City of Belgrade was, together with the Cities of Budapest, Novi Sad and Bucharest, identified as one of the major sources of organic pollution along the Danube. In the last three years, the WWTP system of the City of Budapest has been significantly improved (Csepel system) and so the Cities of Belgrade, Bucharest and Novi Sad remain the main sources of organic pollution.

To illustrate the importance of the improvement of the status of the Danube and the Sava Rivers, a short description of the basin area is enclosed.

The Danube River Basin (Figure 2) covers an area of about 801,000 km^2 and it is shared by 19 countries in Central and South-Eastern Europe (Germany, Austria, Switzerland, Italy, Poland, the Czech Republic, Slovenia, Slovakia, Hungary, Croatia, Serbia, Romania, Bosnia and Herzegovina, Macedonia, Albania, Montenegro, Moldova, Bulgaria, and Ukraine). More than 83 million people inhabit the area. The total length of Serbian section of Danube is 587.5 km. The Danube River is important for the conservation of biological diversity of aquatic and riparian ecosystems.

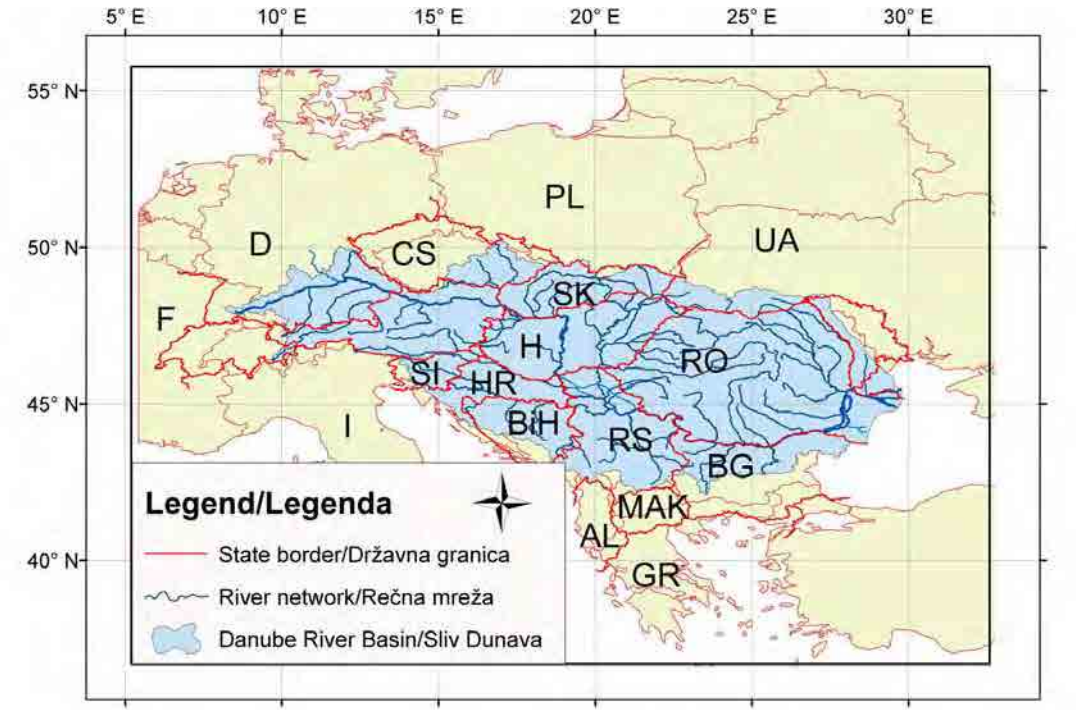


Figure 2. The Danube River Basin District

The Sava River Basin (SRB) covers an area of 95,719 km^2 and is situated in the southern part of the Danube Basin. Together with its tributaries, this 940 km long watercourse represents a mighty river system. The Sava flows from mountain region in Slovenia, throughout lowlands of Croatia, Bosnia and Herzegovina and Serbia, and confluences the Danube in Belgrade (river km 1171). According to the average discharge (1,513 m^3/s at the Sremska Mitrovica station, about 100 km from the confluence to the Danube), it is the largest tributary of the Danube. Further, by its catchment area, the Sava River is the second largest sub-basin of the Danube after the Tisa River Basin. The SRB is shared by Bosnia and Herzegovina (40.0% of the basin area), Croatia (26.0%), Serbia (15.4%), Slovenia (11.0%), Montenegro (7.5%), and Albania (0.1%). About 8.8 million people live in the basin. More than 50% of the Sava watercourse is navigable, from the mouth up to the Kupa confluence (Croatian section).

The elevation of the SRB ranges between 71 m above sea level (a.s.l.) at the mouth of the Sava River in Belgrade (Serbia) and 2,864 m a.s.l. (Triglav, Julian Alps in Slovenia), with a mean of 545 m a.s.l.

The SRB is heterogeneous concerning overall environmental conditions. Due to its geographic position, diverse climate, petrographic and pedological variety, and orographic characteristics, it is one of the most complex regions in Europe concerning the distribution of plants and animals.

The Government of Serbia formulated the “Spatial Plan of Republic of Serbia 2010 - 2020” as a state development plan. In accordance with this plan, the City of Belgrade prepared a city master plan with 2021 as the target, the “Master Plan of Belgrade 2021”.

A special strategic objective of the “Master Plan of Belgrade 2021” is the orientation of Belgrade towards the River Danube, which is one of two major transport corridors passing through Belgrade and Serbia. This orientation is reflected in the planning of various commercial, maritime, tourist, recreation and residential facilities along the banks of the River Danube in Belgrade. New initiatives listed in the Master Plan include area that will have a primarily tourist-character by the year 2021; these areas include:

- Belgrade Water Boulevards – the Sava and Danube Rivers, especially in the central city zone (with restaurants, cultural, sporting and entertainment events, and with the development of urban river taxis and passenger traffic);
- Transit nautical centers on the River Danube, with large marinas on the Danube River branches that are not on the Danube international transport route.

The two largest and most visited beaches in Belgrade are the Ada Ciganlija and the “Lido” beach located at the tip of the Great War Island (Veliko Ratno Ostrvo in Serbian). In Serbian the word “ada” refers to an isle or a river island. These islands were formed by the accumulation of sediment in the riverbeds of the Sava and Danube Rivers. In the area of the Belgrade Master Plan to 2021 there are several of these islands, all of which are important in preserving the quality of the environment:

- Great War Island on the River Danube (has the environmental protection status of a reserve and/or area of exceptional importance);
- Ada Ciganlija on the River Sava – a recreational area of the city (area recorded by the Institute for Nature Conservation of Serbia as an area with natural values);
- Ada Medjica on the River Sava – a recreational area of the city (area recorded by the Institute for Nature Conservation of Serbia as an area with natural values);

- Ada Huja on the River Danube – unfortunately, a part of the isle is industrialized, while the other part is an area with indigenous vegetation (evidenced by the size of the Institute for Nature Conservation of Serbia as an area with natural values). The Belgrade Master Plan 2021 includes plans for the revitalization of this isle.

It is possible to have an insight into whole territory of city of Belgrade thanks to BeoINFO application developed by the Urban Planning Institute of Belgrade. Maps generated using this application are presented in the figures below.

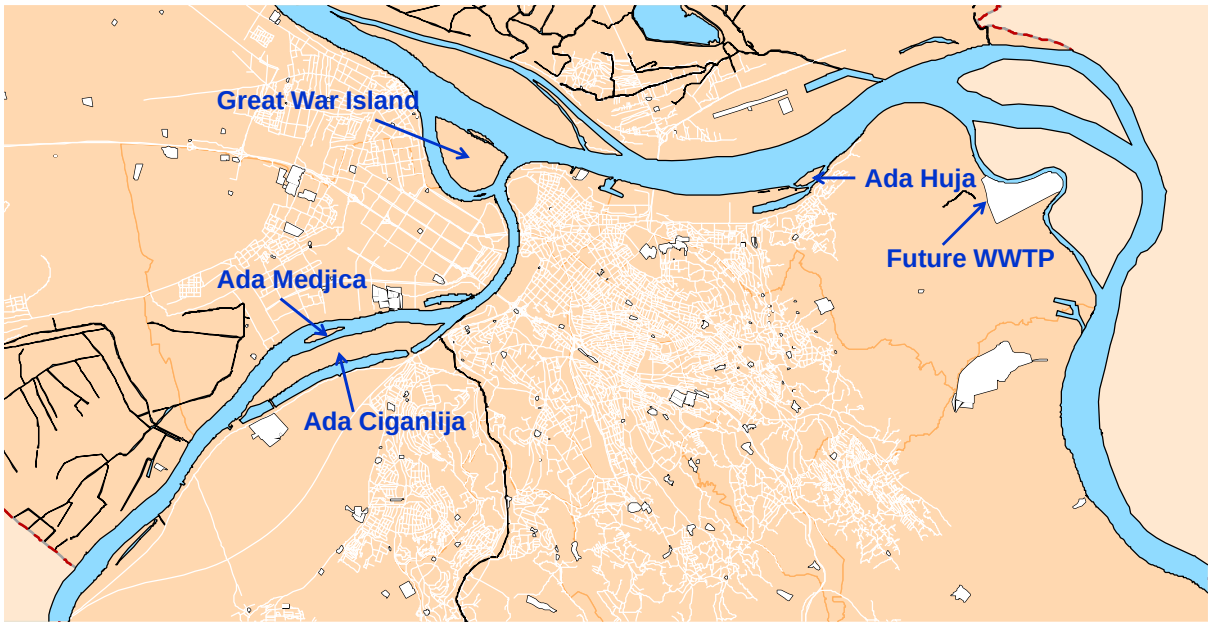


Figure 3. Map generated with the BeoINFO application showing the public utilities and infrastructure areas. The names of the river islands are also added.

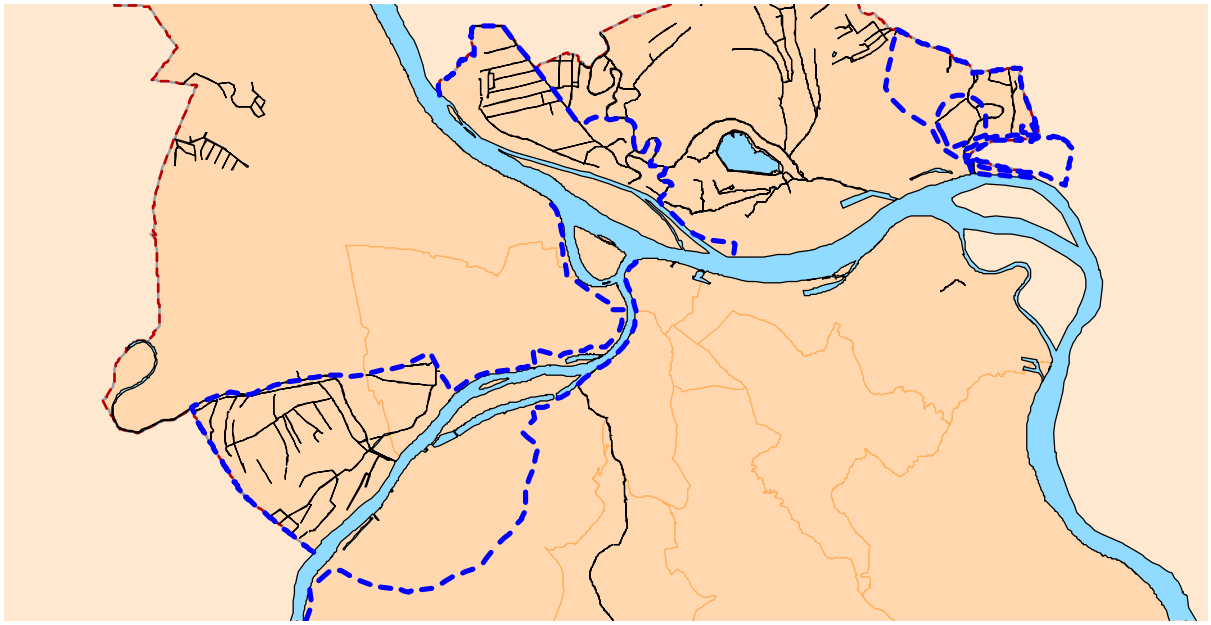


Figure 4. Map generated with the BeoINFO application showing the well protection zones that are used as drinking water sources in blue lines along the rivers in Belgrade

The "Master Plan of Belgrade 2021" contains information on the planned wastewater conveyance and treatment system, which is in line with the planned works described in the Project, as shown in the figure below. This Master Plan also describes the state of river water quality in Belgrade, as summarized in the following two paragraphs.

The waters of the Danube and the Sava Rivers convey pollution from settlements and industries located upstream of Belgrade, and are additionally burdened by the direct discharge of untreated domestic and industrial wastewaters in Belgrade. The deviations from the prescribed river water quality in Belgrade are usually due to increased suspended material values and organic pollutants; these deviations are due to erosion processes in the river basins and the discharge of wastewater that is rich in organic content. Rivers that discharge into the Sava and the Danube Rivers are highly polluted as they receive domestic and industrial discharge of raw wastewater and their flows and the ability of self-purification is low. An example is the Topcider River (Topčiderska Reka in Serbian) which is a tributary to the Sava River.

The characteristics of the groundwater alluvial deposits are influenced by the quality of surface water, due to the direct hydraulic connection with the river bed watersheds. Moreover, due to the overlapping of the wellhead protection zones (drinking water protection areas) with the narrow coastal belt and the previously constructed roads, large indentation springs and collision with the city, there is an increasing risk of contamination of the groundwater resources.

The Technical Infrastructure Development priorities recognized in the City of Belgrade Development Strategy (2011) include the construction of a waste water treatment plant and the increase of sewerage network access to citizens through its continual development. Two of the priorities and required facilities and measures are listed below.

Priority 1: Protection of groundwater and surface water sources (the Sava River)

Required facilities and measures:
- Reconstruction of 8 sewerage pumping stations
- Interceptor Emergency Station (Hitna Pomoć) – Venizelosova Street
- Sewerage pumping stations Čukarica

Priority 2: Protection of the Danube river basin

Required facilities and measures:
- Reconstruction of 5 sewerage pumping stations
- Start-up of the interceptor from Karadjordjev Trg pumping station to Usce

Among the Strategic Priorities 2011-2016 of the Belgrade Development Strategy is Priority Project 6.10 – "Solving the issue of wastewater drainage as a part of improving general sanitary conditions of the City of Belgrade". Project 6.10 is described with the following sentence: "The adverse situation in the area of wastewater drainage from the territory of the City must be solved through comprehensive long-term solutions which would treat waste water drainage as a part of improvement of general sanitary conditions of the City as a whole, with avoiding activities which result in harmful effects on the environment, reducing consumption of energy, reducing all forms of pollution, etc.". The parties named responsible for the implementation of this project are the Belgrade Land Development Public Agency and the public utility company Belgrade Waterworks and Sewerage.

A "Master Plan of the Belgrade Sewerage System" was prepared in 2011 and is in conformity with "Master Plan of Belgrade 2021". The Sewerage System Master Plan elaborates on the sewerage system infrastructure defined in the "Master Plan of Belgrade 2021" and develops the detailed sewer system network and options for wastewater treatment. Map of the wastewater system from the "Master Plan of Belgrade 2021" is shown in the figure below.

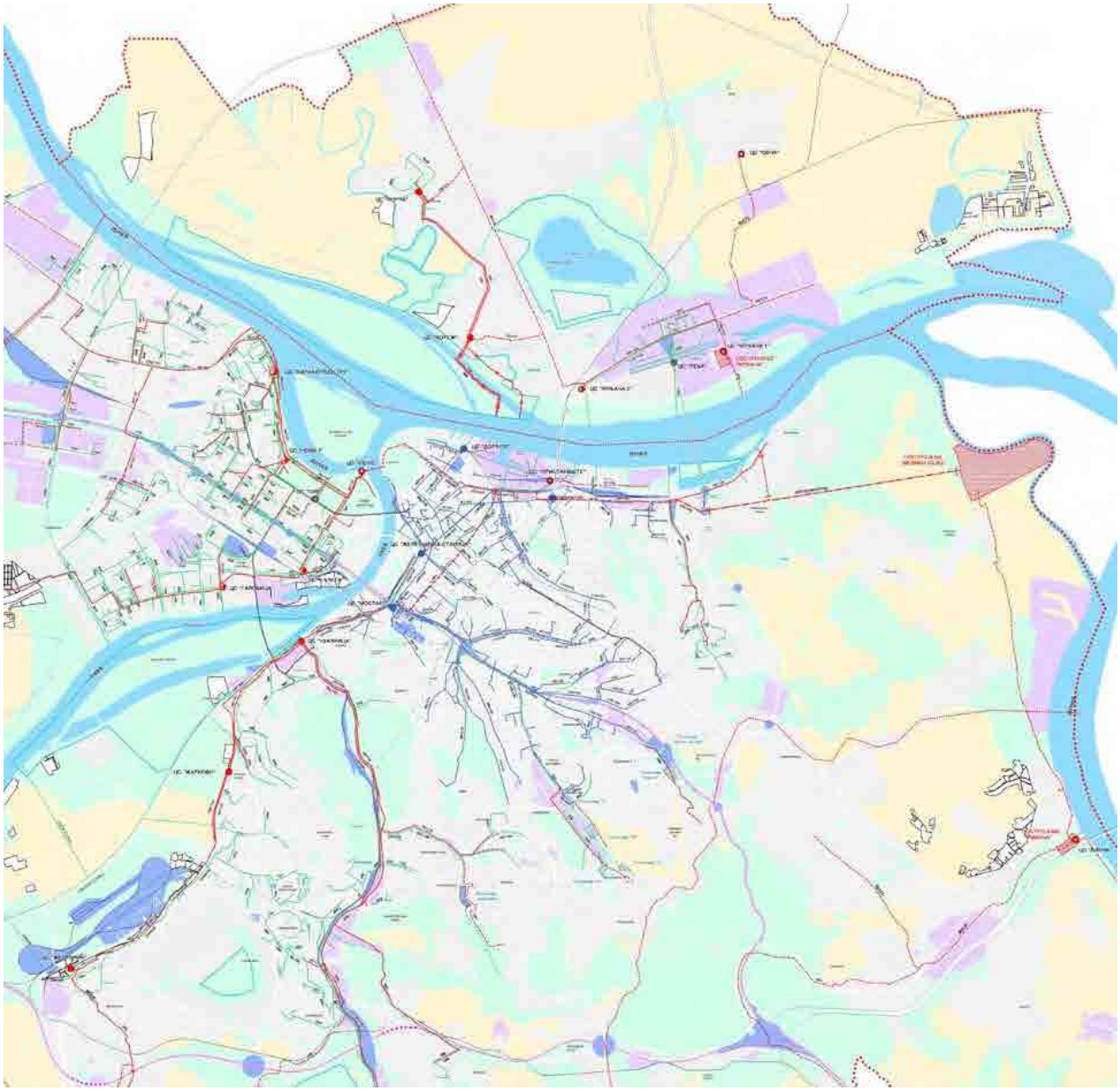


Figure 5. Map of the wastewater system from the "Master Plan of Belgrade 2021". The wastewater pipes, interceptors and the location of the WWTP are marked in red.

The Government of Serbia requested the Japanese Government to extend a Japan International Cooperation Agency (JICA) Loan for a Sewerage System Improvement Project for the City of Belgrade. The scope of works of the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade" (hereinafter referred to as the "Project") is to implement a part of the Sewerage Master Plan and includes the analysis of the facilities presented in the table below.

Table 1. The scope of works of the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade"

Facility	**Current Situation**
Usce pumping station (PS)	Existing Usce PS is of insufficient capacity to pump the wastewater from the entire Zemun and New Belgrade network across the Sava River. The new Usce PS will have a larger grit chamber and a different grit removal method than the existing PS. The existing Usce PS will be abandoned after construction of the new Usce PS. The new Usce PS will have a larger grit chamber and a different grit removal method than the existing PS. The existing Usce PS will be abandoned after construction of the new Usce PS.
Mostar pumping station (PS)	The existing Mostar PS has never been used since its construction. The building and the equipment of the PS need to be rehabilitated renovated and replaced in some parts.
Interceptors (Nos. 1 to 7 and 10 indicated in the figure below)	The named interceptors do not exist and are need to convey wastewater to the Veliko Selo WWTP.
Veliko Selo wastewater treatment plant (WWTP)	Untreated domestic and industrial wastewater is discharged directly into rivers in Belgrade. There is no WWTP.
Sludge Treatment Facilities	Untreated domestic and industrial wastewater is discharged directly into rivers in Belgrade. There is neither a WWTP nor any sludge treatment facilities.

These facilities are located in Central System in Belgrade Sewerage Master Plan as shown in Figure 5 and Figure 6. This Preliminary Environmental Impact Analysis (PEIA) Study Report will focus on the Pumping Stations and the Interceptors, while a separate PEIA Study is prepared for the Veliko Selo WWTP and the Sludge Treatment Facilities.

As the locations of the PSs, the Interceptor routes and the WWTP were already defined in the "Master Plan of Belgrade to 2021" and the "Master Plan of the Belgrade Sewerage System to 2021", the Project focused on the design of the PSs and interceptors (including the force main crossing the Sava River). A general sketch of the layout plan of the force main (Interceptors 1 and 2) is shown in Figure 7, while Figure 8 shows the same layout superimposed over a photo of the area, giving a sense of where the new wastewater infrastructure will be located in regards to the built city, historic monuments and surrounding parks.

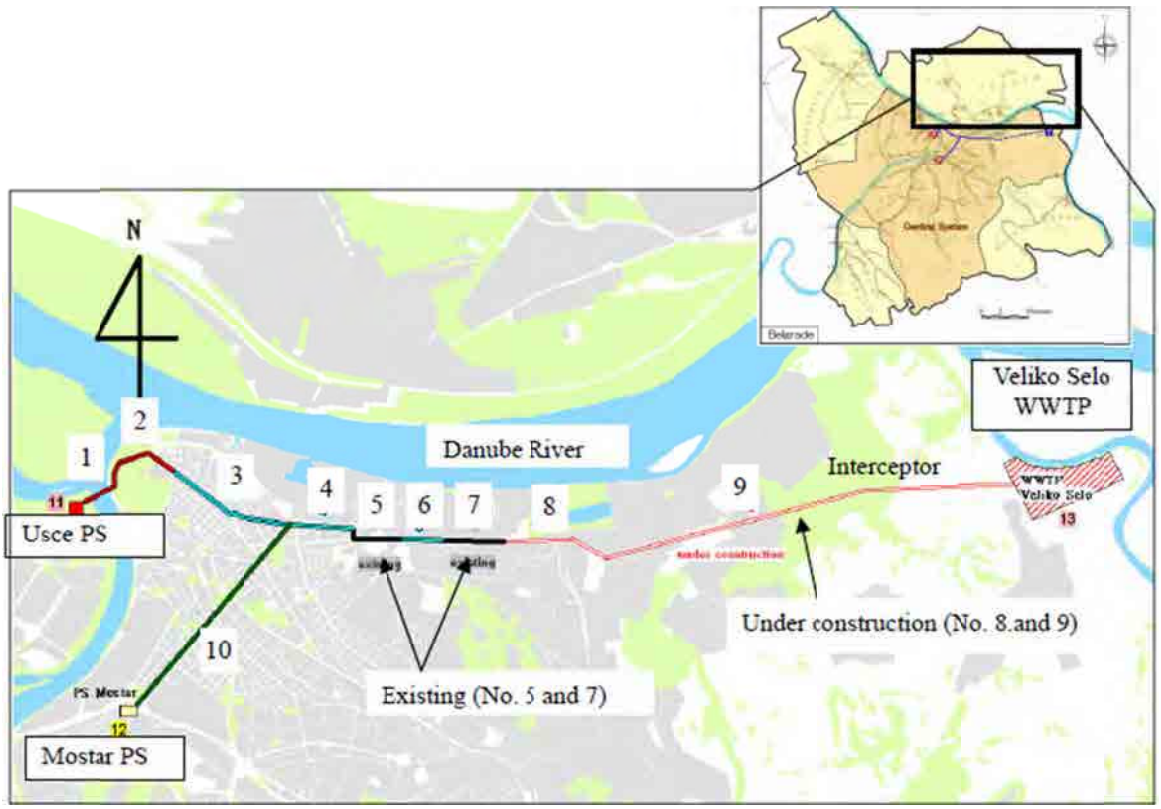


Figure 6. Facilities covered by the Project

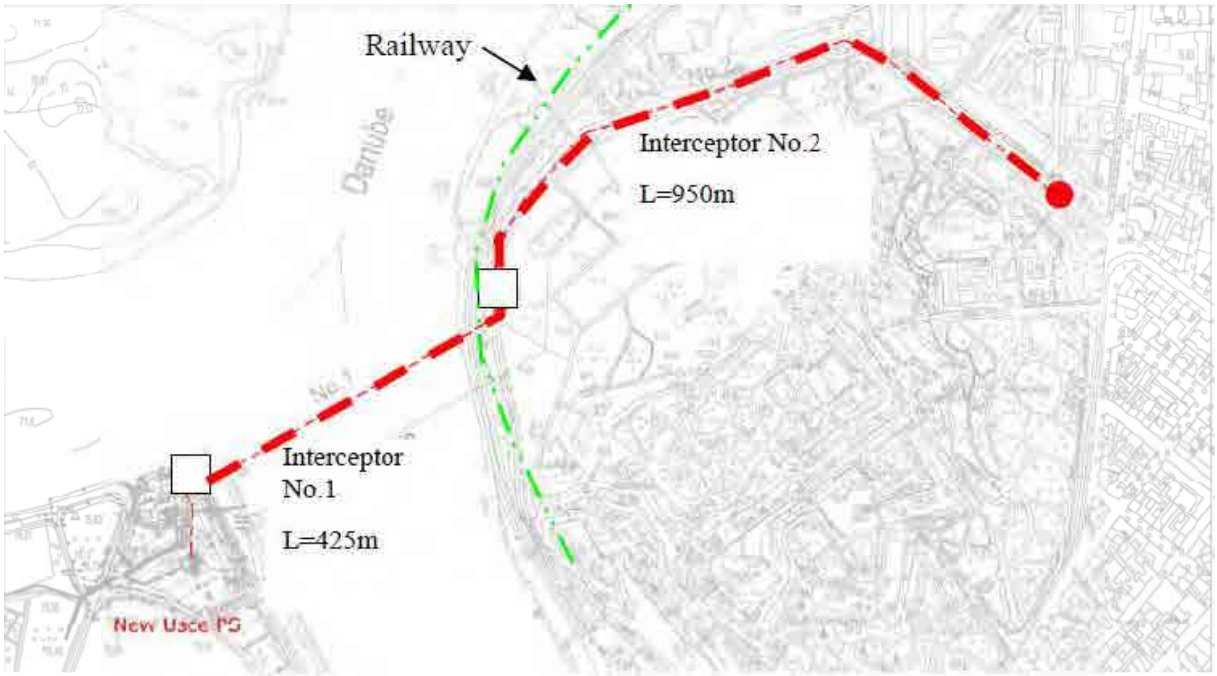


Figure 7. General layout plan of the location of the force main

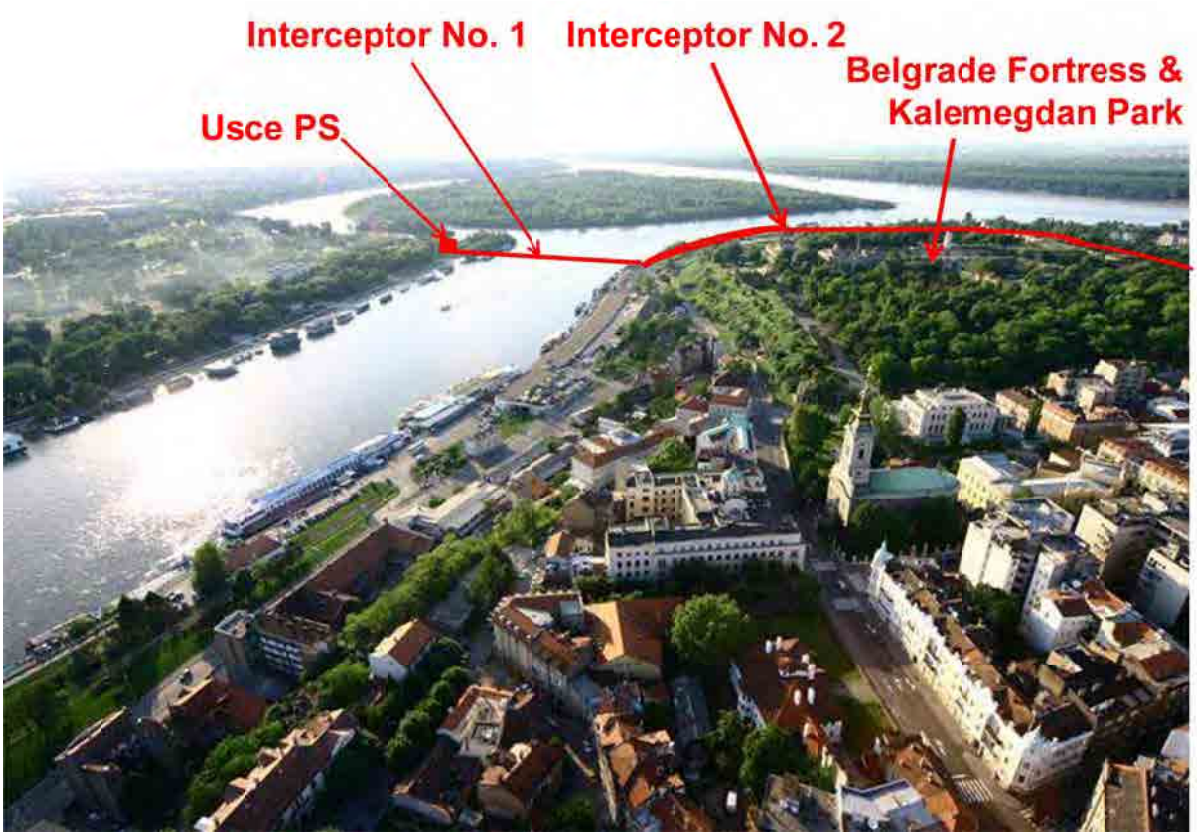


Figure 8. General layout plan showing the location of Usce PS, Interceptors 1 and 2 and the surrounding area – the Usce Park around the Usce PS and the Belgrade.

2.1 Pumping Stations

Currently, wastewater collected from Novi Beograd and is discharged without any treatment via the Usce PS into the Sava River. The existing PS is pictured in Figure 10. The location of the discharge is shown in Figure 9. Figure 9 also shows the location where Interceptor No. 1 will cross the Sava River and be connected to Interceptor No. 2 on the right bank of the Sava River in the area of the Belgrade Fortress.

Figure 9. Location of the wastewater outflow via the Usce pumping station and the location of where Interceptor No. 1 will cross the Sava River. The Belgrade Fortress can be seen in the background.

Figure 10. The existing Usce pumping station

The current Usce PS is of insufficient capacity to pump the wastewater from the entire Zemun and New Belgrade network across the Sava River. A new PS is proposed, adjacent to the existing PS (the process for obtaining the location permission for this site is already underway). The new Usce PS will have a larger grit chamber and a different grit removal method than the existing PS. The existing Usce PS will be abandoned after construction of the new Usce PS. The layout plan for the new Usce pumping station is presented in Figure 11.

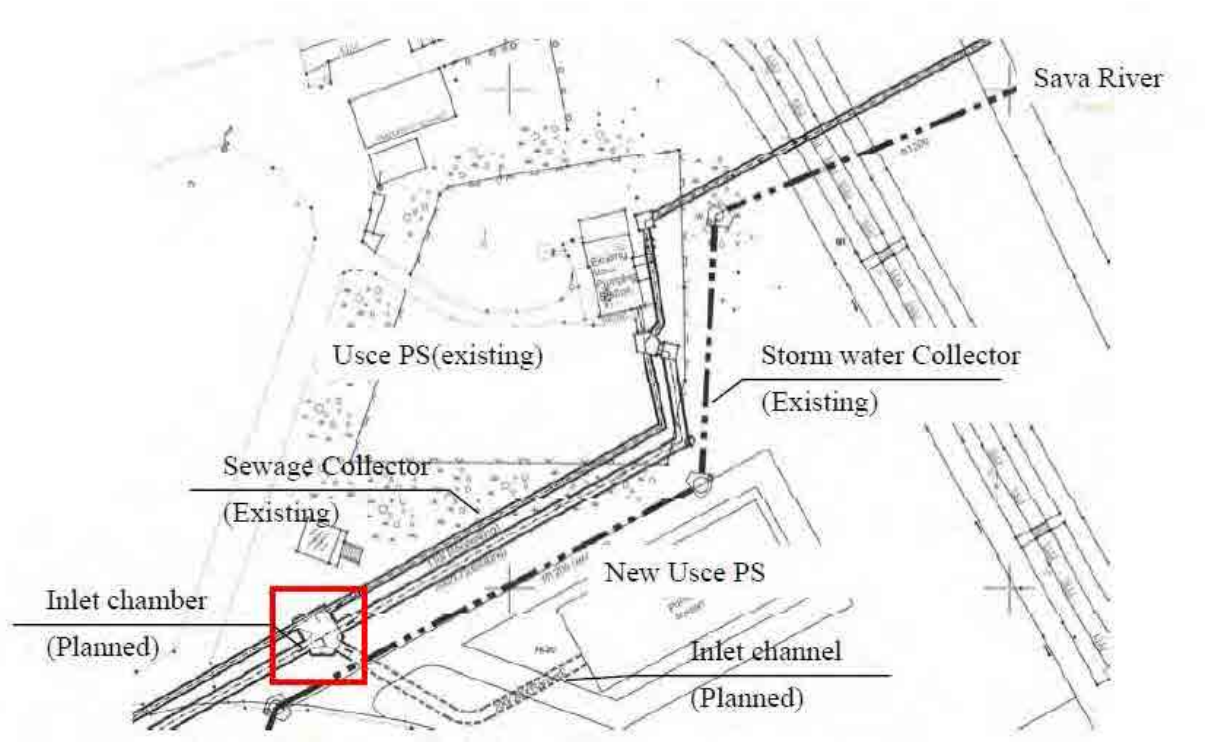


Figure 11. The layout plan for the new Usce pumping station

The existing Mostar PS has never been used since its construction. The building and the equipment of the PS need to be rehabilitated renovated and replaced in some parts. The details are presented in the Project Report (January 2013).

2.2 Interceptors

A summary of the planned and existing interceptor sections is shown in the table below, while the various design alternatives Interceptors No. 1 and No. 2 are discussed in detail below.

Table 2. Adopted interceptor designs

No.	Design
1 & 2	Force main from new Usce PS
3	D200 cm by gravity flow up to the Terazijski tunnel connection and interceptor from Mostar pumping station. Trench work is adopted so as not to damage the underground utilities.
4	D380 cm from the Terazijski tunnel connection up to the existing Interceptor No. 5. Trench work is adopted so as not to damage the underground utilities.
5	Existing pipe 380/380 cm. It was constructed in the 1980's by the Shield method.
6	D380 cm after Interceptor No. 5 until Interceptor No. 7. Micro-tunneling work is adopted because of the deep depth laying.
7	Existing pipe 380/380 cm. It was constructed in 1980's by the open cut method.
8	Existing pipe D400 cm. It was constructed in 2012 by Shield method.
9	Existing pipe D400 cm. It was constructed in 2012 by Shield method.
10	Section 280 cm from Hitna Pomoć to Venizelosova. Micro-tunneling work is adopted due to the deep depth laying. At the downstream end of the interceptor, trench work is adopted due to the shallow depth.

Different construction alternatives for Interceptors No. 1 and No. 2 were examined in the Project Report from the ease of construction, safety, maintenance, environmental, risk and cost perspectives.

Among the six alternative pipeline options considered, Case-2-3 with two force main lines were chosen for operational safety reasons for the Sava River crossing section (Interceptor No. 1). In the chosen option, if one pipeline is non-operational at any point (pipe chocking, pipe damage, etc.), the wastewater can still reach the WWTP. The chosen option includes two D1000 mm pipes to be installed by the micro-tunneling method. The analysis of the alternatives with respect to their design parameters, construction options, maintenance and environmental considerations is presented in the table below.

Installation of two lines was studied for the construction of Interceptor No. 2. However, this alternative was dismissed from the view of protection of cultural heritage. Interceptor No. 2 will be installed under the Vojvode Bojovica Boulevard, which passes along the Belgrade Fortress area, an area of cultural heritage. Based on the opinions from Belgrade City Institute for the Protection of Cultural Monuments, the location within the road and the width of open cut were carefully selected not to affect the cultural heritage by construction and operation of interceptor. A D1400 mm in one line was adopted.

Table 3. Analysis of design alternatives for Interceptor No. 1

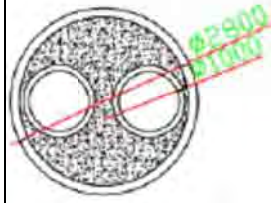
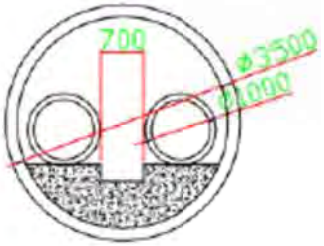
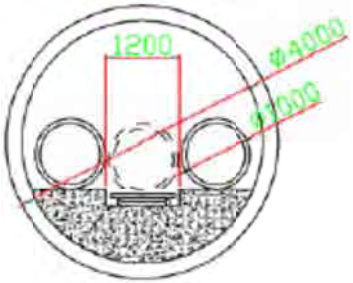
Item	Case-1 (Diameter 1500 (1400mm)x 1 Line)		Case-1 (Diameter 1000mm x 2 Line (both for operation))			
	Case-1-1	Case-1-2	Case-2-1	Case-2-2	Case-2-3	Case-2-4
Description	One force main pipe will be installed with Straight line-shape	One force main pipe will be installed with Arc line-shape	Two force main pipes will be installed with Arc line shape	One Casing pipe will be constructed, and then two force main pipes will be installed inside casing pipe, then inside of casing pipe will be filled in mortar.	One large diameter pipe (Dia3500mm) will be constructed as pipe gallery, and then two force main pipes will be installed inside pipe gallery.	One large diameter pipe (Dia4000mm) will be constructed as pipe gallery to have enough workability inside pipe gallery, and then two force main pipes will be installed inside pipe gallery.
Outside Diameter				Dia2800mm	Dia3500mm	Dia4000mm
Comments				Smallest diameter, but pipes can't be inspected and repaired. Inside of casing pipe will be filled by Mortar.	Space inside of pipe gallery is only for walking. Other utilities can be installed at dead space.	Enough workability for inspection and pipe replacement. Other utilities can be installed at dead space.
Shape						

Table 3 (continued). Analysis of design alternatives for Interceptor No. 1

Item	Case-1 (Diameter 1500 (1400mm)x 1 Line)		Case-1 (Diameter 1000mm x 2 Line (both for operation))			
	Case-1-1	Case-1-2	Case-2-1	Case-2-2	Case-2-3	Case-2-4
Inspection	no	no	no	yes	yes	yes
Repairing	no	no	yes	yes	yes	yes
Cleaning	no	no	no	no	no	yes
Environmental Considerations						
In case of pipe damage	C	C	C	A	A	A
In case of maintenance	C	C	A	A	A	A
Risk Management						
Accident	C	C	C	A	A	A
Flexibity	C	C	B	B	B	A
Construction Method	A	C	C	A	A	A
SUMMARY	Initial costs of Case-1 scenarios are cheaper than other cases, but the differences of Life Cycle Costs are similar from Case-1-2 to Case-2-3. As for risk management and environmental consideration, Case-2-2 to Case-2-4 is more positive than other cases. Case-2-2 is the best solution from a comprehensive viewpoint. And when the benefit of installation of other utilities such as optical cable inside pipe galley can be considered; Case-2-3 also becomes the best solution.					

Note: A (positive) to C (negative)

3 Legal and Administrative Framework

3.1 Legal Framework

This Preliminary Environmental Impact Assessment (PEIA) Report was prepared in accordance with the relevant laws and by-laws of the Republic of Serbia, including:

- Law on Air Protection (2009) and relevant by-laws:
  - Regulation on air monitoring conditions and air quality requirements (2010)
  - Regulation on the air pollutants emission limit values (2010 & 2011)
- Law on Environmental Impact Assessment (2004 & 2009) and relevant by-laws:
  - Rulebook on the Contents of Requests for the Necessity of Impact Assessment and on the Contents of Requests for Specification of Scope and Contents of the Environmental Impact Assessment Study (2005)
  - Rulebook on the Contents of the Environmental Impact Assessment Study (2005)
  - Rulebook on the Procedure of Public Inspection, Presentation and Public Consultation about the Environmental Impact Assessment Study (2005)
- Law on Environmental Protection (2004 & 2009)
- Law on Planning and Construction (2009 & 2001)
- Law on Protection against Noise in the Environment (2009 & 2010) and relevant by-laws:
  - Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010)
- Waste Management Law (2009 & 2010) and relevant by-laws:
  - Regulation on Disposal of Waste in Landfills (2010)
- Water Law (2010) and relevant by-laws:
  - Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012)
  - Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater (2011)
  - Regulation on the Limit Values of Priority and Priority Hazardous Substances that Pollute Surface Waters and the Deadlines for Compliance with the Limit Values (2011)
  - Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012-Amendments)

The full list of relevant regulative for the PEIA Report is listed in the References Chapter of the Report.

The methodology applied in the Report meets the requirements of the “Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations” (2002) as well as “JICA Guidelines for Environmental and Social Considerations” (2010).

3.2 Administrative Framework

The Ministry of Energy, Development and Environmental Protection of the Republic of Serbia is the governing body in regards to performing Environmental Impact Analyses and submitting the subsequent reports. It is also responsible for environmental protection and environmental inspection.

The Serbian Environmental Protection Agency of the Ministry of Energy, Development and Environmental Protection is in charge for development, harmonization and management of the national information system; monitoring of the air and water quality, management of National Laboratory, collecting and processing environmental data, data processing procedures development, coordination and cooperation with European Environmental Protection Agency and European Information and Observation Network as well as other duties determined by the Serbian legislation.

The Republic Directorate for Water of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia is responsible for water use and protection, for the conception and implementation of an integrated national policy related to water resources, including the policy of international cooperation. The issue of water related financial investments and tariffs is subject of the work of the Ministry of Agriculture, Forestry and Water Management – Directorate for Water.

In Belgrade, the City Assembly of Belgrade Secretariat for Environmental Protection performs assignments related to promotion and protection of the environment in seventeen municipalities of the City. These include inspection and surveillance over the application of and adherence to the regulations and other legal provisions in the area of environmental protection: nature, air, noise, waste management, chemical management, etc. Regular control of the quality of the environment is performed by authorized, accredited facilities: the Institute of Public Health of Belgrade, the Hydro-meteorological Service of Serbia, the Serbian Institute of Public Health “Dr. Milan Jovanovic-Batut” and the Institute of Occupational Health of Serbia “Dr. Dragomir Karajovic”, in accordance with the Law on Environmental Protection. The monitoring reports are submitted to the Secretariat for the Environment.

The environmental monitoring results are published monthly in Environmental Bulletins and an annual publication on environmental data is published jointly by the Secretariat for the Environment, the Belgrade Institute of Public Health and the Regional Environmental Center Serbia. The most recent available publication is the “Environment in the City of Belgrade 2010”.

3.3 Environmental Impact Analysis Procedures

Under Serbian regulations and the “Law on Environmental Impact Assessment” (2004 & 2009), an Environmental Impact Assessment (EIA) is conducted at the Preliminary Design stage of a project. At this stage, the project manager submits a request to the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia to determine the necessity of an environmental impact assessment for the project in question, according to the “Rulebook on the Contents of Requests for the Necessity of Impact Assessment and on the Contents of Requests for Specification of Scope and Contents of the Environmental Impact Assessment Study” (2005).

The “Regulation on Establishing the List of Projects for which the Environmental Impact Assessment is Mandatory and the List of Projects for which the Environmental Impact Assessment can be requested” (2008) includes two lists:

- List I - Projects which require an environmental impact assessment

- List II - Projects which may require environmental impact assessment

According to the above mentioned Regulation, an environmental impact assessment is mandatory for a ***wastewater treatment facility project for settlements of over 100,000 people*** and is included in List I of the Regulation.

List II includes projects are projects for ***wastewater transport pipeline over 10 km***; the interceptor which is included in this Project is around 7 km in length and an EIA may not be required. A request to the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia for determination of the necessity of an environmental impact assessment must be submitted.

If Ministry of Energy, Development and Environmental Protection of the Republic of Serbia deems an EIA necessary, it would on provide the required scope and contents of the EIA that are usually aligned with the "Rulebook on the Contents of the Environmental Impact Assessment Study" (2005). Once completed, the EIA Study Report becomes available to the public and a public hearing is organized with the participant of stakeholders and interested parties, according to the "Rulebook on the Procedure of Public Inspection, Presentation and Public Consultation about the Environmental Impact Assessment Study" (2005). Once the public hearing and review process have been completed, a technical committee named by the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia decides upon the approval or disapproval of the environmental impact assessment report, according the "Rulebook on the Work of the Technical Committee for the Environmental Impact Assessment Study" (2005).

As a summary, an EIA is not required by Serbian law for the project titled "Preparatory Survey on the Sewerage System Improvements for the City of Belgrade". However, conducting a preliminary environmental impact assessment at the preparatory stage of this Project allows for environment and social considerations to be included at the earliest stage possible.

At the project preliminary design stage, the List of Conditions (terms and opinions in literal translation from Serbian) are also required and requested from relevant national and local institutions whenever proposed work may affect environmentally sensitive resources, including waterways, wetland resource areas, habitats of rare or endangered species, historic and archaeological sites, or in cleaning up hazardous waste or discharges of pollutants to waterways. These conditions opinions are requested by the project owner. The project preliminary design report in then prepared so that it respects and obliges to the set conditions. These terms and opinions may include:

- Decision on the Protection Requirements from the Institute for Nature Conservation of Serbia;
- Decision on the Issuance of Water Conditions from the Directorate for Water of the Ministry of Agriculture, Forestry and Water Management;
- Decision on Technical Protection Measures from the Belgrade City Institute for Protection of Cultural Monuments and/or the Republic Institute for Protection of Cultural Monuments;
- Conditions for the Preparation of Technical Documentation from the local Power Distribution Company.

4 Baseline Data

In this Chapter, the most recent available baseline data is presented for the Belgrade metropolitan area that is relevant to the Project.

In Belgrade, environmental monitoring is carried out according to the programs of the City of Belgrade Secretariat for Environment Protection. These programs define the frequency, locations and procedures for monitoring of air, water and soil quality, as well as the level of communal noise. Measurements are entrusted to expert and science institutions, such as the Institute of Public Health Belgrade and the Institute of Public Health of Serbia "Dr. Milan Jovanović – Batut".

The Belgrade Secretariat for Environment Protection publishes the monitoring results in monthly "Ecological Bulletins" (air and water quality data only) and the annual "Environment in the City of Belgrade" publications (published jointly by the Secretariat for Environmental Protection, the Institute of Public Health of Belgrade, and the Regional Environmental Center Serbia).

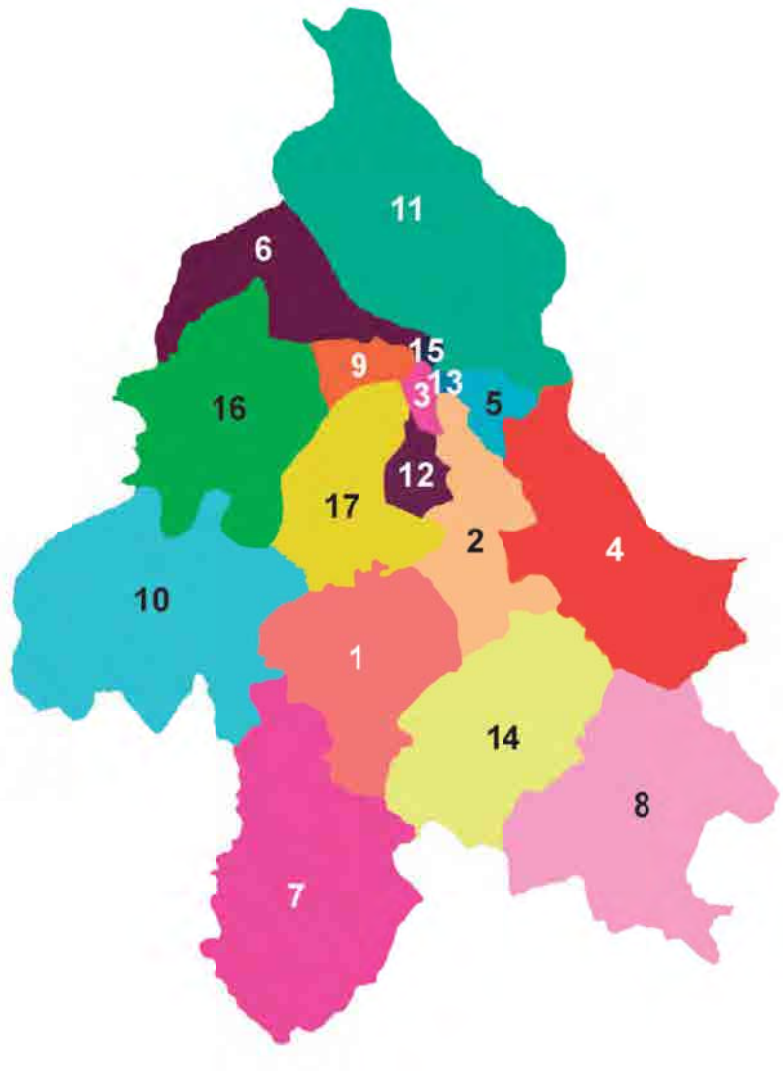
Among other references used in this Report were data from the:

- Statistical Yearbook of Belgrade – 2011 (Institute for Informatics and Statistics);
- Guide to Bio Geo Diversity of Belgrade (2011);
- Institute for Nature Conservation of Serbia;
- Belgrade Fortress Public Enterprise;
- Maps from the Environmental Atlas of Belgrade, developed by the Belgrade Institute of Public Health and the Belgrade Land Development Public Agency in 2002.

4.1 Population, Topography, Bio-Geographical and Landscape Features

The territory of Belgrade covers an area of 322.268 ha (inner-city area covers 35.996 ha), and it is administratively divided into 17 municipalities - 10 urban municipalities (Čukarica, Voždovac, Vračar, Novi Beograd, Palilula, Rakovica, Savski venac, Stari grad, Zemun, Zvezdara) and 7 suburban municipalities (Barajevo, Grocka, Lazarevac, Obrenovac, Mladenovac, Sopot, Surčin). The map of the territory along with the municipality names is presented in the figure below.

According to official results from the 2011 Census, Belgrade has a population of 1,154,589 within the city center and 1,639,121 in the entire City of Belgrade area.



1 Barajevo
2 Voždovac
3 Vračar
4 Grocka
5 Zvezdara
6 Zemun
7 Lazarevac
8 Mladenovac
9 Novi Beograd
10 Obrenovac
11 Palilula
12 Rakovica
13 Savski venac
14 Sopot
15 Stari grad
16 Surčin
17 Čukarica

Figure 12. The territory of Belgrade, with the municipality names (Source: Belgrade in Figures, 2012)

Belgrade's surroundings consist of two different natural systems: the Pannonian depression to the north, covered with wheat and corn, and Šumadija, with orchards and vineyards, south of the rivers Sava and Danube. The highest relief forms in Šumadija hillside are Kosmaj (628 m) and Avala (511 m). Starting from south, the terrain gradually descends to the north, in shapes of wide plateaus, sectioned by stream and river valleys. High plasticity of Belgrade relief, south of the rivers Sava and Danube, makes the city spread over many hills (Banovo, Lekino, Topčidersko, Kanarevo, Julino, Petlovo, Zvezdara, Vračar, Dedinje). North from the rivers Sava and Danube there are alluvial plains and loessial plateaus, which are divided by a steep section, up to 30 m high. New Belgrade is situated on the left bank of Sava, beneath a loessial plateau (Bežanijska kosa), and Zemun is situated on the right bank of Danube, beneath a loessial plateau.

The highest point of inner-city area of Belgrade, is at Torlak (Voždovac), being the Holy Trinity Church at 303.1 m, while the lowest point is on Ada Huja (river island) at 70.15 m. The highest point of the larger-city area is on the Kosmaj Mountain (Mladenovac) at 628 m. The absolute altitude of the Meteorological Observatory - 132 m - is considered the average altitude of Belgrade.

The Danube flows through 60 km of Belgrade area, from Stari Banovci to Grocka, while the Sava covers 30 km from Obrenovac to its intake. The length of river banks of Belgrade is 200 km. There are

16 river islands in that area, and the best known of them are Ada Ciganlija, Veliko ratno ostrvo and Gročanska ada.

In regards to land use, the area of Belgrade could be characterized as heterogeneous. Residential and industrial areas are presented in Figure 13, while green areas and agricultural land are shown in Figure 14.

The project area is situated within the biome of South European deciduous forests in lowland and inundated areas. The biom is characterized by potential vegetation of *Genisto-Quercetum roboris*, *Carpino-Quercetum roboris* and *Salici-Populetum*.

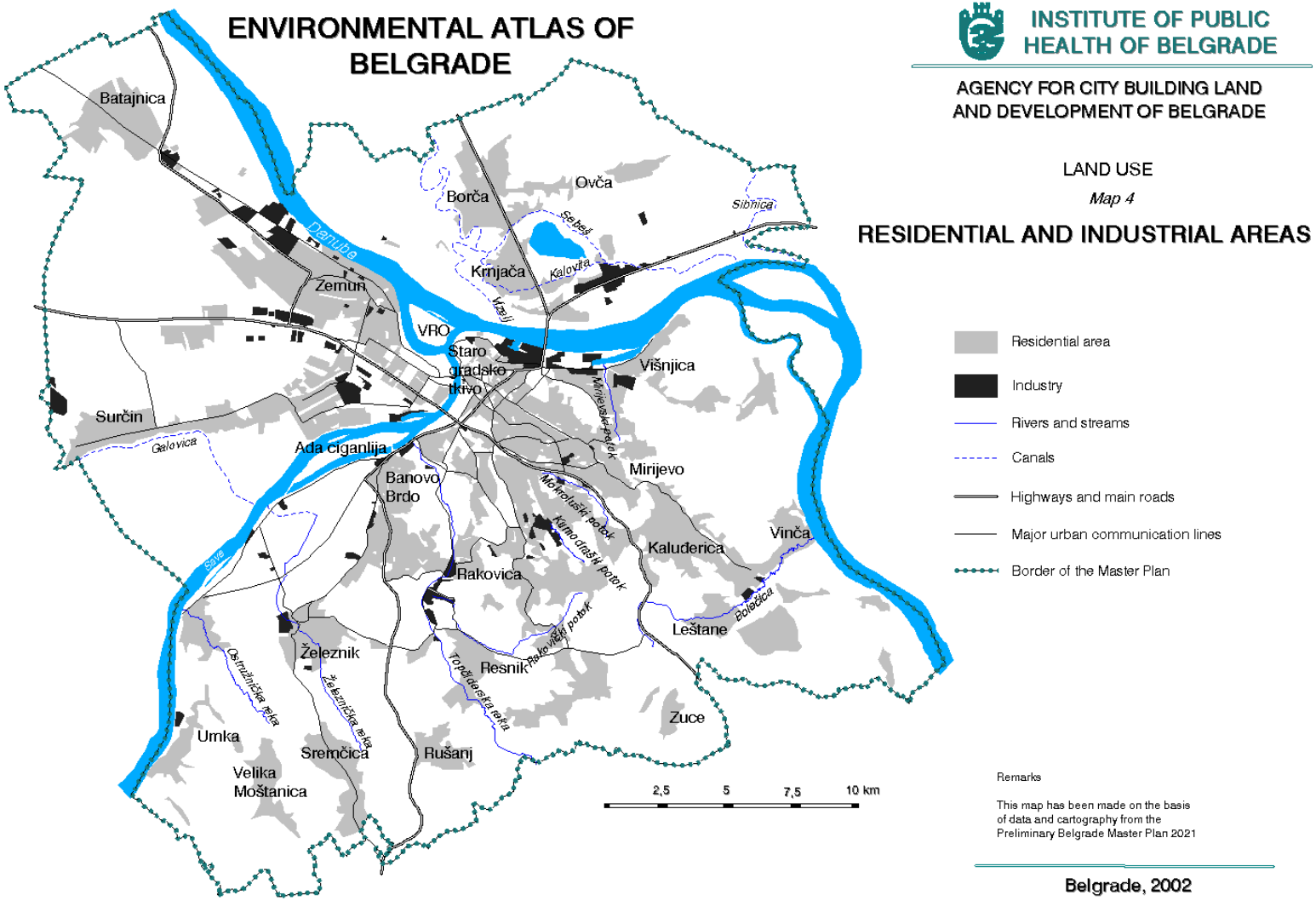


Figure 13. Residential and industrial areas in Belgrade

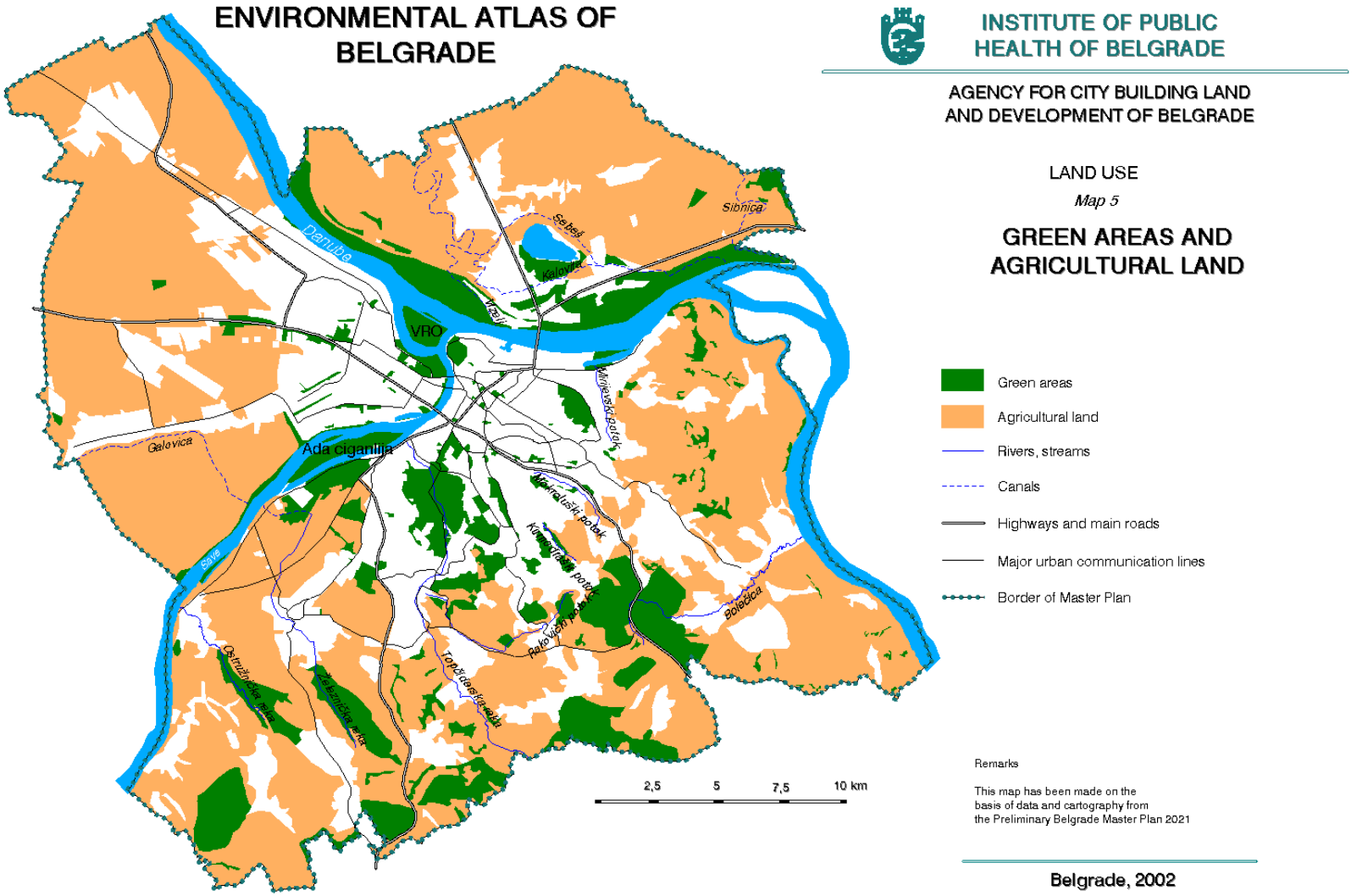


Figure 14. Green areas and agricultural land in Belgrade

4.2 Land Cover in the Project Area

The information on land cover as a fundamental reference dataset for different spatial analyses has been recognized as an important tool for the assessment of the dominant general habitat type in a particular area of concern. These data are especially important for an integrated environmental assessment. In Serbia, the CORINE Land Cover (CLC) inventory is the only dataset that provides a land cover overview at the country level. It consists of the three databases: the CLC databases for the reference years 2000 and 1990, and the database of land cover changes between these two epochs.

The production of the CLC2000 database followed the standard CORINE methodology: computer-aided visual interpretation of Landsat 7 satellite imagery supported with ancillary data (topographic maps, airborne imagery, thematic maps, etc.) and field checking.

As it can be seen in the table and figures below, artificial urban and agricultural surfaces dominate in the Project area (54%). Surface waters and wetlands also cover a significant part within the Project area (40%). Forest and other vegetation cover types cover about 6% of the area.

Table 4. The summary of the CORINE data for area of concern

Area type	Area, ha
Artificial urban surfaces	11,007
Agricultural areas	7,673
Forests	1,524
Shrub and herbaceous vegetation	864
Wetlands	550
Water bodies	12,997

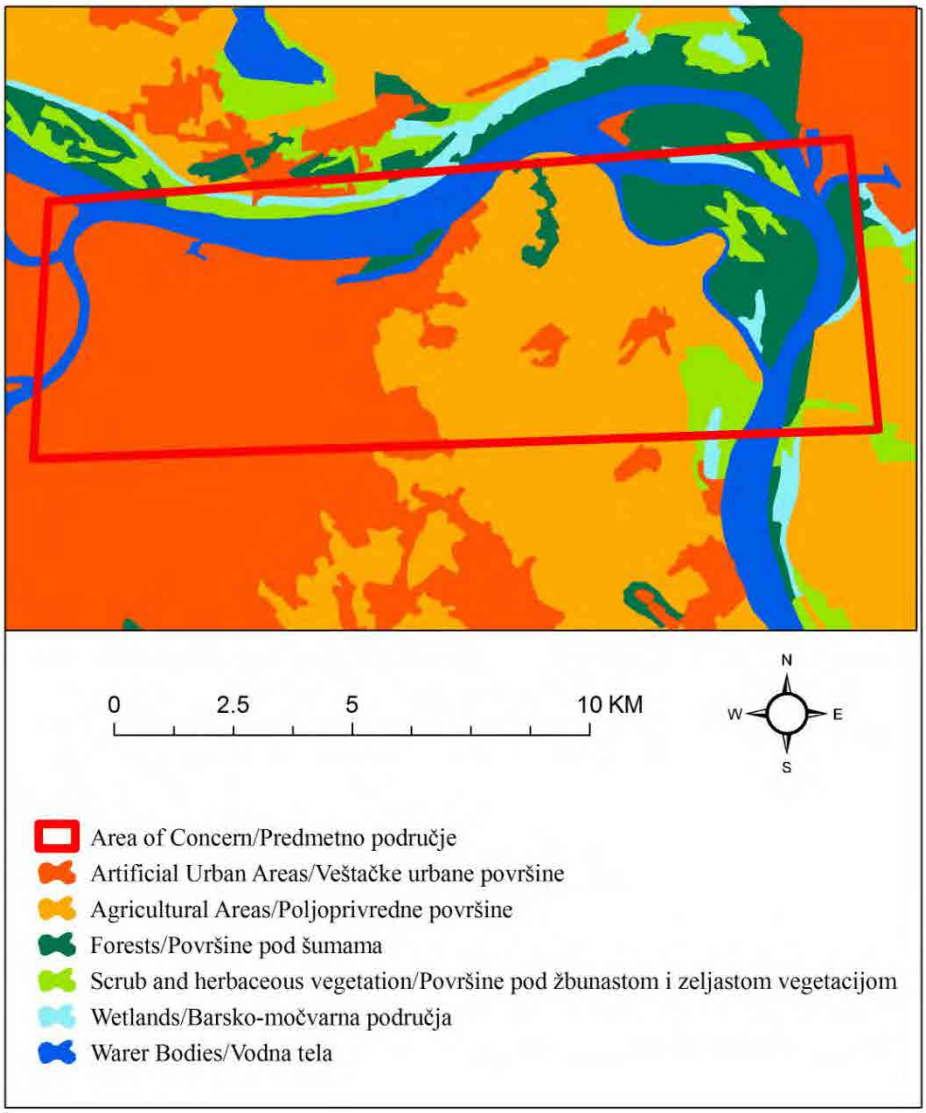


Figure 15. Review of CORINE land cover types within the study area

Further, it should be underlined that there are no “natural” or “near natural” habitats within the area that is subject of this assessment. Urban surfaces, devastated fields with locally invasive and non-indigenous vegetation and agricultural areas dominate within the target area. The forest communities and areas designated as shrub-herbaceous within the area could not be characterized as typical vegetation of the area, due to the intensive anthropogenic influence.

On the contrary, aquatic habitats that cover a large part of the area are important from the aspect of nature conservation. Although they are under significant influence of anthropogenic disturbance and various stress factors, aquatic ecosystems still provide conditions for considerable biological diversity.

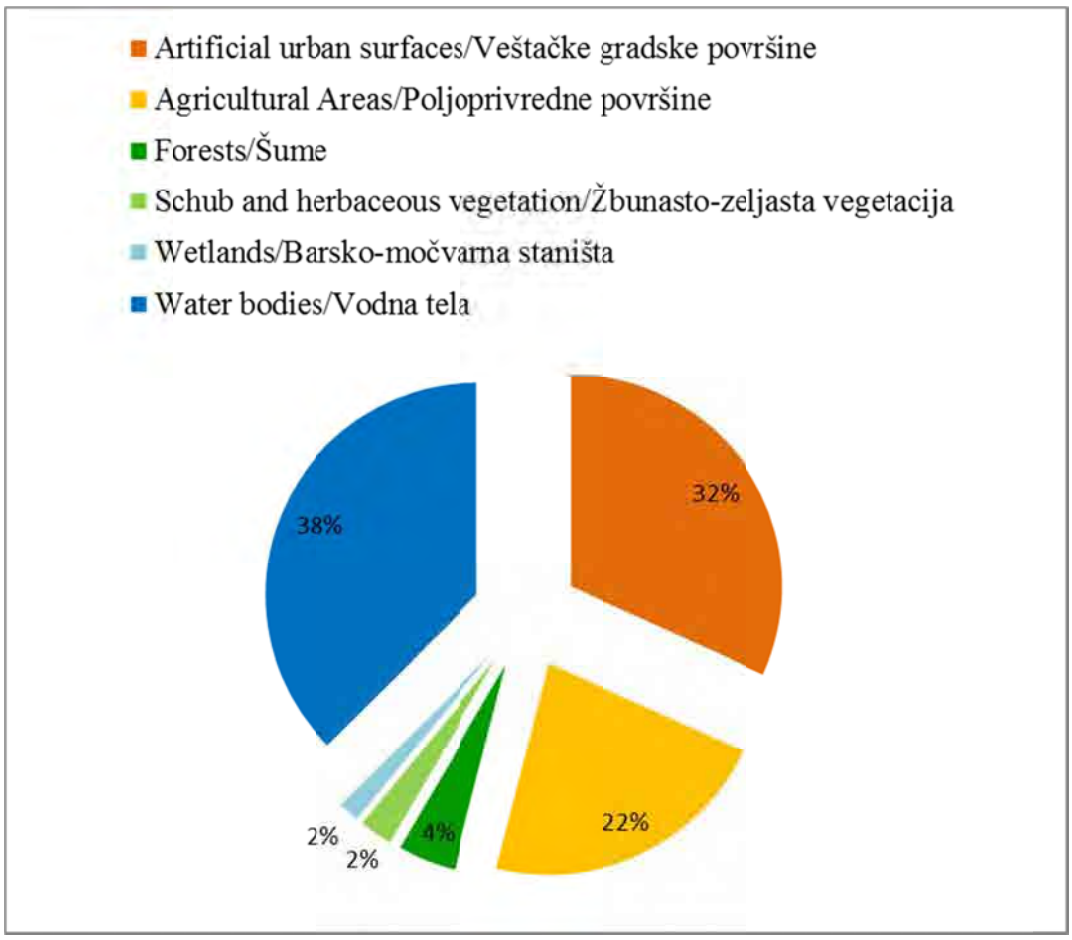


Figure 16. Percentage participation of general CORINE land cover types within the study area

4.3 Geology

This region is characterized by a great heterogeneity of geological substrate with respect to both the age and lithological composition of rocks. Cenozoic (Quaternary) fluvial lacustrine sediments, loess deposits and deluvial formations dominate in the Project area. The geological variations are shown in the figure below.

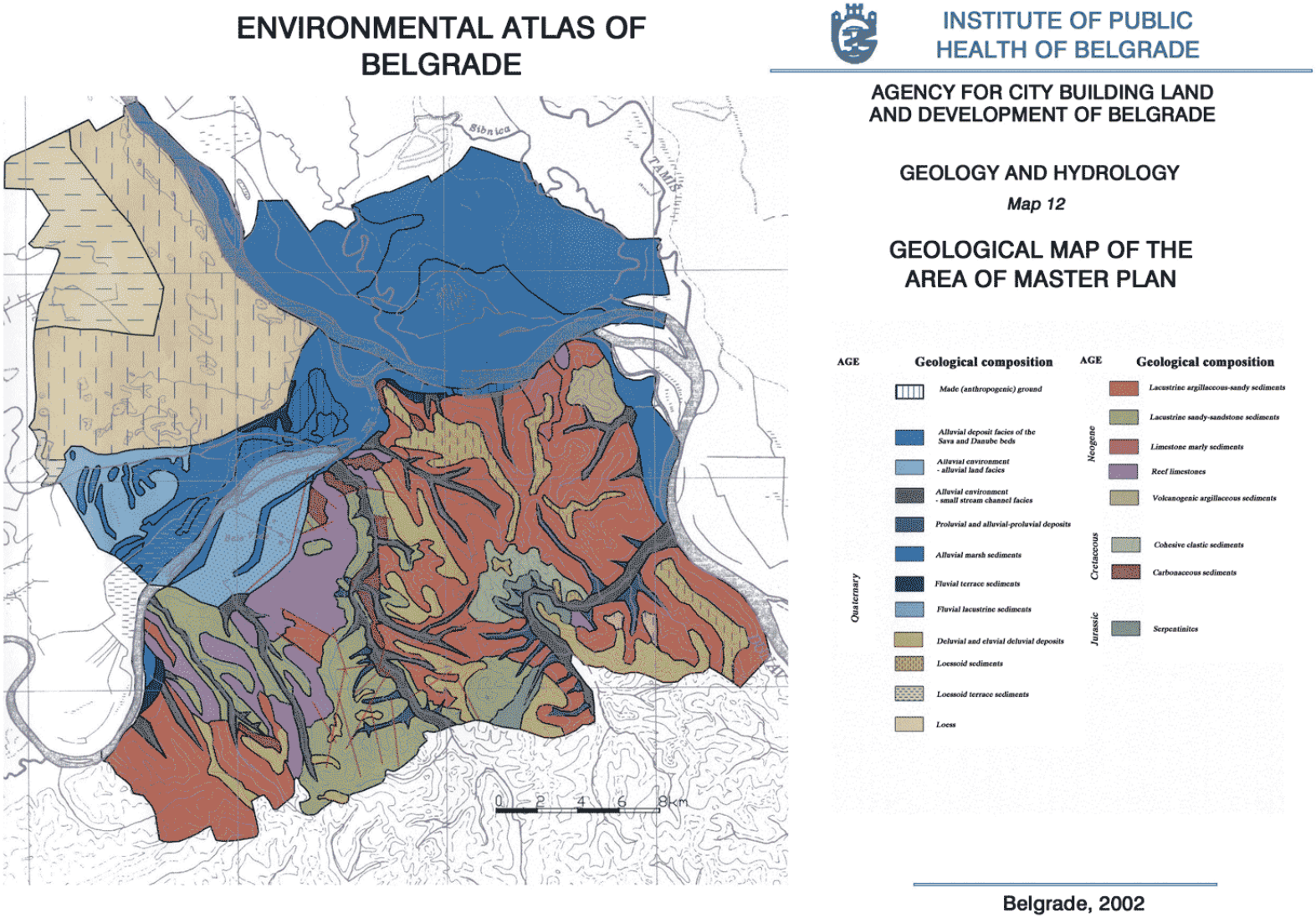


Figure 17. Geological map of Belgrade

4.4 Soil Types and Quality

The inner city area is mostly made up of humic-accumulative soils (chernozems), with some presence of calcareous soils (e.g. at Kalemegdan and Tašmajdan.).

The Sava and Danube River banks are characterized by hydromorphic soil (alluvial fluvisol). The river islands (e.g. Great War Island, Ada Ciganlija, Forkontumac) are also formed in the alluvial deposits of the Sava and Danube Rivers.

Soil quality testing is conducted by the Secretariat for Environmental Protection and by the Belgrade Institute of Public Health. Results interpretation was done according to the norms defined in Regulation on the Program of System- Based Monitoring of Soil Quality, Risk Estimation Indicators of Soil Degradation and the Remediation Programs Methodology (2010).

The Program of systematic soil pollution testing is done to:

- Determine the concentrations of hazardous and harmful substances in the soil;
- Monitor the degree of pollution in urban zones, especially in the sanitary protection zones of the source of water capture for the Belgrade Waterworks;
- Process relevant information and update soil quality databases;
- Define measures that lead to a decrease of pollution in the city area.

The Program involves soil testing from the following sites:

- The soil within the Zone of sanitary protection for the source of water capture of the Belgrade Waterworks - samples were taken from 6 locations in the area of the Sava and Danube Rivers confluence;
- The soil near busy traffic arteries - 3 samples were analyzed from the locations of Novi Beograd, Mirijevo and Leštane;
- The soil within communal environments - 5 samples were taken from the locations of Novi Beograd, Konjarnik, Karaburma and Čubura.
- The soil around public fountains, 19 locations: Topčider, Košutnjak, Rakovica, Miljakovac, Jajinci, Beli Potok, Resnik, Žarkovo, Višnjička banja, Kaluđerica, Leštane, Boleč and Mali mokri Lug.

In 2010, 66 samples of the soil were taken and analyzed from 33 locations. Elevated concentrations of soil pollutants were found in a number of samples, as shown in the figure below. The pollutants detected were heavy metals (Cu, Zn, Pb, Cd) and organic parameters (dichlorodiphenyltrichloroethane - DDT, polycyclic aromatic hydrocarbons - PAHs, hydrocarbon index C_{10}-C_{40} and polychlorinated biphenyls - PCBs). Soil pollutant concentrations did not exceed the Limit Values that would require Remedial actions (please see the table below).

Nickel was found to have the most frequently seen exceedance of permitted soil concentration levels. Increased nickel soil concentrations are related to specific geological/ chemical composition of surface layers in the Belgrade area. However, the possible additional effect of anthropogenic pollution cannot be excluded.

In the locations that belong to Zone of sanitary protection for the water capture sources of the Belgrade Waterworks, no major aberrations were registered in the examined parameter concentrations.

However, DDT was detected (residuals from the use of this pesticide in the past), which requires further future monitoring for the presence of this pollutant in soil and drinking water.

Elevated values of hydrocarbons C_{10}-C_{40} (mineral oils) and Cu were found in the soil near busy traffic arteries. This can be ascribed to the impact of motor vehicles on the soil along these routes.

PCBs were found in the soil near the fountain Zelenjak in Resnik. It has not been safe to use the fountain for a long time and there is a sign nearby, with information “Water unsafe for drinking”.

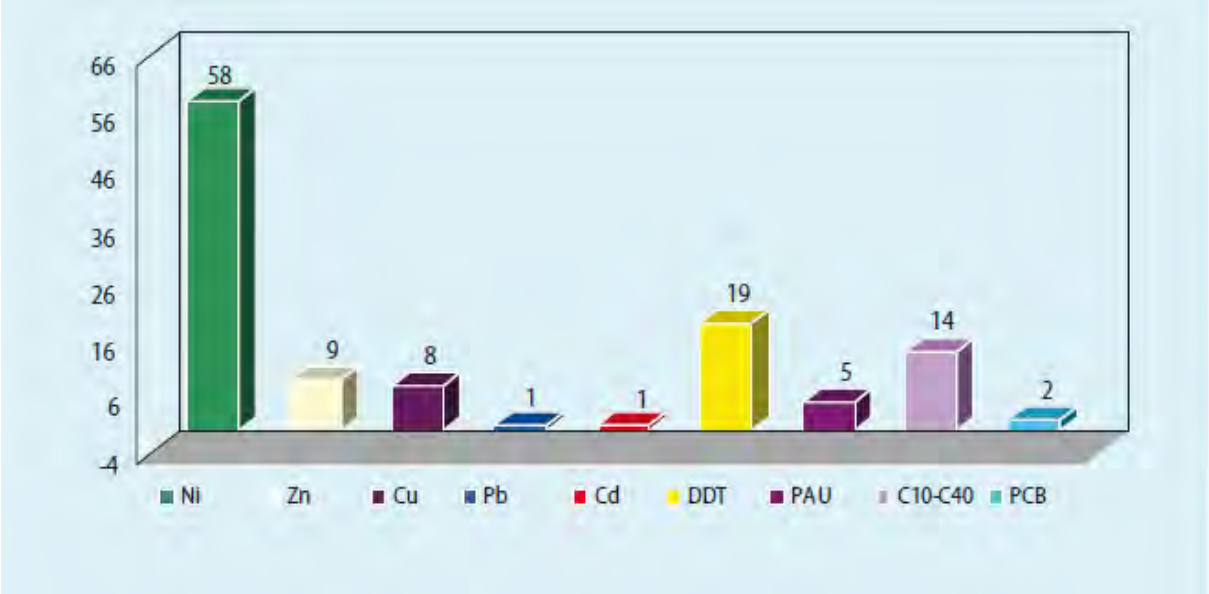


Figure 18. Number of detected exceedances of soil pollutant concentrations from the prescribed limit values (Source: Environment in the City of Belgrade 2010).

Table 5. Limit values for soil pollutants that were detected in elevated concentrations (according to the Regulation on the Program of System- Based Monitoring of Soil Quality, Risk Estimation Indicators of Soil Degradation and the Remediation Programs Methodology, 2010)

Pollutant	**Soil Concentration [mg/kg of dry mass]**	
	Limit Value	**Remediation Value**
Ni	35	210
Zn	140	720
Cu	36	190
Pb	85	530
Cd	0.8	12
	Limit Value	**Values that can indicate significant contamination**
DDT/ DDD/ DDE (total)	0.01	4
PAHs	1	10
C_{10}-C_{40}	50	5000
PCBs	0.02	1

4.5 Soil Erosion

Soil erosion and related sediment problems are recognized as significant problems throughout the world. Erosion and sedimentation are part of the natural evolution of the landscape, but they are accelerated by human activities and they constitute some of the most fundamental problems for the development of agriculture and forestry and for the utilization of natural resources.

Erosion and sedimentation processes are related to the natural characteristics of the area – geology, climate, hydrology, relief, vegetation cover, sediment characteristics, soil characteristics, but are also connected to the intensity of particular human induced pressures to the area – deforestation and other aspects of destruction of natural habitats, intensity and type of agriculture, etc.

In general, the range of erosion rates in Serbia corresponds to the range of erosion rates elsewhere in Europe and an evaluation of total annual soil loss from the Serbian territory indicates a range of 40-$50 \cdot 10^6$ t per km^2. (Petković et al., 1999).

The territory of Serbia is divided into three basic units corresponding to high, medium and low erosion intensities (Petković et al., 1999). According to Petković et al. (1999), the project area is characterized by a low intensity of erosion processes in comparison to other regions of Serbia, although some narrow zones characterized by medium soil erosion rate could be identified.

4.6 Meteorology

Climate characteristics of the area under consideration are determined by the terrain morphology, rivers and synoptic influences related to meridian position. To the north of the area is the Pannonian plane, which allows intrusion of cold, polar air masses from north-eastern Europe. Therefore, the climate may be classified as a moderate continental climate with four distinctive seasons. The annually averaged daytime temperature is 11.7 °C.

4.6.1 Air Temperature

Analysis of air temperature in Belgrade is based on observed temperatures in the period between the years 1978 to 2007 (Republic Hydrometeorological Service of Serbia – RHSS). Table 6 and Table 7 show the averaged maximum and minimum air temperatures throughout the years. July and August are the warmest months with an averaged maximum temperature of 28.2 and 28.3 ^{o}C, respectively, while January is the coldest month with averaged minimum temperature of -1.2 ^{o}C. The absolute maximum temperatures in this period are observed in August, in the range of 37.4 to 40.3 ^{o}C, while the absolute minimum air temperatures are observed in January in the range of -30.7 to -20.3 ^{o}C.

Table 6. Averaged maximum air temperatures in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Max T (^{o}C)	4.5	6.8	12.5	17.6	23.1	26.1	28.2	28.3	23.8	18.3	10.5	5.8	17.1

Table 7. Averaged minimum air temperatures in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Min T (^{o}C)	-1.2	-0.2	3.6	8.0	12.7	15.7	17.2	17.2	13.3	8.9	3.8	0.1	8.3

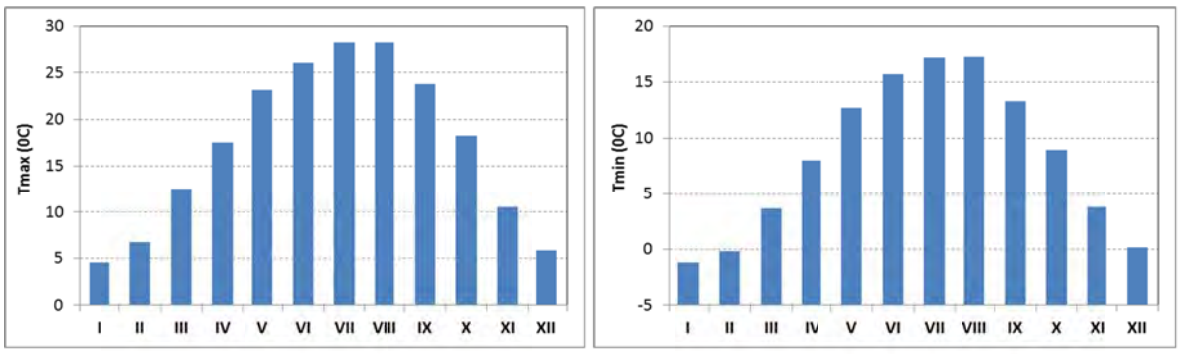


Figure 19. Averaged maximum and minimum air temperatures in Belgrade

4.6.2 Precipitation

In the considered period (1978-2007), the annual precipitation was in the wide range of 368 to 1051 mm (RHSS).

Table 8 shows the averaged distribution of precipitation through the years. It can be seen that the most rainfall occurs in the warmer season, which is characteristic of continental climate. However, some maritime characteristics can be also observed; the annual precipitation pattern shows two maximum and two minimum values. On average, the annual precipitation in the Belgrade area is nearly 700 mm. The month with the highest rainfall is June, with an averaged value of 99.8 mm.

Table 8. Annual distribution of the averaged precipitation

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Sum.
Precip. (mm)	46.6	40.2	48.2	59.4	62.5	99.8	63.9	58.9	56.4	49.6	54.8	55.2	695.5

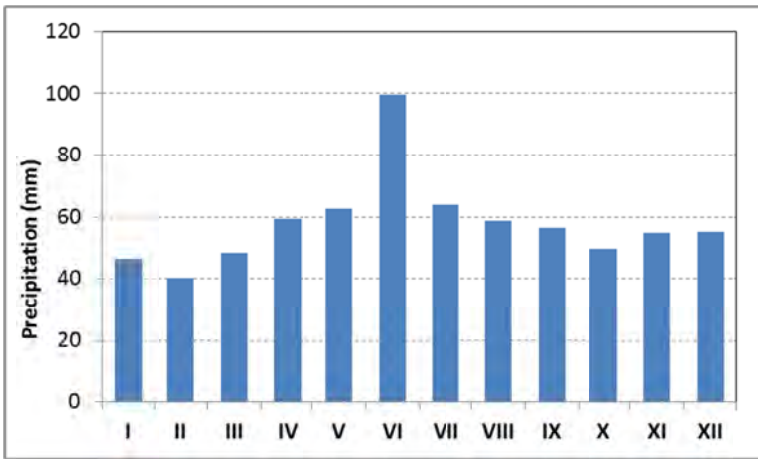


Figure 20. Annual averaged distribution of precipitation

4.6.3 Relative Humidity

The relative air humidity in Belgrade varies between 61% (warm season) and 79 % (December/January), as shown in Table 9 and Figure 21. The averaged annual relative humidity during the observation period from 1978 to 2007 was 68.1 %.

Table 9. Annual distribution of the averaged relative air humidity in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Ann.
(%)	77.7	71.6	63.5	61.3	61.7	63.3	61.5	62.2	67.9	71.0	76.4	79.1	68.1

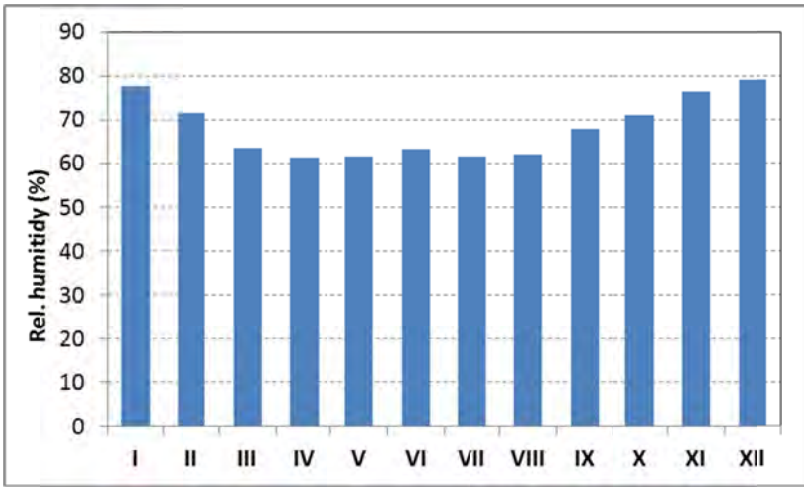


Figure 21. Annual distribution of the averaged relative air humidity in Belgrade

4.6.4 Wind Speed

The highest averaged wind speed in Belgrade is observed in March (2.8 m/s), while the lowest is observed during the summer (June, July and August, 2.0 m/s). The annually averaged value of the wind speed is 2.3 m/s (Table 10).

There are two prime wind directions: the south-eastern one (known as Košava), and the west-north-western one (known as Gornjak).

The annual wind rose and the wind speed in specific directions are shown in Figure 22. Spatial distribution of annual wind roses in the city area is shown in Figure 23, revealing the dominance of south-eastern wind direction in the whole area.

Table 10. Averaged distribution of the wind speed in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Ann.
(m/s)	2.4	2.6	2.8	2.5	2.3	2.0	2.0	2.0	2.1	2.4	2.5	2.4	2.3

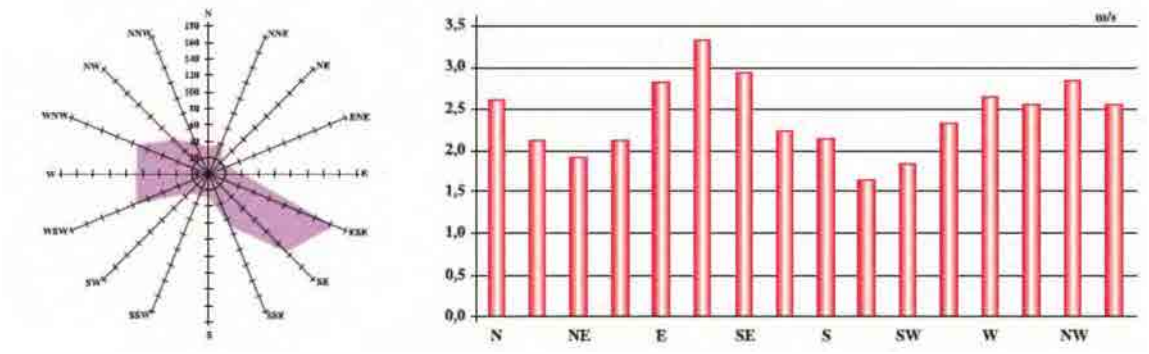


Figure 22. The annual rose and the mean wind speed in specified directions in Belgrade (Source: Statistical Yearbook of Belgrade - 2011, 2012).

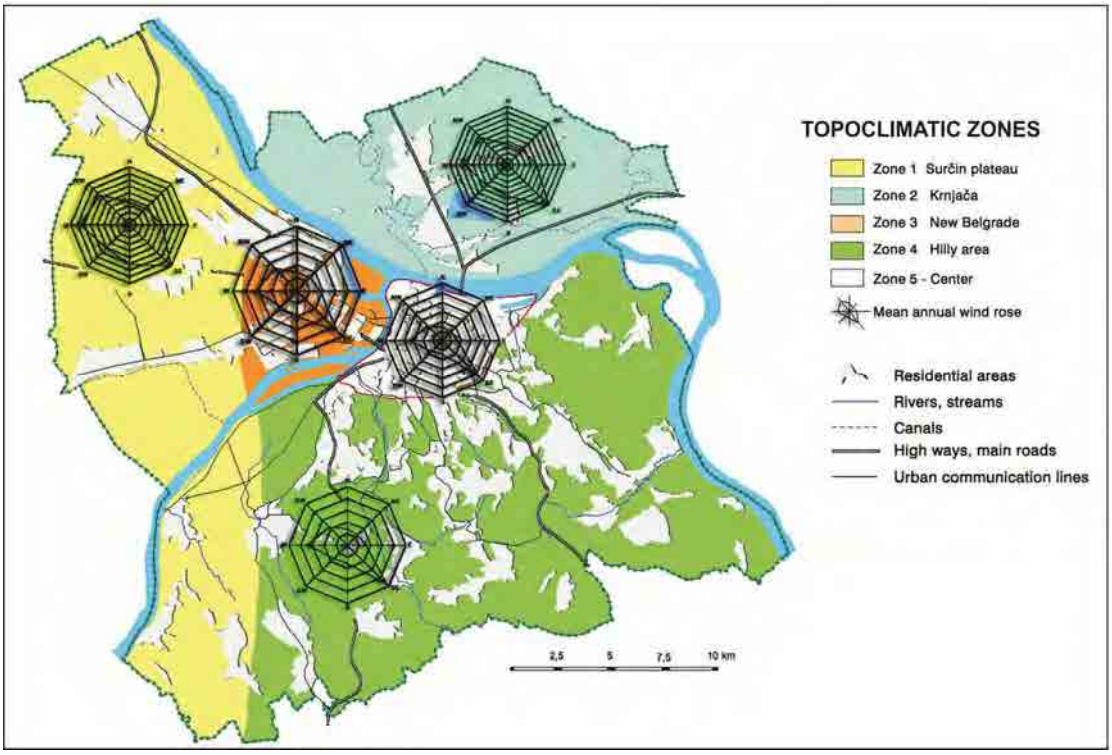


Figure 23. Spatial distribution of annual wind roses (Source: Environmental Atlas of Belgrade, 2002)

4.6.5 Insolation

The averaged annual distribution of insolation is shown in Table 11. The lowest insolation is observed in January (72 h), and the highest in July (286 h). In average, the monthly insolation in Belgrade is 173.6 hours.

Table 11. Averaged insolation in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Av.
(hours)	72.0	100.8	154.4	183.4	234.6	260.0	286.1	268.1	204.3	163.8	89.1	67.1	173.6

4.7 Air Quality

Air quality monitoring in Belgrade is conducted according to the Regulation on Air Monitoring Conditions and Air Quality Requirements (2010), which prescribes following air pollutant concentration limit values (LV):

- SO_2:
  - hourly LV – 350 µg/m^3 (not to be exceeded more than 24 times in one calendar year)
  - daily LV – 125 µg/m^3
  - annual LV – 50 µg/m^3
- NO_2:
  - hourly LV – 150 µg/m^3 (not to be exceeded more than 18 times in one calendar year)
  - daily LV – 85 µg/m^3

- annual LV – 40 μg/m^3

- Particulate matter PM_{10}:
  - daily LV – 50 μg/m^3 (not to be exceeded more than 18 times in one calendar year)
  - annual LV – 40 μg/m^3

- Particulate matter $PM_{2.5}$:
  - annual LV – 25 μg/m3

- Lead:
  - daily LV – 1 μg/m^3
  - annual LV – 0.5 μg/m^3

- Benzene:
  - annual LV – 5 μg/m^3

- Carbon-monoxide:
  - maximum daily 8-hour average value – 10 mg/m^3
  - daily LV – 5 μg/m^3
  - annual LV – 3 μg/m^3

- Soot:
  - daily LV – 50 μg/m^3
  - annual LV – 50 μg/m^3

- Target values for tropospheric (ground level) ozone:
  - maximum daily 8-hour average value – 120 μg/m^3 (not to be exceeded more than 25 times in one calendar year)

- Target values for arsenic, cadmium, nickel and benzo (a) pyrene, for the average annual value of total PM_{10}, are:
  - arsenic – 6 ng/m^3
  - cadmium – 5 ng/m^3
  - nickel – 20 ng/m^3
  - benzo (a) pyrene – 1 ng/m^3

Air quality monitoring is carried out by measuring air borne pollutants originating from stationary and mobile sources, and by monitoring the impact of air pollution on human health and the environment.

An Air Quality Control Program is adopted every two years by the City of Belgrade Assembly and published in the Official Gazette of the City of Belgrade. The most recent Program for the years 2012 and 2013 was published in April of 2012. The Program determines three networks of stations where the following air samples are taken:

1. Continuous sampling of air pollutants emitted from stationary sources in urban areas (17 monitoring stations);
2. Continuous sampling of air pollutants emitted from stationary sources in industrial areas (4 monitoring stations);
3. Indicative sampling of air pollutants emitted from traffic (18 locations positioned at 10 cm from the road curb (at maximum) and at 1.5 meters above ground level).

Indicative sampling of air pollutants is during a 24-hour period once a week, distributed evenly throughout the year. The sampling locations are shown in the map below. The following air pollution parameters are measured: CO, NO_X, Pb, volatile organic compounds (VOCs), SO_2, benzene, xylene and toluene.

Sampling locations marked in red on the map below are of interest as they are positioned near the planned Project works. These locations are:

1. "Mostar", very near the Mostar PS and the beginning of Interceptor No. 10;
2. "Cvijiceva" (Cvijićeva in Serbian), at the intersections of Despot Stefan Boulevard and Cvijiceva Streets, right by the area where Interceptors Nos. 3, 4 and 10 will meet;
3. "Pancevo Bridge" (Pančevački most in Serbian), close to Interceptor No. 6.

70% -80% of the vehicles that pass these busy intersections are passenger vehicles, while the rest are buses and trucks. The average hourly measurement results of air pollution from mobile sources (vehicle exhaust gases) for the months of 2012 are shown in the table below.

Figure 24. Network of stations for indicative sampling of air pollutants emitted from mobile sources

Table 12. Average hourly measurement results of air pollution from mobile sources (vehicle exhaust gases) for the months of 2012 (Source: Ecological Bulletins, 2012) – bolded values indicate exceedance of the permitted hourly limit values.

Month	**Pollutant** (LV_h=hourly limit value)			
	CO LV_h=10 mg/m^3	**NO_X LV_h=150 µg/m^3**	**Pb LV_h=1 µg/m^3**	**SO_2 LV_h=350 µg/m^3**
Location: Cvijiceva				
January	6.4	96	0.4	68
February	4.1	**130**	0.4	43
March	9.5	124	0.8	145
April	8.6	**260**	0.5	74
May	8.2	136	0.4	54
June	4.2	**211**	0.4	56
July	**10.2**	**168**	0.6	88
August	4.8	**169**	0.3	41
September	4.1	**171**	0.3	60
October	6.37	**218**	0.3	46
November	4.48	**188**	0.3	36
December	4.98	127	0.4	40
Location: Mostar				
January	3.5	109	**3**	35
February	2.9	118	0.3	25
March	5.6	**151**	**1.4**	46
April	6.9	**151**	0.3	49
May	5.1	**190**	0.4	33
June	3.6	**164**	0.4	35
July	5.1	**176**	0.5	33
August	5.5	**187**	0.3	35
September	3.1	**157**	0.3	41
October	4.7	**211**	0.3	35
November	3.66	**152**	0.3	29
December	4.39	121	0.4	33
Location: Pancevo Bridge				
January	3.5	116	**1.7**	30
February	3.0	94	0.3	20
March	5.0	140	**2**	45
April	4.1	**154**	0.3	29
May	3.9	**154**	0.4	28
June	4.2	136	0.5	39
July	6.0	**170**	0.5	35
August	7.0	**169**	0.3	49
September	5.0	**173**	0.4	79
October	7.94	**214**	0.4	69
November	4.39	**161**	0.3	40
December	3.85	145	0.3	29

4.8 Noise and Vibrations

The communal noise in Belgrade originates primarily from traffic. Industrial facilities, construction works, small-scale economy and other activities are less important. The Belgrade Institute of Public Health monitors noise levels in Belgrade and reports the finding to the Secretarial for Environmental Protection. Noise measurements are conducted for a 24-hour period twice a year, in the spring and in the autumn, at 35 measuring points. The measuring locations are chosen as representative of different urban zones of the city and along major crossroads. The measurements are conducted according to the:

- Law on Protection against Noise in the Environment (2009 & 2010);
- Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010);
- Rulebook on Noise Measuring Methods, the Content and Scope of the Noise Measurement Report (2010).

The Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Environmental Noise (2010) stipulates the limit values for outdoor noise levels, as shown in the table below.

Table 13. Limit values for outdoor noise levels (according to the Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment, 2010)

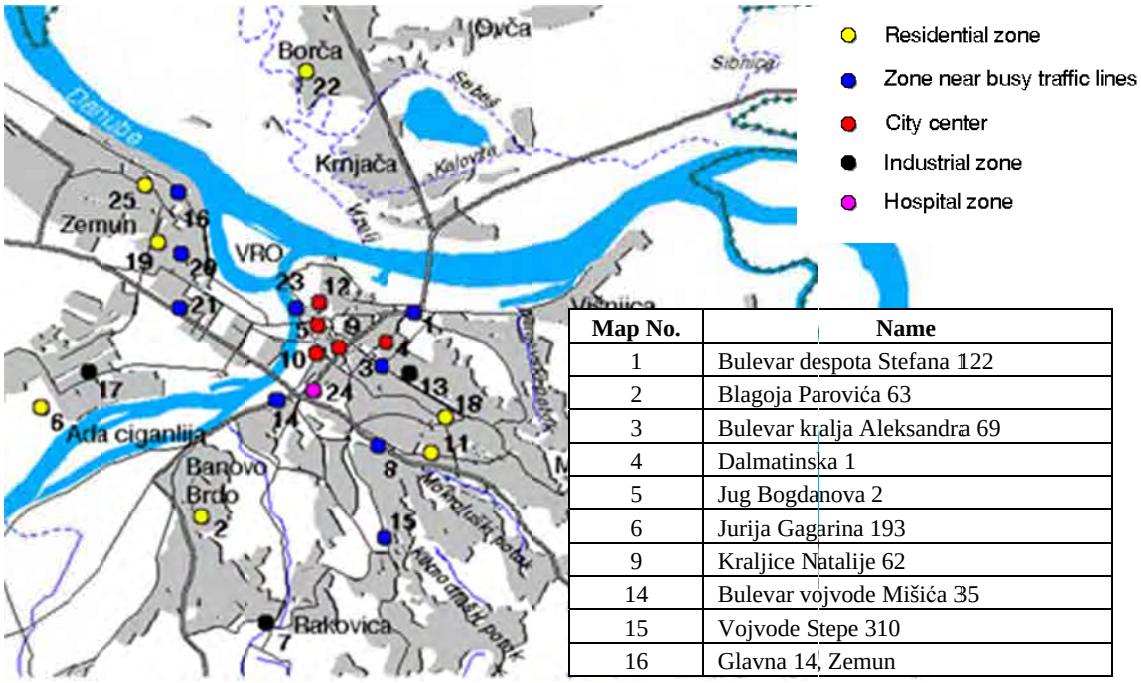
Zone	Land Use	Noise level in dB (A)	
		Daytime	Nighttime 10 PM – 6 AM
1	Areas for recreation, hospital zones and rehabilitation, cultural and historical sites, large parks	50	40
2	Tourist areas, camps and school zones	50	45
3	Purely residential areas	55	45
4	Business-residential areas, commercial-residential areas and playgrounds	60	50
5	City center, commercial, trade, administrative areas with apartments, areas along highways and city roads	65	55
6	Industrial, warehouse and service areas and transportation terminals without residential buildings	At the border of this zone the noise level must not exceed the allowable levels of the boundary zone	

In 2011, daytime and nighttime noise limits were exceeded at 25 and 32 measuring points, respectively. The daytime exceedances were between 0-19 dB (A), while the nighttime exceedances varied from 0-20 dB (A) depending on the zoning. The maximum average exceedances were detected in residential zones and in areas along busy traffic roads. The highest levels of noise were registered in the Despot Stefan Boulevard (Bulevar despota Stefana in Serbian), the Duke Misica Boulevard (Bulevar vojvode Mišića in Serbian) and the Main Street (Glavna in Serbian) in Zemun, where the noise levels reach 75 dB (A) and 70 dB (A) during the daytime and nighttime, respectively. The first two locations are close to the planned Project works. The average noise levels for several locations in 2011 are shown in the

table below. The locations of the measuring points are marked in the figure below (Figure 25). Areas of the dominant sources of noise are shown in Figure 26.

Table 14. Communal noise in Belgrade (Source: Belgrade in Figures, 2012)

Measuring point	*Average*		*Measuring point*	*Average*	
	day	*night*		*day*	*night*
Permitted level: day 65 dB (A) night 40 dB (A)					
Jurija Gagarina 193	60	55	Glavna 14, Zemun	73	68
Bulevar kraqa Aleksandra 69	69	66	Jug-Bogdanova 2	72	61
Kraqice Natalije 62	66	64	Blagoja Parovića 63	66	62
Vojvode Stepe 310	67	65	Dalmatinska 1	65	59
Bulevar despota Stefana 122	82	76	Bulevar vojvode Mišića 35	75	71



Map No.	Name
1	Bulevar despota Stefana 122
2	Blagoja Parovića 63
3	Bulevar kralja Aleksandra 69
4	Dalmatinska 1
5	Jug Bogdanova 2
6	Jurija Gagarina 193
9	Kraljice Natalije 62
14	Bulevar vojvode Mišića 35
15	Vojvode Stepe 310
16	Glavna 14, Zemun

Figure 25. Network for communal noise control in Belgrade

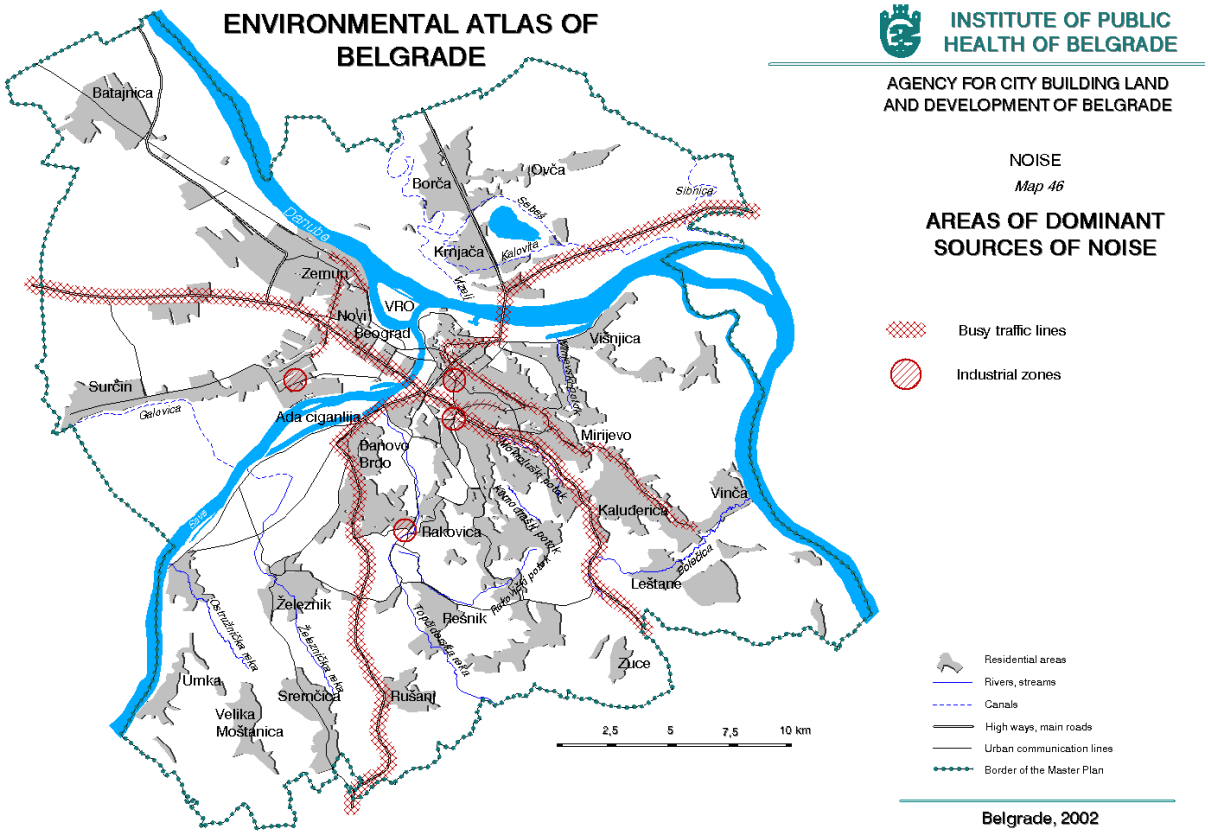


Figure 26. Areas of dominant sources of noise in Belgrade

There is no legislative in Serbia regarding vibrations and there are no published results on vibration measurements in Belgrade. Traffic related vibrations are expected to correlate to the levels of noise measured in Belgrade.

4.9 Solid Waste Management

There are five registered official waste landfills in the wider metropolitan area of Belgrade. Thirteen urban municipalities deposit their waste at the Vinca (Vinča in Serbian) landfill, located near the Vinca settlement. The four other 4 municipalities (Sopot, Mladenovac, Lazarevac and Obrenovac) have their own landfills. The biggest landfill by far in the Vinca landfill and it is the landfill that is relevant to the Project.

The Vinca landfill is located in the southeast Municipality of Grocka, about 10 km from the city center. The landfill was set on agricultural land and the landfill became operational in 1978 as one of several municipal landfills. All other landfills in the urban municipalities were shut down in the 1990's, and the Vinca landfill had been the only operational landfill for the urban municipalities since 1998.

The location of the Vinca landfill in relation to the future WWTP is shown in the figure below.

Waste collection, transportation and disposal are handled by the city public utility company (PUC) "Gradska čistoća" (PUC City Sanitation). All non-hazardous waste, including bulky waste, commercial waste, construction and demolition waste, as well as sanitized medical waste is deposited

at the Vinca landfill. The Vinca landfill receives about 1,700 tons of municipal waste per day. There is no information how much industrial waste is deposited at the Vinca landfill. The Vinca landfill covers an area of about 70 ha, of which the waste disposal area is about 45 ha in size and has a depth of 5–50 m. An additional 35 hectares is available for future waste disposal.

At the time of the landfill was opened in 1978, the composition of the soil and its impermeability satisfied the legal requirements for the construction and operation of the landfill, which is not the case today. There is no collection or beneficial utilization of landfill gas, nor is there monitoring of the landfill gas. There is no leachate treatment; the leachate and storm water are discharged through a channel directly into the Danube River, which is environmentally unacceptable. There is no monitoring of leachate.

A great effort is made to implement sanitary waste disposal, within the limits of the existing possibilities. Deposited waste is compacted and covered by construction and demolition debris as well as earth supplied by the PUC City Sanitation. The density of the compacted waste is about 880 kg/m^3. Reclamation in the form of grass planting is done once a certain part of the landfill is closed for further dumping. Therefore, waste is only visible in the operational part of the landfill. Self-ignition does not occur at the landfill.

Figure 27. Location of the Vinca landfill (1) and the future WWTP (2)

A water sampling program was conducted in 2010 at six locations around the Vinca landfill site and in four locations near the site and at the banks of the Danube River (figures below). The results showed that the water sampled upstream of the deposited waste was not polluted; and that the leachate sampled as it leaves the landfill site indicated a strong organic pollutant influence (the measured BOD_5 values were above 1000 mg/L).

Figure 28. Water sampling locations at the Vinca landfill site perimeter (Source: Local Waste Management Plan for the City of Belgrade 2011-2020, 2011)

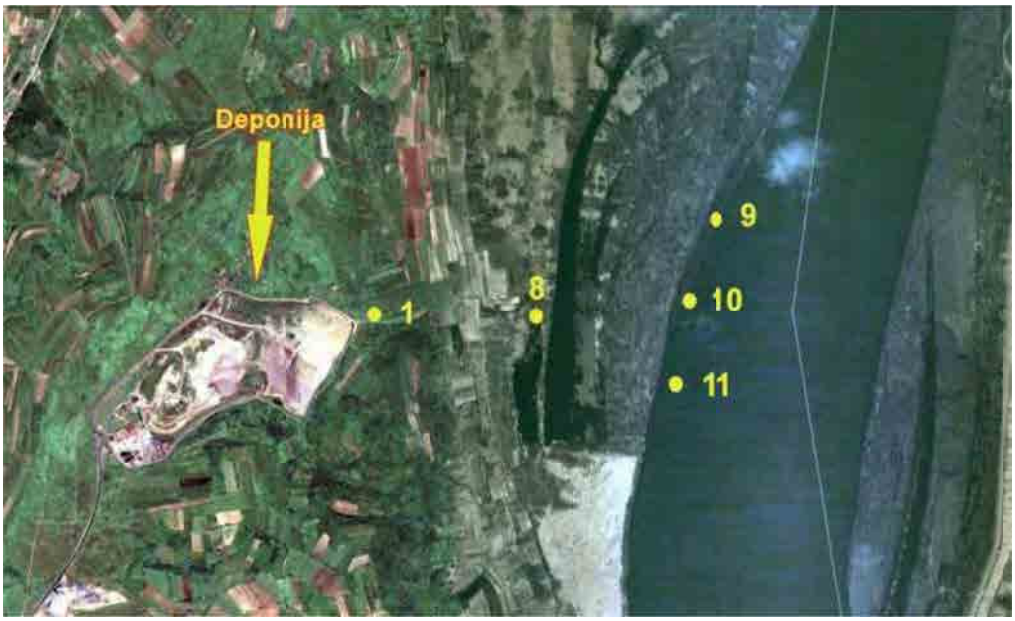


Figure 29. Water sampling locations at the Vinca landfill site perimeter (Source: Local Waste Management Plan for the City of Belgrade 2011-2020, 2011).

In the Local Waste Management Plan for the City of Belgrade 2011-2020 (2011), it is stated that more than 4.5 million m^3 of waste will be deposited at the Vinca landfill in the next 20 years. This demand can be met with the engineered construction of 4 landfill cells within the 30 or so ha of available area at the current landfill site. The required height of the cells is between 18–20 m.

4.10 Wastewater Discharge

Belgrade sewage is now developed on an area of more than 11,500 ha, and covers the settlements of central Belgrade, New Belgrade, Zemun and some settlements on the left bank of the Danube. Collected domestic and industrial wastewater, as well as stormwater, is discharged in its raw form directly into the Sava and Danube Rivers, as well as their tributaries, that at times of low flow periods, turn into de facto open sewer channels.

Figure 30 presented the map of the sewerage system network, while Figure 31 shows the map of identified surface water polluters. Points of discharges of wastewater into surface waters are marked in dark blue. The discharge of raw wastewater has a detrimental effect on surface water quality parameters in Belgrade, especially at micro-locations of wastewater disposal and especially from a recreational standpoint. Industrial wastewaters are also discharged into surface waters mostly without pre-treatment (Figure 31).

As mentioned in Section 2, a special strategic objective of the “Master Plan of Belgrade 2021” is the orientation of Belgrade towards the its water boulevards, the Sava and Danube Rivers. These are to become (and in great part, already are) the central location for various entertainment venues, for tourist and locals alike. These venues include restaurants situated on the rivers themselves, cultural, sporting and entertainment venues. Currently, all existing floating restaurants discharge all their raw wastewater directly into surface waters upon which they are situated. There is no suggestion as to how these discharges should be handled in the Belgrade 2021 Master Plan.

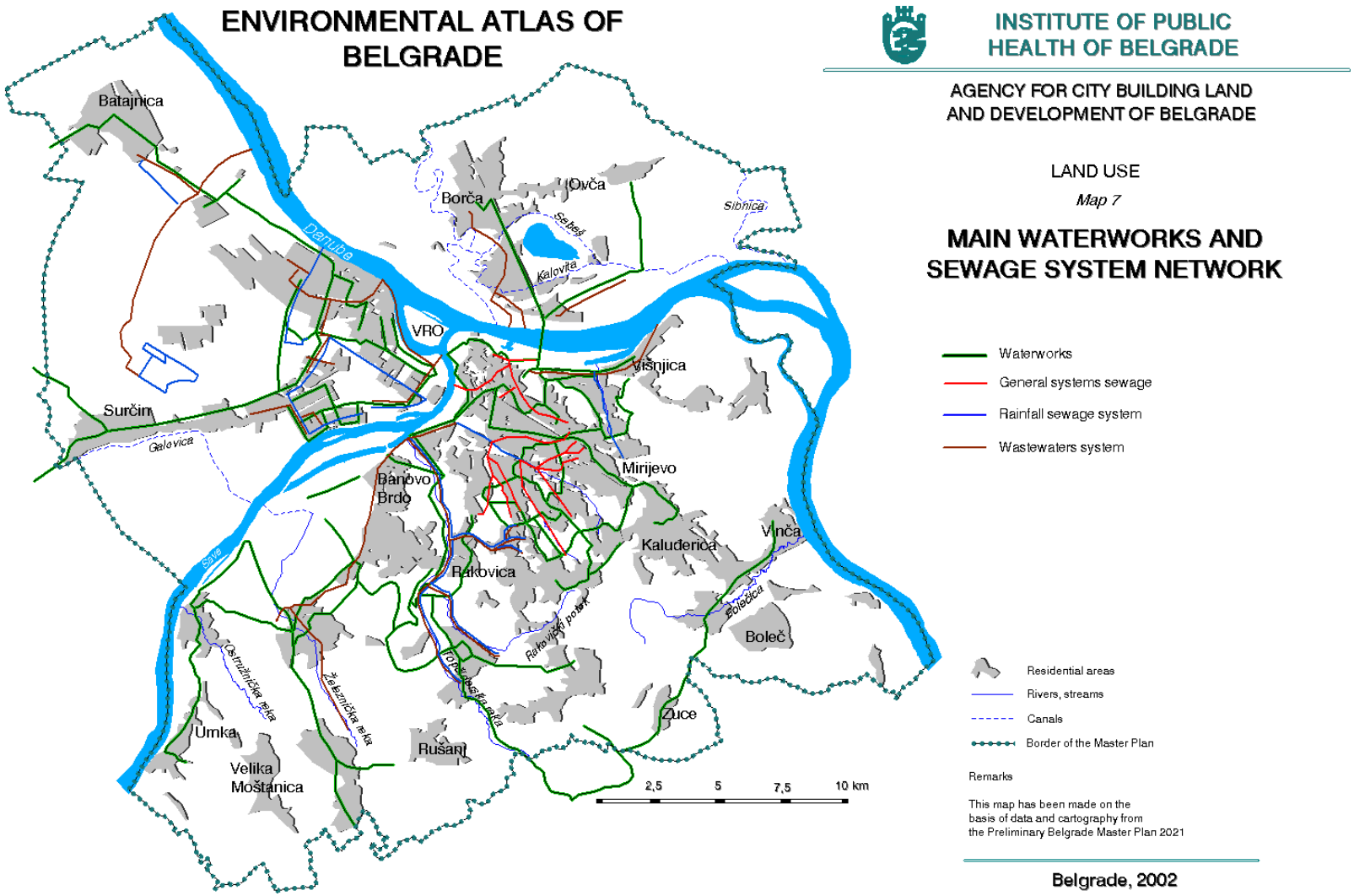


Figure 30. Map of the main waterworks and sewerage system network

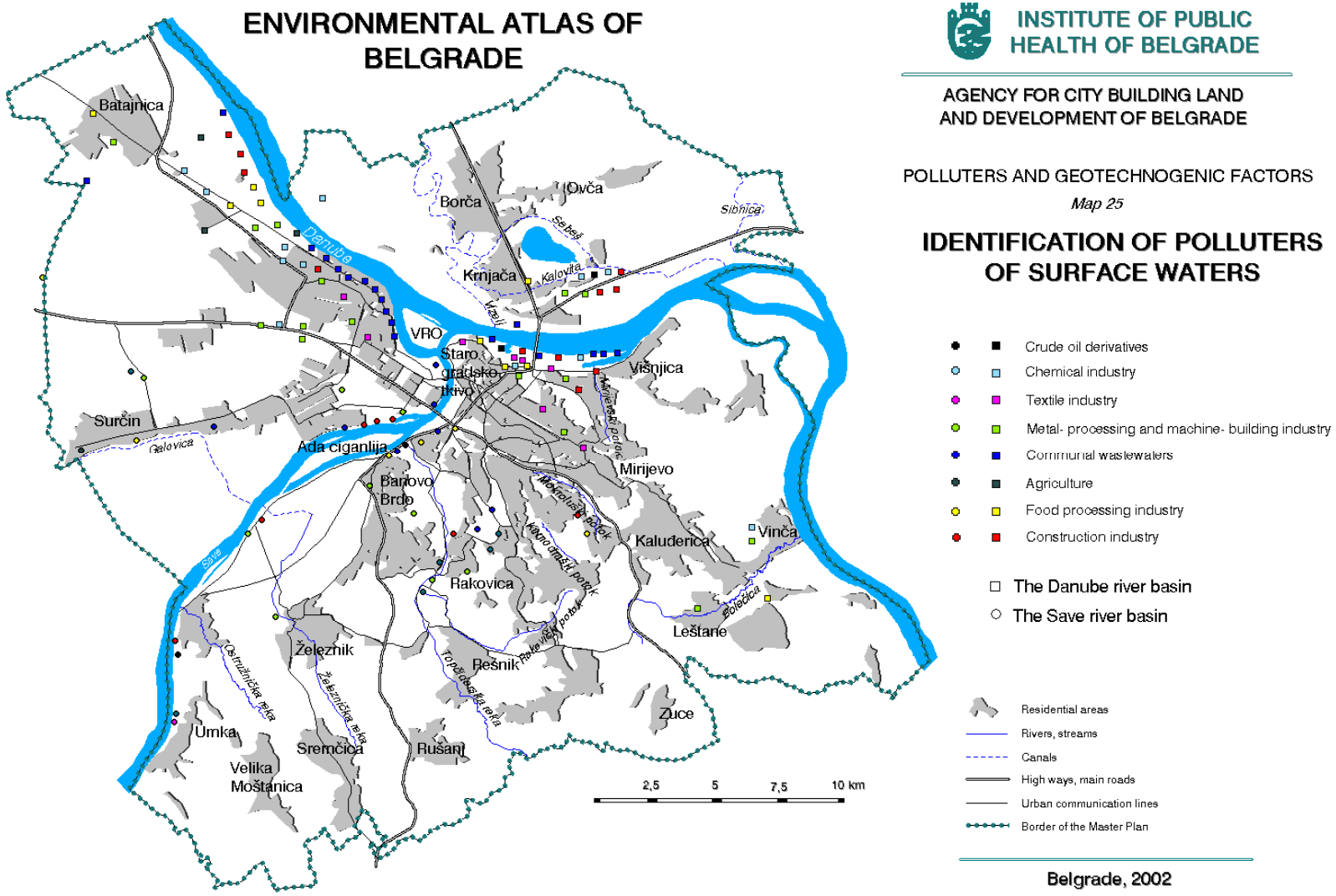


Figure 31. Map of identified surface water polluters

One of the main attractions recommended by the Tourist Organization of Belgrade is their "Belgrade by the Rivers" offer. There are several boat companies that offer regular guided boat tours (a must see for all Belgrade tourists), as well as renting boats for seminars, private parties and weddings. A picture of one such boat is shown in Figure 32. There is even a hostel situated on the water near the confluence of the Sava and Danube Rivers (Figure 33).

The location of the hostel and where the one of the panoramic boating tours begin is shown in Figure 35. What the tourists and most locals do not know is that this location is immediately downstream of a number of untreated wastewater discharges (Figure 35). These discharges also influence the quality of the bathing wasters at the Lido beach (Figure 34), which is located at the upstream side of the Great War Island (Veliko Ratno Ostrvo – VRO).

Four and five river water samples were taken of the Danube at the Lido beach in July and August 2012, respectively. In eight of the nine samples, the detected microbiological water quality parameters were higher than the prescribed limits for bathing water quality. The City officials recommended washing after each swim at the provided showers that were supplied with potable water, especially for young children and adults with an impaired immunity system (Ecological Bulletins of the Belgrade Secretariat for Environmental Protection, July – September 2012).

Figure 32. Guided river tours, a main tourist attraction in Belgrade

Figure 33. Hostel situated on the water near the confluence of the Sava and Danube Rivers

Figure 34. The Lido beach at the tip of the Great War Island

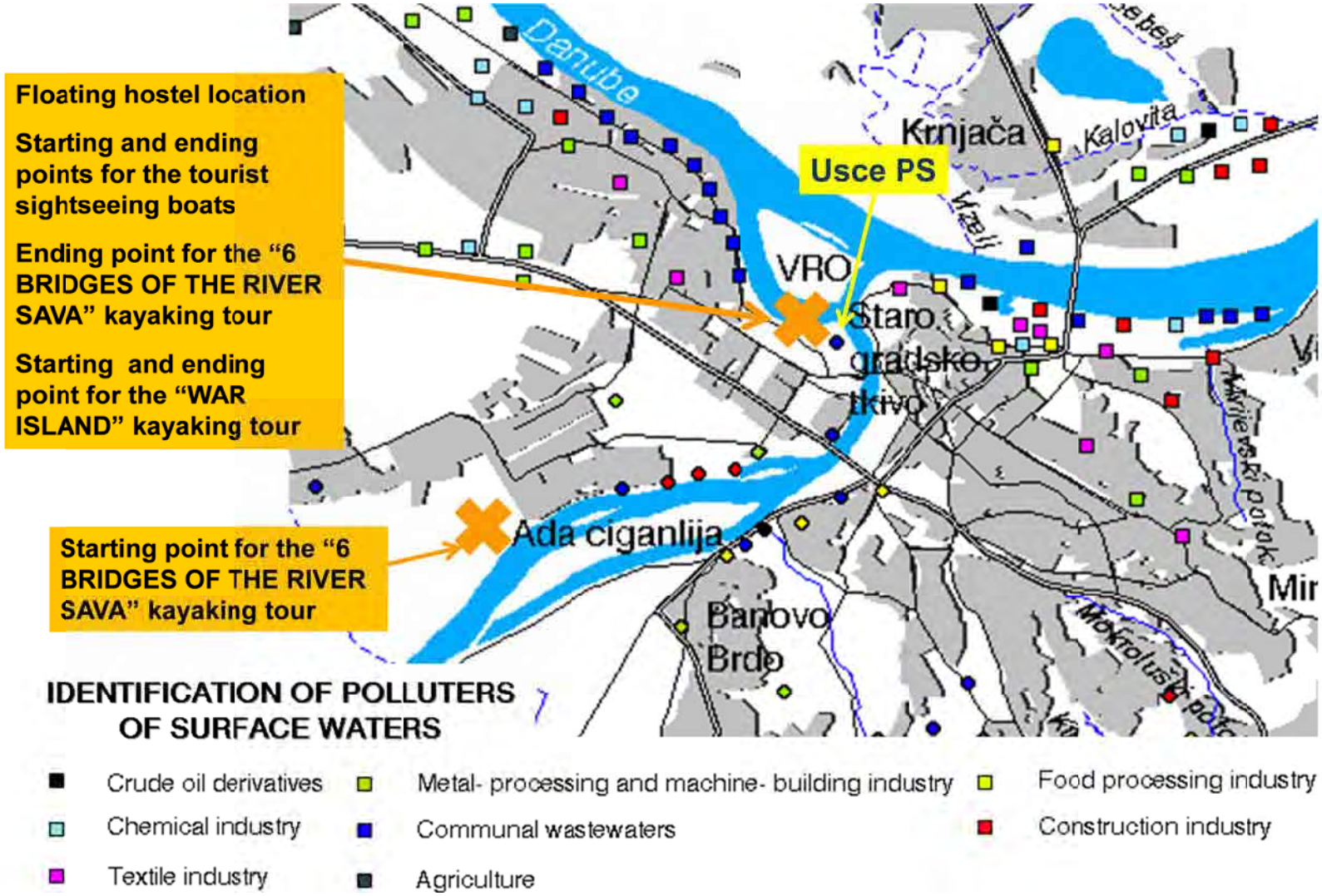


Figure 35. Location of the floating hostel, starting and ending points for the panoramic boating and kayaking tours (VRO = Great War Island)

For the more adventurous, the Tourist Organization of Belgrade advertises the “Belgrade Kayak Adventure”. This new “active holiday” program offers sightseeing from a different perspective, showing visitors a unique Belgrade "river lifestyle" on the Sava and Danube Rivers. There are two tours offered within the program. The “6 Bridges of Sava” tour takes you under Belgrade bridges and “Great War Island – Jungle in the heart of Belgrade" takes you around the island that is a nature preserve and includes a break on the Lido beach. The starting and ending points for both tours are shown in Figure 35, along with the raw wastewater discharge points.

The idea of a fun sightseeing program like the kayaking tours is a great; however, there are currently several problems associated with both tours. During the “6 Bridges of Sava” tour, kayakers are instructed to keep close to the left Sava River bank, as the Sava River is an international transport route and this requirement is made out of safety reasons. The problem is that there are numerous floating river restaurants all along the left bank of the Sava River that discharge raw wastewater directly into the river. So, while one is kayaking, he or she is under the direct contact of these discharges. Secondly, this kayaking tour ends downstream of the location of the Usce PS, from which all of the wastewater from the New Belgrade settlement is discharged, also without prior treatment. This means that the kayakers will actually make their way over the sediment and sludge accumulated at this point and will potentially be exposed to the wastewater, which is much more dangerous than the foul smell that they will experience.

The “Great War Island” kayaking tour also begins and ends near wastewater discharge points and the tour includes a stop at the Lido beach where the kayakers can take a refreshing swim, unknowing that the bathing waters at that beach have microbial water quality issues.

To conclude, all the tourist and recreational opportunities that the two major rivers have to offer will be greatly enhanced by the construction of the new interceptors and other activities of the Project that is the subject of this preliminary Environmental Impact Analyses study.

4.11 Surface Water and Sediment Quality

Surface water quality monitoring in Belgrade is done according to the Water Quality Control Program in Belgrade that the Secretariat for Environmental Protection issues annually. Surface water sampling and testing is done by the Institute of Public Health of Belgrade.

The Water Quality Control Program of Surface Waters and Canals determines the:

- Number of water bodies and the number of control profiles that will be monitored;
- Control parameters;
- Frequency of sampling and analytical testing methods.

The Republic of Serbia has recently adopted a number of new regulations under the Water Law of 2010 and has largely complied with the regulatory requirements of the EU Water Framework Directive (2000/60/EC) and the Law on Ratification of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River (2003). The preconditions were hence made for the establishment of surface water monitoring in accordance with programs already implemented in the EU, which allows more precise definition of the extent and type of contamination, and facilitates the comparison of results with the countries in the Danube River basin, all for the purpose of improving water quality and protection.

The new regulations include:

- Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012);
- Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater (2011);
- Regulation on the Limit Values of Priority and Priority Hazardous Substances that Pollute Surface Waters and the Deadlines for Compliance with the Limit Values (2011).

The limit values of pollutants in surface waters and the limit values for assessing the status and trends of sediment quality (according to the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values, 2012) came into force in the second half of 2012 and are given in the table below. The definition of the categorization according to classes is as follows:

- Class I corresponds to excellent ecological status according to the classification given in the rulebook prescribing the parameters of ecological and chemical status of surface waters (Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater, 2011). Surface waters that belong Class I can be used for the following purposes: drinking water supply after treatment consisting of filtration and disinfection, bathing and recreation, irrigation, industrial use (process and cooling water).
- Class II corresponds to good ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class can be used for the same purposes and under the same conditions as surface waters that belong to Class I.
- Class III corresponds to moderate ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class can be used for the following purposes: drinking water supply after treatment consisting of coagulation, flocculation, filtration and disinfection, bathing and recreation, irrigation, industrial use (process and cooling water).
- Class IV corresponds to poor ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class can be used for the following purposes: drinking water supply with the use of a combination of the above mentioned treatments steps and advanced methods of treatment, irrigation, industrial use (process and cooling water).
- Class V corresponds to a bad ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class cannot be used for any purpose.

Table 15. Limit values of pollutants in surface waters (2012)

Parameter	**Unit**	**Limit Values**				
		Class I	**Class II**	**Class III**	**Class IV**	**Class V**
General						
pH		6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	<6.5 or > 8.5

Parameter	Unit	Limit Values				
		Class I	**Class II**	**Class III**	**Class IV**	**Class V**
Suspended Matter	mg/L	25	25	NM	NM	NM
Dissolved Oxygen	mg O_2/L	8.5[(1)] (or natural level)	7[(2)]	5	4	<4
Oxygen saturation	%					
Epilimnion (stratified water)		90-110	70-90	50-70	30-50	<30
Hipolimnion (stratified water)		70-90	70-50	30-50	10-30	<10
Unstratified water		70-90	50-70	30-50	10-30	<10
BOD_5	mg O_2/L	1.5-2.5[(3)] (or natural level)	4-5[(4)]	7	25	>25
COD ($K_2Cr_2O_7$)	mg O_2/L	10 (or natural level)	15	30	125	>125
COD ($KMnO_4$)	mg O_2/L	5 (or natural level)	10	20	50	>50
Total Organic Carbon	mg/L	2[(5)] (or natural level)	5-6[(6)]	15	50	>50
Nutrients						
Total Nitrogen	mg N/L	1 (or natural levels)	2	8	15	>15
Nitrates	mg N/L	1-1.5[(7)] (or natural levels)	3[(8)]	6	15	>15
Nitrites	mg N/L	0.01 (or natural levels)	0.03	0.12	0.3	>0.3
Ammonium ion	mg N/L	0.05-0.1[(9)]	0.1-0.4[(10)]	0.6	1.5	>1.5
Unionized ammonium	mg/L NH_3	0.005	0.025	NM	NM	NM
Total Phosphorus	mg P/L	0.05[(11)] (or natural levels)	0.1-0.3[(12)]	0.4	1	>1
Orthophosphates	mg P/L	0.02[(13)] (or natural levels)	0.05-0.2[(14)]			
Salinity						
Chlorides	mg/L	50 (or natural levels)	100	150	250	>250
Total residual chlorine	mg/L HOCl	0.005	0.005	NM	NM	NM
Sulphates	mg/L	50 (or natural levels)	100	200	300	>300
Total mineralization	mg/L	>1000 (or natural levels)	1000	13000	15000	>1500
Electric conductivity at 20ºC	mS/cm	>1000 (or natural levels)	1000	1500	3000	>3000
Metals						

Parameter	Unit	Limit Values				
		Class I	**Class II**	**Class III**	**Class IV**	**Class V**
Arsenic	µg/L	<5 (or natural levels)	10	50	100	>100
Boron	µg/L	300 (or natural levels)	1000	1000	2500	>2500
Copper	µg/L	5 (H=10) 22 (H =50) 40 (H =100) 112 (H =300)	5 (H =10) 22 (H =50) 40 (H =100) 112 (H =300)	500	1000	>1000
Zink	µg/L	30 (H =10) 200 (H =50) 300 (H =100) 500 (H =300)	300 (H =10) 700 (H =50) 1000 (H=100) 2000 (H=300)	2000	5000	>5000
Chromium (total)	µg/L	25 (or natural levels)	50	100	250	>250
Iron (total)	µg/L	200	500	1000	2000	>2000
Manganese (total)	µg/L					
Organic substances						
Phenols	µg/L	<1	1	20	50	>50
Petroleum hydrocarbons		-(15)	-(15)	NM	NM	NM
Surfactants (as lauryl sulphate)	µg/L	100	200	300	500	>500
Adsorbic organic halogen	µg/L	10	50	100	250	>250
Microbiological Parameters						
Fecal coliform	cfu/ 100 ml	100	1000	10000	100000	>100000
Total coliform	cfu/ 100 ml	500	10000	100000	1000000	>1000000
Enterococci	cfu/ 100 ml	200	400	4000	40000	>40000
No. of aerobic heterotrophs (Kohl method)	cfu/ 100 ml	500	10000	100000	750000	>750000

(1) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 8.0 mg O_2/L; and lakes at elevations over 200 meters above sea level where the limit values are in the range of 6.5-8.5 mg O_2/L.

(2) except for: waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 6.0 mg O_2/L; reservoirs formed on water bodies type 3 and 4 where the limit value is 8.5 mg O_2/L; reservoirs formed on water bodies type 5 and 6 and for artificial water bodies where the limit value is 5.0 mg O_2/L.

(3) depending on the waterway classification type

(4) depending on the waterway classification type, except for: reservoirs formed on water bodies type 3 and 4 where the limit value is 1.5 mg O_2/L; and for artificial water bodies where the limit value is 6.0 mg O_2/L.

(5) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 3.0 mg/L

(6) depending on the waterway classification type, except for: reservoirs formed on water bodies type 3 and 4 where the limit value is 2.0 mg/L; and for artificial water bodies where the limit value is 7.0 mg/L.

(7) depending on the waterway classification type
(8) except for reservoirs formed on water bodies type 3 and 4 where the limit value is 1.5 mg N/L; reservoirs formed on water bodies type 5 and 6 and for artificial water bodies where the limit value is 4.0 mg N/L.
(9) depending on the waterway classification type, except for: waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 0.20 mg N/L.
(10) depending on the waterway classification type, except for reservoirs formed on water bodies type 3 and 4 where the limit value is 0.4 mg N/L.
(11) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 0.15 mg P/L.
(12) depending on the waterway classification type, except for reservoirs formed on water bodies type 3 and 4 where the limit value is 0.05 mg P/L.
(13) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 0.1 mg P/L.
(14) depending on the waterway classification type, except for reservoirs formed on water bodies type 3 and 4 where the limit value is 0.02 mg P/L.
(15) Petroleum products must not be present in the water in such quantities as to: form a visible film on the water surface or coatings on banks of rivers and lakes, give a distinctive "hydrocarbon" fish flavor and cause adverse effects in fish.

H – Hardness (mg/L $CaCO_3$); NM – Not Measured

Table 16. Limit values for assessing the status and trends of sediment quality (2012)

Parameter	Unit	Target Value	Maximum Allowable Concentration	Remedial Value
Arsenic (As)	mg/kg	29	42	55
Cadmium (Cd)	mg/kg	0.8	6.4	12
Chromium (Cr)	mg/kg	100	240	380
Copper (Cu)	mg/kg	36	110	190
Mercury (Hg)	mg/kg	0.3	1.6	10
Lead (Pb)	mg/kg	85	310	530
Nickel (Ni)	mg/kg	35	44	210
Zink (Zn)	mg/kg	140	430	720
Mineral oils	mg/kg	50	3000	5000
Polycyclic aromatic hydrocarbons (PAHs)	mg/kg	1	10	40
Naphthalene	mg/kg	0.001	0.1	
Anthracene	mg/kg	0.001	0.1	
Phenanthrene	mg/kg	0.005	0.5	
Fluoranthene	mg/kg	0.03	3	
Benzo (a) anthracene	mg/kg	0.003	0.4	
Chrysene	mg/kg	0.1	11	
Benzo (k) fluoranthene	mg/kg	0.02	2	
Benzo (a) pyrene	mg/kg	0.003	3	
Benzo (g,h,i) perylene	mg/kg	0.08	8	

Parameter	Unit	Target Value	Maximum Allowable Concentration	Remedial Value
Indeno (1,2,3-cd) pyrene	mg/kg	0.06	6	
Polychlorinated biphenyls (PCB)	µg/kg	20	200	1
DDD	µg/kg	0.02	2	
DDE	µg/kg	0.01	1	
DDT	µg/kg	0.09	9	
DDT total	µg/kg	10	-	4000
Aldrin	µg/kg	0.06	6	
Dieldrin	µg/kg	0.5	450	
Endrin	µg/kg	0.04	40	
Ciklodien pesticides	µg/kg	5	-	4000
α-HCH	µg/kg	3	20	
β-HCH	µg/kg	9	20	
γ-HCH (lindane)	µg/kg	0.05	20	
HCH total	µg/kg	10	-	2000
Alfa-endosulfane	µg/kg	0.01	1	4000
Heptachlor	µg/kg	0.7	68	4000
Heptachlor-epokside	µg/kg	0.0002	0.002	4000

In 2012, Water Quality Control Program of Surface Waters and Canals in Belgrade included 24 waterways in the wider metropolitan area: Sava, Danube, Kolubara, Galovica, Topčider, Railway (Železnička in Serbian), Barička, Peštana, Turija, Beljanica, Lukavica, Bolečica, Gročica, Veliki Lug, Ralja, Barajev, Sopot, Sibnica, Kalovita, Vizelj, PKB canal, Obrenovac canal, Progarska Jarčina canal and Karas canal. All these waterways are under strong anthropogenic influence.

Water quality testing was done four times a year (seasonally), between March 1st to December 31st 2012, except for:

- the Kolubara River, the Galovica Canal, the Topcider and Railway Rivers, the River Sava and the Danube River at Batajnica (Zemun), where water quality testing was done once per month, between March 1st to December 31st 2012;
- the Makiš (Sava) and Vinca (Danube) sampling locations, where water samples were taken two times a month (as these are locations at the intake of water treatment plants named the same as the measuring points), between March 1st to December 31st 2012.

Water quality results were first analyzed according to the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012) in June 2012. The majority of measuring results indicated that the Belgrade waters do not satisfy the Class II requirements and have a poor ecological status.

The results for the Danube River are presented in the table below. The sampling points on the Danube River are located at:

- Batajnica (Zemun), upstream of the confluence with the Sava River;

- Vinca (Vinča in Serbian), about 7 km downstream of the future WWTP and at the intake of the water treatment plant.

These sampling locations are shown in the figure below.

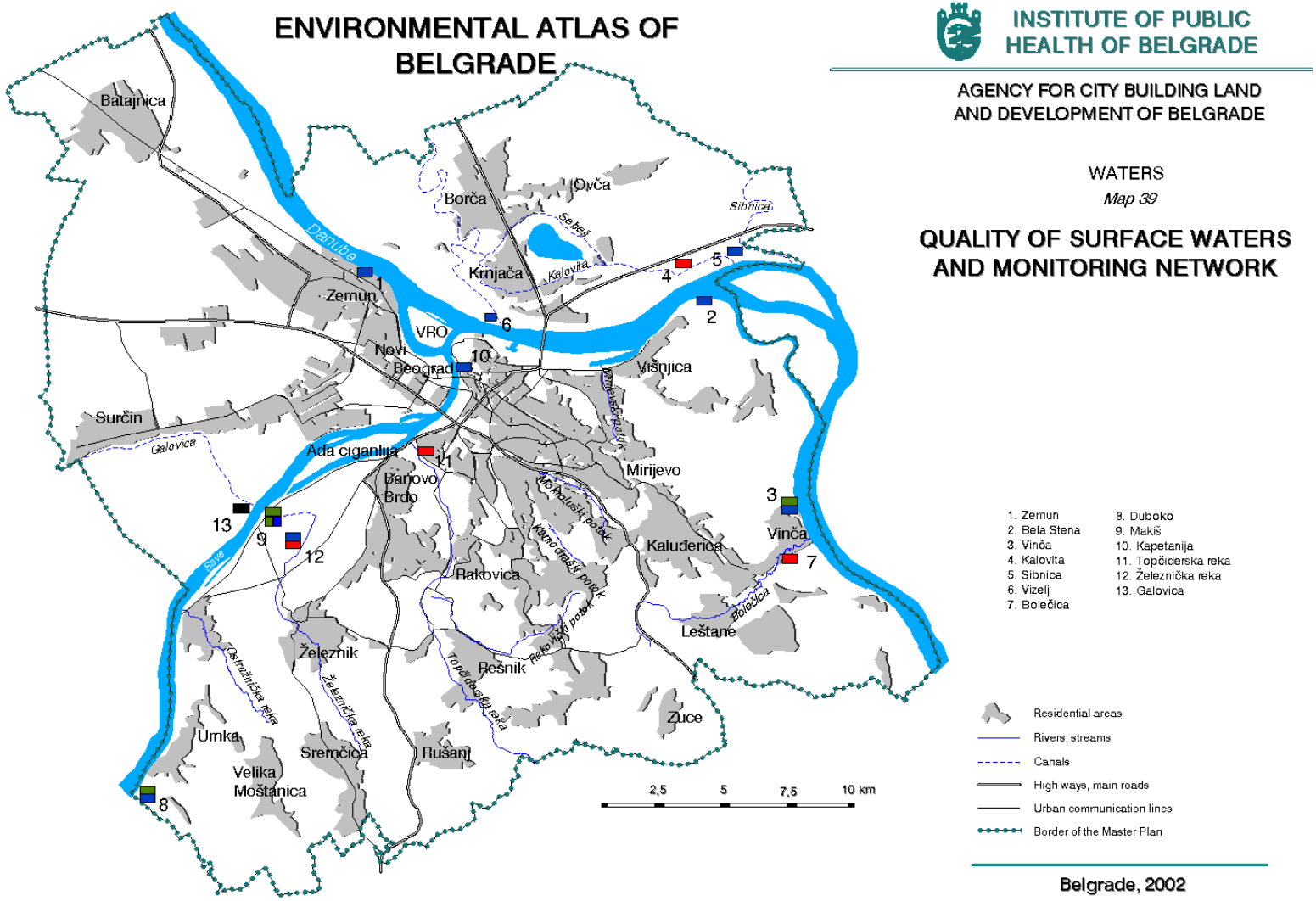


Figure 36. Surface water quality monitoring network (1-Zemun (Batajnica), 3-Vinca)

Table 17. Danube River water quality testing results (Source: Ecological Bulletins, 2012)

Month	No. of Samples	Class II water status	In non-compliance with Class II due to exceedance of:	
			Physical and Chemical Parameters	Microbial Parameters
June	3	0	0	3
July	3	0	0	3
August	3	0	0	3
September	3	1	0	2
October	3	1	0	2
November	3	0	0	3
December	3	3	0	0

As can be seen in the table above, the River Danube mostly does not comply with the Class II requirements due to microbial pollution, which can be an indicator of fecal contamination from raw wastewater discharges.

Four and five river water samples were taken of the Danube at the Lido beach in July and August 2012, respectively. In eight of the nine samples, the detected microbiological water quality parameters were higher than the prescribed limits for bathing water quality. The City officials recommended washing after each swim at the provided showers that were supplied with potable water, especially for young children and adults with an impaired immunity system (Ecological Bulletins of the Belgrade Secretariat for Environmental Protection, July – September 2012).

In 2010, the content of heavy and toxic metals in the Sava and Danube River sediment was not above effective values. The content of polycyclic aromatic hydrocarbons (PAHs) and mineral oils was moderately high. Other micro-pollutants were not detected.

Concentrations of toxic bio-accumulative heavy metals were not above their effective limits in the sediment near the Makiš and Vinca water capture points. This was not the case in years previous to 2010. These substances show characteristics of bio-magnification in food chains.

4.12 Hydrogeological situation

Contamination of groundwater occurs widely in urban areas equipped with sanitation, due to leaks and poor maintenance. In such cases, the groundwater may be contaminated by pathogens and a wide spectrum of household and industrial chemicals. Among the chemicals, the most common pollutant from this source is nitrate, as well as a variety of organic and microbiological pollutants. Nitrate is formed by the sequential, microbially-catalyzed oxidation of ammonia to nitrite and then to nitrate.

Groundwater has been the main source of potable water supply for the City of Belgrade for more than 50 years. The groundwater wellhead is formed on a large area of the River Sava alluvial plane. It is stretched along the river bank from the confluence, 50 km in the upstream direction. By now, 99 wells with horizontal drains (Ranney type) have been formed along the river bank, mainly on the left bank, and nearly 50 tube wells (Figure 37). The largest exploitation of groundwater occurred in the period from 1987 to 1988, with an annual average discharge of 6 m^3/s. After the construction of the Makis (Makiš in Serbian) water purification plant, the consumption of groundwater decreased to nearly 4 m^3/s on an annual average basis.

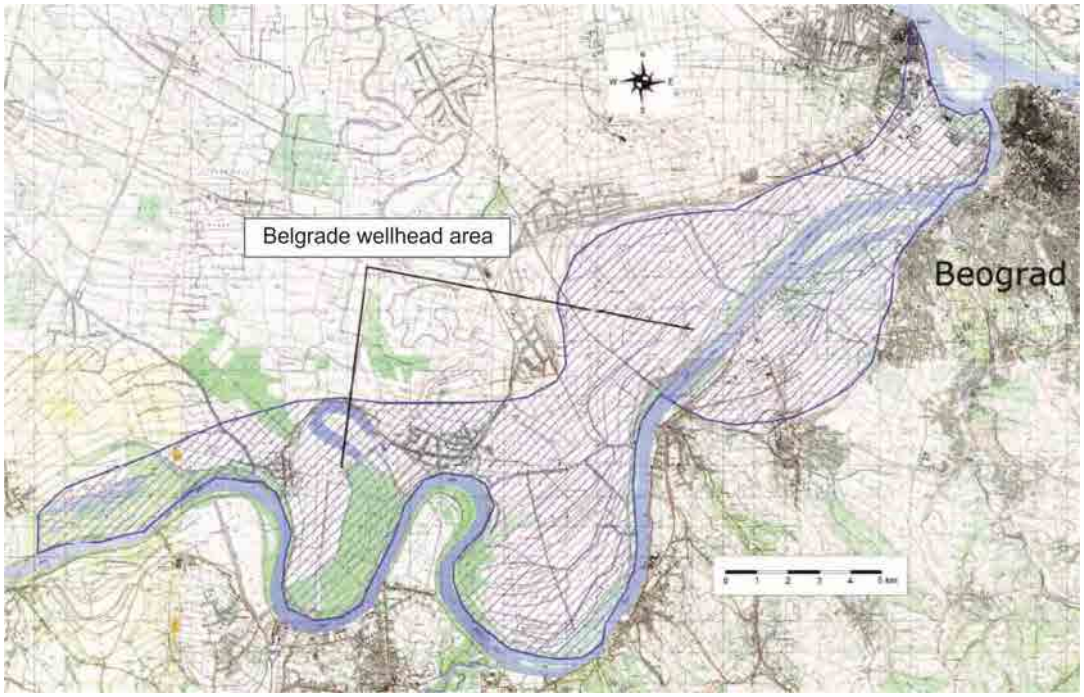


Figure 37. Belgrade wellhead area (Source: Master Plan of the Belgrade Sewerage System, 2011)

The thickness of the Sava alluvium of the Belgrade wellhead is about 25 m (figure below). The aquifer is composed of sand, sandy gravel and gravelly sands. The average effective diameter of the aquifer material (d10) is on the order of 0.3 mm, while the mean grain diameter (d50) is nearly 2 mm.

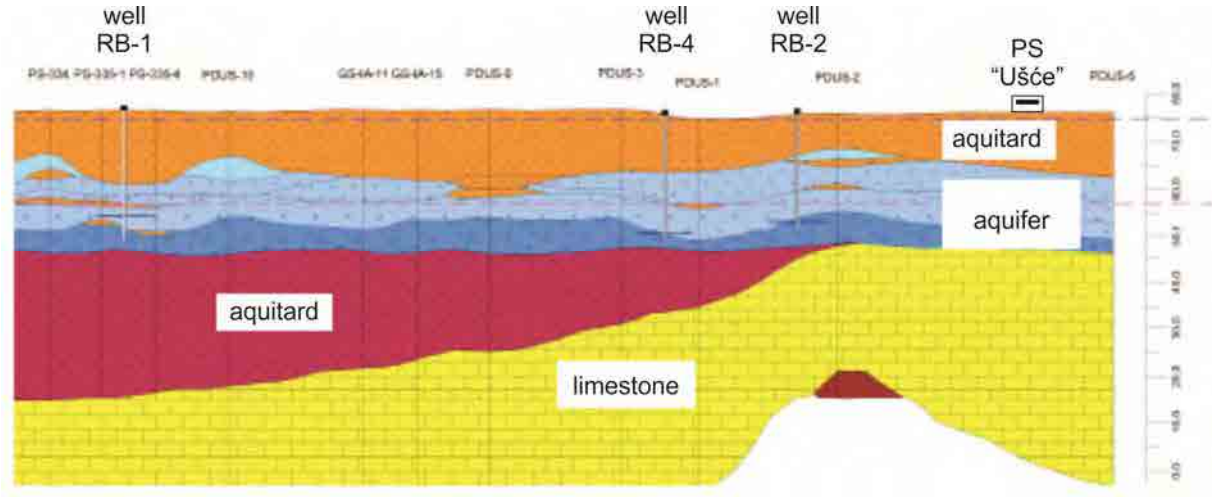


Figure 38. Hydrogeological cross-section along the left bank of the river Sava (Source: Study of Belgrade's Groundwater Source, 2010)

There are two wells relatively near the Project wastewater management facilities. The "RB-2" well, with a capacity of 50 L/s, is located at about 550 m from the Usce pumping station; and further, at an approximate distance of 750 m, is the "RB-4" well with a capacity of 130 L/s. Actually, the Usce PS is located inside the well recharge area, and inside the inner wellhead protection zone of the Belgrade groundwater source. Other parts of the water management facilities (the Interceptors and the Veliko Selo WWTP) have no potential interaction with the Belgrade wellhead facilities.

In the following text, the hydrogeological characteristics of the area shall be analyzed, especially the zone of the Usce PS, where possible influence on groundwater quality may be expected. Hydrogeological characteristics of the Interceptor route vary significantly, with the high capacity unconfined aquifer, karstic aquifer and dry rock zones (figure below)

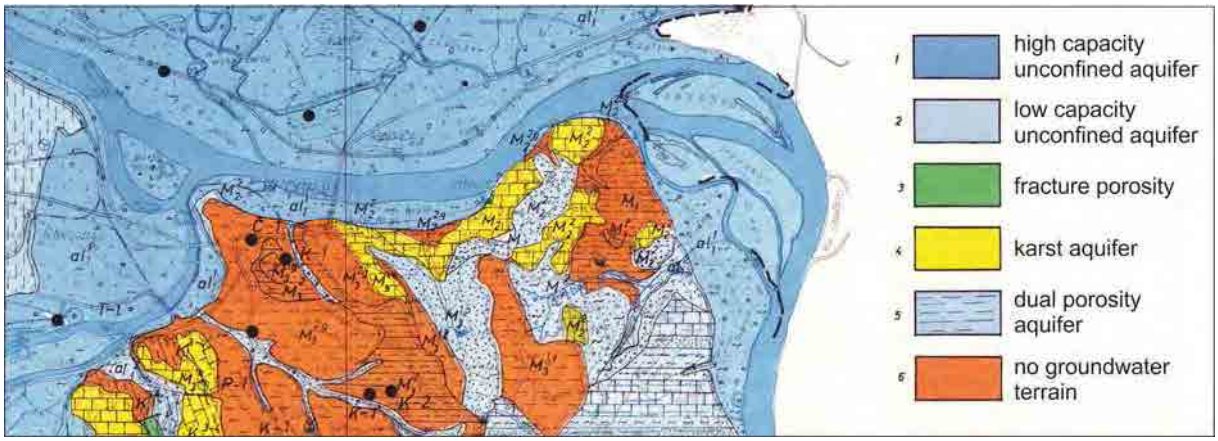


Figure 39. Hydrogeological map of the Belgrade area

4.12.1 Characteristics of the Usce Area

The terrain of New Belgrade is fairly flat. The ground level varies from 75.5 to 77 m above sea level (a.s.l.); this was achieved by sand refilling in layer up to 6 m deep over the original marshy terrain in 1960s. It is a so called New-Belgrade plateau which extends from the Sava River to the town of Zemun.

The basic geology comprises of quaternary deposits of thickness up to 30 m. These deposits include very fine, fine to medium sands and gravelly sands of variable thickness from 10 to 20 m, covered by silty sands and sandy clays of thickness from 5 to 10 m beneath these deposits are tertiary clays. Beneath tertiary clays are limestone sediments (at a depth of more than 35 to 45 m), which are characterized by irregular fractures.

A simplified typical sequence of geological formations of the New Belgrade plateau is as follows:

_____ GL (75.5 to 77.0 m.a.s.l.)
Refilled sand – top soil
_____ 70.0 m.a.s.l.
Silty clay
_____ 65.0 m.a.s.l.
Very fine, fine to medium sand
and gravelly sand
_____ 45.0 m.a.s.l.
Clay
_____ 30.0 m.a.s.l.
Limestone

Figure 40. Scheme of the sequence of soil strata

There are variations in the thickness and the descriptions of these soil strata. According to the report of geological investigation works (2005), specifically planned and conducted for the construction of the

Usce Shopping Centre, the thickness of the layers and the description of formations are as shown in the table below.

Table 18. Thickness and description of soil strata on site (Source: Geotechnical report related to the foundation condition for the Usce Shopping Centre, Block 16, New Belgrade, 2005)

Level of occurrence	**Formation**	**Description**	**Thickness (m)**
GL	Refill	Silty clay with building material waste	0.4-1.2
	Refill	Refilled sand	3.9-6.8
70-72	Clay	Silty clay – previously the top layer, before the refilling in 1960s; low to medium and high plasticity; saturated, containing organic matter (10-15%) and $CaCO_3$ (10-15%)	2.0-4.1
69-66	Sand	Sand of alluvial origin – very fine to fine and medium grain size, with sub-layers of soft saturated silt.	> 7 m
59.5-58.7	Gravel	Graded gravel with large percentage of sand, slightly silty with sublayers of silt.	

The oscillations of groundwater levels in the area are compatible, and directly connected with the oscillations of water levels in Sava and Danube Rivers. The good hydraulic connectivity is a consequence of the fact that the rivers beds are in direct contact with the sand stratum. In some of the reviewed documents, it was noted that the Danube River bed is covered by a thick layer of mud of an approximate thickness of 5 m (conclusion based on investigation of just one profile), which could significantly decrease the hydraulic connection in this zone.

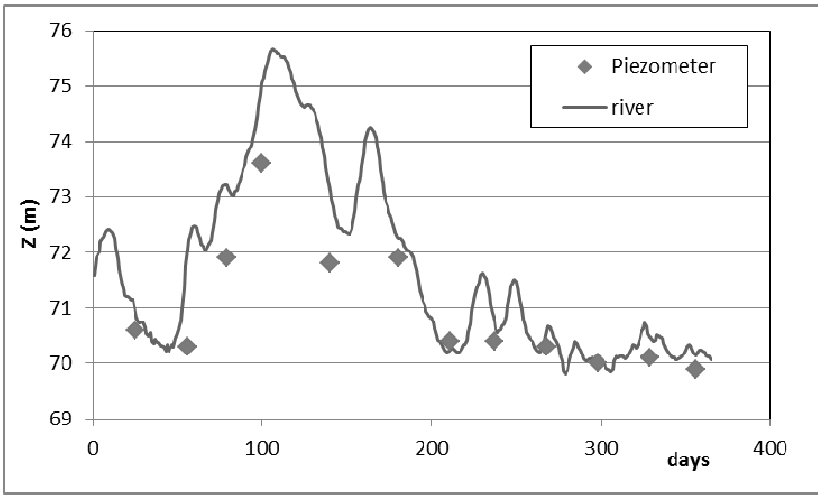


Figure 41. Comparison of water levels at the piezometer in the Usce PS area (Danube right bank) and the river levels in 2006 (Source: Analysis of groundwater regime in the area of Usce Shopping Centre, Belgrade in extreme conditions caused by high water levels in Sava and Danube Rivers, 2008).

It should be emphasized that the groundwater level in the considered zone is influenced by the existence of the two wells located on the left bank of the Sava River (RB-2 and RB-4). These wells are working in a quasi-stationary regime that is dictated by the Public Utility Company Belgrade Waterworks and Sewerage. They were constructed 50 years ago and have been in permanent use since.

According to recently conducted measurements, discharges on these wells are about 50 L/s and 130 L/s, respectively (Study of Belgrade's Groundwater Source, 2010).

Due to the existence of these two wells, the piezometric heads in the vicinity of the wells are in the range of 60 to 65 m a.s.l.

Regardless of the well-known fact that the wells are dominantly recharged from the River Sava, the location of the Usce PS is on the streamline towards the wells, i.e. it is located in the well recharge zone. Therefore, if some source of pollution is present in this area, there is a real risk that the contamination would reach the wells.

4.12.2 Groundwater quality

A comprehensive study on Belgrade wellhead issues was recently conducted (Study of Belgrade's Groundwater Source, 2010), which included a groundwater quality survey. The study was initiated by the Republic Water Directorate of the Ministry of Agriculture, Forestry and Water Management, and Land Development Public Agency, Belgrade.

An important part of the study was the detection and analysis of the anthropogenic impact on groundwater quality through the detection of impact indicators, such as organic micro-pollutants. The impact of the sewerage system was analyzed through the detection of several indicators: microbiological pollutants, chloride, potassium, sodium and boron.

A general conclusion is that the groundwater in the urbanized zones (New Belgrade and Usce area) has increased concentrations of these parameters in comparison to other wellhead zones. However, the limit values were not exceeded.

There is no permanent program of monitoring groundwater quality in specific wells. The Belgrade Institute of Public Health monitors the quality of drinking water in reservoirs that collect water from the wells, as well as across the water distribution system on a daily basis. In addition, drinking water quality is monitored by the Belgrade Waterworks Public Utility Company, as a part of the production process.

Water from the wells that are located in the city zone is firstly transferred to the conditioning facility Bezanija (Bežanija in Serbian). Therefore, the "raw" water quality monitoring at this facility reveals the mean groundwater quality of this area. The observed concentration values in 2010 are shown in the table below. It can be seen that all maximum observed values are below the Maximum Allowable Concentration (MAC) values for drinking water.

The dominant portion of the well recharge originates from the Sava River, after filtration through the river bank. Bank filtration is characterized by self-purifying effects that reflect on groundwater quality extracted from the wells. This can be seen from the comparison of water quality in Sava River and the wells. For example, the mean content of organic compounds, measured by the permanganate value, in the Sava River is about 8 mg/L, while the averaged value in the well water is about 4 mg/L (MAC = 8 mg/L). The averaged total organic carbon value in the Sava River is about 2.5 mg/L, while in the well water it is about 1.2 mg/L. However, the concentrations of sulphate and chloride are higher in the well water (lower than the MAC) than in the Sava River, which may be due to anthropogenic influence. Similarly, nitrate concentrations in the Bezanija facility are about 20 mg/L, while the averaged concentration in the Sava River is about 12 mg/L (MAC = 50 mg/L). In addition, boron concentrations at the Bezanija facility are about 0.07 mg/L (MAC = 0.3 mg/L), in comparison to the Sava River with

about 0.02 mg/L. Boron represent a good tracer of anthropogenic influence by the wastewater, since the main source of boron are usually detergents and other household laundry and cleaning products.

The dedicated monitoring of microbial water quality at 24 wells in 2009 revealed higher microbial pollution in the RB-2 well (1200 cfu/ml), as well as in piezometers P4 and P5, which are located near the Usce PS (Study of Belgrade's Groundwater Source, 2010). The detected bacteria *Bacillus spp.* is not considered as fecal indicator, however its presence may be related to the influence of the Usce PS and related wastewater conduits.

Conclusions regarding groundwater quality

Groundwater quality of the Belgrade wellhead area under consideration generally satisfies the legislation regarding the MACs for drinking water. However, the inspection of several contaminants infers some degree of anthropogenic influence, especially pronounced in the „city'' zone wells. Some aspects of this influence may be related to the wastewater management facilities.

Table 19. Mean, maximum and minimum observed concentrations of specific parameters in drinking water at the Bezanija facility in 2010

Parameter		**Observed concentration**	**MAC***
Aluminum (mg/L)	Mean	< 0.003	0.2
	Max	0.052	
	Min	< 0.003	
Arsenic (mg/L)	Mean	0.005	0.01
	Max	0.007	
	Min	< 0.001	
Copper (mg/L)	Mean	0.001	2.0
	Max	0.003	
	Min	0.001	
Calcium (mg/L)	Mean	78.8	200.0
	Max	83.0	
	Min	76.2	
Potassium (mg/L)	Mean	1.93	12.0
	Max	2.06	
	Min	1.78	
Magnesium (mg/L)	Mean	26.2	50.0
	Max	28.5	
	Min	24.7	
Sodium (mg/L)	Mean	17.4	150.0
	Max	18.2	
	Min	16.8	
Sulphate (mg/L)	Mean	32.2	250.0
	Max	47.4	
	Min	13.4	
Orthophosphate (mg/L)	Mean	< 0.02	0.15
	Max	< 0.02	
	Min	< 0.02	

*Maximum allowable concentration values for drinking water

Table 19 (continued). Mean, maximum and minimum observed concentrations of specific parameters in drinking water at the Bezanija facility in 2010

Parameter		Observed concentration	MAC*
Fluoride (mg/L)	Mean	0.09	1.2
	Max	0.2	
	Min	< 0.05	
Hardness (^{o}dH)	Mean	17.1	
	Max	18.2	
	Min	16.4	

*Maximum allowed concentration for drinking water

4.13 Hydrological Situation

4.13.1 River Regimes

Regimes of Danube and Sava Rivers in Belgrade are complex due to the conditions at the rivers confluence and the influence of the downstream Djerdap Hydro Power Plant (HPP) regime. The influence of the construction of the dam and Djerdap HPP on the change of water levels of Sava and Danube Rivers in this area is significant. The most significant level changes, regarding the natural regime, were in the domain of low and medium flow rates, while the smaller changes are produced in the case of high flow rates. The differences for low flow rates of 1900 m^3/s are up to 2.6 m, and for higher flow rates (over 10,000 m^3/s) are up to 0.3 m.

The duration curve at the Pančevo station indicates registered Danube flows from 1300 m^3/s up to 13,400 m^3/s. The flow of duration of 50% is 5000 m^3/s, and average flow is 5,430 m^3/s. Water levels at the confluence of the Danube and Sava Rivers (according to the study from 1988) are:

- for 5% flow duration - water level 73.3 m
- for 50% flow duration - water level 70.2 m
- for 95% flow duration - water level 67.8 m

In the analysis of hydrological conditions at the confluence, of the special interest are always the coincidence of flood levels in the Sava and Danube Rivers. This is an important fact for flood analysis and protection design.

The water level of the Sava River, which is used for the design and construction of protection embankments, is 76 m a.s.l. (according to the Master Plan of Belgrade 2021).

4.13.2 The Danube River

The Danube River watershed area of 817,000 km^2 produces an average water discharge of 6,500 m^3/s at the Danube mouth to the Black Sea. The River Danube enters Serbia near the village of Bezdan. The main tributaries are the rivers Tisa, Sava and Velika Morava. The nearest hydrological gauge stations, relevant for this study, are Zemun and Pančevo. The Pančevo station is located on the left bank, opposite to the location of the Veliko Selo WWTP.

As pointed out before, the water level regime is under the influence of the Djerdap HPP, i.e. according to HPP exploitation regime for 69.5 m a.s.l. and higher. Since 1991, the regular exploitation regime is strictly defined up to the flow of 13,000 m^3/s, by regulation of the water level at the river Nera estuary profile (Banatska Palanka), according to the table below.

Table 20. The Danube River flow regime at the mouth of the River Nera

Discharge (m^3/s)	Water level (m a.s.l.)
2,000	69.65
8,500	70.70
11,500	70.85
13,000	70.95
> 13,000	> 70.95 natural regime

Observations of the water level at the hydrologic station Pančevo, in the period from 1991 to 2002, show that the minimum water level was 68.45 m, and the maximum 73.62 m a.s.l. Basic characteristics of the water level regime at the Pančevo and Zemun stations are shown in the tables below. Figure 42 shows the water level duration curve for this hydrology station for the same observation period.

Table 21. Monthly annually averaged water levels observed at the hydrologic stations Pančevo and Zemun (m a.s.l.).

H. Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann. Average
Pančevo	70.03	70.45	70.86	71.55	71.33	70.91	70.33	69.69	69.39	69.21	69.45	70.07	70.28
Zemun	70.60	71.02	71.43	72.15	71.93	71.47	70.88	70.24	69.99	69.77	70.03	70.66	70.86

Table 22. Monthly and annually averaged minimum water levels observed at the hydrologic stations Pančevo and Zemun.

H. Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann. Average
Pančevo	69.12	69.42	69.82	70.79	70.62	70.32	69.59	69.11	68.78	68.53	68.63	69.16	69.49
Zemun	69.66	70.02	70.39	71.42	71.17	70.92	70.15	69.66	69.39	69.12	69.24	69.75	70.08

Table 23. Monthly and annually averaged minimum water levels observed at the hydrologic stations Pančevo and Zemun.

H. Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann. Average
Pančevo	70.93	71.36	71.84	72.13	72.08	71.55	71.04	70.41	70.12	70.00	70.46	71.00	71.08
Zemun	71.47	71.89	72.39	72.71	72.59	72.09	71.58	70.93	70.67	70.55	71.01	71.52	71.62

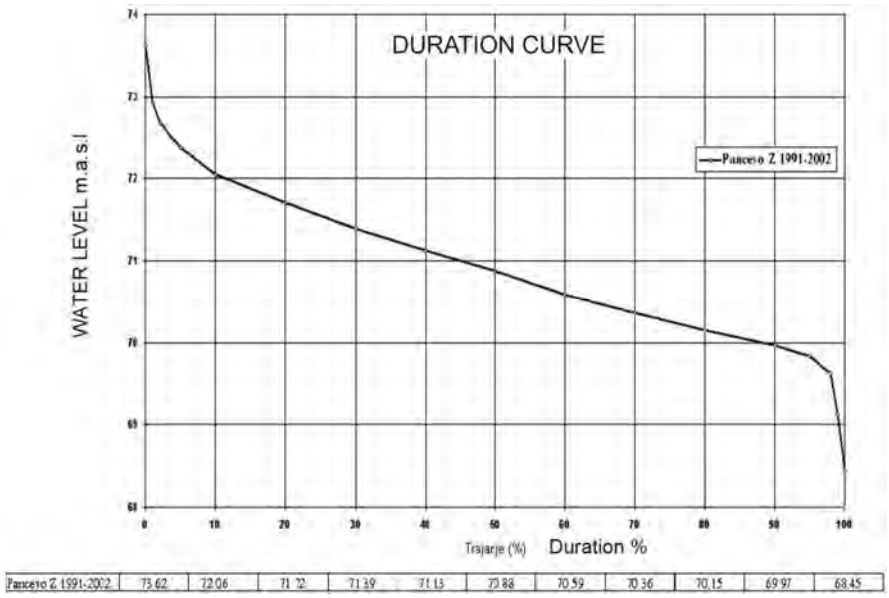


Figure 42. Water level duration curve for hydrology station “Pancevo”, in the period 1991-2002.

4.13.3 The Sava River

The most proximate hydrologic station is the “Sava–Belgrade” station, located at the harbor on the Sava River right bank (close to the Branko Bridge), opposite of the Usce PS. Water stage at this location is observed since 1921 and the complete record from 1921 to 2007 was made available by Republic Hydro-meteorological Service of Serbia.

The duration curve of the water level is shown in the figure below. The characteristic water level with the duration of 10%, 50% and 90% are 72.70 m, 71.18 m and 70.12 m a.s.l., respectively.

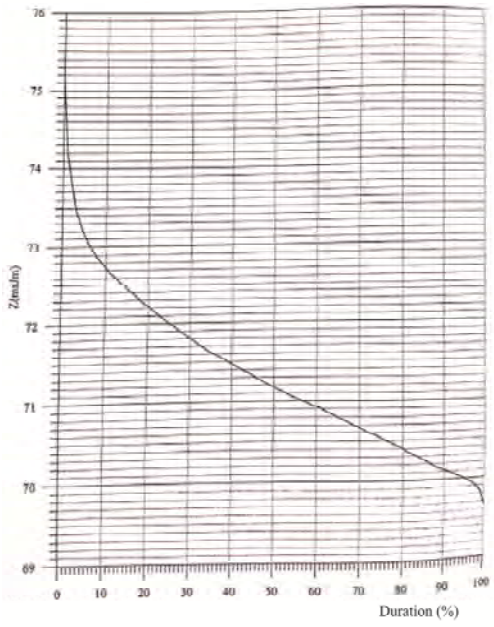


Figure 43. Duration curve of the Sava River water levels at the hydrologic station “Sava-Belgrade”.

4.13.4 Frequency Analysis of Flood Levels

The regime of the Danube and the Sava Rivers at Belgrade is highly influenced by the backwater effect from the Djerdap (also known as the "Iron Gate") hydro-power plant and its reservoir. This is especially true for the low flow and medium flow regimes. Although it could be said that the flood regime is also under influence of the Iron Gate reservoir due to flood wave attenuation, statistical tests have not proven inhomogeneity of the annual maximum flood record at the Sava–Belgrade station and consequently the record has been used for flood level frequency analysis (Analysis of groundwater regime in the area of Usce Shopping Centre, Belgrade in extreme conditions caused by high water levels in Sava and Danube rivers, 2008).

It should also be noted that more reliable results would be obtained if the flood flows were used for frequency analysis and the results transferred into flood levels using a rating curve. However, a reliable rating curve is not available and the frequency analysis is carried out with flood levels.

The annual maximum levels at the Sava–Belgrade hydrologic station from 1921 to 2007 vary between 71.68 and 75.66 m a.s.l. (Figure 44). The properties of the annual maximum series are shown in the table below.

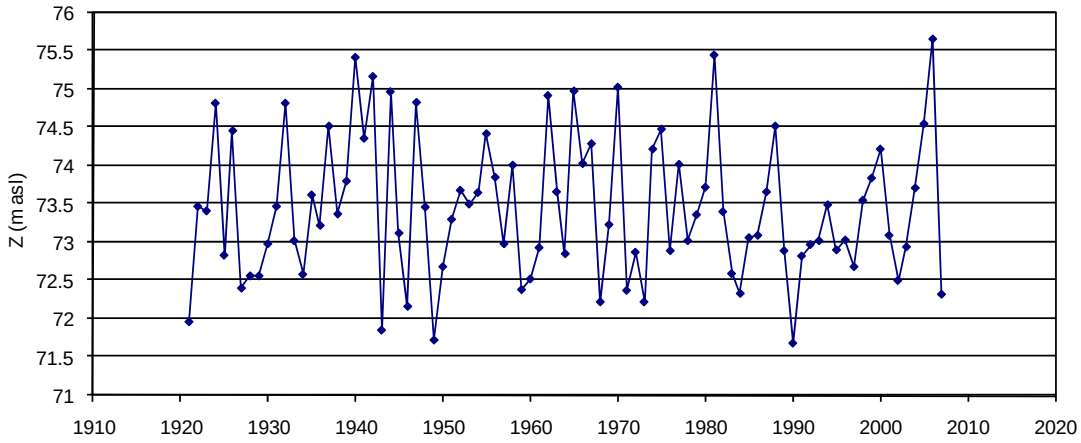


Figure 44. Observed annual maximum levels of the Sava River at Belgrade (1921-2007).

Table 24. Properties of the annual maximum series of flood levels of the Sava River at Belgrade

	Original Series	Log Series
Sample Size	87	87
Mean	515.9	6.2300
Standard Deviation	92.9	0.1792
Skewness Coefficient	0.409	0.036

After fitting several theoretical distributions to sample data, lognormal distribution was chosen as a best fit. Figure 45 shows the normal probability graph with empirical cumulative distribution function and the lognormal fit and Table 20 presents relevant lognormal quantiles for flood levels.

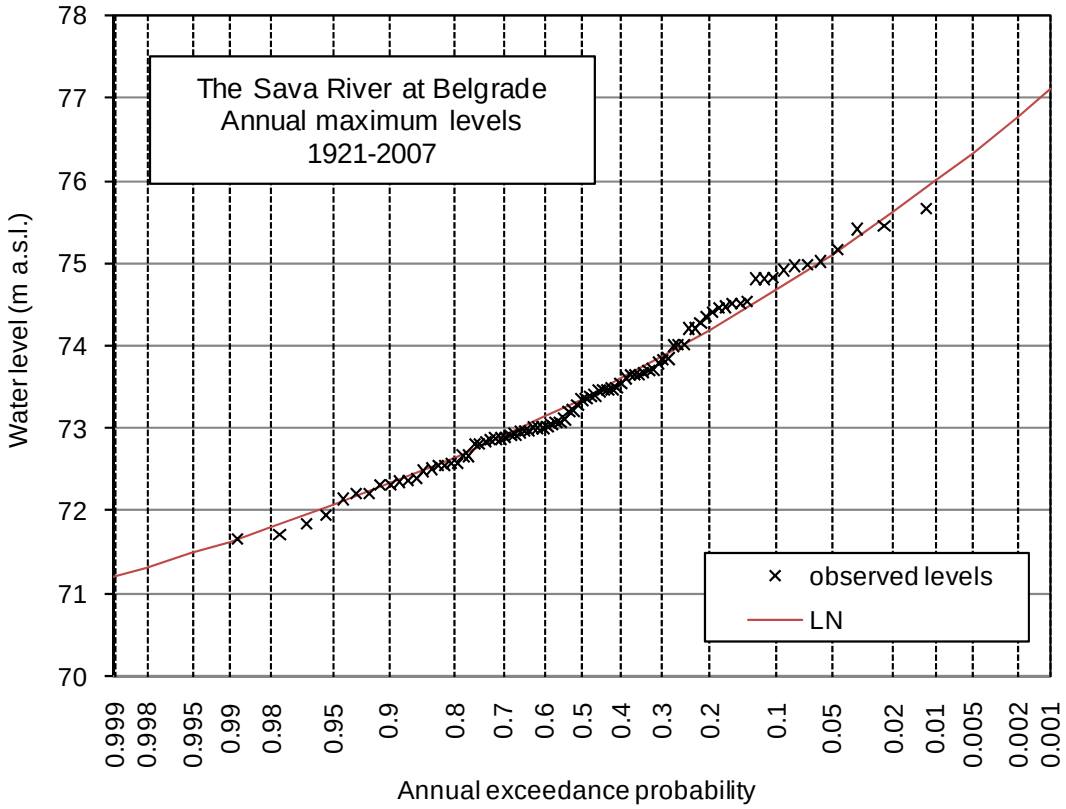


Figure 45. Cumulative distribution function for annual maximum levels of the Sava River at Belgrade

Table 25. Quantiles of the annual maximum levels of the Sava River at Belgrade

Return period (years)	Annual exceedance probability	Water level (m a.s.l.)
2	0.5	73.36
5	0.2	74.18
10	0.1	74.67
20	0.05	75.10
50	0.02	75.62
100	0.01	75.98
200	0.005	76.33

4.14 Coastal Zone

There is no coastal zone in Serbia.

4.15 Natural Environment

4.15.1 Protected Areas

The locations, names and protection status of Belgrade's protected areas are presented in the figure and the table below. The map of Belgrade's natural protected areas shown as Figure 46 was created in the year 2005. Since then, additional trees and the following sites have been put under protection:

- the Great War Island (landscapes of outstanding features) – Veliko ratno ostrvo in Serbian
- Academic Park (natural monument) – Akademski park in Serbian
- Miljakovac Forest (natural monument)
- Topčider (natural monument)
- Košutnjak (natural monument)
- Faculty of Forestry Arboretum (natural monument)
- Silver lime tee Forest (strict nature reserve)

Among the natural protected areas in Belgrade, only the Great War Island (Veliko ratno ostrvo in Serbian) and the Neocene Sandbank at Kalemegdan are within the narrow zone of planned works. They are described in the text that follows.

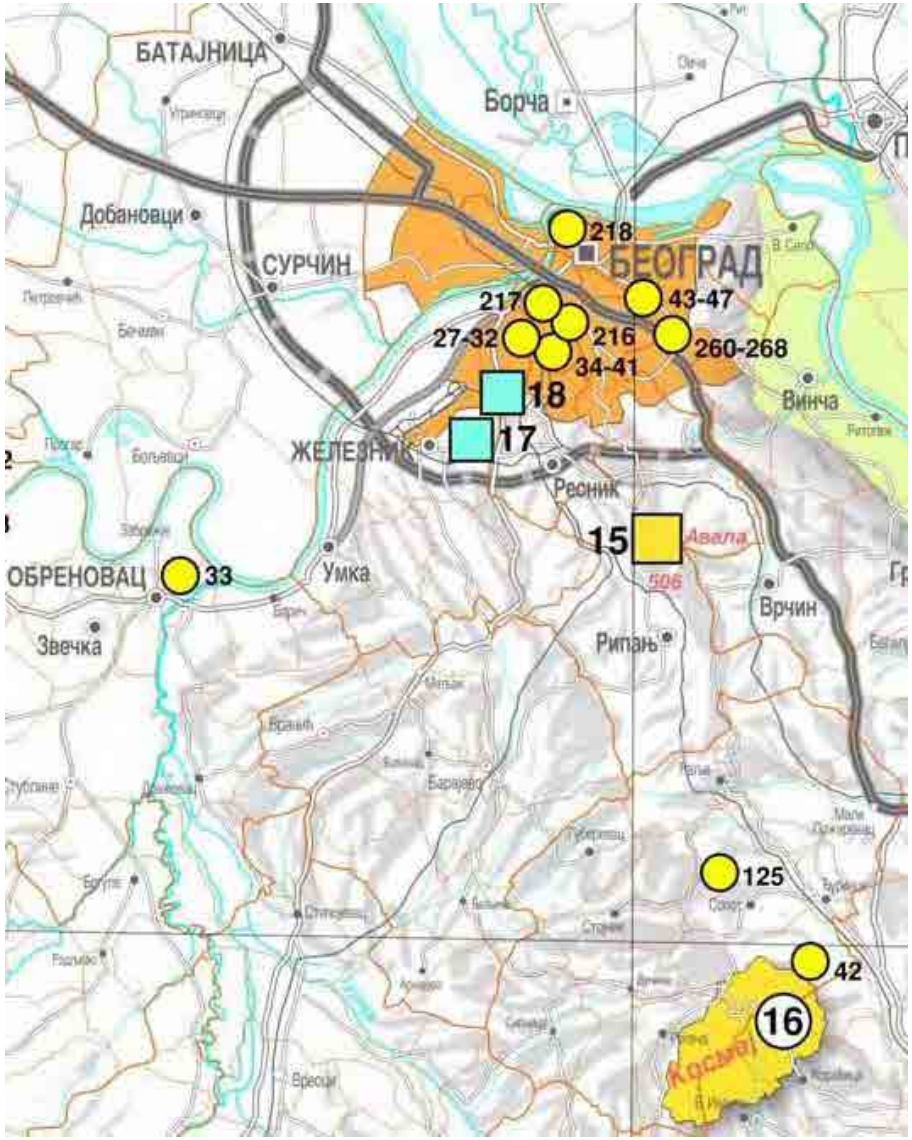


Table 26. Belgrade's natural protected areas

Map No.	Name	Protection Status
15	Mt. Avala	LOF
16	Mt. Kosmaj	LOF
17	Forests of oak and hornbeam at Brigand's fountain	SNR
18	Pioneers' Park	NM
27 – 32	Individual long-living and rare trees	NM
33	Group of oak trees at Jozić's hut	NM
34 – 41	Banjica Forest & individual long-living and rare trees	NM
42	Oak tree (*Quercus robur*) Melnice (over 230 years old)	NM
43 – 47	Botanical Gardens "Jevremovac", & individual long-living and rare trees	NM
125	Oak tree (*Quercus robur*)	NM
216	Miocene sand-shelf at Tašmajdan	NM
217	Maša's Mine in Topčider (geological set layer from the upper Cretaceous Age)	NM
218	Marine Neogene Sandbank in Kalemegdan	NM
260 – 268	Individual long-living and rare trees	NM

LOF – Landscape of Outstanding Features
SNR - Strict Nature Reserve
NM – Natural Monument

Figure 46. Belgrade's natural protected areas (Source: Institute for Nature Conservation of Serbia, 2005)

4.15.1.1 Natural Monument – Marine Neogene Sandbank at Kalemegdan

The profile of the marine Neogene sandbank is located in Belgrade, southwards from the Sava river mouth into the Danube. It is a part of the northernmost branch of the hilly terrain of Šumadija, the so-called "Belgrade cape" which ends in steep slopes on the banks of the Sava and the Danube. The profile gained protection status for the first time in 1969.

The profile below the Belgrade Fortress at Kalemegdan is significant from the aspect of overviewing the complex geological structure of the area where Belgrade was built. The discovered Miocene - Badenian sediments create an antiform made by bending of the layers under the influence of radial tectonics. In the core of the Kalemegdan antiform above the Hammam, there are early Badenian sediments of sandy-sandstone type, from which more than 50 species of fossil molluscs were identified, mostly of the "Rakovački type". Late Badenian sandbank formations, known as the "Lajtovački" limestone and "Lajtovački" carbonate sandstone, lay over them. They are well exposed on the wings of the Kalemegdan "anticline", which emerge to the surface of the terrain near the Zoo and below the monument "The Victor". The profile below the monument "The Victor" is represented by the "Lajtovački" carbonate sandstone and contains many fossils, among which shells from the family Pectinidae are often find. This profile is a true natural rarity, the unique remnant of the Mediterranean phase, the oldest phase in the history of the Pannonian Sea in Serbia.

The profile, as a part of the monumental complex of the Belgrade Fortress with Kalemegdan, with which it makes an inseparable unity, is a symbol of the history of the city - the most impressive monument of Belgrade.

Figure 47. The Profile of the Marine Neogene Sandbank at Kalemegdan (Credit: Institute for Nature Conservation of Serbia)

Figure 48. The Marine Neogene Sandbank at Kalemegdan (Credit: Institute for Nature Conservation of Serbia)

4.15.1.2 Landscape of Outstanding Features – Great War Island

The Great War Island is positioned in the magnificent landscape where the river Sava empties into the Danube, in the triangle confined by the cities of Belgrade and Zemun. Remains of once vast swamps and marshland on the left riverbank of the Danube can be found on this island. This is the last oases of pristine nature, separated by water from the urban heart of the capital of Serbia. The total surface area of 211.38 hectares of the Great War Island was protected in 2005.

These two river islands are representative morphological and geological formations made from an underwater sandbank that has emerged above the water surface during the 16th century.

The surface layers of the islands are alluvial formations of the Danube, and they represent terrestrial ecosystems in a wider zone of the river impact. The rich vegetation consists of aquatic and swamp communities, as well as the communities of alluvial forests of the white willow *(Salix alba)*, almond willow (*Salix amygdalina*), crack willow (*Salix fragilis*), Lombardy poplar (*Populus nigra*), green ash (*Fraxinus viridis*), and desert false indigo (*Amorpha fruticosa*). Such well - developed vegetation, along with the presence of wide open water surfaces, provide food and place for nesting and reproduction of a large number of internationally important bird species, such as the garganey (*Anas querquedula*), ferruginous duck (*Aythya nyroca*), yellow wagtail (*Motacilla flava*), little grebe (*Tachybaptus ruficollis*), squacco heron (*Ardeola ralloides*), and many other.

The fish fauna consists of species that live in both rivers - the Sava and the Danube. During the spawning period, they enter the ephemeral or permanent ponds on the islands and their surroundings, rich in aquatic and marsh vegetation. This locality, where the dynamics of the Danube water level changes is reflected, and isolated from anthropogenic influences, is proclaimed as one of the natural fish spawning places as well.

Three zones with different protection regimes are determined for the total surface of the Great War Island categorized as an important natural area.

Nature protection zone (I degree protection regime) has the character of a special nature reserve and includes Small War Island on the whole, the coastal zone of the Great War Island, forest areas, wetlands within the Great War Island and the water surface around the Small War Island.

Recreation zone (II degree protection regime) involves the internal parts of the Great War Island, the former farmland still used in this way, grasslands of coastal area towards Dunavac (Danube side arm), which are now partly occupied by illegal buildings, and the location of the public pier with controlled traffic route and safety zone with a width of 10 m connecting this site with Lido beach.

The third zone - the tourism zone includes Lido beach with the planned expansion of Lido where an offer of tourist - recreational activities and new facilities could be provided.

In addition to these protection regimes, the protection regimes established by the law and regulations governing the management of international waterways, protection of water supply and water management facilities, wetlands protection, and the protection of hunting and fishing reserves are also applied.

The island also have the international status of an Important Bird Area and an Emerald area („Emerald“- European Ecological Network of Protected Natural Areas).

Legend: Red line – The boundary of the Landscape of Outstanding Features – the Great War Island
Orange – I degree protection regime
Yellow – II degree protection regime

Figure 49. Landscape of Outstanding Features – the Great War Island (Credit: Institute for Nature Conservation of Serbia)

4.15.2 Flora, Fauna and Biodiversity

As discussed in Chapter 4.2, artificial urban and agricultural surfaces dominate in the Project area (54%). Surface waters and wetlands also cover a significant part within the project area (40%). Forest and other vegetation cover types cover about 6% of the area.

It was also underlined that there are no "natural" or "near natural" habitats within the area that is subject of this assessment. Urban surfaces, devastated fields with locally invasive and non-indigenous vegetation and agricultural areas dominate within the target area. The forest communities and areas designated as shrub-herbaceous within the area could not be characterized as typical vegetation of the area, due to the intensive anthropogenic influence.

Within the areas characterized as urban, protected plant species are not expected to be found. The following plant species are typical for the area: *Cichorium intybus* (L.), *Cirsium arvense* (L.) Scop., *Lolium perenne* (L.), *Cynodon dactylon* (L.), *Dactylis glomerata* (L.).

In relation to vegetation, the following habitats/ecosystems could be identified within the zone of planned works:

- Aquatic habitats of the Sava and Danube River and the flooded zone, which include:
  - Running Waters (the Danube and the Sava River and streams in the zone of planned works);
  - Standing Waters (native and artificial pools and native wetlands);
- Pannonian sand dune vegetation**;**
- Subpannonian Steppe Vegetation; and
- Forests ecosystems.

Areas with different types of devastated vegetation cover are also present within the area, which include transition of forest-shrub and herbaceous vegetation, as well as bare habitats (artificial ones).

Classification of ecosystems in Danube and Sava River and neighboring flooding zone may be performed by using macrophyte communities. Flowering plants, mosses and liverworts, a few species of encrusting lichens, the Charales, and other large algal species constitute the macrophytes of flowing waters. Most groups can also be found in standing water, but as one proceeds to faster flows the flora becomes restricted to the small number of species able to withstand current.

Regarding to aquatic vegetation of the lower course of the Sava River, in the zone of planned works (area of Usce PS, Interceptor Sections 1 and 2, and the Great War Island) and neighboring flooding zones involve ecosystems of the floating vegetation (*Lemnetea* W. Koch et R. Tx. 1954), (*Nymphaeon albae* Oberd. 1957) submerged vegetation (*Potametea* R. Tx. et Preising 1942) and amphibian helophyte vegetation (*Isoeto-Nanojuncetea* Br.-Bl. Et Tx. 1943).

Figure 50 illustrates where different kinds of animals can be seen in Belgrade. In the text that follows, animals residing in the area of the planned project works are described.

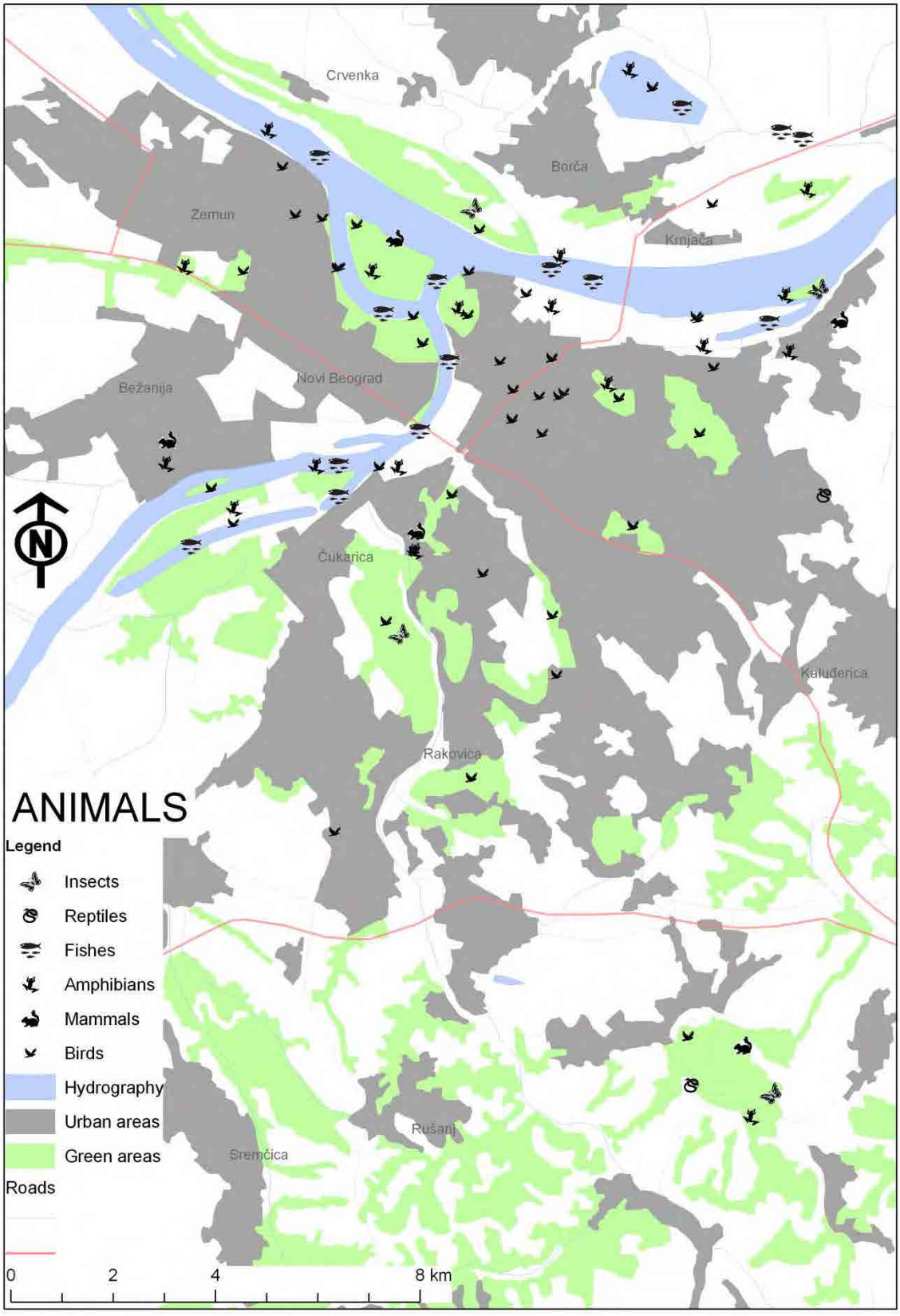


Figure 50. The animals residing in Belgrade (Credit: Milan Kilibarda, Guide to Bio Geo Diversity of Belgrade, 2011)

Among the amphibians that can be found are the green frog (*Rana kl.esculenta*) and the green toad (*Pseudepidalea (Bufo) viridis*).

Figure 51. The green frog (*Rana kl.esculenta*) and the green toad (*Pseudepidalea (Bufo) viridis*) (Credit: Guide to Bio Geo Diversity of Belgrade, 2011)

The fish communities in Belgrade include: perch (*Sander lucioperca*), catfish (*Silurus glanis*), carp (*Cyprinus carpio*), pike (*Esox lucius*), silver bream (*Blicca bjoerkna*) and roach (*Rutilus rutilus*). The catfish is the largest fish in Belgrade. It can grow more than one meter in length and weigh 100 kilograms.

Figure 52. Catfish (Silurus glanis) (Credit: Guide to Bio Geo Diversity of Belgrade, 2011)

There are a number of birds in the area, including: Eurasian sparrow hawk (*Accipiter nisus*), Eurasian blackbird (*Turdus merula*), great tit (*Parus major*), long-eared owl (*Asio otus*), common black-headed gull (*Larus ridibundus*), common goldeneye duck (*Bucephala clangula*), common pochard (*Aythya ferina*), cormorant (*Phalacrocorax carbo*), mallard (*Anas platyrhynchos*), commom coot (*Fulica atra*), white-tailed eagle (*Haliaeetus albicilla*), common raven (*Corvus corax*) and little owl (*Athene noctua*).

Figure 53. Mallard (Anas platyrhynchos) (Credit: Danube Virtual Museum, 2011)

4.16 Cultural Heritage

The map of the cultural heritage of Belgrade is shown in Figure 60. Interceptor No. 2 will be installed under the Vojvode Bojovica Boulevard (Bulevar Vojvode Bojovića in Serbian), which passes along the Belgrade Fortress. Thus the most important cultural and historical site related to this Project is the Belgrade Fortress, an area of cultural heritage.

The general sketch of the layout plan of the force main (Interceptors 1 and 2) is shown in Figure 61, while Figure 62 shows the same layout superimposed over a photo of the area, giving a sense of where the new wastewater infrastructure will be located in regards to the built city, historic monuments and surrounding parks.

Currently, wastewater collected from Novi Beograd and is discharged without any treatment via the Usce PS into the Sava River. The location of the discharge is shown in Figure 63. Figure 63 also shows the location where Interceptor No. 1 will cross the Sava River and be connected to Interceptor No. 2 on the right bank of the Sava River in the area of the Belgrade Fortress.

The basic information about the fortress derived from the Immovable Cultural Monument Data Base of the Republic Institute for Protection of Cultural Monuments is presented in the table below.

Table 27. The basic information about the fortress derived from the Immovable Cultural Monument (ICM) Data Base of the Republic Institute for Protection of Cultural Monuments (http://www.spomenici.heritage.gov.rs/eng/nkd/pregled/beogradska_tvrdjava)

Name:	Belgrade Fortress
Municipality:	Stari Grad (Kalemegdan 14)
Location (place, town, city):	Belgrade
Jurisdiction:	Institute for the Protection of Cultural Monuments of Serbia
Territorial authorities bureau:	Belgrade City Institute for the Protection of Cultural Monuments
Central Registry (CR) No. :	CM3
Date of inscription in the CR:	15.06.1981.
Decision on declaring the monument as ICM:	Decision Belgrade City Institute for the Protection of Cultural Monuments 290/4 dated 31.05.1965.
Category:	ICM of outstanding value
Type:	Cultural monument
Year/period of construction:	as a fortified area developing from the 1st to the 18th centuries

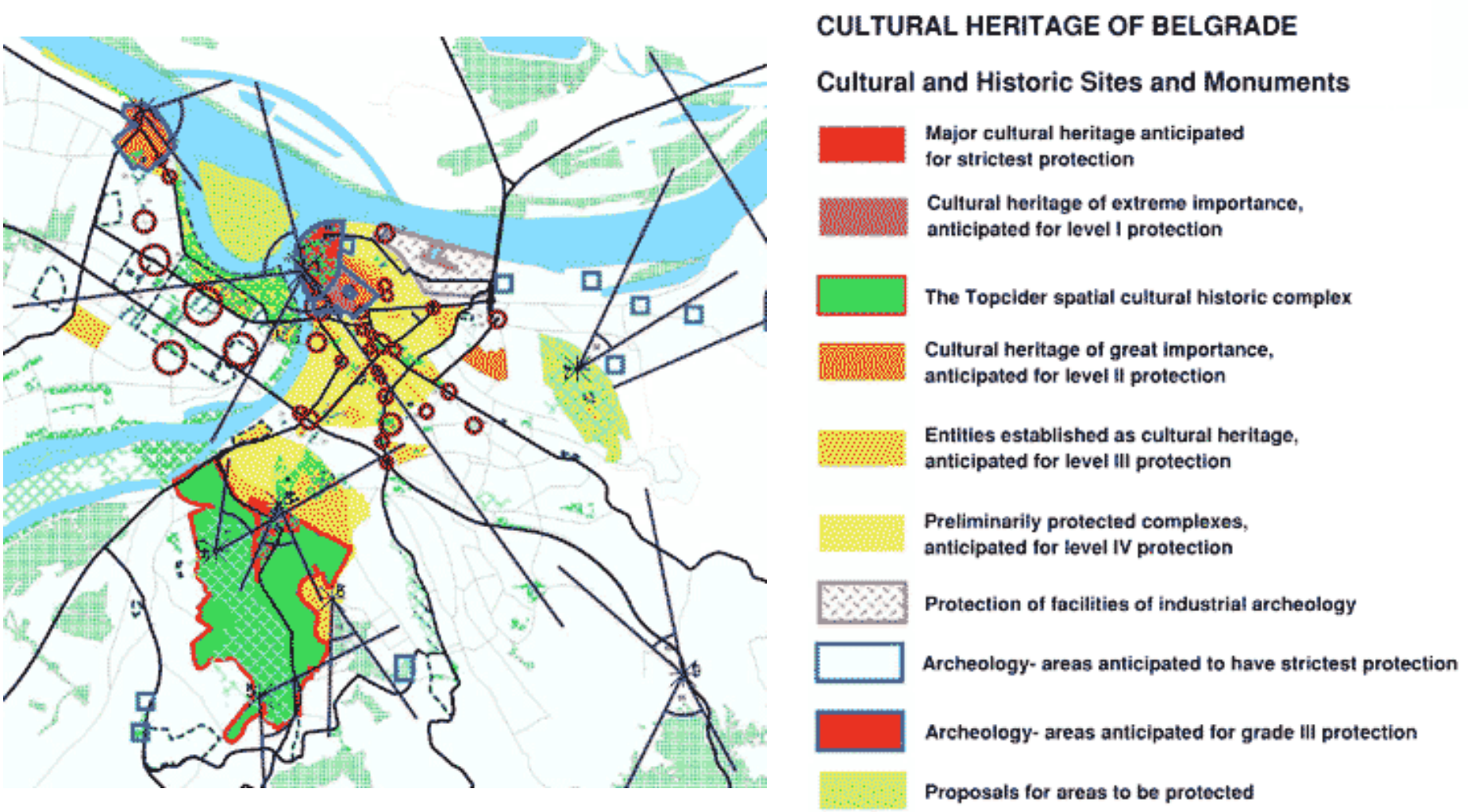


Figure 54. Map of the cultural heritage of Belgrade

The Belgrade Fortress is located on a vantage geostrategic position, on a hill above the confluence of the Danube and the Sava Rivers. The growth of the fortress may be followed by tracing the material remains through epochs: from an ancient castrum to a Byzantine castle, up to a modern 18th fortification. In the late 1st century A.D., the place was used for a military camp of the IV Flavia legion, later to be revived during the rule of the Emperor Justinian. In the early 7th century, the Slavs arrive to Singidunum, but the name of Belgrade (Beograd) does not appear in historic documents until the year 878. Belgrade sees significant growth in the early 15th century, when during the rule of Despot Stefan Lazarevic it becomes the capital of Serbia.

The mediaeval fortress had its inner fortification at the north-west section of the Upper Town, then the east and west settlements below the fort, a vast Lower Town and ports on the Sava and the Danube. The spacious plateau between the mouth of the Rivers Sava and Danube and white lime ridge, after which Belgrade got its name, represents the Lower Town's plateau. During the rule of despot Stefan Lazarevic, this area was fortified and urbanized. It stood for an economic, cultural and spiritual center of the Despotate. Currently, the Lower Town represents a gathering place of athletes, nature lovers and a valuable archaeological site.

Figure 55. Panoramic view of the Belgrade Fortress. The road closest to the river is the Vojvode Bojovica Boulevard, under which Interceptor No. 2 will be installed (Credit: Belgrade Fortress Public Enterprise).

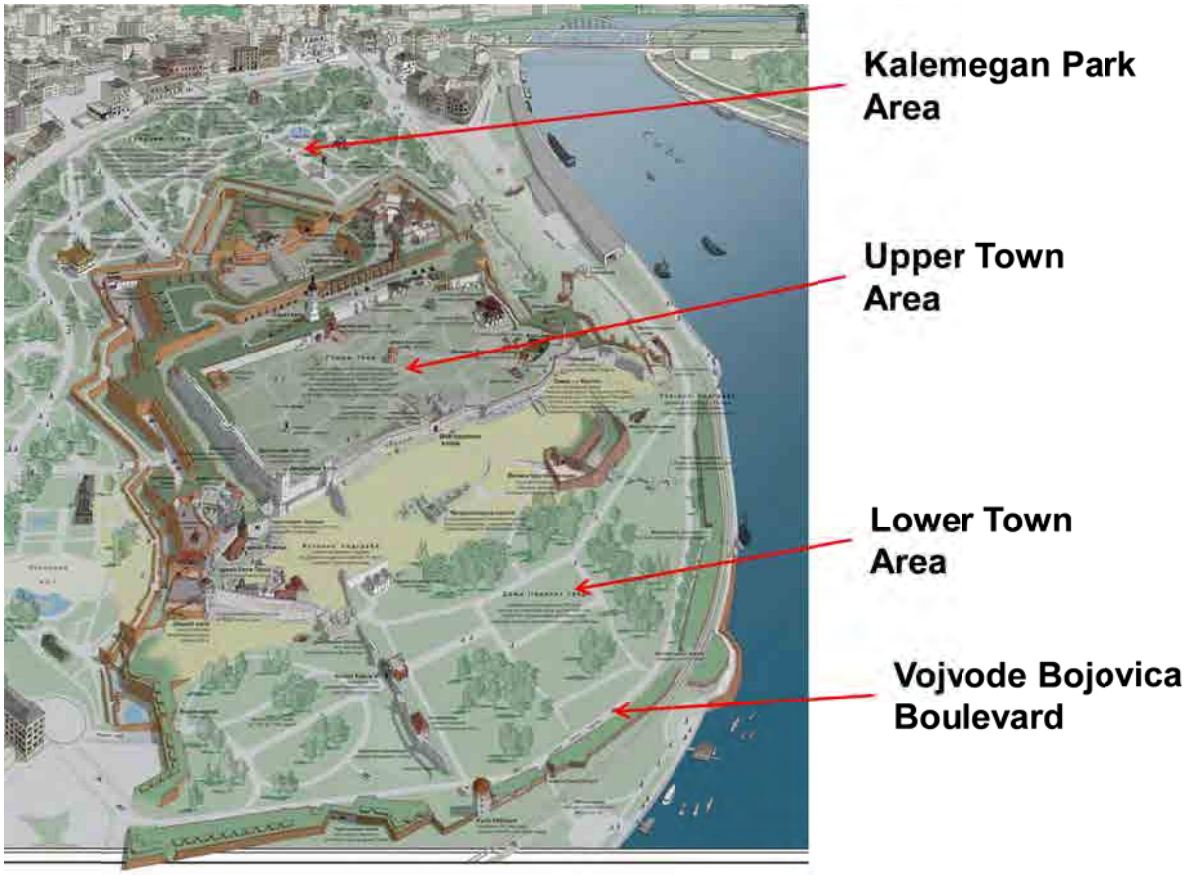


Figure 56. Map of the Belgrade Fortress area (Credit: Belgrade Fortress Public Enterprise)

Figure 57. A closer look at the Vojvode Bojovica Boulevard with the Fortress Lower Town Area to the right and the newly renovated Nebojša Tower to the left.

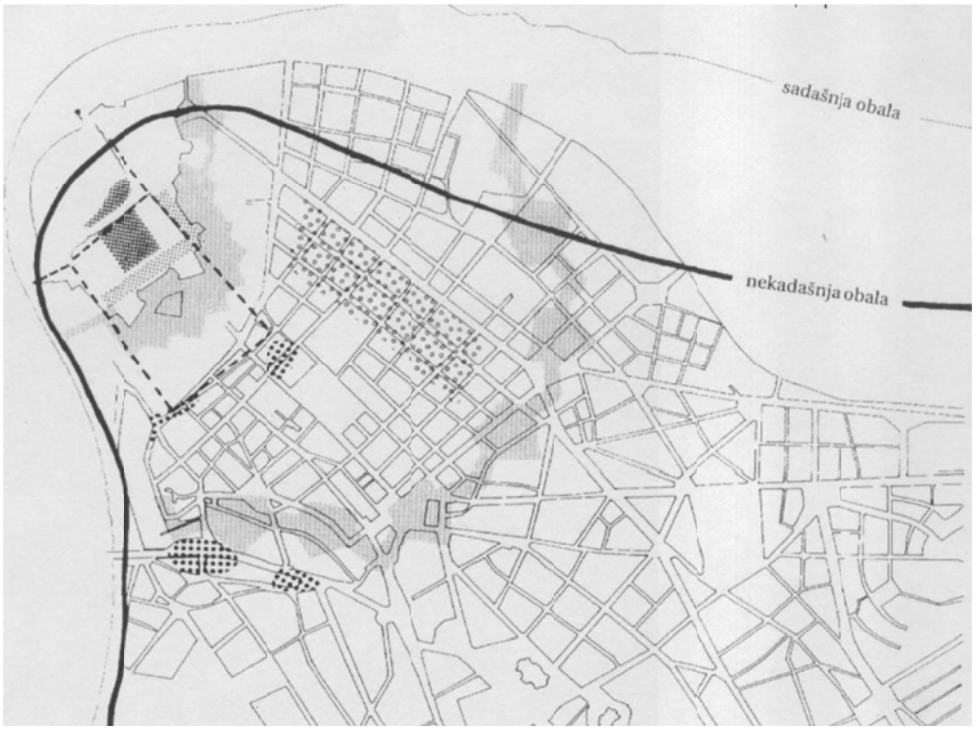


Figure 58. A map showing the current riverbank (sadašnja obala) and the riverbank at the beginning of our era (nekadašnja obala) (from Popović, 1997).

An in-depth discussion was held with Dr. Stefan Pop Lazic about the history of the area along the Vojvode Bojovica Boulevard. Dr. Stefan Pop Lazic is an expert archeologist in matters related to the Belgrade Fortress and works in the Institute of Archaeology in Belgrade. He referred to the article written by Dr. Marko Popovic in the first issue of the *Singidunum* magazine, "Ancient Singidunum: Discoveries and the possibilities of further research" (1997).

This article discussed how the current position of the riverbank has significantly changed compared to when the ancient city was emerging. The analysis of the hydrological situation at the confluence of the Sava and Danube Rivers indicates a constant tendency to shift the right riverbank to the center of the stream, which suggests that at the beginning of our era there was only a relatively small strip of coast, whose inhabitable width was between 50 and 60 m. A map from the article that illustrates this issue is shown in Figure 58.

This means that the Lower Town Fortress area and the Vojvode Bojovica Boulevard lies on sediments formed after the begging of this era, with no traces of earlier cultural layers. The Lower Town area was developed in the middle Ages under the rule of Despot Stefan Lazarevic (15th century), who began renewing old and building the new fortifications, as well as the town walls and towers. Belgrade was divided in two parts: the Upper and the Lower Town. The town was surrounded by double walls with towers and trench from the mainland. In the Upper Town, at the place of the former Byzantine castel, despot built a castle, with especially strong walls with towers and a trench, and the entrance over a drawbridge. There was a court inside the castle occupying the Upper Town area, while a vibrant multicultural city developed in Lower Town during the peaceful times of Despot Stefan Lazarevic's rule. The Lower Town was a market and a craftsmen shops area, where people from all over Europe

traded goods and metals. An artist's impression of the Belgrade Fortress Lower Town in the Middle Ages is shown in Figure 59.

All of the above leads to a conclusion that in the area close to the Vojvode Bojovica Boulevard remains may be found underground, up to about 5 meters in depth, of sunken boats from antiquity that would have remained in the sediment that accumulated in our era, as well as remains from the period of the Middle Ages onwards (fortification remains, building floors and walls, etc.).

Figure 59. An artist's impression of the Belgrade Fortress Lower Town in the Middle Ages (captions from the animated movie "The most glorious place of the ancient times" by Marko Radosavljevic)

5 Analysis of With and Without the Project Scenario

With the implementation of the proposed Project works, the Republic of Serbia and the City of Belgrade will achieve a number of very important goals:

- The Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012-Amendments) will be satisfied, which is a dual great benefit to Serbia – it will improve its water quality status in Belgrade and it will fulfill an environmental requirement set forward by the European Union. The Project will also lead to faster compliance with the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012).

- With the construction of the interceptors and the Veliko Selo WWTP, Belgrade's industries will be forced to comply with the wastewater effluent standards for discharge into the communal sewer system. These waters are currently discharged into the river waters untreated.

- Belgrade's potable water sources are under the direct influence of the surface water quality; the improvement of the surface water quality will enhance the safety of the drinking water sources for the future.

- The further accumulation of pollutants in river bed sediments will be delayed.

- The City of Belgrade's waters will be healthier and this will improve the general standard of living for the city's inhabitants. The City beaches and bating waters will be safer to use due to the discontinuance of raw wastewater discharges in their vicinity. Aquatic habitats will also be improved.

- The tourist potential will be increased by developing different kinds of entertainment venues and tours on the rivers.

- The construction of the interceptors will free up large areas along the Sava and Danube River banks that outlets (e.g. at the location of Ada Huja). This will have a positive effect on surface water quality, riparian flora and the landscape in general. The rehabilitated spaces will be available for recreational and other activities.

If the Project is not completed, the situation will be "status quo" and the quality of the Belgrade's rivers and its bio-systems will continue to be degraded by untreated wastewater discharges at many points along the Sava and Danube Rivers. Also, the non-implementation of the Project works will hinder the advancement of Serbia towards the European Union from the legislative point of view.

6 Environmental Impacts

The management of construction and operation phase impacts should be described in the Project Main (Detailed) Design Report. According to the Law on Planning and Construction (2009 & 2001), the Main Design Report must include the detailed description of measures that prevent or reduce the negative impacts on the environment through appropriate technological processes. The objective is to provide information for environmental management during the proposed construction works and operational activities, for the impacts that need to be monitored/ controlled as defined by the Project EIA Report.

6.1 Construction Phase Impacts

Construction works involve the engagement of construction vehicles, machinery and other equipment. Construction works have the potential to cause temporary air pollution, noise and pollution of surface and groundwater if the machinery and equipment are not maintained in good working condition or are not used properly. The possible impacts of the planned construction works are described below.

The Contractor should, together with the Construction Site Management Plan (CSMP), also adopt and follow the Environment Management Plan (EMP) defined in the Main Design Report, based on the recommendations of the Project Environmental Impact Analyses Study Report.

6.1.1 Soil and Geographical Features (Landscape)

The area of the new Usce PS is adjacent to the existing PS. The location is an urban green area, at the confluence of the Sava and Danube Rivers. During the construction phase, additional neighboring land will likely be occupied to some extent. There is a possibility of dust emission during construction phase, which may influence the surrounding green area. This can be minimized by the application of the best construction management practices. No additional construction roads will be required. During the construction phase, no local resources will be utilized.

Reconstruction of the PS “Mostar” does not require any additional land or utilization of local resources.

As the interceptors will be installed under roads or deeper underground, no lasting impact is expected on land use or the utilization of local resources. Along the trench work, additional land will be required for residential and office accommodation, storage areas and vehicle parking. Visually unaesthetic conditions can be created due to cluttering of construction waste and remains of dug-up roads and pavements during construction, but the CSMP should have instructions on how this issue should be handled.

After the completion of the constructions works, the roads and other places where an open-cut/ trench method will be used for the installation of the interceptors must be repaired and brought to the level of previous construction and esthetic quality or further improved.

6.1.2 Microclimate Parameters

No impact is expected.

6.1.3 Global Warming

The Project has no impact on global warming.

6.1.4 Air Pollution and Offensive Odors

The planned PS and interceptor routes are in the areas of existing busy roads and infrastructure, where transportation noise and pollutant emissions already exist, as recorded during regular air quality monitoring programs by the Belgrade Institute of Public Health at the following monitoring points: Cvijiceva, Mostar and Pancevo Bridge (please see Figure 24 and Table 12). At these locations, higher than permitted concentration values of CO and Pb have been detected, while the levels of nitrogen oxides are almost always above the permitted values. Therefore, the air pollution impacts created due to the installations via the open-cut/ trench method (Interceptors Nos. 2, 3 and 4) from construction vehicles, machinery and equipment are not expected contribute significantly to the immediate surroundings. These effects are temporary and can be minimized with the application of best practice construction methods (modern technologies) and site management. Construction vehicles, machinery and equipment should be in good working condition and well maintained. Dust emissions from piles of soil or any other material during earthwork, excavation and transportation should be controlled by wetting surfaces, using temporary wind breaks and covering truck loads.

As monitoring of environmental air pollutant values is done weekly by the City of Belgrade at locations close to the Project sites, additional air quality monitoring is not needed.

During micro-tunneling for the installment of Interceptors Nos. 1, 6 and 10, malodorous gaseous pollutants may concentrate. Adequate ventilation measures must be defined in the Design Project Reports.

6.1.5 Noise and Vibrations

Temporary noise pollution due to construction works should be controlled by proper maintenance of equipment and vehicles, and tuning of engines and mufflers.

The Contractor will have to ensure that workers operating equipment that generates noise should be equipped with noise protection gear. Workers operating equipment generating noise levels greater than 80 dB (A) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels of 70 – 80 dB (A) should wear earplugs.

The emitted noise affects only the immediate environment and is temporary in nature.

The Mostar PS and the interceptor routes will be along/ underneath existing busy roads where transportation noise emissions already exists, as measured by the Belgrade Institute of Public Health (please see Table 14 and Figure 26). The Mostar PS and the start of Interceptor No. 10 are close to the Duke Misica Boulevard measuring station, while Interceptors Nos. 4 and 6 are close to the Despot Stefan Boulevard measuring stations. These locations are among the noisiest in Belgrade, as shown in Table 14.

The Usce PS and Interceptor No. 2 are located in less noisy areas; however, they are located at a fair distance from residential areas so the construction noise will not be of significant effect.

Interceptors Nos. 1, 6 and 10 will not be constructed by above ground methods (apart from the downstream segment of Interceptor No. 10) and therefore noise emissions can be expected only at the start and end points of these interceptors.

Prior to the start of construction, a baseline noise measurement should be conducted in areas where the open-cut/ trench method will be used for interceptor installations, according to a plan that should be defined in the Project Design Reports and the EMP. This should be done for the purpose of assessing the influence of the Project works related noise emissions in comparison to the existing baseline levels.

If it is found that measured noise levels in the environment close to the construction site are above the existing baseline levels and that the construction site works noise contributions are significant, the effect should be mitigated though the improvement of construction site management and the use of modern and well-maintained vehicles, machinery and equipment.

During excavation works, temporary vibrations are expected to occur that will have no lasting impact on the immediate surroundings.

During tunneling, vibrations may have an impact on the external environment only at interceptor segments where the above earth layer is shallow. There is little reliable information on the threshold of vibration-induced damage in buildings. Although vibrations induced in buildings by ground-borne excitation are often noticeable, there is little evidence that they produce even cosmetic damage. This lack of data is one of the reasons that for variation between international standards, and for the absence of International Organization for Standardization guidance limits. There is also no legislation on vibrations in Serbia. Hence the relevant German standard is DIN 4150: Part 35 will be referred to. This standard provides guidelines for short-term and steady-state structural vibration. For short-term vibration in buildings the limits are listed in the table below.

Table 28. Guideline values of vibration velocity, v_i, for evaluating the effects of short-term vibration (Source: DIN 4150)

Structural type	Vibration Velocity, v_i, in mm/s			
	Foundation			Plane of floor of uppermost full storey
	less than 10Hz	10–50Hz	50–100Hz	Frequency mixture
Commercial, Industrial or Similar	20	20 to 40	40 to 50	40
Dwellings or Similar	5	5 to 15	15 to 20	15
Particularly Sensitive	3	3 to 8	8 to 10	8

The guidelines state that “Experience to date has shown that, provided the values given in the table above are observed, damage due to vibration, in terms of a reduction in utility value, is unlikely to occur. If the values in the table above are exceeded, it does not necessarily follow that damage will occur. Should these values be significantly exceeded, further investigation is necessary”.

The age and existing condition of a building are factors to consider in assessing the tolerance to vibration. If a building is in a very unstable state, then it will tend to be more vulnerable to the possibility of damage arising from vibration or any other ground-borne disturbance.

In the vibration sensitive areas, where vibrations have some potential to cause problems due to land subsidence, vibration measuring instrumentation should be installed and checked regularly (daily), as should described in the Design Project Reports and in the EMP. Structures above the tunnel the tunnel works that may be particularly susceptible to ground-borne vibration should be examined daily, the event of any cracks showing, work must immediately be stopped and remedial measures taken.

Prior to the start of construction, a baseline measurement of vibrations along expected sensitive areas should be conducted according to a plan that should be defined in the Project Design Reports and the EMP. This should be done for the purpose of assessing the influence of the tunnel-works related vibration in comparison to the vibrations that already exist in relevant Project area.

6.1.6 Ground Subsidence

During the trench works, some groundwater drainage could be required. This should be designed carefully, in order to prevent ground subsidence.

6.1.7 Solid Waste Management

Waste will be generated during the construction of the PSs and the installation of the interceptor pipelines. Directions on construction site waste management will be included in the EMP. The EMP should include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site, and a system for supervision and monitoring.

The excavated material from the Interceptor Nos. 1, 6 and 10 tunnels, if of adequate composition or quality, could be transported to the Veliko Selo WWTP to be used for the WWTP foundation works.

Most construction waste is non-hazardous and inert. This waste should be:

- Preferably recycled (construction waste recycling facilities and services do not exist in Belgrade currently, but is expected that they will be available in the near future); or
- Deposited at the Vinca municipal landfill (where it is currently used as landfill cover material).

If any hazardous waste materials are generated on-site, the EMP must have information of the locations where this type of waste can be deposited or the names of companies who handle hazardous waste materials.

6.1.8 Water Resources and River Sediments

Potential impacts on water resources (groundwater and surface water regimes and quality) associated with the construction phase of the Project are considered in the text that follows. The aim is to identify and assess potential adverse impacts on the water regimes and water resources quality, before defining appropriate mitigation measures that will be implemented in the Project.

The Project contains several components: construction of the new Usce PS, reconstruction of the Mostar PS, and construction of the interceptors. As a part of the Belgrade Sewerage Master Plan, the Project has potential impact on water resources. The assessment will cover potential impacts on groundwater (regimes and quality) and surface water (hydrological regime and water quality).

There are two wells relatively near the Project wastewater management facilities. The "RB-2" well, with a capacity of 50 L/s, is located at about 550 m from the Usce pumping station; and further, at an approximate distance of 750 m, is the "RB-4" well with a capacity of 130 L/s. Actually, the Usce PS is located inside the well recharge area, and inside the inner wellhead protection zone of the Belgrade groundwater source. Construction site practices and monitoring listed in the tables below as well as in Chapter 7 will have to be followed to minimize any potential chances of contaminating the groundwater during the construction of the new Usce PS. A Decision on the Issuance of Water Conditions from the Directorate for Water of the Ministry of Agriculture, Forestry and Water Management will be issued during the Preliminary design phase of the Projects that may include additional mitigation measures that will be incorporated into the Project technical documentation and executed during construction.

Potential construction phase impacts include:

- Contamination of groundwater;
- The loss of groundwater resources during tunnel construction;
- Contamination of surface water during site clearance and construction works (oil spills and contamination, wash-out/runoff, etc.).

Due to the huge discharges of the Sava and Danube Rivers, there are no potential impacts of the Project works on the flow regimes.

Water resources that may be affected by the Project works were evaluated regarding the short and long-term consequences in order to assess the relative significance. The utilized sensitivity and magnitudes of the impact gradation are shown in the tables below.

Table 29. Water resource sensitivity criteria

Sensitivity	Characteristics	Example
High	Surface water or groundwater with limited, or no capacity to absorb the impact Surface water or groundwater with minimal opportunity for mitigation Surface water or groundwater providing vital ecosystem services (e.g. fishery). Surface water or groundwater as resource of water supply, major industrial abstraction or large irrigation supplies	Wellhead vital for water supply Water supply for major industry or irrigation use Unconfined, shallow aquifers
Medium	Surface water or groundwater with some capacity to absorb the impact Surface water or groundwater at medium risk of pollution Surface water or groundwater providing important ecosystem services (e.g. fishery). Surface water or groundwater as resource of water supply, major industrial abstraction or large irrigation supplies	Spring or well serving village water supply or local industry Unconfined aquifer with overlying layer of less permeable soil.
Low	Surface water or groundwater with capacity to absorb the impact Surface water or groundwater with moderate opportunity for mitigation Surface water or groundwater already changed from natural condition Surface water or groundwater as resource of individual water supply	Confined aquifer with significant (> 5 m) overlaying aquitard. Large rivers with high discharge, capable to attenuate periodical pollution release (e.g. from CSO facilities).
Negligible	Surface water or groundwater with considerable capacity to absorb the impact	Deep, confined aquifer with significant overlaying aquitard.

Table 30. Magnitude of Impacts

Magnitude	Description
Major	Significant impact resulting in long-term modification, with expected exceedance of national standards limits. Requires significant intervention for revitalization to baseline state.
Moderate	Detectable short or long/term change of baseline state, without exceedance of national standards limits.
Minor	Detectable, minor change of baseline state.
Negligible	No perceptible change of baseline state.

During the construction phase of the Project, potential impacts on water resources are shown in the table below. The most significant potential impacts on water resources during the construction phase are related to groundwater quality issues at the location of the Usce PS, which is in the inner protection zone of the Belgrade wellhead.

Facilities required during the construction include:

- Residential and office accommodation;
- Storage areas;
- Parking for vehicles.

Temporal impacts on surface/groundwater quality may arise due to:

- Spills of the generated wastewater;
- Spills/Leaks of oil products or other chemicals stored at the storage areas.

Possible impacts are shown in the table below. All impacts can be mitigated with the application of best practice construction methods (modern technologies) and site management, as should be defined in the Main Design Project Report and in the EMP. All wastewater generated on the construction site must be properly collected and disposed of. The EMP must include information and instructions on how to handle all on-site waste flows and minimize any negative environmental impacts.

Therefore, the impacts on water quality (surface water and groundwater), from construction facilities are temporary and can be avoided/ mitigated. The overall assessment is Minor adverse.

Table 31. Possible construction phase impacts on water resources regimes and quality

Location	Potential Impacts	Sensitivity	Magnitude	Impact Significance
Usce PS	Temporary, localized pollution releases into the Sava River*	Low	Minor	Minor adverse
	Temporary, localized pollution release into the aquifer*	Medium	Moderate	Moderate adverse
Mostar PS	Temporary, localized pollution release into the aquifer* There is no data on significant aquifer at the location of the Mostar PS	Negligible	Minor	Negligible adverse
	Temporary pollution release into sewerage system*	Negligible	Minor	Negligible adverse
Interceptor No. 1	Temporary chemical pollution release into Sava River*	Low	Minor	Minor adverse
Interceptors Nos. 2-7	Temporary, localized pollution release into the groundwater*	Low	Moderate	Minor adverse
Interceptor No. 10	Potential influence on water regimes of the local aquifers along the route	Low	Major	Minor adverse
	Temporary pollution release into aquifer*	Low	Moderate	Minor adverse

* from fuel and other chemicals used during construction

Table 32. Possible construction phase impacts on water resources quality from construction facilities on site

Location	Potential Impacts	Sensitivity	Magnitude	Impact Significance
Usce PS	Water supply / Wastewater release Earthworks Fuel/ Chemical storage	Low	Minor	Minor adverse
	Discharges to meet Standards or taken for off-site disposal. Fuel and other chemicals to be stored on site must be bundled to avoid leakage and contamination.			
Mostar PS	Fuel/ Chemical storage	Negligible	Minor	Negligible adverse
	Fuel and other chemicals to be stored on site must be bundled to avoid leakage and contamination.			
Interceptor Nos. 1-7 & 10	Water supply / Waste water release Earthworks Fuel/ Chemical storage	Low	Minor	Minor adverse
	Discharges to meet Standards or taken for off-site disposal. Fuel and other chemicals to be stored on site must be bundled to avoid leakage and contamination.			

6.1.9 Natural Environment

The planned Project works will not influence the biological diversity of the area, i.e. they will have no impact on ecosystems, flora and fauna.

The profile of the Marine Neogene Sandbank is away from the location of where Interceptor No. 1 will cross the Sava River and away from the Interceptor No. 2 route, and therefore will not be influenced by the planned works.

Interceptor No. 1 will be constructed below the Sava River bed and the works will not influence the Great War Island protected zones.

6.1.10 Cultural Heritage

Interceptor No. 2 will be installed around the Belgrade Fortress, which is a cultural monument of outstanding value.

At the Project preliminary design stage, the Belgrade City Institute for Protection of Cultural Monuments and/or the Republic Institute for Protection of Cultural Monuments will issue a Decision on Technical Protection Measures for the Project works upon the request of the Project manager. These measures must be incorporated into the Preliminary Project Design and must also be followed during the construction phase of the Project. The Decision may request that the Project manager provide funds for archeological excavations in the area of the proposed Interceptor No. 2 works.

The project manager is also obliged to notify the Belgrade City Institute for Protection of Cultural Monuments on the dynamics of all the works. If archaeological sites and material cultural remains are encountered during earthworks, the contractor is obliged to stop works immediately and notify the

Belgrade City Institute for Protection of Cultural Monuments of the findings, as well as ensure that the site is protected in order to avoid damage or destruction of the findings, until the arrival of professional archeological teams.

6.1.11 Existing social infrastructures and services

Some parts of the interceptors will be constructed by the open-cut/ trench method and traffic disturbance will be expected. The relevant traffic authorities should be notified of the planned works in a timely manner so that alternative traffic routes can be formed and the public alerted. Traffic accidents can be avoided by collaborating with the traffic police and posting warning signs and directions to alternative routes when interceptor construction works will cause the closure of certain roads, in part or fully.

6.2 Operation Phase Impacts

6.2.1 Soil and Geographical Features (Landscape)

No impact is expected during the operation of the Project facilities.

6.2.2 Microclimate Parameters

Water management facilities generally may have effects on microclimate parameters. In that regard, facilities that have the most significant influence are those that increase the surface of the water table, as do retention/detention ponds and lakes. These facilities usually influence air humidity, air temperature, wind speed and the number of days with fog.

The sewerage system improvement project for the City of Belgrade does not include facilities that have a significant water table surface, which could have impact on microclimate parameters.

6.2.3 Global Warming

The Project has no impact on global warming.

6.2.4 Air Pollution and Offensive Odors

During operation, the Project has no impact on air quality, with the proper design and construction of the interceptors and pumping stations.

The potential for odor release from wastewater collection systems is high (Wastewater Engineering – Treatment and Reuse, 2004). The principal sources of odorous compounds in collection systems are from the:

- Biological conversion, under anaerobic conditions, of organic matter containing nitrogen and sulfur; and
- Discharge of industrial wastewater that contains compounds that react with compounds in the wastewater to produce odorous compounds.

Odorous gases released to the sewer/ interceptor atmosphere can accumulate and be released at air release valves, cleanouts, access ports (manholes) and house vents.

The release of odors from the liquid phase in wastewater collection systems can be limited by:

- Maintaining aerobic conditions through the addition of hydrogen peroxide, pure oxygen or air at critical locations in the collection system and to long force mains;
- Controlling anaerobic microbial growth by disinfection or pH control;
- Oxidizing or precipitating odorous compounds by chemical addition;
- Design of the wastewater collection system to minimize the release of odors due to turbulence; and
- Off-gas treatment at selected locations.

The prevention measures for avoiding odor release to the outside environment should be included in the interceptor design, construction and operation.

The operation of pumping stations might also generate offensive odor. The design of the pumping stations and the pumping station buildings should include consideration on how to avoid the release of odors. The designs may incorporate a good ventilation system or an air filtration device to remove the odorous gases. This must be defined in the Design Project Reports.

6.2.5 Noise and Vibrations

During operation, the pump stations will generate noise, but this should be confined within the buildings that house the pumps. The new Usce pumping station will be located in a park alongside the Sava River that is frequently used for leisurely walks by the city inhabitants (Figure 10). The new pumping station and the building it will be housed in should be constructed in a manner that generates the least noise possible so as not to disturb the city dwellers that enjoy this urban park.

6.2.6 Ground Subsidence

Operation of pumping stations and Interceptors does not require groundwater level change, and therefore the soil subsidence due to groundwater drainage is not expected.

6.2.7 Solid Waste Management

Solid waste and sludge generated at the pumping stations or during cleaning of the Interceptors should be disposed of according to directions on waste management that will be included in the EMP for the operational phase of the Project. Waste and sludge would most probably be disposed of at the Vinca municipal landfill until other waste management options become available.

6.2.8 Water Resources and River Sediment

Potential impacts on water resources (groundwater and surface water regimes and quality) associated with the operation phase of the Project are considered in the text that follows. The aim is to identify and assess potential adverse impacts on the water regimes and water resources quality, before defining appropriate mitigation measures that will be implemented in the Project.

The Project contains several components: operation of the new Usce PS, operation of Mostar PS, and operation of the interceptors. The assessment will cover potential impacts on groundwater (regimes and quality) and surface water (hydrological regime and water quality).

Potential impacts on groundwater include contamination during operation. Potential impacts on surface water are: CSO discharges and spills and leakage during operation.

The operation phase adverse impacts on the Danube River water quality may arise during high precipitation events at CSO release facilities along the interceptor route. However, due to huge capacity for attenuation of the Danube and decreased pollutant concentrations in such events, the impact is considered as temporal and local.

On the other hand, having in mind the present situation, with direct release of all wastewater (domestic and industrial) into Sava and Danube Rivers, the beneficial impact of the Project realization is significant, considering all social and environmental aspects.

The design influent wastewater characteristics and effluent standards of the Veliko Selo WWTP are shown in the table below. Table 34 shows the amounts of pollutants that will not be conveyed to the WWTP for treatment and will not be discharged directly into the Sava and Danube Rivers. This will enhance the river water quality and delay further accumulation of pollutants in river bed sediments.

Table 33. The design influent wastewater characteristics and effluent standards of the Veliko Selo WWTP

Parameter	**Adopted waste water concentration**	**WWTP effluent concentration**
BOD_5 (mg/L)	192	25
COD (mg/L)	385	125
TSS (mg/L)	224	35
Total N (mg/L)	35	10
Total P (mg/L)	8	1

Table 34. Design average daily amounts of pollutants transported by the interceptors to the Veliko Selo WWTP

	2015	2021	2031
Wastewater (m^3/day) (dry condition)	394,000	409,000	448,700
Wastewater (m^3/day) (wet weather flow)	1,209,600	1,252,800	1,341,100
BOD_5 (kg/day)	75,648	78,528	86,150
COD (kg/day)	151,690	157,465	172,750
TSS (kg/day)	88,256	91,616	100,509
Total N (kg/day)	13,790	14,315	15,705
Total P (kg/day)	3,152	3,272	3,590

At the location of pumping stations (Usce and Mostar) there is possibility of direct release of wastewater into Sava River due to electricity or mechanical failure.

Pumping stations are designed according to relevant safety standards and the best practice to provide minimal possibility of wastewater release. This includes secondary electricity supply, emergency planning, backup pumps, etc. The overall assessment is minor adverse.

The leakage of wastewater into groundwater, at the Usce PS, would have a significant impact on groundwater quality, with possible effects on the B2 and B4 wells. Therefore, an appropriate monitoring program has to be established that includes monitoring of groundwater quality at monitoring piezometers. Monitoring piezometers should be adequately located in order to provide forehand information for mitigation measures.

Other failure events at the Interceptor route would cause the release of wastewater at the CSO locations and/or at the current sewerage outlets.

Interceptor No. 1 will be constructed in the form of two force mains under the Sava River bottom bed, In case pipe damages or maintenance to one force main, wastewater will be conveyed to the WWTP via the second force main. Both pipes are protected by an outer pipe; therefore wastewater will not seep into the river bed nor pollute the Sava River.

6.2.9 Natural Environment

It is foreseen that proper functioning of WWTP and reduction of pollution from Belgrade will have positive effects to all groups of aquatic biota - algal communities, aquatic macrophytes, invertebrates and fish fauna.

The reduction of pollution, together with the significant ability of self-purification of the potamon type water systems could contribute to progress of some socio-economic areas, e.g. fisheries, tourism, etc.

6.2.10 Cultural Heritage

No influence is expected.

6.2.11 Existing social infrastructures and services

No influence.

7 Environmental Management Plan

The proper construction and operation of the Project facilities will not contribute to environmental pollution. All impacts can be avoided with the application of best practice construction methods (modern technologies) and site management, as should be defined in the Main Design Project Report and in the Project EMP. Proposed mitigation measures for the construction and operation of the Project are summarized in the table below.

Table 35. Proposed mitigation measures for the construction and operation of the Project

Embedded Mitigation (Mitigation that is built-in the Project Design and the EMP)	Environmental mitigation measures are an integral part of the Project. Measures have been developed to avoid or minimize impacts on the surface water and groundwater. These integral design mitigation include the: - Application of best practice to minimize risk of pollution during construction and operation; - Incorporation of control structures and operating rules to prevent the release of wastewater into environment; - Application of pretreatment of industrial wastewater, prior to discharge into the City wastewater collection system.
Mitigation of significant effects	- Control measures for the storage of chemicals and oil products during construction and operation at the location of the Usce PS; - Minimization of the top soil (aquitard) removal / aquifer intrusion during earthworks in the area of Usce PS; - Site construction compounds away from sensitive areas; - Wastewater produced at the construction site will be safely transported from sensitive areas.
Mitigation of non-significant effects	- Adopt best practice to minimize the risk of pollution during construction and operation; - Wastewater produced at the construction site will be safely transported from the construction site and treated before release; - Workers education on pollution control.

The monitoring and mitigation plans are presented in the tables below. The associated costs should be determined at the Preliminary Design Phase and included in the Contract. Monitoring should be conducted by relevant accredited expert institutions. The results of environmental monitoring must be submitted to the Belgrade Secretariat for Environmental Protection.

Table 36. Monitoring Plan

Environmental Item	Standard	Location	Frequency	Responsibility
Construction Phase				
Noise	Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010)	Near construction site	Once/month	Contractor
Vibrations	DIN 4150	Structures susceptible to ground-borne vibration in areas above tunnel works where earth layer is shallow	Daily	Contractor
Sava River Water Quality	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012)	Two locations: upstream and downstream from Usce PS	During construction of Usce PS and Interceptor No. 1, in case of accidental pollution	Contractor
Groundwater Quality	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012) Regulation on Drinking Water Quality (98 & 99)	Piezometers located on streamlines from Usce PS to the RB2 and RB4 wells, Water from wells RB2 and RB4.	Twice/month	Contractor
Cultural Heritage	As set in the Decision on Technical Protection Measures for the Belgrade Fortress (to be obtained during Project Preliminary Design)	Along the Interceptor No. 2 route	As set in the Decision	Contractor
Operation Phase				
Groundwater Quality	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012) Regulation on Drinking Water Quality (98 & 99)	Piezometers located on streamlines from Usce PS to the RB2 and RB4 wells	Once/month, for at least 2 years	PUC Belgrade Waterworks and Sewerage

Table 37. Mitigation Plan

Environmental Item	Mitigation	Responsibility
Construction Phase		
Dust Emission	Wetting excavated surfaces Using temporary windbreaks Covering truck loads	Contractor
Noise Generation	Restriction of working hours to daytime Employing low-noise equipment Proper maintenance of equipment and vehicles, and tuning of engines and mufflers Noise protection equipment for site workers	Contractor
Vibrations	If the tunneling vibrations show a negative impact on the above structures, work must be discontinued and commenced only after appropriate safety measures have been taken. The safety measures should be analyzed and written in the Main Design Report and the EMP.	Contractor
Sava River Water Quality	In case that the Sava River Water Quality monitoring indicates that the water has been polluted by the construction site and works, all works must be stopped and remediation measures taken before further continuation of the works.	Contractor
Groundwater Quality	In the case that increased pollutant concentrations are detected, the works will be suspended until the source of pollution has been identifies and removed, and, if the supervisory authority deems it necessary/ feasible, aquifer remediation will also be done.	Contractor
Cultural Heritage	As set in the Decision on Technical Protection Measures for the Belgrade Fortress (to be obtained during Project Preliminary Design)	Contractor
Operation Phase		
Groundwater Quality	If groundwater contamination is detected during the Project operational phase, an investigation must be made into the source of the pollution and appropriate remedial actions must be taken.	Project owner

8 List of References

8.1 Legislation

Law on Air Protection (2009). Official Gazette of the Republic of Serbia No. 36/09.

Regulation on air monitoring conditions and air quality requirements (2010). Official Gazette of the Republic of Serbia Nos. 11/10 & 75/10.

Regulation on the air pollutants emission limit values (2010 & 2011). Official Gazette of the Republic of Serbia Nos. 71/10 & 06/11.

Air Quality Control Program for the City of Belgrade 2012 – 2013 (2012). Official Gazette of the City of Belgrade No. 17/12.

Law on Environmental Impact Assessment (2004 & 2009). Official Gazette of the Republic of Serbia Nos. 135/04 & 36/09.

Regulation on Establishing the List of Projects for which the Environmental Impact Assessment is Mandatory and the List of Projects for which the Environmental Impact Assessment can be Requested (2008). Official Gazette of the Republic of Serbia No. 114/08.

Rulebook on the Contents of Requests for the Necessity of Impact Assessment and on the Contents of Requests for Specification of Scope and Contents of the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Rulebook on the Contents of the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Rulebook on the Procedure of Public Inspection, Presentation and Public Consultation about the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Rulebook on the Work of the Technical Committee for the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Law on Environmental Protection (2004 & 2009). Official Gazette of the Republic of Serbia Nos. 135/04 & 36/09.

Regulation on the Program of System- Based Monitoring of Soil Quality, Risk Estimation Indicators of Soil Degradation and the Remediation Programs Methodology (2010) Official Gazette of the Republic of Serbia No. 88/10.

Law on Planning and Construction (2009 & 2001). Official Gazette of the Republic of Serbia Nos. 72/09, 81/09 & 24/11.

Law on Protection against Noise in the Environment (2009 & 2010). Official Gazette of the Republic of Serbia Nos. 36/09 & 88/10.

Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010) Official Gazette of the Republic of Serbia No. 75/10.

Rulebook on Noise Measuring Methods, the Content and Scope of the Noise Measurement Report (2010). Official Gazette of the Republic of Serbia No. 72/10.

Waste Management Law (2009 & 2010). Official Gazette of the Republic of Serbia No. 36/09 & 88/10.

Regulation on Disposal of Waste in Landfills (2010). Official Gazette of the Republic of Serbia No. 92/10.

Water Law (2010). Official Gazette of the Republic of Serbia No. 30/10.

Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012). Official Gazette of the Republic of Serbia No. 20/12.

Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater (2011). Official Gazette of the Republic of Serbia No. 74/11.

Regulation on the Limit Values of Priority and Priority Hazardous Substances that Pollute Surface Waters and the Deadlines for Compliance with the Limit Values (2011). Official Gazette of the Republic of Serbia No. 35/11.

Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012-Amendments). Official Gazette of the Republic of Serbia No. 67/11 & 48/12-Amendments.

Regulation on Drinking Water Quality (98 & 99) Official Gazette of the Republic of Serbia Nos. 42/98 i 44/99.

8.2 Guidelines

Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations. April, 2002.

Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations. April, 2010.

8.3 Plans and Strategies

City of Belgrade Development Strategy – Goals, Concept and Strategic Priorities (2011). Urban Planning Institute of Belgrade and PALGO center.

Master Plan of Belgrade 2021 (2003; 2005, 2007 & 2009 - Amendments). Official Gazette of the City of Belgrade Nos. 27/03, 25/05, 34/07 & 63/09.

Master Plan of the Belgrade Sewerage System (2011). Jaroslav Černi Institute for Development of Water Resources.

Spatial Plan of Republic of Serbia 2010-2020 (2010). Official Gazette of the Republic of Serbia No. 88/10.

8.4 General References

Air Quality Control Program for Belgrade 2012-2013 (2012). Official Gazette of the City of Belgrade No. 17/12.

Analysis of groundwater regime in the area of Usce Shopping Centre, Belgrade in extreme conditions caused by high water levels in Sava and Danube rivers (2008). University of Belgrade - Faculty of Civil Engineering.

Belgrade Fortress Public Enterprise – http://www.beogradskatvrdjava.co.rs/

Belgrade in Figures (2012). Institute for Informatics and Statistics.

Census in Serbia (2011). Census of Population, Households and Dwellings in the Republic of Serbia. Statistical Office of the Republic of Serbia. http://webrzs.stat.gov.rs/WebSite/

Danube Virtual Museum presented by the Belgrade Fortress Public Enterprise and the Ministry of Culture and Media of the Republic of Serbia (2011). http://virtuelnimuzejdunava.rs/

Ecological Bulletins. Secretariat for Environmental Protection & Institute of Public Health of Belgrade.

Environment in the City of Belgrade 2010 (2011). Secretariat for Environmental Protection, Belgrade Institute of Public Health & Regional Environmental Center Serbia.

Environmental Atlas of Belgrade (2002). Belgrade Institute of Public Health & Belgrade Land Development Public Agency.

Environmental Impact Assessment Study Report on the Construction of the Ušće – Veliko Selo Interceptor, Tunnel Section from the Veliko Selo Pumping Station to Višnjica (2007). Belgrade Institute of Public Health.

Geotechnical report related to the foundation condition for the Usce Shopping Centre, Block 16, New Belgrade (2005). Kosovoprojekt-Geotehnika.

Guide to Bio Geo Diversity of Belgrade (2011). NGO “School for Survival”.

Institute for Nature Conservation of Serbia – http://www.natureprotection.org.rs/

Local Waste Management Plan for the City of Belgrade 2011-2020 (2011).

Petković, S., Dragović, N., Marković, S. (1999). Erosion and sedimentation problems in Serbia. Journal des Sciences Hydrologiques, 44(1).

Popovic, M. (1997) Ancient Singidunum: Discoveries and the possibilities of further research. *Singidunum* 1, Belgrade.

Preliminary Environmental Impact Assessment (PEIA) Study for the Feasibility Study and Preliminary Design (FS/PD) for Wastewater Treatment Plant (WWTP) Veliko Selo (2006). Sogreah Consultants, IK Consulting Engineers & Ehting.

Preparation Survey on the Sewerage System Improvement Project for the City of Belgrade Report (January 2013). TEC International Co. for the Japan International Cooperation Agency (JICA).

Statistical Yearbook of Belgrade – 2011 (2012). Institute for Informatics and Statistics.

Study of Belgrade's Groundwater Source: Status and Development Directions (2010). Jaroslav Černi Institute for the Development of Water Resources.

Wastewater Engineering – Treatment and Reuse (2004). Metcalf & Eddy.

INSTITUTE FOR HYDRAULIC AND ENVIRONMENTAL ENGINEERING

Telephone (011) 33-70-206
(011) 32-18-530
Fax (011) 33-70-206
E-mail: office@hikom.grf.bg.ac.rs

UNIVERSITY OF BELGRADE FACULTY OF CIVIL ENGINEERING

Bulevar kralja Aleksandra 73, Belgrade
Telephone (011) 32-18-553
Fax (011) 33-70-223

Client: TEC International Co., Ltd.

PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PREPARATORY SURVEY ON THE SEWERAGE SYSTEM IMPROVEMENT FOR THE CITY OF BELGRADE

VELIKO SELO WASTEWATER TREATMENT PLANT

Belgrade, March 2013

Client:	**TEC International Co., Ltd.** 3-7-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013 Japan
Facility:	Belgrade Sewerage System
Location of the Facility:	Belgrade, Serbia
Work Assignment:	**PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PREPARATORY SURVEY ON THE SEWERAGE SYSTEM IMPROVEMENT FOR THE CITY OF BELGRADE IN THE REPUBLIC OF SERBIA**
Assignment Manager:	Assist. Prof. Dr. Zorana Naunović
Authors:	Assist. Prof. Dr. Zorana Naunović, Environmental Engineer Assist. Prof. Dr. Nenad Jaćimović, Civil (Hydraulic) Engineer
Assignment Code:	43970
Date of completion:	March 2013

DIRECTOR OF THE INSTITUTE OF HYDRAULIC AND ENVIRONMENTAL ENGINEERING

Prof. Dr. Dušan Prodanović, CE

DEAN OF THE FACULTY OF CIVIL ENGINEERING

Prof. Dr. Dušan Najdanović, CE

Contents

List of Abbreviations iv
1 Executive Summary 5
2 Project Description 7
2.1 Alternatives for the Wastewater Treatment Process 15
2.2 Selection of the Sludge Treatment Process 17
2.3 The Chosen Design Option 19
3 Legal and Administrative Framework 21
3.1 Legal Framework 21
3.2 Administrative Framework 22
3.3 Environmental Impact Analysis Procedures 22
4 Baseline Data 24
4.1 Population, Topography, Bio-Geographical and Landscape Features 24
4.2 Geology 30
4.3 Soil Types and Quality 32
4.4 Soil Erosion 35
4.5 Meteorology 35
4.5.1 Air Temperature 35
4.5.2 Precipitation 36
4.5.3 Relative Humidity 37
4.5.4 Wind Speed 37
4.5.5 Insolation 39
4.6 Air Quality 39
4.7 Noise and Vibrations 41
4.8 Solid Waste Management 44
4.9 Wastewater Discharge 46
4.10 Surface Water and Sediment Quality 52
4.11 Hydrogeological situation 60
4.11.1 Characteristics of the WWTP Area 62
4.11.2 Groundwater quality 63
4.12 Hydrological Situation 63
4.12.1 River Regimes 63
4.12.2 The Danube River 64
4.12.3 The Sava River 65

4.12.4 Frequency Analysis of Flood Levels 66
4.13 Coastal Zone 68
4.14 Natural Environment 69
4.14.1 Protected Areas 69
4.14.2 Flora, Fauna and Biodiversity 71
4.15 Cultural Heritage 73
5 Analysis of With and Without the Project Scenario 75
6 Environmental Impacts 76
6.1 Construction Phase Impacts 76
6.1.1 Soil and Geographical Features (Landscape) 76
6.1.2 Microclimate Parameters 77
6.1.3 Global Warming 77
6.1.4 Air Pollution and Offensive Odors 77
6.1.5 Noise and Vibrations 77
6.1.6 Ground Subsidence 77
6.1.7 Solid Waste Management 80
6.1.8 Water Resources and River Sediments 80
6.1.9 Natural Environment 83
6.1.10 Cultural Heritage 83
6.1.11 Existing social infrastructures and services 83
6.2 Operation Phase Impacts 83
6.2.1 Soil and Geographical Features (Landscape) 83
6.2.2 Microclimate Parameters 83
6.2.3 Global Warming 84
6.2.4 Air Pollution and Offensive Odors 84
6.2.5 Noise and Vibrations 85
6.2.6 Ground Subsidence 85
6.2.7 Solid Waste Management 85
6.2.8 Sludge Management 85
6.2.9 Water Resources and River Sediment 86
6.2.10 Natural Environment 90
6.2.11 Cultural Heritage 90
6.2.12 Existing social infrastructures and services 90
7 Environmental Management Plan 91
8 List of References 95

8.1 Legislation 95
8.2 Guidelines 96
8.3 Plans and Strategies 97
8.4 General References 97

List of Abbreviations

A^2O	Anaerobic Anoxic Oxic Process
BOD_5	Five Day Biological Oxygen Demand
CAASP	Carrier added activated sludge process
cfu	colony forming unit
COD	Chemical Oxygen Demand
CSMP	Construction Site Management Plan
CSO	Combined Sewer Overflow
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
ELV	Emission Limit Value
EMP	Environment Management Plan
EU	European Union
HPP	Hydro Power Plant
JICA	Japan International Cooperation Agency
LV	Limit Value
m a.s.l.	meters above sea level
MAC	Maximum Allowable Concentration
MBT	Mechanical-Biological Treatment
MLSS	Mixed Liquor Suspended Solids
O&M	Operation & Maintenance
PAHs	Polycyclic Aromatic Hydrocarbons
PCCD/F	Poly-chlorinated dibenzo-dioxins and -furans
PE	Population Equivalent
PEIA	Preliminary Environmental Impact Assessment
PS	Pumping Station
FS/PD	Feasibility Study and Preliminary Design
PUC	Public Utility Company
RFD	Refuse Derived Fuel
RHSS	Republic Hydrometeorological Service of Serbia
SFNDP	Step feed type nitrification denitrification process with coagulant
SRB	Sava River Basin
SRT	Solids Retention Time
SVI	Sludge Volume Index
VOC	Volatile Organic Compound
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 Executive Summary

The current situation in Belgrade is that all wastewater generated in the city, domestic and industrial, is discharged into the Sava and Danube Rivers without prior treatment. The Sava and the Danube rivers represent the "heart" of the City, along whose riverbanks the City was founded and grew. The "riverside" life-style that Belgrade and its inhabitants are known for is becoming increasingly an unsustainable way of life, as the rivers are polluted. Moreover, the discharge of untreated wastewater from the city influences the water quality far downstream of Belgrade and consequently impacts aquatic life – the biodiversity and functionality of aquatic ecosystems.

In order to solve this problem, a "Master Plan of the Belgrade Sewerage System" was prepared in 2011 that is in conformity with "Master Plan of Belgrade 2021". The Sewerage System Master Plan elaborates on the sewerage system infrastructure defined in the "Master Plan of Belgrade 2021" and develops the detailed sewer system network and options for wastewater treatment.

The Government of Serbia requested the Japanese Government to extend a Japan International Cooperation Agency (JICA) Loan for a Sewerage System Improvement Project for the City of Belgrade. The scope of works of the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade" (hereinafter referred to as "the Project") is to implement a part of the Sewerage Master Plan and includes the analysis of the following facilities:

- Usce (Ušće in Serbian) and Mostar Pumping Stations (PS);
- Interceptors;
- Veliko Selo Wastewater Treatment Plant (WWTP);
- Sludge Treatment Facilities.

This Preliminary Environmental Impact Analysis (PEIA) Study Report will focus on the Veliko Selo WWTP and the Sludge Treatment Facilities, while another PEIA Study is also prepared for the Pumping Stations and the Interceptors.

This document summarizes analysis on several aspects of the PEIA:

- Description of the Proposed Project;
- Analysis of the Legal and Administrative Framework;
- Collection and Analysis of Baseline Environmental Data;
- Analysis of With and Without the Project Scenario;
- Identification and Prediction of Impacts;
- Mitigation Measures and Monitoring Plan.

The Republic of Serbia acceded to the International Commission for the Protection of the Danube River in August 2003 and promoted sewerage system development. The majority of measuring results indicated that the Belgrade waters do not satisfy the Class II requirements (good ecological status) and have a poor ecological status. The River Danube does not comply with the Class II requirements due to microbial pollution, which can infer to fecal contamination from raw wastewater discharges.

The proposed location of WWTP is often affected by floods. The preliminary design of the WWTP will have to carefully evaluate the minimum design level of the treated eluent outlet so as to avoid flooding of the wastewater treatment system. This will influence the WWTP hydraulic profile. Also, high groundwater levels must also be considered in defining the zero-level for the WWTP construction works.

The planned works will not influence the biological diversity of the area. It is foreseen that proper functioning of WWTP and reduction of pollution from Belgrade will have positive effects to all groups of aquatic biota.

With the implementation of the proposed Project works, the Republic of Serbia and the City of Belgrade will achieve a number of very important goals:

- The Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012) will be satisfied, which is a dual great benefit to Serbia – it will improve its water quality status in Belgrade and it will fulfill an environmental requirement set forward by the European Union. The Project will also lead to faster compliance with the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012).

- With the construction of the interceptors and the Veliko Selo WWTP, Belgrade's industries will be forced to comply with the wastewater effluent standards for discharge into the communal sewer system. These waters are currently discharged into the river waters untreated.

- Belgrade's drinking water sources (both surface and groundwater resources) are under the direct influence of the surface water quality; the improvement of the surface water quality will enhance the safety of the drinking water sources for the future.

- The further accumulation of pollutants in river bed sediments will be delayed.

- The City of Belgrade's waters will be healthier and this will improve the general standard of living for the city's inhabitants. The City beaches and bating waters will be safer to use due to the discontinuance of raw wastewater discharges in their vicinity. Aquatic habitats will also be improved.

- The tourist potential will be increased by developing different kinds of entertainment venues and tours on the rivers.

- The construction of the interceptors will free up large areas along the Sava and Danube River banks that outlets (e.g. at the location of Ada Huja). This will have a positive effect on surface water quality, riparian flora and the landscape in general. The rehabilitated spaces will be available for recreational and other activities.

2 Project Description

Due to negative anthropogenic impact, watercourses in Serbia are under the influence of three most significant pollution sources: communal wastewater, industrial wastewater and water runoff from agricultural areas. The most significant municipal pollution sources in Serbia include the Cities of Belgrade, Novi Sad and Nis (Niš in Serbian).

The area influenced by the Project includes the City of Belgrade and its wider metropolitan area (Figure 1). Belgrade (Beograd in Serbian) has a population of around 1.6 million (Census in Serbia 2011) and it is situated on the confluence of the Danube and Sava Rivers.

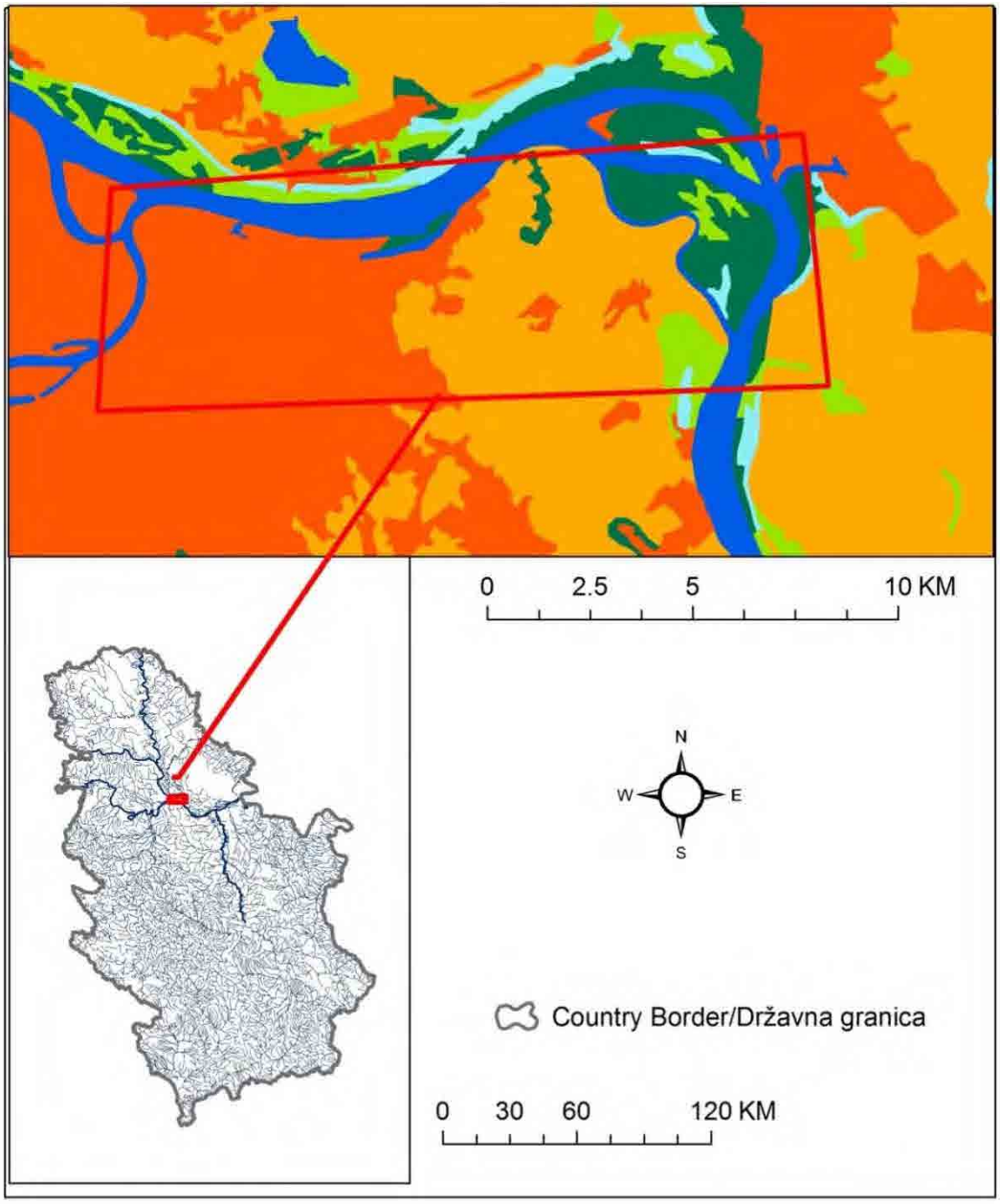


Figure 1. The area of project influence

The sewage system of the city does not have treatment facilities and the wastewater collected through the collection system is discharged directly to the Danube and Sava Rivers. The discharge of untreated wastewater significantly deteriorates the status of the two rivers. In addition, since the drinking water supply services for the City of Belgrade depend on surface water and groundwater sources, the discharge of untreated sewage may cause not only an increase in operation cost of the water treatment plants but also safety problems in terms of water quality of the drinking water in future.

The area that is the subject of this Preliminary Environmental Impact Assessment (PEIA) Study Report (hereinafter referred to as "the Report") includes urban areas.

The planned construction of Waste Water Treatment Plant (WWTP) and the interceptors will primarily contribute to the improvement of the status of the Danube and the Sava Rivers, not only in the narrow zone of Belgrade, but also in the downstream stretch. The improved river water quality will also influence the quality of drinking water, as the drinking water supply services for the City of Belgrade depend in part on surface water sources. The Vinca (Vinča in Serbian) surface water intake (from the River Danube) for drinking water production is located about 7 km downstream of the locality of building of WWTP.

The City of Belgrade was, together with the Cities of Budapest, Novi Sad and Bucharest, identified as one of the major sources of organic pollution along the Danube. In the last three years, the WWTP system of the City of Budapest has been significantly improved (Csepel system) and so the Cities of Belgrade, Bucharest and Novi Sad remain the main sources of organic pollution.

To illustrate the importance of the improvement of the status of the Danube and the Sava Rivers, a short description of the basin area is enclosed.

The Danube River Basin (Figure 2) covers an area of about 801,000 km^2 and it is shared by 19 countries in Central and South-Eastern Europe (Germany, Austria, Switzerland, Italy, Poland, the Czech Republic, Slovenia, Slovakia, Hungary, Croatia, Serbia, Romania, Bosnia and Herzegovina, Macedonia, Albania, Montenegro, Moldova, Bulgaria, and Ukraine). More than 83 million people inhabit the area. The total length of Serbian section of Danube is 587.5 km. The Danube River is important for the conservation of biological diversity of aquatic and riparian ecosystems.

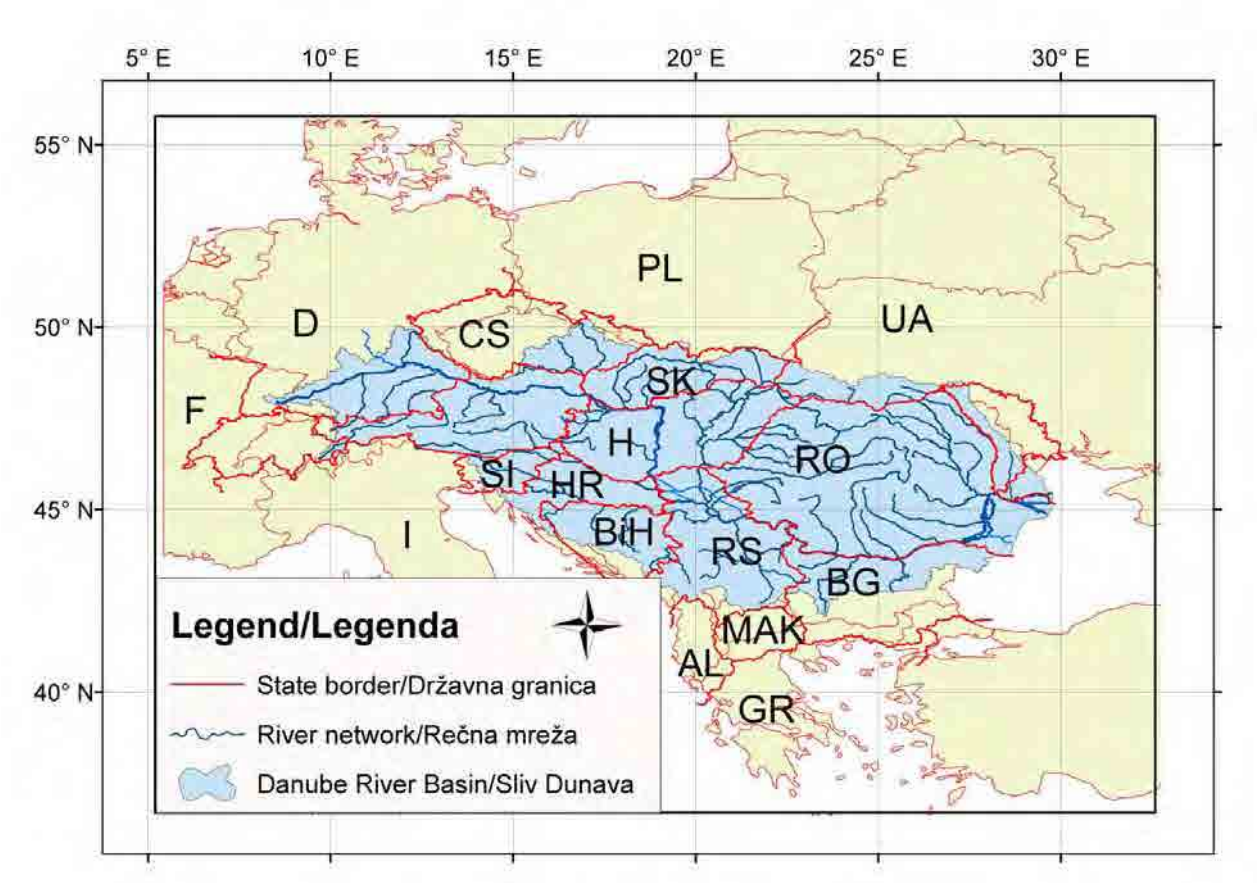


Figure 2. The Danube River Basin District

The Sava River Basin (SRB) covers an area of 95,719 km^2 and is situated in the southern part of the Danube Basin. Together with its tributaries, this 940 km long watercourse represents a mighty river system. The Sava flows from mountain region in Slovenia, throughout lowlands of Croatia, Bosnia and Herzegovina and Serbia, and confluences the Danube in Belgrade (river km 1171). According to the average discharge (1,513 m^3/s at the Sremska Mitrovica station, about 100 km from the confluence to the Danube), it is the largest tributary of the Danube. Further, by its catchment area, the Sava River is the second largest sub-basin of the Danube after the Tisa River Basin. The SRB is shared by Bosnia and Herzegovina (40.0% of the basin area), Croatia (26.0%), Serbia (15.4%), Slovenia (11.0%), Montenegro (7.5%), and Albania (0.1%). About 8.8 million people live in the basin. More than 50% of the Sava watercourse is navigable, from the mouth up to the Kupa confluence (Croatian section).

The elevation of the SRB ranges between 71 m above sea level (a.s.l.) at the mouth of the Sava River in Belgrade (Serbia) and 2,864 m a.s.l. (Triglav, Julian Alps in Slovenia), with a mean of 545 m a.s.l.

The SRB is heterogeneous concerning overall environmental conditions. Due to its geographic position, diverse climate, petrographic and pedological variety, and orographic characteristics, it is one of the most complex regions in Europe concerning the distribution of plants and animals.

The Government of Serbia formulated the “Spatial Plan of Republic of Serbia 2010 - 2020” as a state development plan. In accordance with this plan, the City of Belgrade prepared a city master plan with 2021 as the target, the “Master Plan of Belgrade 2021”.

A special strategic objective of the "Master Plan of Belgrade 2021" is the orientation of Belgrade towards the River Danube, which is one of two major transport corridors passing through Belgrade and Serbia. This orientation is reflected in the planning of various commercial, maritime, tourist, recreation and residential facilities along the banks of the River Danube in Belgrade. New initiatives listed in the Master Plan include area that will have a primarily tourist-character by the year 2021; these areas include:

- Belgrade Water Boulevards – the Sava and Danube Rivers, especially in the central city zone (with restaurants, cultural, sporting and entertainment events, and with the development of urban river taxis and passenger traffic);
- Transit nautical centers on the River Danube, with large marinas on the Danube River branches that are not on the Danube international transport route.

The two largest and most visited beaches in Belgrade are the Ada Ciganlija and the "Lido" beach located at the tip of the Great War Island (Veliko Ratno Ostrvo in Serbian). In Serbian the word "ada" refers to an isle or a river island. These islands were formed by the accumulation of sediment in the riverbeds of the Sava and Danube Rivers. In the area of the Belgrade Master Plan to 2021 there are several of these islands, all of which are important in preserving the quality of the environment:

- Great War Island on the River Danube (has the environmental protection status of a reserve and/or area of exceptional importance);
- Ada Ciganlija on the River Sava – a recreational area of the city (area recorded by the Institute for Nature Conservation of Serbia as an area with natural values);
- Ada Medjica on the River Sava – a recreational area of the city (area recorded by the Institute for Nature Conservation of Serbia as an area with natural values);
- Ada Huja on the River Danube – unfortunately, a part of the isle is industrialized, while the other part is an area with indigenous vegetation (evidenced by the size of the Institute for Nature Conservation of Serbia as an area with natural values). The Belgrade Master Plan 2021 includes plans for the revitalization of this isle.

It is possible to have an insight into whole territory of city of Belgrade thanks to BeoINFO application developed by the Urban Planning Institute of Belgrade. Maps generated using this application are presented in the figures below.

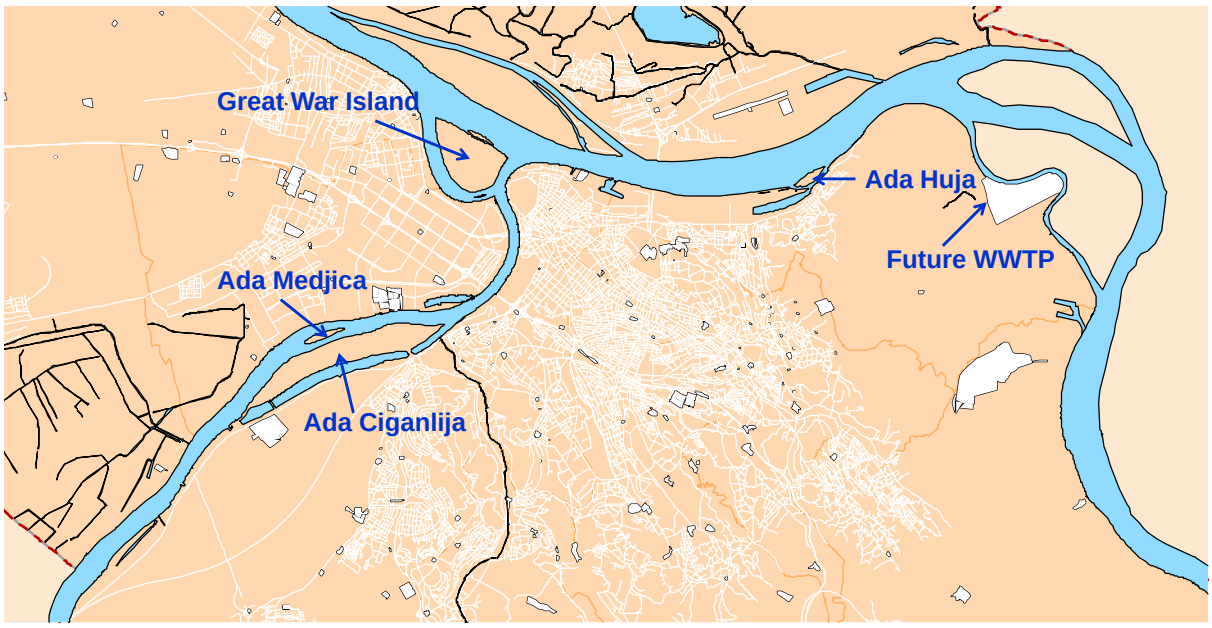


Figure 3. Map generated with the BeoINFO application showing the public utilities and infrastructure areas. The names of the river islands are also added.

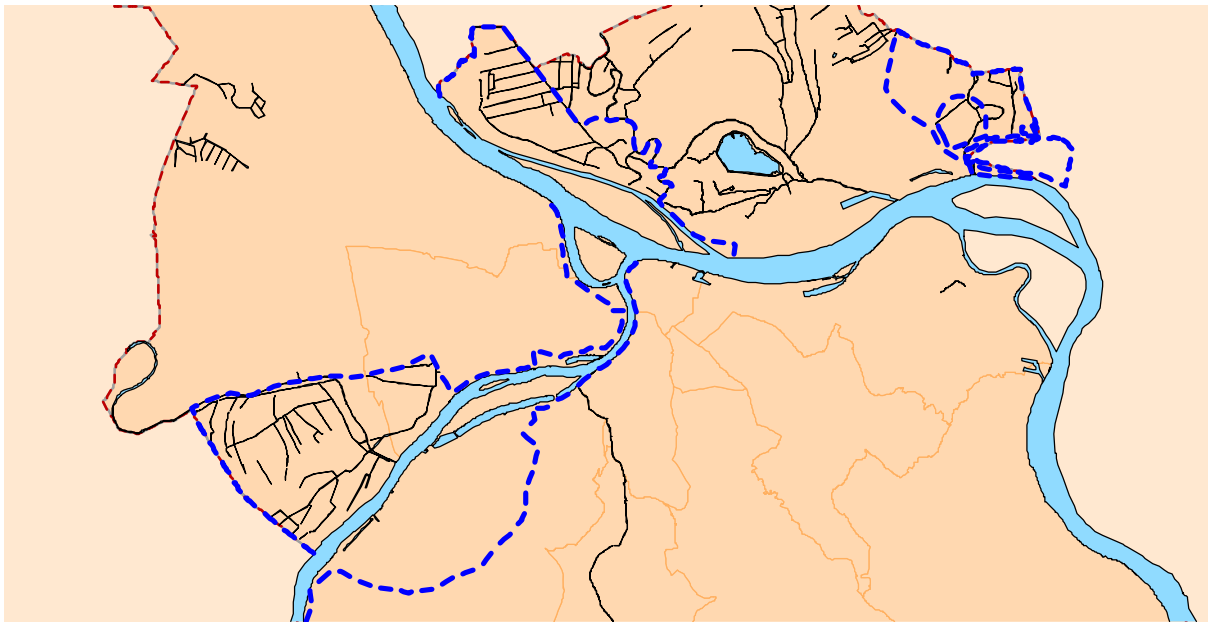


Figure 4. Map generated with the BeoINFO application showing the well protection zones that are used as drinking water sources in blue lines along the rivers in Belgrade

The "Master Plan of Belgrade 2021" contains information on the planned wastewater conveyance and treatment system, which is in line with the planned works described in the Project, as shown in the figure below. This Master Plan also describes the state of river water quality in Belgrade, as summarized in the following two paragraphs.

The waters of the Danube and the Sava Rivers convey pollution from settlements and industries located upstream of Belgrade, and are additionally burdened by the direct discharge of untreated domestic and industrial wastewaters in Belgrade. The deviations from the prescribed river water

quality in Belgrade are usually due to increased suspended material values and organic pollutants; these deviations are due to erosion processes in the river basins and the discharge of wastewater that is rich in organic content. Rivers that discharge into the Sava and the Danube Rivers are highly polluted as they receive domestic and industrial discharge of raw wastewater and their flows and the ability of self-purification is low. An example is the Topcider River (Topčiderska Reka in Serbian) which is a tributary to the Sava River.

The characteristics of the groundwater alluvial deposits are influenced by the quality of surface water, due to the direct hydraulic connection with the river bed watersheds. Moreover, due to the overlapping of the wellhead protection zones (drinking water protection areas) with the narrow coastal belt and the previously constructed roads, large indentation springs and collision with the city, there is an increasing risk of contamination of the groundwater resources.

The Technical Infrastructure Development priorities recognized in the City of Belgrade Development Strategy (2011) include the construction of a waste water treatment plant and the increase of sewerage network access to citizens through its continual development. Two of the priorities and required facilities and measures are listed below.

Priority 1: Protection of groundwater and surface water sources (the Sava River)

Required facilities and measures:
- Reconstruction of 8 sewerage pumping stations
- Interceptor Emergency Station (Hitna Pomoć) – Venizelosova Street
- Sewerage pumping stations Čukarica

Priority 2: Protection of the Danube river basin

Required facilities and measures:
- Reconstruction of 5 sewerage pumping stations
- Start-up of the interceptor from Karadjordjev Trg pumping station to Usce

Among the Strategic Priorities 2011-2016 of the Belgrade Development Strategy is Priority Project 6.10 – “Solving the issue of wastewater drainage as a part of improving general sanitary conditions of the City of Belgrade”. Project 6.10 is described with the following sentence: “The adverse situation in the area of wastewater drainage from the territory of the City must be solved through comprehensive long-term solutions which would treat waste water drainage as a part of improvement of general sanitary conditions of the City as a whole, with avoiding activities which result in harmful effects on the environment, reducing consumption of energy, reducing all forms of pollution, etc.”. The parties named responsible for the implementation of this project are the Belgrade Land Development Public Agency and the public utility company Belgrade Waterworks and Sewerage.

A “Master Plan of the Belgrade Sewerage System” was prepared in 2011 and is in conformity with “Master Plan of Belgrade 2021”. The Sewerage System Master Plan elaborates on the sewerage system infrastructure defined in the “Master Plan of Belgrade 2021” and develops the detailed sewer system network and options for wastewater treatment. Map of the wastewater system from the “Master Plan of Belgrade 2021” is shown in the figure below.

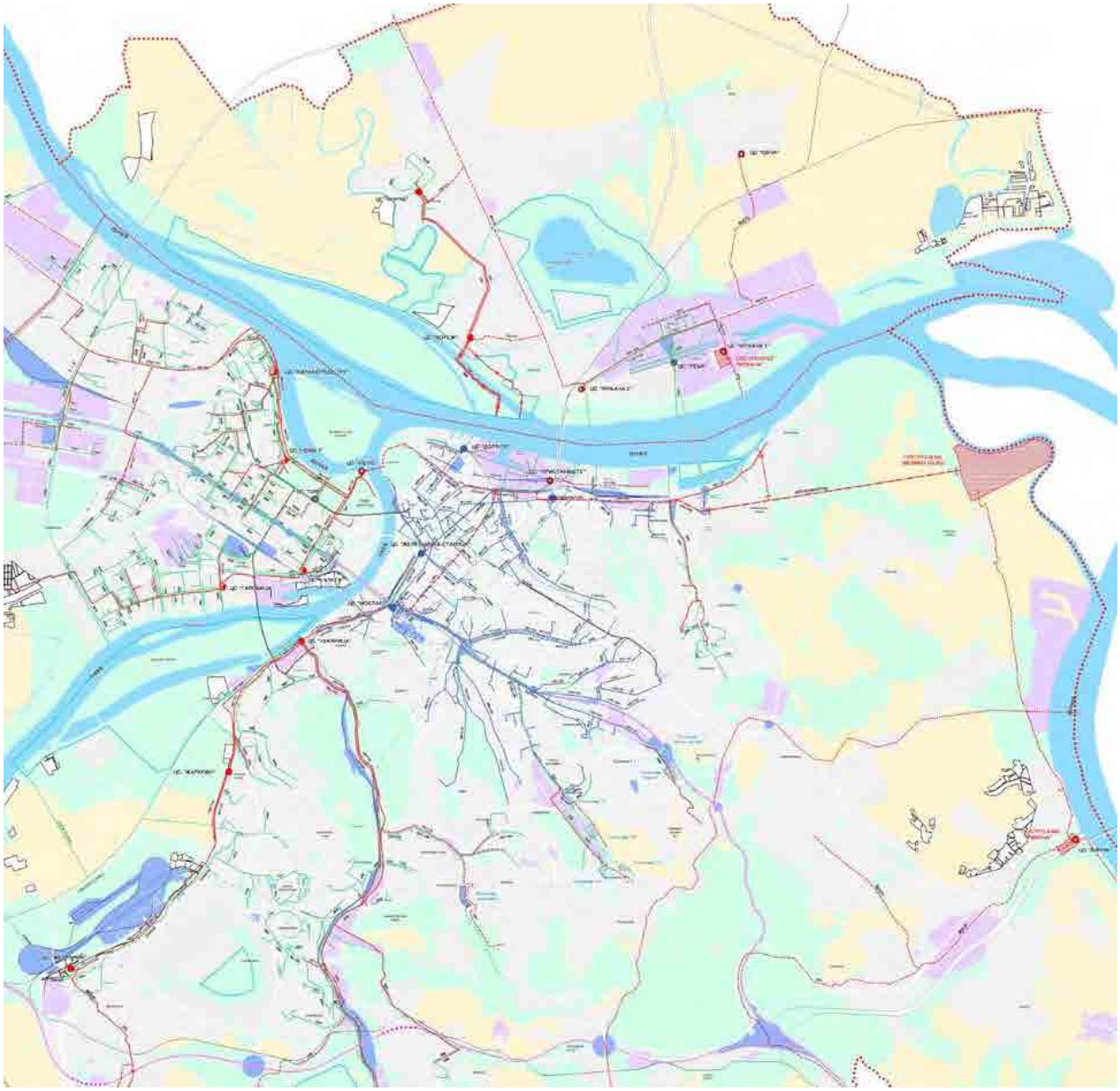


Figure 5. Map of the wastewater system from the "Master Plan of Belgrade 2021". The wastewater pipes, interceptors and the location of the WWTP are marked in red.

The Government of Serbia requested the Japanese Government to extend a Japan International Cooperation Agency (JICA) Loan for a Sewerage System Improvement Project for the City of Belgrade. The scope of works of the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade" (hereinafter referred to as the "Project") is to implement a part of the Sewerage Master Plan and includes the analysis of the facilities presented in the table below.

Table 1. The scope of works of the "Preparatory Survey on the Sewerage System Improvement Project for the City of Belgrade"

Facility	**Current Situation**
Usce pumping station (PS)	Existing Usce PS is of insufficient capacity to pump the wastewater from the entire Zemun and New Belgrade network across the Sava River. The new Usce PS will have a larger grit chamber and a different grit removal method than the existing PS. The

Facility	Current Situation
	existing Usce PS will be abandoned after construction of the new Usce PS. The new Usce PS will have a larger grit chamber and a different grit removal method than the existing PS. The existing Usce PS will be abandoned after construction of the new Usce PS.
Mostar pumping station (PS)	The existing Mostar PS has never been used since its construction. The building and the equipment of the PS need to be rehabilitated renovated and replaced in some parts.
Interceptors (Nos. 1 to 7 and 10 indicated in the figure below)	The named interceptors do not exist and are need to convey wastewater to the Veliko Selo WWTP.
Veliko Selo wastewater treatment plant (WWTP)	Untreated domestic and industrial wastewater is discharged directly into rivers in Belgrade. There is no WWTP.
Sludge Treatment Facilities	Untreated domestic and industrial wastewater is discharged directly into rivers in Belgrade. There is neither a WWTP nor any sludge treatment facilities.

These facilities are located in Central System in Belgrade Sewerage Master Plan as shown in Figure 5 and Figure 6. This Preliminary Environmental Impact Analysis (PEIA) Study Report will focus on the Pumping Stations and the Interceptors, while a separate PEIA Study is prepared for the Veliko Selo WWTP and the Sludge Treatment Facilities.

As the locations of the PSs, the Interceptor routes and the WWTP were already defined in the "Master Plan of Belgrade to 2021" and the "Master Plan of the Belgrade Sewerage System to 2021", the Project focused on the design of the WWTP.

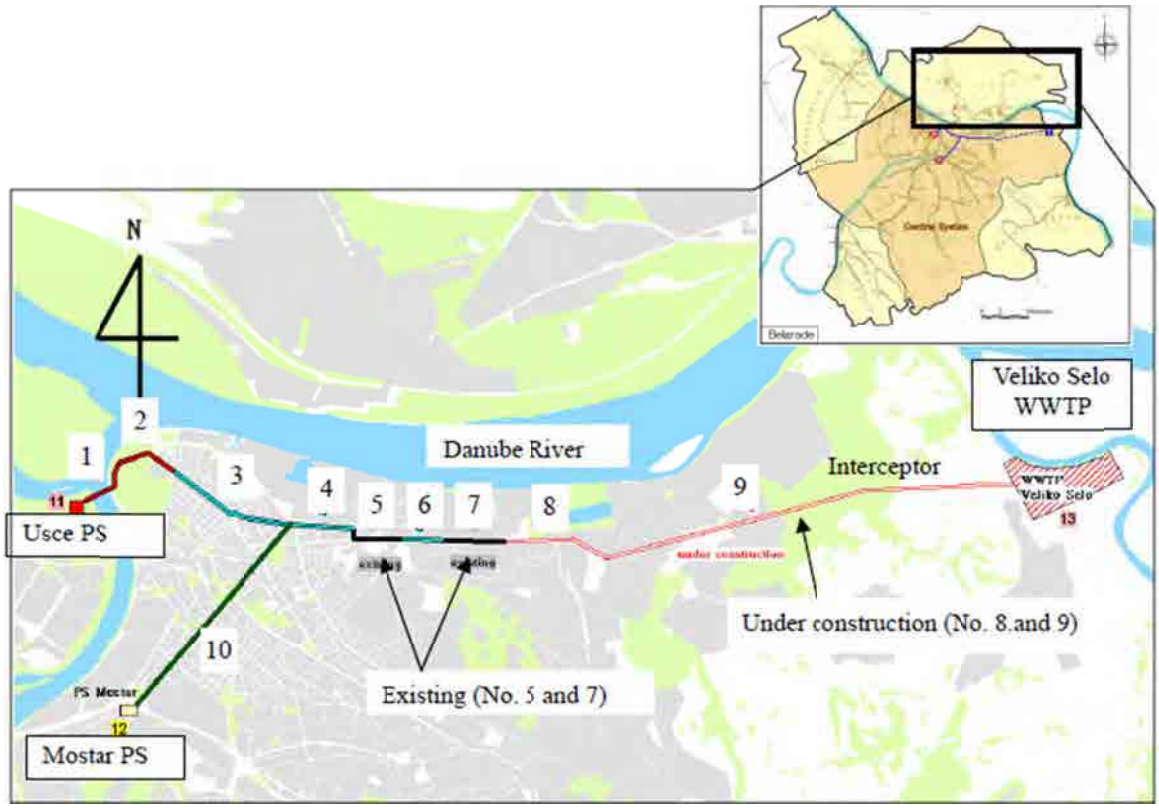


Figure 6. Facilities covered by the Project

WWTP design alternatives were compared by project evaluation factors, such as performance, project cost, environmental/social impacts, energy-saving risk, etc. All alternatives had to fulfill the same requirement – the treated wastewater effluent emission limit values (ELV) prescribed by the Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012), as presented in the table below.

Table 2. Treated wastewater effluent emission limit values (ELV) prescribed by the Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012)

Parameter	**ELV**	**The lowest reduction percentage** (I)
a) ELV on the secondary treatment stage		
BOD (II,VI,VII)	25 mg/L O_2 40 mg/L O_2 (III)	70 – 90
COD (VI)	125 mg/L O2	75
Total suspended solids (IV, VIII)	35 mg/L (more than 10,000 PE) 60 mg/L (2,000 to 10,000 PE)	90 70
b) ELV on the tertiary treatment stage		
Total P	2 mg/L P (10,000 to 100,000 PE) 1 mg/L P (more than 100,000 PE)	80
Total N (V)	15 mg/L N (10,000 to 100,000 PE) 10 mg/L N (more than 100,000 PE)	70 – 80

(Bottom notes are omitted)

The WWTP will be constructed in phases, following the increase of inflow over time.

2.1 Alternatives for the Wastewater Treatment Process

Alternative processes that were chosen for comparison in the Project were the:

- Anaerobic anoxic oxic process (A^2O)
- Step feed type nitrification denitrification process with coagulant (SFNDP)
- Carrier added activated sludge process (CAASP)

The alternatives were compared according to financial aspects including the initial investment, O&M cost and major replacement cost. Environmental and social aspects were also studied and each process had both advantages and disadvantages such as amount of generated sludge and energy consumption.

- The A^2O process generates less sludge than the other processes, while the energy consumption is high;
- The SFNDP process generates more sludge than the A^2O process, while the energy consumption is lower than for the other treatment options;
- The CAASP process generates more sludge than the A^2O process and the energy consumption is high.

As a result of comparison, the step feed type nitrification denitrification process (SFNDP) is recommended due to the following advantages:

- Operation of SFNDP is easier since all stages of tanks can be operated with the same conditions due to equalization of pollutant loading against solids content;
- High removal efficiency of nitrogen is achieved without internal circulation that is needed in the A^2O process;
- Stable removal efficiency of phosphorous is achieved comparing to the other processes owing to the physical-chemical aspect of the process;
- Operation of A^2O has difficulty to maintain the balance of microbes for removing nitrogen and phosphorous at the same time;
- Phosphorous removed by biological process will be easily discharged again in anaerobic digestion;
- A^2O has difficulty to satisfy effluent standard of nitrogen considering contribution of nitrogen from digestion process due to limitation of circulation ratio;
- Initial investment of SFNDP is the least owing to less hydraulic retention time comparing to A^2O;
- SFNDP is the most economical in terms of Net Present Value.

Alternatives for the Filtration Process (Tertiary Treatment)

To achieve the prescribed effluent quality standards and to have better adaptation flexibility to future potential more stringent effluent regulations or worsening of the wastewater influent quality, a tertiary treatment step is planned in the form of a filtrations process. Three filtration alternatives were evaluated:

- Sand filtration
- Fiber filtration
- Disc filtration

From the environmental standpoint, the difference in the three proposed alternatives is the consumption energy during the filtration process. The energy consumed for filtration using the disk filter system is lower than the energy consumed with sand and fiber filtration.

As a result of comparison, the disc filter is recommended due to the following advantages:

- Intermediate pumps can be omitted due to low head loss required for filtration and power consumption is less comparing to the other filtration;
- Initial investment of disc filter is the least since disc filter can be installed in the channel and does not required major concrete structures;

- Stage development of tertiary treatment is easy since the prior investment for channels in which disc filter will be installed is minor;
- Disc filter is the most economical in terms of Net Present Value.

Alternatives for the Aeration Equipment

Alternative aeration technologies that were chosen for comparison in the Project were:

- Fine bubble diffuser (Option 1)
- Ultrafine bubble diffuser (Option 2)
- Submersible aeration devices (Option 3)

From the environmental standpoint, the difference in the three proposed alternatives is the emissions of greenhouse gas:

- Option 1: Emission of greenhouse gas is more than for Option 2 due to lower process efficiency;
- Option 2: Emission of greenhouse gas is the lowest of all the options as energy consumption is the least owing to high oxygen transfer efficiency;
- Option 3: Emission of greenhouse gas is the most since the total energy consumption including blowers and aeration devices is the most.

As a result of comparison, an ultrafine bubble diffuser device is recommended due to the following advantages:

- It is most effective in terms of energy saving due to its high efficiency of dissolving oxygen;
- It can be utilized for relatively longer time due to its non-clogging feature by adequate operation;
- It has high level of flexibility for various operations due to its feature of wide operational range of air flow;
- It is the most economical in terms of life cycle cost since it requires the lowest O&M cost due to its high efficiency.

2.2 Selection of the Sludge Treatment Process

In the 2021 Master Plan, application of the following processes was studied from the viewpoints of process complexity, sludge handling, energy utilization, sludge disposal and adverse environmental impacts:

- Thickening process of primary and secondary sludge;
- Anaerobic digestion process for sludge stabilization;
- Biogas utilization as power production and heat energy;

- Incineration process of dewatered sludge.

As the results of alternative comparisons, the process comprised of thickening, anaerobic digestion with biogas utilization and mechanical dewatering is adopted for sludge treatment process of Veliko Selo WWTP.

A new Regulation on the Conditions and the Procedure of Obtaining the Status of Privileged Electric Power Producers has been adopted in January 2013. This Regulation includes gas generated by anaerobic processes at wastewater treatment facilities as a renewable energy source. The Regulation on Incentives for Privileged Electric Power Producers (2013) gives the incentive purchase price of 6.91 euro cents per kWh of electric energy generated from WWTP digestion gas.

These new regulations open up possibilities of implementing the utilization of digestion gas through a co-generation system that generates electricity and utilizes recovered heat for warming of the digesters (Figure 7). However, under the same legislation, products originating from wastewater are not considered as biomass, so no benefits can be obtained for generating energy from WWTP sludge.

Article 15 of the Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012) states that wastewater treatment residues may be used in the agriculture or other purposes (e.g. covering landfill or landscaping) if the ELV presented in Table 3 are fulfilled. Before use, the residues have to be treated to reduce the number of pathogens and their properties need to be adjusted depending on their further use. Treatment of wastewater treatment residues is according to the waste legislation.

Table 3. ELV for wastewater treatment residues

Parameter	Unit	ELV	
		Agriculture use	Other use
Non-organic matter			
Pb	mg/kg	120	1,200
Cd	mg/kg	2.5	40
Cr	mg/kg	100	1,000
Ni	mg/kg	60	400
Hg	mg/kg	1.6	25
Cu	mg/kg	700	1,750
Zn	mg/kg	1,500	4,000
As	mg/kg	15	75
Organic matter			
Adsorbing organic halogens	mg/kg	400	500
PCB	mg/kg	0.1 (per congener)	0.2 (per congener)
PCCD/F	ng/kg of dry residue	30	30
Pathogens			
Salmonella	(most probable number) /10g of dry residue	0-10	
Enterovirus	(most probable cytophatic number) /10g of dry residue	3	

(Bottom notes are omitted)

As presented in the "Local Waste Management Plan for the City of Belgrade 2011-2020" (2011), future developments at the Vinca landfill site include the construction of a Mechanical-Biological Treatment (MBT) facility and a heat and electricity co-generation facility. The refuse derived fuel

(RDF) that is separated out of the input waste stream by MBT will be used as fuel in the co-generation facility. Dried WWTP sludge will also be used as fuel in the co-generation facility at the landfill site.

The problem is that currently the Vinca municipal landfill is a non-engineered landfill without the necessary environmental protection measures (described in Chapter 4.8). The City of Belgrade is searching for financial assistance to conduct a feasibility study for to move ahead with its waste management plan.

If the WWTP is put into operation before the waste management plans are achieved, the only option for sludge management is disposal at the existing Vinca municipal landfill.

The current Project also involved the assessment of introducing energy utilization technologies. It was concluded that power generation using digestion gas process would be included in the preliminary design, but introduction of sludge fuelization process would be postponed for future plans.

2.3 The Chosen Design Option

The chosen wastewater treatment design option includes a step feed type nitrification denitrification process (SFNDP) using an ultrafine bubble diffuser device, with disc filtration as the tertiary treatment option.

For sludge treatment, the process comprised of thickening, anaerobic digestion with biogas utilization and mechanical dewatering is adopted, using the screw press dewatering machine.

Schematic flow of the Veliko Selo optimized wastewater and sludge treatment processes are shown in Figure 7. The zoning of the facilities and the general layout plan of the Veliko Selo WWTP are shown in Figure 8 and Figure 9, respectively.

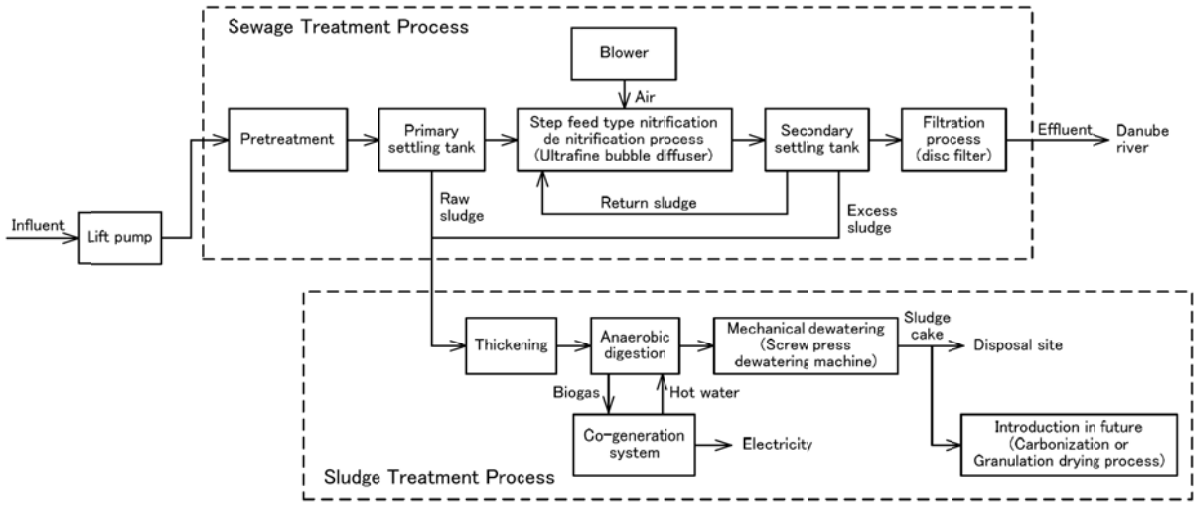


Figure 7. Schematic flow of the Veliko Selo wastewater and sludge treatment processes

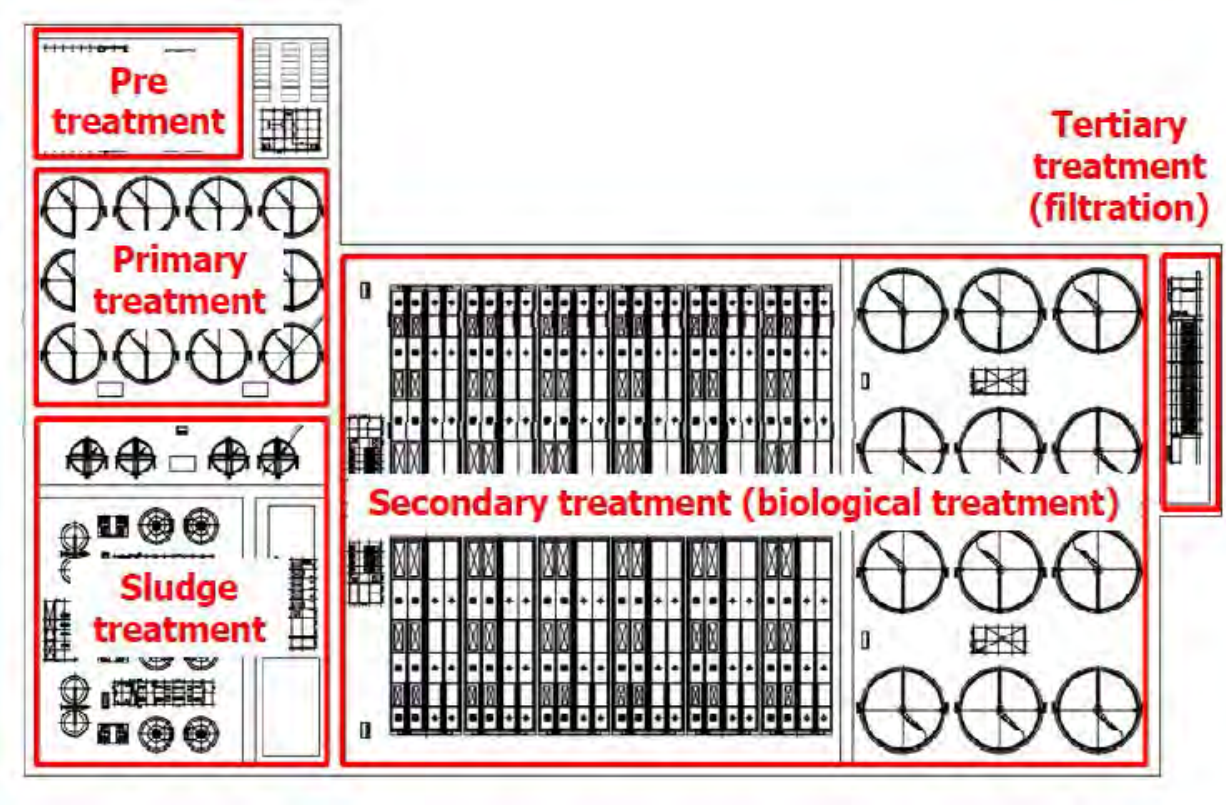


Figure 8. Zoning of the Veliko Selo WWTP facilities

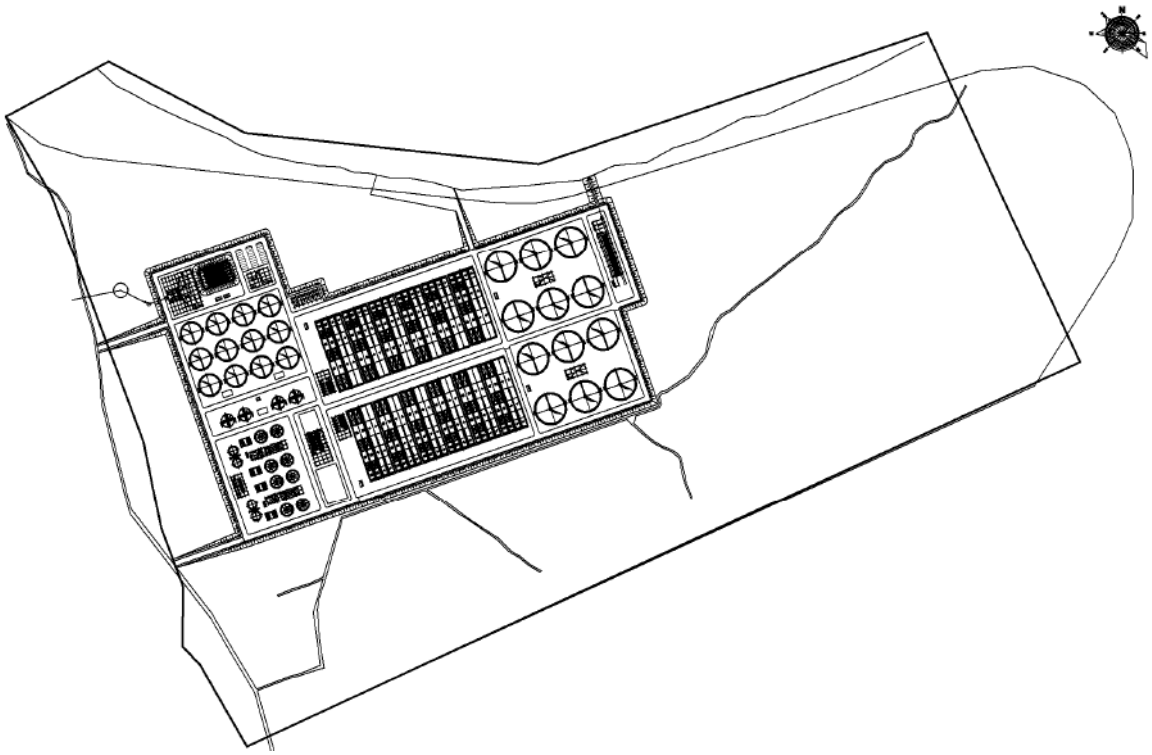


Figure 9. General layout of the Veliko Selo WWTP

3 Legal and Administrative Framework

3.1 Legal Framework

This Preliminary Environmental Impact Assessment (PEIA) Report was prepared in accordance with the relevant laws and by-laws of the Republic of Serbia, including:

- Law on Air Protection (2009) and relevant by-laws:
  - Regulation on air monitoring conditions and air quality requirements (2010)
  - Regulation on the air pollutants emission limit values (2010 & 2011)
- Law on Environmental Impact Assessment (2004 & 2009) and relevant by-laws:
  - Rulebook on the Contents of Requests for the Necessity of Impact Assessment and on the Contents of Requests for Specification of Scope and Contents of the Environmental Impact Assessment Study (2005)
  - Rulebook on the Contents of the Environmental Impact Assessment Study (2005)
  - Rulebook on the Procedure of Public Inspection, Presentation and Public Consultation about the Environmental Impact Assessment Study (2005)
- Law on Environmental Protection (2004 & 2009)
- Law on Planning and Construction (2009 & 2001)
- Law on Protection against Noise in the Environment (2009 & 2010) and relevant by-laws:
  - Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010)
- Waste Management Law (2009 & 2010) and relevant by-laws:
  - Regulation on Disposal of Waste in Landfills (2010)
- Water Law (2010) and relevant by-laws:
  - Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012)
  - Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater (2011)
  - Regulation on the Limit Values of Priority and Priority Hazardous Substances that Pollute Surface Waters and the Deadlines for Compliance with the Limit Values (2011)
  - Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012)

The full list of relevant regulative for the PEIA Report is listed in the References Chapter of the Report.

The methodology applied in the Report meets the requirements of the “Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations” (2002) as well as “JICA Guidelines for Environmental and Social Considerations” (2010).

3.2 Administrative Framework

The Ministry of Energy, Development and Environmental Protection of the Republic of Serbia is the governing body in regards to performing Environmental Impact Analyses and submitting the subsequent reports. It is also responsible for environmental protection and environmental inspection.

The Serbian Environmental Protection Agency of the Ministry of Energy, Development and Environmental Protection is in charge for development, harmonization and management of the national information system; monitoring of the air and water quality, management of National Laboratory, collecting and processing environmental data, data processing procedures development, coordination and cooperation with European Environmental Protection Agency and European Information and Observation Network as well as other duties determined by the Serbian legislation.

The Republic Directorate for Water of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia is responsible for water use and protection, for the conception and implementation of an integrated national policy related to water resources, including the policy of international cooperation. The issue of water related financial investments and tariffs is subject of the work of the Ministry of Agriculture, Forestry and Water Management – Directorate for Water.

In Belgrade, the City Assembly of Belgrade Secretariat for Environmental Protection performs assignments related to promotion and protection of the environment in seventeen municipalities of the City. These include inspection and surveillance over the application of and adherence to the regulations and other legal provisions in the area of environmental protection: nature, air, noise, waste management, chemical management, etc. Regular control of the quality of the environment is performed by authorized, accredited facilities: the Institute of Public Health of Belgrade, the Hydro-meteorological Service of Serbia, the Serbian Institute of Public Health "Dr. Milan Jovanovic-Batut" and the Institute of Occupational Health of Serbia "Dr. Dragomir Karajovic", in accordance with the Law on Environmental Protection. The monitoring reports are submitted to the Secretariat for the Environment.

The environmental monitoring results are published monthly in Environmental Bulletins and an annual publication on environmental data is published jointly by the Secretariat for the Environment, the Belgrade Institute of Public Health and the Regional Environmental Center Serbia. The most recent available publication is the "Environment in the City of Belgrade 2010".

3.3 Environmental Impact Analysis Procedures

Under Serbian regulations and the "Law on Environmental Impact Assessment" (2004 & 2009), an Environmental Impact Assessment (EIA) is conducted at the Preliminary Design stage of a project. At this stage, the project manager submits a request to the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia to determine the necessity of an environmental impact assessment for the project in question, according to the "Rulebook on the Contents of Requests for the Necessity of Impact Assessment and on the Contents of Requests for Specification of Scope and Contents of the Environmental Impact Assessment Study" (2005).

The "Regulation on Establishing the List of Projects for which the Environmental Impact Assessment is Mandatory and the List of Projects for which the Environmental Impact Assessment can be requested" (2008) includes two lists:

- List I - Projects which require an environmental impact assessment

- List II - Projects which may require environmental impact assessment

According to the above mentioned Regulation, an environmental impact assessment is mandatory for a ***wastewater treatment facility project for settlements of over 100,000 people*** and is included in List I of the Regulation.

List II includes projects are projects for ***wastewater transport pipeline over 10 km***; the interceptor which is included in this Project is around 7 km in length and an EIA may not be required. A request to the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia for determination of the necessity of an environmental impact assessment must be submitted.

If Ministry of Energy, Development and Environmental Protection of the Republic of Serbia deems an EIA necessary, it would on provide the required scope and contents of the EIA that are usually aligned with the "Rulebook on the Contents of the Environmental Impact Assessment Study" (2005). Once completed, the EIA Study Report becomes available to the public and a public hearing is organized with the participant of stakeholders and interested parties, according to the "Rulebook on the Procedure of Public Inspection, Presentation and Public Consultation about the Environmental Impact Assessment Study" (2005). Once the public hearing and review process have been completed, a technical committee named by the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia decides upon the approval or disapproval of the environmental impact assessment report, according the "Rulebook on the Work of the Technical Committee for the Environmental Impact Assessment Study" (2005).

As a summary, an EIA is not required by Serbian law for the project titled "Preparatory Survey on the Sewerage System Improvements for the City of Belgrade". However, conducting a preliminary environmental impact assessment at the preparatory stage of this Project allows for environment and social considerations to be included at the earliest stage possible.

At the project preliminary design stage, the List of Conditions (terms and opinions in literal translation from Serbian) are also required and requested from relevant national and local institutions whenever proposed work may affect environmentally sensitive resources, including waterways, wetland resource areas, habitats of rare or endangered species, historic and archaeological sites, or in cleaning up hazardous waste or discharges of pollutants to waterways. These conditions opinions are requested by the project owner. The project preliminary design report in then prepared so that it respects and obliges to the set conditions. These terms and opinions may include:

- Decision on the Protection Requirements from the Institute for Nature Conservation of Serbia;
- Decision on the Issuance of Water Conditions from the Directorate for Water of the Ministry of Agriculture, Forestry and Water Management;
- Decision on Technical Protection Measures from the Belgrade City Institute for Protection of Cultural Monuments and/or the Republic Institute for Protection of Cultural Monuments;
- Conditions for the Preparation of Technical Documentation from the local Power Distribution Company.

4 Baseline Data

In this Chapter, the most recent available baseline data is presented for the Belgrade metropolitan area that is relevant to the Project.

In Belgrade, environmental monitoring is carried out according to the programs of the City of Belgrade Secretariat for Environment Protection. These programs define the frequency, locations and procedures for monitoring of air, water and soil quality, as well as the level of communal noise. Measurements are entrusted to expert and science institutions, such as the Institute of Public Health Belgrade and the Institute of Public Health of Serbia "Dr. Milan Jovanović - Batut".

The Belgrade Secretariat for Environment Protection publishes the monitoring results in monthly "Ecological Bulletins" (air and water quality data only) and the annual "Environment in the City of Belgrade" publications (published jointly by the Secretariat for Environmental Protection, the Institute of Public Health of Belgrade, and the Regional Environmental Center Serbia).

Among other references used in this Report were data from the:

- Statistical Yearbook of Belgrade – 2011 (Institute for Informatics and Statistics);
- Guide to Bio Geo Diversity of Belgrade (2011);
- Institute for Nature Conservation of Serbia;
- Belgrade Fortress Public Enterprise;
- Maps from the Environmental Atlas of Belgrade, developed by the Belgrade Institute of Public Health and the Belgrade Land Development Public Agency in 2002.

4.1 Population, Topography, Bio-Geographical and Landscape Features

The territory of Belgrade covers an area of 322.268 ha (inner-city area covers 35.996 ha), and it is administratively divided into 17 municipalities - 10 urban municipalities (Čukarica, Voždovac, Vračar, Novi Beograd, Palilula, Rakovica, Savski venac, Stari grad, Zemun, Zvezdara) and 7 suburban municipalities (Barajevo, Grocka, Lazarevac, Obrenovac, Mladenovac, Sopot, Surčin). The map of the territory along with the municipality names is presented in the figure below.

According to official results from the 2011 Census, Belgrade has a population of 1,154,589 within the city center and 1,639,121 in the entire City of Belgrade area.

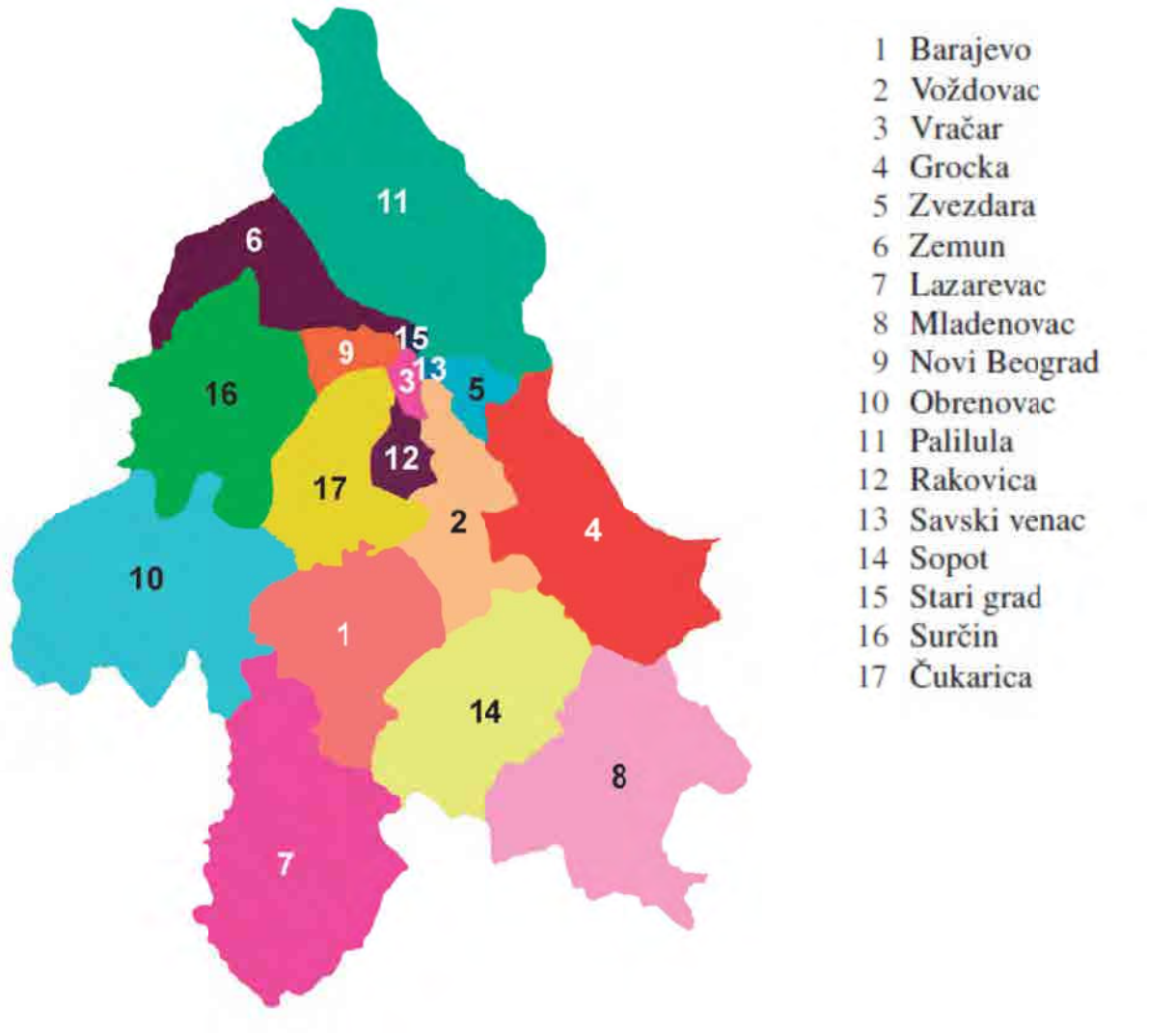


Figure 10. The territory of Belgrade, with the municipality names (Source: Belgrade in Figures, 2012)

Belgrade's surroundings consist of two different natural systems: the Pannonian depression to the north, covered with wheat and corn, and Šumadija, with orchards and vineyards, south of the rivers Sava and Danube. The highest relief forms in Šumadija hillside are Kosmaj (628 m) and Avala (511 m). Starting from south, the terrain gradually descends to the north, in shapes of wide plateaus, sectioned by stream and river valleys. High plasticity of Belgrade relief, south of the rivers Sava and Danube, makes the city spread over many hills (Banovo, Lekino, Topčidersko, Kanarevo, Julino, Petlovo, Zvezdara, Vračar, Dedinje). North from the rivers Sava and Danube there are alluvial plains and loessial plateaus, which are divided by a steep section, up to 30 m high. New Belgrade is situated on the left bank of Sava, beneath a loessial plateau (Bežanijska kosa), and Zemun is situated on the right bank of Danube, beneath a loessial plateau.

The highest point of inner-city area of Belgrade, is at Torlak (Voždovac), being the Holy Trinity Church at 303.1 m, while the lowest point is on Ada Huja (river island) at 70.15 m. The highest point of the larger-city area is on the Kosmaj Mountain (Mladenovac) at 628 m. The absolute altitude of the Meteorological Observatory - 132 m - is considered the average altitude of Belgrade.

The Danube flows through 60 km of Belgrade area, from Stari Banovci to Grocka, while the Sava covers 30 km from Obrenovac to its intake. The length of river banks of Belgrade is 200 km. There are 16 river islands in that area, and the best known of them are Ada Ciganlija, Veliko ratno ostrvo and Gročanska ada.

The project area is situated within the biome of South European deciduous forests in lowland and inundated areas. The biom is characterized by potential vegetation of *Genisto-Quercetum roboris*, *Carpino-Quercetum roboris* and *Salici-Populetum*.

In regards to land use, the area of Belgrade could be characterized as heterogeneous. Residential and industrial areas are presented in Figure 11, while green areas and agricultural land are shown in Figure 12.

Figure 13 and Figure 14 show the micro-location features of the WWTP site.

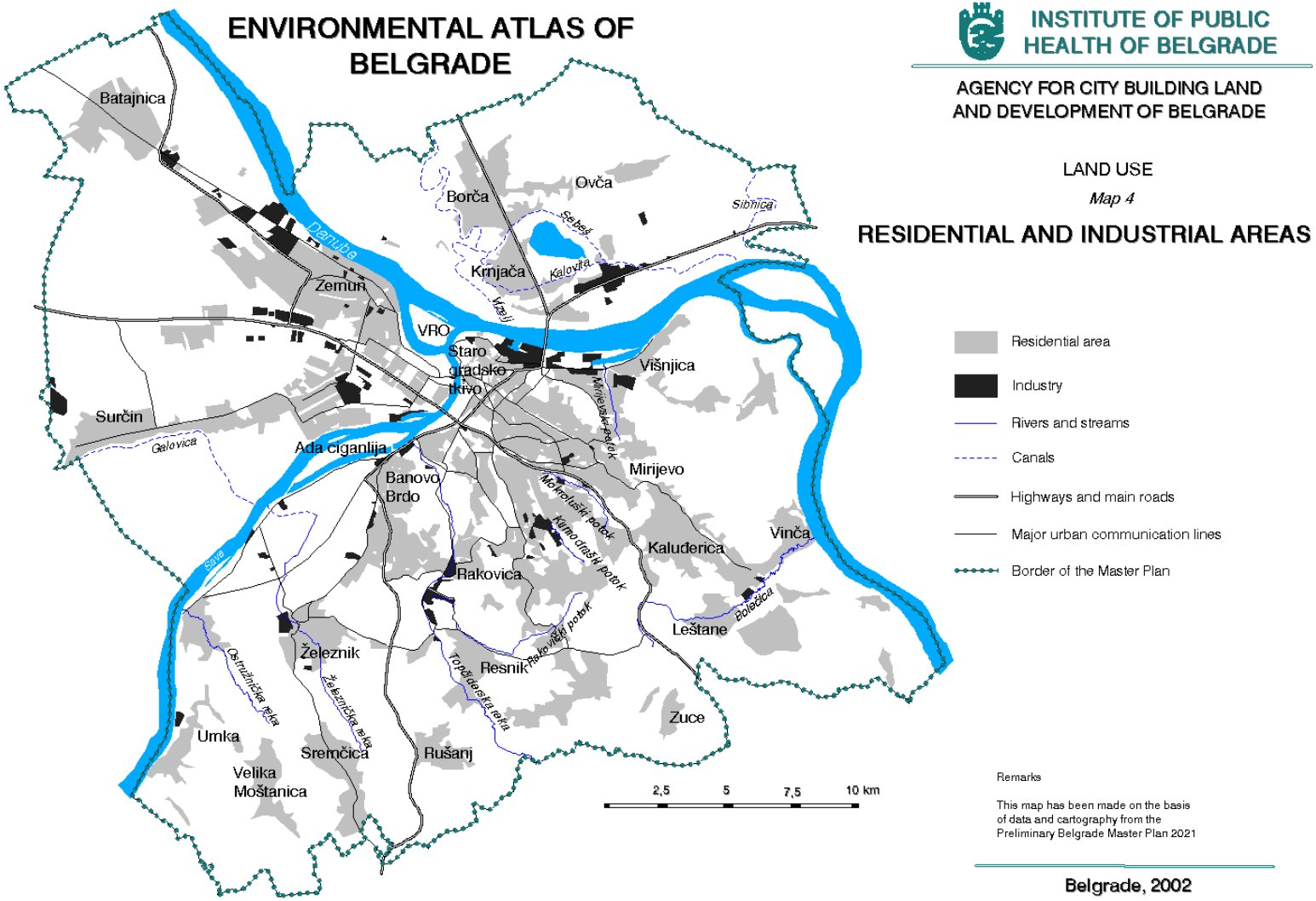


Figure 11. Residential and industrial areas in Belgrade

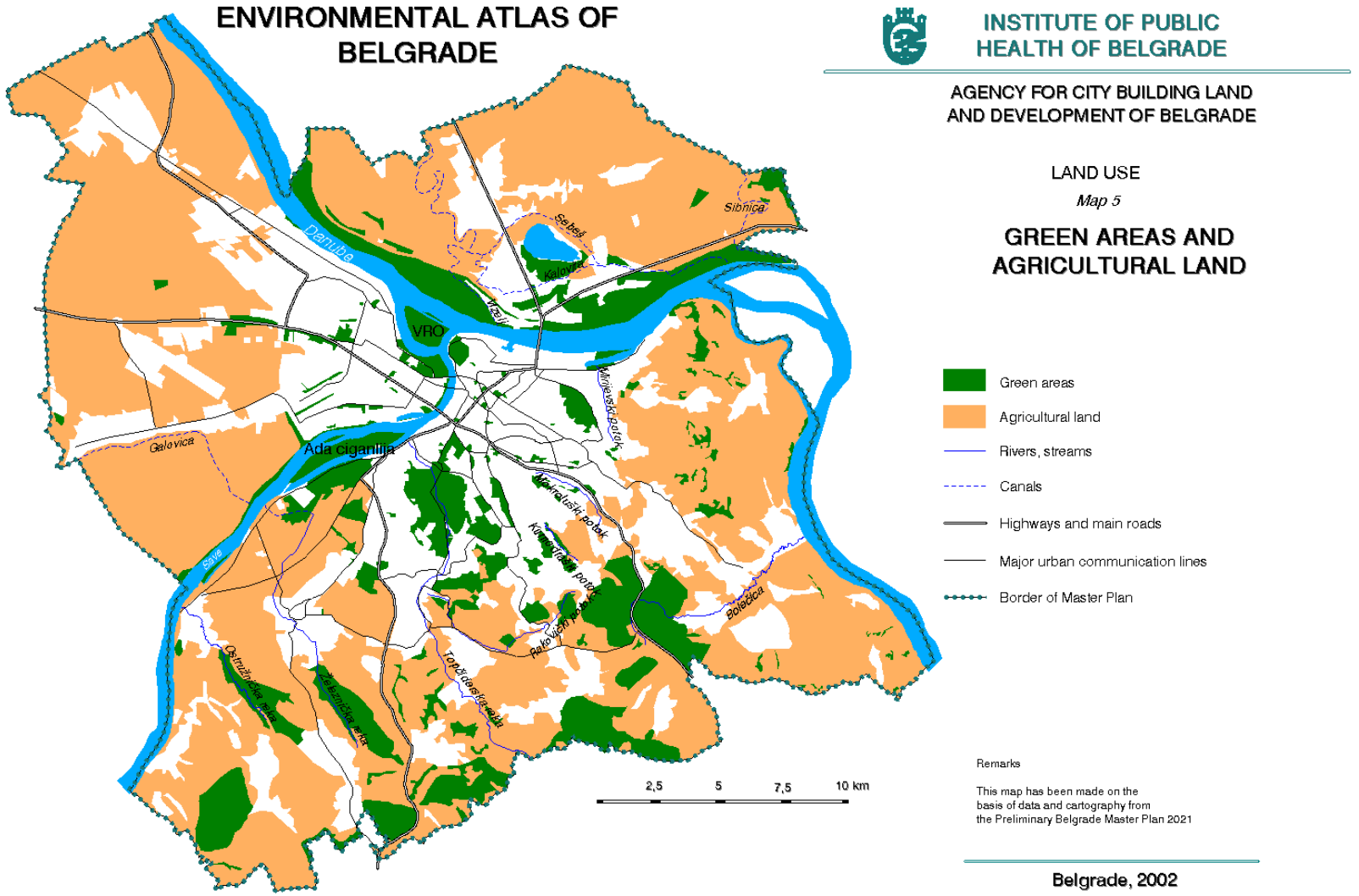


Figure 12. Green areas and agricultural land in Belgrade

Figure 13. An aerial view of the location of the future WWTP in relation to the village of Veliko Selo

Figure 14. An aerial shot of the location of the WWTP. The silver areas are the interceptor building plateau and the silver/ brown/ blue areas are deposits of excavated materials from the interceptor tunnel.

Veliko Selo is located at the right bank of the Danube River where the river is divided into three channels and where four islands are formed: Forkontumac, Čakljanac, Stefanec and Donja Ada. One of the channels is the Danube river side arm – Dunavac, which flows along the river banks where the future WWTP will be located.

Figure 15. The Danube River side arm (Dunavac) by the WWTP location (shown in the downstream direction). The width of the Dunavac is about 150 m.

The Veliko Selo village is located about 1 km from the Project site. Veliko Selo is agricultural, with about 80% of the territory being used for vegetable growing.

4.2 Geology

This region is characterized by a great heterogeneity of geological substrate with respect to both the age and lithological composition of rocks. Cenozoic (Quaternary) fluvial lacustrine sediments, loess deposits and deluvial formations dominate in the Project area. The geological variations are shown in the figure below.

Looking at the map below, one can see that the land where the future WWTP will be was formed by the Danube River alluvial deposits.

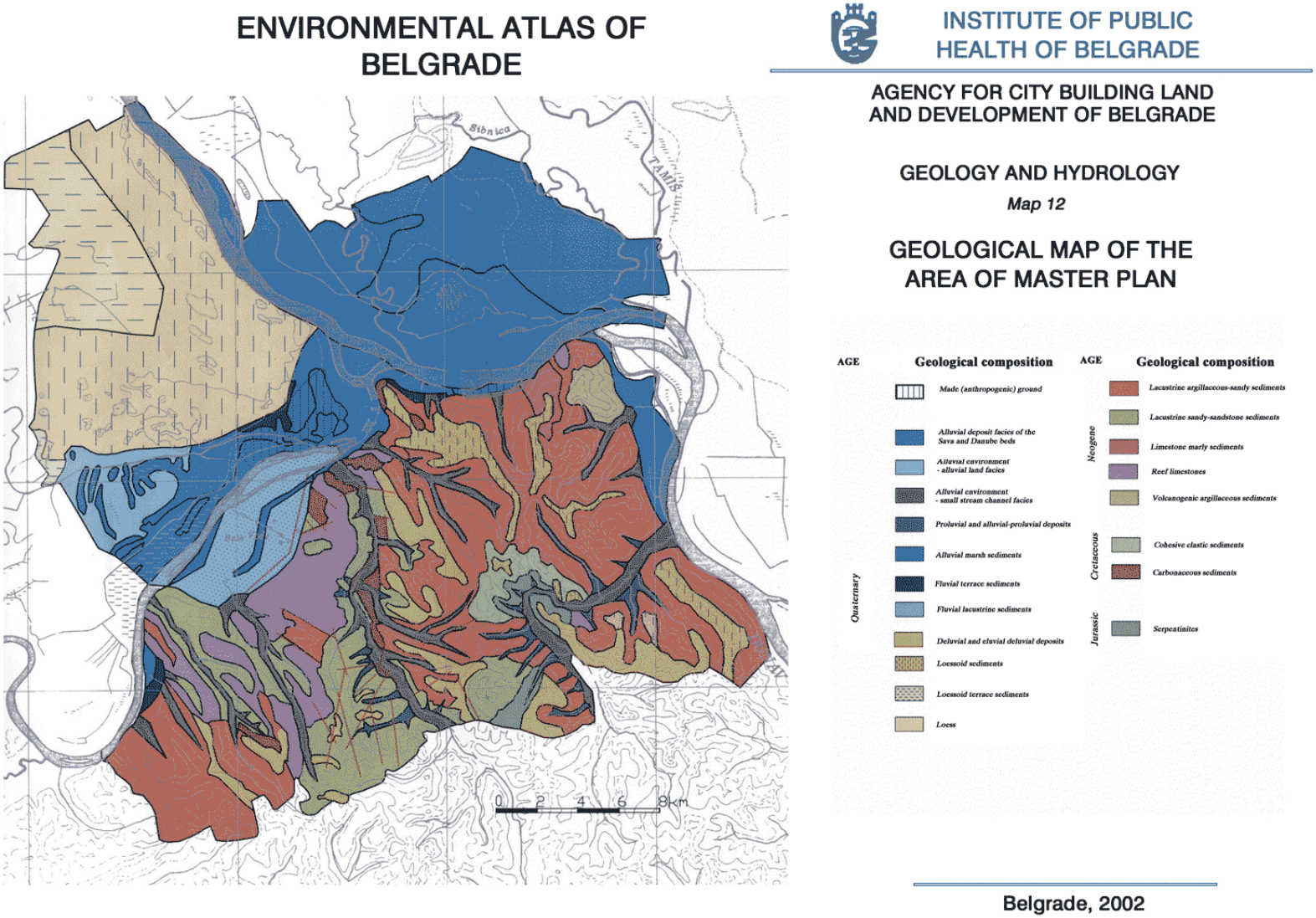


Figure 16. Geological map of Belgrade

The figure to the right is an extract from the map of geo-diversity of Belgrade published in "Belgrade through Nature and Time" (2010). The map shows three interesting locations in the wider area of the planed works in the municipality of Palilula:

1. Višnjica
6. Višnjička banja (spa)
11. Veliko Selo

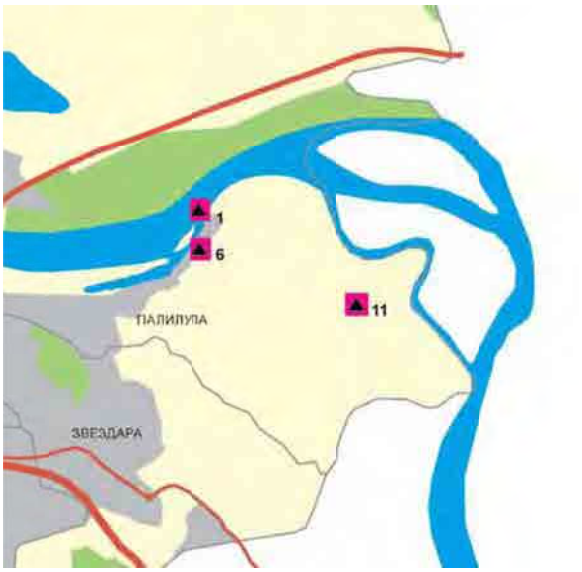


Figure 17. Geo-diversity in the municipality of Palilula

Figure 18 shows the slopes on the banks of the Danube, where there are a number of active and fossil landslides, mostly built of Neogene sediments, with or without the loess cover, that with very unstable.

Figure 18. Višnjica

Figure 19 shows a mineral water source that is rich in sulfur, with a temperature of 14 degrees C. The water is said to help in the treatment of rheumatism, neurological and some other diseases.

Figure 19. Višnjička banja (spa)

Figure 20 shows a geological profile that was created in the earlier, lake stage in the evolution of the sea Paraterisa, the predecessor of the Pannonian Sea (older Miocene period).

Figure 20. Veliko Selo

4.3 Soil Types and Quality

The inner city area is mostly made up of humic-accumulative soils (chernozems), with some presence of calcareous soils (e.g. at Kalemegdan and

Tašmajdan.).

The Sava and Danube River banks are characterized by hydromorphic soil (alluvial fluvisol). The river islands (e.g. Great War Island, Ada Ciganlija, Forkontumac) were also formed by alluvial deposits of the Sava and Danube Rivers.

Soil quality testing is conducted by the Secretariat for Environmental Protection and by the Belgrade Institute of Public Health. Results interpretation was done according to the norms defined in Regulation on the Program of System- Based Monitoring of Soil Quality, Risk Estimation Indicators of Soil Degradation and the Remediation Programs Methodology (2010).

The Program of systematic soil pollution testing is done to:

- Determine the concentrations of hazardous and harmful substances in the soil;
- Monitor the degree of pollution in urban zones, especially in the sanitary protection zones of the source of water capture for the Belgrade Waterworks;
- Process relevant information and update soil quality databases;
- Define measures that lead to a decrease of pollution in the city area.

The Program involves soil testing from the following sites:

- The soil within the Zone of sanitary protection for the source of water capture of the Belgrade Waterworks - samples were taken from 6 locations in the area of the Sava and Danube Rivers confluence;
- The soil near busy traffic arteries - 3 samples were analyzed from the locations of Novi Beograd, Mirijevo and Leštane;
- The soil within communal environments - 5 samples were taken from the locations of Novi Beograd, Konjarnik, Karaburma and Čubura.
- The soil around public fountains, 19 locations: Topčider, Košutnjak, Rakovica, Miljakovac, Jajinci, Beli Potok, Resnik, Žarkovo, Višnjička banja, Kaluđerica, Leštane, Boleč and Mali mokri Lug.

In 2010, 66 samples of the soil were taken and analyzed from 33 locations. Elevated concentrations of soil pollutants were found in a number of samples, as shown in the figure below. The pollutants detected were heavy metals (Cu, Zn, Pb, Cd) and organic parameters (dichlorodiphenyltrichloroethane - DDT, polycyclic aromatic hydrocarbons - PAHs, hydrocarbon index C_{10}-C_{40} and polychlorinated biphenyls - PCBs). Soil pollutant concentrations did not exceed the Limit Values that would require Remedial actions (please see the table below).

Nickel was found to have the most frequently seen exceedance of permitted soil concentration levels. Increased nickel soil concentrations are related to specific geological/ chemical composition of surface layers in the Belgrade area. However, the possible additional effect of anthropogenic pollution cannot be excluded.

In the locations that belong to Zone of sanitary protection for the water capture sources of the Belgrade Waterworks, no major aberrations were registered in the examined parameter concentrations. However, DDT was detected (residuals from the use of this pesticide in the past), which requires further future monitoring for the presence of this pollutant in soil and drinking water.

Elevated values of hydrocarbons C_{10}-C_{40} (mineral oils) and Cu were found in the soil near busy traffic arteries. This can be ascribed to the impact of motor vehicles on the soil along these routes.

PCBs were found in the soil near the fountain Zelenjak in Resnik. It has not been safe to use the fountain for a long time and there is a sign nearby, with information "Water unsafe for drinking".

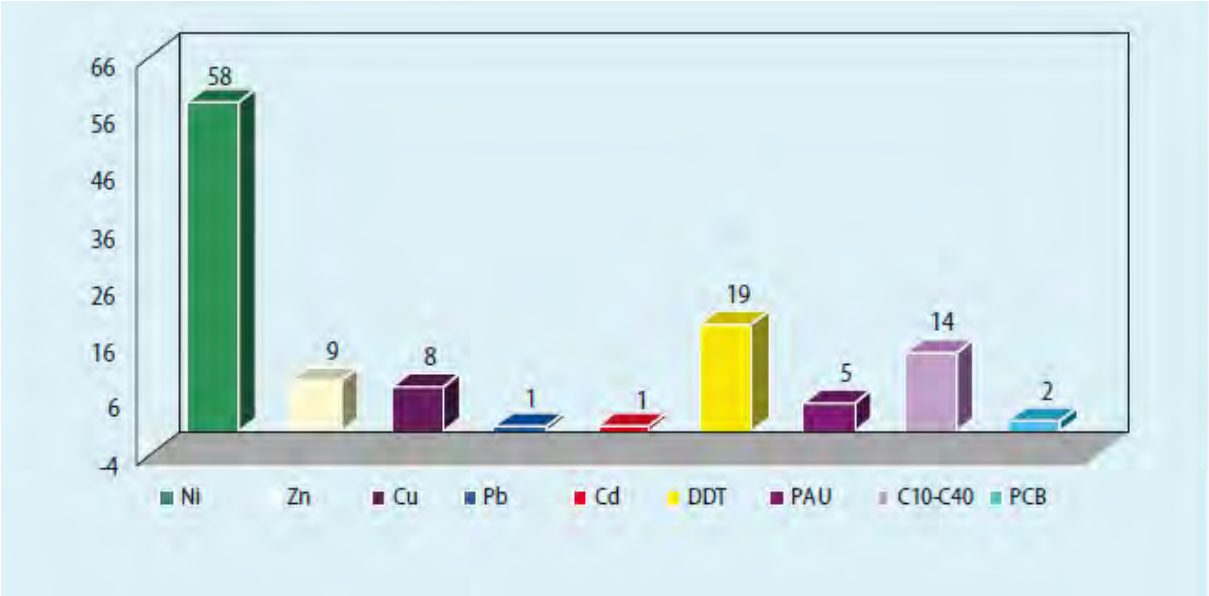


Figure 21. Number of detected exceedances of soil pollutant concentrations from the prescribed limit values (Source: Environment in the City of Belgrade 2010).

Table 4. Limit values for soil pollutants that were detected in elevated concentrations (according to the Regulation on the Program of System-Based Monitoring of Soil Quality, Risk Estimation Indicators of Soil Degradation and the Remediation Programs Methodology, 2010)

Pollutant	**Soil Concentration [mg/kg of dry mass]**	
	Limit Value	**Remediation Value**
Ni	35	210
Zn	140	720
Cu	36	190
Pb	85	530
Cd	0.8	12
	Limit Value	**Values that can indicate significant contamination**
DDT/ DDD/ DDE (total)	0.01	4
PAHs	1	10
C_{10}-C_{40}	50	5000
PCBs	0.02	1

Four soil samples from the Project location were analyzed for the PEIA Study for the Feasibility Study and Preliminary Design (FS/PD) for the Wastewater Treatment Plant (WWTP) Veliko Selo (2007).

Soil was sampled from the Veliko Selo agricultural areas towards the Danube River. Elevated levels of nickel (up to 52.7 mg/kg) were detected in all samples (the limit value is 35 mg/kg of Ni). As can be seen in the figure above, it is common to find elevated values of nickel in the soil in Belgrade, due to the specific geochemical structure of surface soil in the area.

Pesticides, mineral oils and PCBs were detected in the soil samples. The maximum measured concentration of PAHs was 0.35 mg/kg, which is above the permitted level of 0.02 mg/kg.

4.4 Soil Erosion

Soil erosion and related sediment problems are recognized as significant problems throughout the world. Erosion and sedimentation are part of the natural evolution of the landscape, but they are accelerated by human activities and they constitute some of the most fundamental problems for the development of agriculture and forestry and for the utilization of natural resources.

Erosion and sedimentation processes are related to the natural characteristics of the area – geology, climate, hydrology, relief, vegetation cover, sediment characteristics, soil characteristics, but are also connected to the intensity of particular human induced pressures to the area – deforestation and other aspects of destruction of natural habitats, intensity and type of agriculture, etc.

In general, the range of erosion rates in Serbia corresponds to the range of erosion rates elsewhere in Europe and an evaluation of total annual soil loss from the Serbian territory indicates a range of 40-50·10^6 t per km^2. (Petković et al., 1999).

The territory of Serbia is divided into three basic units corresponding to high, medium and low erosion intensities (Petković et al., 1999). According to Petković et al. (1999), the project area is characterized by a low intensity of erosion processes in comparison to other regions of Serbia, although some narrow zones characterized by medium soil erosion rate could be identified.

4.5 Meteorology

Climate characteristics of the area under consideration are determined by the terrain morphology, rivers and synoptic influences related to meridian position. To the north of the area is the Pannonian plane, which allows intrusion of cold, polar air masses from north-eastern Europe. Therefore, the climate may be classified as a moderate continental climate with four distinctive seasons. The annually averaged daytime temperature is 11.7 °C.

4.5.1 Air Temperature

Analysis of air temperature in Belgrade is based on observed temperatures in the period between the years 1978 to 2007 (Republic Hydrometeorological Service of Serbia – RHSS). Table 5 and Table 6 show the averaged maximum and minimum air temperatures throughout the years. July and August are the warmest months with an averaged maximum temperature of 28.2 and 28.3 ^oC, respectively, while January is the coldest month with averaged minimum temperature of -1.2 ^oC. The absolute maximum temperatures in this period are observed in August, in the range of 37.4 to 40.3 ^oC, while the absolute minimum air temperatures are observed in January in the range of -30.7 to -20.3 ^oC.

Table 5. Averaged maximum air temperatures in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Max T (°C)	4.5	6.8	12.5	17.6	23.1	26.1	28.2	28.3	23.8	18.3	10.5	5.8	17.1

Table 6. Averaged minimum air temperatures in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Min T (°C)	-1.2	-0.2	3.6	8.0	12.7	15.7	17.2	17.2	13.3	8.9	3.8	0.1	8.3

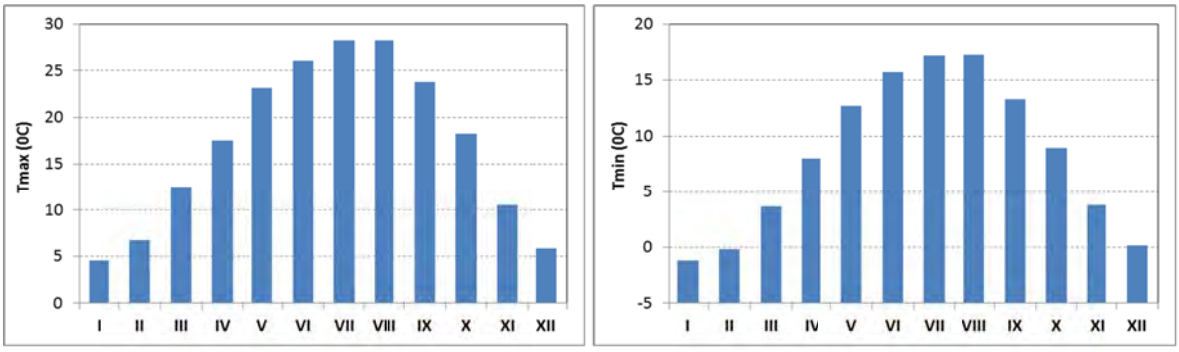


Figure 22. Averaged maximum and minimum air temperatures in Belgrade

4.5.2 Precipitation

In the considered period (1978-2007), the annual precipitation was in the wide range of 368 to 1051 mm (RHSS).

Table 7 shows the averaged distribution of precipitation through the years. It can be seen that the most rainfall occurs in the warmer season, which is characteristic of continental climate. However, some maritime characteristics can be also observed; the annual precipitation pattern shows two maximum and two minimum values. On average, the annual precipitation in the Belgrade area is nearly 700 mm. The month with the highest rainfall is June, with an averaged value of 99.8 mm.

Table 7. Annual distribution of the averaged precipitation

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Sum.
Precip. (mm)	46.6	40.2	48.2	59.4	62.5	99.8	63.9	58.9	56.4	49.6	54.8	55.2	695.5

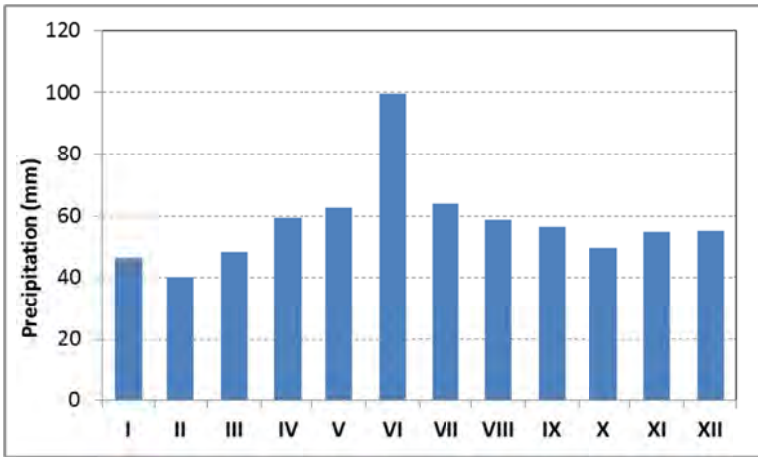


Figure 23. Annual averaged distribution of precipitation

4.5.3 Relative Humidity

The relative air humidity in Belgrade varies between 61% (warm season) and 79 % (December/January), as shown in Table 8 and Figure 24. The averaged annual relative humidity during the observation period from 1978 to 2007 was 68.1 %.

Table 8. Annual distribution of the averaged relative air humidity in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Ann.
(%)	77.7	71.6	63.5	61.3	61.7	63.3	61.5	62.2	67.9	71.0	76.4	79.1	68.1

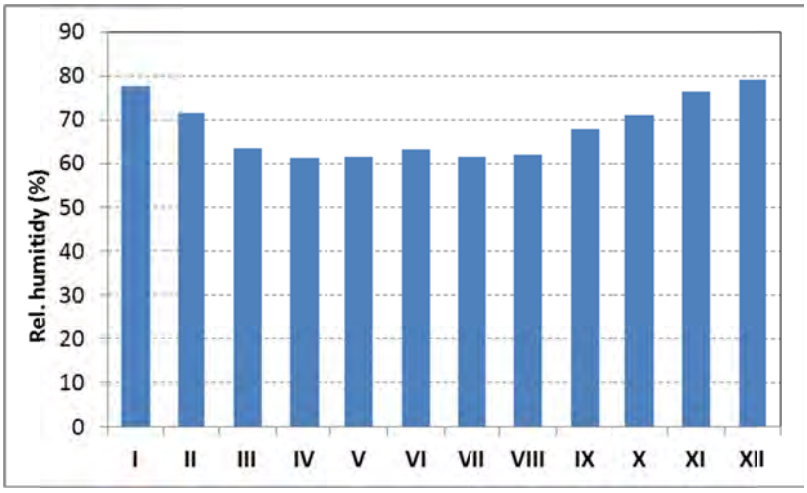


Figure 24. Annual distribution of the averaged relative air humidity in Belgrade

4.5.4 Wind Speed

The highest averaged wind speed in Belgrade is observed in March (2.8 m/s), while the lowest is observed during the summer (June, July and August, 2.0 m/s). The annually averaged value of the wind speed is 2.3 m/s (Table 9).

There are two prime wind directions: the south-eastern one (known as Košava), and the west-north-western one (known as Gornjak).

The annual wind rose and the wind speed in specific directions are shown in Figure 25. Spatial distribution of annual wind roses in the city area is shown in Figure 26, revealing the dominance of south-eastern wind direction in the whole area.

Table 9. Averaged distribution of the wind speed in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Ann.
(m/s)	2.4	2.6	2.8	2.5	2.3	2.0	2.0	2.0	2.1	2.4	2.5	2.4	2.3

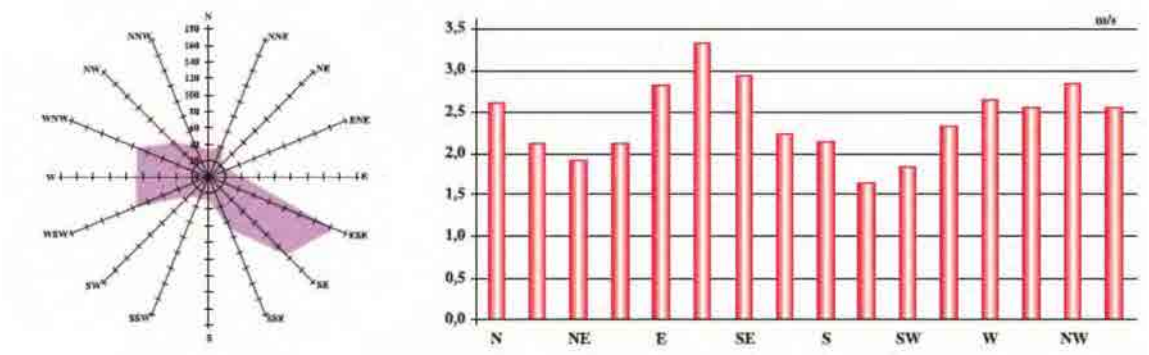


Figure 25. The annual rose and the mean wind speed in specified directions in Belgrade (Source: Statistical Yearbook of Belgrade – 2011, 2012).

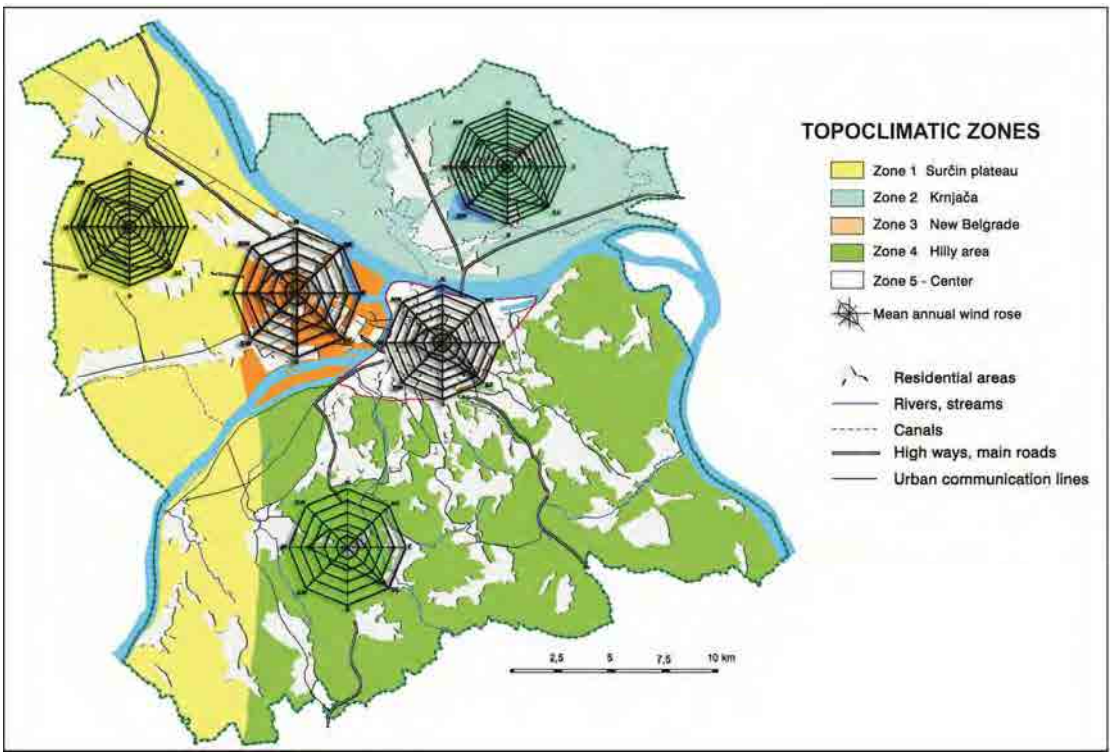


Figure 26. Spatial distribution of annual wind roses (Source: Environmental Atlas of Belgrade, 2002)

4.5.5 Insolation

The averaged annual distribution of insolation is shown in Table 10. The lowest insolation is observed in January (72 h), and the highest in July (286 h). In average, the monthly insolation in Belgrade is 173.6 hours.

Table 10. Averaged insolation in Belgrade

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Av.
(hours)	72.0	100.8	154.4	183.4	234.6	260.0	286.1	268.1	204.3	163.8	89.1	67.1	173.6

4.6 Air Quality

Air quality monitoring in Belgrade is conducted according to the Regulation on Air Monitoring Conditions and Air Quality Requirements (2010), which prescribes following air pollutant concentration limit values (LV):

- SO_2:
  - hourly LV – 350 µg/m^3 (not to be exceeded more than 24 times in one calendar year)
  - daily LV – 125 µg/m^3
  - annual LV – 50 µg/m^3
- NO_2:
  - hourly LV – 150 µg/m^3 (not to be exceeded more than 18 times in one calendar year)
  - daily LV – 85 µg/m^3
  - annual LV – 40 µg/m^3
- Particulate matter PM_{10}:
  - daily LV – 50 µg/m^3 (not to be exceeded more than 18 times in one calendar year)
  - annual LV – 40 µg/m^3
- Particulate matter $PM_{2.5}$:
  - annual LV – 25 µg/m3
- Lead:
  - daily LV – 1 µg/m^3
  - annual LV – 0.5 µg/m^3
- Benzene:
  - annual LV – 5 µg/m^3
- Carbon-monoxide:
  - maximum daily 8-hour average value – 10 mg/m^3
  - daily LV – 5 µg/m^3
  - annual LV – 3 µg/m^3
- Soot:
  - daily LV – 50 µg/m^3
  - annual LV – 50 µg/m^3

- Target values for tropospheric (ground level) ozone:
  - maximum daily 8-hour average value – 120 μg/m^3 (not to be exceeded more than 25 times in one calendar year)

- Target values for arsenic, cadmium, nickel and benzo (a) pyrene, for the average annual value of total PM_{10}, are:
  - arsenic – 6 ng/m^3
  - cadmium – 5 ng/m^3
  - nickel – 20 ng/m^3
  - benzo (a) pyrene – 1 ng/m^3

Air quality monitoring is carried out by measuring air borne pollutants originating from stationary and mobile sources, and by monitoring the impact of air pollution on human health and the environment.

An Air Quality Control Program is adopted every two years by the City of Belgrade Assembly and published in the Official Gazette of the City of Belgrade. The most recent Program for the years 2012 and 2013 was published in April of 2012. The Program determines three networks of stations where the following air samples are taken:

1. Continuous sampling of air pollutants emitted from stationary sources in urban areas (17 monitoring stations);
2. Continuous sampling of air pollutants emitted from stationary sources in industrial areas (4 monitoring stations);
3. Indicative sampling of air pollutants emitted from traffic (18 locations positioned at 10 cm from the road curb (at maximum) and at 1.5 meters above ground level).

Indicative sampling of air pollutants is during a 24-hour period once a week, distributed evenly throughout the year. The sampling locations are shown in the map below. The following air pollution parameters are measured: CO, NO_X, Pb, volatile organic compounds (VOCs), SO_2, benzene, xylene and toluene.

Sampling locations marked in red on the map below in the area of the planed pumping stations and the interceptors. There are no sampling stations close to Veliko Selo.

In the PEIA Study for the FS/PD for the WWTP Veliko Selo (2007), it was assessed that air pollution in the WWTP area is significantly below the prescribed limit values. The assessment was based on the following:

- Pollution from fuel combustion in the Veliko Selo households have little influence on the Project location, due to the fact that the village is located about 1 km from the Project site.

- There are no large industrial facilities in the vicinity of the Project site. The Pancevo industrial complex is located more than 4 km to the north-east from the site, i.e. towards the quadrant where winds rarely occur.

- There is very little traffic at the site.

Figure 27. Network of stations for indicative sampling of air pollutants emitted from mobile sources

4.7 Noise and Vibrations

The communal noise in Belgrade originates primarily from traffic. Industrial facilities, construction works, small-scale economy and other activities are less important. The Belgrade Institute of Public Health monitors noise levels in Belgrade and reports the finding to the Secretarial for Environmental Protection. Noise measurements are conducted for a 24-hour period twice a year, in the spring and in the autumn, at 35 measuring points. The measuring locations are chosen as representative of different urban zones of the city and along major crossroads. The measurements are conducted according to the:

- Law on Protection against Noise in the Environment (2009 & 2010);
- Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010);
- Rulebook on Noise Measuring Methods, the Content and Scope of the Noise Measurement Report (2010).

The Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Environmental Noise (2010) stipulates the limit values for outdoor noise levels, as shown in the table below.

Table 11. Limit values for outdoor noise levels (according to the Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment, 2010)

Zone	Land Use	Noise level in dB (A)	
		Daytime	Nighttime 10 PM – 6 AM
1	Areas for recreation, hospital zones and rehabilitation, cultural and historical sites, large parks	50	40
2	Tourist areas, camps and school zones	50	45
3	Purely residential areas	55	45

Zone	Land Use	Noise level in dB (A)	
		Daytime	Nighttime 10 PM – 6 AM
4	Business-residential areas, commercial-residential areas and playgrounds	60	50
5	City center, commercial, trade, administrative areas with apartments, areas along highways and city roads	65	55
6	Industrial, warehouse and service areas and transportation terminals without residential buildings	At the border of this zone the noise level must not exceed the allowable levels of the boundary zone	

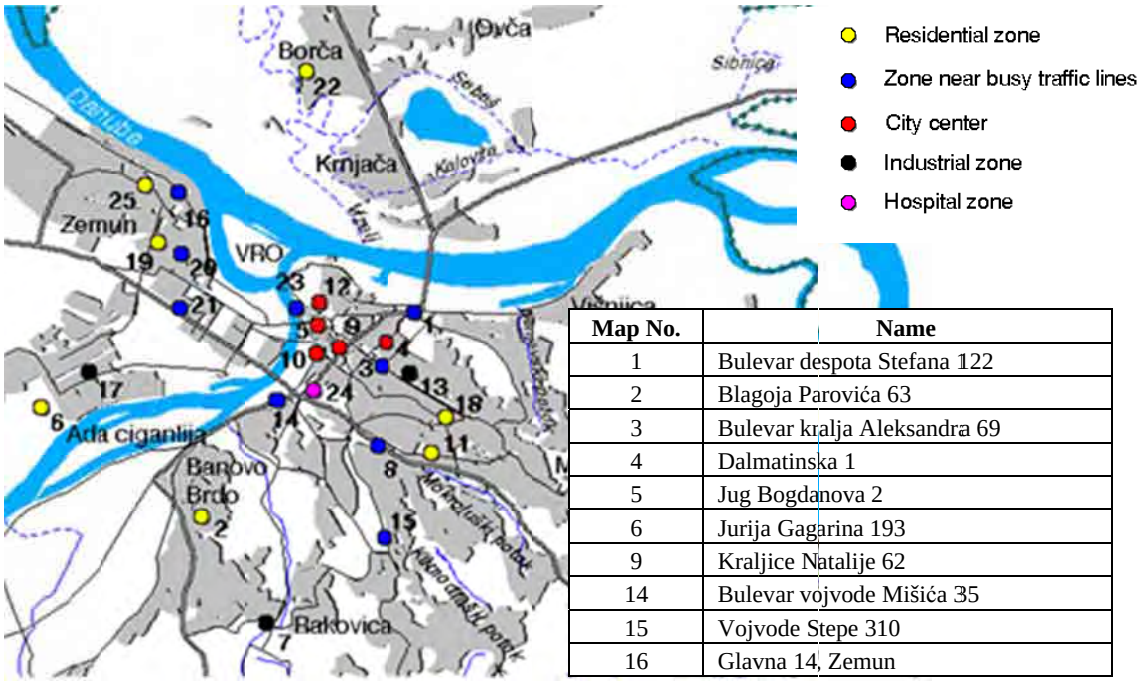
In 2011, daytime and nighttime noise limits were exceeded at 25 and 32 measuring points, respectively. The daytime exceedances were between 0-19 dB (A), while the nighttime exceedances varied from 0-20 dB (A) depending on the zoning. The maximum average exceedances were detected in residential zones and in areas along busy traffic roads. The highest levels of noise were registered in the Despot Stefan Boulevard (Bulevar despota Stefana in Serbian), the Duke Misica Boulevard (Bulevar vojvode Mišića in Serbian) and the Main Street (Glavna in Serbian) in Zemun, where the noise levels reach 75 dB (A) and 70 dB (A) during the daytime and nighttime, respectively.

The average noise levels for several locations in 2011 are shown in the table below. The locations of the measuring points are marked in the figure below (Figure 28). Areas of the dominant sources of noise are shown in Figure 29.

Table 12. Communal noise in Belgrade (Source: Belgrade in Figures, 2012)

Measuring point	*Average*		*Measuring point*	*Average*	
	day	*night*		*day*	*night*
Permitted level: day 65 dB (A) night 40 dB (A)					
Jurija Gagarina 193	60	55	Glavna 14, Zemun	73	68
Bulevar kraqa Aleksandra 69	69	66	Jug-Bogdanova 2	72	61
Kraqice Natalije 62	66	64	Blagoja Parovića 63	66	62
Vojvode Stepe 310	67	65	Dalmatinska 1	65	59
Bulevar despota Stefana 122	82	76	Bulevar vojvode Mišića 35	75	71

There is no legislative in Serbia regarding vibrations and there are no published results on vibration measurements in Belgrade. Traffic related vibrations are expected to correlate to the levels of noise measured in Belgrade.



Map No.	Name
1	Bulevar despota Stefana 122
2	Blagoja Parovića 63
3	Bulevar kralja Aleksandra 69
4	Dalmatinska 1
5	Jug Bogdanova 2
6	Jurija Gagarina 193
9	Kraljice Natalije 62
14	Bulevar vojvode Mišića 35
15	Vojvode Stepe 310
16	Glavna 14, Zemun

Figure 28. Network for communal noise control in Belgrade

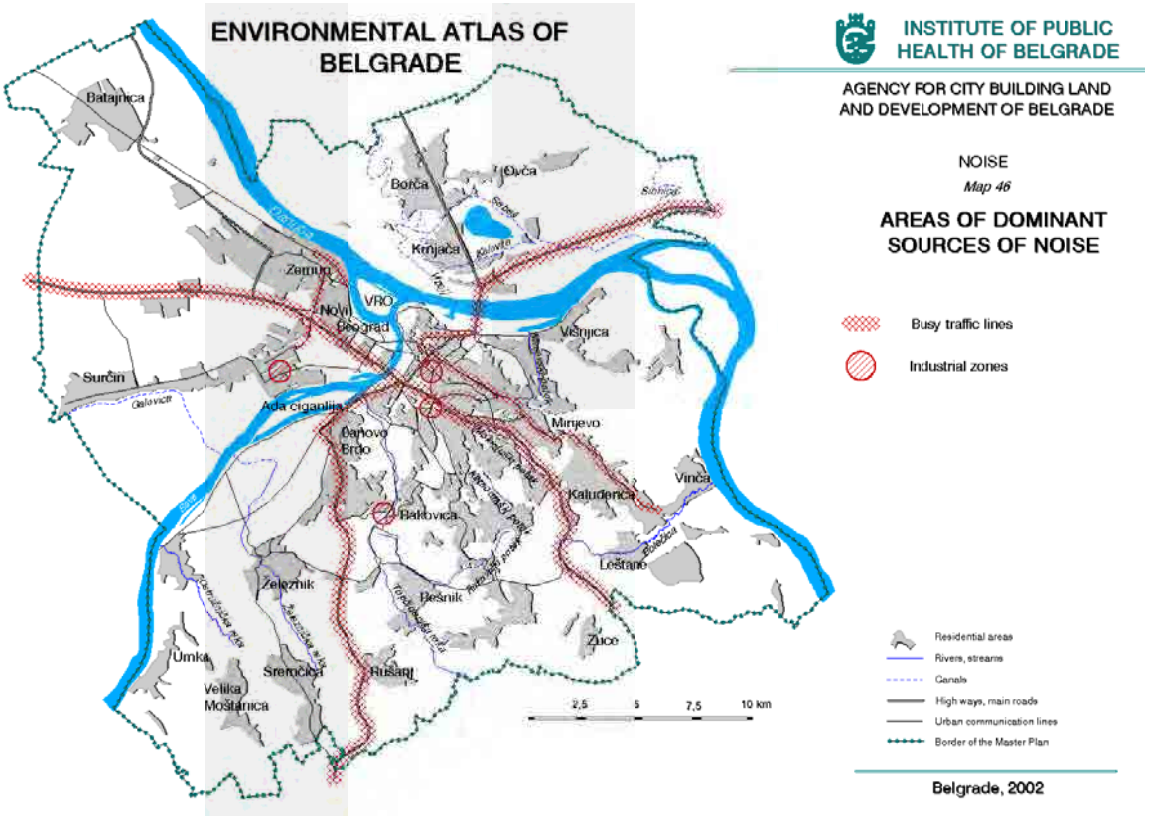


Figure 29. Areas of dominant sources of noise in Belgrade

4.8 Solid Waste Management

There are five registered official waste landfills in the wider metropolitan area of Belgrade. Thirteen urban municipalities deposit their waste at the Vinca (Vinča in Serbian) landfill, located near the Vinca settlement. The four other 4 municipalities (Sopot, Mladenovac, Lazarevac and Obrenovac) have their own landfills. The biggest landfill by far in the Vinca landfill and it is the landfill that is relevant to the Project.

The Vinca landfill is located in the southeast Municipality of Grocka, about 10 km from the city center. The landfill was set on agricultural land and the landfill became operational in 1978 as one of several municipal landfills. All other landfills in the urban municipalities were shut down in the 1990's, and the Vinca landfill had been the only operational landfill for the urban municipalities since 1998.

The location of the Vinca landfill in relation to the future WWTP is shown in the figure below.

Waste collection, transportation and disposal are handled by the city public utility company (PUC) "Gradska čistoća" (PUC City Sanitation). All non-hazardous waste, including bulky waste, commercial waste, construction and demolition waste, as well as sanitized medical waste is deposited at the Vinca landfill. The Vinca landfill receives about 1,700 tons of municipal waste per day. There is no information how much industrial waste is deposited at the Vinca landfill. The Vinca landfill covers an area of about 70 ha, of which the waste disposal area is about 45 ha in size and has a depth of 5-50 m. An additional 35 hectares is available for future waste disposal.

At the time of the landfill was opened in 1978, the composition of the soil and its impermeability satisfied the legal requirements for the construction and operation of the landfill, which is not the case today. There is no collection or beneficial utilization of landfill gas, nor is there monitoring of the landfill gas. There is no leachate treatment; the leachate and storm water are discharged through a channel directly into the Danube River, which is environmentally unacceptable. There is no monitoring of leachate.

A great effort is made to implement sanitary waste disposal, within the limits of the existing possibilities. Deposited waste is compacted and covered by construction and demolition debris as well as earth supplied by the PUC City Sanitation. The density of the compacted waste is about 880 kg/m^3. Reclamation in the form of grass planting is done once a certain part of the landfill is closed for further dumping. Therefore, waste is only visible in the operational part of the landfill. Self-ignition does not occur at the landfill.

Figure 30. Location of the Vinca landfill (1) and the future WWTP (2)

A water sampling program was conducted in 2010 at six locations around the Vinca landfill site and in four locations near the site and at the banks of the Danube River (figures below). The results showed that the water sampled upstream of the deposited waste was not polluted; and that the leachate sampled as it leaves the landfill site indicated a strong organic pollutant influence (the measured BOD_5 values were above 1000 mg/L).

Figure 31. Water sampling locations at the Vinca landfill site perimeter (Source: Local Waste Management Plan for the City of Belgrade 2011-2020, 2011)

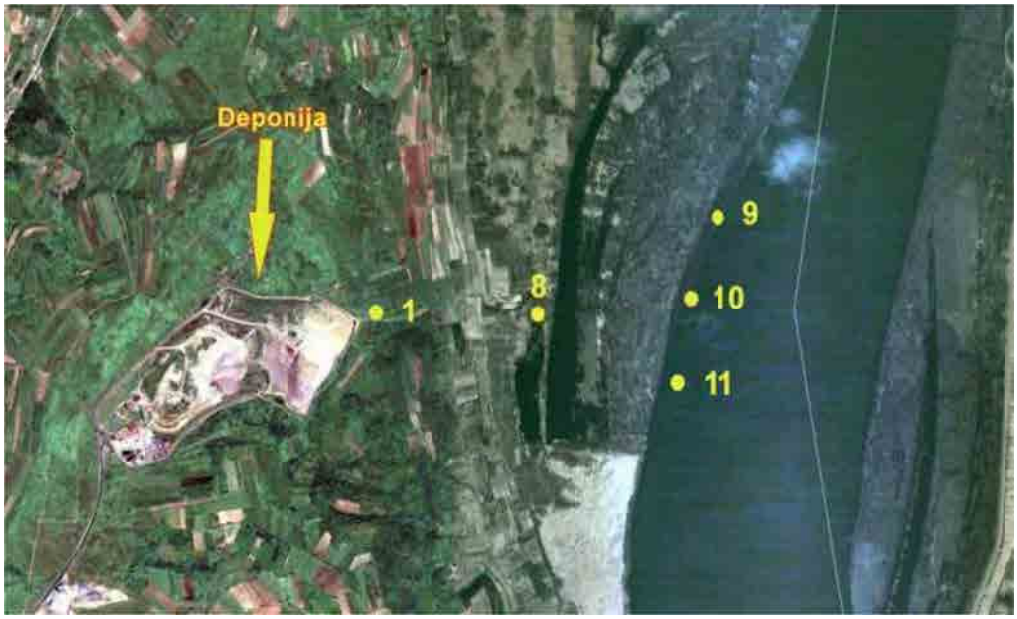


Figure 32. Water sampling locations at the Vinca landfill site perimeter (Source: Local Waste Management Plan for the City of Belgrade 2011-2020, 2011)

In the Local Waste Management Plan for the City of Belgrade 2011-2020 (2011), it is stated that more than 4.5 million m^3 of waste will be deposited at the Vinca landfill in the next 20 years. This demand can be met with the engineered construction of 4 landfill cells within the 30 or so ha of available area at the current landfill site. The required height of the cells is between 18 to 20 m.

4.9 Wastewater Discharge

Belgrade sewage is now developed on an area of more than 11,500 ha, and covers the settlements of central Belgrade, New Belgrade, Zemun and some settlements on the left bank of the Danube. Collected domestic and industrial wastewater, as well as stormwater, is discharged in its raw form directly into the Sava and Danube Rivers, as well as their tributaries, that at times of low flow periods, turn into de facto open sewer channels.

Figure 33 presented the map of the sewerage system network, while Figure 34 shows the map of identified surface water polluters. Points of discharges of wastewater into surface waters are marked in dark blue. The discharge of raw wastewater has a detrimental effect on surface water quality parameters in Belgrade, especially at micro-locations of wastewater disposal and especially from a recreational standpoint. Industrial wastewaters are also discharged into surface waters mostly without pre-treatment (Figure 34).

As mentioned in Section 2, a special strategic objective of the "Master Plan of Belgrade 2021" is the orientation of Belgrade towards the its water boulevards, the Sava and Danube Rivers. These are to become (and in great part, already are) the central location for various entertainment venues, for tourist and locals alike. These venues include restaurants situated on the rivers themselves, cultural, sporting and entertainment venues. Currently, all existing floating restaurants discharge all their raw wastewater directly into surface waters upon which they are situated. There is no suggestion as to how these discharges should be handled in the Belgrade 2021 Master Plan.

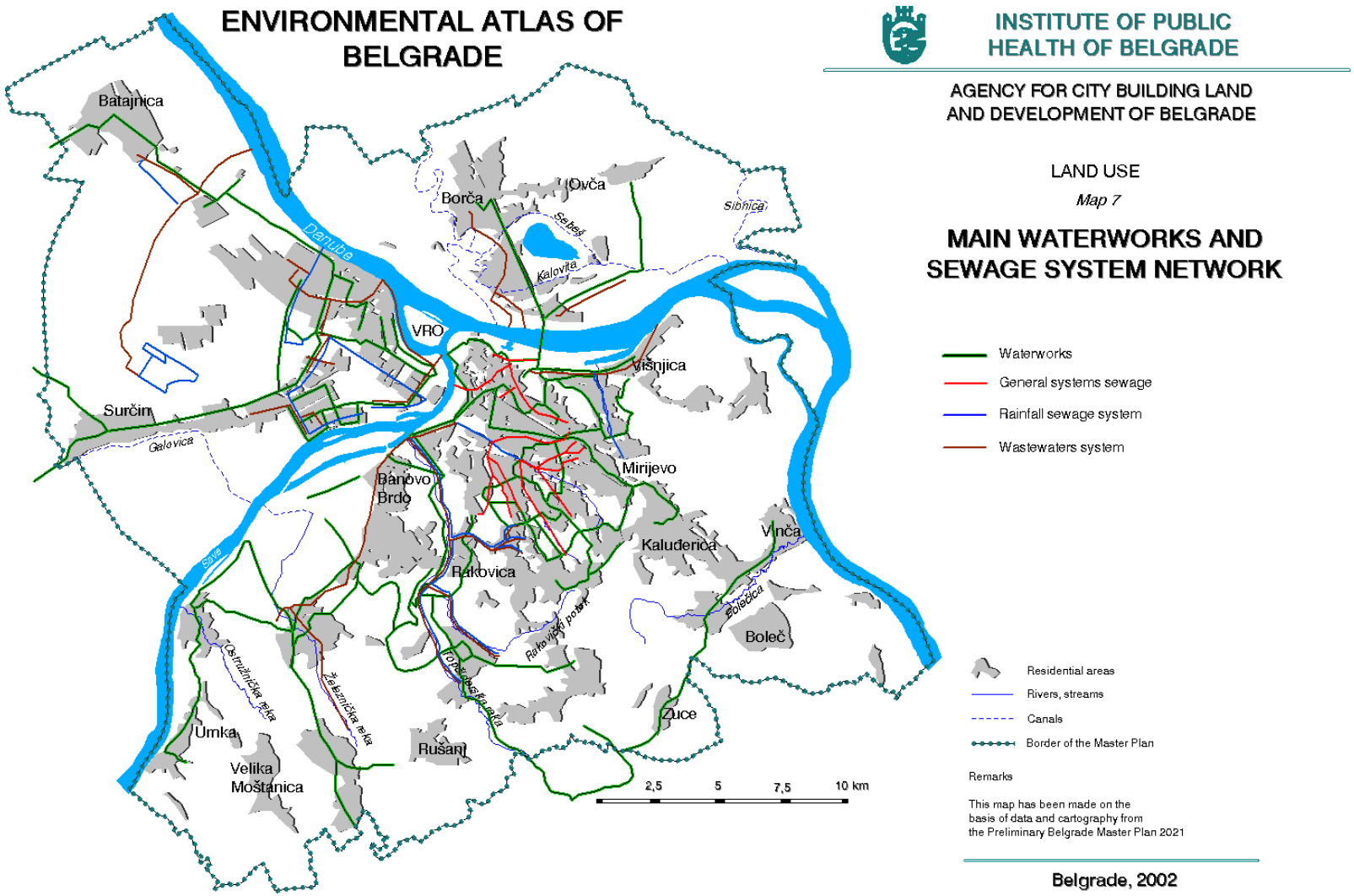


Figure 33. Map of the main waterworks and sewerage system network

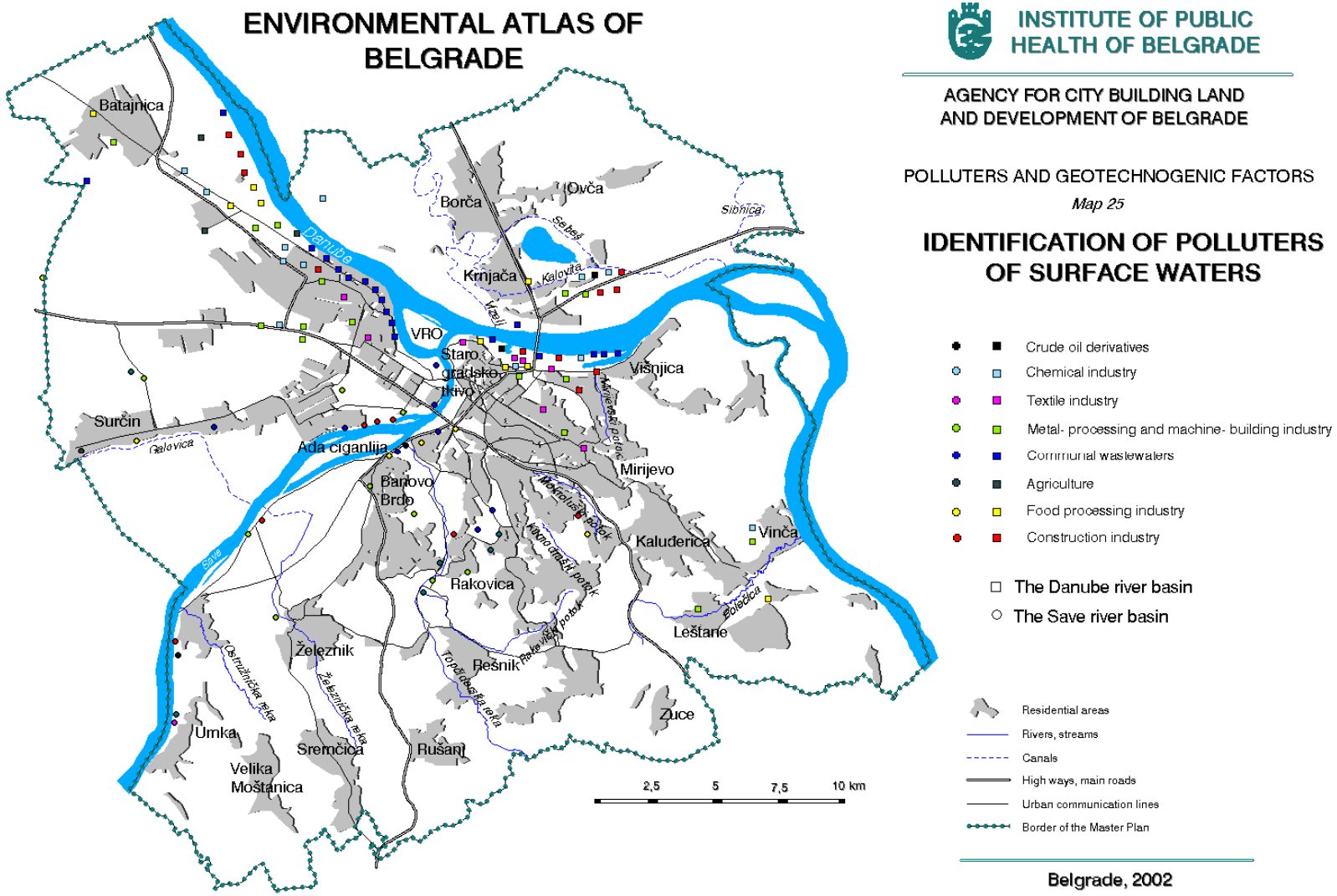


Figure 34. Map of identified surface water polluters

One of the main attractions recommended by the Tourist Organization of Belgrade is their "Belgrade by the Rivers" offer. There are several boat companies that offer regular guided boat tours (a must see for all Belgrade tourists), as well as renting boats for seminars, private parties and weddings. A picture of one such boat is shown in Figure 35. There is even a hostel situated on the water near the confluence of the Sava and Danube Rivers (Figure 36).

The location of the hostel and where the one of the panoramic boating tours begin is shown in Figure 38. What the tourists and most locals do not know is that this location is immediately downstream of a number of untreated wastewater discharges (Figure 38). These discharges also influence the quality of the bathing wasters at the Lido beach (Figure 37), which is located at the upstream side of the Great War Island (Veliko Ratno Ostrvo - VRO).

Four and five river water samples were taken of the Danube at the Lido beach in July and August 2012, respectively. In eight of the nine samples, the detected microbiological water quality parameters were higher than the prescribed limits for bathing water quality. The City officials recommended washing after each swim at the provided showers that were supplied with potable water, especially for young children and adults with an impaired immunity system (Ecological Bulletins of the Belgrade Secretariat for Environmental Protection, July - September 2012).

Figure 35. Guided river tours, a main tourist attraction in Belgrade

Figure 36. Hostel situated on the water near the confluence of the Sava and Danube Rivers

Figure 37. The Lido beach at the tip of the Great War Island

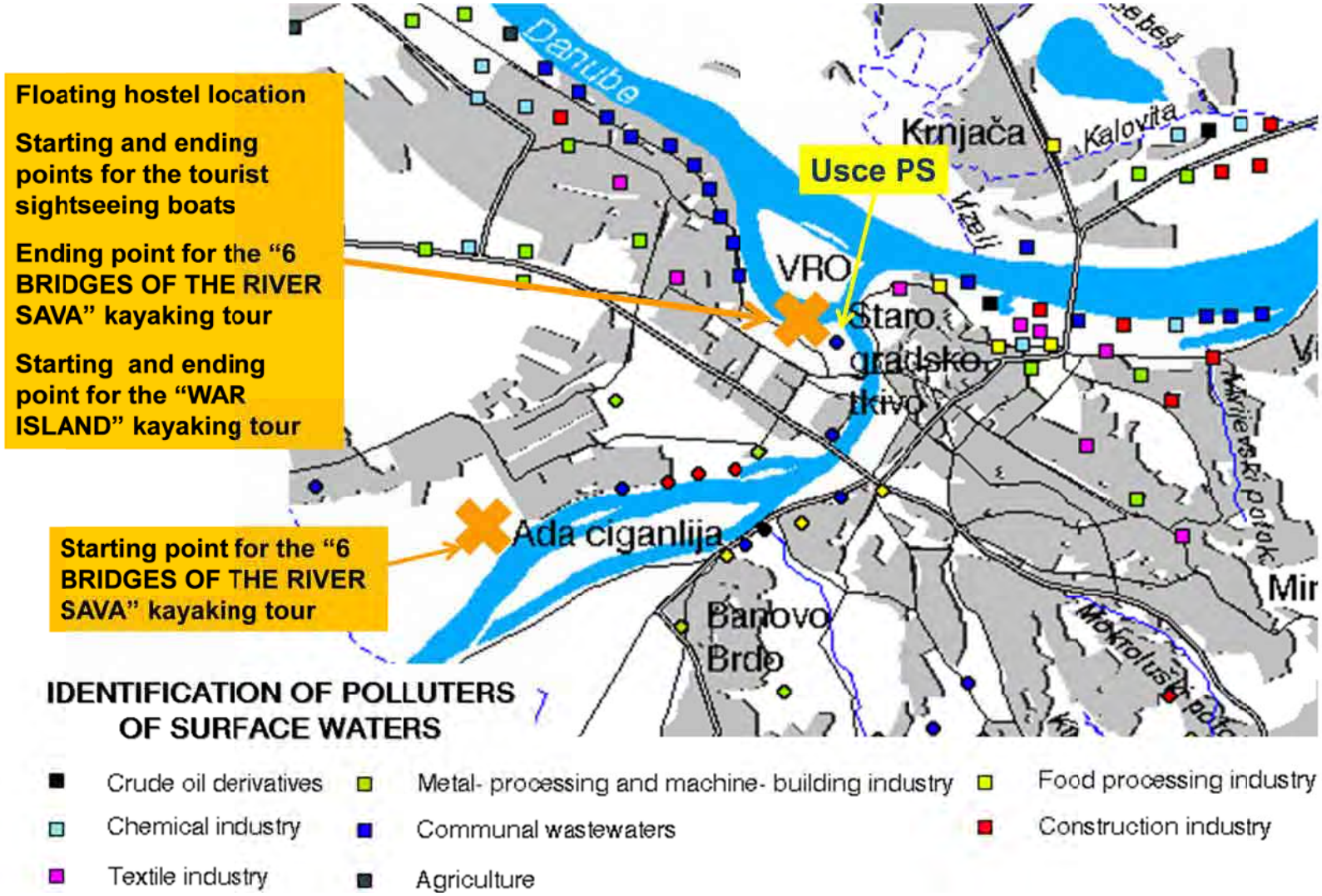


Figure 38. Location of the floating hostel, starting and ending points for the panoramic boating and kayaking tours (VRO = Great War Island)

For the more adventurous, the Tourist Organization of Belgrade advertises the “Belgrade Kayak Adventure”. This new “active holiday” program offers sightseeing from a different perspective, showing visitors a unique Belgrade "river lifestyle" on the Sava and Danube Rivers. There are two tours offered within the program. The “6 Bridges of Sava” tour takes you under Belgrade bridges and “Great War Island – Jungle in the heart of Belgrade" takes you around the island that is a nature preserve and includes a break on the Lido beach. The starting and ending points for both tours are shown in Figure 38, along with the raw wastewater discharge points.

The idea of a fun sightseeing program like the kayaking tours is a great; however, there are currently several problems associated with both tours. During the “6 Bridges of Sava” tour, kayakers are instructed to keep close to the left Sava River bank, as the Sava River is an international transport route and this requirement is made out of safety reasons. The problem is that there are numerous floating river restaurants all along the left bank of the Sava River that discharge raw wastewater directly into the river. So, while one is kayaking, he or she is under the direct contact of these discharges. Secondly, this kayaking tour ends downstream of the location of the Usce PS, from which all of the wastewater from the New Belgrade settlement is discharged, also without prior treatment. This means that the kayakers will actually make their way over the sediment and sludge accumulated at this point and will potentially be exposed to the wastewater, which is much more dangerous than the foul smell that they will experience.

The “Great War Island” kayaking tour also begins and ends near wastewater discharge points and the tour includes a stop at the Lido beach where the kayakers can take a refreshing swim, unknowing that the bathing waters at that beach have microbial water quality issues.

To conclude, all the tourist and recreational opportunities that the two major rivers have to offer will be greatly enhanced by the construction of the new interceptors and other activities of the Project that is the subject of this preliminary Environmental Impact Analyses study.

4.10 Surface Water and Sediment Quality

Surface water quality monitoring in Belgrade is done according to the Water Quality Control Program in Belgrade that the Secretariat for Environmental Protection issues annually. Surface water sampling and testing is done by the Institute of Public Health of Belgrade.

The Water Quality Control Program of Surface Waters and Canals determines the:

- Number of water bodies and the number of control profiles that will be monitored;
- Control parameters;
- Frequency of sampling and analytical testing methods.

The Republic of Serbia has recently adopted a number of new regulations under the Water Law of 2010 and has largely complied with the regulatory requirements of the EU Water Framework Directive (2000/60/EC) and the Law on Ratification of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River (2003). The preconditions were hence made for the establishment of surface water monitoring in accordance with programs already implemented in the EU, which allows more precise definition of the extent and type of contamination, and facilitates the comparison of results with the countries in the Danube River basin, all for the purpose of improving water quality and protection.

The new regulations include:

- Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012);
- Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater (2011);
- Regulation on the Limit Values of Priority and Priority Hazardous Substances that Pollute Surface Waters and the Deadlines for Compliance with the Limit Values (2011).

The limit values of pollutants in surface waters and the limit values for assessing the status and trends of sediment quality (according to the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values, 2012) came into force in the second half of 2012 and are given in the table below. The definition of the categorization according to classes is as follows:

- Class I corresponds to excellent ecological status according to the classification given in the rulebook prescribing the parameters of ecological and chemical status of surface waters (Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater, 2011). Surface waters that belong Class I can be used for the following purposes: drinking water supply after treatment consisting of filtration and disinfection, bathing and recreation, irrigation, industrial use (process and cooling water).
- Class II corresponds to good ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class can be used for the same purposes and under the same conditions as surface waters that belong to Class I.
- Class III corresponds to moderate ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class can be used for the following purposes: drinking water supply after treatment consisting of coagulation, flocculation, filtration and disinfection, bathing and recreation, irrigation, industrial use (process and cooling water).
- Class IV corresponds to poor ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class can be used for the following purposes: drinking water supply with the use of a combination of the above mentioned treatments steps and advanced methods of treatment, irrigation, industrial use (process and cooling water).
- Class V corresponds to a bad ecological status according to the classification given in the rules regulating the parameters of ecological and chemical status of surface waters. Surface waters that belong to this class cannot be used for any purpose.

Table 13. Limit values of pollutants in surface waters (2012)

Parameter	Unit	Limit Values				
		Class I	Class II	Class III	Class IV	Class V
General						
pH		6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	<6.5 or > 8.5
Suspended Matter	mg/L	25	25	NM	NM	NM
Dissolved Oxygen	mg O_2/L	8.5[1] (or natural level)	7[2]	5	4	<4
Oxygen saturation	%					
Epilimnion (stratified water)		90-110	70-90	50-70	30-50	<30
Hipolimnion (stratified water)		70-90	70-50	30-50	10-30	<10
Unstratified water		70-90	50-70	30-50	10-30	<10
BOD_5	mg O_2/L	1.5-2.5[3] (or natural level)	4-5[4]	7	25	>25
COD ($K_2Cr_2O_7$)	mg O_2/L	10 (or natural level)	15	30	125	>125
COD ($KMnO_4$)	mg O_2/L	5 (or natural level)	10	20	50	>50
Total Organic Carbon	mg/L	2[5] (or natural level)	5-6[6]	15	50	>50
Nutrients						
Total Nitrogen	mg N/L	1 (or natural levels)	2	8	15	>15
Nitrates	mg N/L	1-1.5[7] (or natural levels)	3[8]	6	15	>15
Nitrites	mg N/L	0.01 (or natural levels)	0.03	0.12	0.3	>0.3
Ammonium ion	mg N/L	0.05-0.1[9]	0.1-0.4[10]	0.6	1.5	>1.5
Unionized ammonium	mg/L NH_3	0.005	0.025	NM	NM	NM
Total Phosphorus	mg P/L	0.05[11] (or natural levels)	0.1-0.3[12]	0.4	1	>1
Orthophosphates	mg P/L	0.02[13] (or natural levels)	0.05-0.2[14]			
Salinity						
Chlorides	mg/L	50 (or natural levels)	100	150	250	>250
Total residual chlorine	mg/L HOCl	0.005	0.005	NM	NM	NM
Sulphates	mg/L	50 (or natural levels)	100	200	300	>300
Total mineralization	mg/L	>1000 (or natural	1000	13000	15000	>1500

Parameter	Unit	Limit Values				
		Class I	**Class II**	**Class III**	**Class IV**	**Class V**
		levels)				
Electric conductivity at 20ºC	mS/cm	>1000 (or natural levels)	1000	1500	3000	>3000
Metals						
Arsenic	µg/L	<5 (or natural levels)	10	50	100	>100
Boron	µg/L	300 (or natural levels)	1000	1000	2500	>2500
Copper	µg/L	5 (H=10) 22 (H =50) 40 (H =100) 112 (H =300)	5 (H =10) 22 (H =50) 40 (H =100) 112 (H=300)	500	1000	>1000
Zink	µg/L	30 (H =10) 200 (H =50) 300 (H =100) 500 (H =300)	300 (H =10) 700 (H =50) 1000 (H=100) 2000 (H=300)	2000	5000	>5000
Chromium (total)	µg/L	25 (or natural levels)	50	100	250	>250
Iron (total)	µg/L	200	500	1000	2000	>2000
Manganese (total)	µg/L					
Organic substances						
Phenols	µg/L	<1	1	20	50	>50
Petroleum hydrocarbons		-(15)	-(15)	NM	NM	NM
Surfactants (as lauryl sulphate)	µg/L	100	200	300	500	>500
Adsorbic organic halogen	µg/L	10	50	100	250	>250
Microbiological Parameters						
Fecal coliform	cfu/ 100 ml	100	1000	10000	100000	>100000
Total coliform	cfu/ 100 ml	500	10000	100000	1000000	>1000000
Enterococci	cfu/ 100 ml	200	400	4000	40000	>40000
No. of aerobic heterotrophs (Kohl method)	cfu/ 100 ml	500	10000	100000	750000	>750000

(1) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 8.0 mg O_2/L; and lakes at elevations over 200 meters above sea level where the limit values are in the range of 6.5-8.5 mg O_2/L.

(2) except for: waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 6.0 mg O_2/L; reservoirs formed on water bodies type 3 and 4 where the limit value is 8.5 mg O_2/L; reservoirs formed on water bodies type 5 and 6 and for artificial water bodies where the limit value is 5.0 mg O_2/L.

(3) depending on the waterway classification type

(4) depending on the waterway classification type, except for: reservoirs formed on water bodies type 3 and 4 where the limit value is 1.5 mg O_2/L; and for artificial water bodies where the limit value is 6.0 mg O_2/L.

(5) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 3.0 mg/L
(6) depending on the waterway classification type, except for: reservoirs formed on water bodies type 3 and 4 where the limit value is 2.0 mg/L; and for artificial water bodies where the limit value is 7.0 mg/L.
(7) depending on the waterway classification type
(8) except for reservoirs formed on water bodies type 3 and 4 where the limit value is 1.5 mg N/L; reservoirs formed on water bodies type 5 and 6 and for artificial water bodies where the limit value is 4.0 mg N/L.
(9) depending on the waterway classification type, except for: waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 0.20 mg N/L.
(10) depending on the waterway classification type, except for reservoirs formed on water bodies type 3 and 4 where the limit value is 0.4 mg N/L.
(11) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 0.15 mg P/L.
(12) depending on the waterway classification type, except for reservoirs formed on water bodies type 3 and 4 where the limit value is 0.05 mg P/L.
(13) except for waterways of the Pannonian Plain (excluding type 1 waterways) where the limit value is 0.1 mg P/L.
(14) depending on the waterway classification type, except for reservoirs formed on water bodies type 3 and 4 where the limit value is 0.02 mg P/L.
(15) Petroleum products must not be present in the water in such quantities as to: form a visible film on the water surface or coatings on banks of rivers and lakes, give a distinctive "hydrocarbon" fish flavor and cause adverse effects in fish.

H – Hardness (mg/L $CaCO_3$); NM – Not Measured

Table 14. Limit values for assessing the status and trends of sediment quality (2012)

Parameter	Unit	Target Value	Maximum Allowable Concentration	Remedial Value
Arsenic (As)	mg/kg	29	42	55
Cadmium (Cd)	mg/kg	0.8	6.4	12
Chromium (Cr)	mg/kg	100	240	380
Copper (Cu)	mg/kg	36	110	190
Mercury (Hg)	mg/kg	0.3	1.6	10
Lead (Pb)	mg/kg	85	310	530
Nickel (Ni)	mg/kg	35	44	210
Zink (Zn)	mg/kg	140	430	720
Mineral oils	mg/kg	50	3000	5000
Polycyclic aromatic hydrocarbons (PAHs)	mg/kg	1	10	40
Naphthalene	mg/kg	0.001	0.1	
Anthracene	mg/kg	0.001	0.1	
Phenanthrene	mg/kg	0.005	0.5	
Fluoranthene	mg/kg	0.03	3	
Benzo (a) anthracene	mg/kg	0.003	0.4	

Parameter	Unit	Target Value	Maximum Allowable Concentration	Remedial Value
Chrysene	mg/kg	0.1	11	
Benzo (k) fluoranthene	mg/kg	0.02	2	
Benzo (a) pyrene	mg/kg	0.003	3	
Benzo (g,h,i) perylene	mg/kg	0.08	8	
Indeno (1,2,3-cd) pyrene	mg/kg	0.06	6	
Polychlorinated biphenyls (PCB)	µg/kg	20	200	1
DDD	µg/kg	0.02	2	
DDE	µg/kg	0.01	1	
DDT	µg/kg	0.09	9	
DDT total	µg/kg	10	-	4000
Aldrin	µg/kg	0.06	6	
Dieldrin	µg/kg	0.5	450	
Endrin	µg/kg	0.04	40	
Ciklodien pesticides	µg/kg	5	-	4000
α-HCH	µg/kg	3	20	
β-HCH	µg/kg	9	20	
γ-HCH (lindane)	µg/kg	0.05	20	
HCH total	µg/kg	10	-	2000
Alfa-endosulfane	µg/kg	0.01	1	4000
Heptachlor	µg/kg	0.7	68	4000
Heptachlor-epokside	µg/kg	0.0002	0.002	4000

In 2012, Water Quality Control Program of Surface Waters and Canals in Belgrade included 24 waterways in the wider metropolitan area: Sava, Danube, Kolubara, Galovica, Topčider, Railway (Železnička in Serbian), Barička, Peštana, Turija, Beljanica, Lukavica, Bolečica, Gročica, Veliki Lug, Ralja, Barajev, Sopot, Sibnica, Kalovita, Vizelj, PKB canal, Obrenovac canal, Progarska Jarčina canal and Karas canal. All these waterways are under strong anthropogenic influence.

Water quality testing was done four times a year (seasonally), between March 1st to December 31st 2012, except for:

- the Kolubara River, the Galovica Canal, the Topcider and Railway Rivers, the River Sava and the Danube River at Batajnica (Zemun), where water quality testing was done once per month, between March 1st to December 31st 2012;
- the Makiš (Sava) and Vinca (Danube) sampling locations, where water samples were taken two times a month (as these are locations at the intake of water treatment plants named the same as the measuring points), between March 1st to December 31st 2012.

Water quality results were first analyzed according to the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit

Values (2012) in June 2012. The majority of measuring results indicated that the Belgrade waters do not satisfy the Class II requirements and have a poor ecological status.

The results for the Danube River are presented in the table below. The sampling points on the Danube River are located at:

- Batajnica (Zemun), upstream of the confluence with the Sava River;
- Vinca (Vinča in Serbian), about 7 km downstream of the future WWTP and at the intake of the water treatment plant (WTP).

These sampling locations are shown in the figure below.

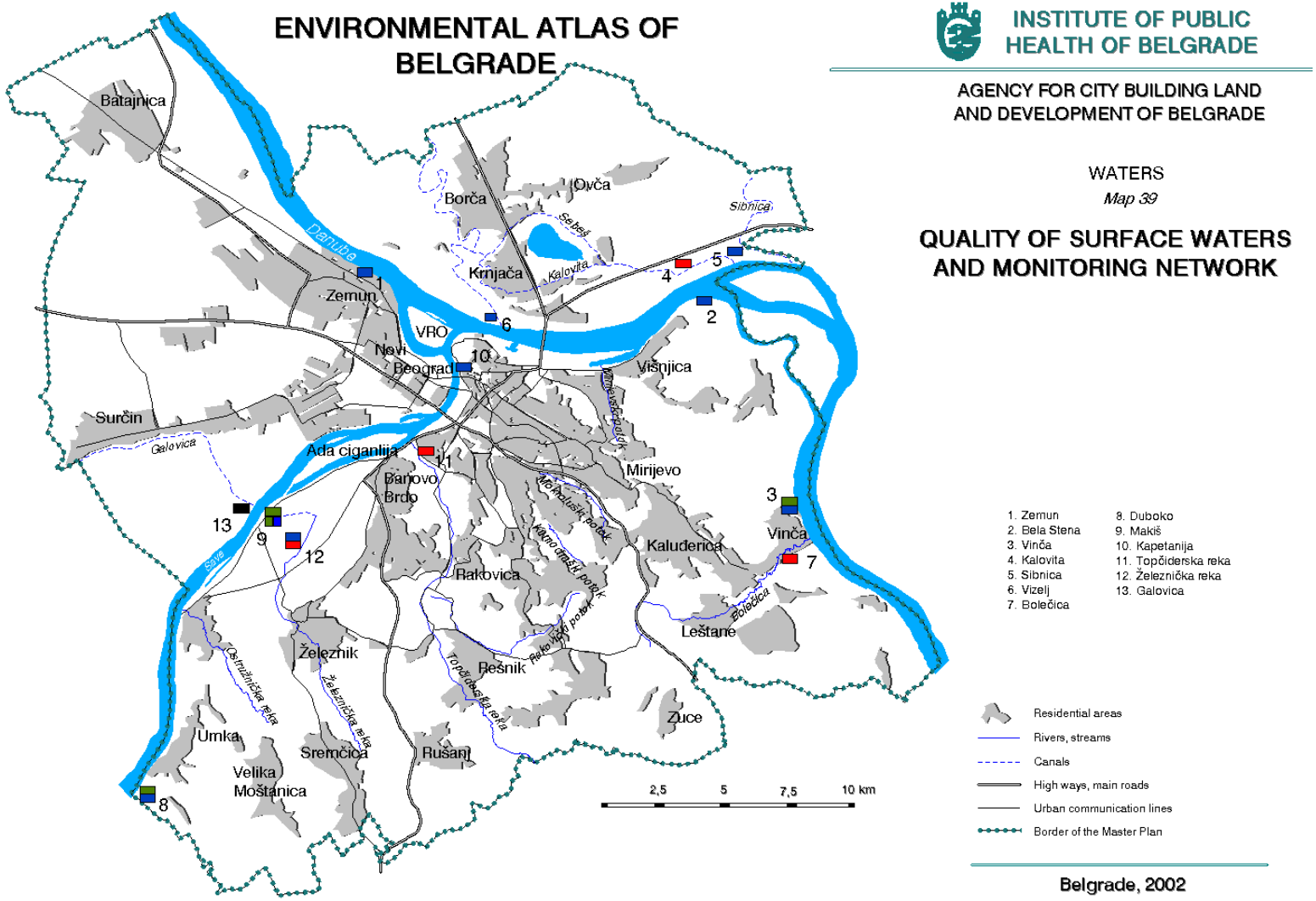


Figure 39. Surface water quality monitoring network (1-Zemun (Batajnica), 3-Vinca)

Table 15. Danube River water quality testing results (Source: Ecological Bulletins, 2012)

Month	No. of Samples	Class II water status	In non-compliance with Class II due to exceedance of:	
			Physical and Chemical Parameters	Microbial Parameters
June	3	0	0	3
July	3	0	0	3
August	3	0	0	3
September	3	1	0	2
October	3	1	0	2
November	3	0	0	3
December	3	3	0	0

As can be seen in the table above, the River Danube mostly does not comply with the Class II requirements due to microbial pollution, which can be an indicator of fecal contamination from raw wastewater discharges.

Four and five river water samples were taken of the Danube at the Lido beach in July and August 2012, respectively. In eight of the nine samples, the detected microbiological water quality parameters were higher than the prescribed limits for bathing water quality. The City officials recommended washing after each swim at the provided showers that were supplied with potable water, especially for young children and adults with an impaired immunity system (Ecological Bulletins of the Belgrade Secretariat for Environmental Protection, July – September 2012).

In 2010, the content of heavy and toxic metals in the Sava and Danube River sediment was not above effective values. The content of polycyclic aromatic hydrocarbons (PAHs) and mineral oils was moderately high. Other micro-pollutants were not detected.

Concentrations of toxic bio-accumulative heavy metals were not above their effective limits in the sediment near the Makiš and Vinca water capture points. This was not the case in years previous to 2010. These substances show characteristics of bio-magnification in food chains.

4.11 Hydrogeological situation

Contamination of groundwater occurs widely in urban areas equipped with sanitation, due to leaks and poor maintenance. In such cases, the groundwater may be contaminated by pathogens and a wide spectrum of household and industrial chemicals. Among the chemicals, the most common pollutant from this source is nitrate, as well as a variety of organic and microbiological pollutants. Nitrate is formed by the sequential, microbially-catalyzed oxidation of ammonia to nitrite and then to nitrate.

Groundwater has been the main source of potable water supply for the City of Belgrade for more than 50 years. The groundwater wellhead is formed on a large area of the River Sava alluvial plane. It is stretched along the river bank from the confluence, 50 km in the upstream direction. By now, 99 wells with horizontal drains (Ranney type) have been formed along the river bank, mainly on the left bank, and nearly 50 tube wells (Figure 40). The largest exploitation of groundwater occurred in the period from 1987 to 1988, with an annual average discharge of 6 m^3/s. After the construction of the Makis (Makiš in Serbian) water purification plant, the consumption of groundwater decreased to nearly 4 m^3/s on an annual average basis.

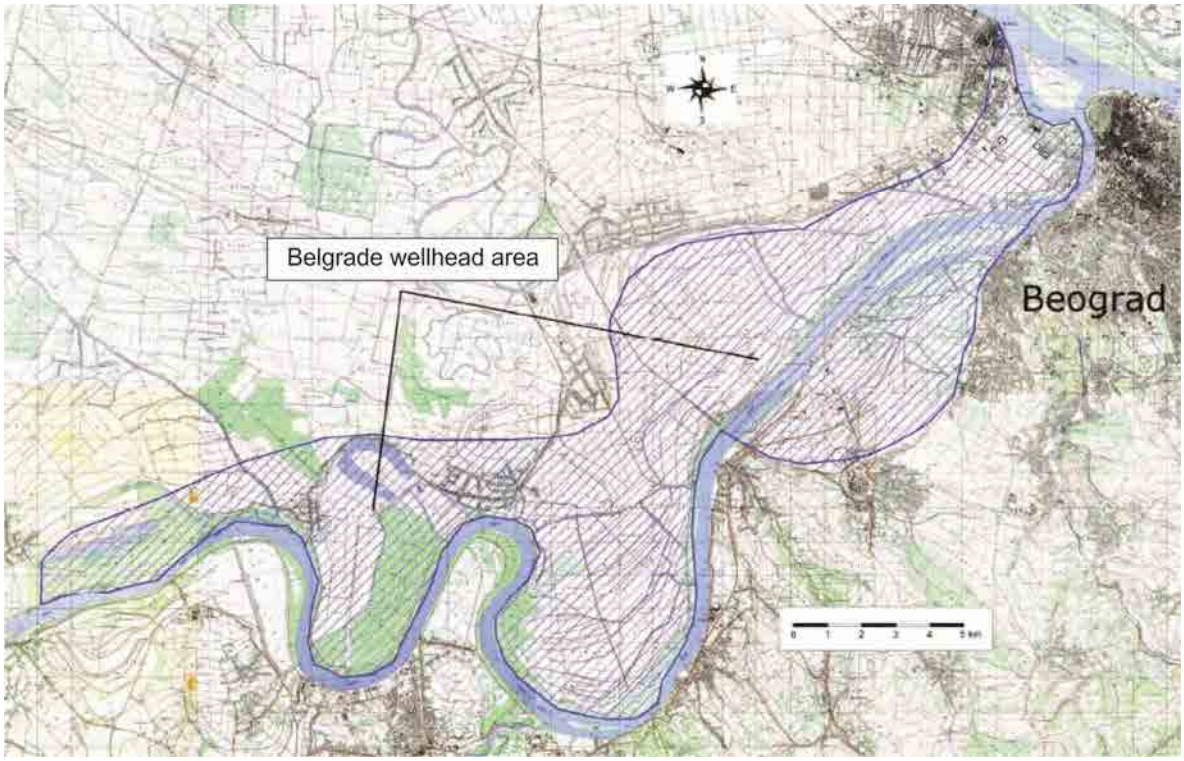


Figure 40. Belgrade wellhead area (Source: Master Plan of the Belgrade Sewerage System, 2011)

The thickness of the Sava alluvium of the Belgrade wellhead is about 25 m (figure below). The aquifer is composed of sand, sandy gravel and gravelly sands. The average effective diameter of the aquifer material (d10) is on the order of 0.3 mm, while the mean grain diameter (d50) is nearly 2 mm.

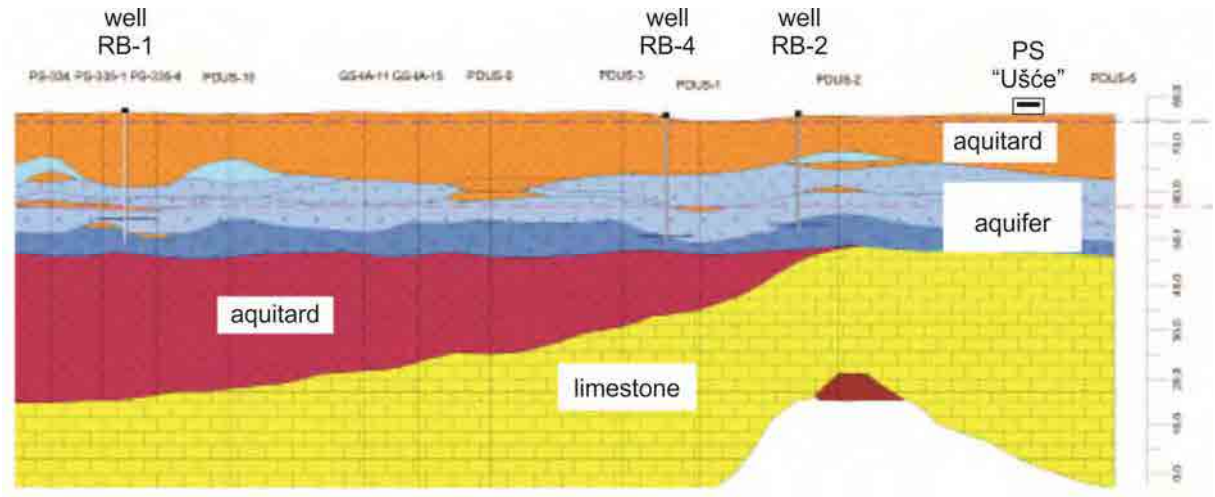


Figure 41. Hydrogeological crossection along the left bank of the river Sava (Source: Study of Belgrade's Groundwater Source, 2010).

There are two wells relatively near the Project wastewater management facilities. The "RB-2" well, with a capacity of 50 L/s, is located at about 550 m from the Usce pumping station; and further, at an approximate distance of 750 m, is the "RB-4" well with a capacity of 130 L/s. Actually, the Usce PS is located inside the well recharge area, and inside the inner wellhead protection zone of the Belgrade groundwater source. Other parts of the water management facilities (the Interceptors and the Veliko Selo WWTP) have no potential interaction with the Belgrade wellhead facilities.

In the following text, the hydrogeological characteristics of the area shall be analyzed, especially the zone of the Usce PS, where possible influence on groundwater quality may be expected. Hydrogeological characteristics of the Interceptor route vary significantly, with the high capacity unconfined aquifer, karstic aquifer and dry rock zones (figure below)

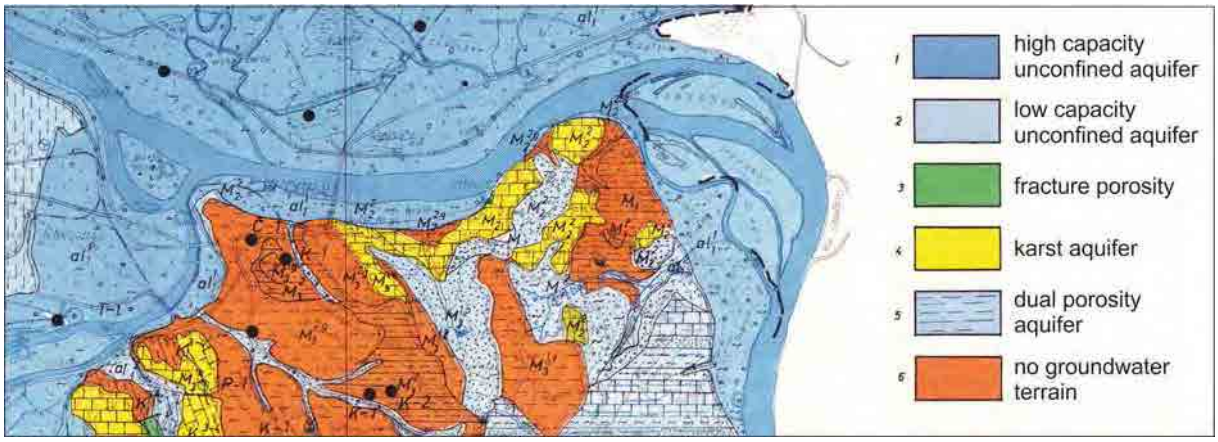


Figure 42. Hydrogeological map of the Belgrade area

4.11.1 Characteristics of the WWTP Area

This area is a part of the Danube alluvial plane, near its edge with Myocenic sediments. The elevation of the area varies between 71.5 and 73.0 m a.s.l. Water bearing soil strata has a significantly lower thickness in comparison with the Usce area. The soil strata composition, thickness of the layers and description of formations are as shown in the table below.

Groundwater is found at 0.5 - 2.0 m below the terrain surface, and it is under dominant influence of Danube River water level.

Table 16. Thickness and description of soil strata of the WWTP area (Source: Geotechnical report related to the foundation condition for the Usce Shopping Centre, Block 16, New Belgrade, 2005)

Level of occurrence	**Formation**	**Description**	**Thickness (m)**
GL	Refill	Silty clay with building material waste	0.3 – 1.0
67 – 69	Clay	Silty-sandy clays – heterogeneous in composition. The color is dark yellow with intervals of dark gray to black, indicating increased content of organic substance. Low to medium plasticity; impermeable.	2.0 – 4.0
64 – 66	Silty sand	Continually distributed under silty clays. Represents	1.0 – 2.0

Level of occurrence	Formation	Description	Thickness (m)
		transition to water bearing sands.	
61 – 63	Sand	Coarse, with lower percent of medium grain fractions, with interlayers of silty sand. At the lower boundary, gravels can be found.	1.0 – 2.0
59 – 61	Bedrock	Neogene sediments	

4.11.2 Groundwater quality

Reliable data on groundwater quality at the location of Veliko Selo WWTP are not available. As a part of the PEIA Study for the FS/PD for the WWTP Veliko Selo (2007), several samples were analyzed from the excavated irrigation well, which was 3 m in diameter and 4 m deep. However, the water quality in the well was influenced by aquatic life and probably by other surface impacts. Therefore the results cannot be considered as representative for groundwater quality assessment.

Chemical analysis revealed high concentrations of organic components, as well as microbiological pollution. However, concentrations of heavy metals (such as arsenic, copper, zinc, iron, chromium, cadmium, manganese, nickel and mercury) were significantly below the maximum allowable concentrations (MAC) for drinking water. Also, pesticides concentrations in samples (22 pesticide parameters) were also significantly below MAC for drinking water.

4.12 Hydrological Situation

4.12.1 River Regimes

Regimes of Danube and Sava Rivers in Belgrade are complex due to the conditions at the rivers confluence and the influence of the downstream Djerdap Hydro Power Plant (HPP) regime. The influence of the construction of the dam and Djerdap HPP on the change of water levels of Sava and Danube Rivers in this area is significant. The most significant level changes, regarding the natural regime, were in the domain of low and medium flow rates, while the smaller changes are produced in the case of high flow rates. The differences for low flow rates of 1900 m^3/s are up to 2.6 m, and for higher flow rates (over 10,000 m^3/s) are up to 0.3 m.

The duration curve at the Pančevo station indicates registered Danube flows from 1300 m^3/s up to 13,400 m^3/s. The flow of duration of 50% is 5000 m^3/s, and average flow is 5,430 m^3/s. Water levels at the confluence of the Danube and Sava Rivers (according to the study from 1988) are:

- for 5% flow duration - water level 73.3 m
- for 50% flow duration - water level 70.2 m
- for 95% flow duration - water level 67.8 m

In the analysis of hydrological conditions at the confluence, of the special interest are always the coincidence of flood levels in the Sava and Danube Rivers. This is an important fact for flood analysis and protection design.

The water level of the Sava River, which is used for the design and construction of protection embankments, is 76 m a.s.l. (according to the Master Plan of Belgrade 2021).

4.12.2 The Danube River

The Danube River watershed area of 817,000 km^2 produces an average water discharge of 6,500 m^3/s at the Danube mouth to the Black Sea. The River Danube enters Serbia near the village of Bezdan. The main tributaries are the rivers Tisa, Sava and Velika Morava. The nearest hydrological gauge stations, relevant for this study, are Zemun and Pančevo. The Pančevo station is located on the left bank, opposite to the location of the Veliko Selo WWTP.

As pointed out before, the water level regime is under the influence of the Djerdap HPP, i.e. according to HPP exploitation regime for 69.5 m a.s.l. and higher. Since 1991, the regular exploitation regime is strictly defined up to the flow of 13,000 m^3/s, by regulation of the water level at the river Nera estuary profile (Banatska Palanka), according to the table below.

Table 17. The Danube River flow regime at the mouth of the River Nera

Discharge (m^3/s)	Water level (m a.s.l.)
2,000	69.65
8,500	70.70
11,500	70.85
13,000	70.95
> 13,000	> 70.95 natural regime

Observations of the water level at the hydrologic station Pančevo, in the period from 1991 to 2002, show that the minimum water level was 68.45 m, and the maximum 73.62 m a.s.l. Basic characteristics of the water level regime at the Pančevo and Zemun stations are shown in the tables below. Figure 43 shows the water level duration curve for this hydrology station for the same observation period.

Table 18. Monthly annually averaged water levels observed at the hydrologic stations Pančevo and Zemun (m a.s.l.).

H. Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann. Average
Pančevo	70.03	70.45	70.86	71.55	71.33	70.91	70.33	69.69	69.39	69.21	69.45	70.07	70.28
Zemun	70.60	71.02	71.43	72.15	71.93	71.47	70.88	70.24	69.99	69.77	70.03	70.66	70.86

Table 19. Monthly and annually averaged minimum water levels observed at the hydrologic stations Pančevo and Zemun.

H. Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann. Average
Pančevo	69.12	69.42	69.82	70.79	70.62	70.32	69.59	69.11	68.78	68.53	68.63	69.16	69.49
Zemun	69.66	70.02	70.39	71.42	71.17	70.92	70.15	69.66	69.39	69.12	69.24	69.75	70.08

Table 20. Monthly and annually averaged minimum water levels observed at the hydrologic stations Pančevo and Zemun.

H. Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann. Average
Pančevo	70.93	71.36	71.84	72.13	72.08	71.55	71.04	70.41	70.12	70.00	70.46	71.00	71.08
Zemun	71.47	71.89	72.39	72.71	72.59	72.09	71.58	70.93	70.67	70.55	71.01	71.52	71.62

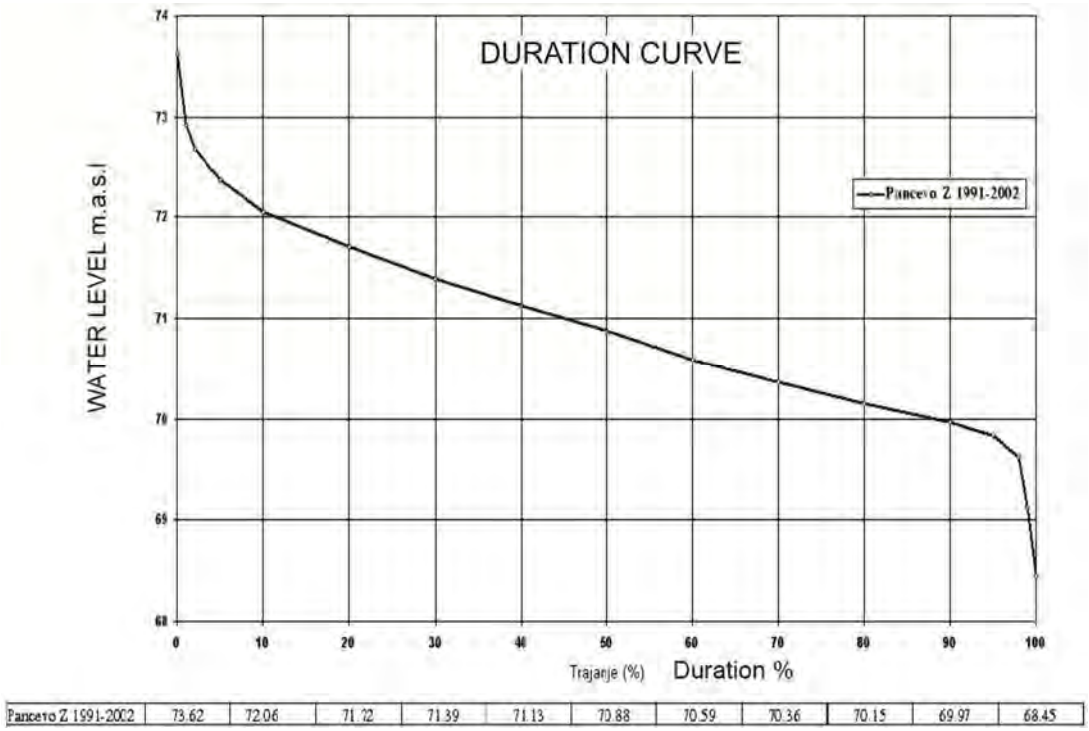


Figure 43. Water level duration curve for hydrology station “Pancevo”, in the period 1991-2002.

4.12.3 The Sava River

The most proximate hydrologic station is the “Sava–Belgrade” station, located at the harbor on the Sava River right bank (close to the Branko Bridge), opposite of the Usce PS. Water stage at this location is observed since 1921 and the complete record from 1921 to 2007 was made available by Republic Hydro-meteorological Service of Serbia.

The duration curve of the water level is shown in the figure below. The characteristic water level with the duration of 10%, 50% and 90% are 72.70 m, 71.18 m and 70.12 m a.s.l., respectively.

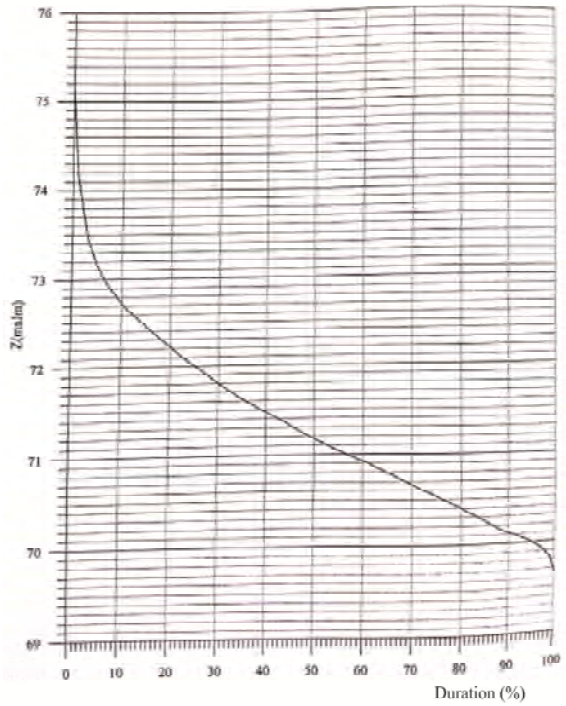


Figure 44. Duration curve of the Sava River water levels at the hydrologic station "Sava-Belgrade".

4.12.4 Frequency Analysis of Flood Levels

The regime of the Danube and the Sava Rivers at Belgrade is highly influenced by the backwater effect from the Djerdap (also known as the "Iron Gate") hydro-power plant and its reservoir. This is especially true for the low flow and medium flow regimes. Although it could be said that the flood regime is also under influence of the Iron Gate reservoir due to flood wave attenuation, statistical tests have not proven inhomogeneity of the annual maximum flood record at the Sava–Belgrade station and consequently the record has been used for flood level frequency analysis (University of Belgrade - Faculty of Civil Engineering, 2008).

It should also be noted that more reliable results would be obtained if the flood flows were used for frequency analysis and the results transferred into flood levels using a rating curve. However, a reliable rating curve is not available and the frequency analysis is carried out with flood levels.

The annual maximum levels at the Sava–Belgrade hydrologic station from 1921 to 2007 vary between 71.68 and 75.66 m a.s.l. (Figure 45). The properties of the annual maximum series are shown in the table below.

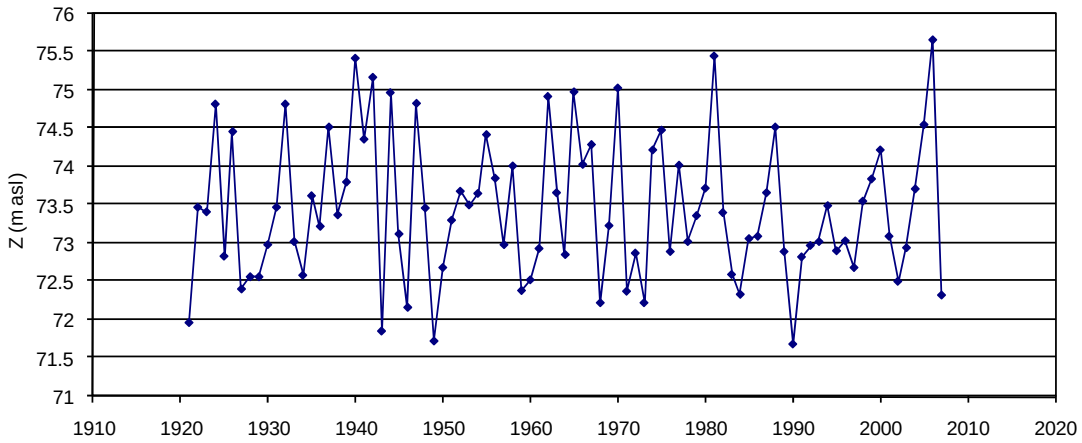


Figure 45. Observed annual maximum levels of the Sava River at Belgrade (1921-2007).

Table 21. Properties of the annual maximum series of flood levels of the Sava River at Belgrade.

	Original Series	Log Series
Sample Size	87	87
Mean	515.9	6.2300
Standard Deviation	92.9	0.1792
Skewness Coefficient	0.409	0.036

After fitting several theoretical distributions to sample data, lognormal distribution was chosen as a best fit. Figure 46 shows the normal probability graph with empirical cumulative distribution function and the lognormal fit and Table 20 presents relevant lognormal quantiles for flood levels.

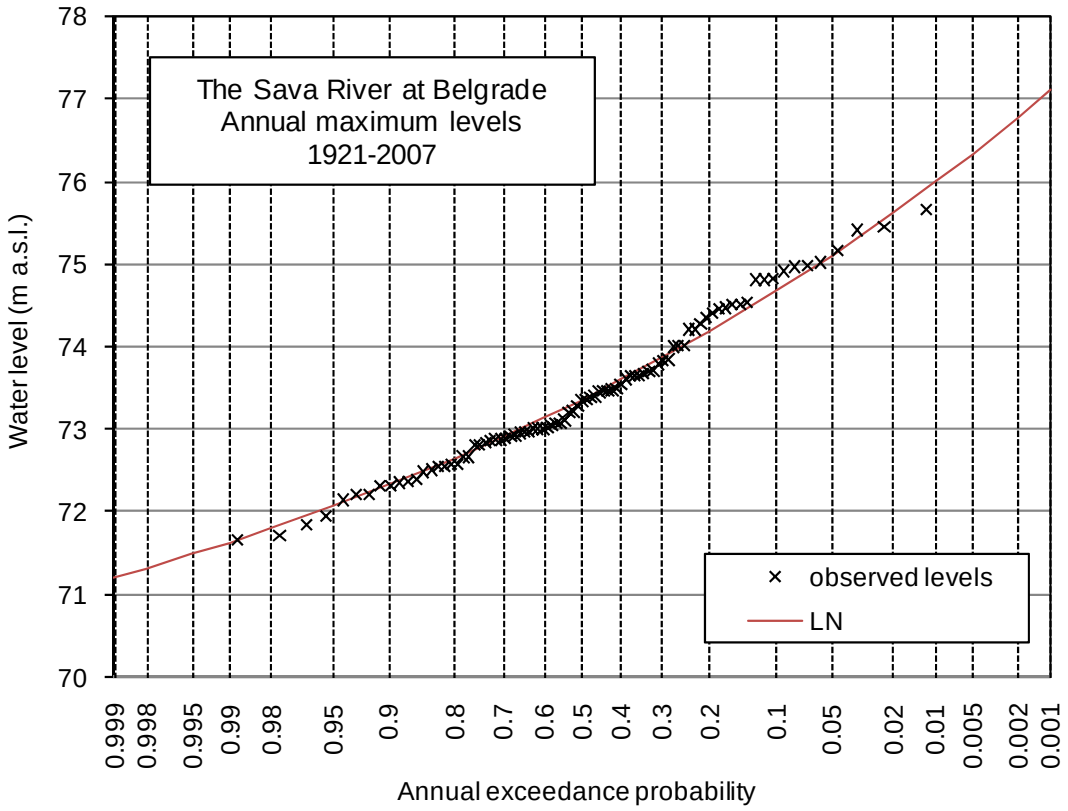


Figure 46. Cumulative distribution function for annual maximum levels of the Sava River at Belgrade.

Table 22. Quantiles of the annual maximum levels of the Sava River at Belgrade.

Return period (years)	Annual exceedance probability	Water level (m a.s.l.)
2	0.5	73.36
5	0.2	74.18
10	0.1	74.67
20	0.05	75.10
50	0.02	75.62
100	0.01	75.98
200	0.005	76.33

4.13 Coastal Zone

There is no coastal zone in Serbia.

4.14 Natural Environment

4.14.1 Protected Areas

The locations, names and protection status of Belgrade's protected areas are presented in the figure and the table below. The map of Belgrade's natural protected areas shown as Figure 47 was created in the year 2005. Since then, additional trees and the following sites have been put under protection:

- the Great War Island (landscapes of outstanding features) – Veliko ratno ostrvo in Serbian
- Academic Park (natural monument) – Akademski park in Serbian
- Miljakovac Forest (natural monument)
- Topčider (natural monument)
- Košutnjak (natural monument)
- Faculty of Forestry Arboretum (natural monument)
- Silver lime tee Forest (strict nature reserve)

There are no protected areas in the zone of planned works. This was confirmed in the A Decision on the Protection Requirements from the Institute for Nature Conservation of Serbia for the WWTP location obtained in 2005 for the Veliko Selo WWTP Preliminary Design Report (PEIA Study for the FS/PD for the WWTP Veliko Selo, 2007).

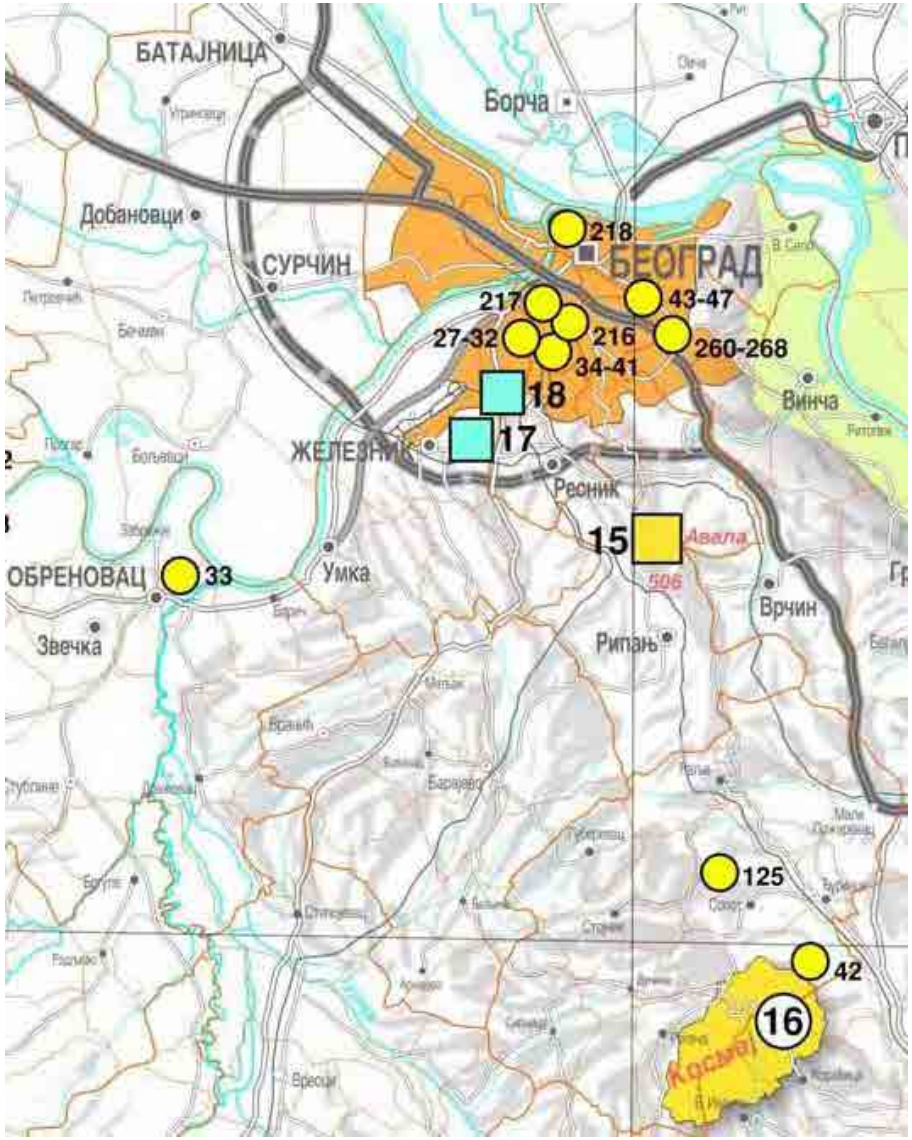


Table 23. Belgrade's natural protected areas

Map No.	Name	Protection Status
15	Mt. Avala	LOF
16	Mt. Kosmaj	LOF
17	Forests of oak and hornbeam at Brigand's fountain	SNR
18	Pioneers' Park	NM
27 – 32	Individual long-living and rare trees	NM
33	Group of oak trees at Jozić's hut	NM
34 – 41	Banjica Forest & individual long-living and rare trees	NM
42	Oak tree (*Quercus robur*) Melnice (over 230 years old)	NM
43 – 47	Botanical Gardens "Jevremovac", & individual long-living and rare trees	NM
125	Oak tree (*Quercus robur*)	NM
216	Miocene sand-shelf at Tašmajdan	NM
217	Maša's Mine in Topčider (geological set layer from the upper Cretaceous Age)	NM
218	Marine Neogene Sandbank in Kalemegdan	NM
260 – 268	Individual long-living and rare trees	NM

LOF – Landscape of Outstanding Features
SNR - Strict Nature Reserve
NM – Natural Monument

Figure 47. Belgrade's natural protected areas (Source: Institute for Nature Conservation of Serbia, 2005)

4.14.2 Flora, Fauna and Biodiversity

There are no “natural” or “near natural” habitats within the area of the planned works. Due to the high influence of urbanization and industry, the area is under strong anthropogenic influence.

The terrestrial vegetation of the area of concern could be characterized as urban. The present agricultural fields are of type 71, subtype 711 (fields with intensive agriculture).

Within the areas characterized as urban, protected plant species are not expected to be found. The following plant species are typical for the area: *Cichorium intybus* (L.), *Cirsium arvense* (L.) Scop., *Lolium perenne* (L.), *Cynodon dactylon* (L.), *Dactylis glomerata* (L.) These plant species have the ability to spread quickly and find new grounds; therefore, the Project works will not affect their survival.

The main types of ecosystems could be identified in Danube River within the target area and neighboring flooding zones involve ecosystems of the floating vegetation (*Lemnetea* W. Koch et R. Tx. 1954), (*Nymphaeon albae* Oberd. 1957) submerged vegetation (*Potametea* R. Tx. et Preising 1942) and amphibian helophyte vegetation (*Isoeto-Nanojuncetea* Br.-Bl. Et Tx. 1943).

There are fragmentary and small areas of preserved autochthon floodplain habitat with wetland vegetation on the river islands in the vicinity of the Project site (please see figure below). The following bird species can be found: Grey Heron (*Ardea cinerea*), Purple Heron (*Ardea purpurea*), Little Egret (*Egretta garzetta*), White-tailed Eagle (*Haliaeetus albicilla*), Common Stonechat (*Saxicola torquata*), Icterine Warbler (*Hippolais icterina*), Eurasian River Warbler (*Locustella fluviatilis*), European Serin (*Serinus srinus*) and Corn Bunting (*Miliaria calandra*).

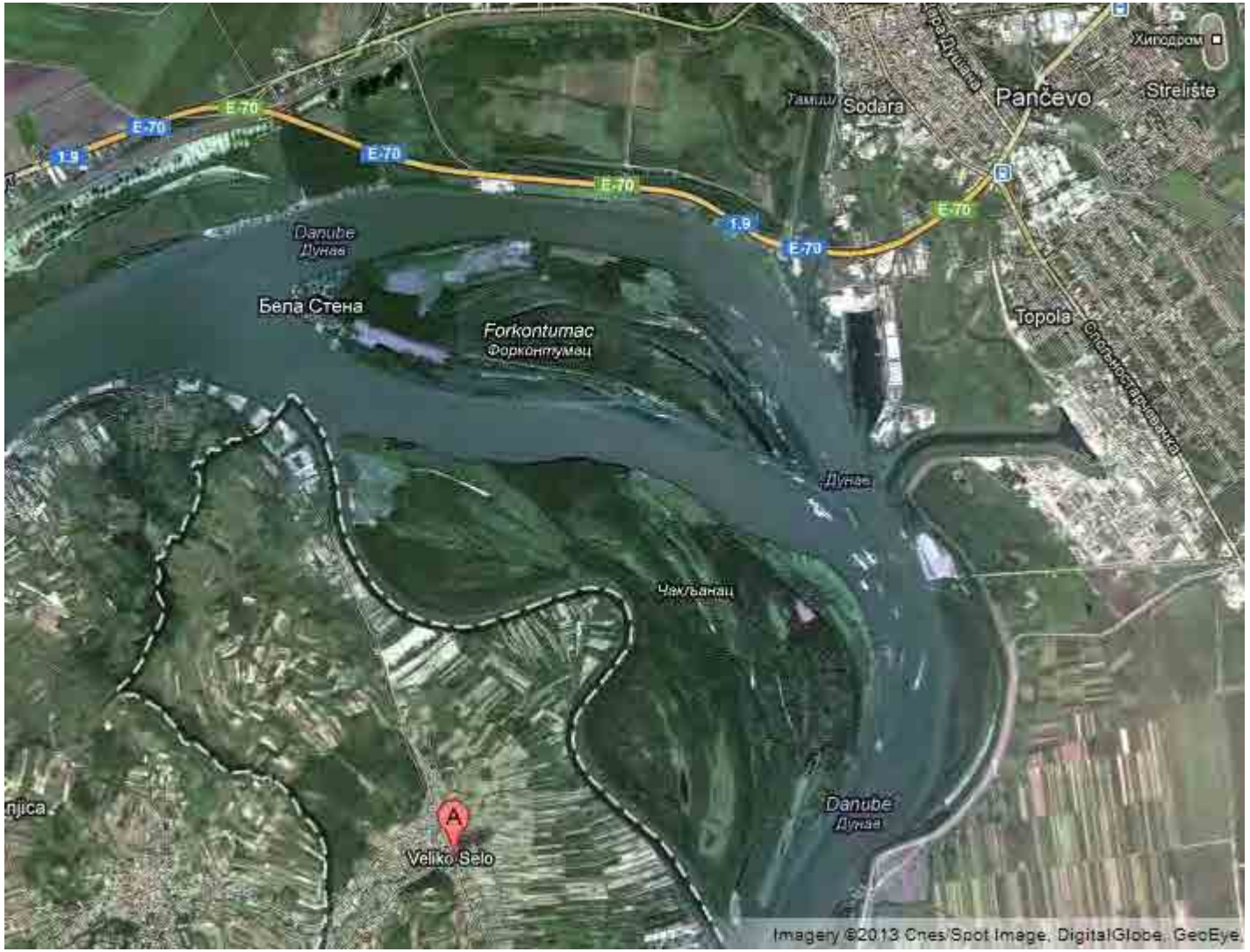


Figure 48. The river islands in the vicinity of the Project site. The isle of Forkontumac has preserved wetland areas.

Figure 49. Grey Heron (*Ardea cinerea)*

Figure 50. Common Stonechat (*Saxicola torquata*)

Figure 51. Eurasian River Warbler (*Locustella fluviatilis*)

4.15 Cultural Heritage

The map of the cultural heritage of Belgrade in the figure below shows that there are no cultural and historic sites and monuments in the area of the future Veliko Selo WWTP.

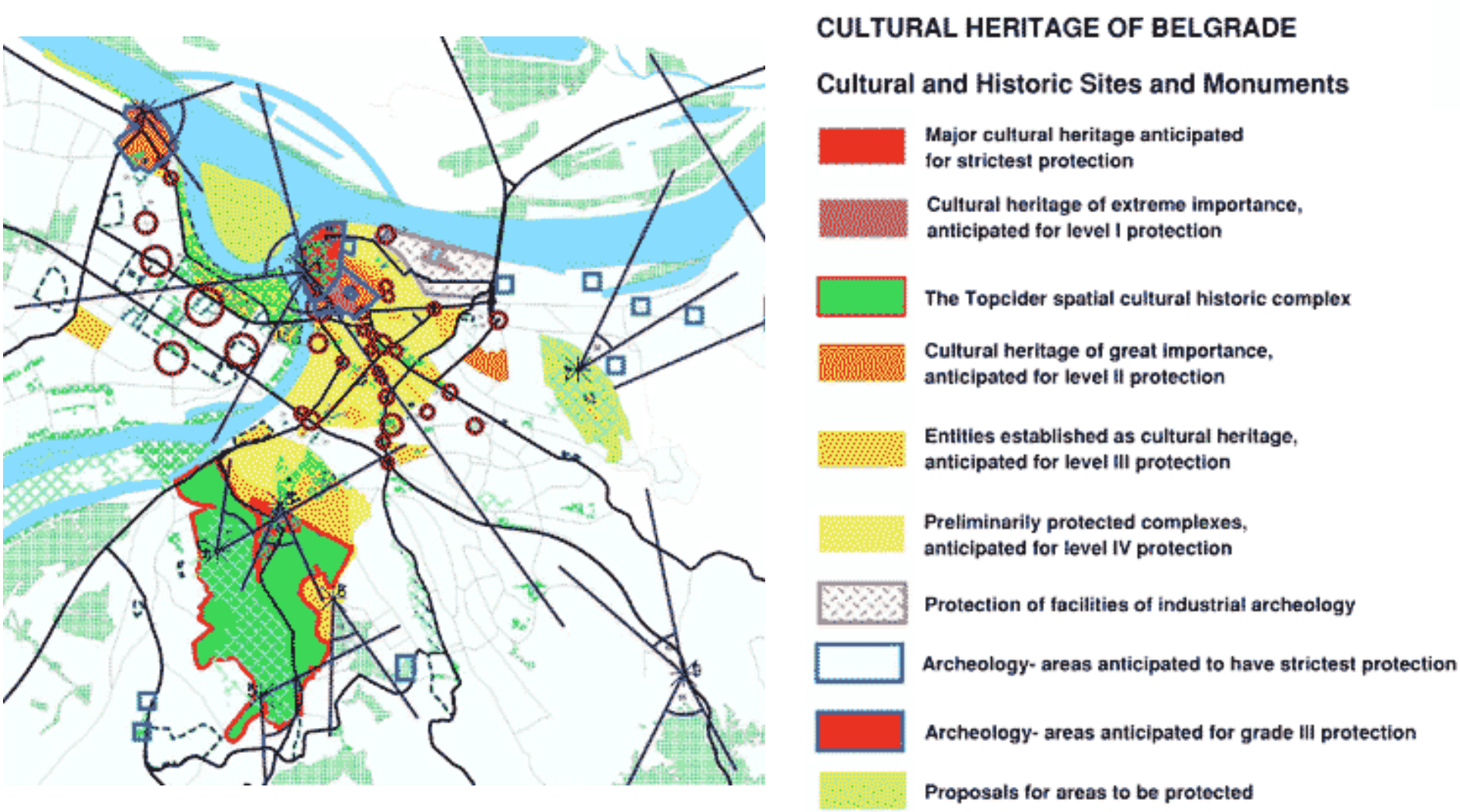


Figure 52. Map of the cultural heritage of Belgrade

5 Analysis of With and Without the Project Scenario

With the implementation of the proposed Project works, the Republic of Serbia and the City of Belgrade will achieve a number of very important goals:

- The Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012) will be satisfied, which is a dual great benefit to Serbia – it will improve its water quality status in Belgrade and it will fulfill an environmental requirement set forward by the European Union. The Project will also lead to faster compliance with the Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012).

- With the construction of the interceptors and the Veliko Selo WWTP, Belgrade's industries will be forced to comply with the wastewater effluent standards for discharge into the communal sewer system. These waters are currently discharged into the river waters untreated.

- Belgrade's potable water sources are under the direct influence of the surface water quality; the improvement of the surface water quality will enhance the safety of the drinking water sources for the future.

- The further accumulation of pollutants in river bed sediments will be delayed.

- The City of Belgrade's waters will be healthier and this will improve the general standard of living for the city's inhabitants. The City beaches and bating waters will be safer to use due to the discontinuance of raw wastewater discharges in their vicinity. Aquatic habitats will also be improved.

- The tourist potential will be increased by developing different kinds of entertainment venues and tours on the rivers.

- The construction of the interceptors will free up large areas along the Sava and Danube River banks that outlets (e.g. at the location of Ada Huja). This will have a positive effect on surface water quality, riparian flora and the landscape in general. The rehabilitated spaces will be available for recreational and other activities.

If the Project is not completed, the situation will be "status quo" and the quality of the Belgrade's rivers and its bio-systems will continue to be degraded by untreated wastewater discharges at many points along the Sava and Danube Rivers. Also, the non-implementation of the Project works will hinder the advancement of Serbia towards the European Union from the legislative point of view.

6 Environmental Impacts

The management of construction and operation phase impacts should be described in the Project Main (Detailed) Design Report. According to the Law on Planning and Construction (2009 & 2001), the Main Design Report must include the detailed description of measures that prevent or reduce the negative impacts on the environment through appropriate technological processes. The objective is to provide information for environmental management during the proposed construction works and operational activities, for the impacts that need to be monitored/ controlled as defined by the Project EIA Report.

6.1 Construction Phase Impacts

Construction works involve the engagement of construction vehicles, machinery and other equipment. Construction works have the potential to cause temporary air pollution, noise and pollution of surface and groundwater if the machinery and equipment are not maintained in good working condition or are not used properly. The possible impacts of the planned construction works are described below.

The Contractor should, together with the Construction Site Management Plan (CSMP), also adopt and follow the Environment Management Plan (EMP) defined in the Main Design Report, based on the recommendations of the Project Environmental Impact Analyses Study Report.

6.1.1 Soil and Geographical Features (Landscape)

The area of the WWTP location is rural, agricultural. The project area covers 115 ha; expropriation of the area stated in 2006 and is still ongoing.

There is a possibility of dust emission during the construction phase, which may influence agriculture. This can be minimized by application of the best practice in construction methods. No additional construction roads will be required.

The changes of general land use type are assessed to be of local character and limited only to the narrow zone around the WWTP at Veliko Selo - change from agricultural to industrial land. Having in mind that the area is already under anthropogenic influence, there are no expected additional negative pressures to geological or biological diversity.

During the construction phase, no local resources will be utilized. The plant will be connected to the water distribution system.

The overall assessment of impacts on land use and utilization of local resources in the construction, as well as in operation phase is negligible adverse.

A silt fence and/or staked hay bales can be installed at the limit of work before construction begins to prevent sediment and debris being transported to down gradient areas. The silt fence/hay bale barrier should be inspected weekly and after all larger storm events, and repaired as needed. The barrier should remain until the area is permanently stabilized. A stockpile of silt fence should be stored on-site for routine maintenance and emergency repairs, and hay bales should be replaced as necessary due to sediment build-up and degradation. The silt fence/hay bale barrier should not be removed until areas are paved or an 80 percent vegetative cover is established.

Work should proceed as rapidly as possible. Limiting the exposure time of disturbed soils to wind and precipitation will minimize soil erosion and subsequent sedimentation.

6.1.2 Microclimate Parameters

No impact is expected.

6.1.3 Global Warming

The Project has no impact on global warming.

6.1.4 Air Pollution and Offensive Odors

During construction, the operation of construction machines and other equipment will cause dust to rise and spread throughout the surrounding area. The motor vehicles and machinery employed at the site will also generate exhaust emissions. This effect is temporary and can be minimized with the application of best practice construction methods (modern technologies) and site management, as should be defined in the Main Design Project Report and in the Project EMP.

Construction vehicles, machinery and equipment should be in good working condition and well maintained. Dust emissions from piles of soil or any other material during earthwork, excavation and transportation should be controlled by wetting surfaces, using temporary wind breaks and covering truck loads.

The Veliko Selo village (closest settlements) is at a considerable distance (around 1 km) and protected geographically from the construction site, so there will be no impact on the local population.

6.1.5 Noise and Vibrations

Temporary noise pollution due to construction works should be controlled by proper maintenance of equipment and vehicles, and tuning of engines and mufflers.

The Contractor will have to ensure that workers operating equipment that generates noise should be equipped with noise protection gear. Workers operating equipment generating noise levels greater than 80 dB (A) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels of 70 - 80 dB (A) should wear earplugs.

The emitted noise affects only the immediate environment and is temporary in nature.

The use of heavy equipment during site clearance and road construction works will inevitably generate noise and vibrations but this should not be of any consequence to adjacent communities that are located sufficiently far away as to not be affected (Veliko Selo is 1 km away from the site). The remoteness of the site should help to ameliorate noises.

The emitted noise and vibrations affect only the immediate environment and are temporary in nature.

6.1.6 Ground Subsidence

The WWTP area has a terrain elevation between 71.5 and 73 m a.s.l. and is prone to flooding. The Danube River water level duration curve between 1991 and 2002, at the hydrology station “Pancevo”,

which is located at the left bank across the WWTP area, reveals that 25% of time the water level is above 71.5 m a.s.l. Therefore, significant filling will be required before construction.

In order to prevent bank erosion, stabilization works will be required in the WWTP zone. Partially, the bank stabilization has already been conducted, during the Interceptor tunnel excavation. Figure 54 illustrates that acute landslide areas exist in the vicinity of the future WWTP site.

Figure 53. The river bank at the WWTP location

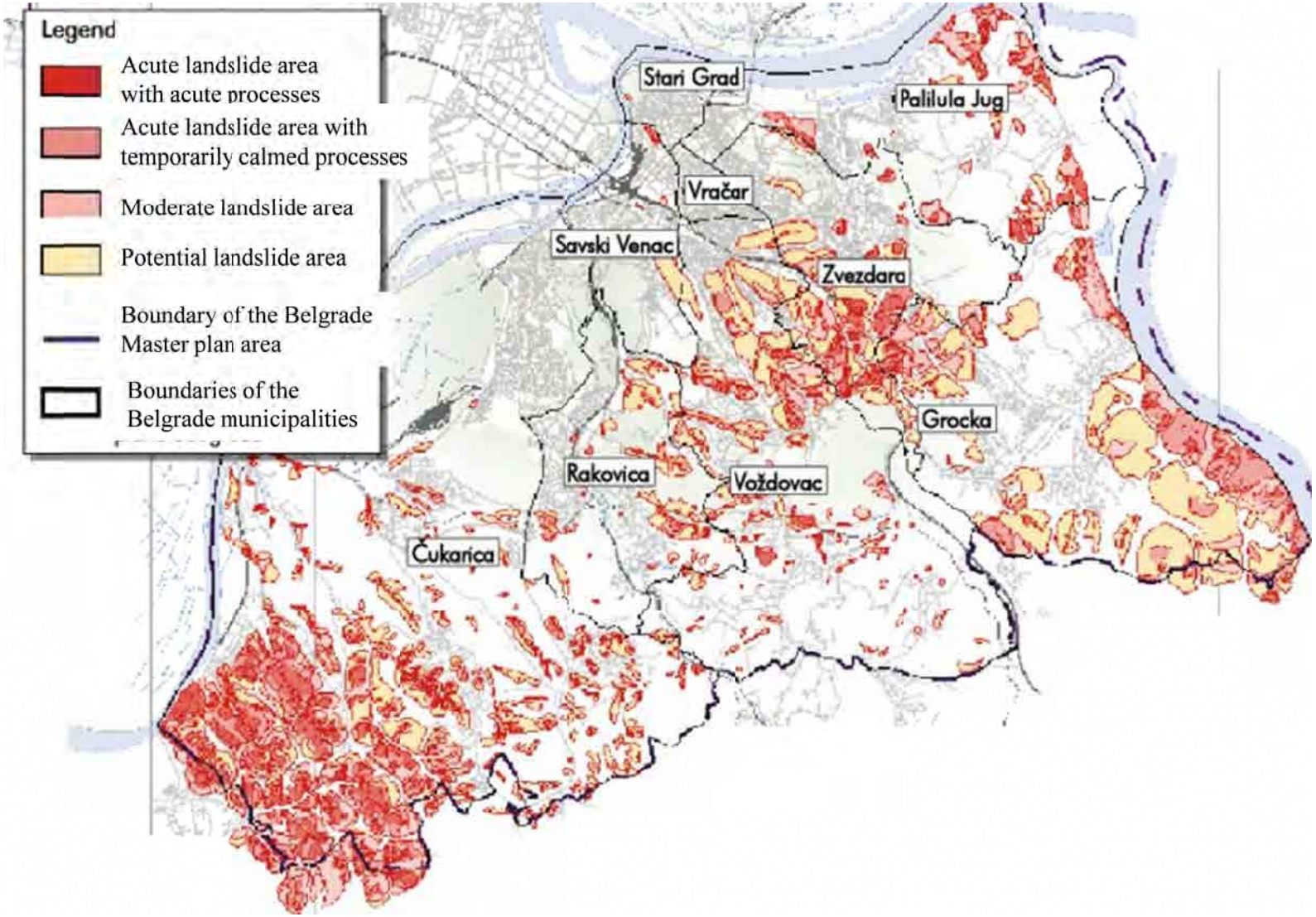


Figure 54. Landslide areas in Belgrade and in the vicinity of the future WWTP site

6.1.7 Solid Waste Management

Waste will be generated during the construction of the WWTP. Directions on construction site waste management will be included in the EMP. The EMP should include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site, and a system for supervision and monitoring.

Most construction waste is non-hazardous and inert. This waste should be:

- Preferably recycled (construction waste recycling facilities and services do not exist in Belgrade currently, but is expected that they will be available in the near future); or
- Deposited at the Vinca municipal landfill (where it is currently used as landfill cover material).

If any hazardous waste materials are generated on-site, the EMP must have information of the locations where this type of waste can be deposited or the names of companies who handle hazardous waste materials.

6.1.8 Water Resources and River Sediments

Potential impacts on water resources (groundwater and surface water regimes and quality) associated with the construction phase of the Project are considered in the text that follows. The aim is to identify and assess potential adverse impacts on the water regimes and water resources quality, before defining appropriate mitigation measures that will be implemented in the Project.

As a part of the Belgrade Sewerage Master Plan, the Project has potential impact on water resources. The assessment will cover potential impacts on groundwater (regimes and quality) and surface water (hydrological regime and water quality).

Potential construction phase impacts include:

- Contamination of groundwater;
- Contamination of surface water during site clearance and construction works (oil spills and contamination, wash-out/runoff, etc.).

Due to significant discharge of the Danube River, there is no reasonable potential impacts on flow regimes of the Project.

Water resources that may be affected by the Project works were evaluated regarding the short and long-term consequences in order to assess the relative significance. The utilized sensitivity and magnitudes of the impact gradation are shown in the tables below.

Table 24. Water resource sensitivity criteria

Sensitivity	Characteristics	Example
High	Surface water or groundwater with limited, or no capacity to absorb the impact Surface water or groundwater with minimal opportunity for mitigation Surface water or groundwater providing vital ecosystem services (e.g. fishery) Surface water or groundwater as resource of water supply, major industrial abstraction or large irrigation supplies	Wellhead vital for water supply Water supply for major industry or irrigation use Unconfined, shallow aquifers
Medium	Surface water or groundwater with some capacity to absorb the impact Surface water or groundwater at medium risk of pollution Surface water or groundwater providing important ecosystem services (e.g. fishery). Surface water or groundwater as resource of water supply, major industrial abstraction or large irrigation supplies	Spring or well serving village water supply or local industry Unconfined aquifer with overlying layer of less permeable soil.
Low	Surface water or groundwater with capacity to absorb the impact Surface water or groundwater with moderate opportunity for mitigation Surface water or groundwater already changed from natural condition Surface water or groundwater as resource of individual water supply	Confined aquifer with significant (> 5 m) overlaying aquitard. Large rivers with high discharge, capable to attenuate periodical pollution release (e.g. from CSO facilities).
Negligible	Surface water or groundwater with considerable capacity to absorb the impact	Deep, confined aquifer with significant overlaying aquitard.

Table 25. Magnitude of Impacts

Magnitude	Description
Major	Significant impact resulting in long-term modification, with expected exceedance of national standards limits. Requires significant intervention for revitalization to baseline state.
Moderate	Detectable short or long/term change of baseline state, without exceedance of national standards limits.
Minor	Detectable, minor change of baseline state.
Negligible	No perceptible change of baseline state.

Facilities required during the construction include:

- Residential and office accommodation;
- Storage areas;
- Parking for vehicles.

Temporal impacts on surface/groundwater quality may arise due to:

- Spills of the generated wastewater;
- Spills/Leaks of oil products or other chemicals stored at the storage areas.

Possible impacts are shown in the table below. All impacts can be mitigated with the application of best practice construction methods (modern technologies) and site management, as should be defined in the Main Design Project Report and in the EMP. All wastewater generated on the construction site must be properly collected and disposed of. The EMP must include information and instructions on how to handle all on-site waste flows and minimize any negative environmental impacts.

Therefore, the impacts on water quality (surface water and groundwater) from construction facilities are temporary and can be avoided/ mitigated. The overall assessment is Negligible adverse.

Table 26. Possible construction phase impacts on water resources quality

Potential Impacts	Sensitivity	Magnitude	Impact Significance
Temporary, localized pollution releases into Danube River during construction phase* *Discharges to meet Standards or taken for off-site disposal. Fuel and other chemicals to be stored on site must be bounded to avoid leakage and contamination.*	Low	Minor	Minor adverse
Temporary, localized pollution release into aquifer during construction phase*	Medium	Moderate	Moderate adverse

* from fuel and other chemicals used during construction

6.1.9 Natural Environment

The planned Project works will not influence the biological diversity of the area, i.e. they will have no impact on ecosystems, flora and fauna.

Landscaping and replanting of trees will be needed to provide some aesthetic quality and may serve as a natural windbreaker and minimize potential odor dispersions. The landscaping plan should seek to avoid the use of non-native and potentially invasive species. It should include low-maintenance local species and the types of trees and shrubs used for feeding by local bird species.

6.1.10 Cultural Heritage

There is no evidence of any archeological or historical monuments in the site region.

At the Project preliminary design stage, the Belgrade City Institute for Protection of Cultural Monuments will issue a Decision on Technical Protection Measures for the Project works upon the request of the Project manager. These measures must be incorporated into the Preliminary Project Design and must also be followed during the construction phase of the Project.

The project manager is also obliged to notify the Belgrade City Institute for Protection of Cultural Monuments on the dynamics of all the works. If archaeological sites and material cultural remains are encountered during earthworks, the contractor is obliged to stop works immediately and notify the Belgrade City Institute for Protection of Cultural Monuments of the findings, as well as ensure that the site is protected in order to avoid damage or destruction of the findings, until the arrival of professional archeological teams.

6.1.11 Existing social infrastructures and services

Power supply connections will probably have to be made and the WWTP will have to be connected to a potable water supply. If the connections are executed properly, there is no adverse impact.

Power supply connections will probably have to be made (application already submitted by the Belgrade Land Development Public Agency) and the WWTP will have to be connected to a potable water supply. A phone connection is also needed. A SCADA system will need to communicate with the outside area (Pump Stations, Belgrade Waterworks and Sewerage Public Utility Company offices, the Serbian Agency for Environmental Protection office, and the like).

If the connections are executed properly, there is no adverse impact.

6.2 Operation Phase Impacts

6.2.1 Soil and Geographical Features (Landscape)

No impact is expected during the operation of the Project facilities.

6.2.2 Microclimate Parameters

Water management facilities generally may have effects on microclimate parameters. In that regard, facilities that have the most significant influence are those that increase the surface of the water table,

as do retention/detention ponds and lakes. These facilities usually influence air humidity, air temperature, wind speed and the number of days with fog.

The sewerage system improvement project for the City of Belgrade does not include facilities that have a significant water table surface, which could have impact on microclimate parameters.

6.2.3 Global Warming

The Project has no impact on global warming.

6.2.4 Air Pollution and Offensive Odors

Operational wastewater treatment plants do not cause air pollution, apart from possible emissions of methane and carbon-dioxide gas contained in the biogas produced during anaerobic sludge digestion. If the biogas is used for electricity generation, the methane is converted to carbon-dioxide in the process, and this should occur in the event that biogas is not beneficially used as well.

Support operations, such as regular truck traffic for sludge management, material and fuel transport and stand-by generators (when in operation) will contribute a certain amount to air pollutant emissions.

Odors emitted at wastewater treatment works may be potential nuisance to the general public. Inlet works, grit channels, screening and grit handling, and sludge holding and dewatering units are the main sources of odor at the wastewater treatment facility. The process equipment for these operations is usually housed in buildings that are ventilated and sometimes have exhaust air odor treatment. In many instances, odors can be reduced or prevented through normal housekeeping and improved operation and maintenance design procedures (incorporated into the Project Design Reports). When kept clean, sludge transfer systems, such as conveyors, screw pumps, and conduits, will not generate odors.

Activated sludge tanks do not normally emit an objectionable odor when a dissolved oxygen level of 2 mg/L is maintained in the mixed liquor. Thus it is essential to execute a regular program of maintenance to prevent the clogging of diffuser plates to maintain adequate dissolved oxygen levels in the aeration tanks, which in turn minimizes the chances for the production of odorous compounds. Regular cleaning of aeration tank walls and floors, washing weirs, and removing scum regularly, also helps in odor reduction.

To reduce odors from final settlement tanks and sludge holding tanks, logical operational solutions include: increasing the pumping rate of the thickened sludge, monitoring a low sludge blanket level, and increasing the influent flow rate to the sludge holding tank without losing thickening. Tank mixing during off-shifts will also minimize the release of trapped gas during the day. Occasional tank draining and filling it with chlorinated water further reduces odor problems. To reduce odors from dewatering units, pH adjustment or introduction of chemicals may be employed. The odorous air from enclosed unit operations, such as the screw presses, may be collected at a central area and relevant odor treatment processes applied. An affordable measure to partly reduce odor problems can be storing produced residuals in closed containers and transporting them in enclosed container trucks. Flow regulating chambers, drainage valves, standby pumps, as well as electric standby generators should be provided to reduce the possibility of wastewater flooding within the wastewater treatment plant site, which results in possible generation of obnoxious smell. The presence of multiple aeration basins in the plant also reduces overflowing problems.

Proper landscaping around the facilities may serve as a natural windbreaker and minimize potential odor dispersions.

6.2.5 Noise and Vibrations

Noise pollution during operation can be generated by mechanical equipment, namely pumps, air blowers, and sludge dewatering units. Noise problems should be reduced to normally acceptable levels by incorporating low-noise equipment in the design and/or locating such mechanical equipment in properly acoustically lined buildings or enclosures. Noise levels decrease according to the inverse-square law, i.e. noise levels are inversely proportional to the square of the distance from the source of the noise. In addition, surrounding land absorbs noise while and vegetation and buildings reflect and absorb sound energy. In the presence of adequate buffer zones between the facility and residential area (the WWTP is located more than 1 km from the Veliko Selo village), noise and vibrations are of insignificance.

6.2.6 Ground Subsidence

The operation of the WWTP does not require groundwater level change, and therefore the soil subsidence due to groundwater drainage is not expected.

6.2.7 Solid Waste Management

Solid waste generated at the WWTP should be disposed of according to directions on waste management that will be included in the EMP for the operational phase of the Project. Waste would most probably be disposed of at the Vinca municipal landfill until other waste management options become available.

6.2.8 Sludge Management

Article 15 of the Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012) states that wastewater treatment residues may be used in the agriculture or other purposes (e.g. covering landfill or landscaping) if the ELV presented in Table 3 are fulfilled. Before use, the residues have to be treated to reduce the number of pathogens and their properties need to be adjusted depending on their further use. Treatment of wastewater treatment residues is according to the waste legislation.

As presented in the “Local Waste Management Plan for the City of Belgrade 2011-2020” (2011), future developments at the Vinca landfill site include the construction of a Mechanical-Biological Treatment (MBT) facility and a heat and electricity co-generation facility. The refuse derived fuel (RDF) that is separated out of the input waste stream by MBT will be used as fuel in the co-generation facility. Dried WWTP sludge will also be used as fuel in the co-generation facility at the landfill site.

The problem is that, currently, the Vinca municipal landfill is a non-engineered landfill without the necessary environmental protection measures. The City of Belgrade is searching for financial assistance to conduct a feasibility study for to move ahead with its waste management plan.

6.2.9 Water Resources and River Sediment

Having in mind present situation, with direct release of all wastewater (sanitary and industrial) into the Sava and Danube Rivers, the beneficial impact of the Project realization is significant, considering all social and environmental aspects. Sanitary and industrial wastewater contains wide spectra of suspended and dissolved pollutants, such as organic and inorganic compounds, oil products, toxic substances and pathogens. At the point of discharge these impose a high risk of diseases and environmental adverse impacts. Wastewater also carries large amounts of nutrients, which are the trigger for eutrophication processes in receiving water bodies, ultimately leading to its deterioration. The start-up of WWTP will have the positive effects on both the water quality and diversity of biota in aquatic ecosystems, not only at a local scale, but far downstream.

Potential impacts on water resources (groundwater and surface water regimes and quality) associated with the operation phase of the Project are considered in the text that follows. The aim is to identify and assess potential adverse impacts on the water regimes and water resources quality, before defining appropriate mitigation measures that will be implemented in the Project.

Potential impacts on groundwater include contamination during operation. Potential impacts on surface water are: spills and leakage during operation and failure events and release of wastewater into the Danube River (due to power failure, mechanical failure and/or failure of biological treatment).

Due to the significant discharge of the Danube River, there is no reasonable potential impact on flow regimes of the Project.

The design influent wastewater characteristics and effluent standards of the Veliko Selo WWTP are shown in the table below.

Table 28 shows the amounts of pollutants that will not be conveyed to the WWTP for treatment and will not be discharged directly into the Sava and Danube Rivers. This will enhance the river water quality and delay further accumulation of pollutants in river bed sediments.

Table 27. The design influent wastewater characteristics and effluent standards of the Veliko Selo WWTP

Parameter	**Adopted waste water concentration**	**WWTP effluent concentration**
BOD_5 (mg/L)	192	25
COD (mg/L)	385	125
TSS (mg/L)	224	35
Total N (mg/L)	35	10
Total P (mg/L)	8	1

Table 28. Design average daily amounts of pollutants transported by the interceptors to the Veliko Selo WWTP

	2015	2021	2031
Wastewater (m^3/day) (dry condition)	394,000	409,000	448,700
Wastewater (m^3/day) (wet weather flow)	1,209,600	1,252,800	1,341,100
BOD_5 (kg/day)	75,648	78,528	86,150
COD (kg/day)	151,690	157,465	172,750
TSS (kg/day)	88,256	91,616	100,509
Total N (kg/day)	13,790	14,315	15,705
Total P (kg/day)	3,152	3,272	3,590

During regular operation of the WWTP, no adverse impacts are expected on water quality. Beneficial effects are significant, as explained earlier, due to the treatment of wastewater according to adopted standards. Regular WWTP operations include monitoring of the following ***process control parameters***: mixed liquor suspended solids (MLSS), solids retention time (SRT), return sludge ratio, sludge volume index (SVI), dissolved oxygen (DO) concentrations, step feeding of wastewater, coagulant dosing rates and excess sludge withdrawal. It is noteworthy to mention that the wastewater treatment plant proprietor or operator should cooperate with the technology provider for a better approach in process control. This course of action is needed since a precise process control strategy translates into a better process performance, and thus compliance. Accurate process control is even more essential at the start-up phase of the activated sludge system to ensure a subsequent uniform operational phase.

Measurements of flow and the quality of raw and effluent wastewater are also done. According to the Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012), only 24 wastewater effluent samples (24-hour composite) need to be controlled annually. The monitoring frequency should be defined in the Project Design Reports and the EMP for all parameters; more frequent monitoring is recommended during the first months of WWTP operation, while the sampling frequencies can be reduced at later stages of operation for the relatively invariable parameters.

Operational problems or unpredictable circumstances could cause malfunctioning of the wastewater treatment system (such as reduced treatment effectiveness) and the release of polluted water into the Danube side arm.

Electricity failure would cause stop of the WWTP operation and release of wastewater without the treatment. Therefore, backup electricity supply will be designed.

Failure of mechanical equipment may also cause emergency disposal/release of wastewater. This can be mitigated through the application of best practice construction methods (modern technologies), which should be specified in the contract.

The accidental situation and accidental pollution could be a consequence of dilution of wastewater caused by natural hazards, e.g. heavy rain that will be problematic in the areas of Belgrade that have a

combined sewer system. Flooding could also influence the work of the WWTP and that should be taken into the consideration during the construction, as well.

The sewerage system will have additional built-in capacity to deal with large wastewater quantities during (extreme) wet events. Three chambers/ retention basins will be constructed in the sewerage system at different locations. As a last resort, the WWTP sedimentation and oil separate facilities will be constructed with an overflow option for emergency use.

Biological treatment failure can also be caused by two possible scenarios: sludge bulking and inhibition of the microbial population. Inhibition of microbial population is potentially caused by release of toxic substances into the sewerage system. In the case of poisoning, complete cleaning and new seeding of activated sludge basin is required.

Since activated sludge microbial population is sensitive to chemical inhibition, the prevention of uncontrolled industrial pollution release into sewerage system is of utmost importance. Those substances are listed in the table below. Substance that may deteriorate the treatment process should be removed in the pre-treatment process at the source location, as prescribed in the Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012).

Table 29. Threshold concentrations of pollutants inhibitory to the Activated sludge process (WWTP design, WPCF Manual, ASCE Manual)

Pollutant (mg/L)	**Carbonaceous removal**	**Nitrification**
Aluminum	15 – 26	/
Ammonia	480	/
Arsenic	0.1	/
Borate	0.05 - 100	/
Cadmium	10 - 100	/
Calcium	2500	/
Chromium (hexavalent)	1 - 10	0.25
Chromium (trivalent)	50	/
Copper	1	0.005 – 0.5
Cyanide	0.1 - 5	0.34
Iron	1000	/
Lead	0.1	0.5
Manganese	10	/
Magnesium	/	50
Mercury	0.1 -5	/
Nickel	1 -2.5	0.25
Silver	5	/
Sulfate	/	500
Zinc	0.08 - 10	0.08 – 0.5
Phenols: - Phenol - Cresol - 2-4 Dinitrophenol	 200 / /	 4 – 10 4 – 16 150

Table 30. Water resources impact assessment of emergency events

Potential Impacts	Sensitivity	Magnitude	Impact Significance
Temporary, localized wastewater discharge into the Danube River due to electrical, mechanical or biological failure of the WWTP. Such discharge would be local and concentrated, and therefore, would possibly cause a detectable local increase of pollution. An emergency management plan will be prepared in order to distribute the disharge by utilization of the CSO facilities and existing outlets.	Low	Moderate	Moderate adverse
Leakage of wastewater or sludge at the WWTP location into groundwater.	Medium	Moderate	Moderate adverse

6.2.10 Natural Environment

It is foreseen that proper functioning of WWTP and reduction of pollution from Belgrade will have positive effects to all groups of aquatic biota - algal communities, aquatic macrophytes, invertebrates and fish fauna.

The reduction of pollution, together with the significant ability of self-purification of the potamon type water systems could contribute to progress of some socio-economic areas, e.g. fisheries, tourism, etc.

6.2.11 Cultural Heritage

No influence is expected.

6.2.12 Existing social infrastructures and services

No influence.

7 Environmental Management Plan

The proper construction and operation of the Project facilities will not contribute to environmental pollution. All impacts can be avoided with the application of best practice construction methods (modern technologies) and site management, as should be defined in the Main Design Project Report and in the Project EMP. Proposed mitigation measures for the construction and operation of the Project are summarized in the table below.

Table 31. Proposed mitigation measures for the construction and operation of the Project

Embedded Mitigation (Mitigation that is built-in the Project Design and the EMP)	Environmental mitigation measures are an integral part of the Project. Measures have been developed to avoid or minimize impacts on the surface water and groundwater. These integral design mitigation include the: - Application of best practice to minimize risk of pollution during construction and operation; - Incorporation of control structures and operating rules to prevent the release of wastewater into environment; - Spill containment equipment (e.g., oil absorbent pads, oil absorbent materials, shovels, etc.) should be stored on-site to clean up accidental releases of fuel or other hazardous substances. In such case, the proper authorities should also be notified in accordance with applicable laws. - Application of pretreatment of industrial wastewater, prior to discharge into the City wastewater collection system; - Application of best practice to minimize risk of electricity, mechanical or biological failure of the WWTP; - The facility is designed to meet Serbian and EU standards regarding effluent quality; - The sludge will be dewatered at the WWTP and transported to city waste landfill.
Mitigation of significant effects	- The most likely emergency event is biological failure of the treatment process, and the most likely reason would be the toxic pollutants in the wastewater. The uttermost important mitigation is strict application of pretreatment of industrial wastewater at its source.
Mitigation of non-significant effects	- Adopt best practice to minimize the risk of pollution during construction and operation; - Workers education on pollution control.

Monitoring measures must be applied for surface and groundwater in order to enable corrective measures implementation if necessary.

The water intake for the Vinca water treatment plant (WTP) is at about 7 km downstream of the WWTP location, which is essential for potable water supply of the Vinca village. The intake, with capacity of 60 L/s, is constructed in the Danube River, about 140 m from the river bank. The purification process consists of coagulation by $Al_2(SO_4)_3$, flocculation by polyelectrolyte, filtration and disinfection by chlorine.

The effluent of the Veliko Selo WWTP cannot have adverse impact on the Vinca WTP performance and potable water quality; however, in possible emergency events, such as hazardous substance occurrence in wastewater, there may be some effect. Therefore, monitoring of the WWTP effluent has to be related to management of the Vinca WTP, i.e. in such emergency events the Vinca WTP should adjust, or eventually, stop the operation.

Construction phase monitoring includes:

- River water quality monitoring upstream and downstream of the WWTP location, including petroleum hydrocarbons and toxic substances (weekly control);
- Monitoring of groundwater quality at piezometers located around the construction site (twice per month control).

Operation phase monitoring should include the assessment of possible negative impact mitigation measures on the aquatic environment and determination of additional measures if necessary. Monitoring measures should include wastewater, river and groundwater. The Monitoring of groundwater quality at piezometers built during the construction phase should have a monthly frequency.

Surface water quality in Belgrade is done according to the Water Quality Control Program of Surface Waters and Canals in Belgrade that the Secretariat for Environmental Protection issues annually. If the wastewater effluent standards are met, there is no need for monitoring outside the regular City program. However, if the effluent parameters are not met and in case of emergencies, surface water monitoring at the Vinca monitoring station should be intensified.

The monitoring and mitigation plans are presented in the tables below. The associated costs should be determined at the Preliminary Design Phase and included in the Contract.

Monitoring should be conducted by relevant accredited expert institutions. The results of environmental monitoring must be submitted to the Belgrade Secretariat for Environmental Protection.

Table 32. Monitoring Plan

Environmental Item	Standard	Location	Frequency	Responsibility
Construction Phase				
Noise	Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010)	Near construction site	Once/month	Contractor
Danube River arm (Dunavac) Water Quality	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012)	Danube river arm (Dunavac), right downstream of the construction site	Weekly	Contractor
Groundwater Quality	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012) Regulation on Drinking Water Quality (98 & 99)	Piezometers located around the construction site	Monthly	Contractor
Operation Phase				
Groundwater	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012) Regulation on Drinking Water Quality (98 & 99)	Piezometers located around the construction site	Once/month, for at least 2 years from the WWTP start-up	Project owner
WWTP Process Control				
WWTP process control parameters	Operation monitoring procedures	WWTP process train and sludge management	As set in the design reports	Project owner
Flow and wastewater quality	Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012)	Inflow and outflow of the WWTP	Daily	Project owner

Table 33. Mitigation Plan

Environmental Item	Mitigation	Responsibility
Construction Phase		
Dust Emission	Wetting excavated surfaces Using temporary windbreaks Covering truck loads	Contractor
Noise Generation	Restriction of working hours to daytime Employing low-noise equipment Proper maintenance of equipment and vehicles, and tuning of engines and mufflers	Contractor
Danube River arm (Dunavac) Water Quality	In case that the Danube River water quality monitoring indicates that the water has been polluted by the construction site and works, all works must be stopped and remediation measures taken before further continuation of the works.	Contractor
Groundwater Quality	ditto	Contractor
Cultural Heritage	If any archeological remains are discovered during construction, the Belgrade City Institute for Protection of Cultural Monuments and/or the Republic Institute for Protection of Cultural Monuments must be informed and the finds preserved until official inspection by the relevant authorities.	Contractor
Operation Phase		
Groundwater Quality	If groundwater contamination is detected, an investigation must be made into the source of the pollution and appropriate remedial actions must be taken.	WWTP Manager
Noise Generation	Incorporating low-noise equipment Locating mechanical equipment in proper acoustically-lined enclosures	Design Engineers

8 List of References

8.1 Legislation

Energy Law (2011 & 2012). Official Gazette of the Republic of Serbia Nos. 57/11, 80/11 – Amendments, 93/12 & 124.12.

Regulation on the Conditions and the Procedure of Obtaining the Status of Privileged Electric Power Producers (2013). Official Gazette of the Republic of Serbia No. 8/13.

The Regulation on Incentives for Privileged Electric Power Producers (2013) Official Gazette of the Republic of Serbia No. 8/13.

Law on Air Protection (2009). Official Gazette of the Republic of Serbia No. 36/09.

Regulation on air monitoring conditions and air quality requirements (2010). Official Gazette of the Republic of Serbia Nos. 11/10 & 75/10.

Regulation on the air pollutants emission limit values (2010 & 2011). Official Gazette of the Republic of Serbia Nos. 71/10 & 06/11.

Air Quality Control Program for the City of Belgrade 2012 – 2013 (2012). Official Gazette of the City of Belgrade No. 17-3.

Law on Environmental Impact Assessment (2004 & 2009). Official Gazette of the Republic of Serbia Nos. 135/04 & 36/09.

Regulation on Establishing the List of Projects for which the Environmental Impact Assessment is Mandatory and the List of Projects for which the Environmental Impact Assessment can be Requested (2008). Official Gazette of the Republic of Serbia No. 114/08.

Rulebook on the Contents of Requests for the Necessity of Impact Assessment and on the Contents of Requests for Specification of Scope and Contents of the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Rulebook on the Contents of the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Rulebook on the Procedure of Public Inspection, Presentation and Public Consultation about the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Rulebook on the Work of the Technical Committee for the Environmental Impact Assessment Study (2005). Official Gazette of the Republic of Serbia No. 69/05.

Law on Environmental Protection (2004 & 2009). Official Gazette of the Republic of Serbia Nos. 135/04 & 36/09.

Regulation on the Program of System- Based Monitoring of Soil Quality, Risk Estimation Indicators of Soil Degradation and the Remediation Programs Methodology (2010). Official Gazette of the Republic of Serbia No. 88/10.

Law on Planning and Construction (2009 & 2001). Official Gazette of the Republic of Serbia Nos. 72/09, 81/09 & 24/11.

Law on Protection against Noise in the Environment (2009 & 2010). Official Gazette of the Republic of Serbia, Nos. 36/09 & 88/10.

Regulation of Noise Indicators, Limits, Methods for Evaluating Noise Indicators, Disturbances and Harmful Effects of Noise in the Environment (2010) Official Gazette of the Republic of Serbia, No. 75/10.

Rulebook on Noise Measuring Methods, the Content and Scope of the Noise Measurement Report (2010). Official Gazette of the Republic of Serbia, No. 72/10.

Waste Management Law (2009 & 2010). Official Gazette of the Republic of Serbia No. 36/09 & 88/10.

Regulation on Disposal of Waste in Landfills (2010). Official Gazette of the Republic of Serbia No. 92/10.

Water Law (2010). Official Gazette of the Republic of Serbia No. 30/10.

Regulation on the Limit Values of Pollutants in Surface Waters and Groundwater and Sediments and the Deadlines for Compliance with the Limit Values (2012). Official Gazette of the Republic of Serbia No. 20/12.

Rulebook on the Parameters of Ecological and Chemical Status of Surface Waters and the Parameters of Chemical and Quantitative Status of Groundwater (2011). Official Gazette of the Republic of Serbia No. 74/11.

Regulation on the Limit Values of Priority and Priority Hazardous Substances that Pollute Surface Waters and the Deadlines for Compliance with the Limit Values (2011). Official Gazette of the Republic of Serbia No. 35/11.

Regulation on Water Pollutants Emission Limit Values and Deadlines for Compliance with the Limit Values (2011 & 2012). Official Gazette of the Republic of Serbia No. 67/11 & 48/12-Amendments.

Regulation on Drinking Water Quality (98 & 99) Official Gazette of the Republic of Serbia Nos. 42/98 i 44/99.

8.2 Guidelines

Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations. April, 2002.

Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations. April, 2010.

8.3 Plans and Strategies

City of Belgrade Development Strategy – Goals, Concept and Strategic Priorities (2011). Urban Planning Institute of Belgrade and PALGO center.

Master Plan of Belgrade 2021 (2003; 2005, 2007 & 2009 - Amendments). Official Gazette of the City of Belgrade Nos. 27/03, 25/05, 34/07 & 63/09.

Master Plan of the Belgrade Sewerage System (2011). Jaroslav Černi Institute for Development of Water Resources.

Spatial Plan of the Republic of Serbia 2010-2020 (2010). Official Gazette of the Republic of Serbia No. 88/10.

8.4 General References

Air Quality Control Program for Belgrade 2012-2013 (2012). Official Gazette of the City of Belgrade No. 17/12.

Analysis of groundwater regime in the area of Usce Shopping Centre, Belgrade in extreme conditions caused by high water levels in Sava and Danube rivers (2008). University of Belgrade - Faculty of Civil Engineering.

Belgrade in Figures (2012). Institute for Informatics and Statistics.

Belgrade through Nature and Time (2010). NGO “School for Survival”.

Census in Serbia (2011). Census of Population, Households and Dwellings in the Republic of Serbia. Statistical Office of the Republic of Serbia. http://webrzs.stat.gov.rs/WebSite/

Ecological Bulletins. Secretariat for Environmental Protection & Institute of Public Health of Belgrade.

Environment in the City of Belgrade 2010 (2011). Secretariat for Environmental Protection, Belgrade Institute of Public Health & Regional Environmental Center Serbia.

Environmental Atlas of Belgrade (2002). Belgrade Institute of Public Health & Belgrade Land Development Public Agency.

Environmental Impact Assessment Study Report on the Construction of the Ušće - Veliko Selo Interceptor, Tunnel Section from the Veliko Selo Pumping Station to Višnjica (2007). Belgrade Institute of Public Health.

Geotechnical report related to the foundation condition for the Usce Shopping Centre, Block 16, New Belgrade (2005). Kosovoprojekt-Geotehnika.

Guide to Bio Geo Diversity of Belgrade (2011). NGO “School for Survival”.

Institute for Nature Conservation of Serbia – http://www.natureprotection.org.rs/

Local Waste Management Plan for the City of Belgrade 2011-2020 (2011).

Petković, S., Dragović, N., Marković, S. (1999). Erosion and sedimentation problems in Serbia. Journal des Sciences Hydrologiques, 44(1).

Preliminary Environmental Impact Assessment (PEIA) Study for the Feasibility Study and Preliminary Design (FS/PD) for Wastewater Treatment Plant (WWTP) Veliko Selo (2007). Sogreah Consultants, IK Consulting Engineers & Ehting.

Preparation Survey on the Sewerage System Improvement Project for the City of Belgrade – Report (January 2013). TEC International Co. for the Japan International Cooperation Agency (JICA).

Statistical Yearbook of Belgrade – 2011 (2012). Institute for Informatics and Statistics.

Study of Belgrade's Groundwater Source: Status and Development Directions (2010). Jaroslav Černi Institute for the Development of Water Resources.

Wastewater Engineering – Treatment and Reuse (2004). Metcalf & Eddy.

PREPARATORY SURVEY

ON

THE SEWERAGE SYSTEM IMPROVEMENT PROJECT

FOR

THE CITY OF BELGRADE

LAND ACQUISITION AND RESETTLEMENT ACTION PLAN

For the Sewerage System in City of Belgrade

March 2013

Table of Contents

1. Introduction 1
1.1 Background 1
1.2 Objectives of LARAP 1
1.3 Project Components which Cause the Land Acquisition 1
1.4 Options Considered to Minimize Impacts 3
2. Legal Framework and Institutional Responsibilities 3
2.1 Legal Framework for Land Acquisition in Republic of Serbia 3
2.2 JICA Guidelines for Environmental and Social Considerations 5
2.3 Gaps between Serbian's Legal Framework and JICA Guidelines 7
2.4 Policy of Land Acquisition and Resettlement of the Project 12
3. Scale of Land Acquisition 12
3.1 Area of the Survey 13
3.2 Census 14
3.3 Asset Inventory and Assessment of Losses 14
3.3.1 Farming Land 14
3.3.2 Crops and Trees 17
3.3.3 Physical Structures Affected 18
3.4 Replacement Cost Survey 18
3.4.1 Land Price of Tax Administration of Ministry of Finance and Economy 19
3.4.2 Market Price of Land 19
3.4.3 Crops 19
3.4.4 Trees 20
3.4.5 Physical Structures 20
3.5 Opinions from the Respondents 21
4. Socio-Economic Survey 21
4.1 Methodology 22
4.2 Result of the socio-economic analysis 23
4.2.1 Respondents Profile 23
4.2.2 Owners Profile 23
4.2.3 Monthly Income of the Household 25
4.2.4 Access to Basic Services and Facilities 27
4.2.5 Project Awareness 27

5. Entitlement 28
5.1 Entitlement Matrix 28
5.2 Cut-off Date 30
5.3 Livelihood and Other Assistance 30
6. Implementation Arrangement 30
6.1 Roles and Responsibilities of Institutions 30
6.2 Monitoring 31
6.3 Grievance Mechanism 32
6.4 Estimated Cost 32
6.5 Implementation Schedule 33
7. Public Consultation 33

List of Table

Table 2.1 Summary of Gap Analysis on Resettlement Policy 8
Table 3.1 Summary of Affected Peoples 14
Table 3.2 Percentage of Land to be Acquired 16
Table 3.3 Trees and Pastures 18
Table 3.4 Sales Price of Crops 19
Table 3.5 Replacement Cost of Trees 20
Table 3.6 Replacement Cost of Facilities 21
Table 4.1 Relations with the Owners 23
Table 4.2 Owner's Profile 23
Table 4.3 Work Place 24
Table 4.4 Health Status 25
Table 4.5 Income Source 26
Table 4.6 Access to Basic Services and Facilities 27
Table 4.7 Project Awareness 27
Table 4.8 Information Source of WWTP Construction 28
Table 5.1 Entitlement Matrix 29
Table 6.1 Estimated Cost 32
Table 6.2 LARAP Implementation Schedule 33

List of Figure

Figure 1.1 Facilities Covered by the Survey 2
Figure 1.2 Layout Plan of WWTP 2
Figure 3.1 Survey Area 13
Figure 3.2 Land Use obtained from Republic Geodesic Institute 15
Figure 3.3 Land Use by Interview Survey 16
Figure 4.1 Monthly Income Distribution 25
Figure 4.2 Socio-Economic Status 26

Abbreviation

JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LARAP	Land Acquisition and Resettlement Action Plan
LDA	Belgrade Land Development Agency
ODA	Official Development Aid
PAPs	Project Affected Peoples
PIU	Project Implementation Unit
RSD	Serbian Dinar
WB	World Bank
WWTP	Wastewater Treatment Plant

1. Introduction

1.1 Background

The Republic of Serbia acceded to the International Commission for the Protection of the Danube River (hereinafter referred to as “ICPDR”) in August 2003 and promoted the sewerage system development. Consequently the development of the sewerage collection system has progressed substantially but the wastewater treatment plants remain not developed due to the constraint of financial sources, resulting in the increase of discharge of untreated sewage to the water bodies. In the City of Belgrade, the capital city of the Republic of Serbia, the sewage is collected by sewer but discharged to the rivers without treatment, too. As the Danube River, which runs through the city center and receives the untreated sewage from the city, is an international river, if the untreated sewage causes deterioration of the river water quality, it may develop into an international issue. In addition, since the drinking water supply services for the City of Belgrade depend on surface water and groundwater sources, discharge of untreated sewage may cause not only an increase in operation cost of water treatment plant but also safety problems of the drinking water in future.

The Republic of Serbia sets the first priority on joining the EU, hence securing the river water quality which meets the EU standards is absolutely imperative for this realization. Based on the “National Physical Plan of the Republic of Serbia” and “Master Plan of Belgrade to 2021” for City of Belgrade, “Master Plan of the Belgrade Sewerage System to 2021” for its sewerage development was prepared. The Government of Serbia requested the Japanese Government to extend JICA Loan for a sewerage project, Sewerage System Improvement Project for the City of Belgrade (hereinafter referred to as “the Project”), which is to implement a part of the said sewerage master plan. JICA sent the Team to provide information required in the appraisal of the eligibilities of the Project as a Japanese yen loan project. As part of the survey, the Land Acquisition and Resettlement Action Plan (LARAP) was prepared.

1.2 Objectives of LARAP

The Land Acquisition and Resettlement Action Plan (LARAP) is prepared to support the executing agency (LDA) to ensure the minimization of negative impacts and the institution of mitigating measures for those negatively affected through providing a package of compensation that will allow project affected people (PAPs) to restore pre-project level of livelihood. This LARAP is prepared according to the Laws and regulations of Republic of Serbia and JICA’s Guidelines for environmental and social considerations (hereinafter referred as “JICA Guidelines”).

1.3 Project Components which Cause the Land Acquisition

The Project components consist of the construction of wastewater treatment plant (WWTP),

pumping stations and interceptors. Among the facilities, the land acquisition is necessary for the construction of WWTP which will be located in Veliko Selo Village in Palilula Municipality.

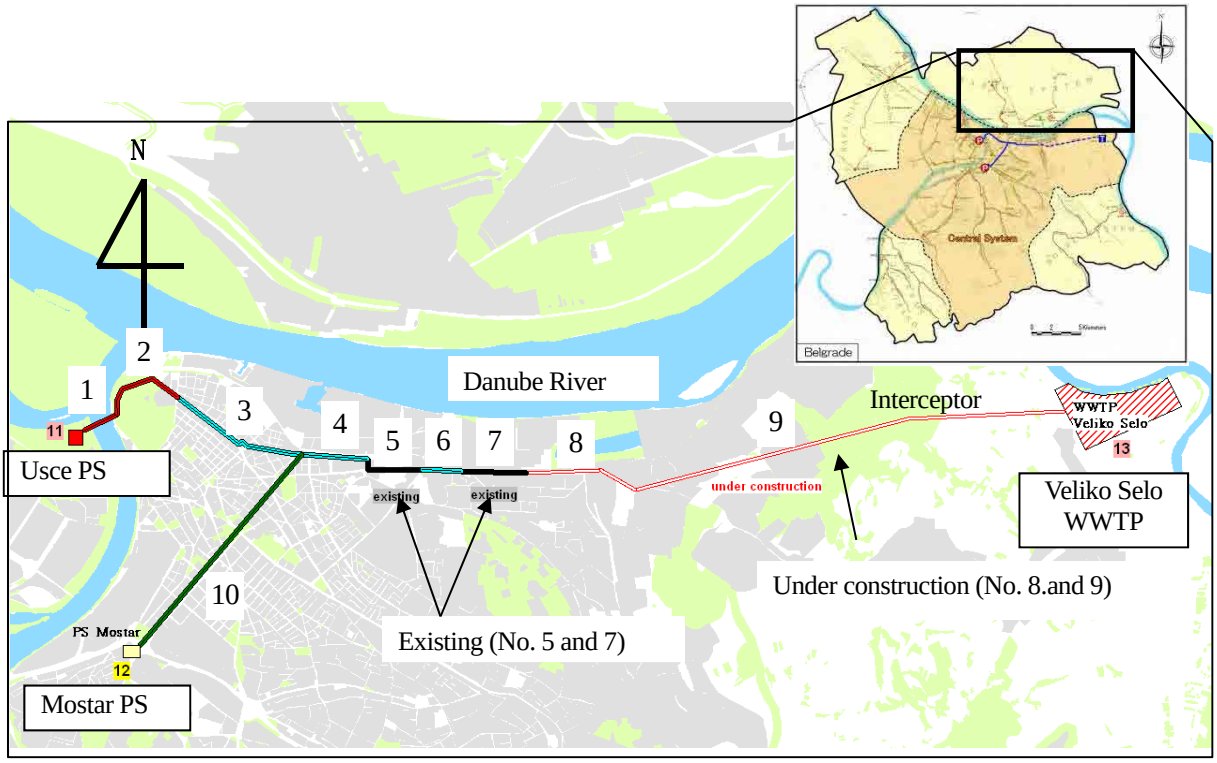


Figure 1.1 Facilities Covered by the Survey

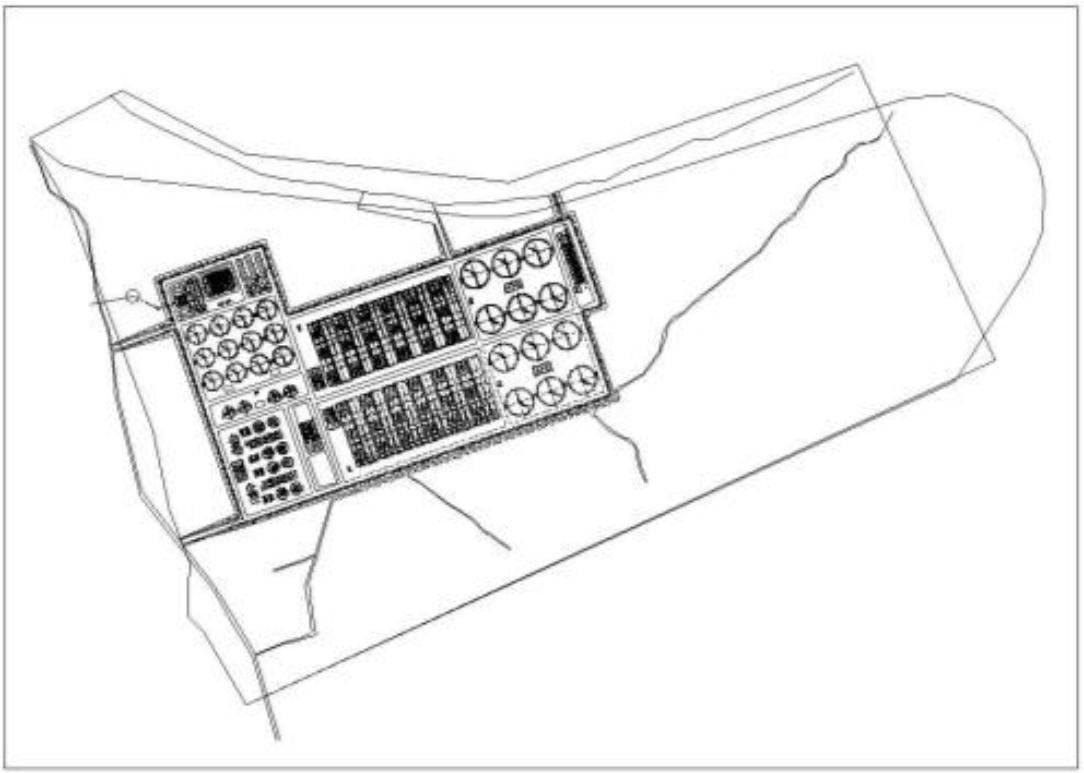


Figure 1.2 Layout Plan of WWTP

The required area for WWTP is around 114 ha and 38 ha are already acquired by LDA. The rest 76 ha are needed to be acquired.

1.4 Options Considered to Minimize Impacts

All necessary efforts have been made in order to minimize the Project impacts on assets and avoid disruption of livelihood as far as possible. In order to minimize impacts to the maximum possible extent, adequate provisions have been incorporated into the planning and design of the Project to minimize or mitigate any unavoidable impacts.

2. Legal Framework and Institutional Responsibilities

2.1 Legal Framework for Land Acquisition in Republic of Serbia

(1) Related Regulations

Serbian law has the following instruments which provide instruction on matters relating to land, land acquisition and compensation for other property losses:

- Law on Expropriation (passed in 1995 and enacted on January 1, 1996, amended in March 2001, amended on March 19, 2009) –"Official Gazette of the Republic of Serbia No. 53/95, 23/2001 and 20/09) "
- Law on Fundamentals of Property relations (1980, applicable from 1st September 1980, amended 1990 and 1996) –"Official Gazette of the Socialist Federal Republic of Yugoslavia (SFRY)", No. 6 dated February 8, 1980; No. 36 dated June 29, 1990; and – "Official Gazette of Federal Republic of Yugoslavia (FRY)", No. 29 dated June 26, 1996.)
- Administrative Code (passed in 1996, amended June 26, 1997) –"Official Gazette of Federal Republic of Yugoslavia" No. 33/1997 and No. 31/2001 and "Official Gazette of the Republic of Serbia'' No. 30/2010.
- Law on Planning and Construction (passed on May 5, 2003, enacted on May 13, 2003) – "Official Gazette of the Republic of Serbia" No. 72/09, No. 81/09 and No. 24/11
- Law of Agricultural Land (passed on July 19, 2006, enacted July 27, 2006) – "Official Gazette of the Republic of Serbia'', No. 62/06, No. 65/08 and No. 41/09

(2) Law on Expropriation

Law on Expropriation (passed in 1995 and enacted on January 1, 1996, amended in March 2001, amended on March 19, 2009) guides land acquisition and serves as a general framework for expropriation in the Republic of Serbia. The Law on Expropriation does not use the term "involuntary resettlement", which is used in the relevant World Bank policy documents, but instead uses the term "expropriation". This law enables government institutions to acquire private property for projects that are deemed to be of national and / or local interest, while

protecting the interests of all project affected persons (PAPs) with legal title, whose assets are to be expropriated. The law also enshrines the principle of fair compensation.

The most important features of the Law on Expropriation are:

- It is intended to ensure simple, efficient process, reducing as far as possible the need for a lengthy judicial process to facilitate necessary expropriation. Under normal circumstances, the entire process of acquisition can be completed within six months.
- The fair value of the land affected by a particular schema, or project, is determined by the Tax Administration, on behalf of the beneficiary of expropriation. The value is assessed on the basis of comparable sales transactions in the area in the recent past.
- As a condition to start expropriation, the beneficiary of expropriation must arrange a Bank Guarantee with a Commercial Bank, in the assessed total sum for payment.
- In the case of expropriating privately owned agricultural land, if land owner demands comparable land of the same type and quality instead of payment of the appropriate value, the project affected person with formal title can be offered such a land in the same area or vicinity, but only if the City of Belgrade possesses such a land in its public ownership
- The comparability of land is determined on the basis of an assessment made by Tax Administration upon request by LDA as the beneficiary of expropriation.
- In case of disagreement on the comparability of the land offered, a different accredited expert would be hired by the local municipality to determine the comparability of the land offered.
- Further disagreement would result in the PAPs resorting to the judicial process, where a decision would be made on the comparability of the land, or the payment of the assessed fair value in monetary terms.
- Where comparable land cannot be identified, the PAPs with legal title is offered the assessed fair value of determined by the Tax Administration. If the PAPs wish to challenge the assessment of fair value, they can resort to the judicial process.
- For the PAPs, without formal title, there is no provision to pay compensation currently under the Law on Expropriation.

The assessment of fair value takes into account the value of land, the cost of structures and installations, crops, woods, trees, fruit bearing trees, age of crops, vineyards, and the time needed to reproduce them. The impact of the scheme on the value of land will not be considered in the fair value of the immovable property.

The Law on Expropriation requires the beneficiary of expropriation to justify the need for expropriation and to demonstrate that the scheme cannot occur without the proposed expropriation. The Decision on public interest is reached by the Government of the Republic of Serbia and it precedes and enables any property acquisition and expropriation. When the scheme is declared to be “of public interest”, a concrete expropriation proposal by

the beneficiary of expropriation is prepared and then submitted to the relevant municipality where immovable assets subject to expropriation are located.. A concrete expropriation proposal is prepared for each PAP that contains the amount of land involved, the assessment of fair value for any immovable property, the justification of the need for the specific expropriation, together with the confirmation that the scheme is included in the relevant regional and/or spatial plan. The concrete expropriation proposal also involves the beneficiary of expropriation arranging a Bank Guarantee with a Commercial Bank for the assessed fair value. This assessment is prepared by referring to the Cadaster Register, which provides details on the title holder, the immovable property, the type of land, and the area of the affected land. The concrete expropriation proposal also obliges the beneficiary of expropriation to submit a request to the Cadaster Office, Land Registry, or other public register, to prevent any transaction on the land to be expropriated.

Under the Law, expropriation must be completed and all PAPs are compensated in comparable land or in monetary terms, before the Building Permit (or Construction License) is issued to the contractor to mobilize and start the civil works. In the event that a PAP (s) disagrees with the offered compensation in either form, they can resort to the judicial process, and the beneficiary of expropriation can request the Ministry of Finance, on an exceptional basis, for the permission to access the said plot (s).

The Beneficiary of Expropriation is not required to prepare a social assessment (socioeconomic study) or a baseline census with regard to project affected persons.

2.2 JICA Guidelines for Environmental and Social Considerations

JICA has its own Guidelines for Environmental and Social Considerations (hereinafter referred as "JICA Guidelines" and the key principle of JICA policies on land acquisition and involuntary resettlement is summarized below.

I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
II. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
IV. Compensation must be based on the full replacement cost[1] as much as possible.

[1] Description of "replacement cost" is as follows.

V. Compensation and other kinds of assistance must be provided prior to displacement.
VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
VIII. Appropriate participation by affected people must be promoted in the planning, implementation, and monitoring of resettlement action plans.
IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is started in JICA Guidelines that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferable at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.
XI. Eligibility of benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
XII. Preference should be given to land-based resettlement strategies for displace persons whose livelihoods are land-based.
XIII. Provide support for the transition period (between displacement and livelihood restoration).
XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic

Land	Agricultural land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration an transfer taxis.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and other structure	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

minorities etc.

XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed financial plan etc.

2.3 Gaps between Serbian's Legal Framework and JICA Guidelines

In general, the institutional framework for expropriation in Serbia is strong and broadly compatible with the World Bank OP 4.12, which is also JICA's requirement. Table below shows the analysis of and means to fill the gaps.

Table 2.1 Summary of Gap Analysis on Resettlement Policy

No.	JICA Guidelines	Laws of Serbia	Gaps	Resettlement policy for the Project
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	Not clearly mentioned. However, when the Urban Plan of Belgrade was prepared, the location for WWTP was selected considering not to cause resettlement nor huge loss of livelihood means.	JICA GL's policy is not clearly mentioned in the laws of Serbia;	The location for WWTP was already carefully selected not to cause involuntary resettlement and loss of means of livelihood. The policy was already applied to the Project.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	Article 1, 3, 15 and 16 of the Law on Expropriation said properties including land, building and other building should be compensated by a fee which cannot be lower than the market.	No significant gap	Population displacement is not occurred by the Project. Effective measures to compensate for losses will be taken.
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	Article 15 and 16 of the Law on Expropriation provide the fair compensation for the lost assets. Article 51 stipulates that the compensation should be determined taking into account the financial and other personal and family conditions, if these circumstances are essential to its financial existence (household size, number of household members who are capable of earning, or who are employed, health conditions, monthly income of the household, etc.).	There is no clear description about the support to improve or restore their standard of living to pre-project level.	There is no resettlement by the Project. The land which will be expropriated by the Project is not used for agriculture and the land is not PAP's primary income source, so the income restoration program is not required.
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Article 41 of Law on Expropriation stipulates that the value of the facility is determined on the market value of these objects. Article 45 stipulates the compensation for vineyard or orchard that bears fruits considering its age and fertility and investment made. Article 46 describes about compensation for nursery garden, Article 47 for mature or nearly mature forest, and Article 52 for crops.	Serbian laws stipulate the compensation not lower than the current market price, and the other assets considering the value of the installations and time needed to reproduce them. The compensation under the Serbian law can be almost comparable to the replacement cost.	Compensation must be based on the full replacement cost as much as possible.

No.	JICA Guidelines	Laws of Serbia	Gaps	Resettlement policy for the Project
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Article 16 of Law on Expropriation said that the compensation should be provided before the demolition of the expropriated property.	No gap	There is no displacement. Compensation must be provided prior to demolition of the expropriated property.
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	Article 29 of Law on Expropriation said that to establish the decision of expropriation for public interest, the proposal which contains information on the project, type of structure, land to be expropriated, expropriated properties, etc. should be prepared.	Some contents which should be included in the resettlement action plan are not included in the documents required by Serbian laws.	Large scale involuntary resettlement will not occur due to the Project so resettlement action plan is not required.
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	Article 41, 42, 43 and 50 of the Law on Planning and Construction stipulated that every plan, General Plan of the city and Detailed plan for certain part of the city, has to be opened to the public including the affected people and suggestions and remarks have to be incorporated to the plan.	During the establishment of the expropriation for public interest, the consultations with the affected people are not required.	Resettlement action plan is not required for the Project. When Land Acquisition and Resettlement Action Plan (LARAP) will be prepared, the consultations with the affected people will be held.
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Article 16 of the Law on General Legal Procedures stipulates the usage of Serbian language, language of minority and interpreter, if necessary.	No gap	Serbian language will be used when the consultation will be held. If minority is included, minority language or interpreter will be prepared.
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	Article 56 of Law on Expropriation stipulates that after the final decision on expropriation, the public hearing/discussion shall be held for mutually agreement of the compensation amount. All PAPs by the Project can be involved in the planning stage of the Project (Article 50 & 52 of Law on Planning and Construction).	During preparation of expropriation proposal, PAPs are not involved.	By organization of the meetings during preparation of LARAP, the participation of PAPs will be promoted.
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Complaint/grievance is established by the Article 213 to 238 of Law on General Administrative Procedures. Landowner may file an appeal against the Decision on expropriation, which is forwarded to the Ministry of Finance and Economy, and if the landowner is not satisfied	Serbia has its own grievance mechanisms there is no significant gap.	Present grievance mechanism can be available for the Project.

No.	JICA Guidelines	Laws of Serbia	Gaps	Resettlement policy for the Project
		with the decision of the Ministry of Finance and Economy, the next appeal level is complaint to the Administrative Court. Article 20 of Law on Expropriation stipulates that an appeal against the Decision on public interest reached by Serbian Government can be submitted to the Administrative Court.. Article 29 stipulates that the appeals against the decision on expropriation solves the ministry responsible for finance and economy. If the land owner has the objections about the value of the properties except land, he can employ another evaluator.		
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferable at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP 4.12 Para.6)	After adoption of detail urban plan, separation of parcels is performed in cadastre in accordance to the plan, after that preparation of geodetic study on the basis which are all property relations are determined (during this, the experts are investigating the terrain and survey the property and the persons using the property) and by listing the property register evidence on the persons and objects are determined on the site for the future construction. Article 50 of Law on Expropriation stipulates that the investments made after the date when proposal for expropriation is notified to the owner in writing form are not compensated.	The law does not clearly mention about the baseline survey, however, such survey is conducted by LDA when LDA expropriates the private land. So no significance gap.	During preparation of LARAP, census survey and socio-economic survey will be implemented.
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census	Art 15 & 16 of Law on Expropriation describe the legal owner of property. Art 43a describes the user of the state or public ownership land. Art 53, 54 & 55 describe the easement and lease. For informal settlement, Law on Social Welfare and Ensuring Social Security of Citizens	No significant gap.	In the proposed expropriated land of the Project, PAPs are land owners with formal legal rights, inheritance of the land where the registered land owner passed away (and land users authorized by the land owner to cultivate it). Eligibility of those PAPs should be

No.	JICA Guidelines	Laws of Serbia	Gaps	Resettlement policy for the Project
	but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP 4.12 Para.14)	stipulates to provide assistance for employment and accommodation.		covered.
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP 4.12 Para.11)	Article 15 of Law on Expropriation said that for expropriated arable land from the person whom land is primary source of income, compensation is determined giving the title to other appropriate land of the same class and bioculture or corresponding values in the same area or in the vicinity.	No gap.	As the appropriate land of the same class cannot be available in the surrounding area and the land is not the primary source of income, the compensation will be paid by cash.
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4.12 Para.6)	No description.	No description about the support for the transition period.	There is no resettlement in the Project so that the support for the transition period is not required.
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP 4.12 Para.8)	Law on Social Welfare and Ensuring Social Security of Citizens stipulates that the vulnerable groups can be assisted to improve their living standards (health, education, employment, etc.). Art 16 of the Law on Expropriation, during the process of apartment allocation, the consideration is taken for elderly people and the location of the apartment in the building.	No significant gap.	There is no displacement by the Project. If the vulnerable groups are included in PAPs, the attention will be paid.
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP 4.12 Para.25)	Laws of Serbia do not require the “resettlement action plan”. Art 29 of Law on Expropriation said that to establish the expropriation for public interest, the proposal which contains information on the project, type of structure, land, expropriated properties, etc. should be prepared.	Some contents which should be included in the abbreviated resettlement action plan are not included in the documents required by Serbian laws.	The Land Acquisition and Resettlement Action Plan (LARAP) will be prepared for the Project.

2.4 Policy of Land Acquisition and Resettlement of the Project

(1) The relevant Republic of Serbia laws and JICA policy (same with WB OP 4.12) will be followed. Where there are gaps between the Serbian legal framework for resettlement and JICA Guidelines mutually agreeable approaches will be identified consistent with Serbian legislation and JICA Guidelines.
(2) Project affected people (PAPs) are registered landowners or their legal successors if the registered land owner is deceased, and persons authorized by the land owner to cultivate the land.
(3) Compensation for temporally or permanently acquired land will be paid to the registered landowners or legal successors if the landowner is deceased. Compensation for the assets eventually could be found on the acquired land will be paid to the PAPs.
(4) All PAPs will be eligible for compensation without any discrimination.
(5) If during the partial expropriation of a property, determined that owner does not have commercial interest to use the remaining property, or if because of the expropriation, the rest of the property is impossible to use or because of expropriation his financial existence is significantly impeded, at his request, the rest of the property will be expropriated.
(6) The Land Acquisition and Resettlement Plan (LARAP) will be designed in accordance with Serbia's Law on Expropriation and JICA Guidelines.
(7) 1st cut-off date is the date of decision on public interest which determines the land plot to be expropriated. After this date, any transaction on identified plot is prohibited. 2nd cut-off date is the date of decision on expropriation, by which landowner is informed his land has been expropriated for the public interest and eligibility for compensation. Once the agreement is signed by both parties, 3rd cut-off date is the data compensation is paid to PAPs and ownership is to be transferred to the City of Belgrade. The 2nd and 3rd cut-off data are individually set for each land plot.
(8) Principle for compensation is market price for the land and assets that could possibly be found on the acquired land. The relevant date to determine the compensation is the date of decision on expropriation (2nd cut-off date determined under item (7)).

3. Scale of Land Acquisition

The results revealed that the involuntary resettlement will not be occurred as there are no houses in the affected area nor the agricultural land to be acquired is not the primary source of income. The scale of land acquisition is summarized in the following section.

3.1 Area of the Survey

The census and socio-economic surveys are implemented to assess the impact by land acquisition. These surveys are implemented by the local consultant company: EKO DIMeC.

This chapter contains the results of research obtained through the census survey of the project affected peoples (PAPs) by the land acquisition for the WWTP of the city of Belgrade and by looking into the available documentation of the Republic geodesic institute. Some parts of the proposed WWTP site are already acquired by LDA (gray colored parcels in the figure below) so that the target of the survey is the remaining part of WWTP site (white colored parcels in the figure below). The whole area (pink colored area) is 114.33 ha, the parts land acquisition was completed is 38.43 ha and the survey area is 75.90 ha.

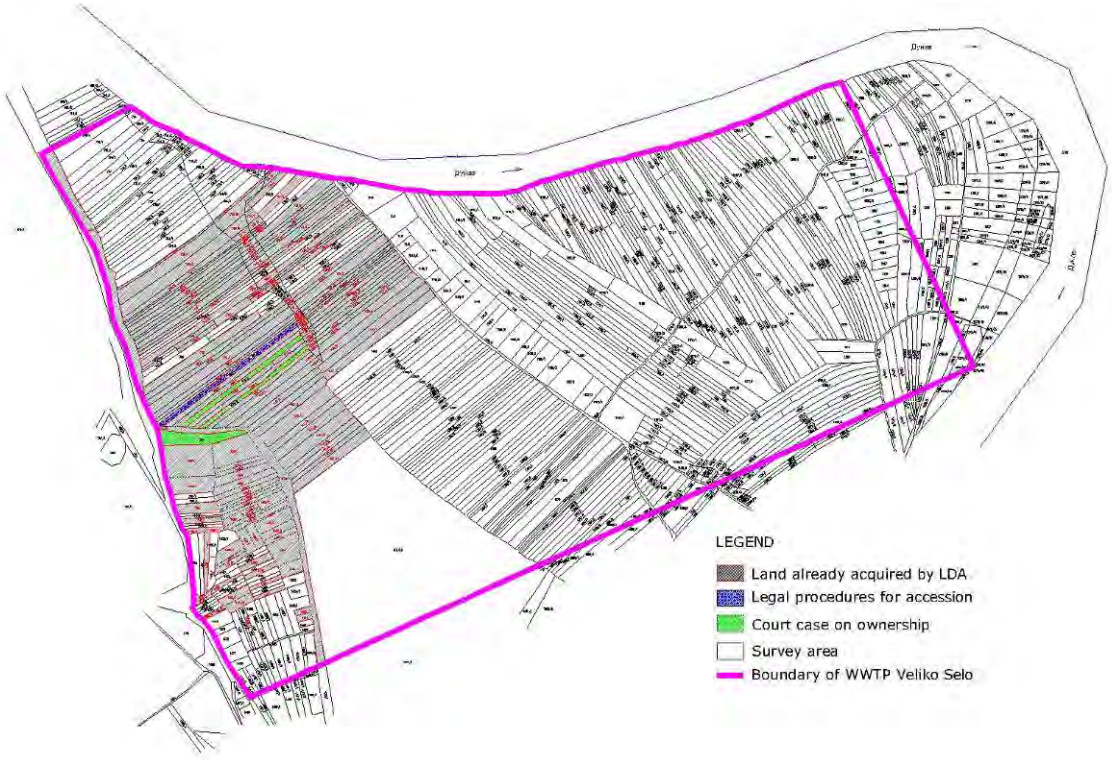


Figure 3.1 Survey Area

According to official data taken from Republic Geodesic Institute in the survey area, there are 511 parcels with their numbers that are written in the cadastral maps. These 511 parcels are with the owner's or co-owner's rights, and 1,228 ownerships were recorded in the lists of real estate.

3.2 Census

The PAPs are identified through census survey and the summary is shown in the following table.

Table 3.1 Summary of Affected Peoples

No. of affected parcels	Affected area (ha)	No. of affected ownership	No. of surveyed ownership	No. of affected owner in the surveyed ownership	No. of surveyed owner	No. of affected household member
511	75,90	1,228	1,140	280	251	1,250

There are 1,228 ownerships in the 511 parcels and 1,140 ownership data are obtained from Republic Geodesic Institute. The issue of ownership is directly related to the procedure of implementation inheritance proceedings. Research showed that the inheritors did not accede to the procedure of conducting the process of the inheritance and, therefore failed to accede to the update of the ownership in the records of the Republic Geodetic Institute.

280 landowners have the ownership right of 1,140 ownerships. Among 280 owners, 251 owners are covered by the census survey as the reasons below:

- The owner is alive but is not in Belgrade - 3 cases out of 280 of those who have the right of ownership or 1.15%
- The owner is not alive and the beneficiaries, that is, heirs, could not be found even after multiple attempts – 10 cases out of 280 of those who have the right of ownership, or 3.6%
- The owner had not willingness to cooperate the census survey – 16 cases out of 280 of those who have the right of ownership, or 5.7 %

3.3 Asset Inventory and Assessment of Losses

3.3.1 Farming Land

(1) Data from the Republic Geodetic Institute

In order to analyze the survey area it is necessary to look in the past, that is, the way in which the land was used as it was registered in the documentation of the Republic geodesic institute and the factual situation reported by the owners – users while they were filling in the survey form.

By looking at the systematized data downloaded from the site of the Republic geodesic institute, we can see how much of the total farming land of 759.047 m2 was used for

farming:

-	Gardens- vegetables	125,769 m^2	(16.6 %)
-	Pastures	8,201 m^2	(1.1 %)
-	Fieldas[2]-official data from RGI.....	608,456 m^2	(80.2 %)
-	Wood	15,871 m^2	(2.1 %)
-	Road: land of the city of Belgrade	750 m^2	(0.1 %)
	Total:	759.047 m2	(100.0 %)

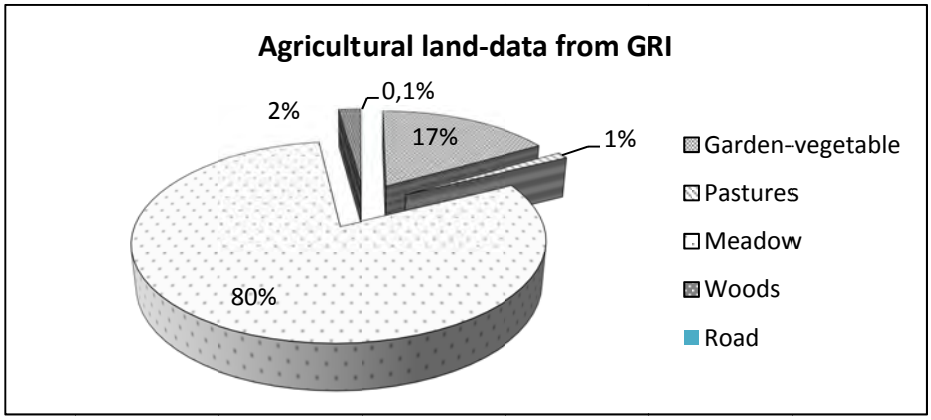


Figure 3.2 Land Use obtained from Republic Geodesic Institute

(2) Research data

After the analysis of the data obtained by the research we have come up with the information about the current ways of using the land:

-	Gardens- vegetables	471,430 m^2	(62.1 %)
-	Pastures (meadows).....	42,375 m^2	(5.6 %)
-	Wood	65,000 m^2	(8.6 %)
-	State road.....	750 m^2	(0.1 %)
-	Local temporary road for owner needs.....	59,250 m^2	(7.8 %)
-	Not in use	120,242 m^2	(15.8 %)
	Total:	759.047 m^2	(100.0 %)

[2] Fidelas, in Serbian language, means area in use for production vegetables or grains. For vegetable production in this Survey we use “garden-vegetable” and for grains “pasture”.

Study showed that there is a huge difference between the RGI data and the data obtained from interviewing people in the affected area. The difference occurred because of the change of the agricultural land's purpose, and that was because, in time, it became economically justified to grow vegetables instead of grains. It can be concluded that in the time passed, the way of using the land intended for expropriation has changed.

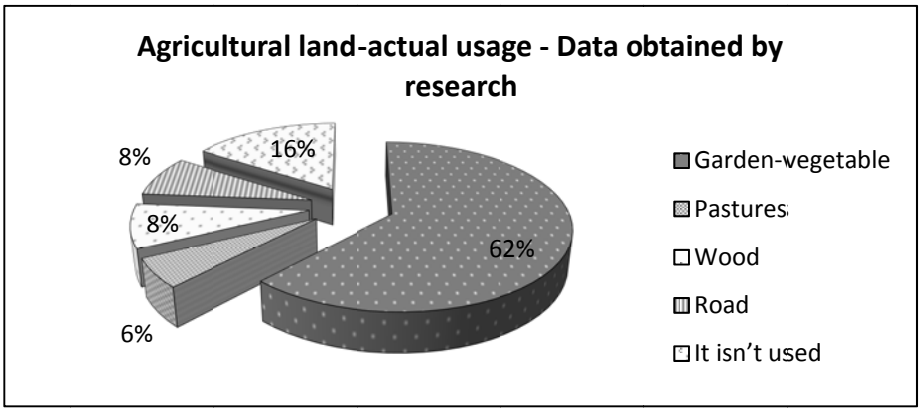


Figure 3.3 Land Use by Interview Survey

According to the research, using the land as arable land for gardens – growing vegetables and pastures takes up 67.7% of the land intended for expropriation. Other areas like woods, road and land with no use take up 32.3%.

Another important fact is that the people have switched to growing vegetables recently. According to the Republic geodesic institute data – 125,769 m^2 are used for gardening while the survey results show that it is actually 471,430 m^2 which is about 300% more. This fact clearly indicates that the households, i.e. agricultural producers have recently switched to growing vegetables. This type of agricultural production has significantly affected the socio- economic status of the population.

The percentage of the land which will be expropriated to the whole owned land is shown in the table below.

Table 3.2 Percentage of Land to be Acquired

Less than 25 %	25 – 50 %	50 – 75 %	More than 75 %	No answer
79.4%	1.4 %	0.2 %	0.3 %	18.7 %

Six respondents (0.5 %) will lose more than 50 % of the owned land by the expropriation. By the results of the socio-economic survey, two respondents among six will lose the part

of income from the expropriated land, 19 % and 0.2 % respectively. Three respondents do not earn any income from the land to be expropriated and one respondent did not give any data about income.

3.3.2 Crops and Trees

(1) Crops

Because of its climate and geographical position, the area is good for production of vegetables. The proximity of the river Danube and the level of the underground waters create basic conditions for watering vegetables in the growing phase, especially during summer months which is the dry period. However, there is the risk of flood in this area.

By conducting the survey we have found out that the following types of vegetables are being produced:

- Cauliflower
- Cabbage
- Onion
- Leeks
- Tomato
- Spinach
- Green beans
- Carrot
- Swiss chard
- Cucumber
- Brussels sprouts
- Lettuce

These vegetable cultures cover the area of 471,430 m^2 or about 62.11% of the land which is the subject of this project.

Special engagement of the population can be seen in changing crops during season, that is, in harvesting one and planting the other, in accordance to weather conditions. This makes it possible to plant and harvest vegetables several times during one year. The ability to combine the vegetable production is certainly helped by the significant number of greenhouses, either movable or immovable.

(2) Trees and pasture

The surveys identify the some fruit trees and poplar for wood in the area.

Table 3.3 Trees and Pastures

Category	Kind	Unit	No.
Fruit	Walnut	Tree	45
	Sweet cherry	Tree	30
	Plum	Tree	160
Wood	Poplar, willow,	Tree	6,929
Pasture		m^2	42,375

3.3.3 Physical Structures Affected

One of the important characteristics of the location is that on it, there are no residential buildings, which would significantly complicate expropriation and affect the amount of compensation. Objects found on the location are actually constructed sites for growing vegetables – greenhouses, or are used for agricultural production – wells and watering systems.

Total area of the land under construction of greenhouses is 28,015 m^2.

- Movable greenhouse constructions on the location cover the area of 23,216 m^2.
- Immovable greenhouse constructions on the location cover the area of 4,799 m^2.

Watering system facilities cover the area of 482,012 m^2 or 64% of the land intended for expropriation. Watering objects are divided into movable and immovable. Immovable systems are 313,035 m^2 and immovable are 168,704m^2.

Wells also belong to the group of constructed facilities, the water is taken out of them with the use of pumps or in some other ways, and is used for watering. Wells are mostly dug, equipped with pumps which have their own power aggregates. Pumps run on diesel fuel or petrol. Besides dug wells, there are drilled wells which are also used for extracting water which is transported through channels or pipes to the locations where vegetables are grown. There are 112 wells in this area and the average depth is about 8 meters.

3.4 Replacement Cost Survey

The replacement cost survey was implemented to determine the compensation cost based on the principle of “replacement cost” for affected land and products. Replacement cost survey consists of data collection from state institutions, tax administration, owners through census and socio-economic surveys, and venders.

3.4.1 Land Price of Tax Administration of Ministry of Finance and Economy

The Tax Administration under Ministry of Finance and Economy regularly set the land price by the area and type based on the market price. The price is adjusted every six month. The price of the area for proposed WWTP is fixed as 949.50 RSD /m^2 in May 2012.

3.4.2 Market Price of Land

During the survey of the people on location, it was very hard to obtain realistic data about the price at which the buying and selling of the land was conducted in the previous period, that is the price which was agreed upon by the interested buyers and owners ready to sell their land.

Having checked real estate agencies, no information about land market in the affected area was found. One of the obstacles is the inability of verification buying and selling contracts in court, because of the disorganized documentation in real estate registers. Changes in real estate registers were not made mostly because of unsettled relations between the people who inherited the land. Since the contracts weren't made by state agencies, the access to the official data of the market and value of the real estates in the affected area was not possible.

By surveying the local people, we have found out that buying and selling of the land in the vicinity was done at the price of 1,200 dinars/m^2 and 1,500 dinars/m^2 depending on the class of land and culture which can be grown on the lot.

3.4.3 Crops

Sale price of the crops (vegetables) is expressed in dinars, according to the type of vegetables it is listed in the following table. Sale prices in the table are those which the producer of the product gets as a seller.

Table 3.4 Sales Price of Crops

Crop	Sale price RSD/kg	Sale price EUR[3]/kg
POTATO	40	0.35
BABY POTATOES	250	2.17
BEANS	170	1.48
GREEN BEANS	110	0.96
SPINACH	90	0.78

[3] The euro exchange rate in the whole document is RSD 115 per EUR 1

Crop	Sale price RSD/kg	Sale price EUR[3]/kg
CABBAGE	25	0.22
KALE	40	0.35
CAULIFLOWER	40	0.35
ZUCCHINI	35	0.30
LEEKS	40	0.35
CARROT	50	0.43
TOMATO	70	0.61
CUCUMBER	40	0.35
PEPPERS	70	0.61
AUBERGINE	40	0.35
BEET	50	0.43
RADISH (BUNCH)	40	0.35
PARSLEY (BUNCH)	10	0.09
LETTUCE (HEAD)	20	0.17
BROCCOLI	35	0.30
RUCCOLA	500	4.35
CELERY (PIECE)	80	0.70
CHARD (BUNCH)	20	0.17
PARSNIP	100	0.87

3.4.4 Trees

This is the evaluation of wood found on the location. The value is shown in the following table:

Table 3.5 Replacement Cost of Trees

Type of culture	Unit	Sale price in RSD	Sale price in EUR
Timber mass-woods	m3	3,500.00	30.43
Timber mass-nut	m3	20,000.00	173.91

The selling price of the timber mass from the fruit trees which are in the affected area is the same as the price of the forest trees, except the wood pulp of the walnut tree, which was being calculated separately.

3.4.5 Physical Structures

As stated in the chapter 4.2.4, the greenhouses, watering system and wells as physical structures exist within the survey area. The replacement cost of these structures is shown in the table below.

Table 3.6 Replacement Cost of Facilities

Facilities		Replacement Cost	
		RSD/m2	EUR/m2
Greenhouse	Immovable	5,000.00	43.48
	Mobile	100.00	0.87
Irrigation	Immovable systems	30.00	0.26
	Mobile systems	10.00	0.09
Wells (RSD/m)		3,000	26.10

3.5 Opinions from the Respondents

We have obtained different information by conducting the survey and by asking the owners questions about their opinions on the Project and expropriation.

- 45% of the surveyed population do not have their opinion on the project and the readiness to start solving the situation
- 52% of the surveyed population is ready to accept the monetary compensation, which creates the situation in which expropriation can be carried out with favorable monetary compensation
- 3 % of the surveyed population (10 landowners) expressed their doubts that the procedure carried out by the city direction is fair. They did not provide their willingness to accept price.

The acceptance of the monetary compensation is defined in the final conclusions. This is also supported by the fact that that majority of people have already been informed about the type of facility that is to be built. Citizens express their wish for the infrastructure in their settlement to be dealt with, which means construction of sewage system, water network, fixing up streets as well as the possibility of future employment in the new facilities of the plant that is to be built on their lots.

4. Socio-Economic Survey

According to the requirements of feasibility study, socio-economic research and survey of the population in the affected area, should show the basis of socio-economic characteristics of the project, which will serve as the basis for the assessment of fair compensation for property which is planned for expropriation. Expropriation of land is a fundamental prerequisite for giving the purpose to the location, and preparing the ground for construction of a WWTP of the City of

Belgrade.

By defining the compensation, the residents of Veliko Selo should not be endangered in any segments. The goal is to create the prerequisites for the position of improved living standards with regard to the state before the implementation of the project.

For the construction of facilities which need to be implemented in the expropriation procedure, it is practiced, before the project design, implementation of socio-economic survey about project impacts on the population, with particular emphasis on households that will be directly affected by these activities.

4.1 Methodology

For the purposes of this survey, it is prepared a questionnaire on socio-economic status of the population. The questionnaire was coordinated with representatives of the Direction of the city of Belgrade (LDA), that is in charge for the project.

After compliance with questions asked in the questionnaire, the training of interviewers was started. The training was conducted by the expert team Eko DIMeC Ltd. that processing this part of the study. Eight interviewers were trained and they received the details about the way of work, making contacts with the affected population and the method of collecting and entering data, served as the basis for a study of the affected area.

Along with the training of interviewers, the expert team has prepared an electronic form of the complete questionnaire. The instruction of the Purchaser of the study is meant to consider only area where it is not performed or initiated expropriation by the LDA, and the data on land owners of the area should be taken from the website of the Republic Geodesic Institute. Downloading and systematization of documents from the website of RGI was a very complex and detailed work. According to these data, at the location 511 real estate papers were identified with 1228 names of owners for subnumbers-parts of lots. All these documents have been scanned and are attached in the Study. Identified data have been transmitted in electronic form in front of the questionnaire and they served as the basis for finding the vulnerable owners or their successors-users in the field.

One of the very important preparatory activities is a meeting with residents of Veliko Selo, owners of land on the concerned site. The meeting was held on 11.10. 2012 in Veliko Selo. At

the meeting, the participants described the goal of the Study and how the survey will be conducted among the population. Participants at the meeting had the opportunity to ask questions and to express their views. In addition, to participants of the meeting were presented the interviewers, as well as the members of the professional team.

This approach proved to be very good and has enabled the collection of sufficient data, required to create the socio-economic analysis.

4.2 Result of the socio-economic analysis

4.2.1 Respondents Profile

The number of the respondents is 264 landowners among the total 280 landowners.

The relations of respondents with the land owner are shown in the following table. Out of 264 surveyed people, 196 of them are owners and the rest are their family members because the owners were not available at the time of research.

Table 4.1 Relations with the Owners

No	Relationship with owner	Number of respondents	Ratio in %
1.	Owner	196	74
2.	Spouses	10	4
3.	Children	33	13
4.	Parents	1	0
5.	Other relatives	24	9
Total:		264	100

4.2.2 Owners Profile

The average age of the surveyed landowner was 53.5 years. This suggests that in the affected area, mainly late middle-aged population are affected by the land acquisition. The basic profile of landowners are shown in the following table.

Table 4.2 Owner's Profile

	Sex		Marital status		
	Male	Female	Single	Married	Divorced
No.	202	62	22	242	0
%	76.5	23.5	8.3	91.7	0

No	Education	Number	Ratio in %
1.	Without education	1	0.38
2.	Unfinished primary school	2	0.76
3.	Primary school finished	74	28.03
4.	Unfinished secondary school	1	0.38
5.	Secondary school finished	160	60.61
6.	Unfinished faculty	2	0.76
7.	Faculty finished	24	9.09
Total:		264	100.00

No.	Occupation	Primary		Secondary	
		Number	Ratio in %	Number	Ratio in %
1.	Farmer	184	69.70	67	25
2.	Business	9	3.41	0	0
3.	Worker	2	0.76	0	0
4.	Employed	20	7.58	0	0
5.	Retired	36	13.64	0	0
6.	Unemployed	4	1.51	0	0
7.	Student	2	0.76	0	0
8.	Housewife	2	0.76	0	0
9.	Other	5	1.89	0	0
Total:		264	100.00		

The largest percentage of the population who are involved in agriculture is with a secondary school degree, followed by those with a primary school education. Survey results show that a very small number of vulnerable people is with no education or incomplete primary school which is only about 1%.

From the results of the research it is shown that the main occupation of majority of the population is agriculture. Residents of Veliko Selo who responded as "other", about 5 of them or about 2% did not have a clear definition of their profession. 25 % of them have the dual work as farmers.

Regarding to the workplace, or distance from home to work place the following responses were obtained:

Table 4.3 Work Place

No.	Work place	Number	%
1.	at home	102	38.6
2.	less than 1 km	0	0.0
3.	between 1 and 2 km	140	53.0
4.	between 2 and 4 km	3	1.1
5.	more than 4 km	19	7.2
Total:		264	100.0

The data show that most respondents have a job at home, or their work place is at a respectful distance from home - to 2 km. obviously that the majority of respondents considered their land as their work place.

The health status of the population, according to the responses received from the interviewed is shown in the following table:

Table 4.4 Health Status

No.	Health status	Number	Ratio in %
1.	Normal health status	204	77.27
2.	Disabled person	6	2.27
3.	Very old/sick	54	20.46
Total:		264	100.00

The results show that the most population is in good health and in high percentage - 77% in working age. However, it mustn't be ignored that 54 persons, or 20.46% fall into the category of very old / sick people.

4.2.3 Monthly Income of the Household

The answer to the question about the total monthly income was given by 122 of the total 264 respondents, or 46.21%. The average monthly income of those who responded was 46,490.25 dinars. The median of the monthly income is 34,500 dinars. The figure below shows the distribution of the monthly income.

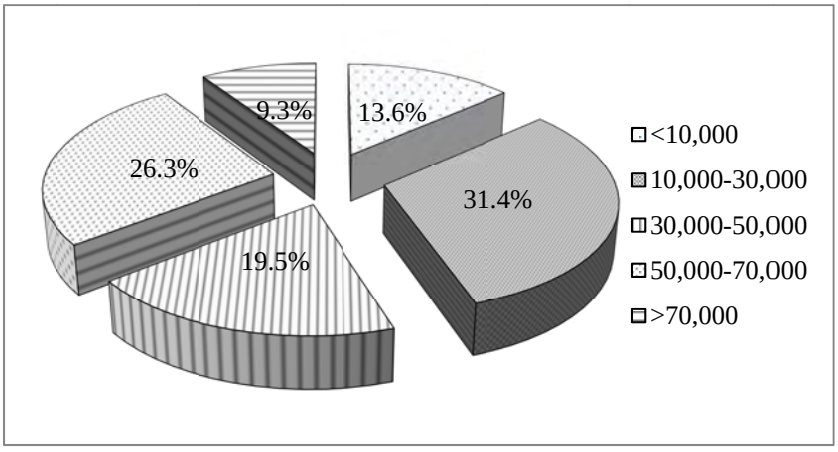


Figure 4.1 Monthly Income Distribution

Among 122 respondents, number of respondents who indicated that they had no monthly income is 52 or 19.70%. This data must be interpreted with caution, especially if we take into

account the income of agricultural land which was reported by respondents in the second part of the questionnaire. We can see that there is the presence of "gray" economy. It is difficult to evaluate closer the real situation because some of the respondents did not want to answer the question about the monthly income.

According to these data, it can be concluded that the majority of owners (users) of land on the considered site also has some other income, except the income from agriculture.

Income from additional work which 25 % of respondents work as farmers is on average 27,941.18 dinars.

More details of household monthly income are described below.

Table 4.5 Income Source

	Permanent jobs	occasional jobs	Pensions	Agricultur e	Social assistance	Children's allowance	Disability welfare	Lease of house / apartment	Lease of agriculture land
No. of respondents	67	8	103	64	2	3	4	1	2
Average (RSD/month)	49.089.55	34.000.00	18.597.09	307.742.19	8.000.00	5.833.33	15.425.00	10,000.00	15,575.00
No income	165	201	160	122	262	261	260	263	262
Total of respondents	264	264	264	264	264	264	264	264	264

Their feelings on their socio-economic situation are shown in the following figure.

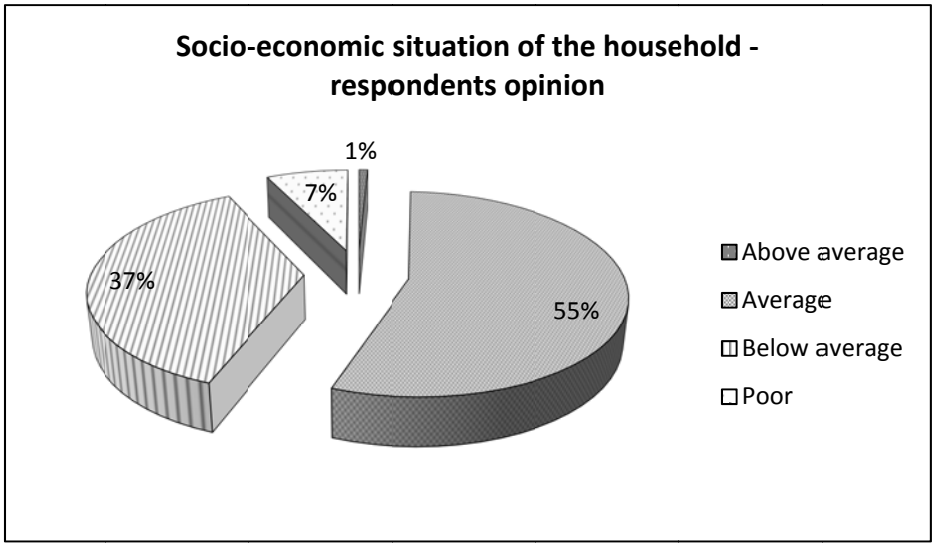


Figure 4.2 Socio-Economic Status

Data in the table show that slightly more than half of the affected population have average living standard. Slightly more than one-third of respondents believe that their socio-economic situation is below average, and less than 10% is considered to live in poverty. The percentage of those who consider themselves above the average standard is almost negligible. In general, the affected area has more than 55% of the population with socio-economic category above average, which is understandable regarding the vicinity of urban area, ways of production and income opportunities in different segments which is about 7% of respondents. Only a small percentage has the status of category poor and it refers mainly to a very old household.

4.2.4 Access to Basic Services and Facilities

The table below shows the access to basic services and facilities of the PAPs.

Table 4.6 Access to Basic Services and Facilities

Water supply					Sewerage				
Piped	Well	Private reservoir	Other	NA	Sewer	Septic tank	Open drainage	Other	NA
95.1%	3.7%	1.1%	0.0%	0.4%	6.0%	88.1%	3.4%	1.1%	0.4%

Electricity					Garbage disposal		
Public line	Illegal connection	Generator	Other	NA	Utility	Own landfill	NA
97.8%	0.0%	0.0%	0.4%	0.4%	92.5%	6.4%	1.1%

4.2.5 Project Awareness

More the 80 % of the respondents know about the sewerage system improvement project and 88 % have been informed about the construction of WWTP in Veliko Selo. The information source of WWTP construction is neighbors & friends (43 %), LDA (24 %) and other (18%). The other sources are by seeing the trucks of interceptor construction, construction of some facilities and through TV and leaflet.

Table 4.7 Project Awareness

About the Project			About the construction of WWTP in Veliko Selo		
Yes	No	NA	Yes	No	NA
81.1 %	18.2 %	0.8 %	87.9%	11.4%	0.8%

Table 4.8 Information Source of WWTP Construction

Local government	Government decisions	BVK	LDA	Newspapers	Neighbors, friends	Other
12.3%	0.0%	0.4%	24.1%	2.2%	43.4%	17.5%

5. Entitlement

The project entitlements developed and presented in the entitlement matrix shown in Table 5.1 correspond to the potential impacts identified.

5.1 Entitlement Matrix

Table 5.1 Entitlement Matrix

Category of impacts/losses	Entitled persons	Project Entitlements	Notes/implementation issues
CATEGORY-A: IMPACT ON LAND			
A-1 Permanent loss of construction or agricultural land	Registered landowner, or legal successors	Cash compensation at current market price and free from transaction costs (e.g. taxes, certification, registration, administration costs)	If during the partial expropriation of a property, determined that owner does not have commercial interest to use the remaining property, or if because of the expropriation, the rest of the property is impossible to use or because of expropriation his financial existence is significantly impeded, at his request, the rest of the property will be expropriated.
	Persons authorized by the landowner to cultivate the land	No compensation for land.	If the crops / productive trees / wells are exist in the land plot, those will be compensated as mentioned in C-2 of this table.
A-2 Permanent loss of public land	City of Belgrade	No compensation is required.	
	Republic of Serbia	No compensation is required.	Administrative cost to transfer the land to City of Belgrade should be covered by the City of Belgrade
A-3 Temporary loss of construction or agricultural land, or temporary loss of land use	Registered landowner, legal successors, persons authorized by the landowner to cultivate the land	Compensation is determined based on the rental price of the nearest similar plot by cash. After the expiry date of the temporary acquisition, land should reinstated to pre-project condition.	Contractor will be responsible for returning land to pre-project / better condition after end of use.
CATEGORY-B: RELOCATION OF AFFECTED HOUSEHOLDS (NOT OBSERVED IN THE PROJECT AFFECTED AREA)			
CATEGORY-C: MOVABLE AND IMMOVABLE ASSETS ON THE LAND			
C-1 Public property (infrastructures / facilities)	City of Belgrade	Repairment/reconstruction or displace of the property based on conditions by concerned authority shall be carried out.	Responsible person for repairment/reconstruction costs shall depend on the type of construction contract.
C-2 Loss of crops, productive trees and wells	Registered landowner, legal successors, persons authorized by the landowner to cultivate the land	The compensation will be done based on Law on expropriation (according to the evaluation by authorized evaluator)	
Category-D Social Assistance (NOT OBSERVED IN THE PROJECT AFFECTED AREA)			

5.2 Cut-off Date

According to the Serbian legislation, there are two dates that determine the entitlements. The 1st cut-off date is the date that the decision of public interest was issued by the Government, i.e. 19 August 2010 of this Project. After this date, any transaction on identified plot is prohibited.

The expropriation is started after the Decision on public interest for expropriation of total land subject that procedure is reached by the Government of the Republic of Serbia. When the Decision on Expropriation is issued for each land to be expropriated, the negotiation will start. This date is the 2nd cut-off date. It often happens that there are several years between the decision on public interest and decision on expropriation, so that the owners can use the land till the decision on expropriation is issued. The assets to be lost due to the expropriation are determined on the date of the decision on expropriation.

5.3 Livelihood and Other Assistance

As stated in 3.3.1, there are six (6) owners among 264 owners who lose more than 50 % of owned land due to the expropriation. Among six, three respondents do not earn any income from the agriculture land and two respondents will lose some part of the income (19 % and 0.2 % respectively) due to the expropriation. The respondent who will lose 19 % of income has the permanent job as trader and the agriculture is not his primary source of income. It can be concluded by the impacts by expropriation on their lives are not significant and any livelihood or other assistance are not required for the Project.

6. Implementation Arrangement

6.1 Roles and Responsibilities of Institutions

The institutions involved in the land acquisition process are LDA, as the beneficiary of expropriation, City of Belgrade, Municipality of Palilula as an administrative institution through which the expropriations being completed, Ministry of Finance, Ministry for Spatial Planning and Environmental Protection, Land Cadastre Office, Tax Administration Office. The beneficiary of expropriation LDA is determined to be beneficiary according to the Law on Expropriation.

<u>LDA</u>

- Obtain the decision of public interest by the Government (it was obtained on 19 August 2010)
- Obtain the decision on expropriation of each plot
- Contact the Tax Administration for the assessment of fair value for all land to be acquired.
- Hire an accredited expert (s) to assess the value of the agricultural output, and all immovable

property and structures.

- Prepare and submit the expropriation proposal which includes all the needed papers and information with the bank guarantee.
- Coordinate the project construction and implementation schedule.

City of Belgrade

- Provides budget for expropriation to LDA.

Municipality of Palilula

- Administer the expropriation process at the local level in conjunction with the beneficiary of expropriation.
- Review the expropriation proposal and attached documents.
- Send the invitation to all PAPs for the consultative meeting to inform about the project, their rights and grievance redress mechanism.
- Agree with the PAPs about the decision on expropriation.
- Issues the decision on expropriation
- Implements the compensation procedure for expropriated land plot, crops and wells

Ministry of Finance

- Decide the appeals in second level related with expropriation and properties real rights.

Tax Administration Office

- Determine the market value of the land being expropriated.

Cadaster Office

- Register all changes on the land affected by the expropriation.

Ministry of Construction and Urban planning

- Issue building permit

6.2 Monitoring

To ensure that the Project is implemented in accordance with the Serbian legislation, JICA Guidelines and this LARAP, the monitoring should be undertaken to assess the progress and results of LARAP implementation.

The internal monitoring for LARAP implementation will be carried out by PIU (Project Implementation Unit) which will be set up for the implementation of the Project within LDA. PIU with the consultants who are in charge of the supervision and project management of the Project will

carry out internal monitoring to assess and promote the progress of LARAP implementation.

Responsibilities of the PIU will include: (i) consultation and informal interviews with PAPs, (ii) regular visits to project affected areas and scheduled meetings with PAP, (iii) review of grievances received through grievance redress mechanism, (iv) preparation of monitoring reports that summarize results of LARAP implementation, investigations of grievances and solutions taken to solve the grievances. The consultants will support PIU in (i) ensuring the LARAP is implemented based on the principle mentioned in the LARAP, (ii) reviewing the grievance screening and redress procedure and providing advice based on the best international experience, (iii) assessing grievances received and finding measures to redress them, and other aspects of LARAP implementation, as needed.

6.3 Grievance Mechanism

By the Law on Expropriation, the grievance mechanism is stipulated. When PAPs have the grievance against the decision on expropriation such as against the expropriation of his land, the appeals are solved by the Ministry of Finance, as the public interest and expropriation is the decision of the Government. If PAPs cannot accept the decision of Ministry of Finance, within 30 days from the decision, they can resort to the judicial process.

When PAPs disagree with the assessed fair value for lost assets (except land), they can demand the reevaluation of the assets by evaluator hired by LDA. The PAPs can hire an accredited expert, at the expense of LDA to review and determine the assessed fair value for the lost assets. The mediation by all possible measures is taken, involving the municipality, councilors of the concerned area, and evaluator. If after mediation, the PAP disputes the assessment of fair value, they are free to enter the judicial process in a manner consistent with the Law on Expropriation.

6.4 Estimated Cost

The table blow shows the estimated cost for the expropriation.

Table 6.1 Estimated Cost

Structure		Unit	Quantity	Rate (RSD)	Amount (RSD)
Land		m^2	758,297.00	949.50	720,003,001.50
Greenhouses	Mobile	m^2	23,216.00	100.00	2,321,600.00
	Immovable	m^2	4799.00	5,000.00	23,995,000.00
Irrigation	Mobile	m^2	168,704.00	10.00	1,687,042.74
	Immovable	m^2	313,035.00	30.00	9,399,238.18
Wells		m	896.00	3,000.00	2,688,000.00
Wood	Forest	m^2	6,770	3,500.00	23,295,000.00
	Walnut trees	m^2	20	20,000.00	400,000.00
TOTAL:		-	-	-	783,788,882.42

6.5 Implementation Schedule

The payment of compensation should be completed before the contractor obtains the building permit. As the expropriation cannot be started without the arrangement of the budget for expropriation, the schedule of LARAP implementation is different by the plot. The whole WWTP site (75 ha) is not necessarily acquired but the 35 ha for the area of WWTP should be completed by the project implementation. The schedule shows the earliest possible case of the Project implementation.

Table 6.2 LARAP Implementation Schedule

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Implementation of LARAP										
Decision on expropriation										
Evaluation of the movable and immovable assets										
Proposal for expropriation										
Consultative meeting										
Agreement and payment										
Signing of Loan Agreement										
Selection of Consultant										
Detailed Design										
Selection of Contractor										
Construction Works										
Trial Operation Period										

7. Public Consultation

The expropriation of proposed WWTP site has started from 2006 based on the Serbian legislations. Since then, the several public debates were organized to explain the project, need of expropriation, expropriation procedures and entitlement for compensation. All the PAPs are already familiar with the procedures and entitlement. The next procedures will go into individual and detailed consultation with PAPs upon the arrangement of the budget for expropriation.

The gap analysis between Serbian legislation and JICA Guidelines shows no significant gaps and the policy and entitlement of the compensation explained in the public debates almost accord with the JICA Guidelines. It means that the past debates are considered to be carried out practically in conformity with JICA Guidelines. In addition, if the public consultation is held at this moment, PAPs consider this as detailed consultation and expect the immediate payment of compensation. To avoid these misunderstanding occurred, the public consultation will be organized in accordance with the Serbian legislations as well as JICA Guidelines upon the budget arrangement for compensation becoming ready and the results of such public consultation will be recorded.

In the past public debates that LDA organized in several times, the following topics were explained and the main comments from PAPs (landowners and their legal successors) are as follows.

Subject of public debates was to inform landowners that LDA submitted request to the Municipal Palilula that their parcels will be expropriated for the construction of WWTP. Landowners are also informed of the policy for compensation, expropriation procedures, their rights on compensation for land, as well as for crops, trees and wells which can be found on the land, evaluation method and grievance redress mechanism.

PAPs concerned that the schedule of the compensation payment and the amount of the compensation and legal successors rights.