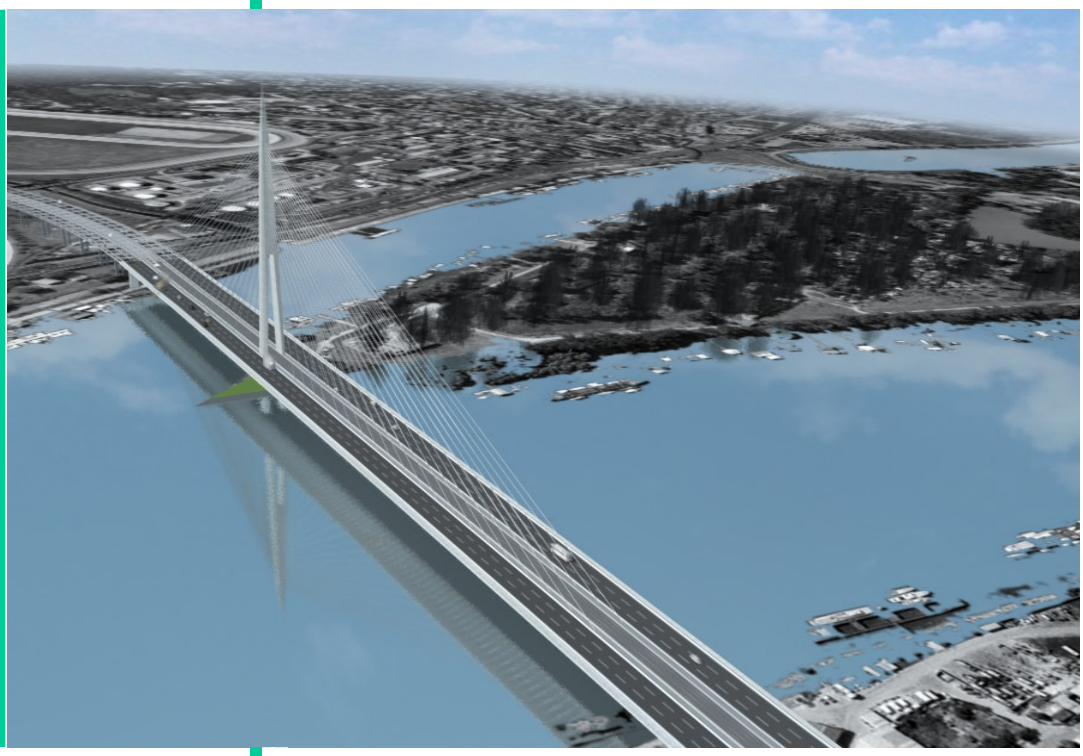
ДИРЕКЦИЈА ЗА ГРАЂЕВИНСКО ЗЕМЉИШТЕ И ИЗГРАДЊУ БЕОГРАДА

PUBLIC ENTERPRISE DIRECTORATE FOR BUILDING
LAND AND CONSTRUCTION OF BELGRADE

Njegoševa 84 Belgrade



ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR THE PROJECT OF CONSTRUCTING A BRIDGE ACROSS THE RIVER SAVA IN BELGRADE WITH ACCESS ROUTES – PHASE I OF SECTION I OF THE INNER ARTERIAL SEMI-RING ROAD FROM ULICA TOŠIN BUNAR TO PAŠTROVIĆEVA ULICA

NON-TECHNICAL SUMMARY

October 2009

DDC svetovanje inženiring,
Družba za svetovanje in
inženiring, d.o.o.

ДИРЕКЦИЈА ЗА ГРАЂЕВИНСКО ЗЕМЉИШТЕ И ИЗГРАДЊУ БЕОГРАДА

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Contract No. 48713/96000-II-90

Project

Environmental impact assessment study of the project for constructing a bridge across the River Sava in Belgrade with access routes – Phase I of Section I the Inner arterial semi-ring road from Ulica Tošin bunar to Paštrovićeva ulica

NON-TECHNICAL SUMMARY

Project Number PVO – 201A / 09

DDC svetovanje inženiring, Družba za svetovanje in inženiring, d.o.o.

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Date October 2009

CONTENT

1 INTRODUCTION

Project stakeholder **PE Directorate for building land and construction of Belgrade**

ДИРЕКЦИЈА ЗА ГРАЂЕВИНСКО ЗЕМЉИШТЕ И ИЗГРАДЊУ БЕОГРАДА

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The Directorate for building land and construction of Belgrade, Njegoševa 84, Belgrade, is preparing the construction of Phase I of Section I of the new road around central Belgrade, named the inner arterial ring road (hereinafter referred to as UMP).

At regional level, the fundamental goal of constructing the inner arterial semi-ring road is to prevent further deterioration of the traffic basis and passenger and cargo transport conditions, as well as to establish the basis for (traffic) system development in the future. From this point of view, we may expect the UMP to ensure the following:

- Easing the load on the most-congested sections of the motorway passing through Belgrade (within the E-70 and E-75 international roads) – the parts from Sava centar to Mostar, and from Mostar to Autokomanda;
- Improved functionality of the entire primary street network in the central zone, especially of today's most-congested radial stretches: Ulica Kneza Miloša – Takovska ulica, Bulevar Oslobođenja, and Brankova ulica - Branko bridge - Bulevar Lenjina.

The construction of the UMP around the old core of Belgrade will be one of the most monumental contemporary projects which will become indelibly etched into the nature's existing systems and among the city's structures. The new road will be a significant generator of further urban development of the metropolis and the wider region alike. New interventions in the sensitive urban texture and landscape of the city do not automatically mean spatial degradation; on the contrary, they may pose a

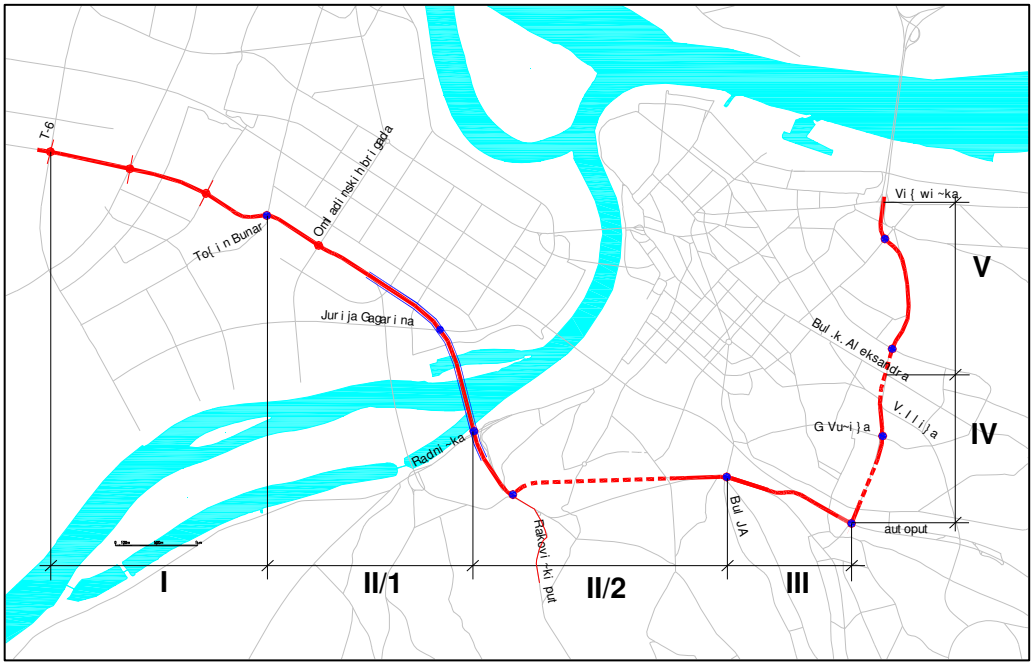
challenge resulting in well-conceived, creative engineering, urban planning and architectural solutions that will make it possible to establish a new spatial balance, functionally and shape-wise. Seemingly unresolvable conflict situations related to space are the very situations wherein potential solutions for shaping new, quality environments are hidden. A ride or walk down the new routes will offer encounters with new landscapes, a new revival of the urban area, as a panoramic view from a slightly higher position, in particular from the new bridge across the River Sava, will feature an entirely new outlook of Belgrade's contours.

In 2002, in the General Plan, the General Project and Preliminary Justifiability Study were elaborated for the proposed UMP route. Later, in 2005, a Detailed regulation plan was elaborated and approved for the UMP stretch from the T-6 route to the Pančevo Bridge, whereby some solutions from the General Project were modified. The route proposed in the Programme has been approved by the modifications to the 2005/1 General Plan of Belgrade.

The starting foundation for elaborating a strategic assessment study was the Programme for elaborating the UMP section from the T-6 route to the Pančevo Bridge, which was done for the purpose of adopting the Decision on plan elaboration, as well as the Draft Detailed Regulation Plan for the UMP section from Ulica Tošin bunar to the Autokomanda junction in Belgrade.

The Detailed Regulation Plan includes only the second UMP section, from Ulica Tošin Bunar to the Autokomanda junction, spanning 6.493 km, and the planned road solution in the hippodrome zone: Paštrovićeva ulica, part of Požeška ulica in the hippodrome zone, as well as the new route of Rakovički put and its connection with the UMP, while the strategic impact assessment encompasses the area of an UMP route spanning approx. 16 km, from the T-6 route in New Belgrade to the Pančevo bridge.

Route segmentation for environmental protection purposes in the strategic assessment elaboration phase was associated with the need for a more detailed environmental evaluation and varying levels of protection for specific segments. The particularly sensitive areas are the crossing over the River Sava in the Ada Ciganlija zone, the Topčider and Dedinje zones, as well as zones characterised by exceptional cultural and natural features. For easier comparison and monitoring of conditions, the strategic impact assessment relies on the division of the route into 5 (five) sectors and the stages proposed by the plan's programme. The order of the sectors is shown in Picture 1.



Picture 1: Division of UMP route into five sectors.

Sector I – the UMP section along the stretch from the T-6 route to Ulica Tošin bunar.

Sector II - spanning from Ulica Tošin bunar via the New Belgrade area, along the bridge across the River Sava and the Topčider Valley to the entrance of the tunnel underneath the Topčider hill, then on through the tunnel to Ulica Dr Milutina Ivkovića and the old Autokomanda. Due to the diversity of the areas it traverses and its own specific features, the sector is divided into three stages:

- stage **II-1** from Ulica Tošin Bunar with the bridge across the Sava to Radnička ulica (including the junction),
- stage **II-2** from Radnička ulica with the tunnel underneath the Topčider Hill to Ulica Dr Milutina Ivkovića, just before the old Autokomanda junction (Dinarska ulica).
- stage **II-3**, consisting of the Paštrovićeva and Požeška streets in the hippodrome zone

Sector III is comprised of the UMP section from Dinarska ulica via the old Autokomanda to the connection with the existing motorway in the planned Šumice junction.

Sector IV represents the section spanning along the corridor of the existing Grčića Milenka and Pop Stojanova streets, from the Šumice junction to Bulevar Kralja Aleksandra,

Sector V represents the part of the UMP stretch from Bulevar Kralja Aleksandra and along the corridor of Tršćanska ulica and Severni bulevar to the Pančevo Bridge.

This Environmental impact assessment study for the project of constructing a bridge across the River Sava in Belgrade, with access routes, encompasses Stage II-1 from Ulica Tošin bunar with the bridge across the Sava to Radnička ulica (including the junction) and the initial part of Stage II-2 of SECTOR II of the inner arterial semi-ring road.

The subject matter and goal of the Environmental impact assessment is to determine and describe the direct and indirect impact of planned activities or measurements on various environmental aspects. Also, it needs to ensure an overall assessment of these impacts on human health and the environment, as well as to incorporate resource and environmental management issues in order to minimise negative impacts.

Pursuant to Articles 14, 16 and 46 of the Environmental Impact Assessment Act (Official Gazette of RS No. 135/04) and Article 192 of the General Administrative Procedure Act (Official Gazette of FRY No. 33/97 and 31/01), and according to Article 2 of the Rules on the content of environmental impact studies (Official Gazette of RS No. 69/05), the City of Belgrade, the City Administration, the Secretariat for Environmental Protection – Sector for Nature and Environmental Protection, in reference to the request of PE Directorate for building land and construction of Belgrade, 11000 Beograd, Njegoševa 84 of 13 June 2005 for determining the scope and content of the environmental impact assessment study of the project for constructing a bridge across the River Sava in Belgrade with access routes – Phase I of Section I the Inner arterial semi-ring road from Ulica Omladinskih brigada to Paštrovićeva ulica, has adopted the Resolution on the content and scope of the environmental impact assessment study (Number: 501-322/05-V-03, 25 October 2005). The study has been elaborated pursuant to the Environmental Impact Assessment Act („Official Gazette of RS" No. 135/04) and Article 2 of the Rules on the content of environmental impact studies (Official Gazette of RS No. 69/05), and Resolution No. 501-322/05-V-03 of 31 October 2005, whereby the Secretariat for Environmental Protection defined the content of the Study for the stakeholder of the project.

2 LOCATION DESCRIPTION

Within the continually built-up urban area, an inner arterial semi-ring road is envisaged around the central zone consisting of the old Belgrade city core, the future centre in the Sava amphitheatre, the old and new centres in New Belgrade and the old city core of Zemun. The route of this section spans from New Belgrade, via the new road south of the railway line, crossing the Sava in the zone of the downstream tip of Ada Ciganlija and aligning with Bulevar Vojvode Mišića.

Part of the road from Ulica Tošin bunar to Paštrovićeva ulica with the bridge across the Sava will connect the left bank of the Sava (the New Belgrade side) with the right bank (the Belgrade side), passing through three municipalities, specifically, the municipalities of New Belgrade, Čukarica and Savski Venac.

The route of the road on the left bank of the Sava begins at the intersection at Ulica Tošin bunar, running parallel with the railway line towards the northwest-southeast all the way to the intersection between Ulica Milutina Milankovića and Ulica Jurija Gagarina. On both sides of the UMP route, special business complexes are envisioned along the major boulevards, with existing business activities and zones planned for transformation into commercial activities and general city centres in harmony with the environment. On the eastern side (between the railway line and Treći bulevar) the New Belgrade passenger railway station is planned, with an international bus station with accompanying facilities.

The area along Ulica Jurija Gagarina is planned for special business complexes along the main boulevards, while the existing complex of business activities (Shipyard) is expected to be transformed into commercial activities and general city centres. From the intersection with Ulica Jurija Gagarina, the traffic route will be connected with the bridge across the River Sava by viaducts to the east of the Shipyard complex and on via the winter shelter.

The water surface of the River Sava is in the bridge zone. The bridge across the Sava will have a foundation at the tip of Ada Ciganlija, which is a green surface with natural values significant for preserving the quality of the environment, and an area with the Ada Ciganlija Sports Centre for sport and recreational purposes.

The geological profile traversed by the route is that of alluvial drifts of the River Sava. Geological research has shown that the thickness of Quaternary sediment layers in the New Belgrade area is approximately 30 m, and that they are rich in aquifiers, renewed by precipitation and water from the River Sava. On the right bank of the Sava, underground waters are at depths of 40-60m. The route runs along the section from Ulica Jurija Gagarina to Radnička ulica in the sanitary protection zone proper. The wells are situated in the wider sanitary protection zone A. The distance from the nearest Ranney well, No. 29, at Mala ada is 200m, with well No. 20 at Ada Ciganlija 600 m away, and well No. 28 is within the traffic route itself.

The Sava is the right and the most water-rich tributary of the Danube, into which it flows at 70 m above sea level. Its valley is very ample and situated between the neogenic hills of Beogradska Posavina and the Zemun Loess plateau. The width of the valley between Bežanija and Čukarica is about 3.5 km. The alluvial plain of the Sava is not entirely flat. Coastal ridges and elliptical recesses are noticeable in it; in the past there were also swamps and branches that are now covered up or dried out by constructing artificial canals for draining underground waters. At the Čukarica Bay, the Topčider River, springing near Parcanski vis, flows into the Sava.

On the left bank of the Sava, the traffic interchange itself – the intersection with Radnička ulica is surrounded on the southern side by the Jugopetrol industrial complex, whose two tanks that lie closer to the junction are to be removed. The park at Gospodarska mehana on the opposite side, with the Belgrade Hippodrome complex, which is part of the sport, sports facilities and complexes, borders on the area of the traffic route, while, on the northern side, it is limited by the Senjak residential zone, typical of individual housing units.
In the immediate vicinity of the planned traffic route (up to 100 m away) there is the Plavo pozorište and Ister Teatar, the Toma Rosandić Museum at Ulica Ljube Jovanovića 3, the Josif Pančić Elementary School and the 13th Belgrade Grammar School (approx. 1100 m away), the Faculty of Forestry (600m) and the Čukarica health centre (1250m).

The impact zone of the following stages of Sector II (stages II-2 and II-3) also includes part of the protected cultural and historical whole comprised of Topčidersko brdo-Senjak-Dedinje and the Mašin majdan natural monument.

The land surface required at the time of work execution is approx 47 ha.

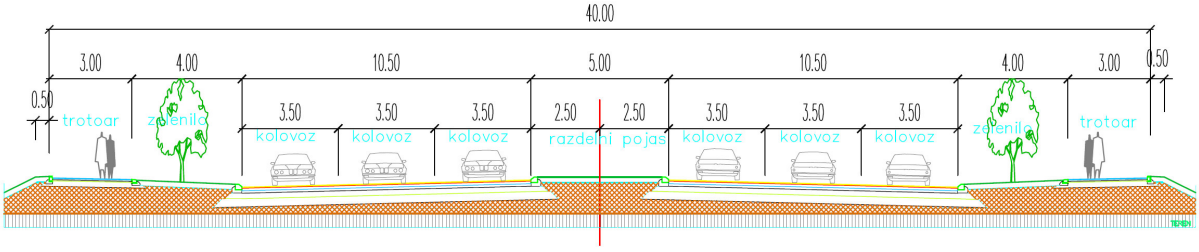
3 PROJECT DESCRIPTION

The traffic route encompasses the construction of the route between Ulica Tošin Bunar and Paštrovićeva ulica, including the construction of the bridge on the River Sava over the tip of Ada Ciganlija, spanning 929.28 m. The total length of the planned route is 4,677m. (from km 2+769,90 to km 7+447.00).

Situation-wise, the UMP route in New Belgrade follows the railway line and the corridor envisioned in the general project. To rationalise land use, space has been left between the route and the railway line which corresponds to the planned widening of the railway line, specified in preliminary project conditions set out by the Belgrade Rail Transport Company. Across the relevant section, opposite the railway line, the existing tramway depot is completely retained, and will serve the same purpose for the light rail traffic. From the intersection with Ulica Španskih boraca, in the strip between the UMP structures, a corridor is left in the terrain for a light rail traffic station, and a corridor for adjusting the level of the light rail traffic to the bridge across the Sava – all according to the requirements of the project task, in collaboration with the Urban Planning Institute and the Investor. After the intersection with Ulica Proleterske solidarnosti, the route moves away from the railway line in order to retain the existing facility of the Belgrade Rail Transport Company, and achieve the most favourable intersection with Ulica Jurija Gagarina.

The cross section of the relevant traffic route, the intersecting roads and barriers at interchanges have been dimensioned according to traffic requirements and network rankings.

On the New Belgrade section, while the route is still on the terrain, the UMP profile features; a 5-metre-wide severance lane, which also features a 3-metre-wide manipulative lane for left turns, 4-metre-wide lateral turf strips and pedestrian paths that are 3 metres wide.



Picture 2: Geometric cross section of UMP route

At the beginning of the relevant section, from Ulica Tošin Bunar, the level of the UMP route matches the levels of the existing Ulica Omladinskih brigada.

The intersection with Tošin bunar at km 2+796,907 is planned as a surface intersection, while retaining the space for the final solution. The Programme for preparing the Detailed Regulation Plan for the UMP section from The T-6 route to the Pančevo Bridge envisages a delevelled connection between the UMP and Ulica Tošin Bunar, which will be elaborated in detail as part of further elaboration of the section between the T-6 route and Ulica Tošin bunar, as envisaged by the Programme.

Further on, from Ulica Omladinskih brigada, the level matches those of the surrounding terrain up to the intersection with Ulica Dr Agostina Neta, where a four-leg surface intersection is formed. Up to the intersection with Ulica Španskih boraca, the route reaches the height that ensures a free profile for the LRT in Ulica Španskih boraca, as required by the plan documentation. Level-wise, the route remains at the levels reached until after the intersection with Ulica Jurija Gagarina, where a rise begins, reaching the preliminary project requirements dictated by Srbijavode on the bridge across the Sava, as well as the structure height stipulated in the adopted solution for the bridge across Ada.

On the bridge across the Sava, the level of the relevant section is adjusted to the bridge project and the requirements of the execution technology associated with the adopted solution for the bridge across the Sava (Ada). After moving from the bridge across the Sava onto the viaduct on the Čukarica bank of the Sava, the route level is dictated by the height of the tramway bridge towards Banovo brdo and the requirement to allow the planned light rail transport to abandon the UMP route towards the centre and Banovo brood. After crossing the tramway bridge and then running above a four-track railway line, the level of the UMP route falls, matching the levels of the existing Bulevar Vojvode Mišića at the intersection of the relevant section with Paštrovićeva ulica.

The level of Savska ulica is designed so as to allow passage across a four-track railway line with a free height specified in preliminary project requirements of the Belgrade Rail Transport Company, but for the span between the portals, which suggests that such a position of the level requires changes to electrical installations on the railway line section intersecting with the UMP corridor and Savska ulica on the Čukarica bank of the Sava. The level of Savska ulica could not have been positioned otherwise due to adjustments to the UMP level and the levels of the adopted Radnička interchange.

The interchange of the UMP and Radnička ulica is one of the most important and most complex interchanges on the semi-ring route. The solution for this interchange also changes the way Radnička ulica is connected to Bulevar Vojvode Mišića. According to the detailed regulation plan, this is one of the potential solutions, and this is to be determined in a public tender.

The major specific feature of the conceptual design is certainly the pylon shape, which makes the bridge on the lower tip of Ada Ciganlija recognisable.

The project envisages a reconstruction of the existing Radnička ulica, and also requires minimal disruption of existing traffic during construction.

There are no suitable recipients for draining the traffic route pavement, meaning that any precipitation reservoirs are unable to receive additional quantities of water. Drainage of the road strip is envisioned to take place via a closed precipitation sewer system. The drainage of subgrade with drainage pipes in the cut also takes the water from the road base into a closed precipitation sewer system. At places where precipitation is let out into the recipient, purification with suitable separators is envisioned. In the area of this section, separator locations are planned in the zone of the bridge structure across the Sava on the New Belgrade side and in Čukarica, in the hippodrome zone, while a separator location is also planned for adjacent parts of the route in the immediate vicinity, in the zone of the intersection between Paštrovićeva ulica and the Topčider River.

Demolitions

Along the entire route, several business facilities are to be demolished, three residential structures on the New Belgrade side, a petrol station, the „Akademski jedriličarski klub" building at Ada ciganlija, and two ″Jugopetrol″ reservoirs.

4 OVERVIEW OF MAIN ALTERNATIVES

A strategic impact assessment of the Programme of the plan for the UMP traffic section from the T-6 route to the Pančevo Bridge discussed the variants analysed in the General project and the preliminary justifiability study for the traffic route Inner arterial semi-ring road from The T-6 route to the Pančevo Bridge.

For this purpose, several variants were analysed for the location of the bridge across the Sava, as were several variants for the Topčider tunnel entrance. The evaluation included urban planning, traffic, environmental, climatic, construction and infrastructural, hydrotechnical and geological criteria. The accompanying study of the General Project, titled "Environmental impact analysis" discussed three variants of the UMP route crossing the Sava in the Ada Ciganlija area, specifically: a tunnel according to General Plan for Belgrade until 2021 (variant V0-t), a tunnel according to the General Plan for Belgrade until 2021, positioned in line with the isthmus (variant V0-t), and the bridge at the tip of Ada Ciganlija (variant V1), which was not included in the General Plan for the area, but proved to be justifiable during the elaboration of the General Project.

The ecological criteria used for evaluating the variant solutions are the following: noise levels on the section observed, air pollution (emissions) on the section observed, pollution of surface waters and soil, danger to underground waters, the surface of endangered vegetation in the route's impact zone, impact on the environmental status (ecosystem) of the wider surroundings and accident risks during construction and maintenance. Further on, based on the same seven environmental criteria, an evaluation of the selected V1 variant was conducted with respect to the extension of the traffic route after crossing the Sava and entering the tunnel, specifically:

- variant with the bridge at the tip of Ada, with tunnel entrance at Careva Ćuprija (V1-g) – according to the 2021 Belgrade General Plan.
- variant with the bridge at the tip of Ada, with the tunnel entrance underneath Senjak (V1-s) – emerged during elaboration of General Project.

No.	Criteria	Variants evaluated				
		V0-t	V0-m	V1	V1-g	V1-s
1.	Noise levels on section observed	5	3	3	3	3
2.	Air pollution (emissions) on section observed	4	3	3	3	3
3.	Pollution of surface water and soil	3	3	3	3	3
4.	Danger to underground waters	1	4	4	4	4
5.	Surface to endangered vegetation in traffic route's impact zone	4	1	2	2	3
6.	Impact on environmental status (ecosystem) of wider surroundings	2	1	3	3	4
7.	Accident risks during construction and maintenance	1	2	3	3	3
Overall:		20	17	21	21	23

V0-t - variant with tunnel according to General Urban Planning Plan (GUPP)
V0-m - variant with bridge according to GUPP
V1 - variant with bridge at the tip of Ada
V1-g variant with bridge at the tip of Ada and tunnel entrance according to General
V1-s - variant with bridge at the tip of Ada and entrance to Senjak tunnel

Based on the evaluation of different variants of tunnel entrances, variant V1-s was selected as the more favourable one, which is level with Senjak as it enters the tunnel – unlike the one in the 2021 Belgrade General Plan. The geological aspect is the most favourable in variant V1-s, which has the best engineering and geological characteristics and the most favourable implementation conditions. In terms of hydrotechnical criteria, variants V1 and V1-s received the best ratings.

Taking only ecological indicators into account, the comment on evaluation results would be the following:

- noise levels on the section observed – the tunnel is the favourable variant, the noise at the tip is lower than in the GUPP variant, yet it does not exceed the permitted level in either case
- air pollution (emission) on the section observed – the tunnel is the favourable variant, except for the entrance and exit portal, air pollution is minimally higher at the tip of Ada, yet it does not exceed the permitted level in either case
- pollution of surface waters and soil – surface water and soil pollution is identical, as it is assumed that drainage of surface waters will be dimensioned and treated accordingly
- danger to underground waters – tunnel construction will disrupt the underground water system, while bridges will have no impact on potential dangers. With respect to the protective zone of the spring, the situation is similar for all variants.
- the endangered vegetation surface in the route's impact zone – the vegetation will mostly be endangered by the bridge according to the GUPP (200 m on each side), while the variant with the tip of Ada more favourable (50 m towards Ada). Variant V1-g is less favourable than V1-s since the route runs alongside a protected natural area
- impact on the environmental status (ecosystem) of the wider surroundings – the variant at the tip of Ada is the most favourable since it crosses Ada with little negative impact and protects the hippodrome hinterground and the Topčider area. V—s more favourable due to an earlier entrance into the tunnel.
- accident risks during construction and maintenance – due to the tunnelling technology, permanent disruption and compositional changes will take place at Ada, as well as in the River Sava.

The functional evaluation and capacity checks of alternative solutions were conducted based on the forecast traffic requirements for 2021. Traffic loads on the part of the section from Ulica Tošin bunar to the bridge will average 19,700 to 22,400 vehicles per day, with a daily 37,100 vehicles crossing the bridge, while the section from the bridge to the end of the section at Paštrovićeva ulica will average 22,200 vehicles per day.

The Detailed Regulation Plan for the UMP traffic section from the T-6 route to the Pančevo Bridge – section from Ulica Tošin bunar to the Autokomanda interchange envisages the solution with the bridge at the tip of Ada and a tunnel entrance underneath Topčider hill.

5 OVERVIEW OF ENVIRONMENTAL CONDITIONS

5.1 Geological and geomorphological characteristics

Geomorphological characteristics

The area of the planned route features three natural morphological relief forms and an anthropogenous relief resulting from human activity. On the left bank of the Sava, there is a fluvial relief; the lower tip of the Ada Ciganlija island is covered by a fluvio-paludal relief, while the route runs across a lacustrine relief.

Geological characteristics

The space along the traffic route includes several different geological structures that are mostly products of normal sedimentation, without major interruptions or major discordances in the history of their creation. Their present spatial distribution is a consequence of many factors that had an impact on creation processes, but also on later changes, mostly as a result of external factors. On the geological pylon of the wider area, the terrain was created on a platform of cretaceous sediments which have received new marine sediments on their relief in the final phase of a large marine basin.

Seismics

According to the tracing on the seismological map showing a 500-year reverse period of earthquakes (Official Gazette of SFRY No. 52/90) the relevant location is in the region of the eighth degree of the MSK – 1964 seismic scale, with a 63-percent likelihood of occurrence. The seismic coefficient is defined with the following value: $K_s = 0.05$.

5.2 Underground waters

The geological profile traversed by the route is that of alluvial drifts of the rivers Sava and Danube. Geological research has shown that the thickness of Quaternary sediment layers in the New Belgrade area is approximately 30 m. The Quaternary sediment layers are rich in aquifiers, renewed by precipitation and water from the River Sava on both sides. The aquifier layer shows prominent water changes, i.e. renewal of used underground water with water from surface water courses. The hazardous substance load is therefore quickly transferred into the body of underground waters, including drinking water.

On the right bank of the River Sava, the underground waters are very deep below the surface of the surrounding terrain (40-60m), i.e. slightly below the levels of the Sava and the Danube. The aquifier layer is rugged, and absorbs precipitation water, with drainage occurring through the springs.

Belgrade's water supply comes from the springs in the coastal area of the River Sava. The ratio of underground water to surface water is 70:30. Underground water is gathered with 45 wells with horizontal drainholes and 45 pipe wells. The quantity of gathered underground water is approx. 5,200 l/s. The capacity of the underground water spring is limited by colmatage of the bottom of the River Sava and the drainholes of the wells. The capacity of the well has shrunk to 30-100 l, averaging approximately 50 l/s.

The route, with the accompanying infrastructure, runs along the section from Ulica Jurija Gagarina to Radnička ulica in the "sanitary protection zone proper" for underground water. "Ranney" wells 20 (at the tip of Ada Ciganlija) 28 and 29 (opposite the tip of Ada Ciganlija, at the shipyard) are in routine operation.

The current condition of underground waters was evaluated based on information on drinking water quality obtained from a programme for monitoring drinking water quality:

1. analysis of water from Ranney wells 20 and 29 from 2005, and
2. analyses for the purpose of the Study of current environmental conditions in the bridge construction zone on the Sava at Ada Ciganlija, conducted at Ranney wells 29 and 52 in 2008,

The quality of drinking water was evaluated based on drinking water criteria in normal conditions. Irrespective of the evaluation methods, it needs to be stressed that assessments of water quality and pollution by hazardous substances stand for average values calculated for one-year periods, while results of individual tests slightly deviate from the average values. The values may change (deteriorate) at higher air temperatures, i.e. in periods without substantial precipitation quantities.

As part of the existing monitoring of drinking water monitoring, there is no routine sampling or laboratory tests of individual underground water samples from Ranney wells; water quality is monitored on installations for processing drinking water, in reservoirs and within the distribution network.

Since underground water from the said wells is processed into drinking water at the Bežanija production plant, it is important to show the average values of parameters stated under points 1, 2, 3 for drinking water from the said plant over a multi-year period: arsenic 0.006 mg/l, TOC-1.82 mg/l, ammonium <0.05 mg/l.

Based on the above, it may be said that, over a period of several years, underground water from Ranney wells 29 and 52, at its present quality, has no impact on average values of the parameters observed in drinking water from the Bežanija plant, which fluctuate within the required maximum permitted concentrations.

5.3 Surface waters

The River Sava is the largest surface watercourse in the traffic route area. The Topčider River is the most important tributary of the River Sava, primarily in terms of additional hazardous substance loads. From the hydrological aspect, there are no other major hazardous substance loads in the River Sava in this area, including potential additional hazardous substance loads. The current condition of underground waters was evaluated based on information on drinking water quality obtained from a programme for verifying drinking water quality, conducted in the Belgrade city area.

The evaluation of water quality in the Sava was conducted pursuant to the Decree on classification of waters, international waters and the coastal sea of Yugoslavia (Official Gazette of SFRY No. 6/78) and the Decision on the maximum permitted concentrations of radionucleids and hazardous substances and in inter-republican watercourses, international waters and coastal sea waters of Yugoslavia (Official Gazette of SFRY No. 8/78).

In the area envisioned for constructing the section, the verification programme is conducted at the River Sava, e.g. on sampling location Makiš and Kapetanija (part of the River Sava at the confluence into the Danube) and on Topčiderska reka before the confluence into the River Sava (in the Čukarica branch area). The verification programme includes parameters defined by regulations.

The water quality was evaluated based on:
- hazardous substance loads, i.e. evaluation of the chemical composition of water;
- criteria for salmonoid surface waters specified in Council Directive 78/659/EEC Council Directive 78/659/EEC of 18 July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life.

Irrespective of the evaluation methods, it needs to be stressed that assessments of water quality and pollution by hazardous substances stand for average values calculated for one-year periods, while results of individual tests slightly deviate from the average values. The values may change (deteriorate) at higher air temperatures, i.e. in periods without substantial precipitation quantities. Based on test results, it was established that water quality in the River Sava has improved compared to 2003 (2003 being the year of the best conditions over the past 10 years).

The other conclusions are the following:
- oxygen quantities are in compliance, although deviations were established in periods of increased air temperatures, in particular in the section of the watercourse near the city of Belgrade;
- pH and electrical conductivity are at the expected constant values;
- nitrogen, ammonium, nitrite and nitrate compounds are within the limit values for Category II water quality, while the value of the quality of surface waters necessary to support fresh-water fish life is exceeded (78/659/EEC);

- as regards heavy metals, traces of Cd, Hg, Ni and Pb were established;
- mineral oils and compounds from the PAO group occur occasionally; the limit for Category II quality was not exceeded;
- the established phenol content is at the limit of significant content for the test methodology used;
- the established values of organochlorine compounds (DDT and derivatives, HCH compounds and others) are within the limits for the testing methodology used;
- a constant presence of 1,1,2-trichloroethylene and 1,1,2-tetrachloroethylene was established, as well as of benzene and its derivatives. The measured values are at the limits determined for the test methodology used.

The results of pollution content tests performed on sediments of the River Sava indicate loads of heavy metals, loads of PAU compounds and mineral oils on the entire tested section of the River Sava (from the village Ušće to the confluence into the River Danube, on the Kapetanija location). The sediment from the Kapetanija location for 2001-2004 clearly indicates a trend of decreasing cadmium and chromium loads, as well as increased zinc loads.

The reasons behind increased five-day biological oxygen consumption as well as of increased content of degradable organic substances in the water at Kapetanija and Topčider River are the following: waste let out from the city sewage network, numerous illegal outlets from residential facilities and non-treatment of sanitary waste water from companies letting out their waste water directly into these watercourses. Also contributing to water pollution in the Sava are numerous "rafts" letting out waste water directly into the river, without any treatment whatsoever.

Additional programme tests of sediment quality conducted in 2008 and an evaluation of test results, international regulations in this field were used, due to the lack of national legal regulations. Results of tests performed on disturbed samples of surface sediment layer were interpreted in accordance with "Canadian Sediment Quality Guidelines" from 1992. The evaluation of non-organic micropollutants (heavy and toxic metals) was conducted by comparing the established concentrations with the "probable effect levels" from "Canadian Sediment Quality Guidelines", since there are no corresponding Serbian regulations in this field.

High total concentrations of hydrocarbons are recorded on both control locations, in particular at the downstream profile, where the concentration is twice as high as that on the Makiš profile, which would point to identical pollution sources in the urban area proper, already stated in the section on surface water quality.

Occurrence of higher concentrations of heavy metals at Makiš is not rare since it is partially accounted for by transport of dragged sediment, while all major sources of pollution by heavy and toxic metals are situated dozens of kilometres upstream from the Belgrade area proper.

5.4 Soil

The current soil load was evaluated based on existing data from soil testing for hazardous substance content from 2003 and the results of further soil condition tests conducted in 2005, as well as on additional tests from 2008.

In 2003, soil testing was performed on the sampling location on the coast of Ada Ciganlija, the coastal part of the Čukarica branch and Ušće, as well as other coasts not directly linked to the construction and operation of the traffic route (e.g. the Makiško polje coast, the central urban area (Cvijićeva ulica and the location at the Clinic for Infectious Diseases in Belgrade, as well as locations on traffic routes and at the Nikola Tesla Airport). Additionally, additional soil testing was conducted in 2005, on three locations in the Ada area (Locations of soil load tests for hazardous substances in 2005).

Within the planned tests of environmental substrates on the location of the future bridge across the Sava, soil sampling and laboratory test were conducted in 2008. The sampling was conducted on 30 Sept 2008, on the following locations (a total of 3), with one sample from each:

- at the tip of Ada Ciganlija and
- on the left bank of the River Sava
- on the right bank of Čukarica branch.

Evaluation of results of tests conducted in 2003 and 2005

In terms of potential soil pollution resulting from traffic impact, the information on nickel content having been detected in the soil on all tested water sanitary zones in Belgrade water wells is significant. The measured values vary between 50 to 120 mg/kg Ni. It may be concluded that the load on geogenous springs increased. For a more accurate definition, additional systematically planned test are required.

In the area traversed by the traffic route with the accompanying infrastructure, no pesticides (atrazine) or other organochlorine compounds were detected in the soil.

Evaluation of results of additional tests conducted in 2008

After a targeted testing for hazardous and harmful substances in the soil in the territory observed, we may conclude that deviations recorded on two of three locations tested are related to increased nickel content.

Increased lead concentration in soil samples from the right bank of Čukarica branch most likely indicates impact of a very high-traffic route (Bulevar Vojvode Mišića), situated in the immediate vicinity of the sampling location.

This indicates significant loads on surface soil layers due to the presence of the said pollutants, which is related to the existing facilities (marina, rowing clubs, servicing

and maintenance of vessels, etc.). The recorded deviations may be related to the conditions and the ways of utilising the said area.

5.5 Air pollution and climate characteristics

Current air pollution in the intervention area is based on multi-year air pollution measurements in Belgrade and additional air quality measurements in 2005 and 2008. The air immission limit values in RS are defined in the Rules on limit values, immission measurement methodology, criteria for establishing measurement locations and data records, Official Gazette of RS 54/92, 30/99, 19/06.

The climatic characteristics in the area of Stage I of UMP Section I were taken from the General Project and a preliminary justifiability study for the UMP traffic route, Based on measurements of climatic parameters over periods longer than 100 years, it has been proved that Belgrade and its wider surroundings have a moderate continental climate. In general, the climatic parameters for Belgrade are characterised by the following average values:

- the average temperature is: annual 11.7°C, January 0.0°C, July 22.1°C, with the average temperature on a steady increase over the past 100 years;
- annual average relative air humidity is 70%;
- the annual average precipitation is 620-745 mm, depending on the observation period;
- the annual average number of snowy days is 34-38;
- the dominant winds are those from the southeast (košava), northeast and the west;
- the winds reach their maximum speeds during the winter, with maximum gusts up to 35.9 m/s.

The Belgrade area is exposed to intrusions of polar and subtropical air masses, resulting in unstable weather conditions all year round, but mostly during the spring and autumn. During cyclone activity, characterised by strong winds, showery precipitation, increased cloudiness, etc, the impact of local factors is minimal; the situation is reversed during anti-cyclone activity, and local factors come to the fore, making an impact on modifications to climatic elements, in particular, in surface layers of the atmosphere above residential areas (differences in the horizontal temperature raster and precipitation).

The results from the Karađorđev park and Surčin clearly indicate that the basic wind direction is approximately 110° (east-southeast). Another direction occurring frequently in strong three-second wind gusts is approximately 300° (west – southwest).

Based on a 40-year measurement period at weather stations Karađorđev park and Surčin, and according to EN 1991-1-4, which defines reference wind speed $v_{ref,}$ as a ten-minute average value at 10 m above the ground, the designer recommends that a reference speed of $v_{ref=}$28.5 m be used for Belgrade.

Air quality conditions in the wider Belgrade area

As the basis for assessing air pollution in the Stage I area of the construction of UMP, the results of air pollution measurements conducted in the wider Belgrade area by the City Institute of Public Health in Belgrade were taken. In the Belgrade area, air pollution by concentrations of SO_2, NO_x, soot and total sediment substances, and some specific pollutants, is monitored. The local urban network for air pollution monitoring in the Belgrade area is comprised of 16 measurement locations for basic pollutants, 3 measurement locations for specific pollutants (industrial pollution), and 3 measurement locations in the suburban area. The air quality control programme includes two groups of pollutants - basic and specific pollutants.

Data collected from the Annual reports of the City Institute of Public Health in Belgrade on Air pollution conditions in the territory of Belgrade for the 1995-2005 period yielded certain results for specific pollutants. For an analysis of current air pollution conditions in the UMP corridor, the entire Belgrade area was considered, since air pollution cannot be delineated. For a comparative analysis, 6 measurement locations were selected, with air pollution levels monitored based on multi-year measurements with the following parameters: sulphur dioxide, nitric oxide, soot, total sediment substances and total suspended particles.

SO_2 concentrations

Annual average SO_2 concentrations are below 50 µg/m³ on all measurement locations, which is equivalent to the annual ILV, except for Ulica Dr. Subotića, where the annual average SO_2 value in 2005 amounted to 62.7 µg/m³. Over an eleven-year period, the values were considerably even, with the lowest values in 1995 and 2000, and a slight increase in 2005.
At annual level, this is still within limits of acceptability, in view of the World Health Organisation recommendation to keep the number of days exceeding the ILV not above 10% of the observed period (which amounts to 37 days annually).

Soot concentrations

The results indicate that annual average soot immissions were below the level permitted by law on all measurement locations. Since all results displayed represent annual average values, they do not reveal the periodically exceeded ILVs occurring on specific days. The number of days with soot immissions above immission limit values is used as an indicator of these occurrences. Considering the changes at ten-year level (1995-2005), an increased number of days of exceeded ILV is evident in 2005. Compared to 1995, soot values rose also in 2000 and 2005, exceeding the permitted number of ILV violations on several measurement locations (for 37 days).

NO_2 concentrations

The maximum daily concentrations exceed the ILV (85 µg/m³) in most cases, with a maximum of (192 µg/m³) recorded on the measurement location at Ulica Mate Vidakovića in 2003. The presence of NO_2 in the air is mostly associated with traffic. With NO_2 concentrations on measurement locations rising since 2001, it needs to be

borne in mind that the planned traffic route (UMP) will contribute to an increase of the current concentration in the route zones, while, in the city centre, a reduction of the load on traffic routes would result in the favourable reduction of NO_2 concentrations.

Aerosediment concentrations

For the overview of aerosediment concentrations, data on the annual average values in the 1995-2000 period was used. Unlike the previously stated pollutants, annual average aerosediment concentrations exceed the ILV over the entire measurement period on all measurement locations, with occasional exceptions on measurement locations in Ulica Ljutice Bogdana and Požeška ulica. The minimum aerosediment concentration was recorded in 1998 on the measurement location in Požeška ulica, amounting to 78.5 mg/m^2/day. There is a regular pattern noticeable in the alternating falls and rises in aerosediment concentrations over the eleven-year period, as well as a drop in concentrations on all measurement locations in 2005 by an average 100 mg/m^2/day. Based on the collected data, it is assumed that aerosediment concentration in the air may be unfavourable to the UMP route and its surroundings, with annual average values fluctuating above ILV.

Concentrations of suspended particles

Suspended particles (SP) are very significant for assessing air quality in urban areas. They represent a complex mixture of organic and inorganic substances (hydrocarbons, metal oxides, cancerogens, etc.), which, due to their micron sizes, have a significant influence on health. Based on information from 2005, the only measurement location where the annual average concentration of total SP was below the ILV of 70 μg/m^3 was Bulevar Despota Stefana (48.4 μg/m^3), unlike all other locations, where the GVI was exceeded multiple times over (including the measurement location at M. Vidakovića – 236.5 μg/m^3). With respect to the maximum daily values, measurements in B. Despota Stefana indicated 807.1 μg/m^3, with 729.7 μg/m^3 measured in M. Vidakovića. In 2008, additional measurements of suspended particles took place in the New Belgrade area (Omladinskih brigada 104, at FOB). On the measurement location at Omladinskih brigada 104 the annual average value of SP10 was 36.4 μg/m^3, with the maximum 24-hour value at 174 μg/m^3. In the winter period, the average value was at 43.6 μg/m^3, and 27.5 μg/m^3 in the summer period.

Additional air pollution measurements in UMP Stage I area

In order to determine the existing conditions in the UMP impact zone in the Čukarica area (ulica Radnička bb) additional continuous measurements were carried out in the period between 22 November and 8 December 2005 to determine air pollution by sulphur dioxide, nitrogen dioxide, carbon monoxide, suspended particles SP_{10}, and ozone, with measurements of weather parameters. The measurements were conducted by the City Institute of Public Health in Belgrade, the Department for Hygiene Activity and Environmental Protection, the Human Ecology Laboratory.

The measurement methodology, the equipment, the parameters tested and the interpretation of results have been brought to compliance with the Rules on limit values, immission measurement methodology, criteria for establishing measurement locations and data records (Official Gazette of RS No. 54/92, 30/99 and 19/06). Detailed information on the measurement location and methodology, equipment and results are given in report No. HE O 011 of December 2005; hereby we give the key findings:

- the maximum measured concentrations of **sulphur dioxide**, despite the fact that the measurements were conducted during the heating season, did not surpass the one-hour limit values, with the measured maximum amounting to 135 μg/m³ (GVI 350 μg/m³), and the daily limit values, with the measured maximum at 54 μg/m³ (GVI 150 μg/m³);
- the maximum measured concentrations of **nitrogen dioxide** did not surpass the one-hour limit values, with the measured concentration amounting to 65 μg/m³ (GVI 150 μg/m³), and the daily limit values, with the measured concentration at 39 μg/m³ (GVI 85 μg/m³);
- during the measurement, the maximum measured concentrations of **carbon monoxide** amounted to a mere fraction of the one-hour limit value, with the measured concentration amounting to 3.3 g/m³ (GVI 10 g/m³), and the daily limit value, with the measured concentration at 1.4 g g/m³ (GVI 5 g/m³);
- as expected, during the measurement, the maximum measured concentrations of **near surface ozone** were below the one-hour limit values due to low levels of solar radiation in the winter period, with the measured value amounting to 100 μg/m³ (GVI 150 μg/m³), and the daily limit values, with the measured value at 76 μg/m³ (GVI 85 μg/m³); In periods of higher-intensity solar radiation, the expected ozone concentration is higher than the limit values, which is a characteristic of all major urban areas,
- **suspended particles Sp_{10}** represent a part of the total suspended particles with aerodynamic diameters of <10 μm for which the Rules on immission limit values do not specify the daily limit values. As regards the ILV for the total concentration of suspended particles over 24-hour periods, according to the Rules, the limit value was not exceeded, with the measured value at 60 μg/m³ (GVI 120 μg/m³). As regards the limit values, according to Directive 1999/30/EC (GVI 50 μg/m³ – the annual permitted number of violations amounts to 35), the daily limit value was exceeded 4 times.

In 2009, the City Institute of Public Health elaborated an additional study of existing environmental conditions in the zone of the construction of the bridge across the Sava at Ada Ciganlija.

Compared to usual pollutant concentrations in the air, monitored in the territory of the city of Belgrade through the Programme for systematic measurements of air pollution conditions, it may be said that benzo(a)pyrene, nickel and chromium values were significantly exceeded on all measurement locations. Soot and SP_{10}

concentrations fluctuated within the permitted values; it must, however, be stressed that they were near the upper limit of ILV.

Soot concentrations in the central zone and individual zones with more furnace locations exceeds the permitted values. The number of days exceeding the soot ILV is over the recommended 10% per year in these zones. Concentrations of suspended particles up to 10 microns also exceed the required values, especially at rush hours. Automatic monitors have been registering increased benzene concentrations, especially in canyon-like streets that are also subjected to significant traffic loads.

5.6 Noise

The existing noise level conditions and noise loads on the relevant UMP route and its direct surroundings is represented on the basis of continuous noise measurement in the existing network of measurement locations over a period of several years (1995-2005), conducted by the City Institute of Public Health. In addition to these results, the environmental impact assessment study also presents noise measurements data taken from the "Noise measurement report in the Stage I area of UMP construction" from 2005 (City Institute For Health Protection), as well as noise measurement data taken from the "Study of current environmental conditions in the zone of the construction of the bridge across the Sava at Ada Ciganlija" in 2008 (City Institute of Public Health). The noise limit values with respect to the purpose of a specific area pursuant to the Rules on noise levels permitted in the environment, Gazette of RS No. 54/92 ((JUS U J6.205), are given in the table.

Table 1: Noise limit values in outdoor environments according to JUS U.J6.205 u dB(A)

Degree	Purpose of area	*Noise limit values in outdoor environments, dB(A)* Daytime	Nighttime
I.	Rest and recreation areas, hospital areas, cultural event areas, large parks	50	40
II.	Tourism areas, small and large residential areas, camps, educational areas	50	45
III.	Purely residential areas	55	45
IV.	Business and residential areas, commercial and residential areas, playgrounds	60	50
V.	Central urban areas, industrial, commercial and administrative areas, areas around motorways and arterial roads	65	55
VI.	Industrial, warehousing and servicing areas and transport terminals without housing	Violations of levels for contiguous areas not allowed at area boundaries	

Due to outdoor noise sources, the noise limits for noise-sensitive dwelling premises defined in the Rules on noise levels permitted in the environment, Gazette of RS No. 66/91 are given in table 2.

Table 2: Noise limit values in noise-sensitive residential premises in dB(A)

Type of area	Daytime	Night time
Apartment dwelling premises	40	35

Existing noise loads in the wider Belgrade area was taken from data obtained by noise measurements conducted by the City Institute for Health Protection and its Hygiene and Medical Ecology Service. Noise measurement data for outdoor environments were also taken from annual reports in the multiyear 1995-2005 period (Communal noise in Belgrade, City Institute for Health Protection 2006).

Results of communal noise measurements indicate the following:

- an analysis of measurement results points to the fact that both daytime and night time noise levels exceed the permitted values. The measurement location at Ulica Vojvode Bogdana 1 (industrial zone) is the only one within the permitted limit values, with the measured noise levels not exceeding 70 dB(A) over the entire measurement period from 1995 to 2005.
- evidently, traffic noise is the predominant source of noise. In zones along high-traffic city routes, noise levels are higher than permitted, night and day alike. On all seven observed measurement locations along high-traffic routes, daily noise levels exceeded the permitted 65 dB(A) daily value by 0-15 dB(A), while the permitted night time level (55 dB(A)) was exceeded by 1-20 dB(A);
- the highest violations were registered in Bulevar Vojvode Mišića, where the measured noise levels was always higher than permitted – daytime values were exceeded by 6-15 dB(A), and night time values by 11-20 dB(A);
- high violations of the permitted noise levels occur in Bulevar Despota Stefana Prvovenčanog (0-15 dB(A) at daytime, 4-20 dB(A) at night time), Krivolačka ulica (4-14 dB(A) at daytime, 8-18 dB(A) at night time), Bulevar Revolucije (0-12 dB(A) at daytime, 4-15 dB(A) at night time) and similar traffic routes due to high traffic loads and presence of buses, cargo vehicles, rail vehicles or a combination of these parts;
- the least deviation of the measured noise levels from permitted noise levels in the zone along traffic routes was on measurement location in Ulica Goce Delčeva, where there were no violations at daytime, with a 2-7 dB(A) violation at night time;
- measurement results indicate that also on measurement locations in the residential zone where the UMP route is envisioned, the respective daytime and night time noise levels were 0-18 dB(A) and 0-21 dB(A) higher than the permitted value. Also, on the measurement location in Ustanička ulica, noise levels are constantly higher than permitted – 9-18 dB(A) at daytime, and 7-11 dB(A) at night time, while the situation in Ulica Radojke Lakić is slightly more favourable – the violations amount to 0-11 dB(A) at daytime , and 0-4 dB(A) at night time.

Existing noise loads in the UMP Stage I area is mostly a result of traffic on the main routes in the observed route (Bul. Vojvode Mišiča, Bul. Jurija Gagarina, Radnička and Paštrovićeva ulica), railway traffic on the Ruma – Belgrade and Belgrade – Kragujevac railway lines, tramway traffic in Čukarica and industrial noise on th

beginning and the end of the route. An additional noise source in the Ada Ciganlija area is the river traffic (dock, shipyard).

The noise load in the current conditions in the area around UMP Stage I area between Ulica Tošin bunar and Paštrovićeva was determined on the basis of noise measurements in 2005 and 2008. The measurements were conducted by the City Institute of Public Health in June 2005 and September 2008.

Noise measurements in u 2005 included brief daytime measurements on four locations (New Belgrade – Blok 65, Savski nasip, the hippodrome at Čukarica and Careva Ćuprija), brief night-time measurement on a single location (Careva Ćuprija), and longer measurements (24 hours) on two locations (Drinička ulica in the Senjak residential area and Ada Ciganlija). Noise measurements were conducted pursuant to the ISO 1996-1,2,3 and JUS J6.090 methodology:

- on measurement locations (Senjak residential zone), the measured noise level exceeds the permitted noise levels for noise protection levels III and IV;
- in the current conditions at Ada Ciganlija and the hippodrome, the permitted daytime noise levels for noise protection level I (rest and recreation area) were exceeded by 4 dB(A), while permitted night time values were exceeded by 12 dB(A) at Ada;
- on the measurement location (Savski nasip) the noise levels are within the permitted limits for noise protection level V.

In 2008, the City Institute of Public Health elaborated an additional study of existing environmental conditions in the zone of the construction of the bridge across the Sava at Ada Ciganlija. The goal of the Study was to obtain information on environmental conditions on the relevant location prior to the start of works for constructing the bridge across the Sava. The collected and processed data will aid the monitoring of the environmental impact of the planned works by means of a comparison with the results of tests carried out throughout the construction period in the form of targeted monitoring.
Zero condition noise measurements on the location of bridge construction at Ada Ciganlija were conducted on five selected measurement locations.

- MM 1, Ada Ciganlija (Partizan Rowing Club),
- MM 2, "Ranney" well No. 28 (near the Gemax company),
- MM 3, Ada Ciganlija (Administrative building),
- MM 4, Drinička 7b,
- MM 5, Belgrade Fair (Hall XIV).

Zero condition noise measurements were conducted between 22 September and 28 September 2008:

- on measurement locations 1, 3 and 4, the average seven-day noise levels exceed the daytime and night time permitted levels, while noise levels on measurement locations 2 and 5 (bordering the city centre zone, zones along the motorway, arterial and urban traffic routes) are within the permitted levels;

- on all selected measurement locations, the differences between the measured daytime and night time values turned out to be small, which could suggest that the noise is not caused by a specific source in a nearby zone;
- at MM 4, the differences between the respective daytime and night time regimes are negligible, and their significance is questionable (indicating the existence of remote noise sources)

5.7 Vibrations

The assessment of current structure conditions in the area impacted by Stage I of UMP construction was elaborated on the basis of on-site testing and a visual assessment of the condition of structures impacted by the traffic route.

The assessment of vibration impact on structures resulting from traffic on UMP Stage I was elaborated on the basis of testing that took into account the data on projected traffic density and structure in 2021, vehicle speeds and other parameters impacting vibration emission.

On the initial section of the route, up to the grade separated intersection with Bulevar Jurija Gagarina, there are no residential structures, while structures to the south of Bulevar Jurija Gagarina and structures around Ulica Savski nasip are partially loaded by vibrations resulting from traffic on Buleva Jurija Gagarina; structures south of the Sava in the Senjak area are loaded by vibrations due to road traffic (Bulevar Vojvode Mišića, Radnička ulica, Paštrovićeva ulica), and vibrations resulting from railway traffic on the Belgrade – Kragujevac line.

There is no measurement data on existing vibration loads on structures around UMP Stage I route. The expert assessment elaborated by the City Institute for Health Protection in Belgrade for one of the previous variants for crossing the Sava concluded that, as expected, railway traffic accounted for a larger part of vibration loads compared to road traffic.

5.8 Flora, fauna, vegetation, and habitat types

Flora and vegetation

The data on flora and vegetation were collected by field research in the second half of June 2005 and the end of September 2009 when we recorded those plant species and vegetation communities that were identifiable at the time. We also used data from the Institute for Protection of Nature of Serbia and the document Environmental Impact Analysis as well as data from experts.

The most important sites on the route's section from the Ulica Tošin bunar to Paštrovićeva ulica in terms of flora and vegetation are the following:

The railway embankment northwest of Ulica Dr. A. Neta

A plant species from the *Tragopogon* L. genus – deemed new in flora of Serbia – has been registered in the area. It appears in the area of approximately 500 m^2 (5 m along the embankment in the total length of approximately 100 m). As the species has not been previously registered in Serbia, the site is important for study and research purposes.

Ada Ciganlija area

The original vegetation in the Ada Ciganlija area was hygrophile forest which was replaced by more or less anthropogenic vegetation communities. An older literature source on vegetation in the Ada Ciganlija area is a paper in Glasnik Prirodnjačkog muzeja Srpske Zemlje, Beograd, Vegetacija Ade Ciganlije (Rajevski, L., 1950) /*Vegetation of Ada Ciganlija*/ In his master's thesis (Radulović, S., 1982) Vegetation of Ada Ciganlija, the author states that phytocenosis of the area consists of 110 species. Today, the following vegetation communities appear in the Ada Ciganlija area:

- The *Salicetum triandrae* Malc. community – almond willow forest
- *Salicetum albae* S.L. community – white willow forest
- *Saliceto albae-Populetum* Raj community – white willow and poplar forest
- *Populetum albo-nigrae* Slav. community – white and black poplar forest
- *Populetum nigrae* Knapp. community – black poplar forest
- *Populetum albae* Knapp. community – white poplar forest (*Populus alba*).

The list of flora in the area between Ulica Tošin bunar and Paštrovićeva ulica, including Ada Ciganlija, which records a total of 162 plant species representing 24.1% of the 671 species listed for different types of ruderal sites in the area of Belgrade. (Taken from "Supplements to Conditions for Protection of Nature and the Living Environment for Preparation of the Design Project for the Inner Main Half-Ring Road from Ulica omladinskih brigada to Paštrovićeva ulica (no. 03-729/02 of 25/05/2005, institution no. 03-1808/4 of 20/12/2004)", the Institute for Protection of Nature of Serbia). The total number of plant species is estimated at more than 1500 (Jovanović, S., 1994)

In the area of Ada Ciganlija there are also growing sites of an endangered species of fungi *Myriostoma coliforme*, which is on the list of endangered species of the Bern Convention (the Convention on the Conservation of European Wildlife and Natural Habitats, adopted in Bern on 19 September 1979). We are not expecting its habitats in the area of the development (the tip of Ada), mostly because the area is heavily flooded and is thus an unsuitable habitat for the species (anaerobic condition of the soil).

Habitat types, typology and value of biotopes in the area of the development

In the mapped area of approximately 320 ha we have recorded 21 habitat types with developed areas prevailing (53.5% of the mapped area) while green areas (oases, gardens, ruderal areas, small forest islands and parks) extend over roughly 33% of the mapped area. The planned development comes the closest to a highly evaluated HT *44.13 of the riverbank white willow in the Ada Ciganlija area where the development and landscaping will affect the mentioned HT on roughly 2 ha. More valuable water habitats and habitats linked to the Sava River (watercourse, riverbanks with silt deposits and riverbank white willow) appear in the mapped area on roughly 34.7 ha (prepared on the basis of the European habitat types classification supported by the European Council Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora).

In line with the implemented project (2007) Mapping and evaluation of biotopes of Belgrade – stage III of the project "Green regulation of Belgrade" (Urban Planning Institute of Belgrade, 2007), we present below the list of biotope types and potential values of biotopes in the area of the development. Biotopes with the potential value of 5 are predominant on the left bank of the Sava River (valuable biotopes, extensively used and with rich structure), on Ada Ciganlija highly valuable, naturally close biotopes with high refugial function, deserving protection of nature (potential value of 6), and on the right bank of the Sava River biotopes with predominant potential value of 4 and 5 – still valuable biotopes, good capability of development, previously extensively used and sufficiently structured, and valuable biotopes, extensively used and with rich structure.

Fauna

Ornitofauna (birds)

The coast of the Sava River, the river itself and Ada Ciganlija offer refuge to many bird species, notably those with water habitats. The area is particularly significant during the winter when many species of swamp birds are present on the Sava River. Although located in the city centre, the area from Ada Ciganlija to the outflow to the Danube is characteristic for the presence of certain rare and endangered species. The area around Ada Ciganlija itself is characteristic as the winter area of pygmy cormorant. In the SPEC – Species of European Conservation Concern – classification pygmy cormorant is listed in the first group, i.e. the group of European species with global significance. In the global IUCN red list, pygmy cormorant is listed in the Near Threatened (NT) category. In Serbia (not including Montenegro) up to 500 pairs of the species is nesting, while the population spending the winter there equals between 2,000 and 3,400 individuals.

Basic characteristics of plankton and water quality of the Sava River in Belgrade calculated on the basis of plankton

Representatives of a typical potamoplankton community are the most common in the Sava River. In the largest number of studies, on various points, as well as different

seasons, Bacillariophyta is the dominant group, sometimes amounting up to 90% of the total number of taxon present. The following species are particularly frequently found and numerous: *Cyclotella meneghiniana* Kütz, *Fragilaria ulna* (Nitzsch.) L.B., *Melosira varians* Ag., *Aulacoseira granulata* (Ehr.) Simonsen, *Ditoma vulgaris* Bory, *Cocconeis placentula* Ehr., *Cymbella minuta* Hilse. Whereby the first four of the above species are very non-specific as they are characteristic also for a number of rivers outside the country (example of 67 different rivers – Rojo et al. 1994).

Ichtiofauna (fish composition)

In accordance with data from October 2003, ichtiofauna in the main bed of the Sava River near Belgrade (the Makiša area) includes 19 species of lampreys and fish from 6 families (Petromyzontidae, Esocidae, Cyprinidae, Siluridae, Centrarchidae and Percidae). In addition to these species, there are also hybrids, which are usually detected as individuals in sampling. The occurrence of hybrids is typical for individuals of the family Cyprinids nei (Cyprinidae) and is the result of joint spawning in limited spawning areas – propagation areas. As regards fishing, they are insignificant due to their relatively small frequency and often also poorer production (growth) in comparison with the parents.

5.9 Natural and cultural heritage

Natural heritage

Based on the documentation of the Institute for Protection of Nature of Serbia as well as an insight in the Register of protected natural heritage, it has been established that no protected natural heritage exists in the area delimited by the Main project stage I of the IMH road from Ulica Tošin bunar in New Belgrade. The recorded natural heritage is a non-indigenous plant species from the *Tragopogon* family. Its habitat is at the railway embankment (the site has scientific & research character).

Based on an insight in the Central register of protected natural heritage kept by the Institute for Protection of Nature of Serbia, it can be stated that the following is present along the corridor of the route of the section from the beginning of the bridge across the Sava River to the intersection with Paštrovićeva ulica (200 m):

1. *Protected natural heritage:*

the Topčider-Košutnjak complex comprises an ambient and functional whole, protected in 1958 as the *Spatial cultural & historical site Topčider,* Decision on declaring certain sites as cultural heritage (Official Gazette of the City of Belgrade, nos. 19/81, 23/84, 21/86, 16/87, 12/89, 21/89, 26/92, and 24/94), as a site of great cultural importance.

The following is located along the route of the corridor of the section:
The area of the hippodrome
The area of the shooting range and the mint also belong to this area. Although no especially valuable and preserved parts of nature were found by a field analysis, the surrounding green areas are significant in the biological and ecological sense.

2. *Protected spatial cultural & historical site Topčidersko brdo – Senjak - Dedinje.*
3. *Recorded natural heritage:*

- Black poplar tree on Ada Ciganlija.
- Ada Ciganlija – sites with fungi, especially Myriostoma coliforme (found on only four sites in Serbia and on 170 sites in Europe, and one of the 33 fungi species from the Bern Convention list).

4. Recorded areas with important natural value for preserving the quality of the living environment (forest park on Ada Ciganlija, Ada, non-indigenous plant species from the genus Tragopogon on the railway embankment on Ulica Dr A. Neta).

- Forest park (city forest) near Topčider River (up to the hippodrome).
- Park near Gospodarska mehana.

5. Areas with protected rare natural values:
several protected bird species are encountered during the winter on the Sava River and the Sava Lake. They are mostly birds of water habitats: Red-throated Loon (Gavia stellata), Great Crested Grebe (Podiceps cristatus), Pygmy Cormorant (Phalacrocorah pygmaeus), Red-crested Pochard (Netta rufina), ferruginous duck (Authia nyroca), Common Pochard (Aythia ferina) and Tufted Duck (Aythia fuligula), protected as rare natural value (Decree on protection of rare natural values, Official Gazette of the Republic of Serbia, no. 50/93). In the SPEC – Species of European Concern – classification pygmy cormorant is listed in the first group, i.e. the group of European species with global significance.

The following is also present in the wider zone of impact:
1. protected natural heritage of major significance, Monument of Nature Mašin majdan, of geological & paleontological character, representing a bank from the Cretaceous period near the Summer Stage.
2. Heritage envisaged for protection by the Action Programme of the Institute for Protection of Nature of Serbia for 2005.

Protected cultural heritage
In the area from Tošin bunar to the bridge across the Sava River in the wider area of the discussed IMH route there is the site Central Zone of New Belgrade which has the status of preliminary protection (comprises nine central blocks of New Belgrade – 21, 22, 23, 24, 25, 26, 28, 29 and 30), and in block 65 the Hangar of the Old Airport at the Ulica Đorđa Stanojevića, which enjoys the status of a piece of heritage under preliminary protection.

On the right bank of the Sava River in the zone of impact there is the spatial cultural & historical site Topčider which has been, due to its total value created in the 19th and 20th century including buildings of public, sacral and private character, public monuments, fountains, historic sites and sites of famous events, natural beauties and rare values, established as cultural heritage of extreme importance to the Republic of Serbia (Official Gazette of the Republic of Serbia, no. 47/87) and the site under preliminary protection Senjak, Dedinje and Topčidersko brdo.

Special value of the Spatial cultural & historical site Topčider comprises in the area of the discussed section (relief of Topčider with flora, the river and springs, sports facilities: the Hippodrome, shooting range, sports facilities of the former DIF and the Route Gospodarska mehana-Topčider-Rakovica; Route Topčiderska zvezda-Topčider and the Route Careva ćuprija-Banovo brdo, and in the wider area of the complex the Topčider Park in which there are Residence of Prince Miloš, Church of St. Peter and Paul, church house, Miloš Fountain near Topčider Church, Residence of Prince Mihajlo (residence of the patriarch), Milošev konak restaurant, Vruća česma Fountain near the railway station, Vračarska česma Fountain, obelisk as a tribute to the year 1859, a monument to Archibald Reis, small and big waterfall, Žetelica sculpture, economic development facilities: hotbed in Topčider, the first railway station in Topčider, sugar factory and mint, and the Summer Stage; cemeteries: a German military cemetery with a monument to Serbian soldiers killed in 1915 and the Topčider Cemetery.

Among the listed facilities, the following were established as cultural heritage:

- extraordinary importance: Residence of Prince Miloš (Official Gazette of the Socialist Republic of Serbia, no. 14/79).
- Important cultural heritage: Topčider Church (Decision of the Arts Museum, no. 1108 of 02/12/1946), Church House in Topčider (Decision of the Arts Museum, no. 1108 of 02/12/1946), Obelisk in Topčider Park (Decision of the Institution, no. 3/22 of 28/05/1965), Monument to Archibald Reis (Decision of the Institution, no. 3/28 of 03/07/1965), Žetelica Sculpture (Decision of the Institution, no. 3/18 of 22/03/1965), Sugar Factory (Official Gazette of the City of Belgrade, no. 23/84), House of Dr. Archibald Reis (Official Gazette of the City of Belgrade, no. 23/84), House of the Popović-Predić Family (Decision of the Institution).

The site Senjak, Dedinje and Topčidersko brdo under preliminary protection is planned for level four protection. Within the spatial cultural & historical site Topčider and Senjak there is a site established as cultural heritage envisaged for level three protection.

5.10 Landscaping characteristics and visual characteristics

The landscaping characteristics of the area of the development can be divided into the following characteristic units:
Unit 1 – urbanised landscape on a riverbank and plane relief
area on the left bank of the Sava River – New Belgrade: from Ulica Tošin bunar to the Sava River
The following is characteristic for the wider area of the planned development: plane relief, islands of non-residential (commercial and industrial) and residential use, geometric raster of street infrastructure, presence of the railway corridor and individual overgrown, degraded and undeveloped areas within the raster model of the street network.

Unit 2 – landscape of the river watercourse
Area of the waterbed of the Sava River – area between the left and right bank of the Sava River.
A plane river world is characteristic of the wider area. The landscaping model has a prevailing share of natural elements (watercourse and riverbank vegetation). A special feature of the landscaping model is a river island (Ada) grown in vegetation and intended for recreation. The river island is located between the main course of the Sava River on the left side and a backwater of the river (Čukarica Bay) on the right side.

Unit 3 – urbanised landscape on a riverbank plane and hilly relief
area on the right bank of the Sava River – Senjak - Topčider: from the Sava River to Paštrovićeva ulica.
Characteristic for the wider area of the planned development is a hilly area (Senjak, Čukarica and Banovo brdo) and a plane area of the Topčider River and the riverbank area of the Sava River. General features of the area are great plasticity and smooth lines. Valleys are wide and shallow and between them lie wide and flattened areas or wide and slightly sloped watersheds.

5.11 Socioeconomic characteristics and the quality of life

The existing role of Belgrade in the network of cities in Southeastern Europe is not even close to its natural and macro-transport position. The city's potential in the contact zone between Europe and the Balkans, at a crossorads of two of the ten European corridors has been for the most part left unused. Incomplete and underequipped motorway network and technologically outdated railway and water transport coupled with international isolation between 1990 and 2000 contributed to a diminished role of Belgrade in the European network of multimodal transport nodes taking shape to a certain extent at the beginning of the 1980s.

With regard to the discussed area, the road section from Ulica omladinskih brigada to Paštrovićeva ulica will pass through three municipalities, namely:

- Municipality of New Belgrade, no. of residents 217,773
- Municipality of Čukarica, no. of residents 168,508
- Municipality of Savski Venac, no. of residents 42,505

according to the 2002 census which showed a reduction in the number of residents during the 1990s.

Four spatial zones have been defined in the General Plan for Belgrade, prepared on the basis of main spatial & functional, urban planning & architectural and environmental characteristics. Specific conditions must be complied with in each of the zones during the project implementation.

On the left bank of the Sava River, the route will pass through the urban site of the Sava part of New Belgrade, the island is a part of the Ada Ciganlija urban site and the right bank of the Sava River lies in the urban site Senjak, Dedinje, Topčider and the Sava Amphitheatre, and Prokop.

The following has a major impact on the quality of life in Belgrade:

- the quality of the air and raised noise levels resulting from industry and traffic
- appearance of illegal estates with no infrastructure
- pollution of the air and watercourses with household and industrial wastewater and leakage of water from unregulated waste deposit sites
- waste management
- risks stemming from uncontrolled releases from industry and transport.

The main sources of pollution in Belgrade are transport and industry. Industrial emissions have been falling in the last two years as a result of a reduction in industrial activity. Health of the population is at the greatest risk from air pollution in the central zone and around major roads. Excessive pollution with deposited dust, smog, lead and nitrogen oxides are recorded in the area. In the area of the planned route, on the left and right bank of the Sava River, there is an industrial zone (heating station, cement plant, sand separation, shipyard, petroleum products storage facility etc.).

A large part of water supply of Belgrade ($6m^3/s$) is made by exploitation from the underground water of the Sava River. According to data, the quality of drinking water has been roughly constant since 1991 with detected slight increase in the concentration of iron and visible particles but the deviations were within the permitted limits. Drinking water has also been, albeit rarely and mostly during the summer, microbiologically incompliant.

6 DESCRIPTION OF POTENTIAL MAJOR IMPACTS ON THE ENVIRONMENT

6.1 Geological and geomorphologic characteristics

During construction

In the area of the planned road route, there are predispositions for instability and active ground movement, notably on terrains with inclination of more than 7-8^{o}. In the alluvia area there is no risk of instability from natural or filled terrain, unless excavations are made in the embankment. It is a particular problem in an embankment of refulation sand when widths of excavations are less than 2 m and excavations deeper than 2 m. Excavations must be spread, otherwise well-compacted sand soil will collapse in a wide radius.

Extensive construction and earthwork will be implemented during construction which will be related exclusively to the building site. In the part of the route passing on the embankment, the top soil layer will be removed and replaced by sand material to consolidate the terrain.

Construction of the bridge across the Sava will result in 37,763 m^3 of material. The major part will come from foundations of pillars, and will be partly used for reconstruction of the top layer and partly deposited to a deposit site. A certified laboratory issues for the excavated material a certificate that the soil is not contaminated and can be used to fill certain locations.

Foundations by rods are safe and environmentally acceptable. Concrete pillars are implemented by using self-moving boarding with circular changeable cross-section. The pillar at the tip of Ada will be based in depth of 25-30 m below the bottom of the Sava River. The steel part of the structure is set across permanent and, if need be, temporary support. The main arc across the Sava River is built by installation using consoles and no intervention in the river during construction. During construction of pillars there is danger of destabilisation of the riverbank and soil erosion. It is therefore not recommended to remove the root system. Geological characteristics of the terrain were taken into account in calculations of stability and foundations.

During exploitation

The natural morphological forms of the relief will be slightly changed. The changes will be primarily visible at the beginning and the end of the section where viaducts will be connected to the embankment. A natural relief will change to an anthropogenic one.

Changes in the basic geological structure will be caused already at the moment of construction with foundation of pillars. No additional impact on the geological structure of the soil will occur during exploitation.

6.2 Underground water

During construction
The impact of construction will be felt on soil and thereby, indirectly, on underground water in the entire area of the route of the discussed section. Additionally, a part of the route layout passes through an area of water protection and because of the depth of foundations below the underground water level and if inappropriate technology is used the condition of underground water could be directly affected.
In reconstruction of the existing roads on the discussed section, an additional criterion for control of handling of waste material is setting the method for handling waste asphalt which can be classified as dangerous waste (special conditions regarding handling and disposal are prescribed for others). Such waste material should be handed over to a certified recycling operator because such waste material might contain remains of fuel, motor oils and greases, protective means and other hazardous substance.

During exploitation
The road could have a negative impact on soil load and thereby the condition of underground water, notably during maintenance work. Roadway maintenance includes reconstruction of traffic, i.e. asphalt areas, maintenance of the drainage system and concrete and steel structures as well as the use of spreading material to maintain traffic safety during low air temperatures periods.

During maintenance, in line with the obligations, the competent organisation managing and maintaining the road shall comply with the relevant regulations and in the case any hazardous waste is produced comply with the Rules on Management of Waste Having Properties of Hazardous Substance (Official Gazette of the Republic of Serbia, no. 12/95), the Decree on the Transfer of Hazardous Substances in the event of Road or Railway Traffic (Official Journal of Republic of Serbia, no. 53/02), the Waste Material Management Act (Official Journal of the Republic of Serbia no. 54/92) and the Rules on Waste Management (Official Gazette of the Republic of Serbia, nos. 84/1998, 45/2000, 20/2001, 13/2003 and 41/2004.

6.3 Surface waters

During construction
The biggest impact on the condition of surface waters is by earthwork and construction on riverbanks and bed of the watercourse due to the following in particular:

- increased content of insoluble and decomposed material in water. The result is chemical pollution resulting from decomposition of individual elements of solid material (e.g. organic substances, sulphides, organic substances needing oxygen dissolved in water). A result is reduced level of oxygen and increased

concentration of nitrogen, sulphur and other elements of the sediment as well as increased content of non-dissolved substances.
- Changes in sediment structure. Toxic metals, sulphur and nitrogen compounds, which are stably linked to sediment but disturbed by development on the riverbed could begin to disintegrate. That could result in a type of reaction primarily resulting in transfer of hazardous substances in water, the dissolved stage affecting food of water organisms.
- Direct pollution of water and the sediment by construction and insulation material.

It is expected that the condition of the Sava River at the location of construction of pillars could make the condition worse which will be restricted to the part of the watercourse downstream from the construction site while the scope of the impact will depend on the zone of mixing and on the hydrological situation of the Sava River at the time of construction.

During exploitation
During the exploitation, the road could have a negative impact on condition of surface water:
1. permanently via meteoric waters if they were led to the recipient untreated.
2. In the case of an accident by leakage or spilling of hazardous liquids or other substances. That could result in additional pollution of the soil with hazardous substances, which could make worse the condition of surface waters and place additional load on sediments of the Sava River with hazardous substances.
3. During maintenance (e.g. reconstruction of the roadway and the structural elements of the roadway as well as road maintenance in low temperatures by the use of spreading material and the use of material, for example bitumen resins, greasing oils, surface coatings and other material, that could contain hazardous substances).

6.4 Soil

During construction
In line with the regulations, a suitable method for removing, i.e. temporary and permanent disposal, of excavated material must be provided for. Note that it is prohibited to dispose excavated material containing prohibited, i.e. unacceptable, levels of heavy metals in organic compounds on soil subject to stricter criteria in terms of pollutant content (e.g. soil for food production and soil on water protection areas).

During exploitation
Maintenance work and the use of material (e.g. bitumen resins, greasing oils, surface coatings and other material that can contain hazardous substances) is regulated by Serbian legislation on waste material, waste packaging and wastewater. Therefore,

the relevant regulations shall be complied with, e.g. in the case any hazardous waste is produced, the competent organisation managing and maintaining the road must, in line with the Rules on Management of Waste Having Properties of Hazardous Substance (Official Gazette of the Republic of Serbia, no. 12/95) dispose of such waste.

6.5 Air pollution

During construction
While construction of the IMH between Ulica Tošin bunar and the Sava River will take place on a flat terrain and at distance of more than 300 m from the nearest residential buildings, in continuation the construction will pass over protected natural and recreational areas (Ada Ciganlija) and adjacent to recreational (Hippodrome) and residential (Senjak) areas.

Construction will take place in an area where the air is already polluted with substances from traffic emissions. This is particularly true for the Čukarica area on the right bank of the Sava River. Transport for construction purpose will be routed on the IMH route and on the existing city road network. The following construction work will result in additional air pollution adjacent to the route:

- preparatory work (excavations, disposal and deposit of the top and bearing layer of soil);
- demolition of buildings in the area between J. Gagarina and the Sava River;
- preparatory work and construction of pillar on Ada Ciganlija;
- construction of the bridge across the Sava River;
- demolition of buildings and extensive earthwork in Čukarica;
- extensive construction work in building of structures on the route, construction of deviations and in the area of reconstruction of existing roads;
- transport, spreading and stabilisation of material for the top layer;
- development of municipal infrastructure.

The biggest increase in air pollution during the construction will be by dust particles. Dust emissions from the construction site will be the biggest in dry and windy weather. The load will be the greatest during preparatory work on the route and during demolition of existing structures, transport of excess material from the construction site and in transport and spreading of material for the top layer. Emissions of gases and dust particles will be additionally increased due to emissions from transport vehicles and construction machinery as well as from dust from transport vehicles.

<u>During exploitation</u>
The total air pollution by nitrogen oxide and suspended particles SP_{10}, accounting for average concentration of pollutants, has been assessed in the area of the bridge across the Sava River. In the existing condition in Belgrade, the average annual

concentration of nitrogen oxide NO_2 is roughly 25 $\mu g/m^3$ and of suspended particles SP_{10} roughly 30 $\mu g/m^3$. Accounting for the existing concentrations and adding the additional pollution within 50 m from the road's axis, the average annual concentrations of NO_2 will increase to 35 $\mu g/m^3$, and the mean annual concentrations of SP_{10} to 32 $\mu g/m^3$. The estimated number of hourly concentrations of NO_2 exceeding 200 $\mu g/m^3$ is 14 (in accordance with the Directive 1999/30/EC, the permitted number of exceeded concentration is 18 annually); the estimated number of exceeded 24-hour concentration of SP_{10} over 50 $\mu g/m^3$ (in accordance with the Directive 1999/30/EC the permitted number of exceeded concentration is 35 annually) is 55 due to high background concentrations and exceeds the permitted number of exceeding of the daily concentration limit.

6.6 Noise pollution

During construction

During the preparatory work the biggest noise sources are construction machinery for soil excavations and transport of excess material. The following construction machinery and transport vehicles will be used at the construction site during the work.

At the construction site for the bridge across the Sava River and in areas of construction of the overpass, there will be particularly increased noise pollution during laying of pillared foundations for the structure which will from time to time result in excessive impulsive noise events.

During exploitation

Noise pollution during exploitation will increase along the entire route with the biggest load expected in the recreational area of Ada Ciganlija, in the housing estate of Senjak and along Bulevar Vojvode Mišića.

Ada Ciganlija is a green area intended for sports and recreation and the Hippodrome area is intended for sports according to the plan. Level 1 of noise protection is prescribed in these areas. The limit in a level 1 noise protection area is 50 dB(A) during the day and 40 dB(A) during the night. In the existing condition, the area of Ada Ciganlija and the Hippodrome exceeds the noise levels for level 1 protection due to the adjacent infrastructural noise sources.

The Senjak housing estate is deemed a residential area according to the plan (level 3 noise protection) and in the existing condition the area along Ulica Sanje Živanović features an office & residential building with some small playgrounds (level 4 noise protection). In the existing condition, noise levels in Senjak (Drinička ulica) exceed the limits for level 3 noise protection.

The assessment of noise pollution in exploitation of stage I of the IMH shows that during the night in 2021 the limit for level 5 noise protection will be exceeded for 14

residential buildings; all potentially overloaded residential buildings are located in the area of Senjak and Bulevar Vojvode Mišića; and during the day, 65 dB(A) will be exceeded for seven residential buildings and in 2021, during the night, 50 dB(A) will be exceeded for a total of 40 residential buildings.

In the recreational area of Ada Ciganlija during exploitation of stage I of the IMH, pollution will partly increase with regard to the current situation, noise pollution during the day and during the night will be 55 dB(A) and 49 dB(A), respectively. The prevailing noise source in the area will continue to be Radnička ulica. Noise levels on Ada Ciganlija solely from traffic on the bridge across the Sava River and on the Čukarica intersection will not exceed 52 dB(A) during the day. The bridge will be built 20 m above the terrain level and will be 45 m wide; protective fences 0.8 m high are planned at the border of the roadway which will partly prevent noise from spreading into the surrounding area.

6.7 Vibrations

During construction

Construction between Ulica Tošin bunar and the intersection off-grade with Bulevar J. Gagarina will pass on a flat terrain. Several commercial buildings will be demolished and the distance from residential buildings exceeds 300 m. In the area between J. Gagarina and the connection to the bridge across the Sava River several residential buildings will be demolished; the construction area will come close to residential buildings on Ulica Savski nasip. Connecting to traffic from a highly-loaded Radnička ulica and Bulevar Vojvode Mišića, crossing a triple-track railway line and crossing the tramway line will be needed on the right bank of the Sava River. In this area extensive earthwork and construction will take place at a distance of less than 20 m from the nearest residential buildings. Construction of stage I of the IMH will result in vibrations affecting a number of residential buildings south of the Sava River. Vibrations caused by construction work may be impulse or permanent.

Impulse vibrations result from the use of vibration rollers, percussion hammers, working with falling or pneumatic chisels for breaking hard soil base, in falls of heavier weights and in blasting work. The vibrations intensity in this case is proportionate to the square of energy released in soil in an event and real vibrations depend primarily on the local soil composition. Vibrations of this type are characterised by a wide-range spectrum in the frequency range of up to 80 Hz. The source of vibrations during construction may also be driving of heavy construction machinery and trucks on an uneven base. Transport for construction purposes will be routed on the road route and on the existing road network.

Stationary vibrations result from the use of spreaders and machines for compacting the base such as vibration rollers and compacters. From the aspect of the impact on the load by vibrations on buildings adjacent to the construction site, more suitable

machinery is that operating in the frequency range of over 35 Hz which in principle prevents resonance occurrence in inter-storey structures in adjacent buildings.

During exploitation
The vibration load resulting from road traffic in principle depends on the condition of the roadway, weight and speed of vehicles, geological composition of the soil, distance from the road and the building type. The impact factors are interdependent and no simple links exist between them (Traffic Vibration in Buildings, June 2000). Vibration levels resulting from road transport in practice rarely achieve the values resulting in direct damage on buildings such as cracks on walls, inter-storey structures and foundations. A smaller scope of vibration loads is expected.

6.8 Flora, fauna, vegetation, and habitat types

During construction
The selected variant of construction of the bridge across the Sava River affects only a small part of forests on Ada Ciganlija. The area has foremost the community of white willow (*Salicetum albae*), which in accordance with the Habitat Directive (the Council Directive 92/43/EEC of 21 May 1992) represents a priority habitat type (*44.13 White willow gallery forests, EU Code 91E0*), a habitat type, which is in danger of disappearing in the EU. In relation to the total cover of Ada Ciganlija by forest, the bridge construction will affect a relatively small area of the vegetation cover, in particular if we observe the direct impact on the narrower zone of impact (50 m) at the very tip of Ada, and the same applies to the habitat type of great importance for protection of the environment. The most important factor for conservation of white willow forests is the level of underground water.

The map of biotope evaluation also shows that the tip of Ada features primarily highly valuable biotopes, naturally close biotopes with a high refugial function deserving protection of nature. Biotopes at the tip of Ada will be removed in the area of the development.

Construction of pillars at the lower end of Ada Ciganlija may result in removal of the top soil layer, removal of tree vegetation and the root system which would lead to destabilisation of the riverbank and substantial soil erosion. Removal of bushes and trees together with their root systems should therefore be avoided as much as possible.

The development on the riverbed will have a negative impact on communities of non-vertebrae water organisms and periphyton algae (benthic communities). Displacement of gravel which will be the biggest during building of the bridge foundations will result in flooding, a "catastrophic drift". The effect on benthic communities will be small due to a small scope of the development compared to the area of the Sava River.

Potential negative impacts of the envisaged project on birds (populations of pygmy cormorant and other listed species) do not reflect merely through direct destruction of habitats, but also by increased disturbance of birds resulting from noise, light and mechanical obstacles.

During exploitation
Insufficient light for the plants due to shadow (bridge across the Sava River and viaducts) may as a final result bring defoliation of both trees and bushes. The bridge across the Sava River will be high so such problems are not expected on Ada. A larger impact of shadow is expected under viaducts, notably on parts where they pass into embankment. In areas below covered areas, primarily where the level of underground water is insufficient, plants are exposed to stress due to drought.

As the pillar will be placed at the point of a willow forest, the island willow forest will inevitably be destroyed for the most part but a minor negative impact is expected due to creation of a new flood bank as the base for a future willow forest and smaller filling of soil along the right bank as well as restoration of white willow *Salix alba*, which pygmy cormorants require for their "sleeping quarters".

Potential negative impacts of the envisaged project on birds (populations of pygmy cormorant and other listed species) do not reflect merely through direct destruction of habitats, but also by increased disturbance of birds resulting from noise, light and mechanical obstacles. Mechanical structures may pose a problem, notably cables or wires on bridges with which birds have impacts in bad weather and at night resulting in fatal consequences for the birds.

6.9 Protected natural and cultural heritage

During construction
Ada Ciganlija features forest areas with natural value significant for preservation of the living environment, and the island itself is also protected. *The entire Ada Ciganlija area is a major recreational zone. The original vegetation of Ada Ciganlija was hygrophile forest but after hydrotechnical rehabilitation of the island the original vegetation was only partially preserved.* With compliance with the prescribed mitigation measures the impact on natural and cultural heritage will be noticeable but present to a minimum extent.

The area under impact of the construction site will not include the area of the protected monument of nature "Mašin majdan". The section's route ends before the intersection with Paštrovićeva ulica. The construction site will also stay clear of the Topčider Park, which features a group of swamp cypresses, as well as of the location of the London Plane Tree near the Residence of Miloš.

During exploitation
It is deemed that during exploitation, noise from the road will affect primarily the areas of Ada Ciganlija and Senjak. A somewhat increased noise level will also be present in the areas of the Hippodrome and the Topčider River. Presence of a roadway structure will reduce the experience of natural value landscape. The visual quality of the areas intended for recreation will be reduced due to the presence of an anthropogenic corridor nearby, with a greater share of natural elements (Ada and Hippodrome).

6.10 Landscaping characteristics and visual quality

During construction
During the construction, presence of a construction site and degradation of the environment will temporarily reduce the visual appeal of the spatial image. The construction site arrangement (machinery, lighting and signalisation) will be a major hindrance to the landscape image. The construction site will be most visible in areas of major landscaping and visual qualities, primarily in crossing of the Sava River and around forest, green and recreational, i.e. park areas. Impacts during construction will result from destruction of the existing vegetation and reshaping of the relief (embankments, excavations and bare land) on the left and right bank of the Sava River.

During exploitation
The IMH section with the crossing over the Sava River was designed as an engineering and architectural & urban planning solution that will establish new functional and visual relationships in space. The new bridge across the Sava River will definitely be the most important and distinctive element of the section. It is envisaged to become a major urban symbol of Belgrade because of its spatial scope and visibility.

6.11 Socioeconomic characteristics and the quality of life

During construction

Damage on existing buildings (residential and commercial buildings) is possible during the construction in direct vicinity of the construction site and around transport routes. They might primarily appear on older buildings as a result of vibrations. Such buildings were usually built from lower-quality material and so their structures are particularly sensitive to damage from vibrations. No impact is envisaged on the spatial cultural & historical area Topčider.

Damage or interruptions on the existing utility infrastructure, power grid and telecommunication network may appear during the construction. Any damage during construction must be remedied by the contractor at their expense.

Rafts (inns and motels) are located at the Čukarica Bay and the owners received concessions to set them up. Rafts will have to be removed from the construction site during construction. The moorings for boats, which are located in the construction site, will be inactive.

The road will pass above and around the existing infrastructure on the right bank of the Sava River and hence no major impact on the soil is expected. The following will be demolished in the area: Beogradska pekarska industrija, oil reservoirs of NIS Jugopetrol and a residential building.

Pollution of the environment with dust particles, emission gases and noise will have a negative impact on the rest and recreational area (Ada Ciganlija). Three rowing clubs are located at the tip of Ada. Such river recreation will be occasionally hindered during the construction as will be all other river transport. A reduced quality of the living environment will also be noticeable in the Hippodrome area.

<u>During exploitation</u>
A developed road link is a precondition for an area to be attractive to domestic and foreign investors. The Sava River in its existing condition represents a bottleneck hence bridging the river is crucial in construction of the IMH. After construction of the discussed section and later the entire IMH, the area will become much more attractive for development of commercial activities.

Construction of the discussed main road will primarily affect the urban units through which it will pass: Sava Amphitheatre, Prokop, the Sava area of New Belgrade, Ada Ciganlija and Senjak, Dedinje and Topčider. Connections between different areas of Belgrade will be enabled in those areas which will make the area attractive for development of commercial activities.

The road construction will contribute to meeting of the basic objectives of protection of the living environment. Improved traffic flows should have a positive impact on air quality, primarily for parameters of SO_2, NO_x, CO and ozone, as well as reducing noise pollution in the central zone.

Exploitation of the road on the right bank of the Sava River will create a major traffic intersection joining traffic from four main city routes with heavy traffic loads. The area under influence of the intersection will include recreational and residential areas (Senjak and the Hippodrome). Increased traffic volumes in the area of the Radnička cloverleaf could result in additional excessive air pollution in the area. It was established at the time of calculation of noise pollution in the area that all potentially

overburdened residential buildings lie in the area of Senjak while the impact will also be felt on Ada Ciganlija, a recreational area. Noise protection measures are envisaged to reduce noise pollution, such as anti-noise fences, sound rehabilitation of windows on buildings etc.

The risk of danger to the environment from traffic accidents will be reduced due to an orderly traffic situation following construction of the IMH. Environmental pollution from meteoric waters from the roadway will be prevented by drainage to the public meteoric drainage system.

Improved traffic links will enable faster access to primary health care institutions.

7 ASSESSMENT OF ENVIRONMENTAL IMPACTS FROM AN ACCIDENT

Among significant requirements regarding mitigating negative environmental impacts resulting from construction and exploitation of the road on additional soil pollution and thus indirectly on pollution of surface and underground waters are potential incidents involving leakage of hazardous liquids or spilling of other hazardous substances.

An accident with leakage or spilling of hazardous liquids or other substances could occur during construction of the section. That could result in additional pollution of the soil with hazardous substances, which could make worse the condition of underground waters of the water supply systems and place additional load on sediments of the Sava River with hazardous substances.

Given that at the relevant section of Sector II no freight transport is planned, and in particular no transport involving harmful and hazardous substances, the consequences of car accidents could be limited and controlled through regular protection measures.

The conclusion is also based on the fact that, in the past, traffic accidents in Serbia involving only cars included no case that could be characterised as a chemical accident.

Natural disasters cannot be foreseen and therefore the following parameters must be taken maximally into account in building of structures:

- seismicity;
- stability of soil;
- geotechnical features of soil;
- relevant precipitation etc.

which in this case primarily applies to the bridge.

The listed parameters take into account the probability of an unforeseen event and specify preventive measures, notably construction & technical ones.

In that sense, already during the preparation of the main project the Analysis of impacts on the stability of the bridge and the pillar with regard to storm winds, testing in an air tunnel and numerical simulations have been performed (Eusani-Hormanns-Zahlten Ingenieurgesellschaft mbH and tragwerksdynamik & innovative Tragwerksplanung Konstruktiver Ingerieurbau, Final Report, 9 January 2009).

8 DESCRIPTION OF MEASURES ENVISAGED TO PREVENT, MITIGATE AND ELIMINATE HARMFUL EFFECTS ON THE ENVIRONMENT

Measures envisaged by law and other regulations, norms and standards, and the implementation deadlines

During construction

Waters and soil pollution

- it is prohibited in the area of sanitary protection of underground waters to temporarily or permanently deposit the removed material from excavations in the part of the route on which the construction of the discussed road section enters the existing transport links;
- the technology of construction of foundation pillars to be defined in preparation of the main project for the bridge must be adjusted so that waters of the Sava River are not excessively polluted;
- it is prohibited in the zone of sanitary protection to deposit material hazardous and harmful to the source, without special measures for protection of underground and surface waters, construct deposit sites for waste material and silt from wastewater treatment facilities and to release wastewater;
- in the area of the construction site, lead potentially oily meteoric waters within the working zones, from handling areas and parking spaces via a collector through a special drainage system to a separator of oil and grease and release to the recipient only after treatment.

Air pollution

- prevent creation of dust from open parts of the route and the construction site; the measure requires regular wetting of open parts of the route and the construction site in dry and windy weather;
- prevent uncontrolled spreading of construction material from the construction site by transport vehicles; the measure requires cleaning of vehicles when driving from the construction site to public roads, covering bulk cargo during transport on public roads and wetting of open parts of the route and the construction site;
- compliance with the norms for emissions concerning construction machinery and transport vehicles used; the measure requires use of construction machinery and transport vehicles in perfect working order;
- preventing unnecessary delays on existing roads due to the construction; the measure requires introduction of a temporary traffic regime in the wider area of the construction.

Noise pollution

- envisaged use of tools and construction machinery produced in line with the norms for noise emissions of construction machinery, in accordance with the Directive 84/534/EEC;
- construction work near residential buildings in the zone of impact on the Senjak housing estate should take place between 7 a.m. and 7 p.m.; and

- setting up temporary noise-protection fences for residential buildings.

Vibrations

Protective measures for vibrations resulting from compacting of the bottom layer by vibration rollers and transport of material require the use of tools, machinery and vehicles that are produced in line with the norms on vibrations of construction machinery, tools and transport vehicles. Protection of buildings (notably in the area near the Senjak housing estate) adjacent to the construction site (up to 50 m) requires mitigation of impacts of vibrations by using lighter vibration machinery. Work with vibration-generating machinery should be restricted to the daytime.

Natural and cultural heritage

The excavated material (substrate) should be deposited during the construction at a collection point outside the areas of natural or cultural heritage and any depositing of waste material of any kind into the water body should be prevented. If any value is discovered during the earthwork, which may represent a piece of natural or cultural heritage (geological & paleontological, mineral & petrographic and archaeological), the contractor shall immediately inform the competent institution and take the necessary measures to secure the site of the finding until the competent persons arrive.

Flora, fauna, vegetation, and habitat types

On the basis of the fact that the winter resting area of pygmy cormorant (species protected by the Decree on Protection of Natural Rarities) is located along the route, and that other species protected by the Decree are also present there, the following measures shall be carried out in the zone, also having the status of natural heritage and divided into three subzones, after construction of the bridge:

- **Subzone A**; check the possibility for removing the existing rafts (few mostly old and abandoned items) and create from the excavated soil a flood bank 15-20 m wide and 200-250 m long where white willow *Salix alba* would later be planted (*).
- **Subzone B**; after completion of the construction and as a compensation measure, arrange a flood bank as the basis for a future willow forest on a wider location outside the impact of the bridge's shadow and in line with the final arrangement of the area of the pillar.
- **Subzone C**; after completion of the construction and as a compensation measure (in Subzone C placed under protection), arrange a low flood bank as the basis for a future willow forest.

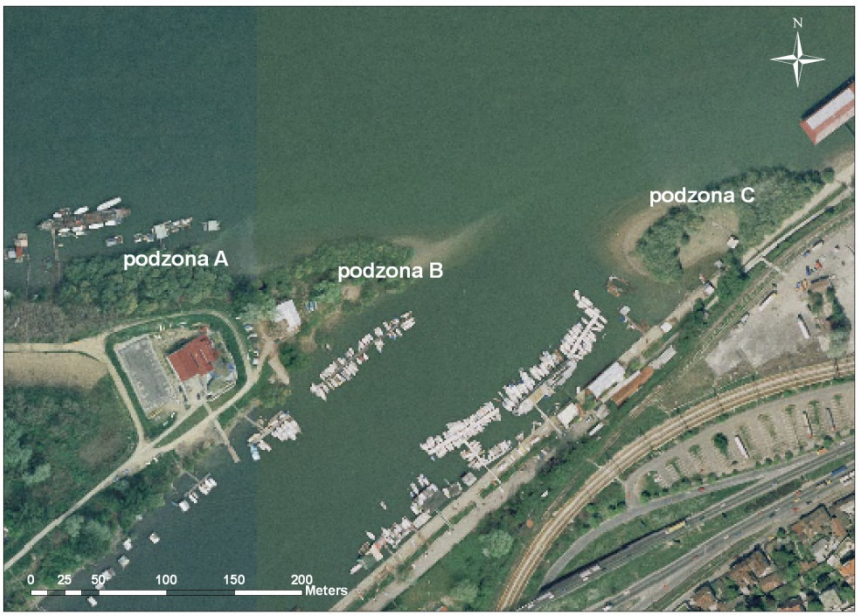


Figure 3: Location of Subzones A, B and C

Other measures:

- apply such measures and solutions for organisation of the construction that will reduce the destroyed area of the willow forest at the downstream end (tip) of Ada Ciganlija while at the same time sparing from destruction and to the greatest possible extent leaving undisturbed the neighbouring willow forest on the right bank of the river, downstream from the future bridge, in the period between November and the beginning of April, which means complete suspension of intensive work in the area of Ada Ciganlija and the right bank of the Sava River; correct daily dynamics for any preparatory work (suspension of work during the night starting two hours before sunset) and regulate for any work and activities performed from the water sailing and mooring of vessels, their number as well as noise and light they emit, in particular near winter resting areas, or prohibit passage, anchoring and lighting of willow forests downstream from the tip of Ada Ciganlija on the right bank of the Sava River.

Demolition work

Not all legal real estate issues have been resolved for the discussed project and the investor must settle before demolishing any buildings with the owners any legal issues in the area of the planned road.

All measures shall be applied until completion of all construction and other work.

During exploitation

Waters and soil pollution

Mitigating measures for impacts of exploitation of the road:

- drainage of meteoric waters must be made by an appropriate project and construction of a system of collection, treatment and disposal (including built

treatment facilities). The system must be maintained and capable of handling increased precipitations.
- It is prohibited in the zone of sanitary protection to deposit material hazardous and harmful to the source; no special measures for protection of underground and surface waters.

Noise pollution

Rehabilitation measures comprise reducing emissions at the noise source, proposal to demolish certain buildings and additional active measures to reduce noise spreading into the surrounding area (noise-protection fences) as well as passive measures of noise protection (rehabilitation of sound insulation of windows) to reduce noise pollution in residential buildings. The following noise-protection measures are proposed:

- **reducing noise emission at the source** by using an absorption protective layer on the roadway. The concept design envisaged in the entire area of stage I of the IMH and on Radnička ulica an absorption layer Mikroasfalt 0/8. The use of an absorption layer will reduce noise by 2 dB(A);
- **active noise protection measures** on the IMH; proposed setting up of an anti-noise fence in total length of 500 m to protect residential buildings on the Senjak estate (Ulica Milana Glišića, Ulica Drinička, Ulica Sanje Živanović). The fence is 2.5-3.5 m high. Noise protection measures on the bridge – check in subsequent stages of preparation of the main project the possibility for active noise protection on the bridge, to protect the recreational area of Ada;
- **noise protection measures** for living rooms in overburdened buildings. The measures will be needed along Bulevar Vojvode Mišića and on higher storeys of individual residential buildings in the area of Ulica Sanje Živanović. Checking for the need of sound rehabilitation of windows should be made based on the results of noise measurements after the beginning of exploitation of the IMH.

Measures to be taken in the case of an accident

During construction

In line with the readiness in the case of an accident involving leakage of toxic substances or spreading of hazardous substances, the contractor shall submit their plan for additional measures depending on the conditions of an accident. If an accident occurs, the contractor shall take all planned measures and monitor the level of pollution of the soil and surface and underground waters of the Sava River. The contractor's plan shall include the methodology for assessing and measuring chemical accidents and the urgent measures to be taken in the case of an accident.

During exploitation

The measures to mitigate and prevent negative impacts of exploitation of the road include an appropriately designed system for collecting, treating and disposing meteoric waters (including the appropriate treatment facilities). Protection of subsoil is envisaged by treatment of the soil below the bed of the road with impermeable

material and drainage piping of the bed. The drainage piping of the bed is connected to the common meteoric drainage system via separator of light petroleum products and a depositor of material from the drainage.

Plans and technical solutions for protection of the environment (recycling, treatment and disposal of waste material, replanting, rehabilitation etc.)

During construction

As regards the excavated material, related to the presence of certain pollutants in the soil (PCB and heavy metals) on the downstream end of Ada Ciganlija, it is urgent to conduct before any excavations of potentially contaminated soil the legally prescribed procedure for determining the character of waste and determining further handling. A certified laboratory will issue a certificate that the soil is not contaminated and can be used to fill certain locations. Any waste having properties of hazardous substances should be handed over to a certified recycling operator.

During exploitation

Silt from the wastewater treatment facility shall be handed over to a certified recycling operator.

Other measures that could affect preventing or mitigating harmful effects on the environment

During construction

- Slopes and the supporting wall should be after construction covered by humus and planted with deeper pockets of humus material on points where low plants are planned.
- Interventions on soil shall be made by affecting the land areas as little as possible and will be made in areas determined before the beginning of work or development.
- Use the existing infrastructural and other handling areas as temporary traffic and construction areas.
- Spraying of traffic areas and cleaning of traffic areas in dry and windy weather are needed to remove construction elements from existing roadways and to carry out earthwork.
- The handling areas for construction machinery and storage of material and hazardous substances should be outside the areas of valuable habitat types.
- The excavated material (substrate) should be deposited during the construction at a collection point outside the areas of natural or cultural heritage and any depositing of waste material of any kind into the water body should be prevented.
- Affect forest areas as little as possible, only plants directly obstructing work can be removed. When performing work on Ada Ciganlija, special attention

should be paid to large trees (trunk diameter exceeding 60 cm). Felling or damaging such trees should be avoided to the maximum extent.

- Cutting trees and bushes on riverbanks should be made by cutting trees directly above the ground and preserving the root system underground. That reduces soil erosion and provides for faster rehabilitation of vegetation after the development. Cutting shall be carried out outside the nesting season of birds, lasting from April to July, and on the tip of Ada Ciganlija also outside the period of winter rest of pygmy cormorant, lasting from November to April.
- Transport routes, parking areas and deposits of waste or construction material should be outside the areas of natural and cultural heritage.
- It is prohibited to access the lower tip of Ada Ciganlija by land, instead material is transported by barges for which RoRo ramps must be envisaged. Access by land can only be made in difficult conditions for the use of river transport (strong winds and waves with official prohibition of the use of vessels by the port authority), in such a case the contractor shall obtain an official permit from the Public Company Ada Ciganlija for access by land.
- Poorer visual and landscaping qualities can be mitigated by planting the areas adjacent to the road: planting of embankments of banks, planting the surroundings of pillars, landscaping of touching points of bridging structures with the surface relief, rehabilitation of degraded areas and rehabilitation of edge vegetation.
- The following is needed for landscaping:
    - plant the lower parts of embankment slopes with the appropriate high bushes which will visually reduce height of the embankment;
    - form slopes that will due to the recommended regular lawn mowing be appropriately shaped and not too steep;
    - seed grass around pillars and if possible green the pillars themselves;
    - advantage shall be given to indigenous planting material;
    - the selected planting material will be appropriate for conditions of the site;
    - the applied solutions shall not affect traffic safety;
    - advantage shall be given to engineering & technical and sanitary functions of plants;
    - the minimum distance of green material from different installations shall be complied with, as prescribed by the project task.
- The embankment shall be protected with biotorkret and fast-growing low plants to protect it from line erosion and small washing off.
- The correct mixture of grass to be used shall be determined for grass areas. A pre-prepared grass carpet shall be used for small grass areas.
- Noise protection shall in form comply with the overall image of the roadway structure. Use of transparent material is appropriate from the aspect of visual characteristics and opening of the view to the surroundings, although its use should be limited to prevent collisions of birds.
- In forest and green areas, the construction site should be limited to the width of the road's complex, routes to the site shall not be outside the existing

roads. Avoid to the maximum possible extent interventions in the green area outside the road's layout: in arrangement of local and construction roads, building of ancillary facilities, ditches etc.

During exploitation

- Maintenance of restored areas is required during exploitation. Regularly maintain embankments and areas below viaducts as well as the slopes.
- Lighting of the bridge, cables, wires and other structures (high pillars) shall be implemented by using solutions (light sources and fluorescent tubes) providing clear visibility but with a lighting of moderate luminosity (not glaring from afar).
- The directions in which sources of lighting shall not be directed are under the roadway and the nearby willow forest on the right bank of the Sava River where pygmy cormorant spends the winter and nights as well as above the top of the pile (which would attract bird flocks during night movement).
- Any damage to the fences and other structures on the road and in the entire area of mitigation measures should be regularly checked and remedied if necessary.
- From the aspect of visual qualities, it is important to maintain the structure itself and the area along the road, which may include minor corrective interventions to improve the conditions, e.g. covering certain structures or unwanted views with additional vegetation planting etc.

9 PROGRAMME FOR MONITORING ENVIRONMENTAL IMPACTS

Geological and geomorphologic characteristics

Geotechnical supervision is needed during the work in order to record the true geotechnical conditions and remove in an expertly and efficient manner any problems on such complex terrain, in the zone of the embankment and the cut; on the relation supervisor – contractor – investor.

Underground water

During construction

Monitoring the conditions on the construction site and in areas that can be linked to the construction work (transport routes and other handling areas) for the development:

- monitoring handling of removed material;
- monitoring handling of construction and other material, e.g. hydroinsulation coatings;
- monitoring the situation in the sense of technical perfect order of machinery and transport vehicles as well as handling fuel, machine and other oils and monitoring the procedure for handling waste packaging.

Testing the quality of underground water at water wells "Ranney" well no. 29 and "Ranney" well no. 52 is needed. The implementer of the programme for monitoring the environment regularly informs the building contractor on the results at least through quarterly reports. Studies are performed at least quarterly and additionally by sampling before construction work begins.

During exploitation

Additional tests of underground waters are not envisaged so it is necessary to monitor the results of studies of the quality of underground water on wells in the area of Ada Ciganlija ("Renny" well nos. 29 and 52) for at least two years. Test results are assessed by comparing the measured values with values from the existing condition. An assessment of the measured values includes an assessment of weather and spatial trends.

Surface waters

During construction

Monitoring the conditions on the construction site and in areas that can be linked to the construction work (transport routes and other handling areas) which could affect the condition of the Sava River comprises:

- monitoring handling of construction and other material, e.g. hydroinsulation coatings;

- monitoring the situation in the sense of technical perfect order of machinery and transport vehicles as well as handling fuel, machine and other oils;
- monitoring handling of waste packaging.

Monitoring of condition of the Sava River during the road construction is intended for following the level of oxygen and other parameters (for example, content of non-dissolved substances and ammonia) which could affect the river's condition as regards the criterion of cyprinid surface waters.

Testing is performed at least quarterly and additionally by sampling before the beginning of construction work, is performed, with regard to the dynamics of construction of pillars of the bridge and pillars of access roads, at least monthly and additionally by sampling before the construction work begins.

Test results are assessed by comparing the measured values with values from the existing condition and with the permitted limit values. The implementer of the monitoring programme regularly informs the building contractor on the results at least through quarterly reports.

During exploitation

Monitoring of teh condition of the Sava River during exploitation of the section is intedned to monitor the impact of traffic emissions and maintenance work on condition of the Sava River. Water is tested twice a year for two years (the minimum period of the programme). Sampling of the sediment and a saprobiologic analysis are performed annually, in December or January, and a saprobiologic analysis in late spring and early autumn (June to September).

Test results are assessed by comparing the measured values with values from the existing condition and with the permitted limit values. An assessment of the measured values includes an assessment of weather and spatial indicators.

Soil

During construction

Monitoring the conditions on the construction site and in areas that can be linked to the construction work (transport routes and other handling areas) comprises:

- monitoring handling of construction and other material, e.g. hydroinsulation coatings;
- monitoring the situation in the sense of technical perfect order of machinery and transport vehicles as well as handling fuel, machine and other oils;
- monitoring handling of waste packaging.

Studies are performed at least quarterly and additionally by sampling before construction work begins.

During exploitation

Monitoring is performed on one point at the tip of Ada Ciganlija. Tests of soil are made annually for a period of five years (the minimum programme period) and afterwards minimally 14 days after precipitation. An assessment of the measured values includes an assessment of weather and spatial trends.

Monitoring in the case of an accident

In the case of an accident involving leakage of hazardous liquids or spillage of hazardous substances, additional monitoring must be planned (which could based on the incident) include monitoring of polluted soil, surface and underground waters. The programme's contents are determined on the basis of an assessment of the incident's scope and characteristics of the liquid or substance in relation to possible impacts on underground waters. The programme is performed by a certified laboratory regardless of the period of implementation of the programme for monitoring the condition of the environment.

Air pollution

During construction

Monitoring air pollution during the construction comprises monitoring of implementation of measures to prevent emissions on the construction site, implementation of continuous measurements of the total weight of deposited dust and content of heavy metals in dust, continuous measurements of concentrations of airborne particles PM_{10} and checking the imission concentrations against the limits. Monitoring during construction is planned to be set up at three locations:

- Gr-Va1, Ada Ciganlija, VK Partizan
- Gr-Va2, Senjak, Ulica Milovana Glišića
- Gr-Va3, Senjak, Bulevar Vojvode Mišića

During exploitation

It is proposed that the measuring point in Senjak is included in the network of measuring points to monitor air pollution in Belgrade.

Noise pollution

During construction

Noise measurements should be performed during preparatory work at the nearest residential buildings. If limit values are exceeded, the contractor shall take additional noise protection measures and continue with the work when their effectiveness has been checked. Noise monitoring during construction comprises measurements and assessments of the overall noise pollution from construction at five locations:

- Gr-Bu1, Ada Ciganlija, VK Partizan
- Gr-Bu2, Senjak, Ul. Milovana Glišića,
- Gr-Bu3, Čukarica, hippodrome – sports & recreational area

- Gr-Bu4, Senjak, Ul. Sanje Živanović,
- Gr-Bu5, Senjak, Bulevar Vojvode Mišića.

During exploitation

Noise monitoring during exploitation requires preparation of an isophonic chart of noise. Noise calculation requires obtaining numerous data on traffic loads for all sections of the road and access roads with day, evening and night distribution of cars and freight vehicles and measurements of the overall noise pollution on five locations (see locations for measurements during the construction).
Noise monitoring after the start of exploitation of the road should be performed through:

- preparation of an isophonic chart for calculations after obtaining data on traffic in the first year of exploitation to be completed after 14 months;
- measuring the overall noise pollution after 3-12 months after the start of exploitation;

and conclude the report by comparing the results in the final deadline of 15 months after the start of exploitation of the road.

Vibrations

The structural condition of all buildings in the area of 50 m from the border of the construction site should be recorded during the construction. Visible damage on external supporting walls of the monitored buildings should be recorded and documented before the construction begins. The structural condition of buildings in the area of construction of stage I of the IMH and reconstruction of the existing streets must be recorded in detail and included in further monitoring. Measuring during construction is planned to be set up at two locations:
- Gr-Vib1, Senjak, Bulevar Vojvode Mišića,
- Gr-Vib2, Senjak, Ul. M. Glišića.

Flora, fauna, vegetation, and habitat types

During construction

During the construction work, supervision should be agreed with a competent institution for protection of nature, notably in the area of the tip of Ada Ciganlija. Monitoring of birds should be made by an expert ornithologist. Continuous expert supervision should be provided for the purpose of adequate monitoring and following of the effects of work and the bridge itself to the number, allocation and behaviour of birds, especially pygmy cormorant and other protected species and in accordance with the results correct the dynamics and methods of work, type of work, lighting and noise protection.

During exploitation

Five-year monitoring is proposed for appearance of pygmy cormorant (*Phalacrocorax pygmeus*) in the area of the route (bridge across the Sava River) where it should be checked annually whether any significant changes occurred in the number of birds, location of winter resting areas etc. The possibility should be envisaged that on the basis of monitoring results and if required, a resting period (without any traffic and with appropriate lighting) be provided after completion of the bridge during the winter months (November – April) in order to enable undisturbed and the fastest possible return of the birds. Monitoring should be made by an expert ornithologist.

We propose three-year monitoring of growth of all planted areas (notably on Ada) and restortaion of the forest belt. Monitoring should be performed by an expert institution twice a year and, obligatory in the spring and summer.