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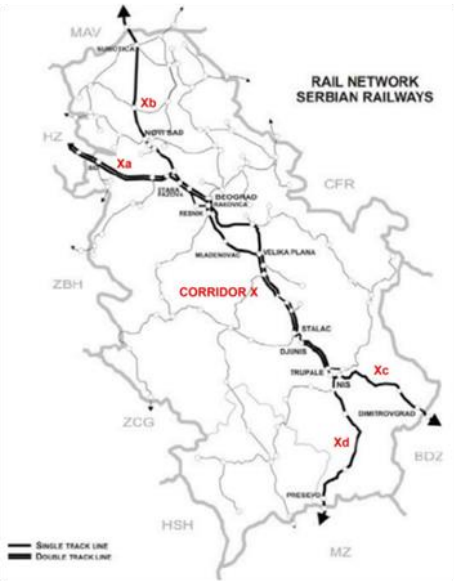

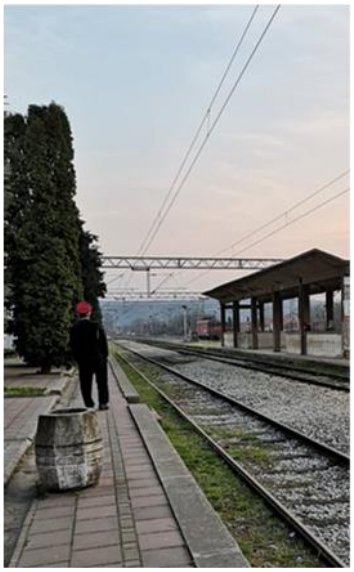

CORRIDOR ENVIRONMENTAL & SOCIAL ASSESSMENT REPORT

Corridor Level Environmental and Social Assessment for the Belgrade-Nis High Speed Railway Corridor, Serbia

July 2022

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1 List of Abbreviations

AoI	Area of Influence
AVIS	Audio Visual Information System
CAQI	Common Air Quality Index
CCS	Control-command and signalling
CESMP	Construction Environmental and Social Management Plan
CHA	Critical Habitat Assessment
CTC	Centralised Traffic Control
EAAA	Ecologically Appropriate Areas of Analysis
EBRD	European Bank for Reconstruction and Development
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMU	Electric Multiple Unit
ERTMS	European Rail Traffic Management System
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
E&S	Environmental and Social
ESP	Environmental and Social Policy
ETCS	European Train Control System
ETS	Electric Traction Substations
EU	European Union
GAR	Global Assessment Report
GHG	Greenhouse Gases
GIIP	Good International Industry Practice
HDV	Heavy-Duty Vehicles
IBA	Important Bird Area
KBA	Key Biodiversity Area
LWR	Long Welded Rail
NGO	Non-Governmental Organisation
NTS	Non-technical Summary
OCS	Occupation Control System
OESMP	Operational Environmental and Social Management Plan
OHS	Occupational Health and Safety
PA	Protected Area
PFS	Pre-Feasibility Study
PHI	Public Health Institute
PIU	Project Implementation Unit

PPF	Project Preparatory Facility
PR	Performance Requirement
PUC	Public Utility Company
RAP	Resettlement Action Plan
RBC	Radio Block Centres
RoS	Republic of Serbia
RPF	Resettlement Policy Framework
RTU	Remote Terminal Unit
SEP	Stakeholder Engagement Plan
SEPA	Serbian Environmental Protection Agency
SPEI	Standard Precipitation Evaporation Index
SRI	Serbian Railways Infrastructure
SRPS	Serbian standard
TEN-T	Trans-European Transport Network
TS	Transformer Substation
TSI	Technical Support Instrument
UIC	International Union of Railways
VoIP	Voice over Internet Protocol
WBIF	Western Balkans Investment Framework
WMP	Waste Management Plan

2 Introduction

2.1 Project Context

The European Bank for Reconstruction and Development (the "EBRD") is considering providing finance to the Republic of Serbia ("RoS") for the benefit of Serbian Railways Infrastructure ("SRI"). The loan will be used to finance the **rehabilitation and upgrade of the rail infrastructure of Rail Corridor X** ("Corridor X"), the railway line connecting Belgrade to Nis (the "Project"). The Project is expected to be co-financed by (i) EIB and (ii) the EU through the Western Balkans Investment Framework ("WBIF") or other EU mechanism.

Corridor X is the main north-south route running through Serbia and is an integral part the extended Trans-European Railway Network ("TEN-T") connecting Western and Central Europe with Greece, Serbia and the Middle East. It is also an axis of national importance and represents 25% of the Serbian rail network, handles over 50% of the total traffic (freight and passenger), and connects the three largest cities of the country (Novi Sad, Belgrade and Nis) and a large number of settlements and industrial centres.

The Project involves a combination of upgrading the design speed to up to 160/180/200 km/h (depending on the sections) and doubling of the single tracks. The Belgrade-Nis rail route will be fully electrified. Thanks to the improved infrastructure, the travel time between Belgrade and Nis will be significantly reduced, safety will be improved, as well as the capacity and comfort of the passenger and freight services. This will increase competitiveness of rail transport, especially for international and transit freight traffic, allowing significant modal shift to rail as low carbon intensity sector. This modal shift from road-based transport will have a significant impact in terms of lowered carbon emissions.

The loan will be tranched based on a schedule of subsection rehabilitation, with the first tranche committed to finance the works of the Stalac-Djunis subsection (approx. 17 km in length), the only subsection for which an environmental and social assessment has been carried out to date (please see Chapter 2.4 for more information). Tranches to finance other subsections of Corridor X will be uncommitted.

As this Project involves greenfield development and involves extensive linear infrastructure development (Belgrade-Nis), the EBRD has assigned it as a **Category A project**[1]. This means that a comprehensive Environmental and Social Impact Assessment (ESIA) and review of associated documents must be carried out for each subsection, followed by their public disclosure for a minimum period of 120 days.

2.2 Project Significance

With the aim of connecting European countries with the Turkish railways, the importance of development Belgrade-Nis railway line was recognised at the Berlin Congress in 1878. The development of Corridor X, and one of the key subsections – Stalac-Djunis, is recognised as **one of the strategic priorities in both the previous Spatial Plan of RoS (2010-2020) and the new Draft Spatial Plan (2021-2035).** The new Spatial Plan includes planning solutions for the reconstruction, construction and modernisation of the existing railways of the Corridor X (E-70 and E-85) through RoS in double-track electrified high-performance railways for speeds up to 200 km/h.

Modernisation of the Corridor X as the backbone of the railway infrastructure system of the country is also **recognised as a priority in country-level strategies and programs**, such as the Strategy of Railway, Road,

[1] The EBRD Environmental and Social Policy (2019) categorises projects as A, B, C and FI to determine the nature and level of environmental and social investigation, information disclosure and stakeholder engagement required. The categorisation corresponds to the nature, location, sensitivity, scale and likely significance of adverse effects of the project in question.

Inland Waterway, Air and Intermodal Transport Development in the Republic of Serbia (2008-2015), the Railway Master Plan (2012-2021) and National Public Railway Infrastructure Program (2017-2021)[2].

The largest and most dynamic urban centre, Belgrade, with the support of the urban centre of Nis, will be crucial for the development of the overall economy. Smaller regional centres such as Jagodina, Cuprija and Paracin will contribute to the development capacity on the Belgrade-Nis route. The importance and significance of the railway Belgrade-Nis has been confirmed on multiple occasions at both the European and national levels.

The Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Belgrade-Nis Railway Line (section Velika Plana-Nis) was developed in 2020 for speeds up to 160 km/h. The Government of RoS adopted the Spatial Plan September 2020. Given that the maximum speed on the Belgrade-Nis section has been increased to 200 km/h, the Spatial Plan is currently being updated and a new Spatial Plan for the Resnik-Velika Plana section is being developed[3]. For the subsection Stalac-Djunis, a **Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Line Stalac-Djunis and accompanying Strategic Environmental Assessment Report** were adopted in 2017 by the Government of the RoS and published in the Official Gazette, with a planning horizon up to 2036. It is acknowledged that the construction of the new two-track subsection will eliminate the bottleneck on the Belgrade-Nis railway line.

2.3 Project Implementation Arrangements

The Ministry of the Finance of RoS will be the Borrower, while SRI will be the Implementing Entity for the Project. A Project Implementation Unit (PIU) will be responsible for the Project management.

The Ministry of Environmental Protection is responsible for issuing permits and licensing, monitoring, data collection and inspection.

The Ministry of Construction, Traffic and Infrastructure is responsible for development and adopting the Spatial Plan of the Special Purpose Area.

2.4 Project Status and Available Documentation

The Belgrade-Nis railway line is still in the design phase – only a Conceptual Design has been developed for the entire Corridor, while the completion of the Preliminary Design is expected in the first quarter of 2023. For this, the Government of RoS has been receiving support via the Project Preparation Facility (PPF9) of the EU. The exception is the Stalac-Djunis subsection for which a Conceptual Design has already been developed[4].

The available documentation for the railway includes:

Entire Corridor:

1. Preliminary Feasibility Study and General Design for Reconstruction and Modernisation of the Railway Line Belgrade-Nis (2007)
2. ESIA Study for construction of a single-track railway bypass around Nis (2016)
3. Pre-Feasibility Study for the Corridor (PFS), including a Stakeholder Engagement Plan (SEP), Scoping Report (SR) and Resettlement Policy Framework (RPF) (2022)

[2] This program specifically stipulates that the performance parameters for the main railway line development must be in accordance with Commission Regulation (EU) 1299/2014 (TSI relating to the 'infrastructure' subsystem of the rail system in the EU).
[3] Note: The new Spatial Plan must be adopted before EIA submission.
[4] The construction of the Stalac-Djunis subsection will be implemented by two separate "design and build" contracts, one for LOT 1 (tunnelling works for Tunnel 4) and one for LOT 2 (all other civil works and track superstructure for the entire subsection). In February 2022, a contract for the design and execution of works on the construction of Tunnel no. 4 on the subsection Stalac-Djunis (LOT 1) was signed between SRI and China Railway 21st Bureau Group Co. LTD.

Stalac-Djunis subsection:

1. Draft Environmental and Social Impact Assessment Study (2016)
2. National Environmental Impact Assessment Study (2018)
3. Preliminary Design (2018)
4. Location Conditions and opinions of relevant authorities (2021)
5. Conceptual Design (2021)
6. Approval of national Environmental Impact Assessment Study by the Ministry of Environmental Protection (issued in 2018 and extended in 2022)
7. Resettlement Action Plan (2022) for Lot 2 of the subsection[5]
8. Supplementary Study with Environmental and Social Management Plan (ESMP), Environmental and Social Action Plan (ESAP), Non-technical Summary (NTS) and Stakeholder Engagement Plan (SEP; an appendix to the Corridor-level Stakeholder Engagement Plan) (2022)

2.5 Project's Disclosure Package

The Project's Disclosure Package includes (in both English and Serbian):

- This Corridor E&S Assessment Report
- Corridor E&S Scoping Report
- Corridor RPF
- Corridor ESAP
- Corridor ESMP
- Corridor SEP
- Corridor NTS
- Draft ESIA for Stalac-Djunis subsection (2016)
- National EIA Study for Stalac-Djunis subsection (2018)
- Supplementary Study with accompanying ESMP for Stalac-Djunis subsection
- ESAP for Stalac-Djunis subsection
- NTS for Stalac-Djunis subsection
- RAP for Stalac-Djunis subsection for LOT 2

2.6 Objective of this Assessment Report

This Assessment Report presents a high-level assessment of the overall Project. It will be further developed and complemented by the sub-section specific ESIAs, which will become the basis of EBRD's approval of further tranches of the loan. The key objectives of the high-level Corridor assessment are to:

- establish baseline E&S conditions of the Project area;
- identify and assess any potentially significant future adverse E&S impacts associated with the proposed Project;
- set the framework for impact assessment methodology for all subsequent ESIAs;
- determine the general E&S measures needed to prevent, minimise, mitigate and compensate adverse impacts and identify potential E&S opportunities;
- determine if there are any material negative impacts and impacts for which no mitigation is foreseeable and/or require additional detailed studies to define mitigations;

[5] There has been no land acquisition needed for LOT 1 of the Project – the land needed for the exit and entrance portals to Tunnel 4 was already owned by SRI, whereas land needed for access roads is public land. Therefore, a RAP was prepared for LOT 2 only.

> determine the scope of detailed surveys and assessments needed for a particular Project section to be carried out within the section-level ESIA.

This Corridor Assessment demonstrates the main impacts and proposed general mitigations associated with the Project and any section-specific E&S risks and potential mitigations measures which will ensure that such risks can be managed through further ESIA processes.

3 Project Description

3.1 Existing Railway Route

Corridor X is the main north-south route running through Serbia and is an integral part the extended Trans-European Railway Network ("TEN-T") connecting Western and Central Europe with Greece, Serbia and the Middle East. It is also an axis of national importance and represents 25% of the Serbian rail network, handles over 50% of total traffic (freight and passenger), and connects the three largest cities of the country (Novi Sad, Belgrade and Nis) and a large number of settlements and industrial centres.

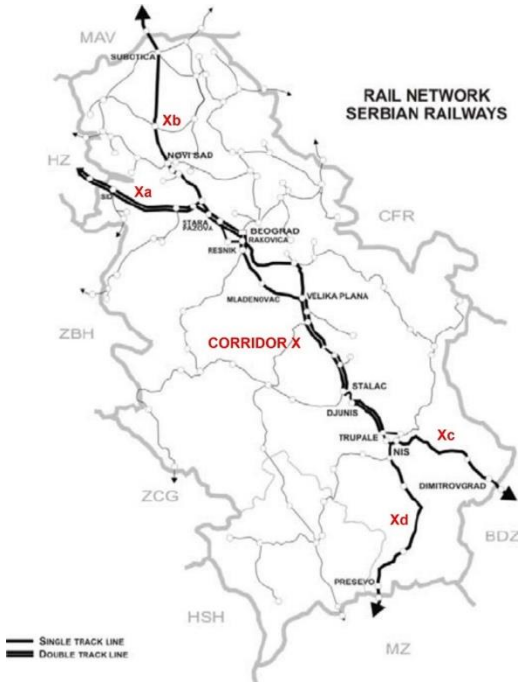


Figure 1: Corridor X as part of the Serbian railway network

The railway route Belgrade-Nis is part of the Main line 102: Belgrade Centre-Rasputnica (Junction) "G"-Rakovica-Mladenovac-Lapovo-Nis-Presevo-State Border. It is part of the Corridor X and is defined as a priority for the development of the Serbian railway network.

The entire railway route Belgrade-Nis is with the normal track gauge (1,435 mm) and has continuously welded rails. The track is mostly made of UIC 49 rails, and partly of UIC 60 rails. Based on national standards, the official

loading gauge is SZ I[6], while the loading gauge UIC-GB[7] has been reported for international traffic (in accordance with European standards).

A summary of the **main characteristics of the existing railway line Belgrade-Nis** are presented below:

Speed: The commercial speed of passenger trains is less than 50 km/h. Restricted-speed running has been introduced in multiple parts of the railway. The highest permissible speed of trains is 120 km/h between Jagodina and Paracin in the length of 17.4 km. The highest permissible speed on the rest of the railway line Belgrade Centre-Mladenovac-Nis is mainly 100 km/h, although on certain individual sections train speeds range from 50 to 80 km/h. The lowest permissible speed of trains is 30 km/h at the entrance to the station Nis.

Electrification: While the railway line Belgrade-Nis is completely electrified, the electrical and telecommunicating equipment are technologically obsolete.

Junctions: The section Belgrade Centre-Resnik is a part of the Belgrade railway junction, and the section Trupale-Medjurovo is a part of the Nis railway junction.

Tracks: From Belgrade to Velika Plana, there are two single-track railway lines, which are not in the same corridor, that are used as a two-track railway line for one part of the traffic, i.e. for the direction towards Nis via Mladenovac, and via Mala Krsna for the direction from Nis.

Structures: There is a total of 9 tunnels, 130 bridges and bridge structures, 449 culverts and other smaller-sized structures, as well as 126 level crossings.

Stations: There are 31 stations, 27 stops, 4 passing points, 5 junctions and 1 service point. 25 stations are mixed stations serving passengers and freight, whereas 6 are intended exclusively for passenger service (Belgrade Centre, Rakovica, Klenje, Ripanj tunel, Kovacevac and Mala Plana). Belgrade Centre is the central passenger station of the railway network in RoS.

Specific sections:

- *Railway section Gilje-Paracin:* The section from Gilje to Paracin was modernised by constructing a new double-track railway for speeds up to 160 km/h including the construction of a new double-track bridge over the Velika Morava River.
- *Railway section Stalac-Djunis*: The section from Stalac to Djunis is currently a single-track one. A Preliminary Design for the construction of the new double-track section for speeds up to 160 km/h has been completed, and a contractor has been selected for LOT 1 (construction of tunnel No. 4).

After years of under-investments, the current conditions of the railway infrastructure are far from satisfactory and are not in accordance with the EU standards, with significantly limited operational speed and technologically outdated electrical equipment. An important safety issue to both rail and road traffic is the large number of level crossings, very often without proper safety equipment.

3.2 Planned Investments

Key railway characteristics. The reconstruction and modernisation of the Belgrade-Nis line is a priority action for the future development of the Serbian railway network[8]. This railway line will be modernised, so that:

[6] The loading gauge that applies to domestic traffic on railway lines is SZ I. SZ I gauge is slightly larger than the UIC GA loading gauge and slightly smaller than UIC GB. Loading gauge (train gauge) is a limited space viewed as a cross section vertical to the track axis that may not be exceeded by any part of the rail vehicle, whether loaded or empty.

[7] (UIC) GB is the international freight profile designation defined in the TSI Rolling Stock (2002/735 / EC), which specifies the maximum permissible "external" dimensions of rolling stock together with the load. The dimensions of the GB load profile are determined by the Rulebook on Technical Conditions and Maintenance fo the Upper Machine (Parts) of Railways ("Official Gazette of RS", No. 39/16 and 74/16).

[8] As defined in the National Transport Strategy.

- the maximum speed will be increased from the current average of 50 km/h to the range of 160 to 200 km/h. Some smaller sections will have lower speeds, primarily in urban areas;
- the second track will be constructed where needed;
- the line will be equipped with modern ERTMS systems;
- the length of the main tracks in all stations and crossings will be at least 740 m;
- the clear cargo profile in the tunnels will be upgraded to UIC-GC;
- in official passenger stations, platforms of 55 cm height will be constructed;
- the minimum length of passenger platforms will be at least 400 m where international trains are planned to stop.

Subsections. For the purpose of an in-depth and concise analysis for the needs of this Corridor E&S Assessment, the Belgrade-Nis railway is divided into 9 subsections[9] (as shown in Figure 2):

Subsection 1: Belgrade-Resnik

Subsection 2: Resnik-Velika Plana

Subsection 3: Velika Plana-Gilje

Subsection 4: Gilje-Paracin (*note: already modernised several years ago by constructing a new double-track railway for the design speed of 160 km/h; therefore, this section will not be the subject of new reconstruction, but small-scale additional construction works are possible to enable reaching a speed of 200 km/h*).

Subsection 5: Paracin-Stalac

Subsection 6: Stalac-Djunis

Subsection 7: Djunis-Medjurovo

Subsection 8: Resnik-Ostruznica (as a part of Belgrade node)

Subsection 9: Crveni Krst-Nis Center-Nis Marshalling yard (as a part of Nis Railway Node)

[9] The subsection division was made taking into account: (i) population density (section Belgrade-Resnik is the most densely populated); (ii) single-track sections (Resnik-Velika Plana); (iii) sections that have already been reconstructed (Gilje-Paracin); (iv) sections whose reconstruction will start soon (Stalac-Djunis).

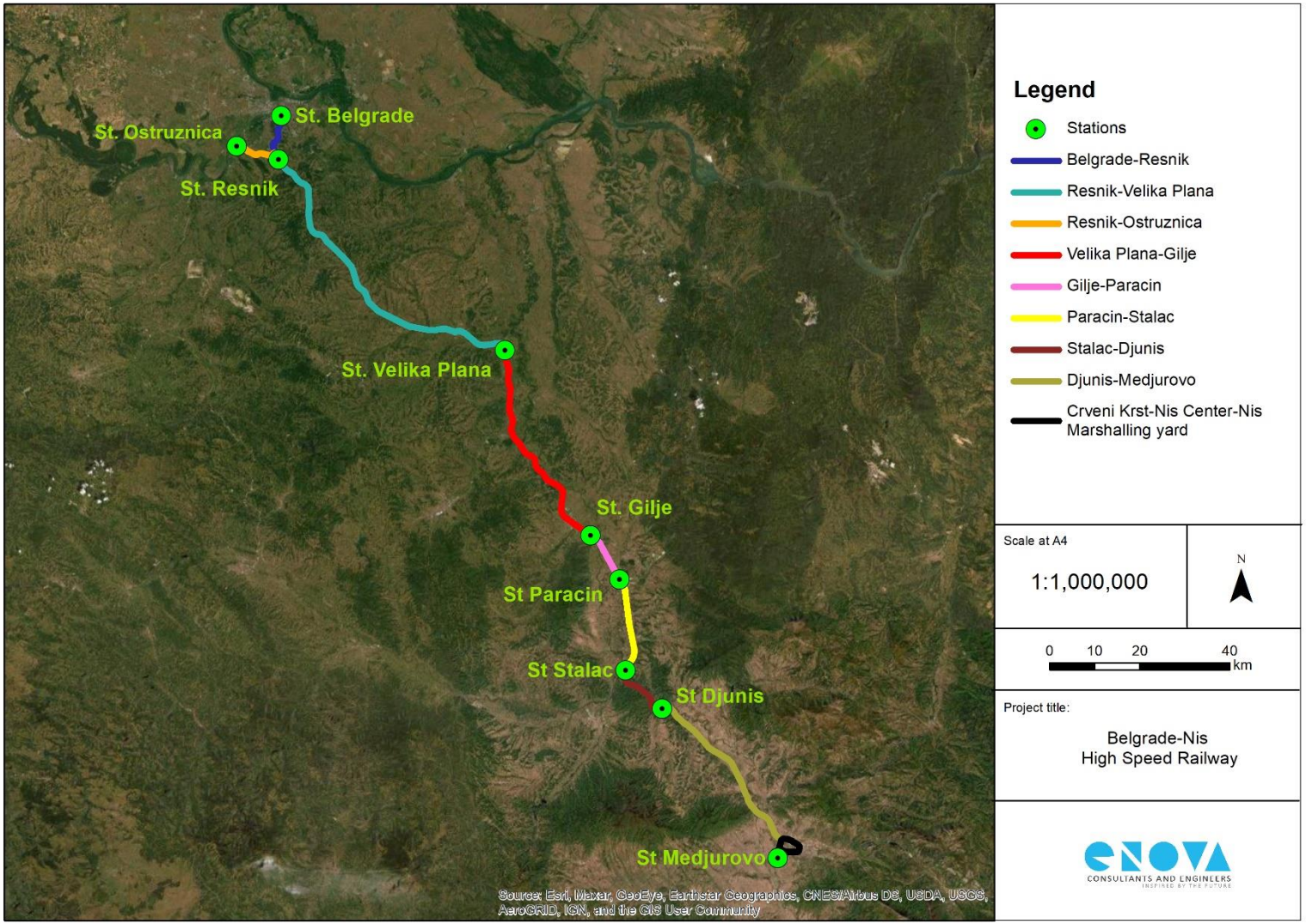


Figure 2: Subsections on Belgrade-Nis railway alignment

The subsection division was made taking into account: (i) population density (section Belgrade-Resnik is the most densely populated); (ii) single-track sections (Resnik-Velika Plana); (iii) sections that have already been reconstructed (Gilje-Paracin); (iv) sections whose reconstruction will start soon (Stalac-Djunis).

Even though a conceptual design for the subsections Resnik-Ostruznica and Crveni Krst-Nis Center-Nis Marshalling yard has not yet been developed, a preliminary assessment of the E&S baseline and potential negative impacts based on the current railway alignment, with emphasis on more detailed analyses that need to be conducted at a Project later stage, is also considered in this Assessment Report.

A comparative overview of the characteristics of these 9 subsections is given in the following chapters. It should be noted that the presented characteristics and further analysis of E&S impacts of the future railway alignment are made on the basis of the existing Conceptual Design. Changes are possible in the process of developing the Preliminary Design.

3.3 Subsection 1 (Belgrade-Resnik)

Characteristics		Existing Railway	Planned Railway
Railway surroundings		The railway line passes through highly developed and densely populated areas of Belgrade. The route crosses the following 4 streams or rivers[10]: Topciderska River, Kijevski stream, Kadinac stream and Sikljevac stream.	The railway line passes through highly developed areas and densely populated areas of Belgrade. The existing double-track railway line is retained from the Belgrade Centre to Resnik station. The route crosses the following 4 streams or rivers[11]: Topciderska River, Kijevski stream, Kadinac stream and Sikljevac stream.
Length		11.6 km	11.3 km
Number of tracks		2	2
Trains		*Number of trains in passenger services:* Belgrade Centre-Rakovica Fast – 4 Regional – 8 BG train – 6 Facultative – 2 Rakovica-Resnik Fast – 4 Regional – 8 Slow – 2 BG train – 6 Facultative – 2 *Number of planned train paths in freight services[12]:* 43 regular international trains 19 regular domestic trains	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 14 Local trains – 48 *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)		120 km/h	120 km/h
Max. permitted speed		70 km/h Belgrade Centre-Junction "G" 80 km/h Junction "G"-Rakovica 70 km/h Rakovica-Resnik	100 km/h
Stops		Belgrade Centre (Station) Rakovica (Station) Knezevac (Halt) Kijevo (Halt) Resnik (Station)	Same as existing
Level crossings		3	3
Ancillary[13] structures	Bridges	4	1
	Viaducts	--	--
	Galleries	2	1
	Tunnels	3	2
	Overpasses	6	6
	Underpasses	--	--
Fencing		No fencing	Fencing
Access roads		3x Street	3x Street
Municipalities		Savski Venac (City of Belgrade) Rakovica (City of Belgrade)	Same as existing

Figure 3 provides an overview of the existing and planned railway (subsection 1) with ancillary structures.

[10] Data taken from https://a3.geosrbija.rs/ (layer: larger watercourses)
[11] Data taken from https://a3.geosrbija.rs/ (layer: larger watercourses)
[12] Freight trains will operate on Belgrade Marshalling yard – Resnik route
[13] Data for the planned railway taken from Pre-Feasibility Study – Conceptual Design (Annex A)

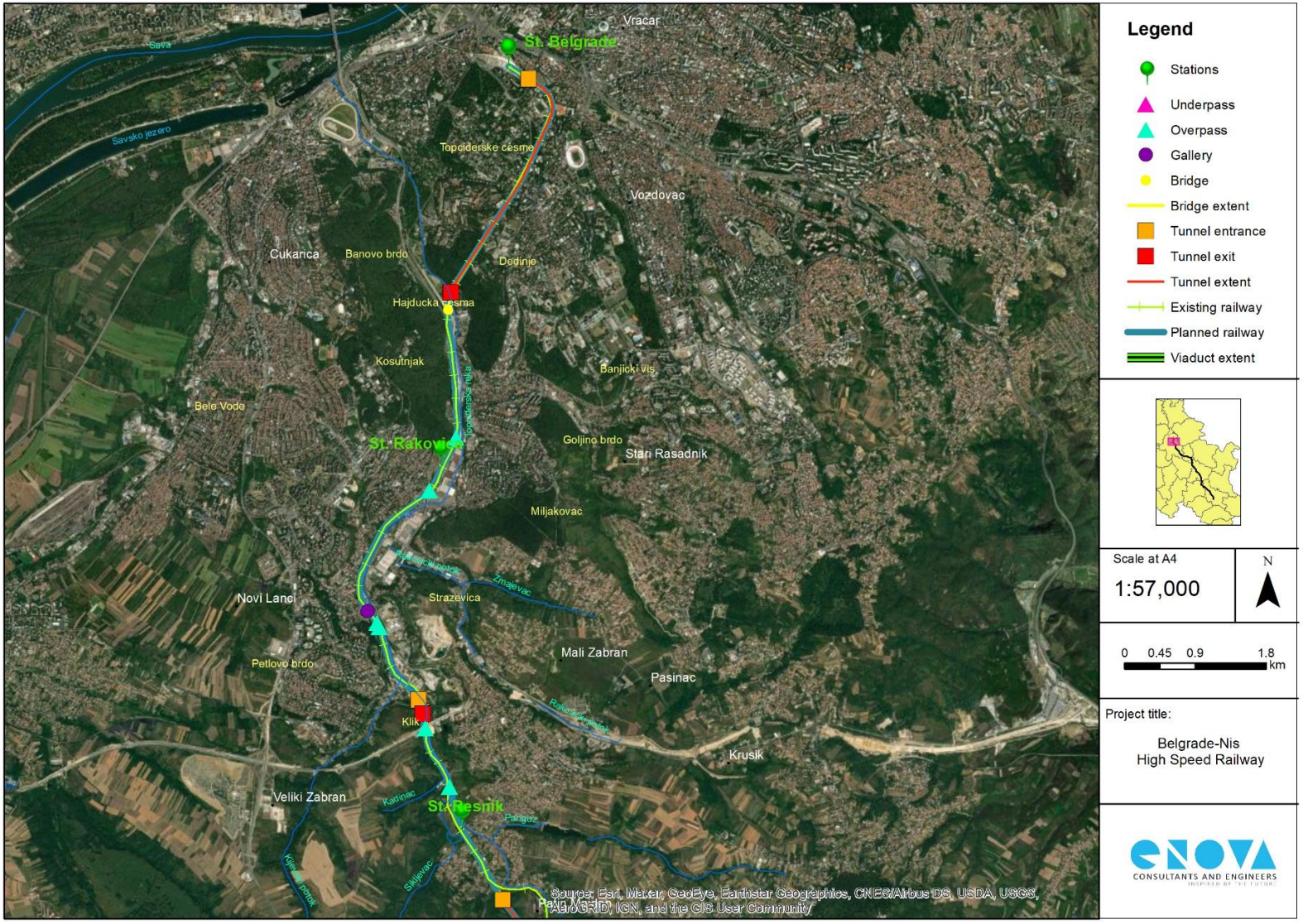


Figure 3: Existing and planned railway with ancillary structures (Belgrade-Resnik subsection)

3.4 Subsection 2 (Resnik-Velika Plana)

Characteristics	Existing Railway	Planned Railway
Railway surroundings	The existing railway route passes through and/or near the following 11 settlements: Resnik, Ripanj Kolonija, Ripanj, Ralja, Djurinci, Vlaska, Mladenovac, Kusadak, Glibovac, Smederevska Palanka and Velika Plana. The route crosses the following 21 streams or rivers[14]: Radusnje stream, No name stream, Bela River, Palanka River, Sardinia stream, Ralja River, Bulin stream, Kokorin stream, Radovanov stream, Serava stream, Batasev stream, Ladjevac stream, No name stream, Bojanac River, Mali Lug River, Drenovcic stream, Bulina voda stream, Ivak stream, Kudrecki stream, Jasenica River and Bukovacki stream.	The new railway route will avoid and/or will be moved away from 6 settlements: Resnik (partially), Ripanj Kolonija, Ralja, Vlaska, Mladenovac (partially), Kusadak (partially). The new route will avoid crossing: No name stream, Bela River, Smrdanski stream, Bulin stream, Bojanac stream. The new route will cross Sutlovacki stream, Duboki stream, Lugriver, Lunjevacki stream and Veliki Lug River.
Length	76.4 km	74.1 km
Number of tracks	1	2
Trains	*Number of trains in passenger services:* Resnik-Mladenovac Fast – 4 Regional – 8 Slow – 2 BG train – 6 Facultative – 2 Mladenovac-Velika Plana Fast – 6 Regional – 10 Slow – 2 Facultative – 2 *Number of planned train paths in freight services:* 43 regular international trains 19 regular domestic trains	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 14 Local trains – 48[15] *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)	120 km/h	160 km/h – 200 km/h
Max. permitted speed	30 km/h Resnik-Pinosava 50 km/h Pinosava-Sopot Kosmajski 100 km/h Sopot Kosmajski-Velika Plana	200 km/h Resnik-Pinosava 160 km/h Pinosava-Ripanj Kolonija 200 km/h Ripanj Kolonija-Ripanj Tunnel 160 km/h Ripanj Tunel-Ralja 200 km/h Ralja-Sopot Kosmajski 160 km/h Sopot Kosmajski-Mladenovac 200 km/h Mladenovac-Velika Plana
Stops	Resnik (Station) Pinosava (Passing point) Ripanj Kolonija (Halt) Ripanj (Station) Klenje (Station) Ripanj Tunel (Station) Ralja (Station) Sopot Kosmajski (Station) Vlasko Polje (Station) Mladenovac (Station) Kovacevac (Station)	Resnik (Station) Ripanj (Station) Ralja (Station) Sopot Kosmajski (Station) Mladenovac (Station) Kusadak (Station) Palanka (Station) Velika Plana (Station)

[14] Data are taken from https://a3.geosrbija.rs/ (layer: larger watercourses)
[15] 12 trains will operate on Belgrade - Mladenovac route

Characteristics		Existing Railway	Planned Railway
		Rabrovac (Halt) Kusadak (Station) Ratare (Halt) Glibovac (Passing point) Palanka (Station) Mala Plana (Station) Velika Plana (Station)	*Note: On the Resnik-Mladenovac section, 3 railway stations Ripanj, Ralja and Sopot Kosmajski will be moved to new locations:.
Level crossings		34	1
Ancillary[16] structures	Bridges	18	33
	Viaducts	--	--
	Galleries	--	--
	Tunnels	3	9
	Overpasses	--	18
	Underpasses	--	--
Fencing		No fencing	Fencing
Access roads		State road IIA No. 147 State road IIA No. 150 State road IIA No. 156 State road IIB No. 346 State road IIB No. 349 13x Local road 2x Street 14x Agricultural road	State road IIA No. 150 State road IIB No. 349 5x Local road 2x Agricultural road
Municipalities		Rakovica (City of Belgrade) Vozdovac (City of Belgrade) Cukarica (City of Belgrade) Sopot (City of Belgrade) Mladenovac (City of Belgrade) Smederevska Palanka Velika Plana	Same as existing

Figure 4 provided an overview of the existing and planned railway (subsection 2) with ancillary structures.

Note: Considering the length of the Resnik-Velika Plana section and the number of ancillary structures, more detailed maps for the subsections Resnik-Sopot Kosmajski and Sopot Kosmajski-Velika Plana are given in Figure 5 and Figure 6.

[16] Data for planned railway are taken from Pre-Feasibility Study – Conceptual Design (Annex A)

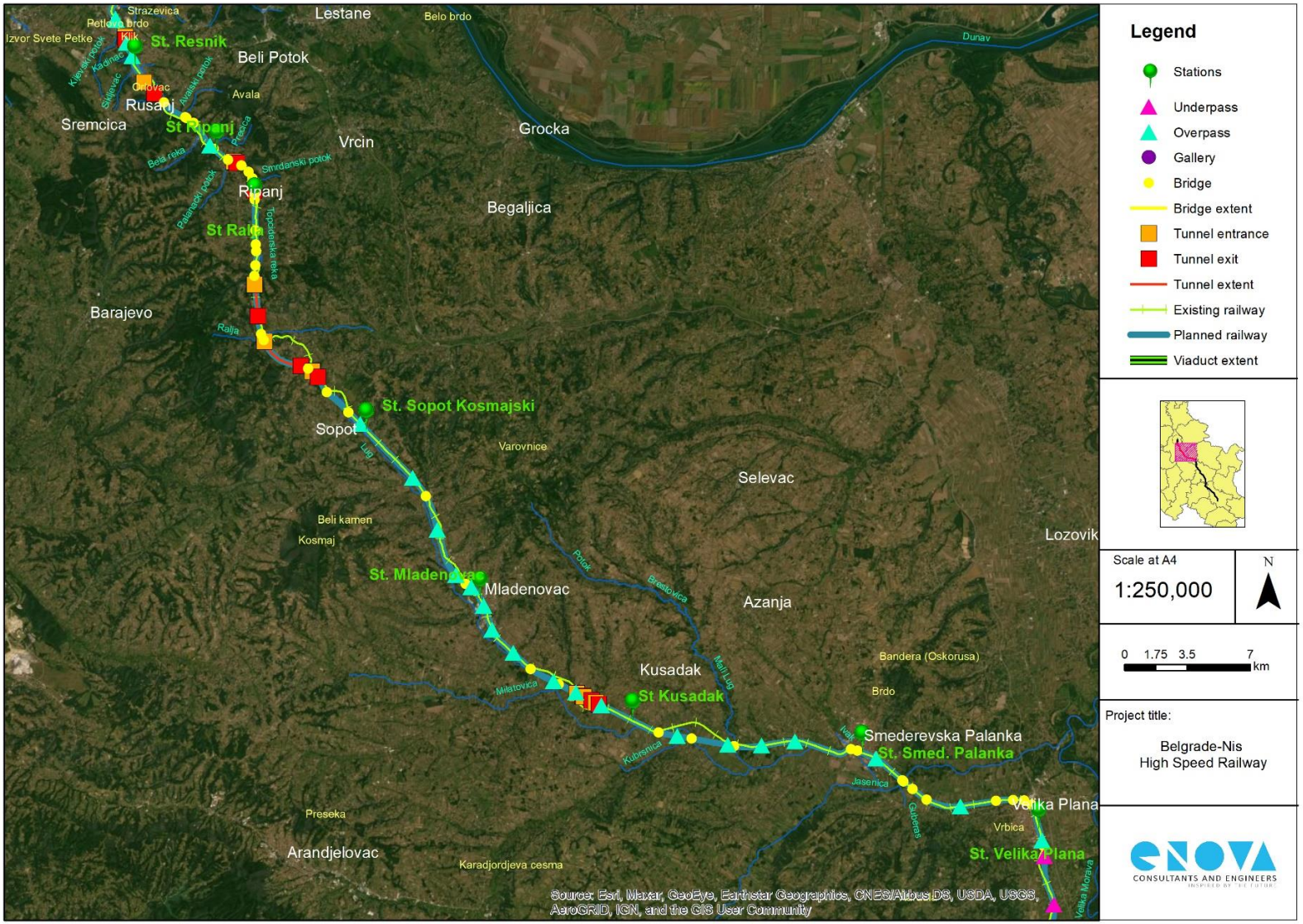


Figure 4: Existing and planned railway with ancillary structures (Resnik-Velika Plana subsection)

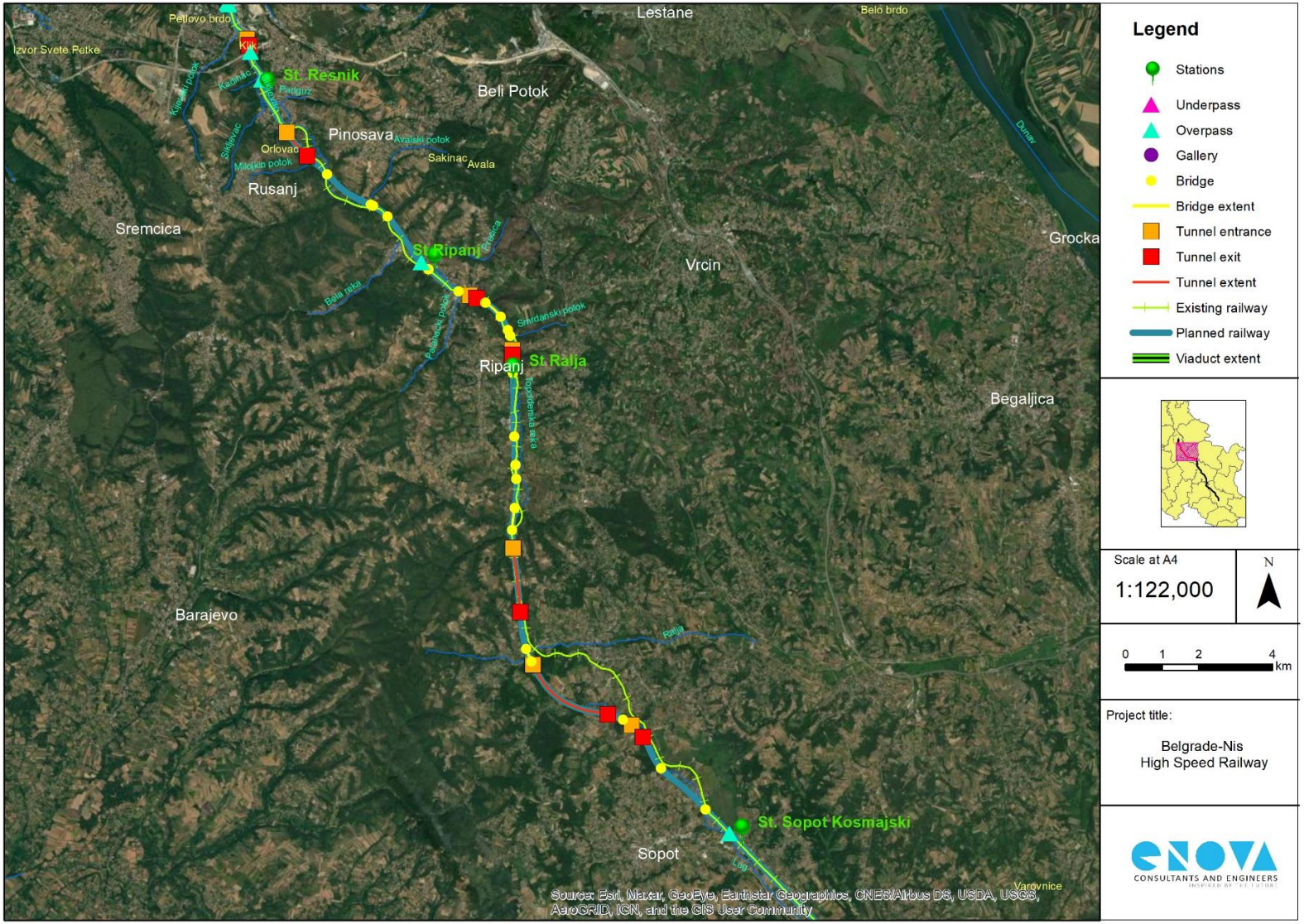


Figure 5: Existing and planned railway with ancillary structures (Resnik-Sopot Kosmajski subsection)

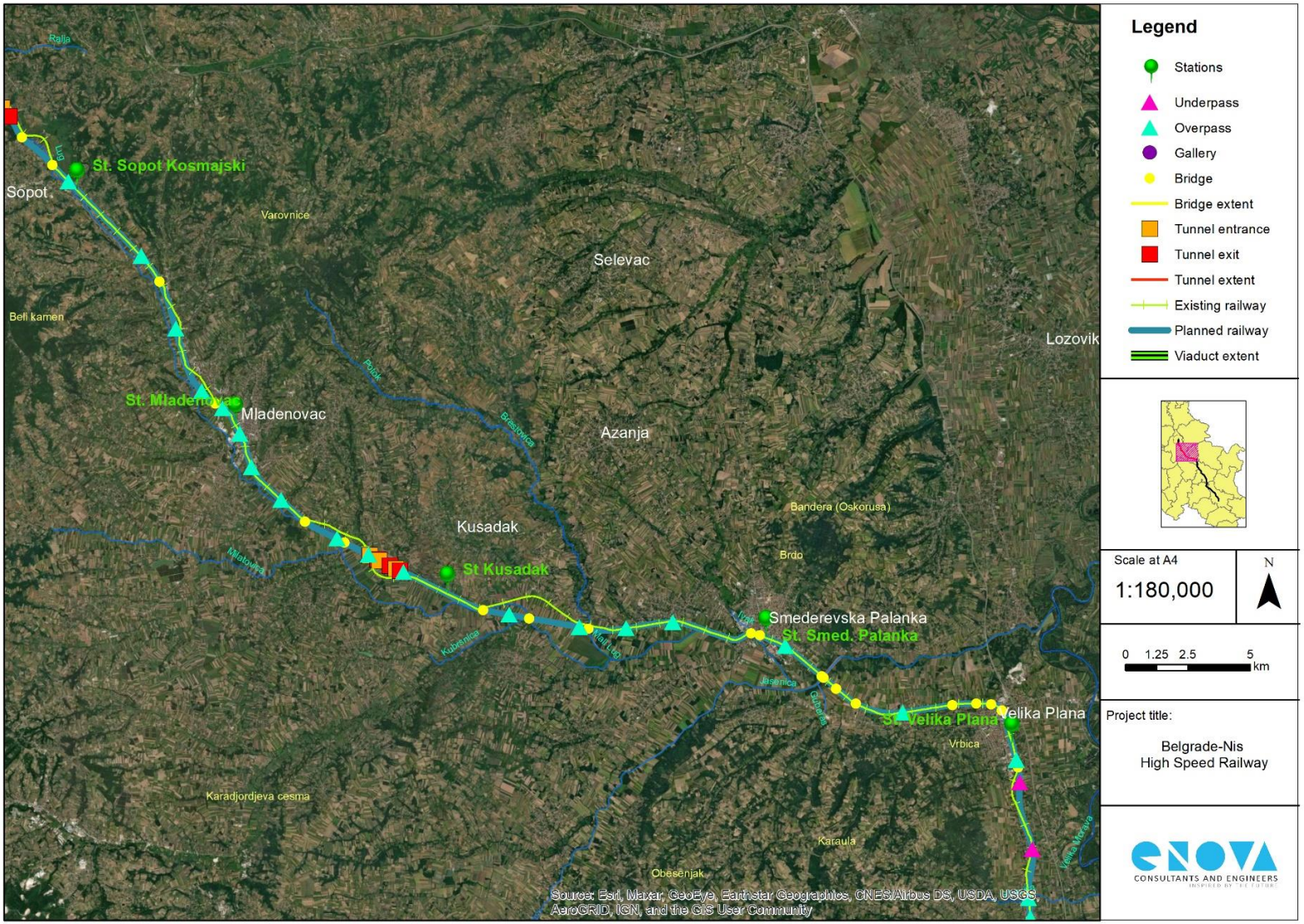


Figure 6: Existing and planned railway with ancillary structures (Sopot Kosmajski-Velika Plana subsection)

3.5 Subsection 3 (Velika Plana-Gilje)

Characteristics	Existing Railway	Planned Railway
Railway surroundings	The existing railway route passes through and/or near the following 11 settlements: Velika Plana, Staro Selo, Novo Selo, Markovac, Lapovo, Brzan, Milosevo, Bagrdan, Novo Laniste, Ribnik and Jagodina. The route crosses the following 16 streams or rivers[17]: Grabavacki stream, Recica River, Mlaka stream, Gibavica stream, Raca River, Kazanski stream, Lepenica River, Kijevski stream, Grabovik River, Kovanluk River, Ludi stream, Osaonica River, Kameniti stream, Suvi stream, Belica River and Lugomir River.	The new railway route will avoid and/or will be moved away from 4 settlements: Staro Selo (partially), Milosevo (partially), Novo Laniste and Ribnik. The route crosses the following 16 streams or rivers: Grabavacki stream, Recica River, Mlaka stream, Gibavica stream, Raca River, Kazanski stream, Lepenica River, Kijevski stream, Grabovik River, Kovanluk River, Ludi stream, Osaonica River, Kameniti stream, Suvi stream, Belica River and Lugomir River.
Length	50.2 km	49.7 km
Number of tracks	2	2
Trains	*Number of trains in passenger services:* Velika Plana-Lapovo Fast – 6 Regional – 16 Slow – 2 Facultative – 2 Lapovo – Jagodina Fast – 4 Regional – 8 Slow – 2 Facultative – 2 Jagodina - Gilje Fast – 4 Regional – 12 Slow – 2 Facultative – 2 *Number of planned train paths in freight services:* 43 regular international trains 19 regular domestic trains	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 28[18] Local trains – 38[19] *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)	120 km/h	160 km/h – 200 km/h
Max. permitted speed	70/50 km/h[20] Velika Plana-Markovac 100 km/h Markovac-Lapovo 50/70 km/h Lapovo-Bagrdan 50/100 km/h Bagrdan-Jagodina 120 km/h Jagodina-Gilje	200 km/h Velika Plana-Lapovo 160 km/h Lapovo-Bagrdan 200 km/h Bagrdan-Gilje
Stops	Velika Plana (Station) Staro Selo (Halt) Novo Selo (Halt) Markovac (Station) Lapovo Varos (Halt) Lapovo (Station) Brzan (Halt) Milosevo (Halt) Bagrdan (Station) Laniste (Halt)	Velika Plana (Station) Markovac (Station) Lapovo Varos (Halt) Lapovo (Station) Bagrdan (Station) Jagodina (Station)

[17] Data are taken from https://a3.geosrbija.rs/ (layer: larger watercourses)
[18] 14 regional direct trains will operate on Jagodina - Nis route
[19] 18 local trains will operate on Jagodina - Nis route
[20] Belgrade-Nis direction/ Nis-Belgrade direction

Characteristics		Existing Railway	Planned Railway
		Bukovce (Halt) Jagodina (Station) Gilje (Halt)	
Level crossings		23	--
Ancillary[21] structures	Bridges	32	16[22]
	Viaducts	--	--
	Galleries	--	--
	Tunnels	--	--
	Overpasses	--	23
	Underpasses	31	9
Fencing		No fencing	Fencing
Access roads		State road IB No. 27 State road IIA No. 185 18x Local road 3x Street	5x Local road
Municipalities		Velika Plana Lapovo Batocina Jagodina Cuprija	Same as existing

Figure 7 provides an overview of the existing and planned railway (subsection 3) with ancillary structures.

[21] Data for planned railway are taken from Pre-Feasibility Study – Conceptual Design (Annex A)
[22] In Pre-Feasibility Study – Conceptual Design, only the major bridges are shown.

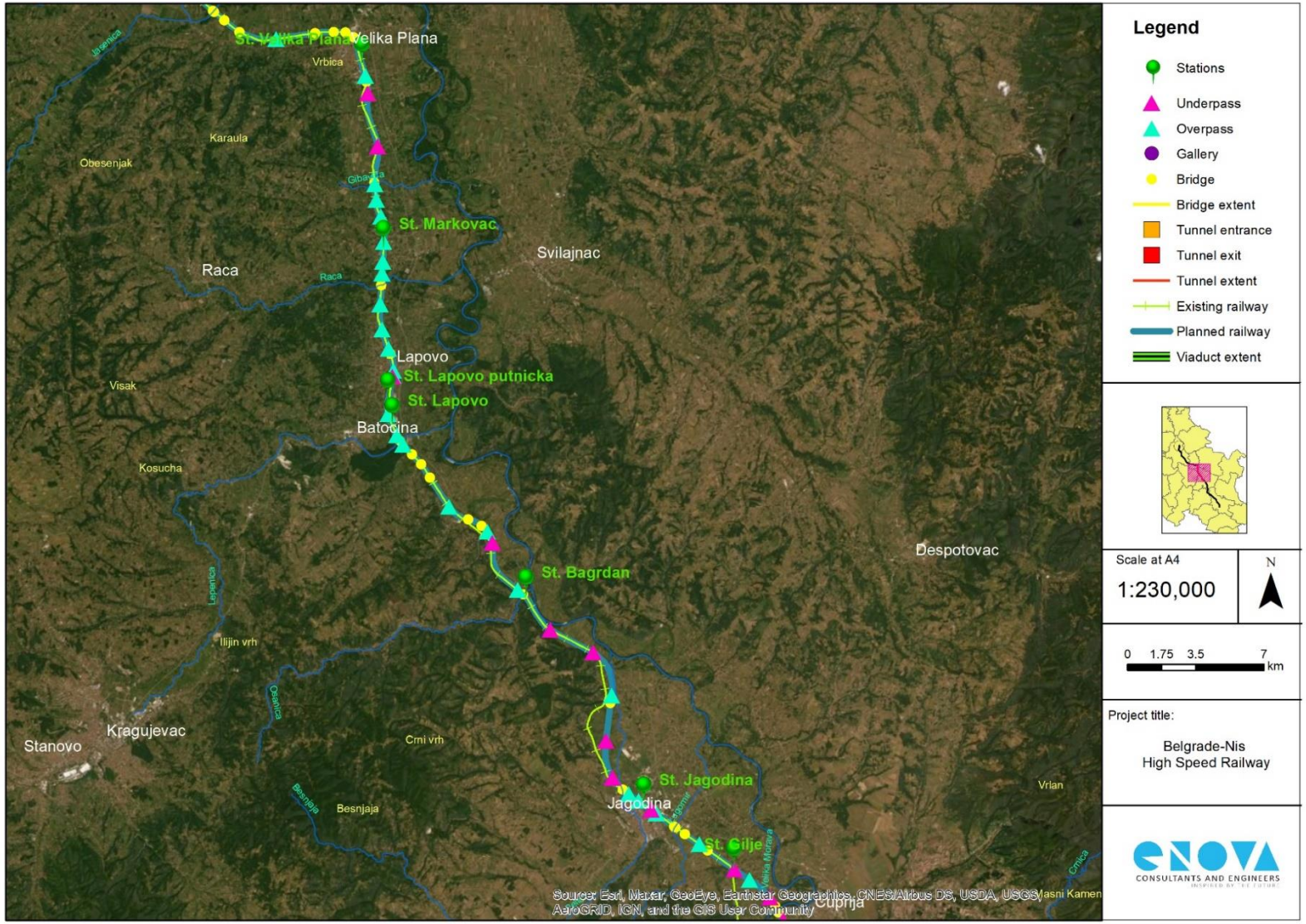


Figure 7: Existing and planned railway with ancillary structures (Velika Plana-Gilje subsection)

3.6 Subsection 4 (Gilje-Paracin)

Characteristics		Existing Railway	Planned Railway
Railway surroundings		The existing railway route passes through and/or near the following 3 settlements: Mijatovac, Cuprija and Paracin. The route crosses[23] Velika Morava River and Cuprijski stream.	The Gilje-Paracin section was reconstructed several years ago for the design speed of 160 km/h. *According to information obtained from PPF9, this section will not be the subject of new reconstruction, but small-scale additional construction works are possible (such as correcting parts of the alignment (curves) to enable reaching a speed of 200 km/h).*
Length		12.0 km	12.0 km
Number of tracks		2	2
Trains		*Number of trains in passenger services:* Gilje-Paracin Fast – 4 Regional – 12 Slow – 2 Facultative – 2 *Number of planned train paths in freight services:* 43 regular international trains 19 regular domestic trains	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 28 Local trains – 38 *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)		160 km/h	160 km/h (potentially 200 km/h)
Max. permitted speed		160 km/h	Same as above
Stops		Gilje (Halt) Cuprija (Junction) Paracin (Station)	Gilje (Halt) Cuprija (Junction) Paracin (Station)
Level crossings		2	2 (If design speed is increased to 200 km/h, the level crossings are to be replaced by separate grade crossings)
Ancillary structures	Bridges	1	1
	Viaducts	--	--
	Galleries	--	--
	Tunnels	--	--
	Overpasses	1	1
	Underpasses	5	5
Fencing		No fencing	Fencing
Access roads		1x Local road 1x Street	1x Local road 1x Street
Municipalities		Cuprija Paracin	Cuprija Paracin

Figure 8 provides an overview of the existing and planned railway (subsection 4) with ancillary structures.

[23] Data taken from https://a3.geosrbija.rs/ (layer: larger watercourses)

Figure 8: Existing and planned railway with ancillary structures (Gilje-Paracin subsection)

3.7 Subsection 5 (Paracin-Stalac)

Characteristics		Existing Railway	Planned Railway
Railway surroundings		The existing railway route passes through and/or near the following 8 settlements: Paracin, Striza, Ratare, Sikirica, Drenovac, Cicevac, Lucina and Stalac. The route crosses the following 6 streams or rivers[24]: Crnica river, Bacijski stream, Slatinski stream, Krezbinski stream, Jovanovacka river and Potok stream.	From Paracin to Stalac, the line remains in the same corridor with increased radii of curves for the speed up to 200 km/h. The route crosses the following 6 streams or rivers: Crnica river, Bacijski stream, Slatinski stream, Krezbinski stream, Jovanovacka river and Potok stream.
Length		21.1 km	21.2 km
Number of tracks		2	2
Trains		*Number of trains in passenger services:* Paracin-Stalac Fast – 4 Regional – 12 Slow – 2 Facultative – 2 *Number of planned train paths in freight services:* 43 regular international trains 19 regular domestic trains	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 28 Local trains – 38 *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)		120 km/h	200 km/h
Max. permitted speed		Paracin-Cicevac 50/100[25] km/h Cicevac-Stalac 100/50 km/h	200 km/h
Stops		Paracin (Station) Sikirica/Ratari (Halt) Drenovac (Halt) Cicevac (Station) Lucina (Halt) Stalac (Station)	Paracin (Station) Cicevac (Station) Stalac (Station)
Level crossings		12	1
Ancillary[26] structures	Bridges	7	3[27]
	Viaducts	--	--
	Galleries	--	--
	Tunnels	--	--
	Overpasses	--	6
	Underpasses	4	4
Fencing		No fencing	Fencing
Access roads		State road IIA No. 220 5x Local road 5x Street 1x Agricultural road	--
Municipalities		Paracin Cicevac	Paracin Cicevac

Figure 9 provides an overview of the existing and planned railway (subsection 5) with ancillary structures.

[24] Data taken from https://a3.geosrbija.rs/ (layer: larger watercourses)
[25] Belgrade-Nis direction/ Nis-Belgrade direction
[26] Data for planned railway are taken from Pre-Feasibility Study – Conceptual Design (Annex A)
[27] In Pre-Feasibility Study – Conceptual Design, only the major bridges are shown.

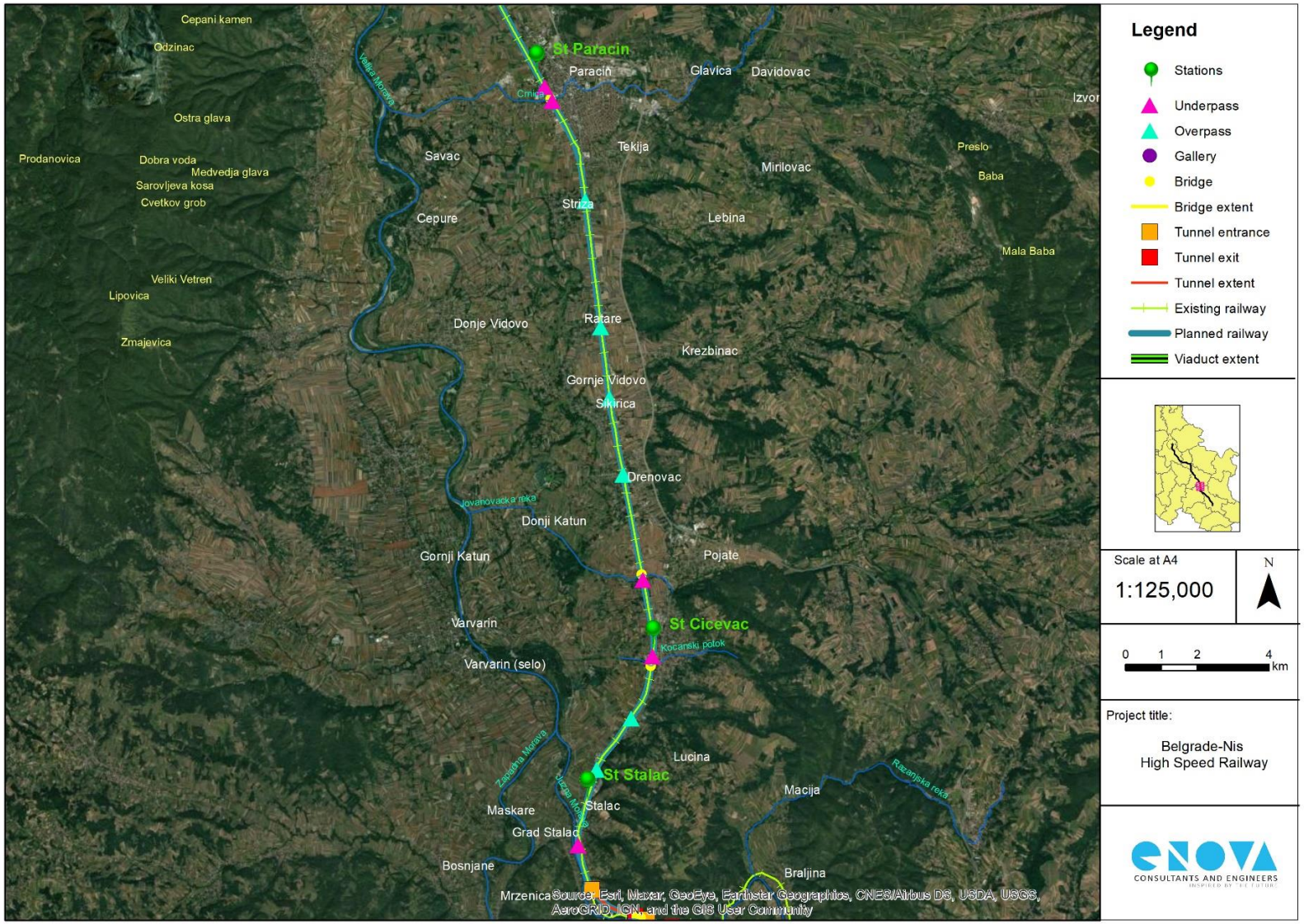


Figure 9: Existing and planned railway with ancillary structures (Paracin-Stalac subsection)

3.8 Subsection 6 (Stalac-Djunis)

Characteristics		Existing Railway	Planned Railway
Railway surroundings		The existing railway route passes through and/or nearby the following 7 settlements: Stalac, Stalac Town, Braljina, Mojsinje, Cerovo, Trubarevo and Djunis. The route is located within the ecologically important area "Mojsinje Mountain and Stalac Gorge of the Juzna Morava (Juzna Morava) River"[28]. The route runs parallel to the Juzna Morava River (Stalac Gorge) at a greater or lesser distance, on the entire subsection. The river is designated as an ecological corridor of international importance[29]. The route crosses the following 10 streams or rivers: Vinogradski stream, Pajin stream, Razanska river, Krnji stream, Jabucki stream, Vetrenjski stream, Bucina stream, Juzna Morava River, Zmijarnik river, Ribarska river.	The new railway route will avoid and/or will be moved away from 2 settlements: Braljina and Cerovo. It will pass under the Mojsinje settlement with a tunnel. The new route will go through the ecologically important area "Mojsinje Mountain and Stalac Gorge of the Juzna Morava River" almost entirely in tunnels, the only exception being the one 30 m-long half-buried gallery between tunnel 4 and tunnel 5, south of Mojsinje village. The route will leave the Juzna Morava River watercourse and the Stalac Gorge in the length of almost 10 km. The new route will avoid crossing the Pajin stream, Razanska river, Krnji stream, Jabucki stream, Vetrenjski stream and Bucina stream.
Length		18.6 km (22.0 km including the sections before Stalac and after Djunis in order to fit into the existing railway line)	17.7 km (including the sections before Stalac and after Djunis in order to fit into the existing railway line)
Number of tracks		1	2
Trains		*Number of trains in passenger services:* International trains – 4 Regional and local trains – 8 International agency trains – 4 *Number of trains in freight services:* International trains – 11 Domestic trains – 4	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 14 Local trains – 18 *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)		120 km/h	160 km/h
Max. permitted speed		65 km/h Stalac-Braljina 85 km/h Braljina-Djunis	160 km/h
Stops		Stalac (station) Stevanac (passing loop) Braljina (station) Cerovo Razanj (halt) Staro Trubarevo (passing loop and halt)[30] Djunis (station)	Stalac (station) Djunis (station)
Level crossings		8	--
Ancillary structures	Bridges	15	6
	Viaducts	--	1
	Galleries	--	1
	Tunnels	1	5
	Overpasses	--	--
	Underpasses	3	2
Fencing		No fencing	Fencing[31]
Access roads		Dr Ilije Nagulica street (Stalac Station) Zeleznicka street (Braljina station) Zeleznicka street (Cerovo Razanj halt)	Dr Ilije Nagulica street (Stalac Station) State road No. 215 (Djunis station)

28 The Decree on Ecological Network, 2010
29 Ibid.
30 The Preliminary Design mentions Staro Trubarevo as a passing loop only but it is both a passing loop and a halt.
31 Although both the EIA and ESIA studies state that the Stalac-Djunis subsection will not be fenced, this entire subsection will indeed be fenced with a wire fence.

Characteristics	Existing Railway	Planned Railway
	Kralja Petra Prvog street (Staro Trubarevo passing loop) State road No. 215 (Djunis station)	
Municipalities	Cicevac Krusevac	Cicevac Krusevac

Figure 10 provides an overview of the existing and planned railway (subsection 6) with ancillary structures.

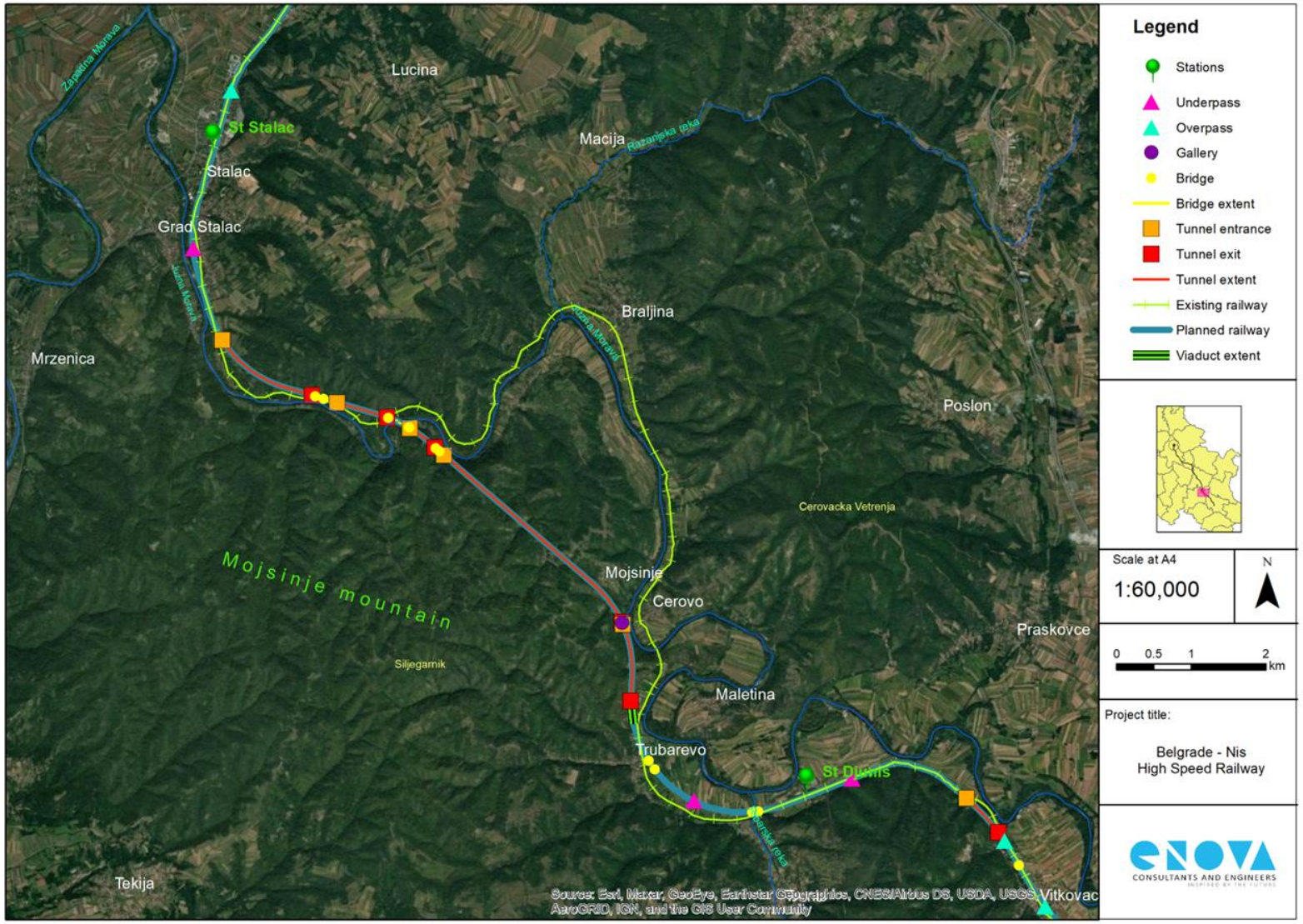


Figure 10: Existing and planned railway with ancillary structures (Stalac-Djunis subsection)

3.9 Subsection 7 (Djunis-Medjurovo)

Characteristics	Existing Railway	Planned Railway
Railway surroundings	The existing railway route passes through and/or near the following 19 settlements: Djunis, Vitkovac, Donji Ljubes, Srezovac, Gornji Ljubes, Korman, Trnjane, Donji Adrovac, Zitkovac, Moravac, Luzane, Tesica, Grejac, Veliki Drenovac, Supovac, Mezgraja, Vrtiste, Trupale and Nis. The route crosses the following 6 streams or rivers[32]: Simin stream, Jankov stream, Srezovacka River, Radevacka River, Suvi stream, Suhotnicki stream, Turija River, Dasnicka River, Juzna Morava River and Nisava River.	The new railway route will avoid and/or will be moved away from 4 settlements: Zitkovac (partially), Moravac (partially), Veliki Drenovac (partially) and Supovac. The route crosses the following 6 streams or rivers: Simin stream, Jankov stream, Srezovacka River, Radevacka River, Suvi stream, Suhotnicki stream, Turija River, Dasnicka River, Juzna Morava River and Nisava River. From Trupale station to Medjurovo station, the railway route is in the existing corridor, due to the fact that this section is part of the Nis railway node.
Length	39.9 km[33]	39.0 km[33]
Number of tracks	2	2
Trains	*Number of trains in passenger services:* Djunis-Aleksinac Fast – 4 Regional – 8 Slow – 2 Facultative – 2 Djunis-Nis Fast – 4 Regional – 10 Slow – 2 Facultative – 2 *Number of planned train paths in freight services:* 43 regular international trains 19 regular domestic trains	*Number of trains in passenger services:* High speed trains – 34 International trains – 12 Regional direct trains – 14 Local trains – 52[34] *Number of trains in freight services:* International trains – 20 Direct trains – 10 Local (manipulative) trains – 2
Design speed (maximum)	120 km/h	100 km/h – 200 km/h
Max. permitted speed	100 km/h Djunis-Trupale 70 km/h Trupale-Crveni Krst 30 km/h Crveni Krst-Nis	160 km/h Djunis-Gornji Ljubes 200 km/h Gornji Ljubes-Adrovac 120 km/h Adrovac-Aleksinac 160 km/h Aleksinac-Luzane 200 km/h Luzane-Trupale 100 km/h Trupale-Nis
Stops	Djunis (Station) Vitkovac (Halt) Donji Ljubes (Halt) Gornji Ljubes (Halt) Korman (Station) Trnjani (Halt) Adrovac (Station) Aleksinac (Station) Nozrina (Halt) Luzane (Halt) Tesica (Halt) Grejac (Station) Supovacki Most (Halt)	Djunis (Station) Korman (Station) Adrovac (Station) Aleksinac (Station) Luzane (Halt) Grejac (Station) Mezgraja (Halt) Trupale (Station) Crveni Krst (Station) Nis (Station)

[32] Data are taken from https://a3.geosrbija.rs/ (layer: larger watercourses)
[33] Djunis-Trupale section
[34] 18 local trains will operate on Jagodina-Aleksinac route and 34 local trains will operate on Aleksinac-Nis route

Characteristics		Existing Railway	Planned Railway
		Mezgraja (Halt) Vrtiste (Halt) Trupale (Station) Crveni Krst (Station) Nis (Station)	
Level crossings		32[35]	1
Ancillary[36] structures	Bridges	30	14[37]
	Viaducts	--	--
	Galleries	--	--
	Tunnels	--	2
	Overpasses	--	16
	Underpasses	13	7
Fencing		No fencing	Fencing
Access roads		15x Local road 8x Street 1x Agricultural road	Milana Jovanovica Street
Municipalities		Krusevac Aleksinac Crveni Krst (City of Nis) Palilula (City of Nis)	Same as existing

Figure 11 provides an overview of the existing and planned railway (subsection 7) with ancillary structures.

[35] Djunis-Trupale section
[36] Data for planned railway are taken from Pre-Feasibility Study – Conceptual Design (Annex A)
[37] In Pre-Feasibility Study – Conceptual Design, only the major bridges are shown.

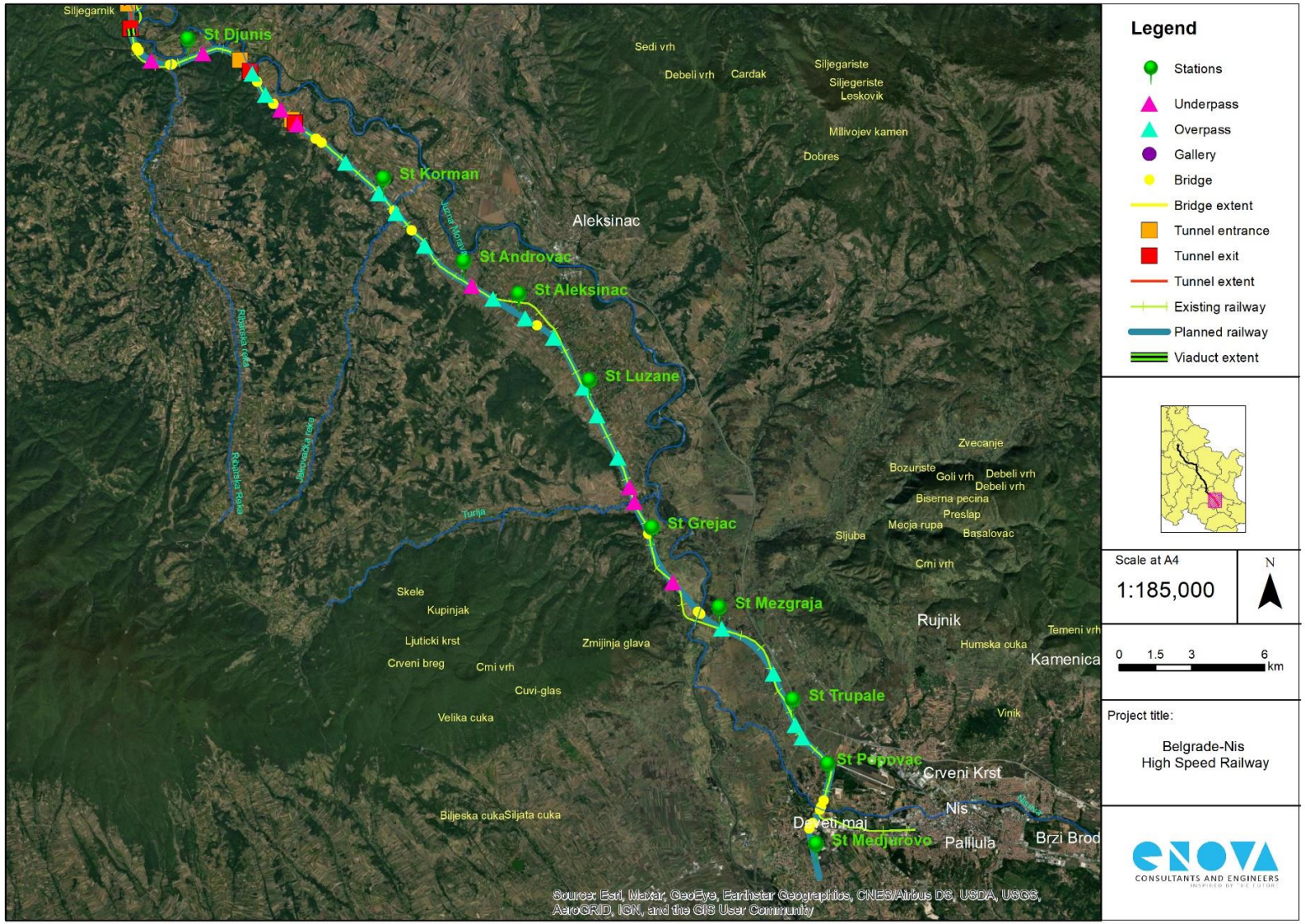


Figure 11: Existing and planned railway with ancillary structures (Djunis-Medjurovo subsection)

3.10 Additional Sections as Part of Railway Nodes

3.10.1 Subsection Resnik-Ostruznica

With an increase in freight traffic volume that is expected after modernisation of the Belgrade-Nis railway, Ostruznica-Resnik subsection will clearly become a bottleneck, and, for the forecasted demands, a second track must be built.

Since a conceptual design including technical specifications and future railway alignment for the Resnik-Ostruznica subsection have not yet been developed, a preliminary description of the subsection is given in this chapter based on the railway specifications given in the 2022 PFS and the observations of the railway alignment using Google Earth.

The single-track Ostruznica-Resnik subsection is part of the Belgrade railway junction. This section separates in the Resnik settlement and goes towards the Ostruznica settlement, as presented in Figure 12.

Figure 12: Resnik-Ostruznica subsection

In the Resnik settlement, the railway line passes near the Topciderska river, and then towards the Ostruznica settlement it mainly follows the route of the existing highway A1 and the motorway E75. After passing through the village of Resnik and before entering the village of Zeleznik, the railway line passes through 2 tunnels. The railway alignment goes through the densely populated urban settlement of Zeleznik. There are several residential and commercial buildings near the railway station in Ostruznica. The Sava River is near the railway station.

The existing infrastructure is in a very poor condition and speed is very low. Theoretically, only 43 trains can operate during the day. However, the actual capacity is even lower – 28 trains per day however only 25 trains pass this section within a 22-hour period. When the existing infrastructure is reconstructed, the theoretical capacity of the line will be 78 trains per day, i.e. 71 train within a 22-hour period.

3.10.2 Subsection Crveni Krst-Nis Center-Nis Marshalling Yard

Since a conceptual design including technical specifications and future railway alignment for Crveni Krst (Red Cross)-Nis Center-Nis Marshalling yard have not yet been developed, a preliminary description of the subsection location and E&S characteristics is given based on location of current railway alignment (using Google Earth) and some railway specifications given in 2022 PFS.

The subsection includes the double track loop of the railway line: Crveni Krst Station-Nis Centar Station-Marchalling yard Station-Crveni Krst Station, as presented in Figure 13.

Figure 13: Crveni Krst-Nis Center-Nis Marshalling yard subsection

From Crveni Krst to Nis Centar, the subsection passes through a densely populated area and crosses the Nisava River. The maximum permitted speed is 30 km/h. From Nis Center to Nis Marshalling yard, the subsection passes through a business/industrial area, near sporadic and linear type of settlements, and again crosses the Nisava River. On the stretch from the Nis Marshalling yard to Crveni Krst, the railway line passes near a significant number of agricultural land plots and business facilities on the left and "Konstantin Veliki" airport on the right. This section will be modernised as part of the Nis Bypass project.

The main technological purpose of railway stations is as follows:

- Crveni Krst station – to regulate train movements on the main railway lines. Crveni Krst station is connected to the depot for towing trains, and the station will continue to serve private sidings in the industrial zone of Nis. The station has 6 main arrivals – departure tracks for servicing trains, 2 classification tracks, 2 side tracks and 3 shunting necks.
- Nis Center station – to regulate train movements on the main railway lines and to perform operations in passenger traffic. All categories of passenger trains (international trains, domestic passenger trains on longer distances, regional trains and suburban and city trains) will stop at the Nis Center station. The station track capacities can be divided into two yards: (i) passenger yard consisted of the main group with 5 arrivals and (ii) local cargo yard consisted of the main group with 3 arrivals. This will will be further evaluated in the next stages of project design.
- Nis Marshalling yard station – this station will continue to be used as a marshalling yard with an international and local character.

3.11 Project Structures

3.11.1 Rail Track

For tracks of the open railway line and stations, appropriate types of rails and switches are applied, in accordance with the design speed and purpose of the track, on concrete sleepers with elastic rail fastenings in I category ballast:

- The rail type for main running line and relief tracks is 60E1, and 49E1 for other tracks according to the standard SRPS EN 13674 - 1, clause 5;
- Switches:
  - 60E1-1200-1:18.5 (160 ≤ V ≤ 220 km/h in straight, 100 km/h in turn);
  - 60E1-760-1:14 (160 ≤V ≤ 220 km/h in straight, 80 km/h in turn);
  - 60(49) E1-300-6° (100 ≤ V ≤ 140 km/h in straight, 50 km/h in turn).
- Concrete sleeper length 2.60 m;
- Ballast shoulder width is 0.50 m;
- Ballast slope inclination is 1:1.5;
- Ballast thickness under sleeper min 30 cm, on bridges min 35 cm;
- Rails and switches welded into Long Welded Rail (LWR).

Following the designed structure of the superstructure on the open railway line, the design was prepared for superstructure on bridge structures, longer than 40 m, which are the subject matter of the present design, with the following characteristics:

- Running rail type: 60E1
- Concrete sleepers with even top surface, 2.60 m long, at 60 cm distance between centre lines 60 cm
- Ballast of I category crushed stone according to SRPS EN 13450
- Ballast thickness under sleeper in front of and behind bridges min 30 cm
- Ballast thickness under sleeper on bridge structures min 35 cm
- Rails welded into LWR.

Typical cross section is designed according to the Rulebook on technical requirements and maintenance of superstructure of railway lines[38] and the Rulebook on technical requirements and maintenance of substructure of railway lines[39].

Gauge UIC GC is adopted, which enables all modes of combined transport. Distance between tracks on the open line is 4.50 m, and between main running lines in stations it is 4.75 m. Relief tracks in intermediate stations are at 6.40 m distance from the running line and between them overhead contact system masts and drainage system manholes are located.

For the purposes of protection against harmful effects of train derailment, design envisages guard rails type 60E1 with elastic rail fastenings, which are to be placed on bridge structures and also at 10.4 m in front of and behind the bridge. Concrete sleepers with even top surface are envisaged, and guard rails shall be mounted via double steel base plates.

In accordance with the category of the railway line and the applicable regulations relating to reconstruction, modernisation and construction of double-track railway line for the speed of up to 200 km/h, it is envisaged that

[38] "Official Gazette of the RS", No. 39/16 and 74/16
[39] "Official Gazette of the RS", No. 39/16 and 74/16

all intersections of the railway line with roads must be grade separated, which requires cancellation of all existing road and pedestrian level crossings except in Belgrade and Nis railway nodes, where speeds are lower and each cross-section should be considered separately due to the various criteria.

3.11.2 Fencing

Given the category of the railway line and the design speed of up to 200 km/h, design envisages that the railway line is fenced with a type of fence used for highways. The fence shall have multiple purposes:

- Protects and deters against unauthorised access to railway facilities and equipment,
- Safety – it prevents uncontrolled access for people and animals to the railway line.

The fence is envisaged to be placed on both sides of the railway line, at 1.0 m from the channel edge, i.e., from toe of embankment. On the outer side of the fence, a 5 m space is reserved for service roads.

3.11.3 Drainage

The railway line drainage addresses the drainage and protection of the designed railway line against rainwater from the track bed and from the storm water, the protection against the hillside waters on sections of the railway line which are in cut and parts of the railway line which are on the embankment when the terrain falls towards the railway line. The design also includes the drainage of water from the designed structures along the railway line. These are road deviations, overpasses, underpasses, and bridges.

Channels are envisaged on one or both sides, depending on the railway line finished level and the configuration of the surrounding terrain. On the sections of the railway where the embankment is higher and where, in the transverse sense, the terrain "falls" from the railway line, no channels are envisaged.

Designed channels are earth or concrete channels. Concrete channels are 40 cm wide in the bottom in plain view and their minimum height is 25 cm, in order to prevent water from retaining at track foot, given the small available falls. The layout and levelling solution of the drainage channel is conditioned by the existing structures on the alignment, longitudinal and cross falls, relevant rains, and catchment areas. The location of the channel is part of the railway line civil engineering design. The same applies to railway station drainage.

For drainage of track bed in railway stations, drainages are designed and fit into the railway line drainage system.

The collected water is discharged to the nearest recipient (river, municipal network) by the shortest route.

Open infiltration ponds are envisaged, which represent green artificial depressions in the soil, with layers of broken rock and gravel at the bottom, which are occasionally filled up during heavy rains and completely emptied in dry weather. An alternative is absorbing wells and/or drainage fields. The principle in locating the infiltration facility was to keep it at a minimum distance of 5 m from the edge of the slope of the railway embankment.

The drainage principle for the railway line in the zones of sanitary protection of water source areas is, like in the remaining part of the railway line, by channels, with the following additional elements:

- lineside channels are concrete on the entire height, with dimensions larger than the ones required for drainage of the track bed, so that it can retain the incident amount of fluid which could be possibly spilled from the tank wagons;
- the entire surface under the superstructure is separated by foil to the channel, so that the possibly spilt pollutant could safely end up in the channels;
- in front of the outflow into irrigation canals or absorbing well, separators with settling basins are envisaged, and space is reserved for installation of tertiary treatment, should the need for it arise in the future;
- at the entry to the separator, a floodgate is envisaged, which will get down in case of incident.

3.11.4 Stations

The Project proposes new conceptual solutions for 22 official points on the railway section Resnik-Trupale, including Resnik and Trupale stations as border stations of the Belgrade and Nis railway nodes. For Lapovo railway node, conceptual solutions are proposed for stations Lapovo Varos and Lapovo as intermediate stations on the main line Belgrade-Nis and junction stations at which a line for marshalling yard Lapovo Ranzirna branch off. The reconstruction of marshalling yard Lapovo Ranzirna is out of scope for this Project, and it keeps its existing track layout and its current role in freight services with dominant local character of work. Within this Project, cancelation of its current role in passenger service at the railway line 102: Belgrade-Nis is proposed, due to the lack of passengers.

The official points Gilje and Cuprija Junction remain at the level of the existing track layouts that were built as a part of the construction of double track railway section Gilje-Cuprija-Paracin in 2016. For the stations Stalac and Djunis, track layouts designed according to the Preliminary Design for Reconstruction and Modernisation of the railway section Stalac-Djunis (prepared in 2018) are kept. Although the reconstruction of station layouts in the area of Belgrade and Nis railway nodes is not assumed as a part of this study, conceptual framework for the reconstruction of main railway stations in Nis node in order to facilitate the next design stage of the modernisation project for railway line Belgrade-Nis is provided.

28 stations have been proposed on the line from Belgrade to Nis, as seen in the table below. The following stations are proposed to be closed: Klenje, Ripanj Tunel, Vlasko Polje, Kovacevac, Mala Plana, Lapovo Ranzirna and Laniste, while 19 halts are proposed to be closed. It should be noted that the decision on closure of other stations/halts has not been officially made to date.

Table 1: Official places on the new Belgrade Centre-Nis (Medjurovo) railway line

No.	Official place	Chainage
1	Belgrade Centre	0+000
2	Rakovica	5+950
3	Resnik	11+300
4	Ripanj	18+000
5	Ralja	21+900
6	Sopot Kosmajski	37+400
7	Mladenovac	48+900
8	Kusadak	60+250
9	Smederevska Palanka	73+600
10	Velika Plana	85+400
11	Markovac	95+200
12	Lapovo Varos	102+300
13	Lapovo	104+400
14	Bagrdan	116+000
15	Jagodina	129+700
16	Gilje	135+200
17	Paracin	147+150
18	Cicevac	163+600
19	Stalac	168+300
20	Djunis	181+900
21	Korman	192+500
22	Adrovac	197+300
23	Aleksinac	200+000
24	Luzane	204+700
25	Grejac	211+400
26	Mezgraja	215+600

No.	Official place	Chainage
27	Trupale	220+850
28	Medjurovo	227+600

The Resnik station remains an intermediate station on the main line Belgrade-Nis and a junction station at which another main line Belgrade-Bar branch off. The station keeps the role of the border station in the Belgrade railway node, at which the freight subsystem with the Belgrade marshalling yards and Ostruznica station branch off from the main line. Main tasks of the station are related to the traffic management, shunting work organisation and the performance of passenger and wagonload services.

The Ripanj station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and local passenger services.

The Ralja station main tasks are related to local passenger services within the integrated public transport system in Belgrade.

The Sopot Kosmajski station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and local passenger services. In addition, the station has to provide a service of an existing military spur track.

The Mladenovac station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management, shunting work organisation and the performance of passenger and wagonload services. The station remains opened for domestic and international passenger services, and it keeps the role of the terminus station for commuter trains within the Belgrade integrated public transport system.

The Kusadak station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and local passenger services.

The Smederevska Palanka station remains an intermediate station on the main line Belgrade-Nis opened for domestic and international passenger services. For freight services, it remains opened for wagonload services at station loading tracks and private sidings.

The Velika Plana station remains an intermediate station on the main line Belgrade-Nis and a junction station at which another main line Rakovica-Mala Krsna-Velika Plana branch off. Main tasks are related to the traffic management, shunting work organisation and the performance of passenger and wagonload services.

The Markovac station remains an intermediate station on the main line Belgrade-Nis and a junction station at which another main line Markovac-Resavica branch off. Main tasks are related to the traffic management and the station remains open for local passenger services.

The junction Lapovo Varos (existing) will change the role on the network and become an intermediate station on the main line Belgrade-Nis. It remains the north border station in the Lapovo railway node at which the freight tracks to the marshalling yard Lapovo Ranzirna branch off the main line. Main tasks of the station are related to the traffic management and the station remains open for local passenger services.

The Lapovo station remains an intermediate station on the main line Belgrade-Nis and a junction station at which another main line Lapovo-Kraljevo branch off. The station remains the south border station in the Lapovo railway node and branch off freight tracks directed to the marshalling yard Lapovo Ranzirna. Main tasks of the station are related to the traffic management. The station remains opened for domestic and international passenger services.

The Bagrdan station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and local passenger services. In addition, the station services private sidings.

The Jagodina station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management, shunting work organisation and the performance of passenger and wagonload services. The station remains opened for domestic and international passenger services. For freight services, it remains opened for wagonload services at station loading tracks and private sidings.

The Gilje remains a halt on a two-track line with two main-through tracks and it remains open for receiving and dispatching passengers in local traffic.

The Paracin station remains an intermediate station on the main line Belgrade-Nis and a junction station at which two lines branch off: Rasputnica (Junction) Cuprija-Paracin and Paracin-Stari Popovac, respectively. Main tasks are related to the traffic management, shunting work organisation and the performance of passenger and wagonload services. The station remains opened for domestic and international passenger services. For freight services, it remains opened for wagonload services at station loading tracks and private sidings.

The Cicevac station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and passenger services. In addition, the station services private sidings.

The Stalac station keeps the track layout designed according to the Conceptual Design for Stalac-Djunis Railway Section prepared in 2022.

The Djunis station keeps the track layout as presented in the 2022 Conceptual Design for Stalac-Djunis Railway Section. The station will continue to be used as a technological service station, while a small modern passenger station building will be built in the vicinity of the existing one.

The Korman station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and local passenger services.

The Adrovac station will become the freight point under the supervision of the Aleksinac station open only for freight work. The service of this official place will be performed from the Aleksinac station.

The Luzane station main tasks are related to receiving and dispatching passengers within the local passenger services.

The Grejac station remains an intermediate station on the main line Belgrade-Nis. Main tasks of the station are related to the traffic management and local passenger services. In addition, the station remains opened for wagonload services.

The Mezgraja station main tasks are related to receiving and dispatching passengers within the local passenger services.

The Trupale station remains an intermediate station on the main line Belgrade-Nis and a junction station at which another main line Trupale-Nis Ranzirna-Medjurovo branch off. The station will be used for traffic management and will also remain open for local passenger services.

3.11.5 Ancillary Structures

Tunnels. The Project foresees construction of several new tunnels while some of the existing ones will be reconstructed.

The new tunnels should be designed in such a manner, as to meet the interoperability requirements related to tunnels, in accordance with the Technical Specifications for Interoperability of the Trans-European Conventional Railway System for the Infrastructure construction subsystem.

Total of 18 tunnels will be constructed on the Belgrade-Nis double-track railway line: 9 tunnels of up to 500 m, 3 tunnels from 500 to 1,000 m and 6 tunnels over 1,000 m. To meet the project requirements, it was proposed for all the tunnels of up to 1,000 m to be single-tube double-track, and for the tunnels with a length of over 1,000 m to be double-tube single-track (with the exception of tunnels on the Stalac-Djunis section, which are

single-tube double track). The total length of 12 new single-tube tunnels would therefore be 4,710 m, and the total length of 4 new double-tube tunnels will be 8,365 m. For one of the double-tube tunnels (no. 6), a new tube (1,755 m) will be constructed, and the other tube (1,614 m) will be reconstructed, while for another double-tube tunnel (no. 1), both tubes will be reconstructed (3,070 m). The total length of the new single-track tunnel tubes would be 18,485 m, and the length of the reconstructed tubes would be 7,754 m. The proposed tunnels are shown in Table 2.

Table 2: Proposed tunnels on the Belgrade Centre-Nis (Medjurovo) railway line

No.	Chainage	Subsection	Length [m]
1	0+300 - 3+370	Belgrade-Resnik	3,070
2	9+350 - 9+530	Belgrade-Resnik	180
3	12+150 - 13+030	Resnik-Velika Plana	880
4	18+920 - 19+110	Resnik-Velika Plana	190
5	20+920 - 21+045	Resnik-Velika Plana	125
6	26+320 - 28+075	Resnik-Velika Plana	1,755
7	29+550 - 32+150	Resnik-Velika Plana	2,600
8	32+840 - 33+320	Resnik-Velika Plana	480
9	56+850 - 57+180	Resnik-Velika Plana	330
10	57+295 - 57+760	Resnik-Velika Plana	465
11	58+040 - 58+200	Resnik-Velika Plana	160
12	170+885 – 172+335	Stalac-Djunis	1,450
13	172+690 - 173+380	Stalac-Djunis	690
14	173+715 - 174+150	Stalac-Djunis	435
15	174+315 - 177+590	Stalac-Djunis	3,275
16	177+620 - 178+660	Stalac-Djunis	1,040
17	184+275 – 184+890	Djunis-Medjurovo	615
18	187+580 – 187+740	Djunis-Medjurovo	160

In line with the request from technical specifications for interoperability – safety in railway tunnels (SRT TSI), in the tunnels longer than 500 m, the pedestrian paths for evacuation are envisaged on both sides.

Bridges. According to the 2022 PFS, there will be 14 bridges longer than 40 meters. Proposed locations of the bridges are shown in Table 3.

Table 3: Proposed bridges on the Belgrade Centre-Nis (Medjurovo) railway line

No.	Chainage	Subsection	Length [m]
1	3+610	Belgrade-Resnik	375
2	18+600	Resnik-Velika Plana	40
3	19+670	Resnik-Velika Plana	525
4	20+450	Resnik-Velika Plana	130
5	21+290	Resnik-Velika Plana	90
6	24+245	Resnik-Velika Plana	350
7	25+530	Resnik-Velika Plana	570
8	76+325	Resnik-Velika Plana	75
9	115+810	Velika Plana-Gilje	45
10	173+540	Stalac-Djunis	100
11	174+200	Stalac-Djunis	45
12	178+800	Stalac-Djunis	305
13	181+180	Stalac-Djunis	60
14	214+700	Djunis-Medjurovo	100

3.12 Electrification

The reconstructed and modernised subsection Belgrade Centre will be electrified with single-phase system, 25 kV, 50 Hz. The designed overhead contact system is foreseen in the way that it corresponds to the maximum train speed envisaged on the railway line (200 km/h).

A system should be designed to improve energy efficiency through automatic monitoring of energy consumption of each train. Exceptionally in the transition period, it is allowed to reconstruct parts of the railway infrastructure to renew the existing electric traction installations.

Within the scope of reconstruction, modernisation, and construction of double-track railway line Belgrade-Nis, it is necessary to perform the reconstruction and modernisation of the existing power supply substations and sectioning posts located on this section.

Technical solutions for electric traction substations are foreseen in the way to provide technologically integral part with the solutions envisaged by the technical documentation on the sections Gilje-Cuprija and Stalac-Djunis.

The disposition of the Electric Traction Substations (ETSs) remains unchanged, in reconstruction, so the existing connection to the 110 kV power distribution grid and the space where the ETS is located will be used.

The existing sectioning posts cannot be used due to the change in the configuration of the overhead contact system, deterioration and obsoleteness of the equipment, and lack of available space in the buildings, therefore construction of completely new ones is envisaged. The applied equipment is to be uniform with the corresponding equipment applied in the ETS and standardised for all posts. For 25 kV circuit breakers, vacuum technology is to be used. For the protection of the Occupation Control System (OCS) and remote control, microprocessor-based equipment is to be used. The 25 kV switchgear is to be envisaged in manufactured metal sheet cubicles with withdrawable circuit breakers. The existing locations and disposition of posts are to be used to the maximum possible extent. New locations shall be envisaged as necessary, due to the change in the alignment of the railway line.

Preliminary Design shall contain the design of the temporary remote-control centre located in the premises of the existing centre and local and remote control of motor-driven disconnectors. The design envisages equipment (and software) of temporary remote-control centre for fixed electric traction installations. Connection with the remote-control centre is realised via Remote Terminal Unit (RTU) cabinets located in the nearest building with the train dispatcher's office, wherever the distances allowed so, in view of enabling the train dispatcher to control the disconnectors in case of failure of the remote-control centre (otherwise, the RTU cabinet is in the prefabricated outdoor container).

For back-up supply of signalling and interlocking devices, devices for control of motor-driven disconnectors and switch point heating, on the section Belgrade Centre-Nis (Medjurovo) transformer substations (TS) supplied from the overhead contact system are envisaged, whereof ratio is 25/0.23 kV, power: 5 kVA, 50 kVA and 100 kVA.

Transformer substation is pole-mounted with overhead connection to the overhead contact system and low-voltage cable tap. Transformer is connected to the overhead contact system via disconnectors with earthing blades. In addition to the transformer and disconnector, the support structure also carries the disconnector leverage, post insulators, high-voltage fuse, surge arrester, connections, and distribution cabinet.

3.13 Signalling System

The Interoperability Directive which has been transposed as well as technical specifications for interoperability relating to the control-command and signalling subsystems (TSI CCS) of the EU rail system are the basic preconditions for deployment of new signalling system. In December 2020, SRI has officially adopted

"User/functional requirements specification for ETCS level 2 on railway network in the Republic of Serbia" (URS ETCS), which should represent a legal base for all further deployments of the ETCS system on its' network.

The signalling system will include following elements:

- Installation of conventional signalling system – station electronic interlocking devices (EIXL) with electronic automatic line block system (APB), prepared for integration into the Centralised Traffic Control (CTC) system of the railway line and including corresponding interfaces with station on the border of the corresponding section (station Belgrade Centre). In this phase it is predicted to connect new equipment to the existing CTC system Westinghouse Flexicode, with CTC centre located in station Belgrade Ranzirna-Marshalling (Makis), until the new CTC system is completed within the project of Unique Dispatching Centre for whole Serbian network (JDC project). All potential interfaces between equipment predicted within this Project and within JDC project, will be included in the JDC project.
- Installation of ETCS level 2 system, including trackside equipment (fixed eurobalises and additional signs (STOP markers, location markers, etc.), and four Radio Block Centres (RBC) for coverage of the entire railway section in scope. All equipment will be in redundant configuration.

3.14 Control Systems

The modernised railway line would meet the requirements defined by the international agreements (AGC, AGTC, SEECP). The reconstructed and modernised railway for mixed passenger and freight traffic would be equipped with modern ERTMS devices (ETCS-L2, GSM-R) in accordance with the requirements of interoperability (TSI). In line with EU Regulations, it is fundamental to ensure that interoperability measures are in place to facilitate cross border traffic without unnecessary delay.

It is necessary to have railway optical and electronic telecommunication systems, with railway mobile telephony GSM-R which together with ETCS should enable the application of the European railway traffic management system ERTMS.

The telecommunication system on the open railway line and stations will include installation of following installations and systems: copper cables, fibre optic cables, dispatcher and trackside telephone devices, radio-dispatching system, GSM-R system, transport system and station telecommunication systems.

Copper cables. Relocation and protection of existing trackside cables and local cables refers to: lineside STKA[40] cable Belgrade Centre-Lapovo-Nis and local cables in stations.

The lineside cable in terms of capacity and characteristics will be adapted to the existing STKA cable as well as telecommunication, signal-interlocking and remote-control systems that operate along the cable. In all stations, a new local cable network will be provided.

Fibre optic cables. It will be laid on independent routes on both sides of the railway line, and in the stations in accordance with the construction solution of the station. The trackside fibre optic cable will enable the functioning of modern telecommunication and signalling systems for the ETCS-L2 security level. Fibre optic cables are single mode with 96 and 48 optic fibres according to the G.657A1 standard.

Dispatcher and trackside telephone devices. In all stations, the new integrated digital station dispatcher telephone devices (central devices with remote control desk (TK) and anti-vandal telephones on the entrance and exit signals) will be installed. In the open track, telephones in anti-vandal casings, with selective transmitters, will be installed next to the automatic block signals as well as telephones and, as needed, selective transmitters in the electric traction facilities. The new devices will be compatible with the devices on other sections.

[40] Railway telecommunication and signaling cable with inductive protection for electrified railway.

In the dispatcher centres CTC, CDU, and JDC (JDC-Unified Traffic Control Centre) in Makis, the dispatcher trackside telephone CDS and CDEV systems, executed in modern technology in accordance with the traffic technology, will be installed.

Integrated dispatcher telephone devices in stations and dispatcher centres will have the option to operate along the copper pairs and along the optical fibres.

Radio-dispatching system. The radio dispatching system shall remain in unchanged function, but it will be adjusted to the railway line alignment, track layout and traffic control centres. The number and the locations of additional trackside radio stations will be assessed in relation to the present condition, as a basis for assessment of investment costs. The exact number and location of trackside radio stations will be determined based on EM field measurements.

Replacement of the existing analogue trackside radio stations with the modern technology devices and RD exchanges, in accordance with the traffic technology, will be envisaged fully in accordance with the recommendation of UIC 751-3, ensuring the interoperability with the existing systems.

GSM-R system. The GSM-R system will be designed as a platform for transmission of information for ETCS-L2 (primary) and a platform for voice communication and other services between the railway staff. The system will be interoperable with the European Rail Traffic Management System. GSM-R system will ensure the optimum configuration with the required level of redundancy for ETCS-L2, fully in accordance with the technical specifications EIRENE/MORANE, ERTMS and EU directives and the relevant national and railway standards. Measurements of electromagnetic field along the railway line alignment will be envisaged as verification of selected locations, determined based on applying the radio wave range prediction models. The planned GSM-R system will be extendible and will support upgrading to LTE system.

The central equipment of GSM-R system and the equipment for monitoring and control for the entire railway line (Belgrade Centre)-Mladenovac-Nis will be accommodated in two geo-redundant centres.

Transport system. The railway section will be equipped with the transport system consisting of the SDH system of high reliability and availability for transmission of critical services of telecommunication and signalling devices for the ETCS-L2 system and remote control of fixed electric traction facilities, with protection of traffic, ensuring a very fast response rate, and the DWDM system for transmission of non-critical services based on IP solutions.

Station telecommunication systems. All stations and stops will be equipped with the following telecommunication systems:

- Telephone and computer installations – according to the principle of structural cabling within the joint communication network;
- Railway automatic telephone network (ŽAT) – the centralized Voice over Internet Protocol (VoIP) telephony system for communication of railway staff along the entire railway section (Belgrade Centre)-Mladenovac-Nis;
- Video surveillance system – based on the concept of IP technology and equipment;
- Public address system – modern digital public address system, which has to operate in local and central mode, connected to the AVIS system;
- Visual passenger information system – based on IP technology and equipment, connected to the AVIS system
- Clock system – based on IP technology and equipment;
- Audio visual information system (AVIS) – enables the harmonised publication of predefined messages through a public address system and information board system;
- Security systems – access control system, burglary signalling system, fire alarm system, SOS system, in accordance with applicable laws, regulations and standards.

3.15 Overview of the Construction and Operation Phases

Construction. The technology and organisation of works on the reconstruction and modernisation of the Belgrade-Nis railway will depend on numerous factors, especially on the organisation of traffic on the existing railway during the works. Since works on such linear projects involve a set of activities that are repeated in each location for the entire length of the work, the impacts will be limited in time and space, and they will move as the works progress.

A Framework ESMP has been developed along with this Assessment Report, which will serve as a basis for site-specific Construction E&S Management Plans (CESMPs) to be prepared for each subsection by the selected contractor. The objectives of the CESMPs are to:

- Define the requirements for compliance with the national and local regulations, permit/consent conditions, client/contract requirements.
- Clearly define the responsibilities and actions required by all parties during Project implementation and maintain compliance with the E&S requirements.
- Provide necessary procedures for communication, documentation, and review of E&S compliance activities.

The CESMP will condition the implementation of mitigation measures by developing specific subplans such as Traffic Management Plan, Noise and Vibration Management Plan, Health, Safety and Security Plan, etc. Further details are provided in the Project's Framework ESMP.

Commissioning and testing. Upon completion of the construction works commissioning and testing of the Project will commence. This will include:

- Progressive verification and validation through inspection and testing in a safe way that all rail systems and structures operate correctly and meet the Project requirements including all specifications and standards;
- Verification that all safety requirements are met including specific tests to show that safety features operate correctly;
- Specific tests of fault conditions to show that redundancy features and emergency and protective features work as intended and that single fault conditions do not have catastrophic consequences;
- Integration testing to show that the railway performs safely and meets operational requirements through: (i) undertaking test runs, whereby the speed is gradually increased to reach the maximum speed for the trains; and (ii) undertaking test runs, whereby the number of trains operating on the line is gradually increased to reach the maximum number of trains.

All of the commissioning and testing should be clearly documented as to:

- Details of the test procedure, equipment, and methodology;
- A clear description of the pass/fail criteria;
- Recording of actual results so that there is a clear audit trail showing successful completion of commissioning and testing.

Operation and Maintenance. SRI will be responsible for the operation and maintenance of the railway infrastructure. It will involve routine, planned maintenance and system testing, as well as ad-hoc maintenance and repairs. The maintenance will include, among other things, replacement of: ballast, sleepers, rails, fastenings, switches, component parts of the overhead line system, etc.

For the operation phase, SRI will develop an Operational E&S Management Plan (OESMP) and will be responsible for its implementation, as well as for ensuring that any maintenance (sub)contractors understand the requirements contained within the OESMP and have contractual conditions in place.

The OESMP will include supplementary subplans such as a Waste Management Plan, Air Quality Management Plan, Noise and Vibration Management Plan, etc. Further details are provided in the Project's Framework ESMP.

3.16 Project's Land Requirements

At this Project development stage, the magnitude of impacts associated to land acquisition is still unknown. For this reason, a Resettlement Policy Framework (RPF) was developed at a very early stage of the Project (pre-feasibility and scoping stage) to define the key resettlement principles, procedures and organisational arrangements. The RPF is part of the Project's Disclosure Package. Detailed land requirements of the Project will be known only once the final designs and detailed expropriation studies have been prepared for each sub-section, after which specific resettlement instruments (Resettlement Action Plans) will be prepared based on a detailed census and socio-economic survey which will be conducted in line with EBRD's and EIB's requirements.

Note: A Resettlement Action Plan has been developed to date for the Stalac-Djunis subsection only, and is part of the Disclosure Package for this subsection. Acquisition and clearing of approx. 79 ha of land (of which approx. 43% is privately owned) will be needed. The total number of land plots which will be affected is 877, of which 86% are privately owned. It should be noted that a significant number of land plots are planned to be only partially acquired. Some structures will be affected as well, all located on the territory of Municipality of Cicevac. Further information on land and persons affected are provided in the RAP.

3.17 Project Alternatives

The 2007 General Design for the Belgrade-Nis railway considered four alternatives:

1. Reconstruction and keeping the existing railway route with an increase in speed up to 100 km/h,
2. Reconstruction and keeping the existing railway route with an increase in speed up to 120 km/h,
3. Abandonment of the existing railway route, for the most part, with an increase in speed up to 160 km/h,
4. Abandonment of the existing railway route, for the most part, with an increase in speed up to 200 km/h.

For each of the alternatives, railway length and costs were analysed. The General Design selected the alternative 3 that envisages upgrading the railway for a speed of up to 160 km/h along the entire route and for a speed of 120 km/h in the part of Aleksinac-Trupale railway subsection. The new alignment was proposed to enable greater speed and shorten the travel time.

The 2022 PFS considered the four new alternatives including the *"do nothing"* alternative and three alternatives for increasing speed up to 200 km/h with the aim of reducing the travel time and increasing the competitiveness of the national railway traffic,. The speed within the Belgrade and Nis railway nodes is limited to 100 km/h in all alternatives as they are situated in densely populated city area but also due to limitations of the existing infrastructure.

In the "do nothing" alternative: (i) the section from Stalac to Djunis will remain as a single-track railway, (ii) the current condition of the railway infrastructure on the Belgrade-Nis line will continue to be unsatisfactory, (iii) the electrical equipment will remain to be technologically obsolete, (iv) the commercial speed of passenger trains will stay at about 50 km/h, (v) large number of level crossings will continue to pose danger to road users and will jeopardise safety of both rail and road traffic.

Furthermore, the "do nothing" alternative would ignore the obligations of the RoS as a candidate for EU membership, which addresses the need for a sound, high quality, and integrated transportation network to effectively connect the European market. For all the above reasons, it was considered that the choice of this alternative was not prudent and not considered further within the selection of the alignment.

The PFS **alternative 1** was considered so that the largest part of the railway is designed for speeds up to 200 km/h, with an expected increase in investment costs. The speed of 200 km/h is achieved on 84% of the line, being about 192 km out of the total length of 227 km.

At the Belgrade railway junction, the existing double track railway line is retained from the Belgrade Centre to Resnik station. The design speed on this section is 100 km/h except at the section before and after Rakovica station where the speed is limited to 10 km/h due the current technical problems with switches. Just after the Resnik station the alignment of the double-track railway line abandons the existing alignment because the characteristics of the existing curves that do not allow the speed more than 70-80 km/h, and runs along a new corridor close to the existing one but with curve radii that enables speed of 200 km/h.

On the Resnik-Mladenovac section, three railway stations Ripanj, Ralja and Sopot Kosmajski are planned to be moved to new locations. The Mladenovac station is kept at its current position because it is located in highly urbanised area and finding an adequate new location is impossible. The design speed in the station area is limited to 100-120 km/h. After the Mladenovac station the alignment abandons the existing route all the way to the Velika Plana station except in the area of the Kusadak station which will keep its original position.

The Smederevska Palanka station will also be moved to a new location on the outskirts of the city in order to be able to achieve the design speed up to 200 km/h which are currently impossible to reach due to narrow existing corridor through the city centre with several level crossings. The Velika Plana station will stay on the existing location because it is not possible to find the new location without crossing over the Belgrade-Nis highway and being far from the city. Another issue is how to connect the new railway with the existing railway line 103 Belgrade Center - Rakovica-Jajinci-Mala Krsna-Velika Plana.

From the Velika Plana station to the Lapovo Putnicka (Passenger) station the existing corridor is retained in order to keep the existing marshalling yard between the Lapovo Varos and Lapovo Putnicka (Passenger) stations, with some adjustments to increase curve radii.

The Markovac station remains at the same location. After the Markovac station up to the Gilje station the alignment remains the same, except for some adjustments to increase curve radii and allow the speed to be 200 km/h. The Jagodina and Bagrdan stations which are found along the way will remain on the same location. At places with bigger curve radii the new alignment has been moved from the existing one.

The Gilje-Paracin section was reconstructed several years ago for the design speed of 160 km/h and is not considered within this Project except for small upgrades, if and where needed. From Paracin to Stalac, the alignment mainly stays in the same corridor, except where the radii of curves is increased to reach speeds up to 200 km/h and therefore where the new alignment has been moved from the existing one.

The Cicevac station is relocated to a new position outside the urban area.

The Conceptual Design for the Stalac-Djunis section for speed up to 160 km/h is finished and the Tender for execution of works is currently in preparation. The radii of curve at the exit of Djunis station is increased compared to the first solution presented in the Preliminary Design. Beyond this point, the existing corridor is retained, but radii of curves are increased to achieve 200 km/h all the way to Trupale station.

The Korman and Adrovac stations will stay at the existing locations, while the Aleksinac station will be moved to a new location outside the urban area with possibility to connect with the existing industrial tracks in the city. Finally, from the Trupale to Medjurovo station, the design speed is up to 100 km/h because this section is part of the Nis railway node and passes through Popovac marshalling yard.

The PFS **alternative 2** considered the possibility of achieving speed up to 200 km/h on the entire line from Belgrade to Nis (except for lines in junctions), with the exception of parts of the line where it was estimated that increase of the design speed would lead to a significant increase in investment, mainly due to the local restrictions (railway stations located in urban areas), and the most stations remain at their existing locations. Thus, Alternative 2 runs through the existing corridor but with the increased radii of curve to achieve speeds of 200 km/h or 160 km/h depending on the terrain and estimated cost increase. The total length of Alternative 2 is 228.16 km. The speed of 200 km/h is achieved on 56% (127 km) of the total length of the line.

The proposed Alternative II is different from the Alternative I in the following areas:

- Just after the Resnik station the alignment of the double-track railway line abandons the existing alignment because the characteristics of the existing curves that do not allow the speed more than 70-80 km/h and runs along a new corridor close to the existing one but with curve radii that enable speed of 200 km/h.
- The Smederevska Palanka station is retained at its existing location and design speed is up to 120 km/h in the city area.
- After the Markovac station, the aligment remains in the same corridor as the existing line, except where radii of curves are increased to allow for speed of 200 km/h. This solution is adopted all the way to the Jagodina station which remains in the same position as well as the Bagrdan station, and onwards to Gilje within the same corridor.
- At places with bigger curve radii the new alignment has been moved from the existing one, but from km 120 to km 124 new aligment is closer to the existing Belgrade-Nis motorway.
- The Cicevac station is kept at the existing location and design speed through the station is 160 km/h.

The PFS **alternative 3** was based on a premise of minimum investments with maximum effects, i.e., with a major part of the railway line being designed for speeds of 200 km/h, incurring the least possible construction costs, while all stations remain at their existing locations with the design speed of up to 120 km/h in the station area. The total length of Alternative 3 is 228.84 km. The speed of 200 km/h is achieved on 37% (85 km) of the total length of the line.

The proposed Alternative 3 is different from the Alternative 1 in the following areas:

- Just after the Resnik station the alignment of the double-track railway line abandons the existing alignment because the characteristics of the existing curves that do not allow for speeds of more than 70-80 km/h and runs along a new corridor close to the existing one but with curve radii that enable speed of 200 km/h.
- The Smederevska Palanka station is retained at their existing locations and design speed is up to 120 km/h in the city area.
- The Velika Plana station stays at the existing location because of impossibility to find the new location without crossing over the Belgrade-Nis highway and far from the city. Another issue is to connect the existing railway line from Mala Krsna (single track line from Belgrade and Pozarevac).
- After the Markovac station, the line remains in the same corridor as the existing line, except where radii of curves are increased to allow for speeds of 200 km/h. This solution is adopted all the way to the Jagodina and Bagrdan stations which both remain on the same position, and onwards to Gilje within the same corridor.
- At places with bigger curve radii the new alignment has been moved from the existing one as in the Alternative II.
- The Cicevac station is kept at the existing location and design speed through station is 160 km/h.

The main objective of the Project is to modernise the existing railway line in compliance with TEN-T standards, making it a reliable and competitive mode of transport and increasing passenger and freight traffic demand. Furthermore, the objective is to be achieved in a cost effective and sustainable way in compliance with strategic plans at national, regional, and local level. Given the category of the line, it should comply with internationally agreed Technical Specifications for Interoperability and with the technical requirements for the core TEN-T.

The goal of the option analysis was to present any significant differential impacts between the proposed alternatives, and in accordance with that, the evaluation criteria are defined. The criteria in which no significant

difference between options was observed or assumed were not included in further analyses. List of all adopted criteria with their significance on the evaluation of alternatives (weight) is shown in Table 4.

Table 4: Main criteria with weighting coefficients

Main criteria	Initial weight for main criteria [%]
Financial	22
Demand	20
Operation	13
Social & Environmental	22
Safety	12
Risks	11

Based on the assessed weights for the main criteria group, the weighting coefficients for each sub-criterion has been calculated and the final set of criteria was chosen and presented in Table 5.

Table 5: Final set of selected criteria

Main criteria	Label	Sub-criteria	Type	Relative sub-criterion weight
Financial	C1	Estimated total costs (investments, O&M)	cost	15.00%
Demand	C2	Estimated travel time of inter-city trains, in minutes	cost	15.00%
Operation	C3	Operational efficiency	cost	10.00%
Social & Environment	C4	Population to be resettled	cost	10.00%
	C5	CO_2 emission, in tonnes	cost	10.00%
	C6	Estimated noise and vibrations' impact to the population	benefit	10.00%
Safety	C7	Expected number of accidents at level crossings	cost	10.00%
	C8	Reduction of road accidents due to modal shift to a safer mode	benefit	10.00%
Risks	C9	Duration of construction period, in days	cost	10.00%

To compare the operational requirements, the “Operational efficiency” sub-criterion was introduced, which is based on the uniformity of the maximum speeds, designed for each of the alternatives. To properly evaluate the values, according to this sub-criterion, the sum of additional acceleration and deceleration times for the inter-city (high-speed) and regional trains has been determined; local trains have a maximum speed lower than designed, so they are not considered.

Numerical values for all alternatives by each sub-criterion are shown in Table 6.

Table 6: Numerical values for all alternatives by each sub-criterion

	C1	C2	C3	C4	C5	C6	C7	C8	C8
Alternative 1	2192.195	96.13	5.45	196	1.8	72298.11	0.160	6313.54	1705
Alternative 2	1959.940	99.94	7.54	178	1.9	72085.30	1.151	6127.13	1523
Alternative 3	1830.875	107.96	20.27	101	2.0	71709.11	1.727	5714.35	1400

A Multi Criteria Analysis (MCA) has been conducted to compare the alignment alternatives in terms of their technical, environmental, and social performance.

Alternative 1 is significantly more expensive than the remaining two and was not selected, as the benefits regarding other criteria were not sufficient to overweight the disadvantages of the “Financial” criterion.

Comparing the other two variants, it was concluded that Alternative 2 is more acceptable according to the following criteria:

- Cost-effectiveness
- Estimated travel time of inter-city trains
- Operational efficiency

- Reduction in total transport CO_2 emissions due to modal shift
- The expected number of accidents at level crossings
- Reduction of road accidents due to modal shift to a safer mode.

So, **Alternative 2 is chosen as the final framework for the railway line modernisation**.

4 Legal and Policy Context

4.1 National Strategies

The key national strategic and planning documents of relevance to the Project are briefly explained in Table 7 below.

Table 7: Relevant national strategic and planning documents

Strategy or plan	Summary of significance
Spatial Plan of the Republic of Serbia from 2021 to 2035 (Draft)	> The Spatial Plan is the basic planning document of spatial planning and development in the RoS. A Strategic Environmental Assessment has been developed for the Spatial Plan. > It includes planning solutions for the reconstruction, construction and modernisation of the existing railways of the Corridor X (E-70 and E-85) through Serbia in double-track electrified high-performance railways for speeds up to 200 km/h. > Spatial differentiation of the environment according to international standards was performed, taking into account the existing status of environmental quality. The main railway corridors are classified as areas of endangered environment. > For areas where the environment is endangered with negative impacts it is necessary to prevent further pollution and degradation of the environment, limit the site of activities that pollute and degrade the environment and take protection measures when locating new activities, especially those with extremely negative impacts on the environment. > The Strategic Environmental Assessment proposes the establishment of a monitoring system as one of the priority tasks so that all proposed environmental protection measures can be successfully implemented in practice.
National Sustainable Development Strategy[41]	> The main goal of the Strategy is to find a balance between three key factors of sustainable development: sustainable development of the economy, production and technology; sustainable development of society based on social balance and environmental protection with rational management of natural resources. > Public participation in decision-making consists of four components: participation in planning, decision-making, implementation and control (e.g., the Aarhus Convention). > Integration and harmonization of national environmental regulations with EU legislation and their full implementation is needed.
Strategy of Railway, Road, Inland Waterway, Air and Intermodal Transport Development in the Republic of Serbia, 2008-2015[42]	> The Strategy is the basic strategic document of the RoS for the development of all types of transports, including railway transport. > It is focused on areas where human health and safety or the environment are jeopardised by uncontrolled transport system growth. > The Strategy defines the transport system in the RoS as market oriented, compatible and integrated into the EU. > Rehabilitation, reconstruction and construction of Pan-European Corridor X as the backbone of the railway infrastructure system of the RoS is important. > The Strategy emphasizes the efficient use of comparative advantages of each mode of transport; upgrading of service quality of transport system; increase of traffic safety and security of transport system; and reducing the negative impacts of transport on the environment, in accordance with principles of sustainable development.

[41] O.G, No. 57/08
[42] O.G, No. 4/08

Strategy or plan	Summary of significance
General Master Plan for Transport in Serbia	> The General Master Plan is a comprehensive plan for future investments in transport infrastructure, providing an overall picture of transport infrastructure in RoS and rolling out infrastructure projects necessary for implementation in the period 2009-2027. > It provides a framework for future investment planning in the transport sector in Serbia and identifies funding requirements both by the national authorities and by the IFIs and bi-lateral donor community. > It provides an operational approach to solving transport problems and traffic forecasts. > It identifies capacity issues for each transport mode and laid out key reforms and investment priorities for the short-, medium- and long-term planning horizons.
Railway Master Plan for the period 2012-2021	> The Railway Master Plan includes a revised railway component of the General Master Plan for Transport in Serbia, including a detailed list of projects and action plans for the period 2012-2016, as well as for the period 2017-2021. > It includes improvements of the safety, security, and reliability of the railway system. > Modernisation of the Corridor X is needed to provide an appropriate level of services for railway passenger and freight traffic.
National public railway infrastructure program for the period 2017-2021[43]	> The Program determines the priorities of implementing railway infrastructure projects. > The development of railway infrastructure is based on the principles of ensuring the quality of life, preservation of the environment, well-being and mobility of individuals. > The performance parameters for the main railway line development must be in accordance with Commission Regulation (EU) 1299/2014 (Technical specifications for interoperability relating to the 'infrastructure' subsystem of the rail system in the EU). > An EIA is mandatory for each railway infrastructure project. The identified measures need to be implemented through project documentation and implementation of projects, as well as through improving the technical reliability of the railway infrastructure elements. > Safety improvements must be planned by implementing measures for closing, deleveling or equipping with automatic traffic safety devices as many level crossings as possible, if it is traffic-technically justified. > The railway infrastructure manager must develop strategic noise maps for major railroads with average annual traffic flow higher than 30,000 trains with the action plans for environment protection from noise.
Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Line Stalac-Djunis[44]	> The construction of the new two-track section Stalac-Djunis eliminates the bottleneck on the Belgrade-Nis railway line. > All level crossings must be de-levelled. > The proposed design of the section Stalac-Djunis was evaluated based on vulnerability of the region and quantification of significant impacts, and environment protection measures have been defined for: air, soil, groundwaters, surface waters, noise, waste and non-ionising radiation.
Regional Spatial Plan of the Area of Sumadija, Pomoravlje,	> The Regional Spatial Plan determines the long-term concept of development, organisation, arrangement, protection and use of the area in its territory.

[43] O.G, No. 53/17
[44] O.G, No. 52/17

Strategy or plan	Summary of significance
Raska and Rasina Administrative Districts[45]	> The most important traffic corridor of RoS - Pan-European Corridor X - passes through the Regional Spatial Plan area. The Corridor is of exceptional importance for intra-regional and trans-regional connections. > The main goal of railway development is to regulate unsafe level crossings. > Strategic noise mapping along traffic lines is one of priority planning solution for identification of the most vulnerable zones and corridors.

4.2 National E&S Requirements

With regard to **railway design and management**, the key relevant laws are the *Law on Planning and Construction*, the *Law on Railways*, the *Law on Safety in Railway Operations* and the *Law on Interoperability of the Railway System*. These laws require that:

- environmental impacts of establishment and operation of the railway system must be assessed and taken into account at the design stage of system. Any used materials must prevent the emission of fumes or gases which are harmful and dangerous for the environment, particularly in the event of fires.
- rolling stock and energy-supply systems must be designed and built in such a manner as to achieve electromagnetic compatibility with the installations and equipment and public and private networks with which they might interfere.
- the design and operation of the railway system must not lead to unauthorised noise levels in the areas close to the railway infrastructure or in the driver's cab of a traction unit.
- the operation of the railway system must not give rise to an inadmissible level of ground vibrations for the activities and areas close to the infrastructure that is maintained in compliance with the regulations.
- the functioning of the electrical or thermal energy-supply systems must not interfere with the environment beyond the specified limits.
- the operation of technical installations and procedures in places where maintenance is conducted must not exceed the permissible levels of nuisance with regard to the surrounding environment.
- technical specifications for interoperability shall apply to newly built, upgraded or renewed railway lines covered by the comprehensive TEN-T (Trans-European Transport Network) network for Southeast Europe.

Since Corridor X is a project of particular importance to RoS, **procedural matters** such as financing, preparation of documentation, obtaining permits and the expropriation process are regulated by the *Law on Special Procedures for the Implementation of Construction and Reconstruction Projects of Linear Infrastructure of Particular Importance for Serbia*. The aim is to ensure more efficient implementation of such projects.

The necessary **technical documentation** is defined in the national *Regulation on the Content, Manner and Procedure of Preparation and Control of Technical Documentation.* The following types of technical documentation must be prepared for projects such as railway projects:

- General Design,
- Conceptual Design,
- Preliminary Design,
- Main Design (so called Design for Construction Permit according to the national law), and
- As-built Design.

[45] O.G, No. 39/14

In addition, projects must meet the following basic requirements: (i) mechanical resistance and stability, (ii) fire safety, (iii) hygiene, health and environment, (iv) safety and accessibility during operation, (v) noise protection, (vi) energy saving and heat retention, (vii) sustainable use of natural resources.

With regard to **permitting requirements**, the *Law on Planning and Construction* defines that the Location Conditions must be obtained for the railway project. The Location Conditions is issued on the basis of a Conceptual or Preliminary Design. After obtaining the Location Conditions, a Design for Construction Permit is prepared. The design is based on the conditions from the Location Conditions, relevant regulations, measures for a facility prescribed in different studies developed at this stage (e.g. EIA) and rules of profession. The Design for Construction Permit is submitted together with an application for the Construction Permit. After construction is completed, a Use Permit is issued based on the Technical Acceptance of the project and its components.

The key laws related to the **national EIA procedure** are the *Law on Environmental Protection* and the *Law on EIA*. EIA is mandatory for projects with significant E&S impacts (construction of the railway subsection Stalac-Djunis). The EIA Study must be approved by the competent authority (this is equivalent to an environmental permit in Serbia). Measures from the EIA Study are mandatory for construction and operation phases. According to the *Law on Strategic Environmental Assessment (SEA),* SEA is required for planning and strategic documents.

Environmental protection is ensured through a set of laws which require that environmental protection is ensured through the implementation of the defined standards for quality of air, water, noise and soil, waste management and other environmental guidelines. The principles are set by the *Law on Environmental Protection* while specific laws address various components of the environment:

- **Air quality**: the *Law on Air Quality* and its by-laws require that measures must be taken to prevent or reduce air pollution emissions, and that air quality must be monitored and data collected in line with the relevant by-law
- **Protection against noise**: the *Law on Environmental Noise Protection* and its by-laws require that a system of protection against noise must be established and maintained; strategic noise maps and action plans must be developed; acoustic zones and noise measurement methods must be applied; limit values for outdoor and indoor noise must be respected; and environmental noise measurements must be done according to SRPS ISO 1996-1 and SRPS ISO 1996-2 standards.
- **Water and wastewater management**: the *Law on Water* and its by-laws require that water (i.e., all surface and groundwater) must be protected and managed adequately; and that limit values for certain groups or categories of pollutants in wastewater must be respected before it is discharged into the public sewer.
- **Waste management**: the *Law on Waste Management* and its by-laws require adequate management of all waste; classification of waste according to the waste catalogue (list of non-hazardous and hazardous waste classified by its origin and composition)
- **Nature protection**: the *Law on Nature Conservation* and its by-laws outline the objectives regarding protection, preservation and improvement of biological, geological and landscape diversity and sustainable use of resources.

In addition, a range of legislation covers other issues such as **labour** (the *Law on Labour*, the *Law on Prevention of Harassment at Work*), **health and safety** (the *Law on Safety in Railway Operations*, the *Law on OHS*, the *Decree on OHS at Temporary or Mobile Construction Sites*), protection of **cultural heritage** (the *Law on Cultural Heritage*) and **land acquisition** (the *Law on Expropriation*).

4.3 Lenders' Requirements

EBRD Requirements. EBRD Environmental and Social Policy 2019 (ESP) details the commitments of the Bank's Funding Agreement to promote in the full range of its activities, environmentally sound and sustainable

development. Bank-financed projects are expected to meet good international practice related to sustainable development. The Bank has defined specific Performance Requirements (PRs) for key areas of E&S issues and impacts as listed below:

- PR 1: Assessment and Management of E&S Risks and Impacts
- PR 2: Labour and Working Conditions
- PR 3: Resource Efficiency and Pollution Prevention and Control
- PR 4: Health, Safety and Security
- PR 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement
- PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PR 7: Indigenous Peoples (not applicable to this project)
- PR 8: Cultural Heritage
- PR 9: Financial Intermediaries (not applicable to this project)
- PR 10: Information Disclosure and Stakeholder Engagement

EIB Standards. EIB requires that all the projects it is financing are acceptable in E&S terms by applying appropriate safeguards to all its operations. The EIB Environmental and Social Standards (2022) provide an operational translation of those standards grouped across 11 thematic areas, as follows:

- Standard 1: Environmental and Social Impacts and Risks
- Standard 2: Stakeholder Engagement
- Standard 3: Resource Efficiency and Pollution Prevention
- Standard 4: Biodiversity and Ecosystems
- Standard 5: Climate Change
- Standard 6: Involuntary Resettlement
- Standard 7: Vulnerable Groups, Indigenous People and Gender (Indigenous People – not applicable to this project)
- Standard 8: Labour Rights
- Standard 9: Health, Safety and Security
- Standard 10: Cultural Heritage
- Standard 11: Intermediated Finance (not applicable to this project).

4.4 Applicable EU Requirements

An overview of EU requirements applicable to the Project is presented in Table 8.

Table 8: Relevant EU requirements

Directive	Key requirements
Directive 2012/34/EU on establishing a single European railway area	The aim of this Directive is to provide efficient and effective rail services within EU. Therefore, Member States shall ensure that their main infrastructure managers participate and cooperate in, among others: (i) developing Union rail infrastructure, (ii) supporting the timely and efficient implementation of the single European railway area, (iii) exchanging best practices and (iv) monitoring and benchmarking performance.
EIA Directive (Directive 2011/92/EU as amended by Directive	The EIA must identify the direct and indirect effects of a project on the following factors: the population and human health, the biodiversity, the soil, the water, the air, the climate, the landscape, the material assets and cultural heritage, and the interaction between these various elements. All projects listed in Annex I (including construction of lines for

Directive	Key requirements
2014/52/EU on the assessment of the effects of certain plans and programmes on the environment)	long distance railway traffic) of the Directive are considered as having significant effects on the environment and require an EIA, while for projects listed in Annex II, the national authorities have to decide whether an EIA is needed.
Directive 2005/50/EC on ambient air quality and cleaner air for Europe	This Directive defines and establishes objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment. Member States shall establish zones and agglomerations throughout their territory. Air quality assessment and air quality management shall be carried out in all zones and agglomerations. This Directive defines the upper and lower thresholds for the concentrations of certain polluting substances in the atmosphere.
Directive 2002/49/EC relating to the assessment and management of environmental noise	All Member States shall ensure that strategic noise maps for all agglomerations with more than 250,000 inhabitants and for all major railways which have more than 60,000 train passages per year have been made on an annual basis. Based on the same criteria, Member States shall develop action plans designed to manage noise issues and effects. Annex II of this Directive describes assessment methods for the noise indicators for railway noise.
Waste Framework Directive (Directive 2008/98/EC on waste)	This Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment. Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy: prevention, preparing for re-use, recycling, recovery, disposal. The Directive incorporates provisions on hazardous waste and waste oils.
Water Framework Directive (Directive 2000/60/EC establishing a Framework for Community Action in the Field of Water Policy)	This Directive establishes a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater, subject to the use for the abstraction of water intended for human consumption and those bodies of water intended for such future use.
Flood Directive (Directive 2007/60/EC on the Assessment and Management of Flood Risks)	The aim of this Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. It requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU.
Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action ('European Climate Law')	This Regulation establishes a governance mechanism to implement strategies and measures designed to meet the objectives and targets of the EU and the long-term Union GHG emission commitments consistent with the Paris Agreement[46], in particular the Union's climate-neutrality objective set out in Article 2(1)[47] of Regulation (EU) 2021/1119 of the European Parliament and of the Council. As a part of National Plans, the following GHG emissions and removal related indicators needs to be reported: (i) number of passenger-kilometres for railway traffic, (ii) freight transport tonnes-kilometres for railway traffic.

[46] The Paris Agreement is an international treaty on climate change, adopted in 2015. The Agreement's long-term temperature goal is to keep the rise in mean global temperature to well below 2 °C (3.6 °F) above pre-industrial levels, and preferably limit the increase to 1.5 °C (2.7 °F). One of the aims of the Agreement is making finance flows consistent with pathways towards low GHG emissions and climate-resilient development.

[47] Union-wide GHG emissions and removals regulated in Union law shall be balanced within the Union at the latest by 2050, thus reducing emissions to net zero by that date, and the Union shall aim to achieve negative emissions thereafter.

Directive	Key requirements
Birds Directive (Directive 2009/147/EC on the conservation of wild birds) and Habitat Directive (Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora)	The two principal EU Directives relating to nature conservation provide a legal framework for the protection of habitats and fauna and flora species. Both Directives promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The Habitats Directive led to the setting up of a network of Special Areas of Conservation to protect the 220 habitats and approximately 1,000 species listed in Annex I and II of the Directive which are considered to be of European interest following criteria given in the Directive. Together with Special Protection Areas which are designated under the Birds Directive, these form a network of protected sites across the European Union called Natura 2000.
Convention on the Conservation of European Wildlife and Natural Habitats (ETS No. 104)	The Convention on the Conservation of European Wildlife and Natural Habitats or Bern Convention is a binding international legal instrument in the field of nature conservation, covering most of the natural heritage of the European continent and extending to some States of Africa. It aims to conserve wild flora and fauna and their natural habitats. The Emerald network is an ecological network launched in 1998 by the Council of Europe as part of its work under the Bern Convention.
Directive 2016/798 on railway safety	This Directive lays down provisions to ensure the development and improvement of the safety of the Union rail system and improved access to the market for rail transport services. It defines common safety targets ('CSTs') and common safety methods ('CSMs'), and common principles for the management, regulation and supervision of railway safety. Safety supervision is centralised on EU level by making the EU Agency for Railways the single body for granting single safety certificates.
Directive 2016/797 on the interoperability of the rail system within the EU	This Directive defines the requirement for Technical Specifications for Interoperability (TSIs) in order to ensure interoperability between the different parts of the European Rail Network. Interoperability is about enabling trains, passengers and train crew from one EU country to operate safely and reliably in all other EU countries by ensuring compatibility of rail systems and minimum safety requirements. Even though Serbia is still not a member of the EU, national legislation stipulates that TSI will apply to newly built, upgraded or renewed railway lines covered by the comprehensive TEN-T (Trans-European Transport Network) network for Southeast Europe.
Regulation 2016/796 on the EU Agency for Railways and repealing Regulation No. 881/2004	This Regulation establishes the EU Agency for Railways. It supports the establishment of the single European railway area, and in particular the objectives relating to the two Directives mentioned above.
OHS Directives	EU has adopted several Directives to improve, and guarantee OHS, the most significant of which are: > Directive 89/391/EEC on the Introduction of Measures to Encourage Improvements in the Safety and Health of Workers at Work (which encourages improvements in relating to the safety and health of workers at work) > Directive 89/654/EEC concerning the Minimum Safety and Health Requirements for the Workplace (which defines the minimum requirements for safety and health at the workplace) > Directive 92/57/EEC on the Implementation of Minimum Safety and Health Requirements at Temporary or Mobile Construction Sites (which lays down minimum safety and health requirements for temporary or mobile construction sites at which building or civil engineering works are carried out and intends to prevent risks by establishing a chain of responsibility linking all the parties involved).

5 Methodology of E&S Assessment

5.1 Approach to Assessment

The baseline conditions of the Project area and the potential E&S impacts have been identified that might be associated with the Project have been analysed based on site visits undertaken conducted throughout March to June 2022 and available information at the time of drafting this Assessment Report.

E&S impacts were identified for the following Project stages:

- Pre-construction phase (mainly for some social impacts such as land acquisition)
- Construction phase
- Operation and maintenance phase

The construction phase includes the construction and reconstruction activities, and removal/replacement of the equipment. The operation phase will include daily railway operations. Due to the nature of the Project, the phase of closure and decommissioning is not expected, as the railway system is planned to be used for a long period of time. If decommissioning take place, impacts are expected to be similar to those during construction.

The classification of each impact has been assessed based on the **magnitude** of impact and the **sensitivity**/value of the affected receptor.

The assessment of impact magnitude is undertaken in two steps. First, the identified impacts of the Project are categorised as beneficial or adverse. Second, impacts are categorised as major, moderate, minor or negligible based on consideration of parameters such as:

- Scale of the impact – how intense or severe the extent of the impact is likely to be,
- Duration of the impact – ranging from “beyond decommissioning” to “temporary with no detectable impact”,
- Spatial extent of the impact – for instance, within the site boundary, within district, regionally, nationally, and internationally,
- Reversibility – ranging from “permanent thus requiring significant intervention to return to baseline” to “no change”,
- Likelihood – ranging from “occurring regularly under typical conditions” to “unlikely to occur”,
- Compliance with legal standards and established professional criteria – ranging from “substantially exceeds national standards or international guidance” to “meets the standards” i.e. impacts are predicted to be less than the standard would allow.

These characteristics generally describe the nature, physical extent and temporal condition of the impact. To facilitate a structured description of impact magnitude, a qualitative scale was applied, ranking the magnitude of change as negligible, minor, moderate or major developed for each of the magnitude characteristics.

Table 9 presents the generic criteria for determining impact magnitude (for adverse impacts). Each detailed assessment will define impact magnitude in relation to its environmental or social aspect.

Table 9: Criteria for determining impact magnitude

Category	Description (adverse impacts)
Major	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature and requiring significant intervention to return to baseline; would violate national standards or Good International Industry Practice (GIIP) without mitigation.

Category	Description (adverse impacts)
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but small change to the specific conditions assessed.
Negligible	No perceptible change to the specific conditions assessed.

Receptor sensitivity is the degree to which a particular receptor is more or less susceptible to a given impact. Receptor sensitivity takes into consideration receptor resilience and value. Receptor resilience describes the ability of the receptor to withstand adverse impacts. It takes into consideration not only activity-impact-receptor pathways, but also environmental characteristics of the receptor that might make it more or less resilient to change.

Sensitivity is specific to each aspect and the environmental resource or population affected, with criteria developed from baseline information. Generic criteria for determining sensitivity of receptors are outlined in Table 10. Each detailed assessment will define sensitivity in relation to its specific environmental or social aspect.

Table 10: Criteria for determining sensitivity of a receptor

Category	Description
High	Receptor (human, physical or biological) with little or no capacity to absorb proposed changes and/or minimal opportunities for mitigation.
Medium	Receptor with little capacity to absorb proposed changes and/or limited opportunities for mitigation.
Low	Receptor with some capacity to absorb proposed changes and/or reasonable opportunities for mitigation.
Negligible	Receptor with good capacity to absorb proposed changes and/or good opportunities for mitigation.

Likely impacts are evaluated considering the interaction between the magnitude and sensitivity criteria as presented in the impact evaluation matrix in Table 11.

Table 11: Impact evaluation matrix

		Magnitude						
		Adverse				Beneficial		
		Major	Moderate	Minor	Negligible	Minor	Moderate	Major
Sensitivity	High	Major	Major	Moderate	Negligible	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	Low	Moderate	Minor	Negligible	Negligible	Negligible	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

For evaluating **significance before mitigation**, it is important to consider the likelihood that a given risk event is expected to occur and the magnitude of the expected impacts. Impacts that have been evaluated as being "moderate" or "major" are significant effects. Consequently, impacts that are "minor" or "negligible" are not significant. Understanding the significance of risks is important for prioritising the need for mitigation measures.

Wherever the Project is likely to result in unacceptable E&S impacts, mitigation measures are proposed. Where mitigation measures are required, the impact will be rated again to show the residual impact after implementation of mitigation or management control.

5.2 Project Area of Influence

The Project **area of influence (AoI)** has been preliminary determined as part of this assignment as the surrounding buffer zone of the railway route in which most of the impacts are expected, including both

environmental and social impacts. The AoI has been set preliminary to include the buffer of 500 m from the rail centreline at each side of the railway route for most of the impacts. However, the following areas of influences were used for some E&S issues:

- Biodiversity: A buffer of 500 m on each side of the planned railway was taken as an initial surveying area as Project's AoI; however, the area shall be further refined based on findings and initial identification of ecologically appropriate areas of analysis (EAAAs). The EAAAs are determined based on ecology and biological needs of species and their respective habitats and are given for biodiversity features of conservation concern as a part of Critical Habitat Assessment (CHA). For protected areas, the zone of 5 km on each side of railway was taken into consideration as AoI.
- Groundwater: For assessing impacts on groundwater, the AoI is defined to be within 1 km of each side of the railway route.
- Landscape: For assessing impacts on landscape and visual values, the AoI is defined to be within 1 km of each side of the railway route.
- Cultural heritage: A distance of approx. 1000 m to the left and right from the axis of both the proposed new railway and existing railway route was considered.
- Social impacts: The social impact assessment considered not only the local communities through which or near which the railway will pass but also the communities where existing stations/halts will be closed, regardless of their distance to the planned route.

6 Stakeholder Engagement Activities

6.1 Previous Stakeholder Engagement Activities

Stakeholder engagement during the development of the Pre-feasibility Study for the Corridor. A series of stakeholder engagement activities were undertaken during the preparation of the Pre-feasibility Study for the Project with:

- National stakeholders (including Institute for Protection of Cultural Heritage of Republic of Serbia, Ministry of Finance, Ministry of Health)
- Local stakeholders (including municipalities, local community offices, the Environmental, Forests and Water Administration Directorate, Archaeological Institute of Serbia, Urban Planning Office, Institute for Nature Conservation, Faculty of Science and Mathematics in Kragujevac, WWF Adria, Hunting Chamber of Serbia).

Detailed information on these activities and the gathered information/concerns is provided in the Stakeholder Engagement Plan (SEP).

Stakeholder engagement during the development of this Corridor E&S Assessment. Additional consultations were organised during the development of this Assessment Report through March to June 2022, which included:

- Discussions with SRI rail staff and crossing keepers
- Consultations with municipal/city authorities and local communities, and site visits to selected points of the Corridor and discussions with local residents – both described in detail in Chapter 7.11.1 (Actions Undertaken to Inform the Social Analysis)

In addition, some initial stakeholder engagement activities with NGOs were undertaken during the development of this Assessment Report. The purpose was to reach out in the early stage of due diligence to potentially interested NGOs in all Project regions to better understand their views, interests and concerns. Nine NGOs were contacted, of which the following five responded to provide an opinion about the Project:

1. NGO WWF Adria
2. Association of Roma Women Nada, Aleksinac
3. National Council of the Roma Minority in Serbia
4. Beekeepers Association Cicevac

A summary of the discussions with NGOs are summarised in the table below.

	NGO	Summary of information
1	National Council of the Roma Minority in Serbia	The NGO operates at national level, with a focus on protection of Roma people. It is familiar with the Project (through the media). It believes the Project will be beneficial for the Roma population as the largest Roma population lives in Nis (ca. over 15,000) and it would facilitate their travel. In addition, the Project may offer employment opportunities for Roma on the reconstruction of the railway, as was the case with the Morravian Corridor (the Pojate-Krusevac highway). The NGO pointed out that it could serve as a communication facilitator between the Project and the Roma people living near the railway line. It has two representatives in municipal/city authorities of Nis.
2	NGO WWF ADRIA	The NGO operates at regional level, with a focus on protection of environment and nature. The NGO is familiar with the Project (through media) and participated in previous informal consultations.

	NGO	Summary of information
		The NGO expects that the Project will contribute to connecting communities and reduce pressure on road transport. No particular benefits are identified for nature protection. In terms of negative impacts, the planned fencing along the railway line could have negative impacts on certain mammals and amphibians. It was suggested by the NGO to inspect the route and identify endangered species. The NGO also recommended wider consultations with other associations.
3	Association of Roma Women Nada, Aleksinac	The NGO operates at local level (municipality of Aleksinac which counts 71 villages), with a focus on protection of Roma women and children, their education, economic empowerment, etc. The NGO is not familiar with the Project but believes it will contribute to the safety of local people, especially Roma children who often walk uncontrolled along the railway line. Specific information provided by the NGO includes: > There are only two buses that run at certain times in Zitkovac (Aleksinac), which results in children arriving late at school "Vuk Karadzic" or being forced to leave earlier than planned. Children from Nozdrine and Luzane settlements occasionally use the railway to get to school. > The railway line should be provided with a fence because the children of the primary school "Vuk Karadzic Zitkovac" tend to walk on railway tracks on their way home. Out of 141 children, 80 are from Roma population (50% are Roma girls). > In the vicinity of the railway (Prcilovic settlement- in Aleksinac) there are two informal Roma settlements (Solunska 1 and Solunska 2).
5.	Beekeepers Association Stalac	The NGO is a local association gathering beekeeping enthusiasts. Beekeeping is a commercial activity particularly developed in the region of the Stalac-Djunis section. The Stalac area is particularly known for its beekeeping activities. Around 5000-6000 beehives are located at the Stalac Gorge area as it is abundant in acacia trees and is therefore favourable for beekeeping (producing acacia honey). Along the planned railway line, there is only some sporadic beekeeping.

Specific stakeholder engagement activities for the Stalac-Djunis Section. As the Stalac-Djunis subsection is in a more advanced stage of development, more specific stakeholder engagement activities were undertaken within the national environmental permitting and spatial planning procedures as well as during the development of the Resettlement Action Plan (RAP), as follows:

- Consultations during **national EIA procedure** (disclosure of request for EIA scoping in 2015; disclosure and public hearing for draft EIA study in 2016
- Consultations during the **adoption of the Spatial Plan** for Stalac-Djunis and the SEA Report (public disclosure in 2016; public hearing in 2017)
- Consultations during the process of obtaining Location Conditions for the Stalac-Djunis subsection (official communication with a range of public bodies and public enterprises to obtain their opinions)
- Consultations during **RAP development** in 2021 (meetings with local authorities and local residents)
- Consultations during the **development of the Supplementary Study** in 2022 (consultations with municipal/city authorities and local communities).

Detailed information on these activities and their outcomes is provided in the Supplementary Study for this subsection.

6.2 Planned Stakeholder Engagement Activities During Further Project Stages

A Stakeholder Engagement Plan (SEP) has been developed for the Project, as required under PR 1 and PR 10. The SEP is part of the Project's Disclosure Package.

The SEP refers to the entire Corridor, while specific subsections will be addressed under its appendices. The SEP's Appendix 1 refers to the Stalac-Djunis subsection, and future subsections will be included separately as the Project design matures.

In accordance with EBRD's requirements for Category A projects, the Project's Disclosure Package will be disclosed for a period of 120 days to allow for review and comments by stakeholders. During the disclosure period, consultations will be undertaken as outlined in the SEP. Following completion of the disclosure period, feedback gained will inform the continued development of the Project. As necessary, the Disclosure Package will be updated to capture the feedback gained.

7 Baseline Conditions

7.1 Biodiversity

7.1.1 Introduction

Note: Since a conceptual design including technical specifications and future railway alignment for the subsections Resnik-Ostruznica and Crveni Krst (Red Cross)-Nis Center-Nis Marshalling yard have not yet been developed, a detailed biodiversity assessment was not possible, but a preliminary description of the location and characteristics of these subsections is given in section 3.10 of this Assessment Report.

Targeted biodiversity surveys of the Project AoI have been performed in the period from late March to mid-June 2022. Surveys included review of all available literature data on habitats and species of the area, as well as field surveys. Groups that were included in the surveys are: habitats, flora, invertebrates, fish, amphibians, reptiles, birds and mammals.

Along with the data given in literature (e.g. published papers, scientific literature etc.), existing Project documentation was reviewed too in order to check for already collected data. The PFS provides information on protected areas in the wider zone (5 km from both sides of the corridor) but does not provide any information on other biodiversity features in the chapter on environmental baseline. The Scoping Report written as a part of preparation for PFS, gives data on flora and fauna of the whole Republic of Serbia and also includes the list of protected areas in the wider Project area. Literature review of present habitats has shown potential presence of 13 habitat types, six natural and seven anthropogenic. Scoping report also lists potentially present plant species, as well as fauna, and notes that fauna of the region around the area of the railway is not well known which was confirmed during 2022 survey as well. Biodiversity baseline presented in the documents is based on literature review only.

Main findings of 2022 biodiversity surveys are presented below. More details can be found in Appendix 4 – Biodiversity Survey Report.

7.1.2 Habitats

Methodology. Given the large scale of the project, the preparational phase of the research study was dedicated to finding and selecting appropriate areas that will provide a good insight into the status of habitats and vegetation along the entire Corridor. The available scientific articles mostly do not address the narrow strip of land around the railway. The information gathered through literature survey was insufficient and was used only to determine the scope of field investigations. Based on the existing data about flora and habitats in relative proximity (2-5 km away from the planned railway), as well as the heterogeneity of the assumed habitat types and vegetation cover, preliminary polygons were sketched using Google Earth Pro Satellite Imagery. The definite length of the selected polygons was decided after visual inspection and preliminary sampling. A total of nine representative polygons were created and numbered in ascending order (from Belgrade to Nis) (Figure 14). The first three polygons (1, 2 and 3) are located in the hilly area of suburban and urban municipalities of Belgrade, where the landform was defined primarily by fluvio-denudational processes. Polygons 4, 5 and 6 belong to the Upper Great Moravian Valley (reaching Bagrdan Gorge), while Polygons 7, 8 and 9 belong to the Juzna Morava Valley, Nis-Aleksinac Depression.

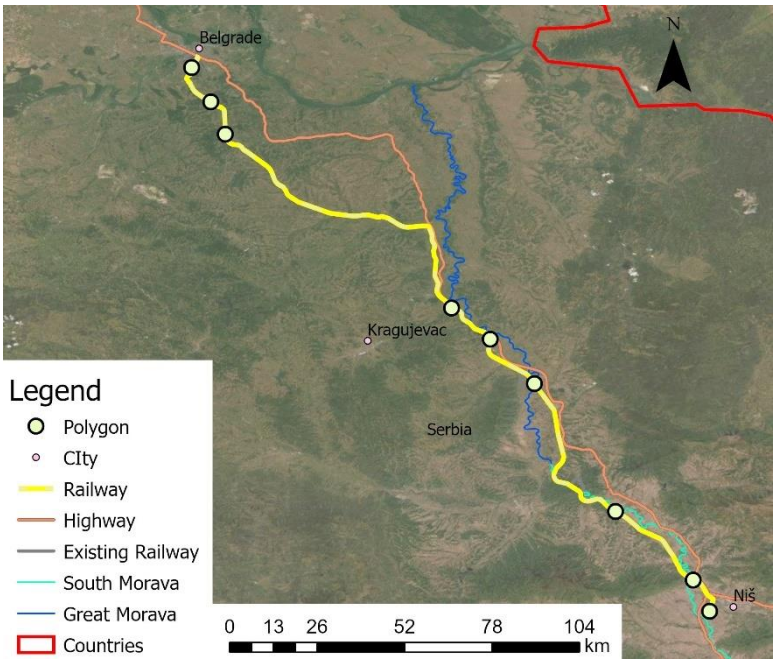


Figure 14: Locations of surveyed polygons in relation to the planned railway

The research plan contained preliminary sample and survey points selected based on the landscape compositional and configurational heterogeneity, the availability of relevant data, proximity to known sensitive habitat types and terrain accessibility. After the field visit, the points were adjusted or replaced, where necessary, especially in case of significant differences between the assumed and the actual state. Each point was designated as either a sample (inventory) or a survey point (visual inspection to determine habitat type), in cases of agricultural land, inaccessible areas, species-poor locations, monodominance and private properties. A total of 42 survey points along the project area were distributed inside the described polygons (Table 12). The classification of the registered habitat types follows the 2012 EUNIS classification (amended in 2019), while the digitalization was performed using ArcGIS Pro.

Table 12: Coordinates of habitat survey points

No.	Longitude	Latitude
1	43.30692	21.83387
2	43.30525	21.82832
3	43.31236	21.825
4	43.30678	21.82955
5	43.38156	21.80636
6	43.37982	21.80619
7	43.3825	21.8039
8	43.38483	21.80066
9	43.39168	21.78105
10	43.39139	21.78479
11	43.39044	21.7873
12	43.40632	21.76152
13	43.58771	21.55463
14	43.56186	21.59074
15	43.58538	21.5591
16	43.59228	21.55945

No.	Longitude	Latitude
17	43.88289	21.38093
18	43.93259	21.35011
19	43.93862	21.34583
20	43.9488	21.3268
21	43.99407	21.24057
22	44.07946	21.18592
23	44.01252	21.2383
24	44.01677	21.23997
25	44.0454	21.23555
26	44.07796	21.19153
27	44.08388	21.18748
28	44.10322	21.16494
29	44.1036	21.16562
30	44.12643	21.12979
31	44.05297	21.23083
32	44.09025	21.17504
33	44.66873	20.49681
34	44.60968	20.53272
35	44.60057	20.53013
36	44.58848	20.53495
37	44.57253	20.54061
38	44.6715	20.49757
39	44.67259	20.49563
40	44.68124	20.48251
41	44.6788	20.48369
42	44.75826	20.45093

Habitats classification. Considering the extent of the project area, the chosen polygons represent a realistic sample for assessing the habitats presence. As mentioned, the new railway route goes along two rivers, Juzna and Velika Morava. The area is abundant in small waterbodies that mostly originate from sand and gravel extraction, separations, watercourse management, but also due to natural meandering. Riverine vegetation and the abandoned meanders, that are relatively frequent in the agricultural zone, are surrounded by watercourse on one side and the beginning of hilly area on the other. The vegetation mostly consists delicate stripes of *Salix* and *Populus* woodland, interspersed with invasive species, such as *Amorpha fruticosa* (false indigo bush). Abandoned extraction sites near riverbanks are either vegetated with ruderal weeds or completely taken over by phreatophytes such as *Tamarix parviflora* (smallflower tamarisk). Because of the flooding nature of Juzna and Velika Morava River, as well as the dense network of underground waters in some parts of the project area, agriculture is well developed and diverse. Scattered between the large crops and fallow land, closer to the floodplain, there are recognizable elements of once large and species-rich wet meadows and grasslands. Degraded mixed deciduous forests are located on the more elevated sections of the project zone, and their composition differs greatly, in accordance with the geomorphological characteristics of the locality. When outside of protected areas, the forests are clearly degraded, species-poor and prone to invasions. Clearings are artificial, used for hay and regularly fertilized. The presence of *Robinia pseudoacacia* (black locust) and *Ailanthus altissima* (tree of heaven) is confirmed throughout the project area. Forest edges near roads, rich in black locust stands, are used for bee keeping activities. When preserved, the physiognomy of the forest is determined by *Quercus robur* (common oak) and *Quercus cerris* (Turkey oak). Reeds, such as *Typha* and *Phragmites* species

occur in different habitats and communities, throughout the agricultural land, as a remaining of the many abandoned meanders, surrounding eutrophic ponds, or as colonizing stands tolerant to nitrophilous conditions and drought, replacing natural grassland.

The project area is dominated by artificial and semi–artificial habitats with continuous fragmentation. Proximity of the highway, rich infrastructure, the existing railway as well as the inadequate management of waterbodies already disturbed biodiversity of the project area to a great extent. Beside the residential unit and domestic gardens, several polygons include industrial sites, both factories and quarries. A total of 36 EUNIS habitat types have been identified in all 6 polygons (Table 13).

Although mostly artificial, semi–natural and strongly influenced by various anthropogenic factors, the described habitats provide resources for different ecological groups. Habitat types belonging to section C (C1, C3.2) - small waterbodies and their surrounding vegetation - are neither species-rich nor natural, but they are probably essential for invertebrate communities, and birds due to the abundance of reeds. Habitat types from section G (G1.11, G1.76, G1.7C) - various broadleaved woodland and forests - have the highest value in terms of preservation, in the protected in urban areas of Belgrade (Nature monument Kosutnjak) as well as Rogot locality (Nature monument Rogot). The shrinking patches of E1 (wet and seasonally wet grasslands), located in Bubanj selo (Polygon 9) and Bukovce and Ribnik (Polygon 5) can be, based on their characteristics, valuable in terms of providing environmental services. This habitat type is continuously declining throughout Morava Valley for decades.

Table 13: EUNIS habitat classification for the project area (combined for all surveyed polygons)

EUNIS code	Description
C1	Surface standing waters
C3.2	Water-fringing reedbeds and tall helophytes other than canes
D5.13	*Typha* beds normally without free-standing water
E2.6	Agriculturally-improved, re-seeded and heavily fertilized grassland, including sports fields and grass lawns
E3	Wet and seasonally wet grassland
E5.1	Anthropogenic herb stands
E5.12	Weed communities of recently abandoned urban and suburban constructions
F9.35	Riparian stands of invasive shrubs
FA.4	Species-poor hedgerows of native species
FB.1	Shrub plantations for whole-plant harvesting
FB.31	Shrub and low-stem tree orchards
FB.41	Traditional vineyards
G1	Broadleaved deciduous woodland
G1.11	Riverine *Salix* woodland
G1.76	Balkano-Anatolian thermophilus *Quercus* forests
G1.7C	Mixed thermophilus woodland
G1.C11	Poplar plantations with megaphorb herb layer
G1.C3	*Robinia* plantations
G5	Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice
I1.1	Intensive unmixed crops
I1.5	Bare tilled, fallow or recently abandoned arable land
I1.53	Fallow un-inundated fields with annual and perennial weed communities
I1.55	Fallow inundated fields with annual and perennial weed communities

EUNIS code	Description
J1.1	Residential buildings of city and town centres
J1.2	Residential buildings of villages and urban peripheries
J1.4	Rural industrial and commercial sites still in active use
J1.6	Urban and suburban construction and demolition sites
J3.2	Active opencast mineral extraction sites, including quarries
J4	Transport networks and other constructed hard-surfaced areas
J4.2	Road networks
J4.3	Rail networks
J6.2	Household waste and landfill sites
X07	Intensively-farmed crops interspersed with strips of natural and/or semi-natural vegetation
X11	Large parks
X13	Land sparsely wooded with broadleaved deciduous trees
X25	Domestic gardens of villages and urban peripheries

The EUNIS habitat types were compared to the habitat types listed in Annex I of the Habitats Directive (HD) using the revised *Annex I of Resolution 4 (1996) of the Bern Convention on endangered natural habitats types using the EUNIS habitat classification* (year of revision 2014) and the website of European Environment Agency (EEA). The Resolution 6 and cross-referencing of EUNIS and HD habitat types are available online[48]. Within the inspected polygons, no sensitive or Annex I habitats from HD or priority habitats from the HD were identified. Four habitat types are referenced in the Bern Convention and used for the designation of Emerald sites (Table 14). Since the potential Emerald network of Serbia does not encompass any part of the project area, it can be concluded that the identified habitats, although suitable in composition, lack quantitative and qualitative attributed for the proposed network, which reflects the observed level of degradation.

Table 14: Habitat types of conservation concern

EUNIS Code	Description
C3.2	Resolution 4 habitat type (used for designation of Emerald sites)
G1.11	Resolution 4 habitat type (used for designation of Emerald sites)
G1.76	Included in a Resolution 4 habitat type at a higher level (G1.7)
G1.7C	Included in a Resolution 4 habitat type at a higher level (G1.7)

Habitat area under impact. In order to gain better understanding of affected habitat types, the scale of (unavoidable) impacts, and propose adequate mitigation measures, calculation of areas under direct and indirect impacts was performed. The area under direct impact is defined as an area under the railway footprint, while the area under indirect impacts is the area of influence (buffer zone of 500 m on both sides of the railway). The surface areas of affected habitat types are given in Table 15. The calculation of losses in the project footprint zone, as well as the potential habitat loss outside of it cannot encompass the complexity of the project when performed in the given spatiotemporal frame, and it should be considered as indicative for future studies. Factors that should be taken into consideration are lack of information about the framework of the reconstruction works in the existing sections of the railway, technical data, railway objects, as well as the quality of the habitat in question and its response to previous disturbance (e.g. due to highway vicinity).

Table 15: Areas under direct and potential impact of the Project (in ha)

EUNIS code	Direct (railway footprint)	Indirect (area of influence)	Total
C1	0.00	10.55	**10.55**

[48] Available at: https://eunis.eea.europa.eu/references/2467/habitats. Accessed on July 1, 2022.

EUNIS code	Direct (railway footprint)	Indirect (area of influence)	Total
C3.2	0.35	13.29	**13.64**
D5.13	0.25	2.71	**2.96**
E2.6	1.60	161.29	**162.89**
E3	1.31	66.49	**67.80**
E5.1	1.38	12.16	**13.54**
E5.12	2.53	171.97	**174.50**
F9.35	5.19	54.63	**59.82**
FA.4	0.00	1.10	**1.10**
FB.1	0.49	19.17	**19.66**
FB.31	0.00	6.02	**6.02**
FB.41	0.00	3.35	**3.35**
G1.11	1.17	162.34	**163.51**
G1	9.58	1,014.56	**1,024.14**
G1.76	0.00	61.10	**61.10**
G1.7C	0.00	47.32	**47.32**
G1.C11	0.00	23.11	**23.11**
G1.C3	8.55	59.59	**68.14**
G5	2.07	58.88	**60.95**
I1.1	14.29	1,292.46	**1,306.75**
I1.5	0.38	22.07	**22.45**
I1.53	0.14	17.00	**17.14**
I1.55	6.18	28.78	**34.96**
J1.1	0.67	153.39	**154.06**
J1.2	2.56	499.28	**501.84**
J1.6	0.00	16.05	**16.05**
J1.4	0.00	31.29	**31.29**
J3.2	0.00	3.11	**3.11**
J4	8.36	20.84	**29.20**
J6.2	0.00	0.88	**0.88**
X07	34.09	1,858.81	**1,892.90**
X11	1.41	89.72	**91.13**
X13	0.00	9.73	**9.73**
X25	2.64	142.48	**145.12**
Total	**105.19**	**6,135.52**	**6,240.71**

Habitat types per subsection. Habitat types registered in surveyed polygons are presented per subsections below.

Polygon 1 - Subsection 1: Belgrade-Resnik. The first surveyed polygon (Polygon 1) is located in Stari Kosutnjak and Topcider area near Belgrade. The area is a hilly thermophilous wooded area characterized by dominant tree species like oaks (Quercus cerris mainly), lindens (Tilia spp.) with understory vegetation consisting of butcher's-broom (Ruscus aculeatus), hedge woundwort (Stachys sylvatica), ramsons (Allium ursinum), wood sedge (Carex sylvatica) and creeping Jenny (Lysmachia nummularia). Invasive species like pokeweed (Phytolacca americana) and boxelder maple (Acer negundo) can also be observed commonly growing within the native vegetation (Figure 15). Around the Royal Complex and National Guard properties in Topcider, there is also an enhanced woodland of similar composition that is managed and reforested by the municipality; therefore, its

categorization is X11: Large parks. It is important to note that the railway will pass under Topcider park in the form of a tunnel. The dominant habitat type in the Polygon 1 is J1.1 - Urban and suburban construction and demolition sites (Figure 16).

Figure 15: Mixed thermophilous woodland G1.7C with Ruscus aculeatus, Polygon 1

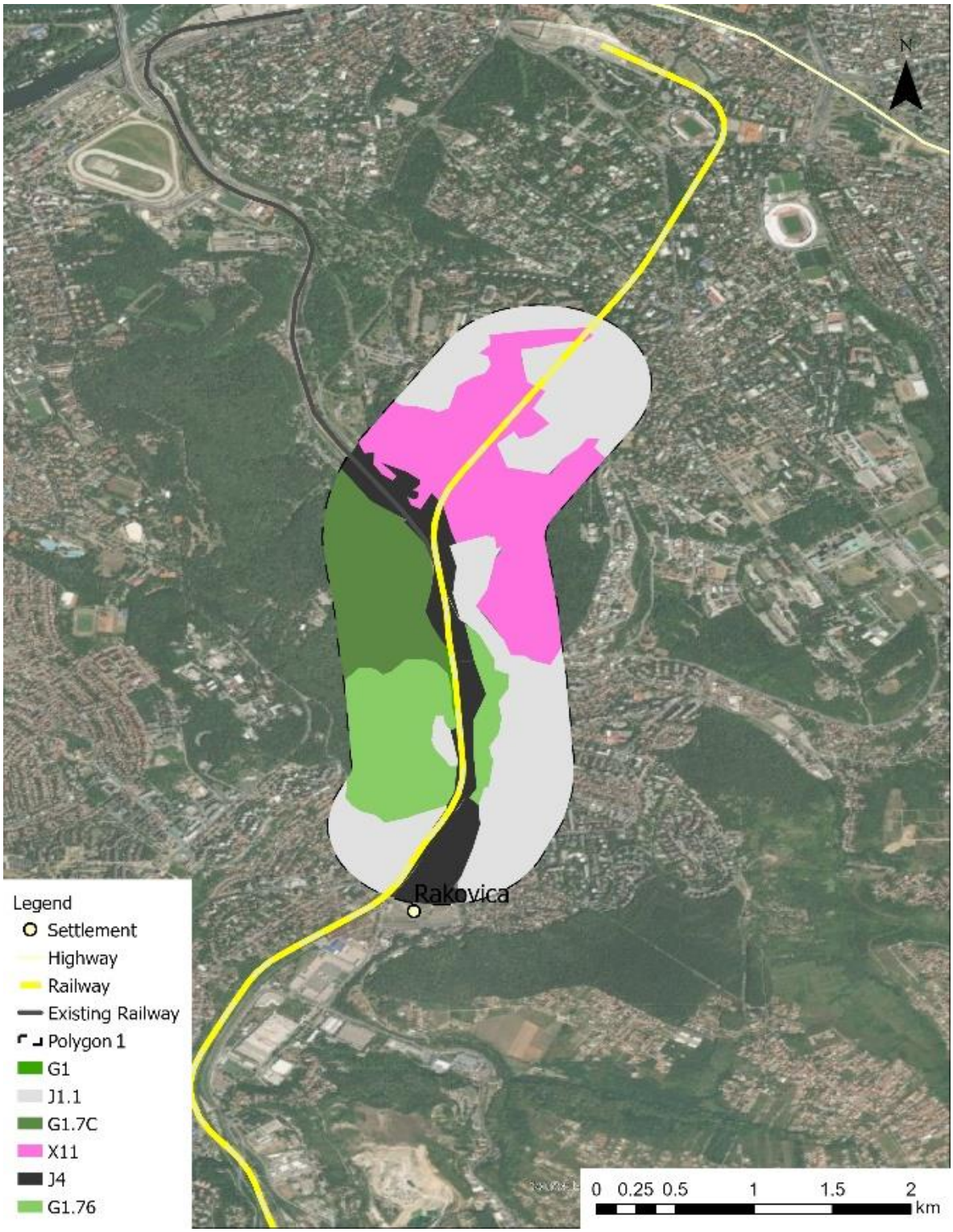


Figure 16: Habitat types registered in Polygon 1

Polygon 2- Subsection 2: Resnik-Velika Plana. Polygon 2 lays in the southern periphery of Belgrade city, located between villages Ripanj and Parcani. The area belongs to the Avala foothills, which is reflected in the composition of deciduous woodland, and its undershrub left of the railway route. The vegetation cover is highly mosaic because of the many different influences, such as Topciderska River which dries out during the summer, intensive crop farming, artificial pastures surrounded by overgrowth and anthropogenic impact of the metropole (Figure 17). The tallest tree story/canopy consists mainly of oaks (mainly *Quercus cerris*) and lindens (mainly *Tilia*

tomentosa), with the lower canopies consisting of trees such as European spindle (*Euonymus europaeus*), tatar maple (*Acer tataricum*), common dogwood (*Cornus sanguinea*), common hawthron (*Crataegus monogyna*). The understory consists of common shade and moisture loving plants that are characteristic for broadleaf forests and forest edges like asarabacca (*Asarum europaeum*), sand leek (*Allium scorodoprasum*), somerset skullcap (*Scutellaria altissima*), toothed dock (*Rumex dentatus*), common comfrey (*Symphytum officinale*), dog's mercury (*Mercurialis perennis*), common honeysuckle (*Lonicera periclymenum*) and an unexpected tassel hyacinth (*Leopoldia comosa*). The drier and more rural part of Ripanj consists of species like blackthorn (*Prunus spinosa*), silver linden (*Tilia tomentosa*), field eryngo (*Eryngium campestre*), danewort (*Sambucus ebulus*). The dominant habitat type in the buffer zone of the railway in Polygon 2 is G1 - Broadleaved deciduous woodland. However, the position of this habitat type in relation to the planned railway is marginal.

Figure 17: Typha bed in Polygon 2 inundated shore of Topciderska river (left) and broadleaved deciduous woodland (right)

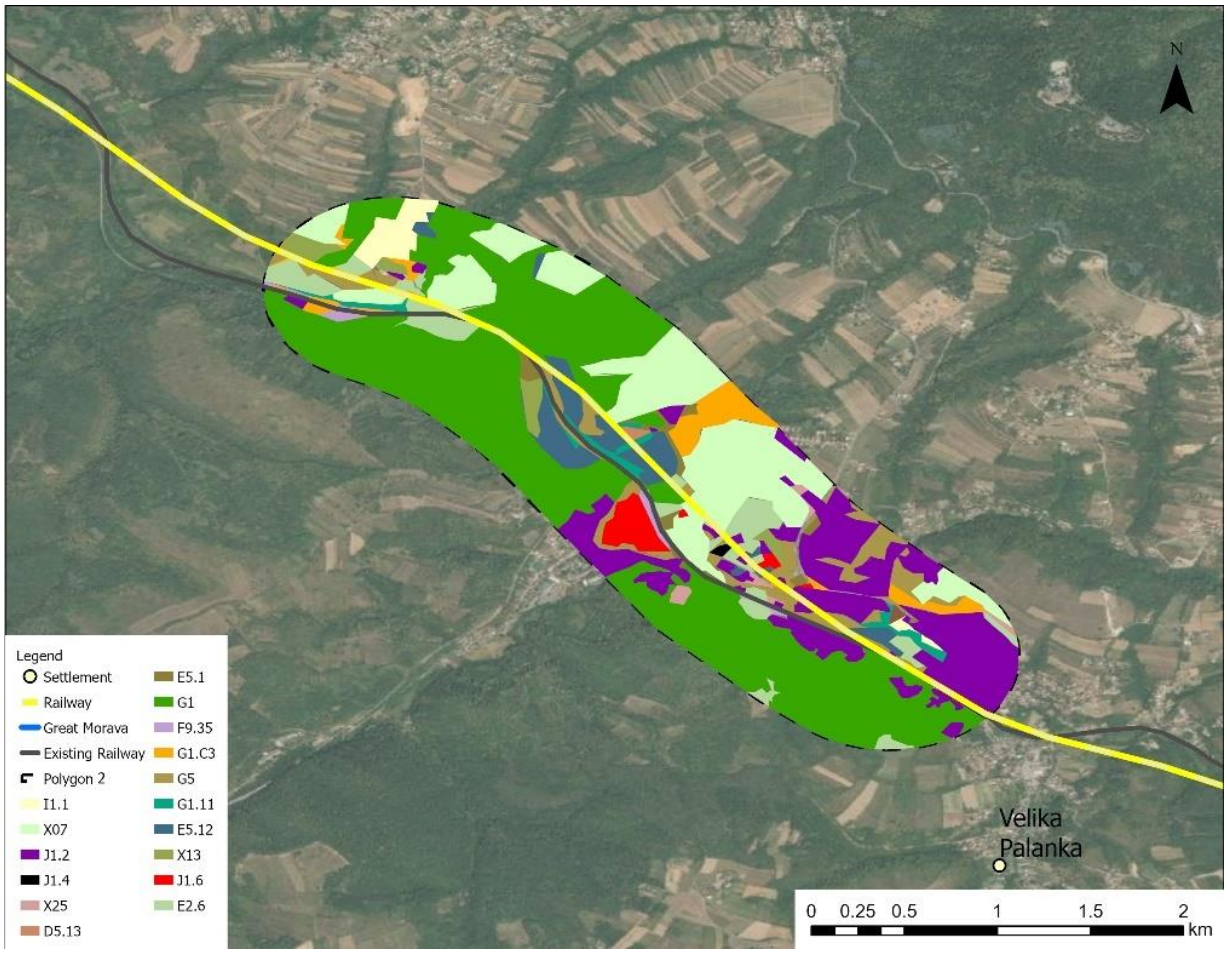


Figure 18: Habitat types registered in Polygon 2

Polygon 3 - Subsection 2: Resnik-Velika Plana. Polygon 3 is located near the Ralja village under the Kosmaj foothills. The surroundings are replanted with conifers at some localities, but the broadleaved deciduous woodland (G1.1) with thermophilus characteristics remained relatively well preserved in the polygon area (Figure 19). Most of it is private-owned. Besides a lavender production farm, which is situated on a forest clearing, and few improved grasslands, the canopy layer is very dense. According to the current preliminary plan, the new railway will change its route in this area compared to the existing railway. The dominant habitat type in the buffer zone of the railway in Polygon 3 is G1 - Broadleaved deciduous woodland (Figure 20).

Figure 19: Broadleaved decidious forests found within Polygon 3

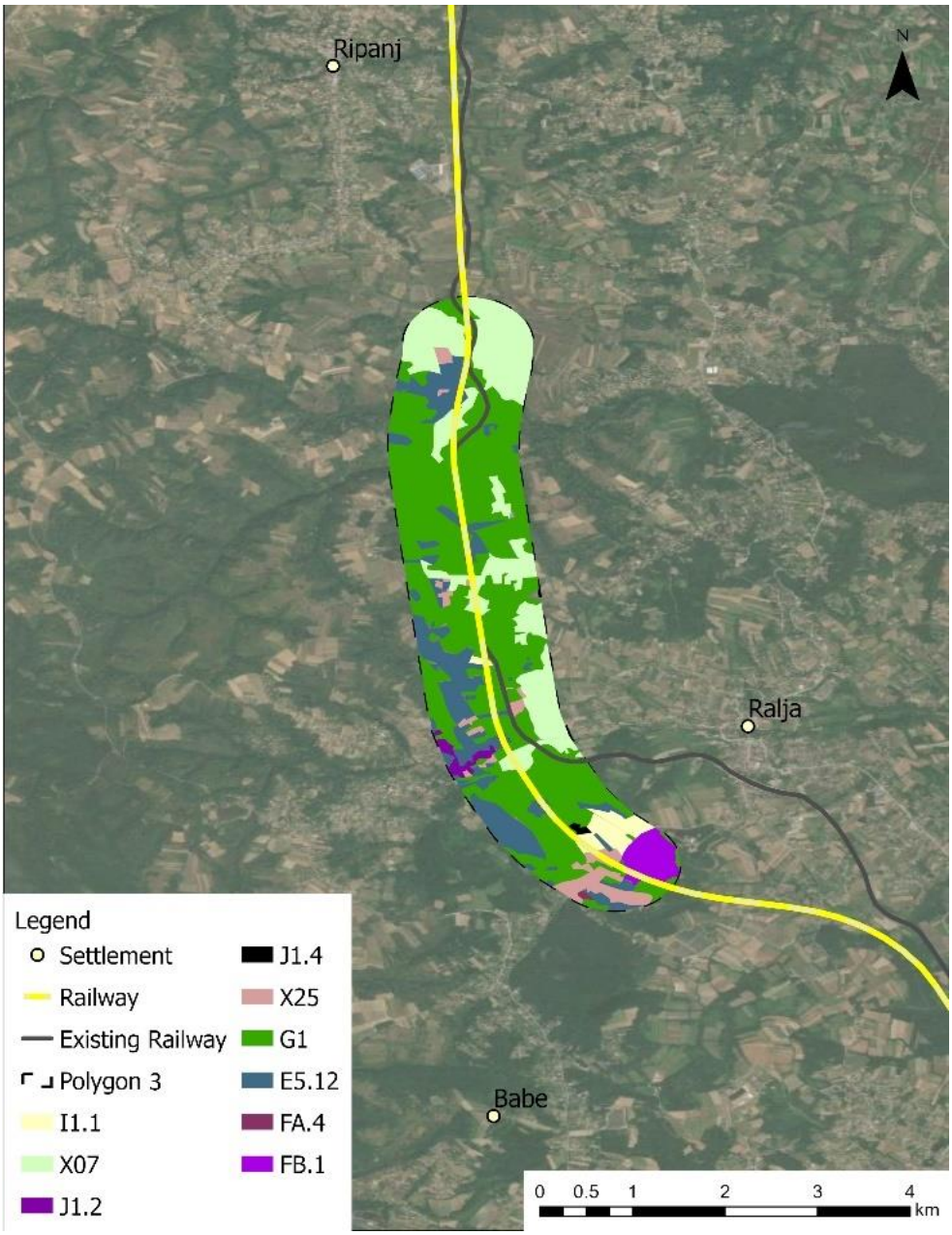


Figure 20: Habitat types registered in Polygon 3

Polygon 4 - Subsection 3: Velika Plana-Gilje. Starting with the Bagrdan ponds, Polygon 4 describes the hilly area of deciduous woodland (G1.11) with mixed canopy composition to the left and agricultural land interspersed with riparian vegetation on the right. This surveyed polygon is located on the Subsection 3: Velika Plana-Gilje. The grasslands of the area are E6.2, which indicates their artificial management. After reaching Milosevo village, the aligment continues parallel to the Brzansko Moraviste without interruption. The main motorway was built inbetween the village and Brzansko Moraviste. Towards the end of the polygon, the railway goes by the Nature monument Rogot, G1 habitat dominated by oaks, which has been selectively improved or replenished after the World War 2 in certain parts (Figure 21). The composition is mixed, with some species being invasive, and other introduced for restoring. Near the Juzna Morava River there was an active quarry site (J3.2) with free-flowing water and small patches of cattail (*Typha* sp.). The river line vegetation consists of willow (*Salix* spp.) and poplar (*Populus* spp.) trees mixed with invasive plant species like boxelder maple (*Acer negundo*), pokeweed (*Phytolacca americana*) and false indigo (*Amorpha fruticosa*). The dominant habitat type present in Polygon 4 is X07 - Intensively-farmed crops interspersed with strips of natural and/or semi-natural vegetation (Figure 22).

Figure 21: Nature monument Rogot (habitat type G1)

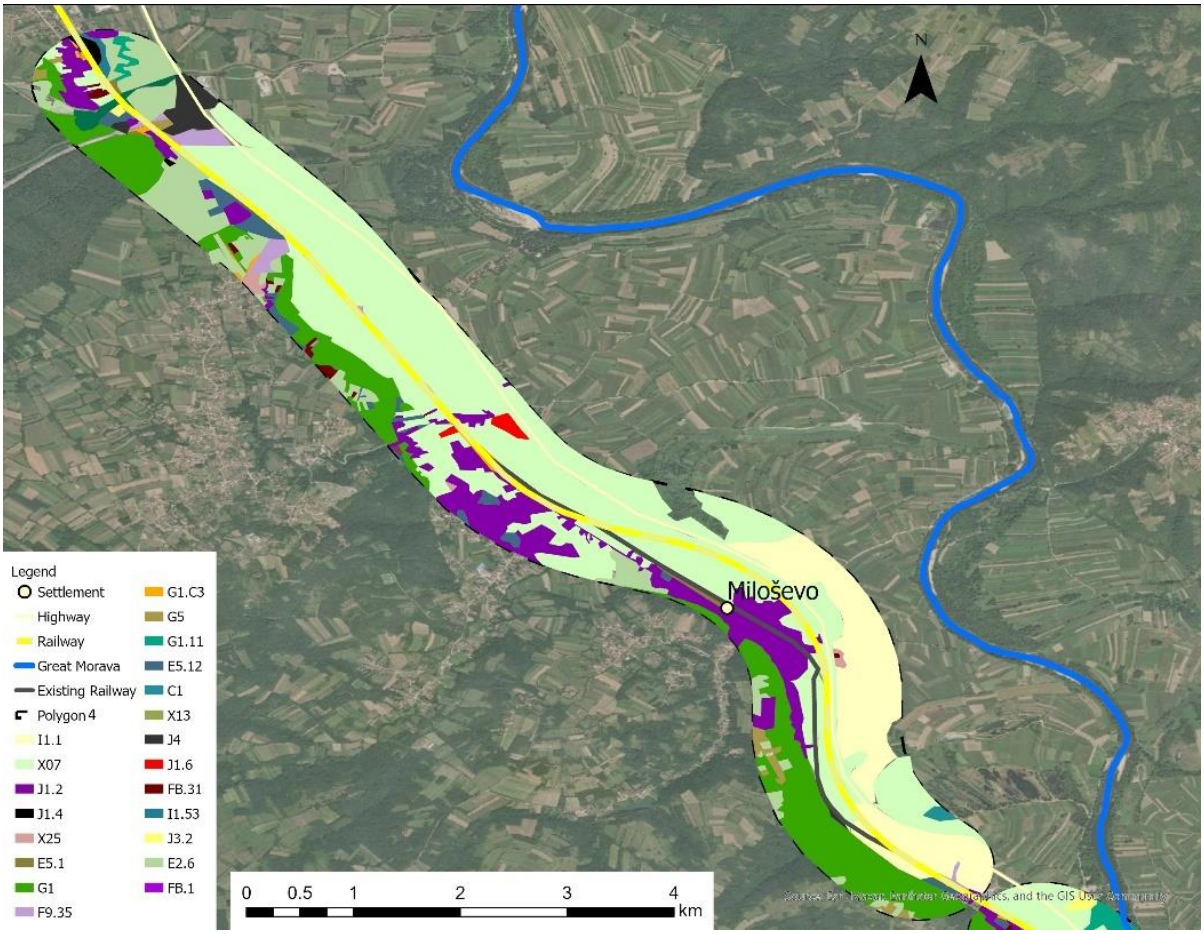


Figure 22: Habitat types registered in Polygon 4

Polygon 5 - Subsection 3: Velika Plana-Gilje. Polygon 5 extends from the periphery of the City of Jagodina, through Bukovce, Ribnik and Novo Laniste villages all the way to the Bagrdan Gorge. It is situated on the footprint of Subsection 3: Velika Plana-Gilje. In this area, the railway will be significantly moved from the original position next to the Ribnik village. The habitat types are classified as E3 - Wet or seasonally wet grasslands, with richer species composition, a strong influence of underground watercourses and semi-natural character. Surrounded

by improved grasslands and lines of deciduous trees, the area is one of the few locations in the entire Juzna Morava Valley that retained some of its original properties. Further ahead, the agricultural land is interspersed with *Salix alba* and *Robinia pseudoacacia* stands around the drainage channels and Belica stream. On the upper left side of the polygon, the vegetation cover is represented with G1 - Broadleaved deciduous woodland, degraded by invasive species and uncontrolled clearings. The most dominant habitat type is, however, I1.1. - Intensive unmixed crops (Figure 23).

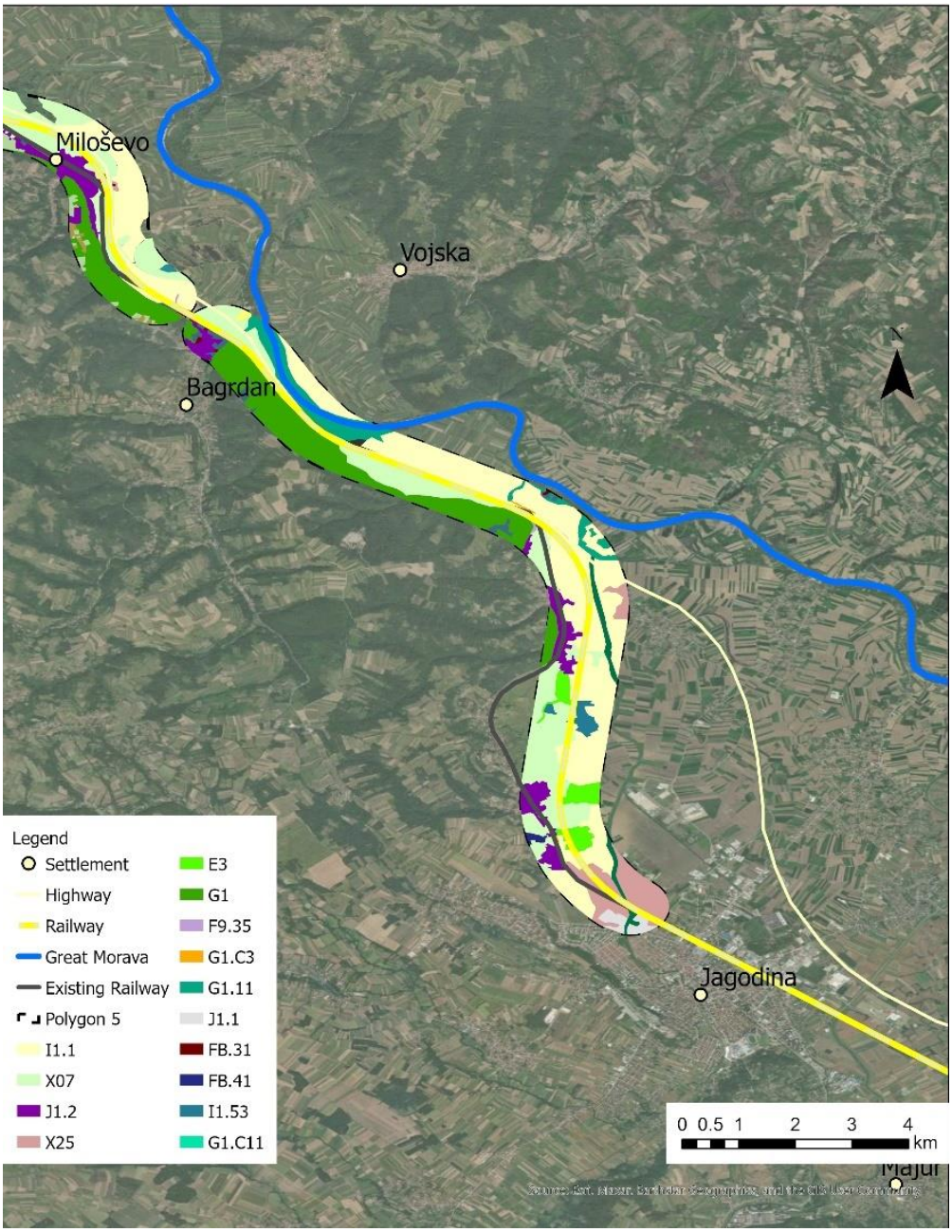


Figure 23: Habitat types registered in Polygon 5

Polygon 6 - Subsection 4: Gilje-Paracin. Polygon 6 is located near Cuprija (one of the few larger human settlements in Juzna Morava valley) and its wider periphery, on future Subsection 4: Gilje-Paracin. The area is mostly covered with intensive unmixed crops (I1.1) and the complex habitat type X07 (Intensively-farmed crops interspersed with strips of natural and/or semi-natural vegetation) (Figure 25). Near the river, there is a large patch of poplar plantantions (G1.C11) with numerous small waterbodies scattered (Figure 24). The area is densely vegetated with black locust (*Robinia pseudoacacia*), common dogwood (*Cornus sanguinea*), shepherd's

purse (*Capsella bursa-pastoris*), common hop (*Humulus lupulus*), mache (*Valerianella locusta*) and others, and is almost inaccessible by foot. Between the plantation patches, some of the natural *Salix* and *Populus* woodland is preserved. Former grasslands in the area are replaced by *Robinia pseudoacacia* stands or artificial grasslands. The Cuprija area has a large number of dumpsites and common urban vegetation composed of species such as white clover (*Trifolium repens*), and long-headed poppy (*Papaver dubium*).

Figure 24: Habitat type C1, eutrophic pond located in Polygon 6

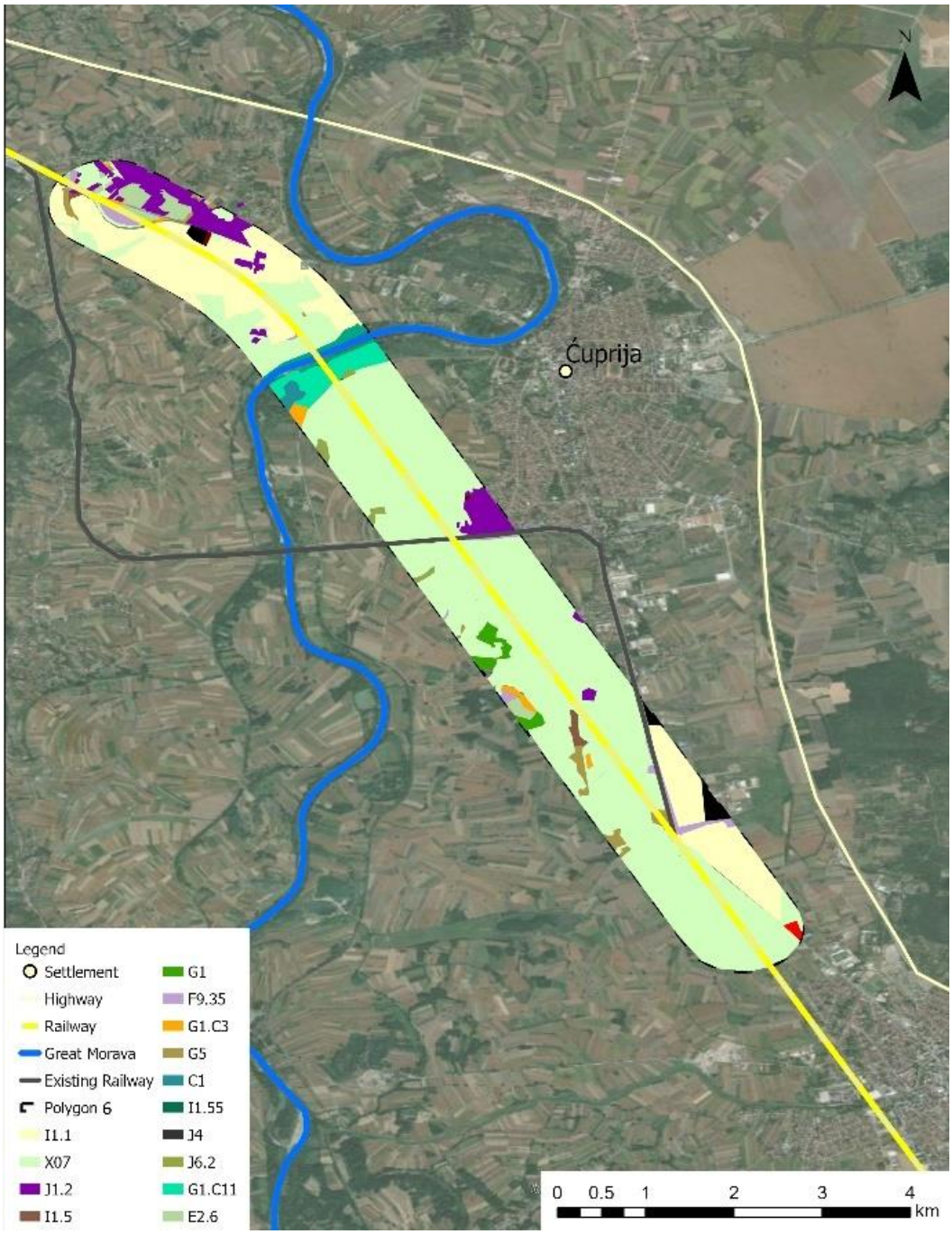


Figure 25: Habitat types registered in Polygon 6

Polygon 7 - Subsection 7: Djunis-Medjurovo. Within the defined Polygon 7, both the existing and the new railway divide the landscape into two very distinct units. On the left side, slightly above the agricultural land, there is a beginning of a hilly area with G1 - Broadleaved deciduous woodland, English oak (*Quercus robur*), European hornbeam (*Carpinus betulus*) and common hawthord (*Crataegus monogyna*) along with the undergrowth vegetation, near the Srezovac village. The right side is influenced by vicinity of the Morava river and its remaining meanders in Donji and Gornji Ljubec and Vitkovac (Figure 26). Near Donji Ljubes, the vegetation consisted of some natural tree stands, willows (*Salix* spp.*),* poplars (*Populus* spp.*),* with a large number of the invasive boxelder maple (*Acer negundo)* and shrubby vegetation consisting of common nettle (*Urtica dioica*), elderberry (*Sambucus nigra*), and danewort (*Sambucus ebulus*). The dominant habitat type in Polygon 7 are I1.1 and X07 with marginal presence of G1 (Figure 27).

Figure 26: EUNIS habitat G1 with thermophilous characteristics

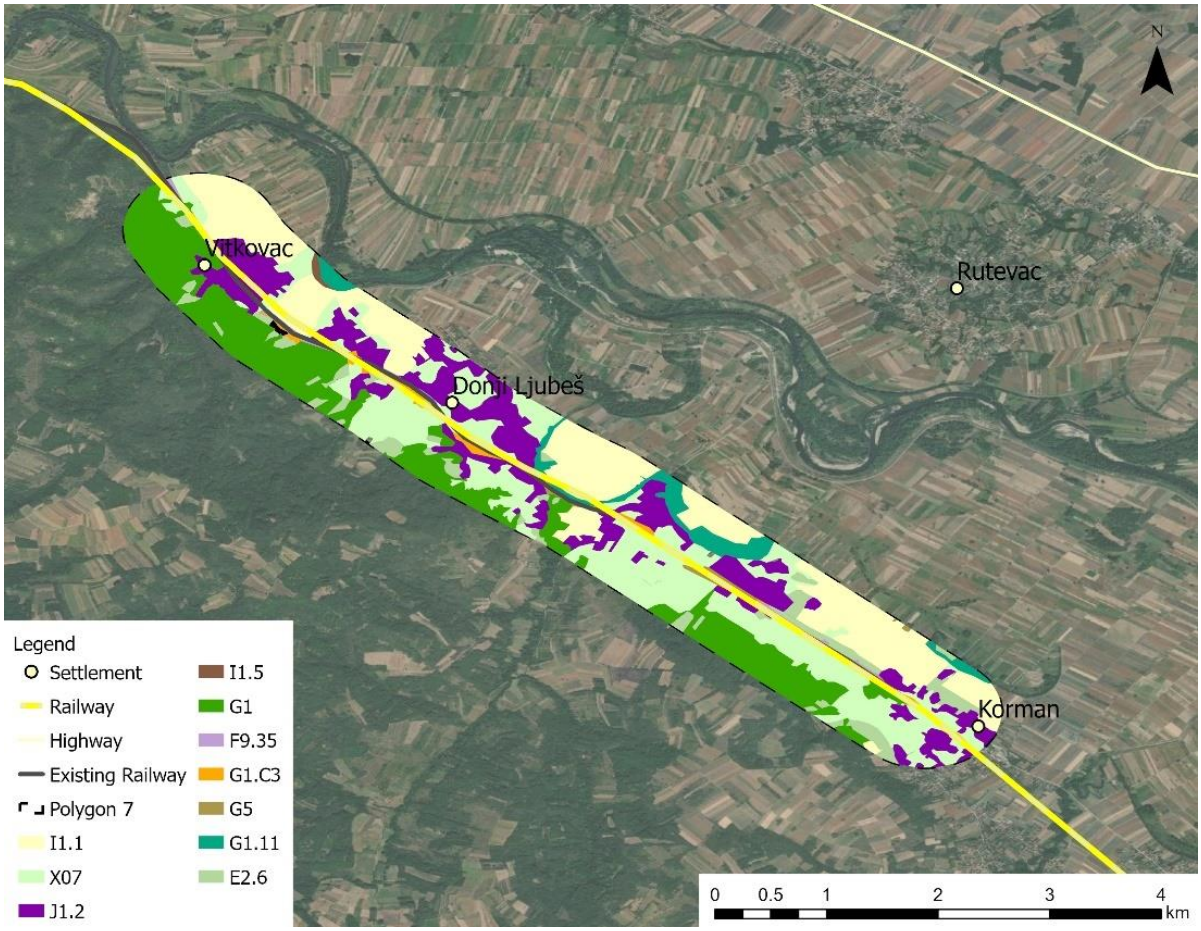


Figure 27: Habitat types registered in Polygon 7

Polygon 8 - Subsection 7: Djunis-Medjurovo. Polygon 8 encompasses several human settlements, and a bridge across Juzna Morava River around the Subsection 7: Djunis-Medjurovo of the planned railway. Most of the area is mosaic in appearance, with intensive crops and vegetation of dried-out meanders, surrounded by strips of *Salix alba*, *Populus alba*, and *Populus tremula* interspersed with *Prunus* species, *Amorpha fruticosa* and *Robinia pseudoacacia* and common herbaceous hydrophytes (Figure 28). Some of the abandoned meanders are accompanied by small waterbodies, with water-fringing reedbeds and tall helophytes other than canes (C3.2).

Identical habitats are found on the right riverbank, where the gravel extraction sites are found, nested inside a degraded riverine woodland of *Salix* and *Populus* species. In the upper left part of the polygon, the village Veliki Drenovac marks the beginning of thermophilus deciduous woodland, which is, at least in this section, heavily degraded and invaded by black locust. In the dryer part of the polygon species such as Hungarian vetch (*Vicia pannonica*), Balkan sage (*Salvia nemorosa*) and Common agrimony (*Agrimonia eupatoria*) can be observed. Near the water bodies there are mosaics mixed crops with some natural vegetation of oaks (*Quercus* spp.), Black locust (*Robinia pseudoacacia*) and False indigo (*Amorpha fruticosa*). The dominant habitat type is I1.1 developed under significant anthropogenic pressure (Figure 29).

Figure 28: Phragmites australis(left) and riverine woodland with large patches of the invasive Robinia pseudoacacia (right)

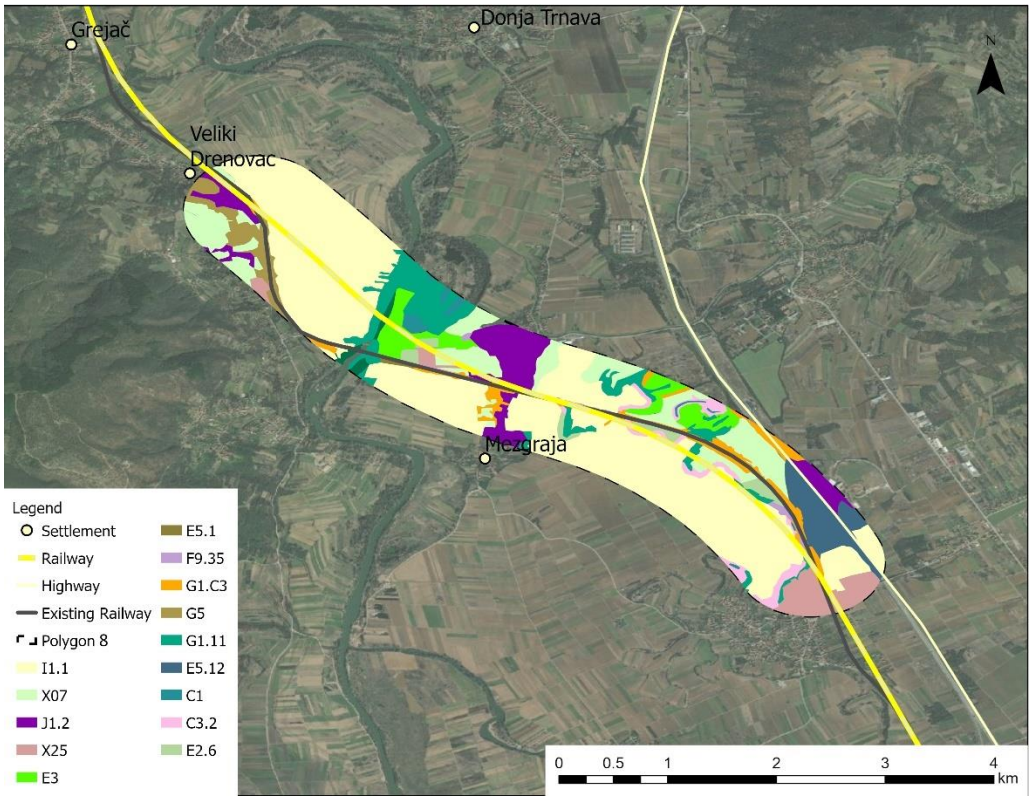


Figure 29: Habitat types registered in Polygon 8

Polygon 9 - Subsection 7: Djunis-Medjurovo. Polygon 9 is situated on the urban periphery of the Nis city and surrounded by rich infrastructure. It is situated on Subsection 7: Djunis-Medjurovo (Figure 30). The villages Donje Medjurovo, Bubanj and Cokot are found nearby. The wider area of these villages was subjected to severe disturbance as the watercourse of Juzna Morava was relocated during the construction of the highway (E75: A1). Within the polygon boundaries, intensive unmixed crops (I1.1) represent the most dominant habitat type (Figure 31). However, on a small, surveyed patch right of the existing railway, there are several fragments of the once large wet grassland (E3) dominated by *Carex vesicaria, Potentilla erecta,* and *Trypholium nigrescens.* It is assumed that the patch kept some of its previous properties due to the strong influence of groundwater courses and frequent flooding. Right next to the railway, there is a large *Typha* bed normally without free-standing water (D5.13) bordered by the nearby factory.

Figure 30: Habitat type D5.13 - Typha bed normally without free-standing water

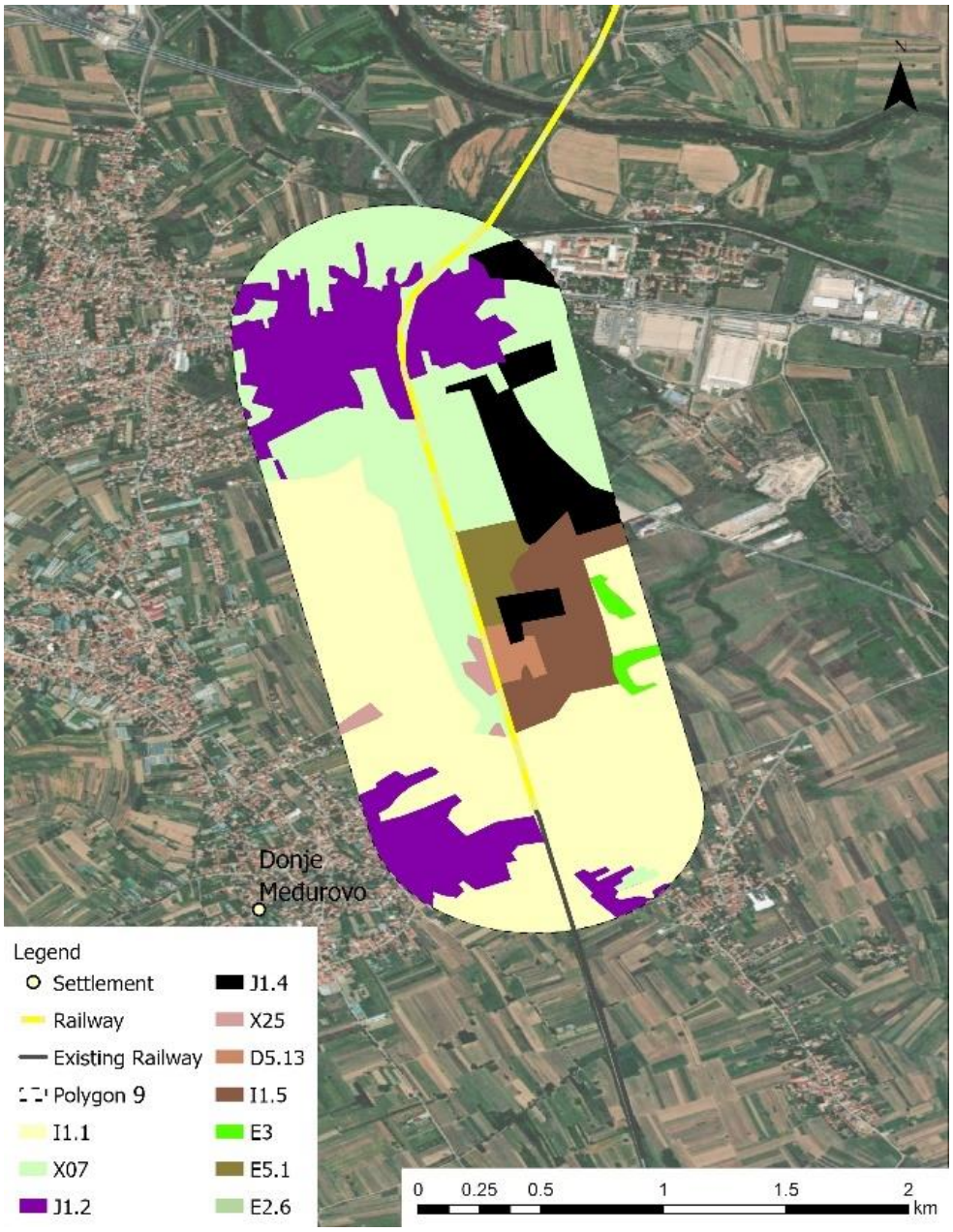


Figure 31: Habitat types registered in Polygon 9

7.1.3 Flora

Methodology. A total of 26 sample locations were visited during the flora surveys (Table 16). Flora was partially assessed in the previous chapter including the descriptions of present vegetation. The floristic inventory for the sample points was conducted either directly in the field or by collecting voucher specimen for laboratory identification.

Table 16: Coordinates of flora sample points

No.	Latitude	Longitude
1	43.3049	21.83031
2	43.30669	21.83531
3	43.38561	21.80151
4	43.39789	21.77348

No.	Latitude	Longitude
5	43.39508	21.77125
6	43.39432	21.77022
7	43.57023	21.58971
8	43.57063	21.57717
9	43.579	21.57653
10	43.89067	21.3749
11	43.93647	21.34603
12	43.93299	21.34555
13	43.93057	21.34479
14	43.93117	21.3437
15	44.02288	21.23884
16	44.02538	21.23916
17	44.05301	21.22778
18	44.07884	21.19037
19	44.09094	21.17664
20	44.09719	21.16171
21	44.11525	21.15526
22	44.12643	21.12979
23	44.15187	21.10647
24	44.66226	20.50445
25	44.67258	20.49147
26	44.67434	20.49319

Literature data was used only for reference in the research planning phase. Considering the narrow, but very elongated and highly disturbed buffer zone, the scarcity of data or specific publications covering the area was expected. All of the sources used for plant identification, fieldwork planning, as well as all recorded species are listed by polygons and sample points in the Habitat and Flora Survey Report given in Appendix 4 to the E&S Assessment Report.

Results. During the fieldwork research that lasted from April 30 to June 5, a total of 212 plant species was recorded by sampling. None of the encountered species are endemic nor listed in The Red Data Book of Flora of Serbia. No strictly protected species were observed in the surveyed and sampled area. Some of the recorded species are protected in terms of trading and commercial use by the *Regulation on the control of the use and trade of wild flora and fauna*[49]:

- Asarabacca (Asarum europaeum)
- Common comfrey (Symphytum officinale)
- Elderberry (Sambucus nigra)
- Lady's bedstraw (*Galium verum*)
- Herb robert (Geranium robertianum)
- Perforate St John's-wort (*Hypericum perforatum*)
- Yellow iris (Iris pseudacorus)
- Ramsons (Allium ursinum)

[49] "Official Gazette of RS", No. 31/05, 45/05, 22/07, 38/08 and 9/10

- Small-leaved linden (*Tilia cordata*)
- Silver linden (*Tilia tomentosa*)
- Common hawthorn (*Crataegus monogyna*)
- Wild strawberry (*Fragaria vesca*)
- Tormentil (Potentilla erecta)
- Common ivy (*Hedera helix*)

The complete list of all flora species found during the surveys on each sampling point are provided in Appendix 4 to the E&S Assessment Report.

7.1.4 Invertebrata

Methodology. From the aspect of fauna of terrestrial invertebrates, the project area is poorly researched except for the area around large cities. In the Biologer database[50], only 162 literature data and 317 data logs are available on the entire section of the railway from Nis to Belgrade (in a zone of 500 meters on both sides of the railway). This database includes almost all data published so far on butterflies from the territory of Serbia as well as a limited data on beetles, while literature data on dragonflies are not available.

Since it is not possible to georeference all literature findings with sufficient precision, literature data up to 10 km around the research area was specifically considered for the purpose of this project. The data provided in the UTM projection, on the MGRS grid of 10×10 km (which represents a frequent practice in the available literature) was included. The resulting list of species was then reviewed and analysed by experts, and those species that were found in the 10-kilometer zone and can possibly be found in the Project area of influence were highlighted. This approach provided a good literature review of previous research in the wider environment of the project area. The findings were, however, carefully interpreted because the locations of the recorded species are either (1) outside the project area or (2) imprecise - the exact locality where the species was recorded is not known.

The literature references included in the desktop study are provided in Invertebrate Survey Report given in Appendix 4 to the E&S Assessment Report.

Surveys of the invertebrate fauna included several insect groups, namely butterflies, beetles and dragonflies. Where necessary, insects were caught with an entomological net, photographed or collected in case identification could not be done in the field. The research period covered the time between April 16 and June 5, 2022. The selection of localities was done by reviewing satellite images in Google Earth software and choosing 42 locations along the entire section of the railway that were later visited (Table 17). The areas that represent more preserved fragments of natural and semi-natural habitats and locations, where the species of importance for protection are expected to be found, were selected. Experts were able to modify these locations during the research; therefore, the final list of visited points is somewhat larger and is shown in Figure 32.

Table 17: Coordinates of localities visited during invertebrate surveys

No	Longitude	Latitude	Locality	Municipality	City
1	44,7176	20,4433	Resnik	Rakovica	Beograd
2	44,7071	20,4446	Resnik_2	Rakovica	Beograd
3	44,6831	20,4719	Pinosava	Vozdovac	Beograd
4	44,6806	20,4831	Pinosava_2	Vozdovac	Beograd
5	44,6709	20,4958	Ripanj	Vozdovac	Beograd
6	44,6110	20,5348	Mala Ivanca	Sopot	Beograd

[50] Regional biodiversity database. Serbian website available at: https://biologer.rs/

No	Longitude	Latitude	Locality	Municipality	City
7	44,5916	20,5342	Ralja	Sopot	Beograd
8	44,5655	20,5367	Parcani	Sopot	Beograd
9	44,5574	20,5561	Ralja_2	Sopot	Beograd
10	44,5459	20,5818	Sopot	Sopot	Beograd
11	44,5371	20,5394	Babe	Sopot	Beograd
12	44,5103	20,6311	Djurinci	Sopot	Beograd
13	44,4935	20,6524	Vlaska	Mladenovac	Beograd
14	44,4052	20,7260	Mladenovac	Mladenovac	Beograd
15	44,3940	20,7583	Kusadak	Smederevska Palanka	Smederevska Palanka
16	44,3864	20,7709	Kusadak_2	Smederevska Palanka	Smederevska Palanka
17	44,3749	20,8260	Ratari	Smederevska Palanka	Smederevska Palanka
18	44,3691	20,8355	Ratari_2	Smederevska Palanka	Smederevska Palanka
19	44,3441	20,9732	Smederevska Palanka	Smederevska Palanka	Smederevska Palanka
20	44,3399	21,0630	Velika Plana	Velika Plana	Velika Plana
21	44,2223	21,0927	Markovac	Velika Plana	Velika Plana
22	44,1517	21,1065	Batocina	Batocina	Batočina
23	44,1156	21,1552	Brzan	Batocina	Batočina
24	44,0245	21,2331	Novo laniste	Jagodina	Jagodina
25	44,0219	21,2406	Novo laniste_2	Jagodina	Jagodina
26	44,0110	21,2374	Bukovce	Jagodina	Jagodina
27	44,0020	21,2386	Bukovce_2	Jagodina	Jagodina
28	43,9898	21,2489	Jagodina	Jagodina	Jagodina
29	43,7891	21,4220	Gornje Vidovo	Paraćin	Paraćin
30	43,6482	21,4659	Braljina Rasinska	Cicevac	Cicevac
31	43,6473	21,4527	Braljina Rasinska_2	Cicevac	Cicevac
32	43,6166	21,4840	Trubarevo	Cicevac	Cicevac
33	43,6083	21,4878	Trubarevo_2	Cicevac	Cicevac
34	43,5990	21,5452	Vitkovac	Aleksinac	Aleksinac
35	43,5738	21,5816	Srezovac	Aleksinac	Aleksinac
36	43,5196	21,6584	Donji Adrovac	Aleksinac	Aleksinac
37	43,4390	21,7379	Bankovac	Aleksinac	Aleksinac
38	43,3970	21,7743	Mezgraja	Crveni Krst	Nis
39	43,3802	21,8060	Vrtiste	Crveni Krst	Nis
40	43,3673	21,8121	Vrtiste_2	Crveni Krst	Nis
41	43,3244	21,8289	Milka Protic	Palilula	Nis
42	43,3122	21,8284	Deveti Maj	Palilula	Nis

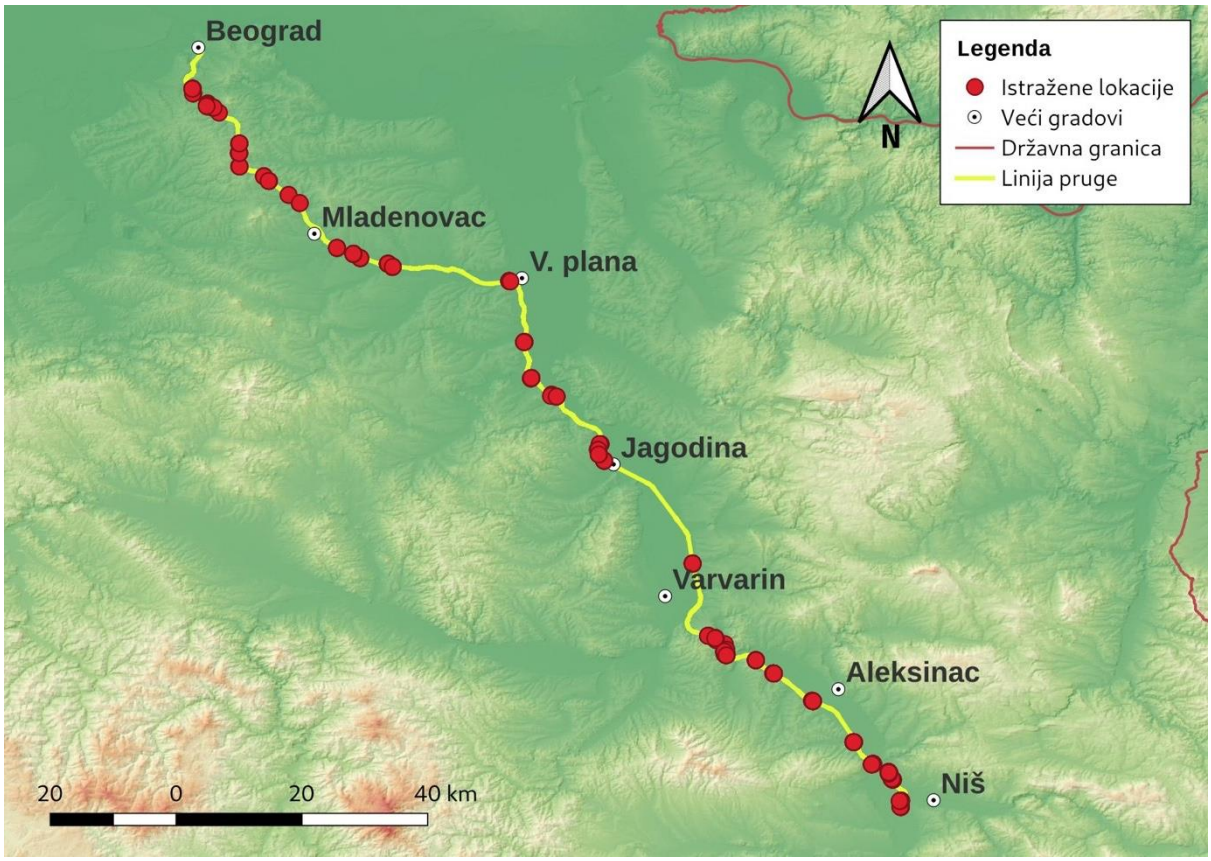


Figure 32: Position of surveyed localities in relation to the planned railway

Results. A total of 118 species of invertebrates from the orders Lepidoptera, Coleoptera and Odonata were registered in the Project area during desktop and field surveys, which is defined as a zone of 500 meters around the area where the Project activities will be carried out. An overview of all recorded species is given in Appendix 4 to the E&S Assessment Report.

Four species found in literature should be excluded from the list. The species *Boloria selena* can be considered extinct from the Project area, given that a large part of the population has disappeared, and that no populations have been recorded in the immediate vicinity of the project area. Also, the species *Colias myrmidone* and *Polygonia egea* can be considered extinct, since they have not been recorded in the territory of Serbia in the last few decades, and are considered probably extinct from the territory of the entire country. The species *Colias chrysotheme* was recorded only once in late 19th century and was not subsequently confirmed. The butterfly is a specialist, feeding on *Astragalus austriacus* and is associated with dry steppe areas that are not present in the researched area. This brings a total number of species in Project's AOI to 114.

According to the *Good Practices for the Collection of Biodiversity Baseline Data*[51], invertebrate surveys should target speces of conservation concern. Following that principle, some recorded species of importance are highlighted below.

Lucanus cervus, Morimus asper, Coenagrion ornatum are species listed in Annex II to the Habitats Directive. Despite being common on Serbia, they will require targeted beasures due to European importance. *Lycaena dispar* is a strictly protected species in Serbia. It is listed in Annexes II and IV to the Habitats Directive and Resolution 6 of the Berne Convention and is globally Near Threatened (NT). It is not endangered in Serbia and

[51] Gullison, R.E., J. Hardner, S. Anstee, M. Meyer. 2015. Good Practices for the Collection of Biodiversity Baseline Data. Prepared for the Multilateral Financing Institutions Biodiversity Working Group & Cross-Sector Biodiversity Initiative.

Europe - last concern (LC). *Phengaris arion* is on Annex IV to the Habitats Directive. It is considered a near-endangered species at the global level (NT), an endangered species in Europe (EN), but not endangered in the territory of Serbia - last concern (LC). *Parnassius mnemosyne*, *Zerynthia polyxena* are also present in the Project area and are listed in Annex IV to the Habitats Directive.

7.1.5 Fish

Methodology. The fish fauna (Osteichthyes) research in the proposed railway section Belgrade-Nis was conducted in two phases: (1) literature data analysis and (2) field investigations. The results of past investigations and studies of the composition and organization of fish communities in this area were used to set the research baseline.

The relevant literature (e.g. previous and continuing assessments, publications and reports) was assessed for the presence of ichthyofauna species in the project area, as well as the project area's ecological conditions. All of the literature references and ichthyofauna identification keys are given in Ichthyofauna Survey Report given in Appendix 4 to the E&S Assessment Report.

The bibliographic data were used in order to identify the fish assemblage at the following rivers: Kubrsnica near Smederevska Palanka (44° 21' 50.72"N 20° 55' 57.07" E), Jasenica near Veliko Orasje (44° 20' 54.95"N 20° 59' 15.39" E), Raca near Markovac (44° 13' 19.93"N 21° 05' 43.26" E), Velika Morava near Bagrdan (44° 04' 11.64"N 21° 11' 47.00" E), Osanica near Bagrdan (44° 04' 47.42"N 21° 11' 08.16" E), Belica near Jagodina (43° 59' 23.41"N 21° 14' 55.82" E), Lugomir near Jagodina (43° 58' 20.28"N 21° 16' 55.83" E), Crnica near Paracin (43° 36' 34.29"N 21° 24' 13.12" E), Juzna Morava near Vitkovac (43° 36' 06.83"N 21° 32' 43.06" E) and near Praskovce (43° 36' 34.52"N 21° 31' 44.76" E) and Nisava near Nis (43° 19' 29.12"N 21° 49' 55.95" E).

In the period from 17th to 20th of May 2022, fishing survey was carried out in the area near Gornja Toponica (43° 23' 51.38"N 21° 46' 18.08" E; Juzna Morava River), Cuprija (43° 56' 02.76"N 21° 20' 50.09" E; Velika Morava River), and Batocina (44° 09' 03.10"N 21° 06' 24.32" E; Lepenica River) (Figure 33). Selection of location was based on currently available railway layout and evaluation of possible impact so that localities under the most pressure are included. Field research was organized based on previous experience and substantial knowledge of ichthyofauna. Surveys were conducted during the fish breeding season. Sampling was conducted by electrofishing with electrofishing device Villager VGI2400 (230 V, 8.7 A, 2.0 kW). A 100 m long transect was performed on each sampling point (SP) to cover all habitat types.

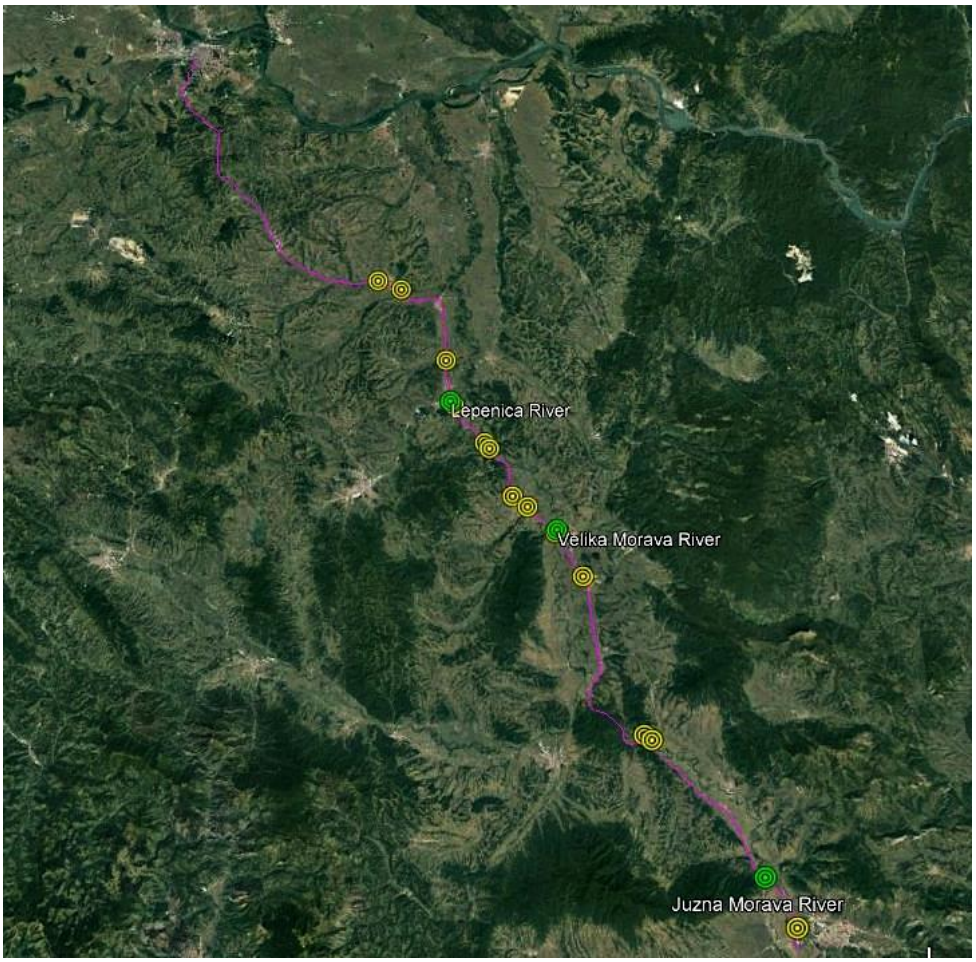


Figure 33: Localities analysed in literature review (yellow) and during field visits (green, labelled)

The following methods based on European Standards have been used during sampling, identification, and quantification of fish fauna:

- EN 14962:2006 (Water quality - Guidance on the scope and selection of fish sampling methods), and
- EN 14011:2003 (Water quality – Sampling of fish with electricity).

At Juzna Morava and Lepenica sampling was conducted by standing in the water, not from the boat, because the rivers were accessible. Sampling at the Velika Morava River was conducted form the boat because of high water level (Figure 34). All fish caught are stored in a large bucket, before being individually counted, measured, weighed, and released back into the river.

Figure 34: Fish were collected in buckets and released back into the water upon measuring

Results. According to the findings of a complete literature analysis of all reliable sources and field observations, the researched area is home to 31 fish species belonging to nine families: Centratchidae (1), Cobitidae (3), Cottidae (1), Cyprinidae (18), Esocidae (1), Gobiidae (2), Nemachelidae (1), Percidae (3), and Siluridae (1). Five non-native invasive species also live in the surveyed area: Pumpkinseed - *Lepomis gibbosus* (Linnaeus, 1758), Prussian carp – *Carassius gibelio* (Bloch, 1782), Monkey gobi - *Neogobius fluviatilis* (Pallas, 1814), Round gobi - *Neogobius melanostomus* (Pallas, 1814), and Topmouth gudgeon - *Pseudorasbora parva* (Temminck & Schlegel, 1848). The full list of registered species with localities and species conservation statuses according to the national and international criteria is provided in the Appendix 4 to the E&S Assessment Report.

The results of field research at two localities (Gornja Toponica – Juzna Morava River; Cuprija – Velika Morava River) are given in following tables.

Table 18: Composition of ichthyofauna in the Juzna Morava River (near Gornja Toponica) on a given transect

Species	Common name	Number of individuals
Alburnus alburnus	Common bleak	1
Alburnoides bipunctatus	Schneider	1
Barbus balcanicus	Danube barbel	1
Barbus barbus	Common barbel	1
Cobitis elongata	Balkan spined loach	1
Rhodeus amarus	European bitterling	11
Sabanejewia balcanica	Balcan spined loach	1

Table 19: Composition of ichthyofauna in the Velika Morava River (near Cuprija) on a given transect

Species	Common name	Number of individuals
Alburnus alburnus	Common bleak	1
Cobitis elongata	Balkan spined loach	2
Neogobius melanostomus	Round goby	5
Rhodeus amarus	European bitterling	2
Silurus glanis	Wels catfish	3
Squalius cephalus	Chub	2
Vimba vimba	Vimba bream	3

The third location for field research was the river Lepenica. In the part of the flow about 3 km upstream from the mouth of the Velika Morava River, it represents a small lowland watercourse, with a width of 6 to 10 m, depth up to 80 cm, with a gravelly - sandy bottom. The expected community of fish should be of the cyprinid type, but due to very strong pollution, the water is cloudy, gray with a lot of foam on the surface, so the fish were not registered (Figure 35).

Figure 35: Fish sampling on Lepenica River

All the rivers analysed in this report belong to the Black Sea basin. Most of them are small lowland slow-flowing watercourses, with sandy-gravel bottom (Kubrsnica, Jasenica, Raca, Lepenica, Osanica, Belica, Lugomir and Crnica rivers). According to the *Rulebook on Determining Water Bodies of Surface and Groundwater*[52], these rivers belong to the third type of water bodies, i.e. small and medium watercourses, altitude up to 500 m, with a predominance of large substrates. According to the above-mentioned Rulebook, the Juzna Morava, Velika Morava and Nisava rivers belong to the second type of water bodies, i.e. large rivers with a predominance of medium-sized sediments. These rivers are strong recipients of various types of pollution (communal, industrial, and agricultural runoff), because they mainly flow through urbanized and industrial areas. In some rivers, the pollution was so prominent that there were no fish in them (rivers Lepenica and Belica). Additionally, the existing Belgrade-Nis railway already crosses most of the analysed waterbodies.

According to the IUCN Status in Serbia, only one species registered in the surveyed area falls under the Vulnerable (VU) category - zingel *Zingel zingel*. The largest number of fish species (25) is in the Least Concern (LC) category[53].

Five species are invasive, non-native.

Some recorded species are migratory, such as Asp – *Leuciscus aspius* (Linnaeus, 1758); Common barbel – *Barbus barbus* (Linnaeus, 1758); Common nase – *Chondrostoma nasus* (Linnaeus, 1758), Danube barbel – *Barbus balcanicus* (Kotlík, Tsigenopoulos, Ráb & Berrebi, 2002) and Vimba bream – *Vimba vimba* (Linnaeus, 1758). Their migratory routes should not be cut and changed during the construction of the railway, especially not in large rivers, such as the Juzna and Velika Morava and Nisava. This impact may arise during construction but can be mitigated by measures given in the ESMP as a part of Construction Biodiversity Management Plan and River Crossing Plan.

Habitats with developed underwater vegetation should not be disturbed by the construction, because they are spawning grounds for most fish species. Sandy coastal habitats are natural habitats for all species of fish belonging to the family Cobitidae. Although all three species mentioned in this report (*C.elongata*, *C.elongatoides* and *S. balcanica*) have LC status in Serbia, all are listed in Annex 1 of *Rulebook on the*

[52] "Official Gazette of RS", No. 96/10

[53] The Red Book of Fish of Serbia is still not publicly available.The expert performing this survey is also participating in development of the Red Book that will be published by the end of 2022, and has access to latest information regarding the fish status in Serbia.

proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Serbia, which means that they are strictly protected species. Such habitats can be found especially in large rivers such as Juzna and Velika Morava and Nisava. Deeper parts of rivers are habitats suitable for larger individuals and predatory species, such as Northern pike – *Esox lucius* (Linnaeus, 1758); Pike-perch – *Sander luciperca* (Linnaeus, 1758) and Wels catfish – *Silurus glanis* (Linnaeus, 1758); therefore, they should not be disturbed and changed.

Out of 26 native fish species that inhabit the investigated localities, 9 species (45%) are on the Reference List of Natura 2000 fish species that occur in the Republic of Serbia. The following species of fish are listed in Annex 2 of the Habitats Directive: *C. elongata*, *C. elongatoides*, *S. balcanica*, *C. gobio* and *R. amarus*; in Annex 5: *B. balcanicus*, *B. barbus* and *Z. zingel*, while the species *L. aspius* is found in both Annex 2 and Annex 5. For most of these species the population size for total distribution is not estimated. As a result, it is highly unlikely but nonetheless impossible to say with certainty whether these local populations are considered as habitats of significant importance for the (inter)national survival of such species.

7.1.6 Herpetofauna

Methodology. The research of amphibians and reptiles in the area defined as the Project's Area of Influence was carried out in two phases: desk study and field surveys.

Literature data on distribution and conservation status of all species of amphibians and reptiles from the area affected by the Project were collected from scientific papers and the Red Book of Amphibians and Reptiles of Serbia. The full list of references is presented in the Herpetofauna Survey Report given in Appendix 4 to the E&S Assessment Report.

Field surveys were conducted in the period from March 26 to May 21, 2022. Fieldwork included visual inspection along transects or detailed inspections of relevant amphibian and reptile habitats (for example: ponds, canals, suitable places for basking, natural or artificial shelters). Information on the species, locality and date where they were found was collected, and the specifics of the habitat were recorded. Since the total length of the railway is 243 km, and the field research is limited to one season and a small number of field days, site selection was made based on literature data and previous field experience. Additionally, the priority was given to the sites that are under a protection regime or sites characterized by habitat mosaic and less anthropogenic impact (e.g. Kosutnjak, Resnik, Pinosava, Ripanj, Banjicka forest, Ralja, Avala, Djrinci, Vlaska, Glibovac, Smederevska, Palanka, Rogot, Batocina, Brzan, Milosevo, Bagrdan, Cuprija, Cicevac, Stalac, Djunis, Vitkovac, Mezgraja, Vrtiste). Total number of general localities was 20, however, transect method was used therefore the larger area around the point was surveyed (Table 20). The position of the selected localities in relation to the planned Belgrade-Nis railway is shown in Figure 36. The figure shows localities in relation to the entire corridor; however, more detailed maps for each railway section are provided in Appendix 4 to the E&S Assessment Report.

Table 20: Coordinates of surveyed points

Name	Longitude	Latitude
1	44,77018269	20,47354097
2	44,76525505	20,43825787
3	44,69452672	20,52079338
4	44,70582848	20,46058422
5	44,6910256	20,46411275
6	44,67702015	20,48819832
7	44,66235017	20,50706154
8	44,57222887	20,53982568
9	44,57210962	20,56137432
10	44,52219149	20,61032336
11	44,50744846	20,63413709
12	44,48928341	20,64888529
13	44,36607292	20,92452155
14	44,14571923	21,09987838
15	44,10230218	21,16402799
16	44,07621642	21,18954249
17	43,91819271	21,35887363
18	43,71239232	21,42926465
19	43,60171946	21,53436328
20	43,39100262	21,79229101

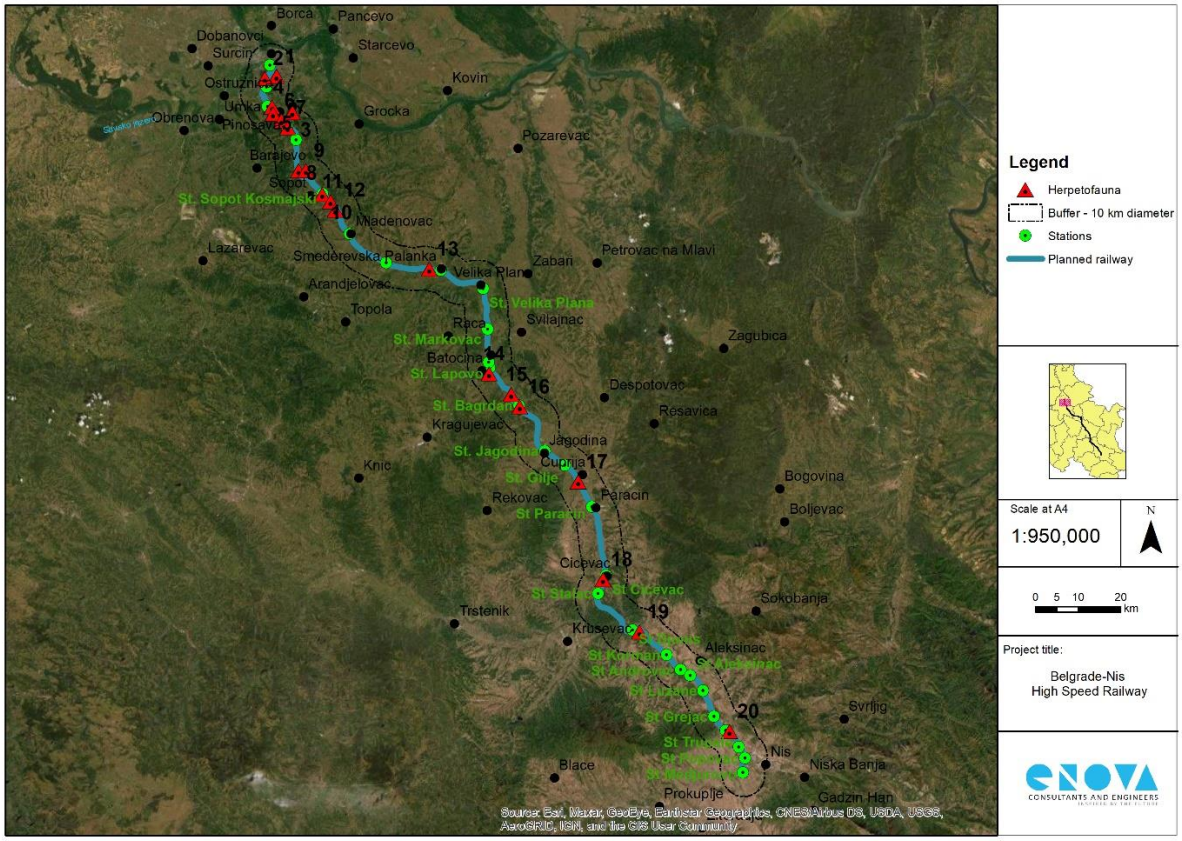


Figure 36: Position of surveyed localities in relation to the planned railway route

Results. Based on the literature data, 16 out of 22 amphibian species known to inhabit Serbia can be found along the Belgrade-Nis high-speed railway corridor, of which 4 species have been recorded during the field survey (*Pelophylax kl. esculentus*, *Pelophylax ridibundus*, *Rana dalmatina* and *Salamandra salamandra*). The most numerous are individuals from the genus *Pelophylax* and the species *Rana dalmatina*.

Based on literature data, 15 out of 26 reptile species found in Serbia inhabit the area around the Belgrade-Nis high-speed railway corridor. During the field research, 11 species of reptiles were found (*Anguis fragilis*, *Dolichophis caspius*, *Natrix natrix*, *Natrix tessellata*, *Zamenis longissimus*, *Darevskia praticola*, *Lacerta viridis*, *Podarcis muralis, Vipera ammodytes*, *Emys orbicularis*, *Testudo hermanni*). The most commonly found individuals are of the following species: *Podarcis muralis, Lacerta viridis, Natrix natrix*, *Natrix tessellata*, *Testudo hermanni, Dolichophis caspius*, *Emys orbicularis.*

The complete lists of amphibian and reptile species, suitability of habitats in the Project's area of influence and species' conservation statuses on national and international level can be found in Appendix 4.

The most common species of reptiles are also the most vulnerable, and special attention should be paid to the species *Testudo hermanni* which moves slowly and can get stuck in tracks or drains next to the railway. Killed *Testudo hermanni* individuals (Figure 37), but also faster and more agile species such as *Dolichopis caspius, Podarcis muralis, Lacerta viridis*, were found on the railway during field research.

Figure 37: Testudo hermanni individual (DOR - dead on road) that very likely collided with a train

The most commonly found amphibians are *Pelophylax* spp. and *Rana dalmatina* but all other species of amphibians (*Bombina bombina, B. variegata, Bufo bufo, Bufotes viridis, Hyla arborea, Pelobates balcanicus, Pelobates fuscus, Lissotriton vulgaris, Salamandra salamandra, Triturus dobrogicus, Triturus ivanbureschi, Triturus macedonicus*) found in the Project's area of influence may be impacted by the implementation of the Project because they use the same water surfaces for reproduction or nutrition. There are several water courses in the immediate vicinity of the railway and targeted mitigation measures should be proposed (Figure 38).

Figure 38: Some of the water bodies registered along the existing and planned railway; Pinosava (left) and Djurinci (right)

The greatest diversity of amphibians and reptiles was observed near water habitats (ponds, canals, rivers and floodplains) and in mosaic habitats (forest edges, crossings between forests and meadows, or agricultural areas). There are often canals or flood zones next to the railway where a large number of amphibians have been spotted, and special attention should be paid to these areas.

According to the IUCN Red list, most species of amphibians and reptiles have the LC status, except *Triturus dobrogicus*, *Darevskia praticola*, *Emys orbicularis* and *Testudo hermanni* which have the NT status.

Based on the Red Book of Amphibians and Reptiles, most species have the LC status, except *Pelobates balcanicus* (VU), *Triturus dobrogicus* (NT), *Triturus ivanbureschi* (VU), *Mediodactylus kotschyi* (CR), *Darevskia praticola* (NT) and *Testudo hermanni* (NT).

Based on the Habitats Directive, most of the registered species of amphibians and reptiles are on Annex II or IV, except *Bufo bufo*, *Lissotriton vulgaris*, *Salamandra salamandra*, *Anguis colchica*, *Anguis fragilis*, *Natrix natrix* and *Darevskia praticola*.

7.1.7 Birds

Methodology. Field research of ornithofauna was conducted during the nesting season, in May and June 2022. The equipment consisted of Nikon binoculars with 8x42 magnification, Vortex with 10x42 magnification and Diamondback binoculars with 20-60x60 magnification, to observe birds on water surface. Photo records were taken with Panasonic LUMIX DZFZ82 digital camera. The NaturaList application was used to collect data from the field (https://data.biolovision.net/). For each observation site, the application records geographical coordinates with high precision (<5m), along with the exact date and time, and the number of encountered individuals for each species. The Collins Bird 18 Guide - 2nd edition (Svensson, 2009), Raptors of the World (Ferguson-Lees and Christie, 2001) and The Complete Guide to the Birdlife of Britain and Europe (Hume, 2001) were used as identification manuals, while the database www.xseno-canto.org was used to confirm the recognized bird song or to invocate certain species.

The chosen methodology for the field study was the transect method (Sutherland et al., 2004) recording birds in the project area, as well as the point census method. For the purpose of ornithofauna field research, a total of 21 transects were completed (Table 21). Transects were visited early in the morning, from 05:30 to 10:00, and in the evening, from 18:00 to 22:00. The described range synchronizes with maximum activity of birds and, at the same time, the activity of nocturnal birds. Transects were predetermined in order to set priorities due to the size of the research area and short duration of research. As the new railway does not pass through any protected areas, the transects were determined based on the distance between the planned railway and the protected areas or IBAs (Important Bird Areas). The new railway does pass through 2 IBA sites, Gornje Pomoravlje and Dobric-Nisava.

Table 21: Coordinates of surveyed localities and transect lengths

No.	Locality name	Coordinates of transect start point		Coordinates of transect end point		Length of covered railway
		Latitude	Longitude	Latitude	Longitude	meters
1.	Donje Medjurovo	43.302607°	21.830407°	43.313515°	21.827143°	1235
2.	Vrtiste	43.380464°	21.805035°	43.388255°	21.793964°	1231
3.	Mezgraja	43.396981°	21.773036°	43.403920°	21.765025°	1143
4.	Stalac	43.669305°	21.412116°	43.677889°	21.413027°	980
5.	Cicevac	43.703075°	21.430235°	43.712185°	21.436286°	1112
6.	Pojate	43.739190°	21.433921°	43.750653°	21.431356°	1293
7.	Paracin	43.874192°	21.391694°	43.883947°	21.384501°	1223
8.	Cuprija 1	43.911991°	21.363552°	43.923698°	21.355104°	1459
9.	Cuprija 2	43.929178°	21.351006°	43.938348°	21.343980°	1162
10.	Brzan	44.114416°	21.151044°	44.119142°	21.139545°	1082
11.	Batocina 1	44.133915°	21.126262°	44.141760°	21.118307°	1079
12.	Batocina 2	44.144710°	21.114555°	44.152147°	21.105810°	1081
13.	Velika Plana 1	44.302623°	21.086508°	44.312090°	21.086433°	1073
14.	Velika Plana 2	44.339279°	21.068332°	44.338858°	21.052957°	1238
15.	Velika Plana 3	44.338313°	21.047952°	44.336726°	21.033677°	1151
16.	Djurinci 1	44.506456°	20.635483°	44.513698°,	20.625608°	1126
17.	Djurinci 2	44.542995°	20.583396°	44.551242°	20.576584°	1119
18.	Ripanj 1	44.642909°	20.533054°	44.653663°	20.526996°	1348
19.	Ripanj 2	44.679663°	20.485047°	44.683103°	20.475209°	894
20.	Kosutnjak 1	44.749700°	20.445253°	44.758213°	20.445485°	952
21.	Kosutnjak 2	44.758629°,	20.445391°	44.767185°	20.444714°	990

Total transects length: 23,971 meters

Results. A total of 1017 data entries was collected, with 2163 specimen of 85 bird species. The complete list of registered species, with precise localities and conservation statuses according to the relevant national and international criteria is provided in more detail in Ornithofauna Survey Report given in Appendix 4 to the E&S Assessment Report. In this chapter only species of conservation concern have been elaborated in detail. The created ornithological list does not represent a complete ornithological inventory of the Project area due to limitations in the territorial coverage and research duration. Even though only about 10% of the railway length was visited, the ornithological inventory should not be significantly different.

Most of the area along the railway consists of uniform habitats with human settlements and agricultural land. However, the dense vegetation that grows right next to the railway proved to be an excellent nesting place for a number of small songbirds. Out of the total recorded species number, 76 species are considered to be nesting birds of the researched area. According to the IUCN global endangered list, northern lapwing (*Vanellus vanellus*) has NT status and European turtle dove (*Streptopelia turtur*) has VU status. All the other registered species have LC status. In terms of national endangerment categories, a larger number of species have some status of endangerment. According to the *Red Book of Fauna of Serbia III - Birds*, two species have EN status, common sandpiper (*Actitis hypoleucos*) and black kite (*Milvus migrans*). Six species have a VU national status: northern goshawk (*Accipiter gentilis*), Cetti's warbler (*Cettia cetti*), common tern (*Sterna hirundo*), grey partridge (*Perdix perdix*), European turtle dove (*Streptopelia turtur*), purple heron (*Ardea purpurea*). Black stork (*Ciconia nigra*) and western marsh harrier (*Circus aeruginosus*) are with the NT national status.

Northern lapwing has been recorded at four localities and it is likely that it nests at all four of them. Of these 4 localities, railway relocation is planned only on Velika Plana 1 and Brzan localities, possibly across the nesting sites. At Donje Medjurovo and Velika Plana 3 localities, the railway retains its position, and it is unlikely that it will disturb the individuals. At the sites where the individuals were found, the influence of the anthropogenic factor (highways, settlements, agriculture) is already very extensive; therefore, the new railway should not pose further threats to the individuals. National population is estimated at 2100-2800 pairs. At four localities where Nothern lapwing was recorded there are approximately 7-15 pairs of this species.

European turtle dove has been recorded at eight locations with 19 individuals, and it is considered a nesting bird at all localities. Mosaic habitats of dense vegetation along the railway and agricultural areas are suitable nesting places for this species. However, European turtle dove nests all over Serbia and such habitats are not unique to the Corridor. The temporary loss due to the railway construction is unlikely to present a big issue. National population is estimated at 49,000-68,000 pairs.

Common sandpiper (national population is estimated at 100-200 pairs) and black kite (national population is estimated at 34-45 pairs) have EN national status, however the localities where these species were found, as well as their behaviour, indicate they were registered during migration and that individuals do not nest at surveyed localities.

Sixteen bird species are listed on Annex 1 of Birds directive.

- Common Kingfisher (*Alcedo atthis*), recorded at 4 locations. Habitats near waterbodies with sand cliffs are suitable for nesting. National population is estimated (NPE) at 2700-4000 pairs.
- Purple heron (*Ardea purpurea*), recorded at 2 locations on migration. NPE at 645-900 pairs, with almost all population being in Vojvodina.
- White stork (*Ciconia ciconia*), recorded at eight locations as the species nests in settlements on electric poles or roofs. Certain localities were suitable for nesting, but no active nests were found. NPE at 1240-1410 pairs.
- Two species also recorded on migration: Black stork (*Ciconia nigra*) NPE 135-172 pairs recorded at two locations, and Little egret (*Egrtetta garzetta*) NPE at 1000-1500 pairs recorded at one location.
- Three species from the Picidae family, each found only at one location: Middle Spotted Woodpecker (*Leiopicus medius*) nests in all regions of Serbia, NPE at 10,000-15,000 pairs. Syrian woodpecker (*Dendrocopos syriacus*) numerous nesting species of the whole of Serbia, NPE 28,000-37,000. Black woodpecker (*Dryocopus martius*) one singing male recorded. NPE at 2400-3200 pairs, in the last years, population growth has been observed. All three species inhabit numerous different habitats (old orchards, different types of forests, parks...) and are spread throughout Serbia.
- Ortulan Bunting (*Emberiza hortulana*) recorded at seven locations and at all locations there were singing males and territorial behaviour that indicate breeding of species. NPE at 29,000-47,000 pairs. Ortulan Bunting prefers mosaic open habitats of orchards and agricultural areas with shrubs.
- Red-backed shrike (*Lanius collurio*) recorded at 18 of 21 locations, species is widespread in Serbia. Almost all recorded individuals were on their territory with breeding behaviour. NPE at 87,000-125,000 pairs. Red-backed nests in numerous different open habitats.
- Lesser Grey Shrike (*Lanius minor*) recorded at 5 locations. All records were at suitable habitats, various mosaic habitats along the railway. NPE at 730-1120 pairs.
- Black-crowned Night-heron (*Nycticorax nycticorax*), recorded at 4 locations, the habitats where they were recorded are suitable, but there were no indications of nesting. The nearest colony is near Velika Plana, about 2.5 km away. NPE at 2800-3820 pairs.
- European Honey-buzzard (*Pernis apivorus*), recorded only on one location at migration. NPE at 700-900 pairs.

- Common tern (*Sterna hirundo*) was recorded on Velika Morava River, in the Stalac locality (Figure 39), however, since a lot of work is being done on the construction of a new highway near the site, the nesting of the species is probable but not proven. National population of Common tern is estimated at 216-280 pairs.
- Western marsh harrier (*Circus aeroginosus*) was recorded on the Brzan, Batocina 1 and Vrtiste localities. National population is estimated at 349-468 pairs.
- Black kite (*Milvus migrans*) recorded only on one locality – Vrtiste.

Figure 39: Common tern on Velika Morava River, locality Stalac

At the Vrtiste locality (Figure 40), the project currently plans for a railway relocation, which will go through one of the rare wetlands in southern Serbia. This habitat was created artificially by relocating the Nisava river, but few years later, after the semi-natural vegetation occupied the area, it has become an oasis for birds in context of nesting and migration. In just one day of field research 29 species of birds were recorded, some of which very rare in southern Serbia and the entire country. Rare and significant species that have been recorded:

- Black Kite (Milvus migrans) and Purple Heron (Ardea purpurea) on migration.
- Savi's warbler (Locustella luscinioides) one singing male. Estimatied population for South Serbia is 0 pairs.
- Cetti's Warbler (Cettia cetti) one singing male. Estimated population for South Serbia is 10-55 pairs.
- Great Reed Warbler (Acrocephalus arundinaceus) 9 singing males. Estimated population for South Serbia is 400-450 pairs.
- Western Marsh Harrier (Circus aeruginosus), possible territory. Estimated population for South Serbia is 0-1 pair. Nation population is estimated at 349-468 pairs.
- Eurasian Reed Warbler (Acrocephalus scirpaceus) 2 individuals in appropriate habitat. Possible breeding. Estimated population for South Serbia is 0 pairs.

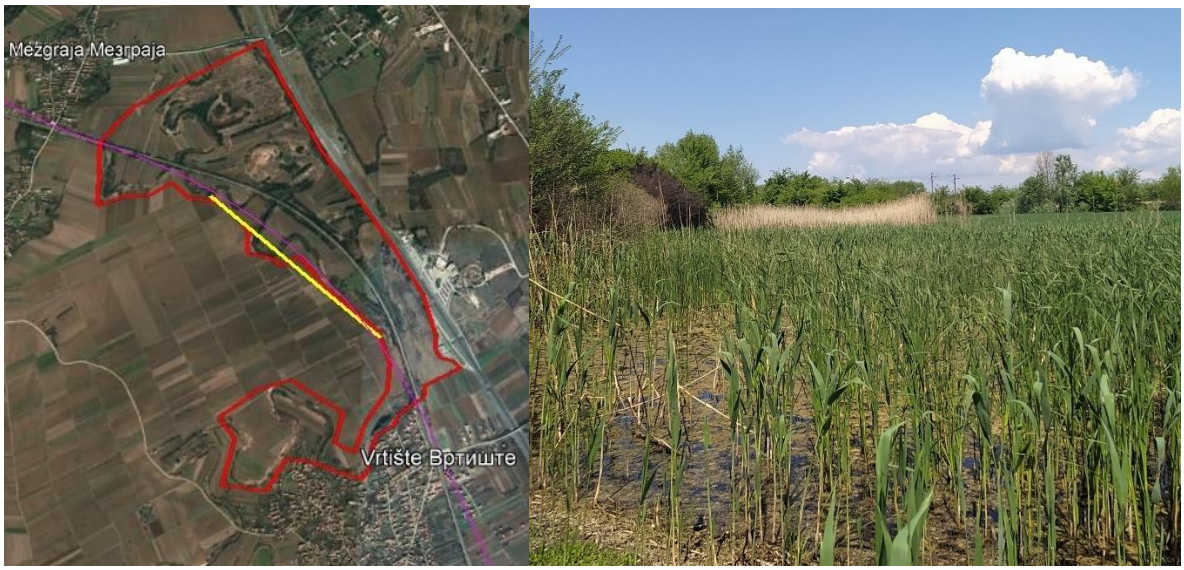


Figure 40: Wetland area on the locality Vrtiste on the left (wetland habitats - red line, transect - yellow line, planned railway - purple line)

7.1.8 Mammals

Methodology. Field research has been undertaken during 6 field visits during May and June 2022, from early morning to late night. Field visits were adjusted so to be performed during optimal weather conditions with no wind and no rain. The methodology included the site inspection and active search for individuals or recording indirect evidence of the presence of the mammal species such as faeces or foot traces.

Desk research was conducted to analyse data from the available scientific literature. However, it was not possible to use any literature data, due to the specifics of the project area covered in this assessment. All available scientific papers on mammalian distribution are related to local geographical concepts or protected areas.

The survey localities were predetermined by the researcher based on the suitable habitats, habitat diversity and on the activities of local hunting associations. Coordinates of visited localities, along with a brief habitat description are provided in Table 22 below and Figure 41 shows the position of surveyed localities in relation to the planned railway.

Table 22: Localities of mammal surveys

No.	Locality	Date	Latitude	Longitude	Description
1	Veliki Drenovac	24.05.2022.	43.415467°	21.751788°	Along the site is the river Juzna Morava, nearby there is a small village with rural households. Lots of mosaic habitats, agricultural areas, orchards, and shrubs. Mali Jastrebac, a mountain with mixed deciduous forests, is on the west side.
2	Paracin	10.05.2022.	43.879926°	21.380400°	Lots of farmland and orchards. The transit route is not far. Several canals that dried up. The town of Paracin is close by.
3	Brzan	01.06.2022.	44.131166°	21.122389°	Habitats along the highway. Mosaic habitats of agricultural plots and wet flooded meadows.
4	Velika Plana	19.05.2022.	44.339502°	21.041345°	Agricultural areas, lot of wetlands, canals with water, residential buildings.

No.	Locality	Date	Latitude	Longitude	Description
5	Sopot	22.05.2022.	44.543561°	20.579877°	Dense vegetation of undershrub. Orchards, wheat fields.
6	Ripanj	21.05.2022.	44.685309°	20.477474°	A stream with dense vegetation of invasive species. Residential buildings. Few orchards. Abandoned fields. To the west there is a young deciduous forest.

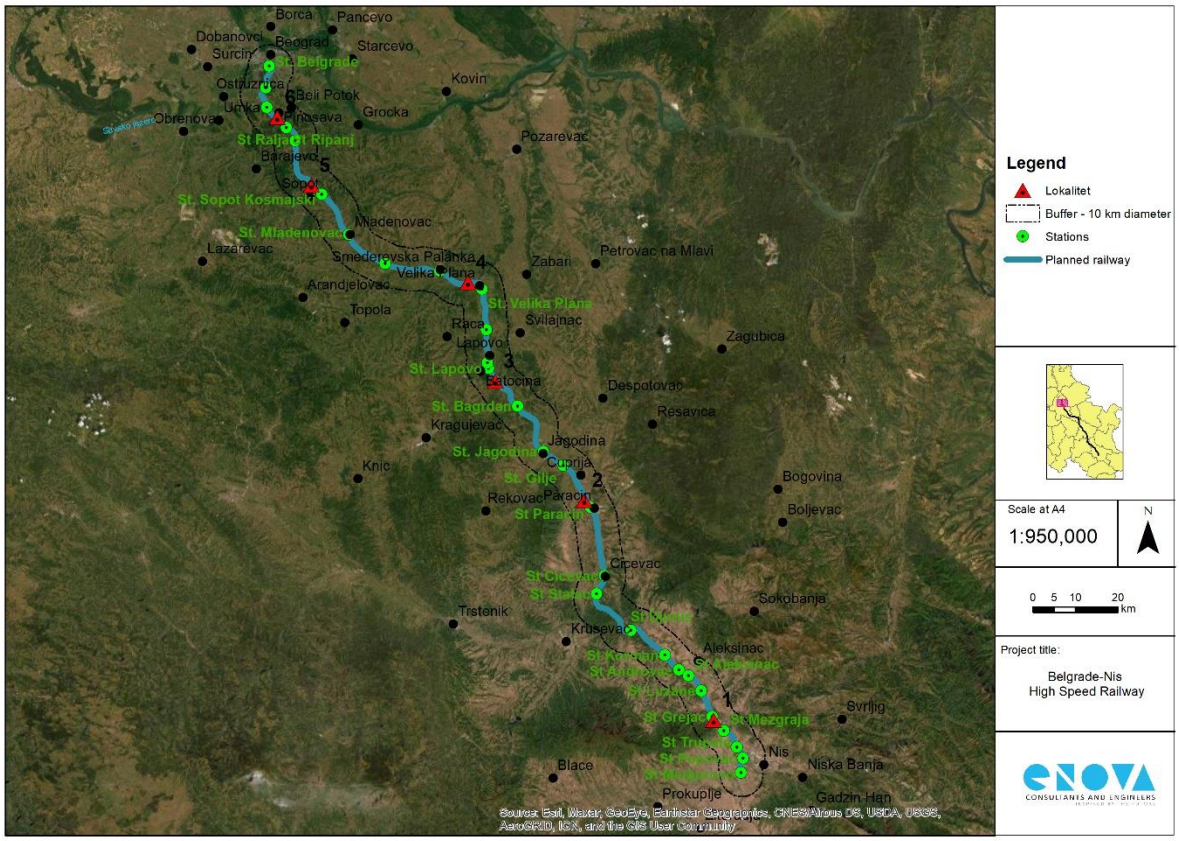


Figure 41: Position of surveyed localities in relation to the planned railway

Duration of research was one day per location. Research was conducted on the direct impact zone of the railway, together with a radius of at least 1 km around the given coordinates. Research was conducted during summer when the vegetation density reaches its maximum (e.g. crop fields and forests), which made data collection difficult. Habitats near the railway are under extensive influence of several anthropogenic factors (highways, settlements, agriculture) and are very fragmented. During field research, nearby settlements were visited, and hunters and other locals were interviewed to obtain more information of mammalian distribution and presence in the area.

Results. During this research, a total of 15 species of mammals was registered. Records of nine species were collected during field work and records for 15 species were collected during interviews. Table provided in Appendix 4 gives detailed information, localities, data sources, and conservation statuses of registered species on national and international level.

According to the IUCN Red list, 14 of 15 species have LC status and only muskrat (*Ondatra zibenthicus*) has NA status. Muskrat was registered on the locality Velika Plana. Prior to the encounter with the species, local people mentioned its presence during an interview.

One species, wolf (*Canis lupus*), has VU national status. Data for this species was collected during interviews with local hunters from the Veliki Drenovac village. According to the hunters, one specimen was seen during winter

in forest habitat of Mt. Mali Jastrebac. Wolf is not a typical inhabitant of these forests but it can be seen near the populated areas during severe winters. Wolf is listed on Annex II and IV of the Habitats Directive. The influence of habitat fragmentation (highways, settlements, roads) is already very extensive; therefore, the new railway should not pose further threats to potential individuals in this area. Based on conditions of the habitat, the area near planned railway has no potential to sustain a population of wolfs.

In the locality Veliki Drenovac, 14 species were recorded which can be attributed to the forest habitats in the area of the Mt. Mali Jastrebac. Thirteen of 14 species have a suitable habitat and, with further research of this area, the list of mammal species would very likely increase. Wildcat (*Felis silvestris*) is on Annex IV and, from data collected from hunters, wildcat is a regular inhabitant of the forests of Mali Jastrebac.

European hare (*Lepus europaeus*), Roe deer (*Capreolus capreolus*) (Figure 42), Red fox (*Vulpes vulpes*) and Red squirrel (*Sciurus vulgaris*) are species that are very common to habitats near the railway. Mixed habitats of forests, meadows, agricultural areas, orchards and dense shrubs are very suitable for these species to feed, but it is questionable whether their nesting is possible there. These species were recorded in all six localities. Another species recorded in all six localities was the Golden jackal (*Canis aureus*). This species currently shows expansive growth in Serbia due to the growing problem of illegal landfills, but also because of the lack of a natural enemy.

Figure 42: Roe deer spotted at locality Ripanj (left) and European hare spotted at locality Brzan (right)

One specimen of European badger (*Meles meles*) was found dead on local unpaved road, probably hit by a car or a truck. According to the local inhabitants, badger is very common in the area of Veliki Drenovac.

The described 15 species certainly do not represent a complete list of mammals in the wider area. Surveyed habitats are right next to the railway, but with existing fragmentation of habitats due to the vicinity of motorway, settlements and other infrastructure, it can be concluded that the project area has no potential to sustain large mammals as most natural habitats are already degraded. If we observe the project area as a transit area for mammals, it is not expected that the project will cause any changes for mammals, mostly because the railway does not substantially deviate from the existing route. As already mentioned, the habitats near the railway are under continuous fragmentation.

7.1.9 Protected areas

The laws and by-laws on nature protection in Serbia, and, subsequently, relevant authorities recognize a number of different areas important for conservation. Therefore, an analysis of available literature data about all areas that are recognized on national and international level was performed. The analysis included officially proclaimed protected areas (PAs), ecological network of Serbia, Emerald sites, Ramsar sites, Important Bird Areas (IBAs), Important Plant Areas (IPAs), Prime Butterfly Areas (PBAs), proposed Special Protection Areas (pSPAs), proposed Sites of Community Importance (pSCIs), Biosphere Reserves (UNESCO) and UNESCO World Natural Heritage sites.

Protected areas (PAs). The PAs are the areas of pronounced geological, biological, ecosystem and/or landscape diversity and are therefore designated as protected areas of general interest by a conservation act. Evaluation, i.e. determination of the value and importance of protected area, according to the *Rulebook on the Criteria for Evaluation and the Procedure of Categorization of Protected Areas*[54] is performed in relation to the degree of the expressed main natural features, phenomena and processes of interest for protection of the area, as well as in relation to the functions and purposes of the area.

Four protected areas are identified within the project area of influence (500 m on each side of the planned railway). This is a zone in which it is possible to expect some impacts from the railway construction and operation on biodiversity. However, respecting the precautionary principle, review of protected areas in the wider zone (5 km on each side of the railway) was also conducted. A total of 38 officially protected areas and areas in the process of designation are identified within the wider zone. It is important to note that 19 of them considers protection of a very small area or a natural monument including protection of one or two trees. As they are not on the project footprint or near to it, no impact can be expected on such PAs. The railway is located on the margins of Natural Monument Kosutnjak Forest (Subsection 1: Belgrade-Resnik) and in immediate vicinity of Natural Monument Rogot (Subsection 3: Velika Plana-Gilje). The largest number of officially protected areas is located near Subsection 1: Belgrade-Resnik - 26. This is due to the fact that a large number of protected trees are found in the city centre. Three PAs are in the AoI of Subsection 1: Resnik-Velika Plana, six PAs are located in the AoI of Subsection 3: Velika Plana-Gilje, and four in the AoI of Subsection 7: Djunis-Medjurovo. Other subsections are not within 5 km of protected areas. Additionally, majority of the registered PAs are outside of Project AoI and impacts on their integrity and functions are not expected.

The full list of PAs is given in Table 23 along with the national and IUCN categories, distance from the railway, and the subsection to which the area is the closest to.

Table 23: Protected areas and areas in the process of designation as protected in 5 km radius from the railway alignment

Name of protected area	National category (IUCN category)	Distance from the railway	Subsection	The reason for protection
Kosutnjak Forest	Natural monument (III)	0.01 km	1	Conservation of *Quercus* forests as habitats for different species.
Rogot	Natural monument (III)	0.06 km	3	Conservation of the last remnants of the *Quercus robur* forest.
Brzansko Moraviste	Special nature reserve (IV)	0.16 km	3	Conservation of swamp which presents very rare habitat type in Serbia.
Miljakovacka Forest	Natural monument (III)	0.3 km	1	Conservation of *Quercus cerris* and *Q. petraea* forests.
Park Uciteljske	Natural monument (III)	0.6 km	3	Historical values, a number of planted species

[54] "Official Gazette of RS", No. 97/15

Name of protected area	National category (IUCN category)	Distance from the railway	Subsection	The reason for protection
škole Jagodina				
Bajford Forest	Natural monument (III)	0.9 km	1	Protection and conservation of natural and aesthetic-environmental values of the forest complex which has significant ecological and spatial functions in connecting the green corridors of Belgrade. Also known as Banjicka Forest.
Park Topcider	Natural monument (III)	0.92 km	1	Historical and great biological value. Botanical value is reflected in the plant diversity and age of trees. Many trees date back to the XIX Century.
Beech on Dedinje	Natural monument (III)	1 km	1	Tree is distinguished by impressive dimensions, strong and imposing habitus and great aesthetic value
Mulberry in Medosevac	Natural monument (not reported)	1 km	7	It is protected due to its dimensions and age (160 years old).
Two trees of Himalayan pine	Natural monument (not reported)	1 km	1	Trees were planted in 1912 on a private property.
Cedar tree	Natural monument (not reported)	1 km	1	Tree has impressive habitus.
Gingko tree	Natural monument (not reported)	1 km	1	Tree has impressive habitus.
City Park Djurdjevo Brdo	Natural monument (III)	1.1 km	3	Cultural values.
Avala	Outstanding Natural Landscapes (V)	1.72 km	2	Conservation of forest ecosystem as important habitats of different autochthonous species.
Arboretum of the Faculty of Forestry	Natural monument (III)	2.2 km	1	Diverse collection of dendroflora in the open, preservation & improvement of the gene pool of autochthonous, allochthonous, exotic dendroflora & rare, endemic, relict species, intended for scientific research and education.
Wintering locality of pygmy cormorant	Protected Habitat (III)	1.21	1	Four smaller localities on Sava Rover in Belgrade aiming to protect pygmy cormorant. The PA is currently not yet protected as it is in the process of designation.
Botanical Garden "Jevremovac"	Natural monument (III)	2.8 km	1	Historical, scientific, educational, and cultural values.
Pionir Park	Natural monument (III)	2 km	1	Cultural values.
Cupressus on Dedinje	Natural monument (III)	2 km	1	Protected as a rare specimen of an exotic conifer species.
Two magnolias on Botic St.	Natural monument (III)	2 km	1	Trees have an impressive habitus.

Name of protected area	National category (IUCN category)	Distance from the railway	Subsection	The reason for protection
Two yew trees of Holy Archangel Michael Orthodox Church	Natural monument (III)	2 km	1	Male & female trees are about 110 years old. The male tree is about 12 m high and the female of about 8 m. Both trees enrich space in front of the Cathedral, which is an immovable cultural asset of great importance for Serbia.
Gingko on Vracar	Natural monument (III)	2 km	1	Tree has an impressive habitus.
Oak tree on Cvetni trg	Natural monument (III)	2 km	1	One of the oldest protected trees, 200 years old.
Hungarian oak on Koporinska Kosa	Natural monument (III)	2 km	2, 3	Tree has an impressive habitus; it is 180 years old. Located in Velika Plana therefore it should be considered as a part of Subsections 2 and 3.
Elm in Novo Selo	Natural monument (not reported)	2 km	7	Protected because of its age (400 years old) and dimensions (18 m high; canopy dimensions 35 x 24 m).
Platanus on Vracar	Natural monument (III)	2 km	1	One of the most beautiful and largest in central Belgrade and is one of the horticultural heritages of the capital. It is about 150 years old.
Yew in Botic St.	Natural monument (III)	2 km	1	Protected as rare and relict species.
Yew in Pozeska St.	Natural monument (III)	2 km	1	Protected as rare and relict species.
Academic Park	Natural monument (III)	2.9 km	1	Historical and cultural values. Park is one of the oldest parks in Belgrade.
Chestnut on Dorcol	Natural monument (III)	3 km	1	Protected because significant dendrometric values.
Kosmaj	Outstanding Natural Landscapes (V)	3 km	2	Conservation of rare species, relicts and endemics.
Veliko Ratno Ostrvo	Outstanding Natural Landscapes (IV)	3 km	1	River Island-important natural habitat for autochthonous species.
Zvezdarska Forest	Natural monument (III)	3.6 km	1	Protection and conservation of natural and aesthetic-environmental values of the forest complex which has significant ecological and spatial functions in connecting the green corridors of Belgrade.
Lipovac forest	Natural monument (III)	4.8 km	1	Conservation of *Quercus* forests and numerous protected plant and animal species.
Lalinacka Slatina	Natural monument (III)	4.8 km	7	Conservation of specific habitat –saltmarsh.
Koca Kapetan's oak	Natural monument (III)	5 km	3	One of the oldest protected tree (250 years old). Cultural values.
Oak in Mijo Kovacevic St.	Natural monument (III)	5 km	1	Protected because significant dendrometric values.

Name of protected area	National category (IUCN category)	Distance from the railway	Subsection	The reason for protection
Rajkovic's oak	Natural monument (not reported)	5 km	7	Protected as a rare speciment of once widespread oak forests.

Ecological network of Serbia. The basis for activities related to the establishment of an ecological network, which includes the international Natura 2000 sites, is Article 38, paragraph 6 of the *Law on Nature Conservation.* According to this law the Institute for Nature Conservation of Serbia, in cooperation with other professional and scientific institutions, prepares documentation for the establishment of an ecological network on the territory of the Republic of Serbia. According to the *Decree on Ecological Network*[55], the ecological network of the Republic of Serbia includes 101 ecologically important areas. These areas include the spatial units in which certain protected areas are located, along with the areas defined by international programs for the identification of Important Plant Areas (IPA), Important Bird Areas (IBA), Prime Butterfly Areas (PBA), Ramsar areas (according to the Convention on Wetlands of International Importance, Especially as Waterfowl Habitats), Emerald Areas (according to the Council of Europe Convention on the Conservation of European Wildlife and Natural Habitats), etc. However, the list of ecological network areas is not fully harmonized with the lists of other areas of concern and ecological networks that exist in parallel (such as pSCI and pSPA elaborated below).

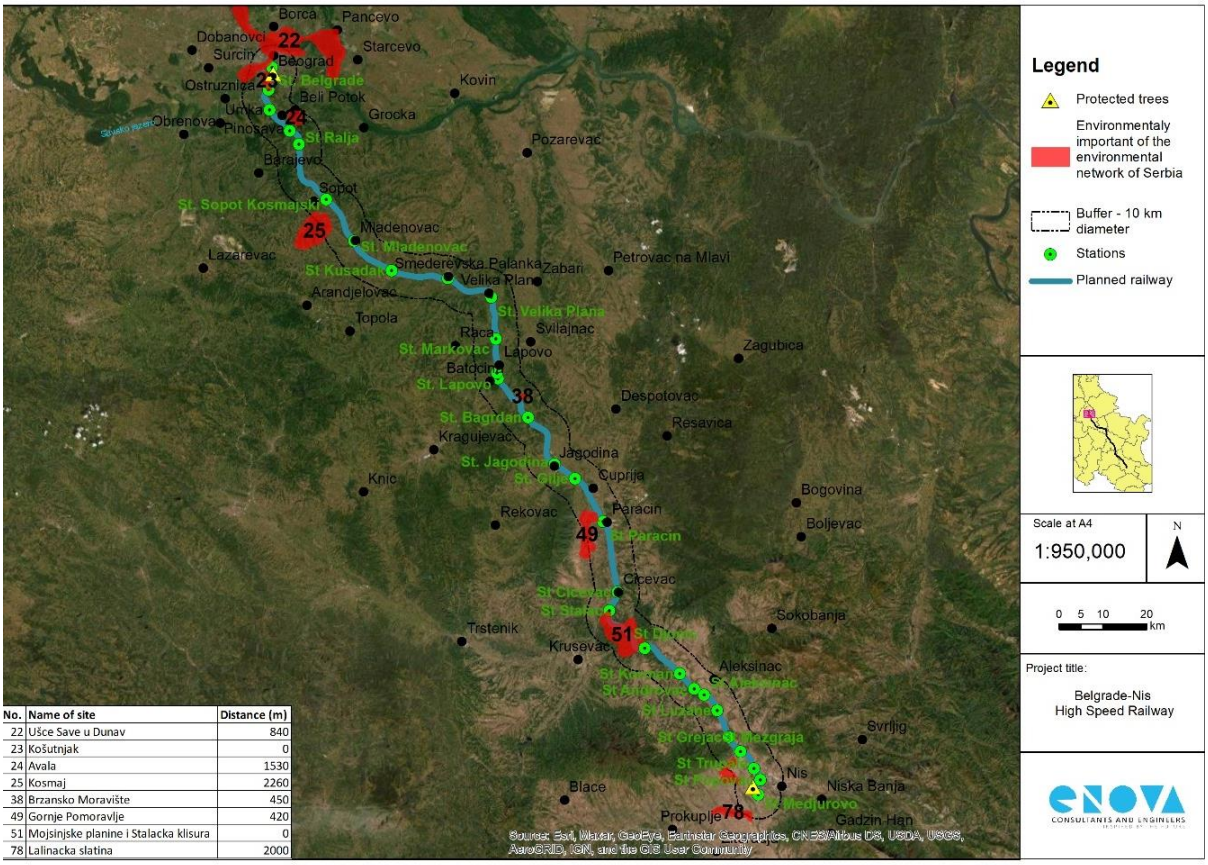
In addition to these areas, the ecological network is composed of certain watercourses with the riparian belts (Danube, Tisa, Sava, Drina, Juzna and Velika Morava, Tamis, Keres, Zlatica, Karas, Nera, Brzava, Moravica, Bosut and Studva) representing the ecological corridors of the international importance since they enable connection with the ecological networks of neighbouring countries.

There are eight ecological network areas in the 5 km-wide zone around the planned railway. The railway will pass through two of them:

- Kosutnjak, subsection 1 – protects forest habitats, mainly *Quercus robur* forests
- Mojsinje Mountains and Stalac Gorge, subsection 6 – protects forest habitats, namely mixed *Quercus frainetto* and *Q. cerris* forests

Two other ecological network areas are in the immediate vicinity: Gornje Pomoravlje located 420 m west of the subsection 4 and Brzansko Moraviste at 450 m east of the subsection 3. Gornje Pomoravlje is included in the ecological network because it is an IBA site, therefore it was designated based on ornithological values. IBA trigger species found in the area are *Sterna hirundo* (common tern), *Alcedo atthis* (common kingfisher) and *Riparia riparia* (collared sand martin). The calculated closest point of Gornje Pomoravlje site is located near the subsection 4, however, this site is in the 5-km buffer zone of the subsection 5 as well. Brzansko Moraviste is a small oxbow lake designated due to high biodiversity, namely birds, amphibians, reptiles and the poplar tree with the largest diameter in Serbia discovered to date (about 200 years old).

[55] "Official Gazette of RS", No. 102/10



No.	Name of site	Distance (m)
22	Ušce Save u Dunav	840
23	Košutnjak	0
24	Avala	1530
25	Kosmaj	2260
38	Brzansko Moravište	450
49	Gornje Pomoravlje	420
51	Mojsinjske planine i Stalacka klisura	0
78	Lalinacka slatina	2000

Figure 43: Environmental network sites in relation to the planned railway

Emerald sites. Council of Europe Convention on the Conservation of European Wild Flora and Fauna and Natural Habitats, known as the Berne Convention, is a binding international legal instrument in the field of nature conservation. The Convention was adopted in Berne (Switzerland) in 1979, entered into force in 1982, and was ratified by Serbia in 2007 by *Law on Ratification of the Convention on the Conservation of European Wild Flora and Fauna and Natural Habitats*[56]. Emerald Network in Serbia is comprised of 61 candidate sites[57] as particularly important for the protection and conservation of wild plant and animal species and their habitats according to the defined criteria for nomination.

There are no Emerald sites in the Project's AoI. Two Emerald sites are located in the wider area of the Project (Figure 44):

- Avala (code RS0000058) – size of the site is 489.13 ha and it is located 1.6 km east of the railway route. The closest railway subsection to the Avala Emerald site is Subsection 2: Resnik-Velika Plana. No impact is expected due to the distance, difference in altitude and trigger biodiversity features. Trigger habitat types for the site are mainly forest habitats not common in the subsection vicinity. Subesquently, the trigger species are predominantly species inhabiting forests and are not abundant in the Project AOI. Avala Emerald site fully overlaps with the Outstanding Natural Landscape Avala – a protected area designated on a national level. The PA is managed by the Public Company "Srbijasume"; however, there is no management plan.
- Kosmaj (code RS0000059) – size of the site is 3514,5 ha and it is located 3 km east of the railway route. It is in the wider area of Subsection 2: Resnik-Velika Plana. Kosmaj site is similar to Avala when it comes

[56] "Official Gazette of RS", No. 102/07
[57] Udpated list of officially nominated candidate Emerald Network sites (December 2021)

to habitat and species composition. Habitat types present on the site are predominantly forest habitats, which is reflected in present species. The Kosmaj Emerald site fully overlaps with Outstanding Natural Landscape Kosmaj – a protected area designated on a national level. It is managed by Public Company "Srbijasume", but management plan does not exist.

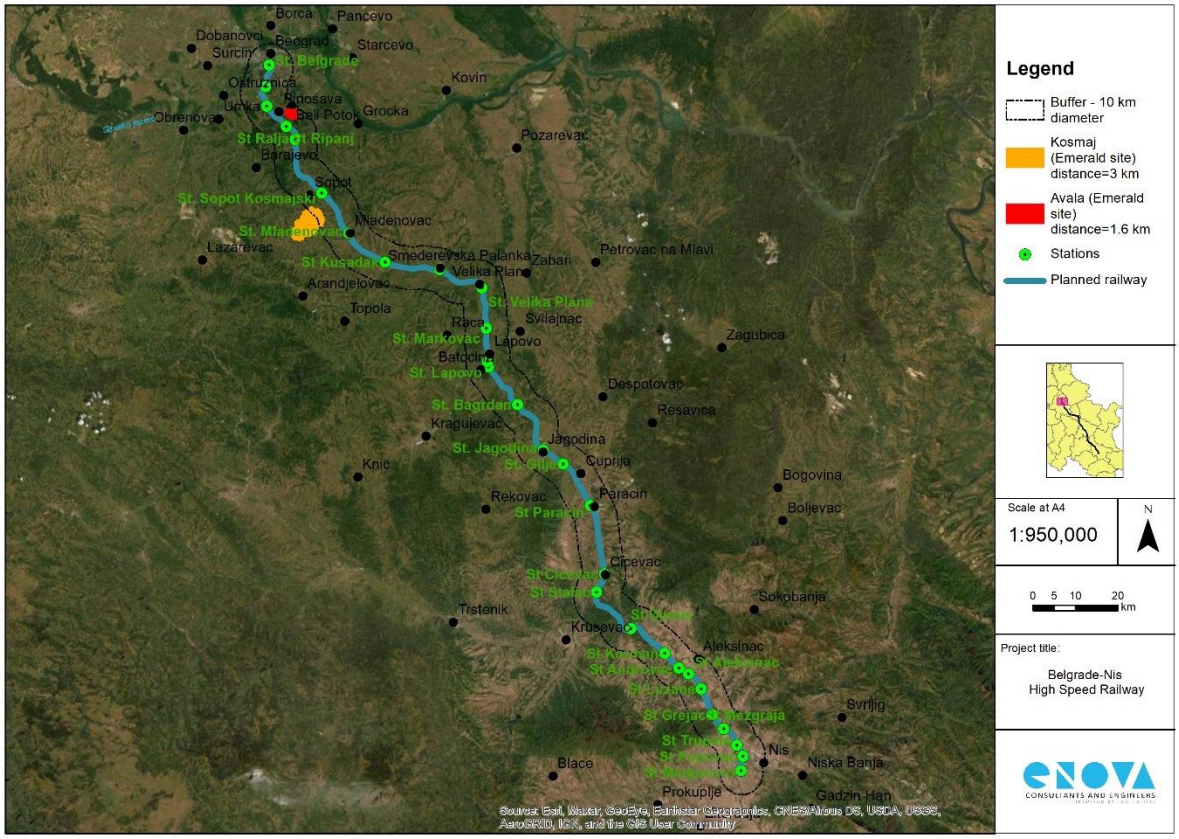


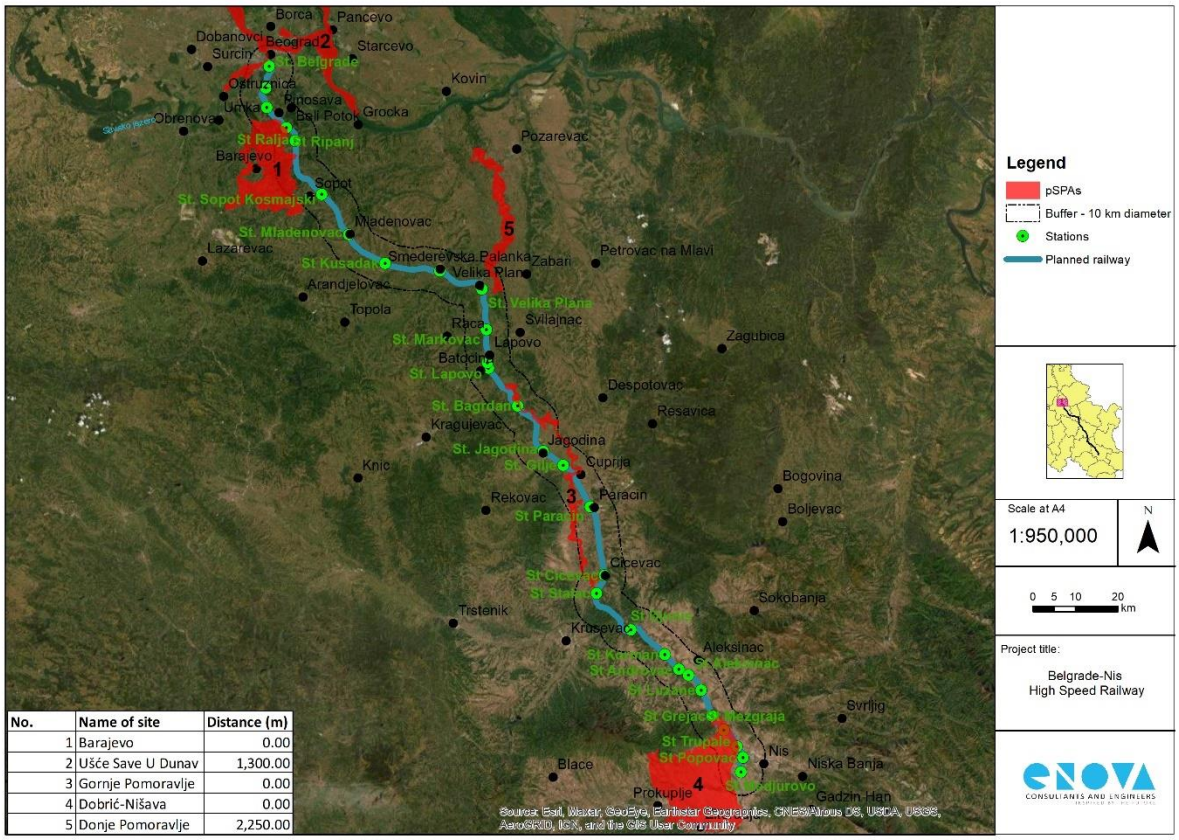
Figure 44: Position of Emerald sites in relation to the railway

Important Bird Areas (IBAs) and proposed Special Protection Areas (pSPAs). As a result of the "EU for Natura 2000 in Serbia" project, a network of pSCIs and pSPAs has been established. pSCIs and pSPAs are not officially included in the *Law on Nature Protection* or its by-laws as such. The Law (Art. 130) states that the ecological network will be established and will become a part of Natura 2000 upon Serbia's accession to the EU. Based on this, the *Regulation on ecological network*[58] (Regulation) was adopted. pSCIs and pSPAs are, generally, areas that countries nominate for Natura 2000 but the Regulation precedes the "EU for Natura 2000 in Serbia" project. Therefore, it is unclear whether Art. 130 refers only to the ecological network established by the 2010 Regulation, or it includes the pSCI/pSPA network as well. Nonetheless, all three areas of concern will be included in the E&S Assessment. pSPAs are areas designated according to the criteria given in the EU Birds Directive and are selected to protect one or more rare, threatened or vulnerable bird species. Similar principles are used in designation of IBAs. The organization that sets the criteria and maintains a central database of internationally important bird areas is BirdLife International. There are currently 79 areas in Serbia that meet the IBA criteria. IBA and pSPA network is assessed jointly as a part of this Report due to the fact that determination of pSPA relied heavily on IBA areas. All accepted IBA sites have been included within the pSPA network, albeit with some minor alterations of site limits (predominantly minor enlargements). Six additional areas that are important for bird conservation but do not meet IBA criteria are included in pSPAs.

[58] „Official Gazette of RS", No. 102/2010

The railway will pass through three pSPAs:

- Barajevo, subsection 2 – pSPA designated based on the occurrence of 25 species listed in Annexes I and/or IIB to the Birds Directive, along with 98 other bird species
- Gornje Pomoravlje, subsections 3, 4 and 5 – pSPA designated based on presence of 40 Natura 2000 bird species, along with 97 other bird species; trigger species for IBA designation are common tern, common kingfisher and collared sand martin
- Dobric-Nisava, subsection 7 – pSPA designated based on occurrence of 50 Natura 2000 bird species, along with 112 other species; trigger species for IBA designation are grey partridge and black-headed bunting



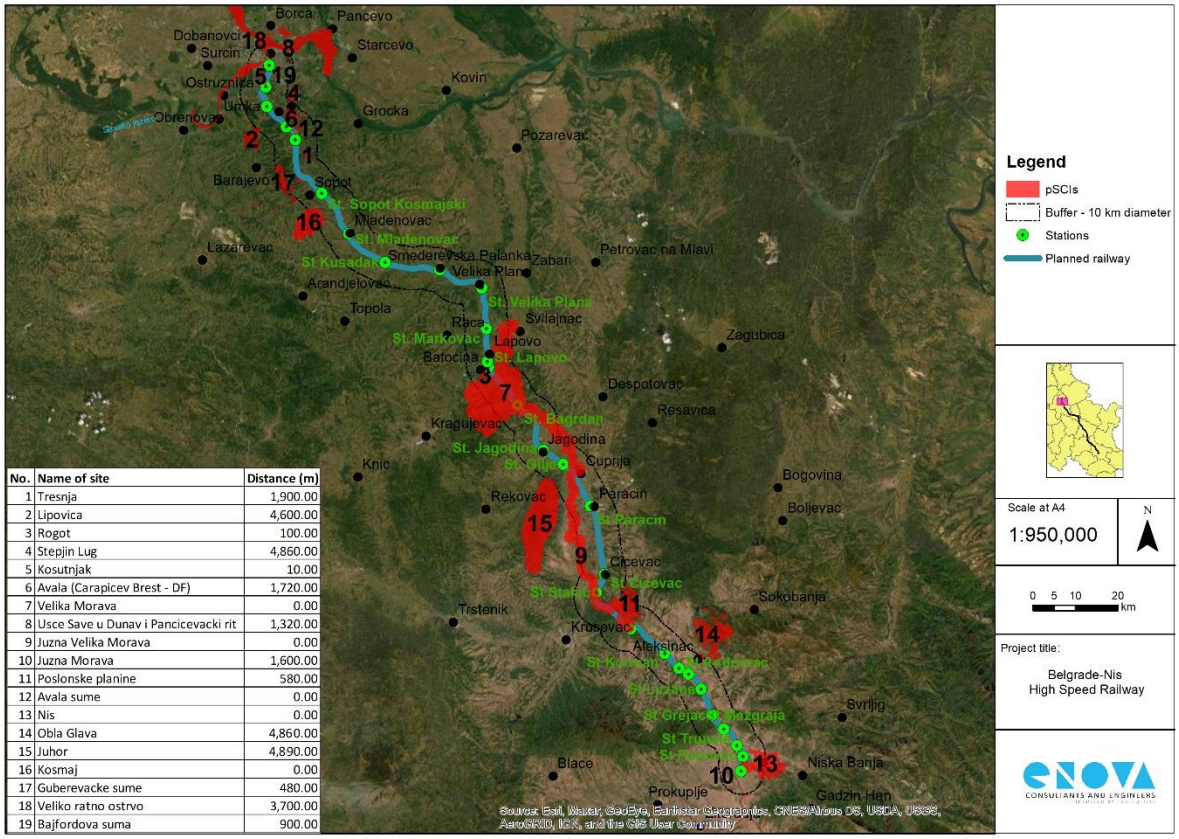
No.	Name of site	Distance (m)
1	Barajevo	0.00
2	Ušće Save U Dunav	1,300.00
3	Gornje Pomoravlje	0.00
4	Dobrić-Nišava	0.00
5	Donje Pomoravlje	2,250.00

Figure 45: pSPAs in the Project's wider region

proposed Sites of Community Importance (pSCIs). As mentioned above, pSCIs were determined in Serbia based on the "EU for Natura 2000 in Serbia". Determination of pSCIs in Serbia was based on criteria given in Habitats Directive. Review of available data on pSCI areas in Project's wider area has shown that a total of 19 pSCIs are within that zone. The railway will pass through a total of four pSCIs:

- pSCI Velika Morava – size of the pSCI is 25,328 ha. It is selected based on presence of eight species of conservation concern: Emys orbicularis, Lutra lutra, Lycaena dispar, Nyctalus noctule, Pipistrellus nathusii, Plecotus austriacus, Theodoxus transversalis, Zerynthia polyxena. The pSCI is located in the AoI of Subsection 3: Velika Plana-Gilje.
- pSCI Juzna Velika Morava – size of the pSCI is 12,745 ha. It is delected for one habitat type: 91M0 Pannonian-Balkanic turkey oak –sessile oak forests, and seven species: *Lutra lutra, Lycaena dispar, Nyctalus noctula, Pipistrellus nathusii, Plecotus austriacus, Theodoxus transversalis, Unio crassus*. The pSCI is located in the AoI of subsections 4 (Gilje-Paracin), 5 (Paracin-Stalac) and 6 (Stalac-Djunis).

- pSCI Avala sume – size of pSCI is 456 ha. Locality is selected for presence of one habitat type listed in on Annex I of the Habitats Directive: 91M0 Pannonian-Balkanic turkey oak –sessile oak forests. The pSCI is located in the AoI of Subsection 2: Resnik-Velika Plana.
- pSCI Nis – size of the pSCI is 4,315 ha. Locality is designated based on presence of 2 species listed in the Annex II to the Habitats Directive: *Eriogaster catax* and *Pipistrellus kuhlii*. The pSCI is found in the AoI of Subsection 7: Djunis-Medjurovo.



No.	Name of site	Distance (m)
1	Tresnja	1,900.00
2	Lipovica	4,600.00
3	Rogot	100.00
4	Stepjin Lug	4,860.00
5	Kosutnjak	10.00
6	Avala (Carapicev Brest - DF)	1,720.00
7	Velika Morava	0.00
8	Usce Save u Dunav i Pancicevacki rit	1,320.00
9	Juzna Velika Morava	0.00
10	Juzna Morava	1,600.00
11	Poslonske planine	580.00
12	Avala sume	0.00
13	Nis	0.00
14	Obla Glava	4,860.00
15	Juhor	4,890.00
16	Kosmaj	0.00
17	Guberevacke sume	480.00
18	Veliko ratno ostrvo	3,700.00
19	Bajfordova suma	900.00

Figure 46: pSCIs in relation to the planned railway route

Ramsar sites. There are no Ramsar sites in the 10 km-wide buffer zone around the planned railway.

Important Plant Areas (IPAs). There are no IPA sites in the 10 km-wide buffer zone around the planned railway.

Prime Butterfly Areas (PBAs). There are no PBA sites in the 10 km-wide buffer zone around the planned railway.

Biosphere Reserves (UNESCO). There are no Biosphere Reserves sites in the 10 km-wide buffer zone around the planned railway.

UNESCO World Natural Heritage sites. There are no UNESCO World Natural Heritage sites in the 10 km-wide buffer zone around the planned railway.

7.1.10 Critical Habitat Assessment (CHA)

Methodology. Potential impacts on sensitive biodiversity features that could be considered a "Critical Habitat" and/or "Priority Biodiversity Feature" have been assessed in accordance with EBRD PR 6 and EIB Standard 4. The EIB's Standard 4 and EBRD's PR 6 have comparable definitions for CH. However, EIB does not introduce the term "priority biodiversity feature" in its policy nor the Guidance Note for Standard 3 published in 2018 (note: biodiversity was previously handled as a Standard 3). Therefore, EBRD's definitions are provided. Regarding criteria, CH criteria for EIB and EBRD Policies are comparable and have matching thresholds; therefore, they have been aggregated in the criteria table given below. EBRD's criteria for PBF determination are also provided.

Critical Habitat (CH) is a description of the most significant and highest priority areas on the planet for biodiversity conservation. It takes into account both global and national priority setting systems and builds on the conservation biology principles of 'vulnerability' (degree of threat) and 'irreplaceability' (rarity or uniqueness). Determination of CH is based upon quantitative thresholds of biodiversity priority which are largely based on globally accepted precedents such as IUCN Red List[59] criteria, local Red Books and Key Biodiversity Area (KBA) thresholds.

Under EBRD PR6, paragraph 14, the most sensitive biodiversity features are defined as CH and include the following:

- Highly threatened or unique ecosystems
- Habitat of significant importance to endangered or critically endangered species
- Habitats of significant importance to endemic or geographically restricted species
- Habitats supporting globally significant (concentrations of) migratory or congregatory species
- Areas associated with key evolutionary processes

While the EIB also introduces an additional criterion: Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups.

EBRD PR6 also uses the concepts of vulnerability and irreplaceability to define areas that, whilst not as globally important as CH, are still of significant ecological importance. Such areas are referred under the EBRD PR6 Guidance[60] as Priority Biodiversity Features (PBF).

PBFs are defined as “a subset of biodiversity that is particularly irreplaceable or vulnerable, but at a lower priority level than critical habitats” by EBRD. They may include areas that contain threatened habitats, vulnerable species, significant biodiversity features identified by a broad set of stakeholders or governments and ecological structure and functions needed to maintain the viability of priority biodiversity features.

In line with EBRD Guidance Note 6, the identification and characterisation of critical habitat should include the following steps:

- Definition of the study area
- Stakeholder consultation and initial literature review
- In-field data collection and verification of available information
- Confirmation of biodiversity likely to meet critical habitat and
- Determination of critical habitat status (of each study area).

In order to conduct a CHA, a study area needs to be defined (critical habitats study area – CHSA). The extent of this is dependent on the biodiversity features of interest and ecological functions that support them which can be different for each feature. The CHSA is independent of the Project area and zone of Project influence and can include a larger geographical area in which impacts on biodiversity are expected.

CHA process starts along with initial screening and scoping to identify biodiversity features that might trigger CH or PBF. With the aim of supplementing rapid field assessment, review of publicly available studies and data regarding the ecological characteristics of the study area must be undertaken as well.

Species registered during desktop and field surveys were assessed with regard to CH and PBF criteria. Assessment of each biodiversity receptor against the CH and PBF/CH criteria uses both qualitative and quantitative thresholds. These are detailed in Table 24 below and summarise both EBRD and EIB requirements.

[59] All references to the IUCN Red List have been taken from the most recent update (Version 2021-3) which can be found at: http://www.iucnredlist.org/ (last accessed 30 May 2022)
[60] EBRD (2020). Guidance Note: EBRD Performance Requirement 6. European Bank for Reconstruction and Development

Species that trigger CH and PBF were brought forward for further assessment. Criteria used to select sensitive biodiversity features, namely species that need further assessment as part of the CHA, are as following:

- EU Habitats Directive[61] – Species listed in Annex II or IV
- EU Birds Directive[62] – Species listed in Annex I
- IUCN[63] Red List – Species with EN, CR or VU conservation status

On the other hand, threatened habitats are habitats considered under pressure by the national, regional or international assessments. These include natural and priority (*) habitats identified under the EU Habitats Directive (Annex I).

Table 24: Criteria and conditions for identifying Priority Biodiversity Features and Critical Habitats

Criterion	Priority Biodiversity Feature	Critical Habitat
1. Priority Ecosystems		
1i Threatened ecosystems		
a) Habitats listed in Annex 1 of EU Habitats Directive (EU members only) or Resolution 4 of Bern Convention (signatory nations only) **b) IUCN Red-List EN or CR ecosystems** **c) Areas recognised as priorities in official regional or national plans**	1 EAAA is habitat type listed in Annex 1 of EU Habitats Directive or Resolution 4 of Bern Convention 2 EAAA < 5% of the global extent of an ecosystem type with IUCN status of CR or EN 3 Key Biodiversity Areas and Important Bird and Biodiversity Areas; nationally and internationally important species or sites for conservation of biodiversity	4 EAAA is habitat type listed in Annex 1 of EU Habitats Directive marked as "priority habitat type" 5 EAAA ≥5% of global extent of an ecosystem type with IUCN status of CR or EN 6 EAAA is ecosystem determined to be of high priority for conservation by national systematic conservation planning
2. Priority Species		
2i Threatened species		
a) Species and their habitats listed in EU Habitats Directive and Birds Directive (EU members only) or Bern Convention (signatory nations only) **b) IUCN Red List EN or CR species** **c) IUCN Red List, or nationally/regionally VU species** **d) Nationally or regionally (e.g., Europe) listed EN or CR species**	a) EAAA for species and their habitats listed in Annex II of Habitats Directive, Annex I of Birds Directive, or Resolution 6 of Bern Convention b) EAAA supports < 0.5% of global population OR < 5 reproductive units of a CR or EN species. c) EAAA supports VU species d) EAAA for regularly occurring nationally or regionally listed EN or CR species	e) EAAA for species and their habitats listed in Annex IV of the Habitats Directive (See EU restrictions) f) EAAA supports ≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species g) EAAA supports globally significant population of VU species necessary to prevent a change of IUCN Red List status to EN or CR, and satisfies threshold h) EAAA for important concentrations of a nationally or regionally listed EN or CR species
2ii Range-restricted species		
	a) EAAA for regularly occurring range-restricted species	b) EAAA regularly holds ≥ 10% of global population AND ≥ 10 reproductive units of the species
2iii Migratory and congregatory species		

[61] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
[62] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009
[63] IUCN 2020. The IUCN Red List of Threatened Species. Version 2020-1

Criterion	Priority Biodiversity Feature	Critical Habitat
	a) EAAA identified per Birds Directive or recognized national or international process as important for migratory birds (esp. wetlands)	b) EAAA sustains, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population at any point of the species' lifecycle c) EAAA predictably supports ≥10 percent of global population during periods of environmental stress

Study area. Where trigger species were known or likely to be present (based on habitat suitability and the presence of field indications nearby or historic records), attempts were made to define the appropriate and relevant study area. It was assigned based on habitats present, species data, an understanding of the Project and expert opinion. Significant limitations in this process were time constraints and large Project area.

The ecologically appropriate area of analysis (EAAA) is determined to include the "wider distribution of potentially affected biodiversity features and the ecological patterns, processes and functions that are necessary for maintaining them throughout this distribution"[64]. Defining an appropriate EAAA is an important step in the CHA process as it ensures assessment of an ecologically relevant feature/area, rather than an area influenced only by the Project footprint. It also has inherent appreciation of ecological function across an area, and therefore avoids the risk of considering the specific areas in which a Critical Habitat trigger may be present discontinuously or seasonally. Determination of EAAA is done separately for every biodiversity receptor, unless species belonging to a certain group have significant EAAA-overlap and EAAAs can be aggregated. In case of uncertainty around distribution, conservative approach was applied and EAAA slightly enlarged as a part of precautionary measures. Further evaluation of EAAA was done with regard to the extent of occurrence (EOO) (if such data was available) and expert inputs to facilitate CHA. The EAAAs for CHs and PBFs listed below are provided in the Appendix 4 to the E&S Assessment Report.

Assessment of habitats and species. Conservation status and presence on HD/BD, red lists and Bern Convention of all species found during the 2022 desktop and field surveys was reviewed. All of the species with conservation status other than DD, LC and NT, and the ones listed in the Natura 2000 directives and/or Bern convention were extracted for analysis. Since there are no Annex I habitat types in the Project's area of influence, only habitats listed in Resolution 4 of the Berne Convention were assessed.

The following table contains a list of registered species that were brought forward for further assessment. The criteria designation is with reference to Table 24 where the PBF/CH qualifying criterion is defined. If the species met criteria for both PBF and CH, they were treated as CH. It is important to note that the Red Book of Fish of Serbia is not yet publicly available, but the expert provided the up-to-date information about the conservation status.

A total of 67 features were analysed, 40 met the criteria for PBF and 27 for CH.

Species	Conservation status	CH/ PBF	Criteria	Comment
Habitats				
C3.2 - Water-fringing reedbeds and tall helophytes other than canes	BC Res. 4	PBF	1iaa	Resolution 6 habitats are used for designation of Emerald sites. Water-fringing stands of tall vegetation by lakes (including brackish lakes), rivers and brooks, usually species-poor and often dominated by one species. This habitat type was recorded in subsection 7.

[64] EIB Guidance Note for Standard 3 on Biodiversity and Ecosystems, 2018

Species	Conservation status	CH/ PBF	Criteria	Comment
G1.11 - Riverine *Salix* woodland	BC Res. 4	PBF	1iaa	Resolution 6 habitats are used for designation of Emerald sites. G1.11 includes *Salix* spp. scrub or arborescent formations, lining flowing water and submitted to periodic flooding, developed on recently deposited alluvion. Willow brushes are particularly characteristic of rivers originating in major mountain ranges. Shrubby willow formations also constitute an element of lowland and hill riverine successions in all major biomes, often making the belt closest to the water course. This habitat type was recorded on subsections 2, 3, 5 and 7.
Invertebrates				
Euphydryas aurinia Marsh fritillary	IUCN LC, **HD II**	PBF	2iaa	It is protected by Annex II of the Habitats Directive and Annex 2 of the Berne Convention. It is not considered an endangered species at the global, European and national level - least concern (LC). It inhabits moist meadow habitats in the lowlands, while at higher altitudes it prefers a slightly wider range of grassy habitats. Caterpillars most often feed on plants from the genus *Scabiosa*, sometimes also on the genus *Gentiana*, less often *Centaurea*. This species is widely distributed. It inhabits almost all of Europe, parts of North Africa and a large part of Asia. During the last few years, it has significantly expanded its area in the territory of Serbia and its EOO is 47,869 km^2. It is found in western, eastern, southern and central Serbia, while in the area of Vojvodina there are only old literary references and individual, random finds. It can likely be found in other locations in the southern part of the project area. The size of the population within the investigated area is rather small. It can be found on one locality along subsection 7: Djunis-Medjurovo.
Lycaena dispar Large copper	IUCN NT, RS LC, **HD II**, **IV**, **BC Res. 6**	CH	2iae	Strictly protected species in Serbia. It is listed in Annexes II and IV of the Habitats Directive, Annex 2 and Resolution 6 of the Berne Convention, and is globally Near Threatened (NT). It is not endangered in Serbia and Europe - last concern (LC). It inhabits marshy habitats, areas near streams, rivers and wet, marshy meadows. Caterpillars develop on different species of sorrel (*Rumex* spp.), sometimes also on *Polygonum bistorta*. This species is widely distributed. It inhabits temperate areas of Europe and Asia. The EOO on the territory of Serbia is 94,551 km^2 and it is located on the entire territory of the country. Populations are always small, but the species is a relatively good local migrant, so it can be expected in additional locations within the investigated area.
Nymphalis vaualbum Compton tortoiseshell	IUCN LC, RS LC, **HD II, IV, BC Res. 6**	CH	2iae	The species is strictly protected in Serbia. It is listed as a priority species for protection in Annexes II and IV of the Habitats Directive. It is found in Annex 2 and Resolution 6 of the Berne Convention. It is not considered an

Species	Conservation status	CH/ PBF	Criteria	Comment
				endangered species at the global, European and national level - last concern (LC). It inhabits forest habitats, but populations in Serbia are mostly associated with slightly cooler areas in the beech belt. Caterpillars can develop on different types of plants from the genera *Populus*, *Salix*, *Ulmus*, *Betula* and *Urtica*. This species is widely distributed and includes the area of Europe, Asia and North America. It is rare in Europe and its range includes the central and eastern parts of the continent. Permanent populations are mostly found in the territory of Serbia and Bulgaria, while migrants are mostly found in other countries. EOO on the territory of Serbia is 58,410 km^2. Permanent populations are linked to the hilly and mountainous regions of the country, while migrants can be found outside this area as well. It can be expected in more localities within well-preserved forests along the railway. It is estimated that the size of the permanent population within the investigated area is small.
Phengaris arion Large blue	IUCN NT, RS LC, **HD IV**	CH	2iae	The species is strictly protected in Serbia. It is on Annex IV of the Habitats Directive. It is considered a near threatened species at the global level (NT), an endangered species in Europe (EN), but not endangered in the territory of Serbia - last concern (LC). In Serbia, it most often inhabits overgrown meadows, less often somewhat more open habitats. Caterpillars feed on oregano plants (*Origanum vulgare*), but populations that develop on *Thyme* (*Thymus* spp.) are also known to science. The butterfly inhabits temperate regions of Europe and Asia. EOO on the territory of Serbia is 62,133 km^2. It is found in the hilly regions of the whole of Serbia. It can be expected at many locations along the railway. The butterfly flight period is outside the period in which field research was carried out. It is assumed that the number of populations within the investigated area is small.
Parnassius mnemosyne Clouded Apollo	IUCN NT, RS LC, **HD IV**	CH	2iae	The species is strictly protected in Serbia. It is listed in Annex IV of the Habitats Directive and Annex 2 of the Berne Convention. It is listed as a near threatened species in Europe. It is not threatened at the global and national level (LC). It inhabits forest roads, clearings, forest edges, clearings, and the belt along the upper forest border in the mountains. Caterpillars feed on *Corydalis* spp. This species is widely distributed and inhabits Europe, western and central Asia. EOO on the territory of Serbia is 73,683 km^2. In Serbia, it is not found in the plains of Vojvodina. It can be expected at multiple locations within the investigated area.

Species	Conservation status	CH/ PBF	Criteria	Comment
				It is assumed that the populations of this species are small to moderate in abundance in the investigated area.
Zerynthia polyxena Southern festoon	IUCN LC, RS LC, **HD IV**	CH	2iae	The species is strictly protected in Serbia. It is on Annex IV of the Habitats Directive. It inhabits open habitats near rivers and streams, but it can also be found in agricultural areas, as well as within human settlements. Caterpillars feed on wolf's apple (*Aristolochia clematitis*, and less often other species from the genus *Aristolochia*). It is widespread in Central Europe, on the Balkan Peninsula and in the western parts of Asia. EOO on the territory of Serbia is 85,887 km^2. It is found throughout Serbia. It can be expected at more locations within the investigated area. There are significant populations of this butterfly in the researched area.
Lucanus cervus Stag beetle	IUCN LC, **HD II, BC Res. 6**	PBF	2iaa	Stag beetle is strictly protected in Serbia. The species is found in Annex 2 of the Habitats Directive and in Annex 3 and Resolution 6 of the Berne Convention. It is listed as globally threatened - last concern (LC). The threat status in the territory of Europe and Serbia is not known. Stag beetle inhabits Central and Southern Europe and Asia Minor. Most preferred habitats are urban woodland and forest. May also occur in grassland, heathland, and shrubs. It can most often be found in old trees or stumps, especially in oak forests. Females lay eggs in old, fallen trees that are beginning to decay. Found on subsections 5 and 6.
Morimus asper Beech Longhorn Beetle	**IUCN VU, HD II, BC Res. 6**	PBF	2ica	The species is strictly protected in Serbia. It is on Annex II of the Habitats Directive and within Resolution 6 of the Berne Convention. It is globally considered an endangered species (VU), but its endangered status is not known at the European and national level. Morimus asper is a silvicolous, xylophagous and saproxylic species, its main habitat being deciduous and mixed forests. The species lives mainly in old-growth forests or well-structured woodlands, with a medium-high density of dead wood. Found on subsection 6.
Coenagrion ornatum Ornate bluet	IUCN LC, **HD II**	PBF	2iaa	The species breeds in shallow, unshaded, slowly-flowing streams with moderate growth. It is absent from water bodies with densely overgrown banks. Most of the known localities in Europe are along ditches in agricultural areas where people regularly mow the banks and clean the bottoms. Found on subsection 7. Populations of these species are very rare and have local character; therefore, any changes in water regime caused by this project may have significant impact.
Fish				
Cobitis elongata Balkan spined loach	IUCN LC, RS LC, **HD II, BC Res. 6**	PBF	2iaa	Found in moderate to fast-flowing stretches of shallow rivers of Danube drainage, on sandy banks and shores, sometimes on rock bottom with submerged vegetation. *Ordinance on measures for preservation and protection of*

Species	Conservation status	CH/ PBF	Criteria	Comment
				fish stock[65] has put a permanent ban on fishing of this species in 2019. Present in: Jasenica, Lugomir, Juzna Morava (Gornja Toponica), Velika Morava (Cuprija) Rivers.
Cobitis elongatoides Spined loach	IUCN LC, RS LC, **HD II**, **BC Res. 6**	PBF	2iaa	Present in the Danube basin from Serbia to Romania. Adults are found in flowing or still waters from small brooks to large rivers, springs, lakes and oxbows on sand, silt or mud bottom. Present in: Jasenica, Kubrsnica, Raca, Lugomir, Velika Morava (Cuprija) Rivers.
Sabanejewia balcanica Balcan spined loach	IUCN LC, RS LC, **HD II, BC Res. 6**	PBF	2iaa	It lives only in the tributaries of the Danube and the Aegean Sea. It lives in the upper and middle reaches of rivers. Present in: Osanica, Lugomir, Juzna Morava (Gornja Toponica), Nisava Rivers.
Cottus gobio Bullhead	IUCN LC, RS LC, **HD II, BC Res. 6**	PBF	2iaa	Inhabits warm, deep, slow-flowing and still waters such as lowland rivers and large, well vegetated lakes. Hardy and tolerant of a wide variety of conditions but thrives in large turbid rivers. Present in Crnica and Lugomir Rivers.
Barbus balcanicus Danube barbel	IUCN LC, RS LC, **BC Res. 6**	PBF	2iaa	Adults inhabit fast to moderate-flowing premontane and montane streams and small rivers with gravel bottom. Found most abundantly in rapids and riffles during the day. Spawn in riffles. Common in Project area and present in: Jasenica, Kubrsnica, Raca, Velika Morava (Bagrdan, Cuprija), Osanica, Lugomir, Crnica, Juzna Morava (Praskovce, Vitkovac, Gornja Toponica), Nisava Rivers. Migratory species, migration route must not be affected.
Cyprinus carpio Common carp	**IUCN VU**, RS LC	PBF	2icc	Inhabits warm, deep, slow-flowing and still waters such as lowland rivers and large, well vegetated lakes. Hardy and tolerant of a wide variety of conditions but generally favor large water bodies with slow flowing or standing water and soft bottom sediments. Thrive in large turbid rivers. Present in: Jasenica, Juzna Morava (Praskovce, Vitkovac) Rivers.
Leuciscus aspius Asp	IUCN LC, RS LC, **HD II, BC Res. 6**	PBF	2iaa	Asp is listed on Annex II of the Habitats Directive and in the Reoslution 6 of Berne Convention. It is not of conservation concern in Europe or Serbia. The species occurs in open water of large and medium-sized lowland rivers and large lakes. It prefers to stay near bridge pillars, near tributaries, under weirs, in deep currents and overgrown parts of river and in quiet bays of river bends. The construction of the railway will not have a permanent impact on the adaptable asp. Present in: Jasenica, Velika Morava (Bagrdan, Cuprija), Juzna Morava (Praskovce, Vitkovac, Gornja Toponica) Rivers. Migratory species, migration route must not be affected.
Rhodeus amarus European bitterling	IUCN LC, RS II, **HD II, BC Res. 6**	PBF	2iaa	Occurs most abundantly in still or slow-flowing water with dense aquatic vegetation and sand-silt bottom as lowland ponds, canals, slow-flowing rivers, backwaters and oxbows, where mussels are present.

[65] „Official Gazette of RS", No. 56/15 and 94/18

Species	Conservation status	CH/ PBF	Criteria	Comment
				Abundant and expanding in most of its range, but locally threatened by water pollution, weed clearing, and stocking of predatory fish. Present in: Jasenica, Kubrsnica, Velika Morava (Bagrdan, Cuprija), Lugomir, Juzna Morava (Gornja Toponica), Crnica, Nisava Rivers.
Zingel zingel Common zingel	IUCN LC, **RS VU**, **BC Res. 6**	PBF	2iaa	Found in moderately flowing river sections of the Danube, Prut, Dniester and some of their river branches. It prefers deep water and relatively fast flows but is not quite as sensitive to impoundment as *Zingel streber*. In Serbia, this fish inhabits the Danube River and its main tributaries (Sava, Tisa, Drina, Velika Morava, Zapadna Morava, etc). *Ordinance on measures for preservation and protection of fish stock*[66] has put a permanent ban on fishing of this species in 2019. Present in: Juzna Morava River (Praskovce, Vitkovac).
Amphibians				
Bombina bombina European fire-bellied toad	IUCN LC, RS LC, **HD II, IV**	CH	2iae	The European fire-bellied toad is found throughout Central and Eastern Europe. This frog generally prefers to live in lowland areas such as ponds and marshes without too much woody vegetation. It is mainly diurnal and aquatic, spending much of their time in slow-moving waters of marshes and ponds. The species can be found on several localities along subsections in the researched area. It is common and numerous in Serbia and can be expected near waterbodies along the railway.
Bombina variegata Yellow-bellied toad	IUCN LC, RS LC, **HD II**, **IV**, **BC Res. 6,**	CH	2iae	The range of yellow-bellied toad covers most of western and central Europe. It usually lives in stagnant waters such as ponds and small lakes, but can also be found in small canals, especially in habitats along forest edges. In Serbia, it inhabits all hilly and mountainous areas. It breeds in and inhabits small water bodies, often created by large machinery and damages to existing (forest) roads. Based on literature data, the species can be found in multiple sections within the investigated area and is likely to be found in all subsections in large numbers.
Bufotes viridis Green toad	IUCN LC, RS LC, **HD IV**	CH	2iae	*Bufotes viridis* is one of the most polytopic amphibians of the Palearctic. It lives in the zones of forests, forest steppes, steppes, semi-deserts and deserts. It is more tolerant to dry conditions than many other amphibians. In the forest zone, the species tends to live in open areas and bushlands, often far away from water bodies, whereas in the southern dry parts of the range it primarily inhabits moist sites such as oases, the shores of irrigation ditches and lakes. It is common and widespread in Serbia. Green toads are species resilient to changes in their habitats. Based on literature data, it is assumed that the species is very common within the investigated area and is

[66] Ibid.

Species	Conservation status	CH/ PBF	Criteria	Comment
				likely to be found along all subsections of the planned railway.
Hyla arborea European tree frog	IUCN LC, RS LC, **HD IV**	CH	2iae	In Serbia, it inhabits the lower mountainous regions and Vojvodina. This small frog is an arboreal species, living mainly on trees in sunny parts of deciduous and mixed forests, in shrubs, orchards, floodplain meadows, floodplain forests, wetlands, reeds, gardens, lake shores and streams at altitudes up to 2300 meters. European tree frog is common and widely distributed in the area. European tree frog is sensitive to habitat fragmentation. It is assumed that the number of populations within the investigated area is large and the species is widespread based on literature data.
Pelobates balcanicus Balkan Spadefoot Toad	IUCN LC, RS DD, **HD II**	PBF	2iaa	*Pelobates balcanicus* is restricted to the Balkan Peninsula, 0–920 m a.s.l. In the north, it is present in northern Serbia and northwestern Romania. It follows the Danube River from Serbia to the Black Sea in Romania. This grassland species typically inhabits soft (e.g., sandy) soils with freshwater ponds for breeding and have a semi-fossorial lifestyle. The species can be found on multiple localities within the investigated area.
Pelobates fuscus Common spadefoot	IUCN LC, RS DD, **HD IV**	CH	2iae	*Pelobates fuscus* is distributed in the plains and hills of Central, Eastern and Southeastern Europe, as well as Western Asia. In Balkans, the species habitats are fragmented. It inhabits a wide spectrum of habitats, including different coniferous, deciduous and mixed forests and their edges, groves, steppes, meadows, fields, parks and gardens. The lowlands and floodplains around large rivers are the most suitable for the species population and i tis very likelu the species can be found along the entire railway. Individuals live on land, except for the mating period, and during the day they rest buried in the sand. The species populations are widespread within the investigated area.
Pelophylax lessonae Pool frog	IUCN LC, RS DD, **HD IV**	CH	2iae	The pool frog is found across most of central and northern Europe from the west coast of northern France to the Western part of Russia. There are also small populations of pool frogs in the United Kingdom, Spain, Sweden and Norway. *Pelophylax lessonae* inhabits deciduous and mixed forests. The frog penetrates steppe within forests and bushlands. It occurs primarily in stagnant water bodies such as lakes, ponds, swamps, large puddles and ditches, generally covered with dense herbaceous vegetation. The pools may be located within the forests, in glades and forest edges, in fields and flooded meadows. The frog occasionally stays in shallow pools along small rivers and streams. The presence of permanent water is necessary for the existence of *P. lessonae* populations. It can be found on several localities in the researched area.
Rana dalmatina Agile frog	IUCN LC, RS LC, **HD IV**	CH	2iae	Agile frog inhabits parts of the Western and Central Europe, Apennine and Balkan peninsulas and northern Asia Minor. In Serbia, it is the most common and widespread brown

Species	Conservation status	CH/ PBF	Criteria	Comment
				frog, which can be found in all three altitudinal regions – Pannonian, Peripannonian and Mountain-valley. It is found mostly in open deciduous forests and damp meadows but also in all habitats with suitable shallow or ephemeral ponds, including steppe fragments, rural habitats, parks and edges of agricultural land. The size of the population within the investigated area is rather small. It can be found on multiple localities along subsection 3: Velika Plana-Gilje.
Triturus ivanbureschi Long-fingered newt	IUCN NE, **RS VU, HD II, IV**	CH	2iae	The species distribution ranges from the Southeastern Balkan peninsula (Western North Macedonia, Serbia Northwestern Greece, Bulgaria, Eastern Thrace) to Western Anatolia. *Triturus ivanbureschi* is typically found inhabiting still ponds with thick vegetation. However, they are found across various environmental conditions. In the early developmental stages, individuals are aquatic, as they grow older, they likely live in a terrestrial environment. The species can be found along multiple sections within the investigated area.
Triturus dobrogicus Danube crested newt	IUCN NT, RS NT, **HD II**	PBF	2iaa	Danube Crested Newt inhabits lowland areas (up to 250 m a.s.l.), flood river valleys and river systems of Southeastern Europe. In particular, species is widespread in lowland parts of the valley of the Danube River system. For half of the year or longer, adults live in slow-flowing river margins, lakes, or ponds, where reproduction takes place. During land phase, the newts live in deciduous forests or groves, bushlands, or meadows. Based on literature data, the species can be found on multiple localities along subsection 1: Belgrade-Resnik.
Triturus macedonicus Macedonian crested newt	IUCN NE, RS LC, **HD II, IV**	CH	2iae	The species distribution area includes Eastern Bosnia-Herzegovina, central and southern Serbia, central and western Macedonia and Albania to northeastern Bulgaria, south into northwestern and central Greece, northwestern Anatolian Turkey. The species lives in different types of waterbodies with a relatively stable hydroperiod, with dense aquatic vegetation, intermediate pH, ionic concentration and without fish. It is closely related to all types of aquatic biotopes during the mating season. After that, it leaves the aquatic environment but never goes too far. The species is common along subsection 7: Djunis-Medjurovo.
Reptiles				
Coronella austriaca Smooth snake	IUCN LC, RS LC, **HD IV**	CH	2iae	The species is found in northern and central Europe, but also as far east as northern Iran. It is a common and widespread species in Serbia present throughout the country. Some active lines in sunny areas of large valleys and some large switchyards, as well as unused railways not dismounted, have a particularly high richness of reptiles. In

Species	Conservation status	CH/ PBF	Criteria	Comment
				fact, those railways may have contributed to the local dispersal of smooth snake[67]. The species is present in a large variety of habitats and it is adaptable therefore is numerous and common within the entire investigated area.
Dolichopis caspius Caspian whipsnake	IUCN LC, RS DD, **HD IV**	CH	2iae	*D. caspius* is related to steppe and forest-steppe habitats and occupies less than 50% of Serbian territory. This snake should be of special conservation interest because its range is highly fragmented due to alterations of original steppes and forest-steppes into agricultural fields. The species can be found on 3 localities along subsection 2: Resnik-Velika Plana and subsection 5: Paracin-Stalac.
Natrix natrix Grass snake	IUCN LC, RS LC, **BC Res. 6**	PBF	2iaa	A very common and widespread species in Serbia present throughout the country. Present in various aquatic habitats, from lowlands to high mountains. Grass snake can be found throughout the Project area, but a special focus should be paid on riverbanks. The habitat loss is possible as a negative impact. It was be found on several localities along subsection 1: Belgrade-Resnik and subsection 2: Resnik-Velika Plana but can be expected in great numbers near aquatic habitats along the railway.
Natrix tessellata Dice snake	IUCN LC, RS LC, **HD IV**	CH	2iae	A common and widespread species in Serbia present throughout the country. The presence is associated with rivers, coasts, streams, lakes, ponds and the surrounding terrestrial habitat. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. It was found on 3 localities along subsection 3: Velika Plana-Gilje and subsection 4: Gilje-Paracin but can be expected in great numbers near aquatic habitats along the railway.
Zamenis longissimus Aesculapian snake	IUCN LC, RS LC, **HD IV**	CH	2iae	The species prefers forested, warm but not hot, moderately humid but not wet, hilly or rocky habitats with proper insolation and varied, not sparse vegetation that provides sufficient variation in local microclimates. Frequented locations include places such as forest clearings in succession, shrublands at the edges of forests interspersed with meadows. They avoid open plains and agricultural deserts. In Serbia, it is a very common species that can be found throughout the country. The species was found on several localities along subsection 2: Resnik-Velika Plana and subsection 3: Velika Plana-Gilje.
Mediodactylus kotschyi Kotschy's gecko	IUCN LC, **RS CR, HD IV**	CH	2ide	Kotschy's gecko is mostly distributed along the coastal areas of the Eastern Mediterranean Sea and the Black Sea. It is native to Serbia. Its typical habitat is cliffs, dry stony areas, scrub, tree trunks, stone walls, and the external and internal walls of buildings. It is found at elevations of up to 1,700 m but is mostly a lowland species. Kotschy's gecko is mainly nocturnal but at cooler times of year it is often active

[67] Lucas, P.S., de Carvalho, R.G., Grilo, C. (2017). Railway Disturbances on Wildlife: Types, Effects, and Mitigation Measures. In: Borda-de-Água, L., Barrientos, R., Beja, P., Pereira, H. (eds) Railway Ecology. Springer, Cham. https://doi.org/10.1007/978-3-319-57496-7_6

Species	Conservation status	CH/ PBF	Criteria	Comment
				in the day as well, especially early and late. It is infrequently found in buildings. Therefore, it was expected that the species was found along subsection 1: Belgrade-Resnik.
Lacerta viridis European green lizard	IUCN LC, RS LC, **HD IV**	CH	2iae	This species prefers warmer habitats, so it is widespread mainly in the southern part of Europe, but also in almost all of France and most of Eastern Europe. In Serbia, it is very common everywhere where habitats are open and dotted with bushes. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. The loss of habitat, if any, will be minor and will be offset by revegetation. It can be found on multiple localities along subsection 2: Resnik-Velika Plana, subsection 3: Velika Plana-Gilje, subsection 4: Gilje-Paracin, subsection 5: Paracin-Stalac, subsection 6: Stalac-Djunis and subsection 7: Djunis-Medjurovo but can be expected along the railway.
Podarcis muralis Wall lizard	IUCN LC, RS LC, **HD IV**	CH	2iae	The species is considered to be widely spread in Europe and of least conservation concern. This is a very common and widespread species, well-adjusted to natural and urban habitats in majority of Serbia. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. It is scientifically established that railways are a desirable habitat and enable dispersal of wall lizards. The species populations are very numerous and widespread along all subsections within the investigated area.
Ablepharus kitaibelii European copper skink	IUCN LC, RS LC, **HD IV**	CH	2iae	*A. kitaibelii* is native to Greece, Romania, Bulgaria, the former Yugoslavia, Hungary, Albania, Slovakia, the Caucasus, Turkey, Syria, Israel, Jordan, Lebanon, the Sinai Peninsula of Egypt and possibly Iraq. It is a shy species, which lives under stones and leaves in dry places, such as south slopes, fields, and meadows. It is active during twilight, and hunts for insects and small snails. It is a typical ground dweller, and dislikes climbing. Based on literature data, the species can be found along subsection 1: Belgrade-Resnik and subsection 2: Resnik-Velika Plana.
Emys orbicularis European pond turtle	IUCN NT, RS DD, **HD II, IV**, **BC Res. 6**	CH	2iae	*E. orbicularis* occupies a large part of the territory of the Republic of Serbia. It can be found in almost all types of aquatic biotopes with stagnant and slowly flowing waters. Its populations are particularly numerous in aquatic biotopes with abundant vegetation. Habitat conservation is one of the fundamental and most important direct protection measures. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. It can be found on two localities along subsection 3: Velika Plana - Gilje.
Testudo hermanni The Hermann's tortoise	IUCN NT, RS NT, **HD II, IV**, **BC Res. 6**	CH	2iae	The species prefers open patchy evergreen Mediterranean oak forest, but in its absence inhabits maquis, garrigue, dune scrub and maritime grassland, as well as agricultural and railway edge habitats, thus showing the adaptability to various range of habitats. The species is endemic to southern Europe.

Species	Conservation status	CH/ PBF	Criteria	Comment
				Possible loss of habitat unlikely to significantly impact the long-term survival of the species but targeted mitigation will be needed. It can be found on multiple localities along subsection 5: Paracin-Stalac, subsection 6: Stalac-Djunis and subsection 7:Djunis-Medjurovo.
Vipera ammodytes Nose-horned Viper	IUCN LC, RS LC, **HD II, IV**	CH	2iae	The species is considered to be widely spread in Mediterranean and South Europe as well as East Asia and of least conservation concern. It is common and widespread in whole Serbia. Possible loss of habitat unlikely to significantly impact the long-term survival of the species. The workers shall be educated on nose-horned viper and instructed not to upset or handle it. It can be found on several locations along subsection 3: Velika Plana – Gilje but it is expected along the railway.
Birds				
Accipiter gentilis Northern goshawk	IUCN LC, RS VU, **BC Res. 6**	PBF	2iaa	Northern goshawks are found throughout the mountains and forests of North America and Eurasia. The species inhabits mature woodland, particularly coniferous, but also deciduous or mixed, preferring areas near clearings and the forest edge. It is a regularly nesting bird in Serbia. It is endangered due to the destruction of habitats, but also due to direct persecution and killing by humans. Northern Goshawk was recorded in one locality, Ripanj, subsection 2, which is a possible breeding location. The population of this species in Serbia is declining and it is estimated that the number is around 1,000 pairs.
Actitis hypoleucos Common Sandpiper	IUCN LC, **RS EN**	PBF	2idd	Common sandpiper has EN national status, however the localities where the species was found, as well as the behavior, indicate that they were in migration, and that individuals do not nest in these localities. National population is estimated at 100-200 pairs. It was recorded on localities along subsections 5, 6 and 7.
Alcedo atthis Common Kingfisher	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	Common Kingfisher was recorded at four locations. Habitats near water with sand clifs are suitable for nesting. National population is estimated (NPE) at 2,700-4,000 pairs. It was recorded on localities along subsections 3, 4, 5, 6 and 7.
Ardea purpurea Purple Heron	IUCN LC, **RS VU, BD I, BC Res. 6**	PBF	2iaa	Purple heron was recorded at 2 locations on migration, on localities along subsections 3 and 7. National population is estimated at 645-900 pairs and almost all population is in Vojvodina (lowlands in Northern Serbia).
Cettia cetti Cetti's Warbler	IUCN LC, **RS VU**	PBF	2icc	Cetti's Warbler was recorded in Vrtiste locality (subsection 7), one singing male in a suitable habitat. Cetti's Warbler is rare bird in Serbia, with the estimated number of individuals in Serbia is 20-110 pairs.
Ciconia ciconia White Stork	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	White stork was recorded at eight locations along subsections 1, 3, 4 and 7. As the species nests in the settlements on electric poles or roofs of houses, certain localities were suitable for nesting, but no active nests were

Species	Conservation status	CH/ PBF	Criteria	Comment
				found. National population is estimated at 1,240-1,410 pairs.
Ciconia nigra Black Stork	IUCN LC, RS NT, **BD I, BC Res. 6**	PBF	2iaa	Black stork was also recorded on migration, at two locations along subsections 3 and 5. National population is estimated at 135-172 pairs.
Circus aeruginosus Western Marsh Harrier	IUCN LC, RS NT, **BD I, BC Res. 6**	PBF	2iaa	National population is estimated at 349-468 pairs. It was recorded on localities along subsections 3 and 7.
Leiopicus medius Middle Spotted Woodpecker	IUCN LC, RS LC, **BD I**	PBF	2iaa	Middle Spotted Woodpecker nests in all regions of Serbia, population is estimated at 10,000-15,000 pairs. It was recorded on locality Cicevac (subsection 5).
Dendrocopos syriacus Syrian Woodpecker	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	It is widespread in the wider area of Southeast Europe and Asia Minor. It is a resident bird. Inhabits semi-open habitats of plains and hills, old orchards, tree lines, bans, hedges, parks and gardens. It nests in holes in tree trunks that it makes itself. European population is declining slightly. However, in Serbia, the population is slightly growing and is estimated at 28,000-37,000 breeding pairs. It is very numerous and nests all over Serbia. It was recorded on locality Cicevac (subsection 5).
Dryocopus martius Black Woodpecker	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	One singing male of Black woodpecker was recorded. National population is estimated at 2,400-3,200 pairs. In the last years, population growth has been observed. It is widespread in Serbia and inhabits many different habitats (orchards, different types of forest, parks…). It was recorded on locality Mezgraja (subsection 7).
Egretta garzetta Little Egret	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	Little egret was recorded at one location but it was in migration. National population estimate is at 1,000-1,500 pairs. It was recorded on locality Cuprija (subsection 3).
Emberiza hortulana Ortolan Bunting	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	Ortulan Bunting prefers preffer mosaic open habitats of orchards and agricultural areas with shrubs. It was recorded at seven locations and at all locations there were singing males and territorial behaviour that indicate breeding of species. National population is estimated at 29,000-47,000 pairs. It was recorded on multiple localities along subsections 3, 4, 5 and 7.
Lanius collurio Red-backed shrike	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	It inhabits most of Europe except Great Britain, parts of the Iberian and Scandinavian peninsulas. It inhabits open habitats (meadows, pastures, etc.) with hedges, shrubs, and bushes, and is regular in mosaic agricultural areas. Europe's population is declining slightly due to intensified agriculture and habitat loss. It is a very common and widespread bird in Serbia, which was confirmed during surveys as it was recorded at 18 of 21 locations. Almost all recorded individuals were on their territory with breeding behaviour. National population is estimated at 87,000-125,000 pairs. Red-backed nests in numerous different open habitats. One of its preferable habitats are scrubs along the railway lines.

Species	Conservation status	CH/ PBF	Criteria	Comment
Lanius minor Lesser Grey Shrike	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	Lesser Grey Shrike was recorded at 5 locations. All records were in a suitable habitat. Various mosaic habitats along the railway are suitable for this species. National population is estimated at 730-1,120 pairs. It was recorded on localities along subsection 3 and 5.
Milvus migrans Black Kite	IUCN LC, RS EN, **BD I, BC Res. 6**	PBF	2iaa	Black Kite has EN national status, however the locality where the species was found (Vrtiste, subsection 7), as well as the behavior, indicate that they were in migration, and that individuals do not nest in these localities. National population is estimated at 34-45 pairs. Additional research on the migration route, with special attention to localities where the railway passes through the IBA areas (Dobric-Nisava and Gornje Pomoravlje) is highly recommended.
Nycticorax nycticorax Black-crowned Night Heron	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	Black-crowned Night-heron was recorded at four locations along subsections 3 and 7. The habitats where they were recorded are suitable, but there were no indications of nesting. The nearest colony is near Velika Plana, about 2.5 km away from the registered locations. National population is estimated at 2800-3820 pairs.
Perdix perdix Grey Partridge	IUCN LC, **RS VU**	PBF	2icc	Grey Partridge has the VU national status. It was recorded on two sites in the south of Serbia (subsection 7), where the species is locally very common, national population is declining and it is estimated at 20,000-28,000 pairs.
Pernis apivorus Honey buzzard	IUCN LC, RS LC, **BD I, BC Res. 6**	PBF	2iaa	The species is a typical migratory bird. It inhabits various habitats in which there are preserved complexes of deciduous, coniferous, or mixed forests and open terrains (meadows, pastures, steppes or agricultural areas), from the plains to the upper forest border. It builds nests on trees. It feeds mainly on social species of wasps, less often on other insects (locusts, etc.), small mammals and frogs. It is endangered due to the disappearance of suitable habitats, reduction of the amount of available prey and suffering on migration. Honey buzzard is a regular nesting bird in Serbia, whose population is estimated at 800-1,000 breeding pairs. It was recorded on locality near Batocina, subsection 3.
Sterna hirundo Common Tern	IUCN LC, **RS VU, BD I, BC Res. 6**	PBF	2iaa	It is strictly protected in Serbia, with national VU status, but LC according to the IUCN. It is also listed on the Annex I to the Birds Directive. National population of Common tern is estimated at 216-280 pairs. Common Tern was recorded on Velika Morava River, in locality Stalac, however, since a lot of work is being done on the construction of a new highway near the site, the nesting of the species is probable but not proven. The species could be present on subsections 5 and 6.
Streptopelia turtur Turtle dove	IUCN VU, **RS VU**	PBF	2icc	It inhabits mosaic habitats with shrubs and trees in the hills and plains, forest edges, floodplains of large rivers, orchards, degraded forest complexes and the like. European Turtle Dove has been recorded at eight locations with 19 individuals (subsections 2, 3, 5, 6, 7), and it is

Species	Conservation status	CH/ PBF	Criteria	Comment
				considered a nesting bird in all localities. Mosaic habitats of dense vegetation along the railway and agricultural areas are excellent nesting places for this species. However, European Turtle doves' nest all over Serbia and such habitats are not unique. National population is estimated at 49,000-68,000 pairs. The turtle dove population is declining for most of the area.
Mammals				
Felis silvestris Wildcat	IUCN LC, **HD IV**	CH	2iae	Wildcat is on Annex IV of the HD and, based on data collected from hunters, wildcat is a regular inhabitant of the forests of Mali Jastrebac. It is a secretive and rarely seen animal inhabiting forest habitats. Wildcat is therefore possible only in locality Veliki Drenovac, subsection 7, according to locals. However, the habitats are not optimal and it may only appear in transit.
Canis lupus Grey wolf	IUCN LC, RS VU, **HD II, IV, BC Res. 6**	CH	2iae	Carpathian and Dinaric-Balkan populations can be found in Serbia. Dinaric-Balkan population has 800-900 wolves with constant slight growth in size and range, while the Carpathian population is still undefined. Intensive forestry practice and infrastructure development are one of the main threats, along with illegal killings and poor management. It is estimated that the number of wolves in Serbia is between 800 and 1,000. The closes known grey wolf habitat is Bukovik Mountain that is located over 10 km northeast from the planned motorway. The habitats in the Project area are not suitable for feeding and breeding of wolves. Data was collected through the interview with local hunters on locality Veliki Drenovac, along the subsection 7. According to the hunters, one specimen was seen during winter in forest habitat of Mt. Mali Jastrebac. Wolf is not a typical inhabitant of these forests, but during severe winters, it can be seen near populated areas.

7.2 Air Quality

Monitoring of air quality indicators in the RoS is performed by the Serbian Environmental Protection Agency (SEPA)[68]. Air quality is monitored by both national and local networks of measuring stations. National network of automatic measuring stations (AMSs) consists of 40 stations (Figure 47). In addition to the national network, the local self-government administration also performs air quality monitoring mainly through local Public Health Institutes (PHI). Thus, the local network of stations consists of PHI monitoring stations and belong to the health sector of the RoS[69]. The official administrator of the Local Network is the local self-government[70].

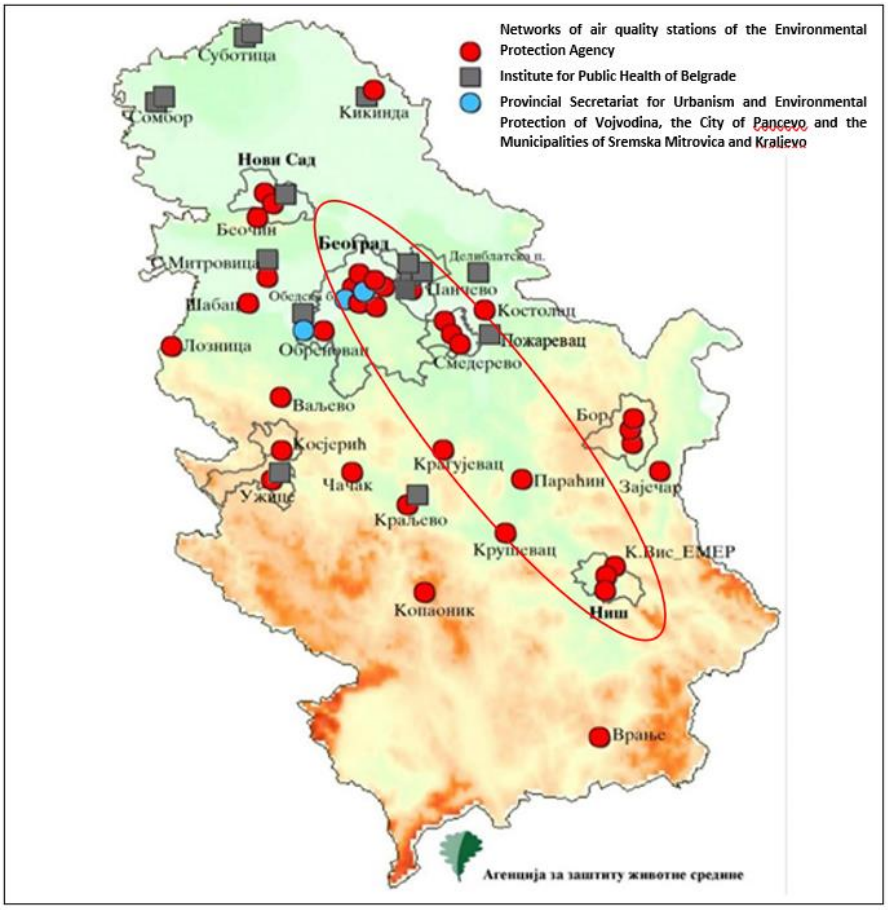


Figure 47: SEPA network of AMSs (Project area - red ellipse)

In accordance with the *Law on Air Protection*, the national network of automatic air quality measuring stations is recognised as an official state network for air quality monitoring, while local networks are informal.

The following table shows the CAQI (Common Air Quality Index) with basic metrics, used in evaluation of the results obtained from the monitoring stations.

[68] Obligations and tasks of the Environmental Protection Agency in air quality management are defined in more detail by the Law on Air Protection ("Official Gazette of RS", No. 36/09 and 10/13). The annual report on the state of air quality in the RoS derives from the obligation of the Agency based on Article 67 of the Law on Air Protection.

[69] Law on Public Health ("Official Gazette of RS", No. 15/16), Regulation on the plan of the network of healthcare institutions ("Official Gazette of RS", No. 68/19), Rulebook on Conditions for Issuance of a Permit for Measuring Air Quality and a Permit for Measuring Emissions from Stationary Pollution Sources ("Official Gazette of RS", No.1/12)

[70] Rulebook on the content of air quality plans ("Official Gazette of RS", No. 21/10)

Table 25: Air quality index – CAQI

Averaging period	Pollutant	Limit µg/m³	Excellent	Good	Acceptable	Polluted	Very polluted
1h	SO_2	350	0 – 50	50.1-100	100.01-350	350.01-500	> 500.01
1h	NO_2	150	0 – 50	50.01-100	100.01-150	150.01-400	>400.01
1h	PM_{10}	90	0 - 25	25.01-50	50-.01-90	90.01-180.0	>180.01
1h	$PM_{2.5}$	55	0-15	15.01-30	30.01-55	55.01-110	>110.01
1h	CO	25000	0 - 5	5.00001-10	10.00001-25	25.00001- 50	>50.00001
1h	O_3	180	0 - 60	60.1-120	120.1-180	180-240	>240.1

An example of air quality measurements results from the Project area is given on the following figure[71].

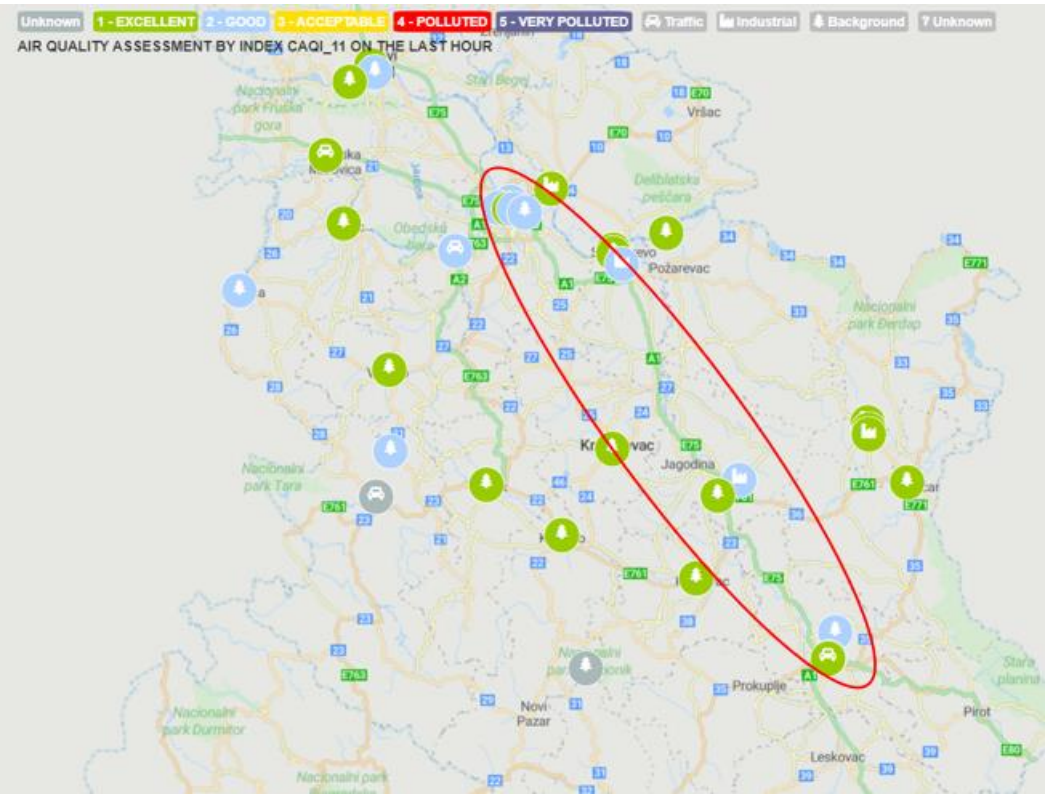


Figure 48: Daily air quality index, June 2022 (Project area - red ellipse)

In accordance with the criteria prescribed by the *Law on Air Protection*, SEPA performs official air quality assessment in the zones and agglomerations of Serbia. This assessment is based on the EU standards which are transposed in the national legislation from the EU Air Quality Directive. The air quality assessment for 2020 per zones and agglomeration is shown in Figure 49[72]. The areas of Belgrade, Kragujevac and Nis are in the third (III) category (excessively polluted air in which limit values are exceeded for one or more pollutant), while the rest of the Project area is in the first (I) category (pure or slightly polluted air in which no limit values are exceeded for any of the polluting substances).

[71] http://www.amskv.sepa.gov.rs/
[72] Environmental Protection Agency, Annual Report on the State of Air Quality in the Republic of Serbia in 2020, September 2021

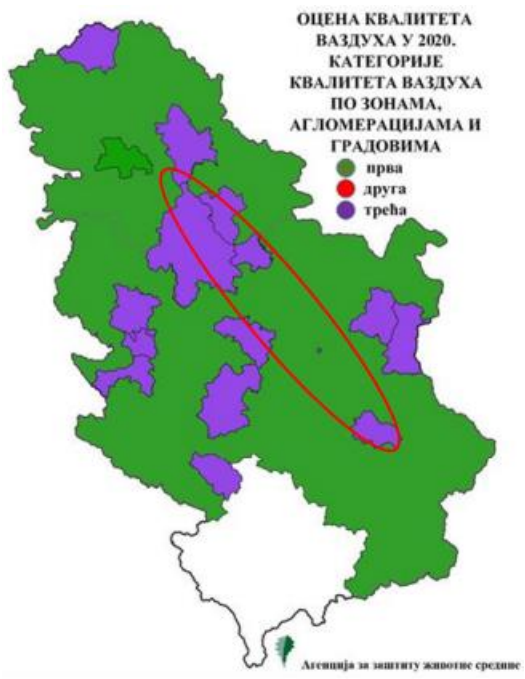


Figure 49: Air quality assessment categories per zones and agglomeration (first category– green; second category – red; third category – purple; Project area - red ellipse)

The air quality assessment categorisation is performed based on the average annual concentrations of pollutants recorded on the stations belonging to the state and local air monitoring networks.

Air quality categories by monitoring stations are shown in Figure 50.

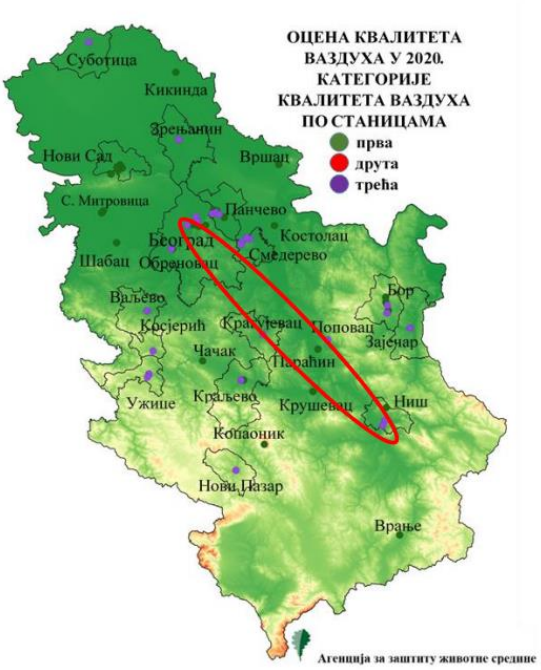


Figure 50: Air quality categories by monitoring stations (first category – green point, second category – red point, third category – purple point; Project area – red ellipse)

The Project relevant stations are located in Belgrade (9 stations) and Nis (2 stations). In the wider area, the stations in Kragujevac (1 station) and Krusevac (1 station) are found. The results of air quality monitoring in 2020 for all stations are presented in Table 26.

Table 26: Annual concentrations of air pollutants at relevant monitoring stations for 2020

Station	Air quality assessment (category)	Annual values of pollutant concentrations											
		SO_2		NO_2		PM_{10}		$PM_{2.5}$	C_6H_6	CO		O_3	
		µg/m³	No. of days with >125 µg/m³	µg/m³	No. of days with >85 µg/m³	µg/m³	No. of days with >50 µg/m³	µg/m³	µg/m³	mg/m³	No. of days with >5 mg/m³	µg/m³	No. of days with >120 µg/m³
Belgrade – Old town	III			23	0	33	46	30		0.39	0	52	0
Belgrade – New Belgrade	III	12	1	21	1	32	52	28	3	0.44	0	59	0
Belgrade Mostar	III	12	1	33	1	24	32	19		0.56	0		
Belgrade Vracar	III	11	1	29	1	35	42	23				41	0
Belgrade – Zeleno brdo	III	10	0	27	0					0.33	0	69	10
Obrenovac Center	III	18	2	38	0	17	7	8		0.46	0		
Belgrade – Despota Stefana G33J3	III	15	0	35	11	46	90			1.00	0		
Belgrade – Obrenovac G33J3	III	12	2	10	0	45	95						
Belgrade – New Belgarde G33J3	III	26	1	27	1	38	74					77	31
Nis – Elementary School Sv. Sava	III	9	0	17	0	49	15	31		0.65	0	62	1
Nis – IZJZ Nis	III	12	0	22	0	47	106	40					
Kragujevac	I	9	0	18	0	42	68			0.62	0		
Krusevac	I			12	0					0.83	0		

The results indicate that the **suspended particles** are dominant pollutant, not just in 2020 but also in the previous years. In the period 2016 to 2020, Belgrade had an extremely polluted air, mainly due to the increased concentration of PM_{10} and $PM_{2.5}$. In 2020, the annual limit value for PM_{10} particles was exceeded at Belgrade Despota Stefana and Belgrade Obrenovac measuring stations. Exceedances of the daily limit values of 50 µg/m³ during 2020 was registered at all measuring points for at least 1 day. The exceeding of annual limit value for $PM_{2.5}$ particles was recorded at Belgrade Old town, New Belgrade, Belgrade Obrenovac, Nis Elementary School Sv. Sava and Nis IZJZ monitoring stations.

Daily limit values of **SO_2** were also exceeded as per records from monitoring stations at Obrenovac Center for 2 days, and at Belgrade Mostar, Belgrade Vracar and New Belgrade for 1 day. Also, the exceedances of daily limit value of **NO_2** were registered in Belgrade: Belgrade Mostar, Belgrade Vracar and New Belgrade for 1 day. As presented in the annual report for 2020[73], the main sources of air pollution due to the increased concentration of SO_2 and NO_2 are the production of electricity and heat.

A comparative overview of the air quality category for the last 5 years in the observed area is given in Table 27.

Table 27: Air quality trend by zones and agglomerations for the period 2016 - 2020

Agglomeration/Zone	Air quality categories				
	2016	2017	2018	2019	2020
Belgrade	III	III	III	III	III
Nis	I	III	III	III	III
City of Kragujevac	III	III	III	I	III

[73] Environmental Protection Agency, Annual Report on the State of Air Quality in the Republic of Serbia in 2020, September 2021

The Belgrade-Nis railway is electrified, so it has a minimal effect on air quality. As a main source of air pollution in the investigated corridor are some industrial plants that represent the source of emissions of harmful pollutants into the atmosphere, as well as individual pollution caused by the combustion of solid and liquid fuels and other substances.

In cold season, home fireplaces and heating plants with a capacity of less than 50 MW additionally contribute to the air pollution. According to the data on national balances[74] heating is the main source of air pollution. Accordingly, an increase in air pollutants' concentration is expected in winter months due to prevailing meteorological conditions (inflow of cold air together with the present anticyclonic field, absence of wind, precipitation, etc.) when a multi-day cumulative increase in concentrations during the cold season can be expected and is recorded in the past.

7.3 Noise and Vibration

7.3.1 Noise

The regulations in the field of noise protection have been harmonised with the relevant EU directives. *The Regulation on noise indicators, limit values, assessment methods for indicators of noise, disturbance, and harmful effects of noise in the environment*[75] defines the highest permissible levels of external noise (outdoor noise indicators), and internal noise (indoor noise indicators) as shown in Table 28. The limit values refer to cumulative noise from all sources in the considered area. The outdoor noise values may be determined by computation or by measurement, while the noise forecast can be done only based on computation models.

Table 28: Maximum allowed outdoor and indoor noise levels

Maximum permissible level of external noise dB(A)			
Zone	Purpose	Day and evening	Night
1	Areas for rest and recreation, hospital zones and convalescent homes, cultural and historical sites, large parks	50	40
2	Tourist areas, small and rural settlements, camps and school zones	50	45
3	Purely residential areas	55	45
4	Business-residential areas, commercial-residential areas, children's playgrounds	60	50
5	City center, craft, trade, administrative zone with apartments, zones along highways and railways	65	55
6	Industrial, storage and service areas and transport terminals without housing	At this area borders, noise must not exceed the limit value of the neighbouring area	
Maximum permissible level of internal noise dB(A)			
No.	Use of premises	Day and evening	Night
1	Common rooms (bedroom and living room) in residential building with closed windows	35	30
2	In public and other buildings, with closed windows:		
2.1	Healthcare institutions and private practice, as follows:	35	30
	a) wards	40	40
	b) surgeries	35	35
	v) surgery theatres without medical devices and equipment	35	30

[74] Ibid.
[75] "Official Gazette of RS", No. 75/10

Maximum permissible level of external noise dB(A)			
Zone	Purpose	Day and evening	Night
2.2	Rooms in the buildings for children and students, bedrooms in nursing homes and places for retired people	40	40
2.3	Rooms for educational-upbringing work (classrooms, theatres, cabinets, etc.), cinemas and reading rooms in libraries	30	30
2.4	Theatres and concert halls	35	30
2.5	Hotel rooms	35	30

The RoS, an autonomous province, or a local self-government unit, legal entities that manage main roads, main railways and main airports, within its competencies, ensure noise monitoring[76]. Strategic maps are mandatory for agglomerations with more than 100,000 inhabitants, for major roads with average annual traffic flow higher than 3,000,000 vehicles, for major railroads with average annual traffic flow higher than 30,000 trains, for major airports with more than 50,000 operations (take off and landings), as well for plants and activities for which integrated permit is issued[77]. The existing railway line Belgrade-Nis does not meet the traffic volume requirement, so the strategic noise maps are not prepared.

Regarding the Belgrade-Nis railway route, the nearest noise monitoring stations are in Krusevac and in the centre of Nis. Both stations are outside the project area of influence and are not relevant for the Project. There are noise monitoring stations in Belgrade measuring the noise level in urban areas under the responsibility of the Department of the Environment Protection of the City of Belgrade. Having in mind the route of the railway through Belgrade, as well as the distance from the measuring stations, the data obtained cannot be considered relevant.

The municipalities have an obligation to apply measures to protect citizens from the environmental noise, and in order to do so, they must determine acoustic areas in settlements, as well as noise limit values for those areas, in compliance with *Rulebook on methodology for determination of acoustic areas*[78]. The acoustic zones shall be determined according to the existing development status, the current as well as the planned land use. The status of acoustic zoning in the railway corridor per each municipality, is shown in Table 29.

Table 29: Acoustic zones along planned Beograd-Nis railway line

Municipality	Acoustical zone	Comment
Beograd	Decision on determination of acoustic zones on the territory of the city of Belgrade[79]	The entire territory of the municipality is not covered. Done only in the territory covered by the General regulation plan – City of Belgrade (Units I-XX). The railway line on the territory of the municipality, from km 0+000 to km 15+750 belongs to the acoustical zone no. 5 and from km 15+750 to km 56+700 is not covered by the acoustical zoning.
Smederevska Palanka	Not done	The railway line on the territory of the municipality, from km 56+700 to km 76+400 is not covered by the acoustical zoning.
Velika Plana	Not done	The railway line on the territory of the municipality, from km 76+400 to km 97+000 is not covered by the acoustical zoning.
Lapovo	Not done	The railway line on the territory of the municipality, from km 97+000 to km 105+450 is not covered by the acoustical zoning.
Batocina	Decision on measures for environmental noise protection[80]	The railway line on the territory of the municipality, from km 105+450 to km 111+200 belongs to the acoustical zone no. 5. There is no map of acoustical zones.

[76] Law on Environmental Noise Protection ("Official Gazette of RS", No. 96/21)
[77] http://www.sepa.gov.rs/index.php?menu=307&id=230&akcija=showAll
[78] "Official Gazette of RS ", No. 72/10
[79] "Official Gazette of the City of Belgrade", No. 2/22
[80] "Official Gazette of the Municiplaity of Batocina", No. 3/11

Municipality	Acoustical zone	Comment
Jagodina	Decision on measures for noise protection and acoustic zoning on the territory of the city of Jagodina[81]	The railway line on the territory of the municipality, from km 111+200 to km 133+650 belongs to the acoustical zone no. 5. There is no map of acoustical zones.
Cuprija	Not done	The railway line on the territory of the municipality, from km 133+650 to km 143+550 is not covered by the acoustical zoning.
Paracin	Not done	The railway line on the territory of the municipality, from km 143+550 to km 160+200 is not covered by the acoustical zoning.
Cicevac	Not done	The railway line on the territory of the municipality, from km 160+200 to km 179+800 is not covered by the acoustical zoning.
Krusevac	Decision on measures for noise protection[82]	The entire territory of the municipality is not covered. Done only in the urban territory of the city of Krusevac. The railway line on the territory of the municipality, from km 179+800 to km 184+050 is not covered by the acoustical zoning.
Aleksinac	Not done	The railway line on the territory of the municipality, from km 184+050 to km 214+400 is not covered by the acoustical zoning.
Nis	Decision on determination of acoustic zones on the territory of the city of Nis[83]	The entire territory of the municipality is not covered. Done only in the urban territory of the city of Nis. The railway line on the territory of the municipality, from km 184+050 to km 228+160 belong to the acoustical zone no. 5.

7.3.2 Vibration

The national laws do not stipulate the permissible values for vibrations and low frequency noise. Provisions from the German standard DIN 4150-2 (Structural Vibration – Human Exposure to Vibration in Buildings), the German standard DIN 4150-3 (Structural Vibration – Human Exposure to Vibration in Buildings), the British standard BS 6472 (Guide to Evaluation of Human Exposure to Vibration in Buildings, Part 1: Vibration sources other than blasting) and the Swiss Directive of the Federal Office for the Environment (BEKS 1999 – Assessment of vibration and structure-born noise from railway traffic) will be used as the criteria for assessment.

Human perception of vibration based on weighted maximum vibration velocity according to DIN 4150-2 is presented in Table 30.

Table 30: Human perception of vibration according to DIN 4150-2[84]

Weighted maximum vibration velocity (KB values)	Perception
0.1	Threshold of perception, just noticeable
0.2	Weakly noticeable
0.4	Noticeable
0.8	Awakening threshold, clearly noticeable
1.6	Strongly noticeable
6.3	Very strongly noticeable

The DIN 4150-3 standard concerns the effects on structures. The short-term vibration are the most important types of vibration in the blasting operations, and they are included in this standard. The short-term vibration values that have an impact on building structures, according to DIN 4150-3, are shown in Table 31.

[81] "Official Gazette of the City of Jagodina", No. 2/20
[82] "Official Gazette of the City of Krusevac", No. 8/12 and 3/14
[83] "Official Gazette of the City of Nis", No. 66/18
[84] Review of existing standards, regulations and guidelines, as well as laboratory and field studies concerning human exposure to vibration, RIVAS Deliverable 1.4 (2011)

Table 31: Guideline values of short-term vibrations for the assessment of the impact on building structures according to DIN 4150-3 [mm/s]

Type of structure	Vibration based on a frequency		
	1 Hz-10 Hz	10 Hz-50 Hz	50 Hz-100 Hz
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2, and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

The assessment of vibration impacts on humans can also be performed based on the British standard BS 6472 – a guide to evaluate human exposure to vibration in buildings for vibration sources other than blasting (1-80 Hz). The BS 6472 standard is more tolerant to short-term vibrations that are quite common during construction work, when much higher levels are allowed. The acceptable values of human exposure to continuous and impulsive vibration in residential buildings according to the BS 6472 standard and different periods of day are shown in Table 32.

Table 32: Criteria for exposure to continuous and impulsive vibration according to BS 6472 (8-80 Hz) [mm/s]

Location	Period	Continuous vibration		Impulsive vibration	
Residences	Day (7^{00} - 23^{00})	0,28	0,56	8,6	17,2
	Night (23^{00} - 7^{00})	0,20	0,40	2,8	5,6

The BEKS standard assesses the impact of low frequency railway traffic noise per type of built-up area. It specifies the noise levels for newly built and modernised railways. Permissible levels of low frequency noise by zone, the period of day and the railway line class are shown in Table 33.

Table 33: Guidance values for ground-borne indoor noise according to BEKS (1999)

Built-up area	Newly built railway line		Modernised railway line*	
	Day (6^{00}-22^{00})	Night (22^{00}-6^{00})	Day (6^{00}-22^{00})	Night (22^{00}-6^{00})
	L_{eq} (16h)	L_{eq} (1h)	L_{eq} (16h)	L_{eq} (1h)
	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
Residential areas, public interest areas of public interest (schools, hospitals)	35	25	**40**	**30**
Mixed areas, town centres, agriculture areas, residential areas already exposed	40	30	45	35

*Alteration or refurbishment of existing tracks, change in operating condition

There is no information on baseline vibration levels in the Project area.

7.4 Waters

7.4.1 Hydrology

The hydrographic network in the project area is quite dense and includes larger rivers: the Velika Morava River (Great Morava River) and Juzna Morava River (South Morava River) as well as their tributaries.

Figure 51: River basins and main river network (Project area - red ellipse)

The list of surface waters found in the project area is as follows:

- On the Belgrade-Mladenovac-Velika Plana subsection, the railway intersects the rivers: Ralja, Resava, Bojanac, M. Lug, Jasenica, Topciderska, Lug, and Kubrusica.
- On the Velika Plana-Nis subsection, the railway intersects the rivers: Grabovacki stream, Gibavica, Recica, Raca, Grabovicki stream, Kazanski stream, Liparski stream, Lepenica, Kijevski stream, Grabovik, Konvanluk Ludi stream, Osaonica, St. Belica, Kameniti stream Zmijic bara, Suvi stream, Belica, Lugomir, Mijatovac stream, Velika Morava, Crnica, Bacijski stream, Burdeljski stream, Slatinski stream, Suvajski stream, Planski stream, Jovanovacka river, Osrece stream, Akalavica, Toplik, Vinograd stream, Pajin, Razanjska river, Krnji stream, Jabucki stream, Vretenj stream, Bucina, Juzna Morava, Livadski stream, Hajducki stream , Plocnik, Zmijarnik, Ribar river, Kukin stream , Zarkov stream , Simin stream, Srezovac river, Radevac river, Suvi stream, Suhotnic stream, Turija, Dasnicka river, Drenovac stream, Bare, Nisava.

These rivers belong to the Velika and Juzna Morava River Basins, except for Topciderska River, which belongs to the Sava River Basin. Following figures provide an overview of the watercourses in the Project area.

Photos of nearby watercourses near the railway alignment on the Belgrade-Nis route are given in Chapter 7.9.3, under section *Floods*.

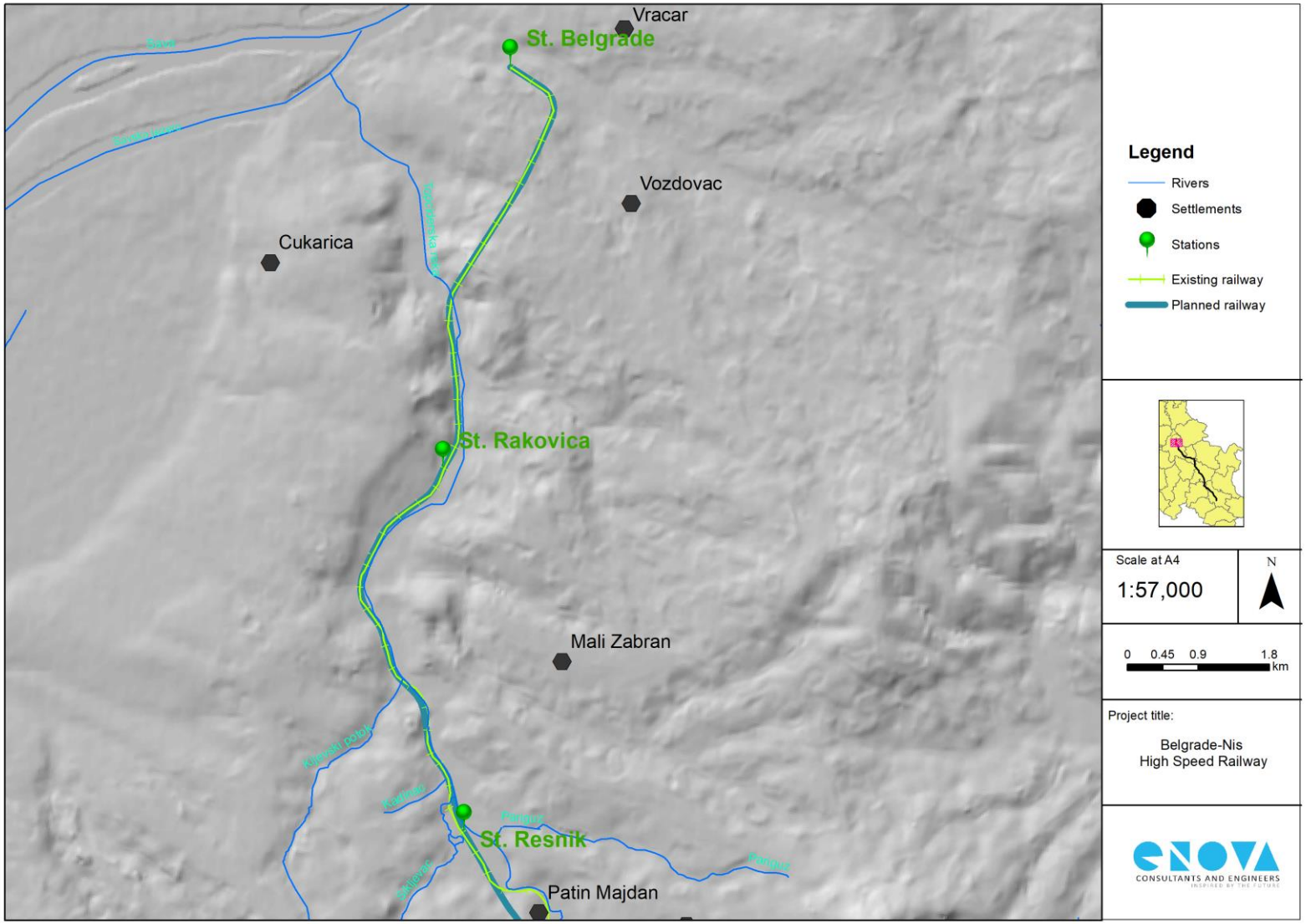


Figure 52: Position of watercourses in the Project area in relation to the existing and planned railway route (Belgrade-Resnik subsection)

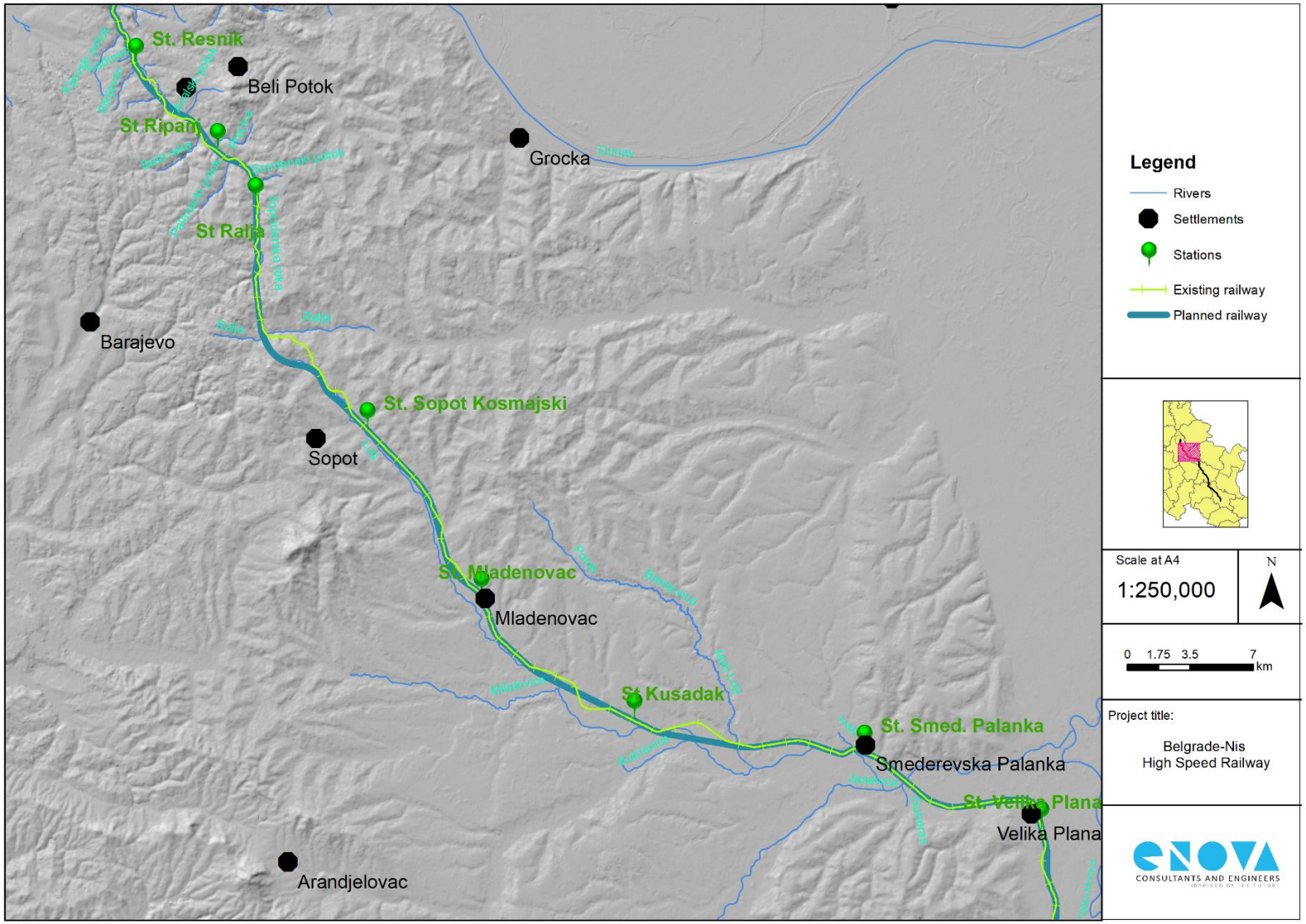


Figure 53: Position of watercourses in the Project area in relation to the existing and planned railway route (Resnik-Velika Plana subsection)

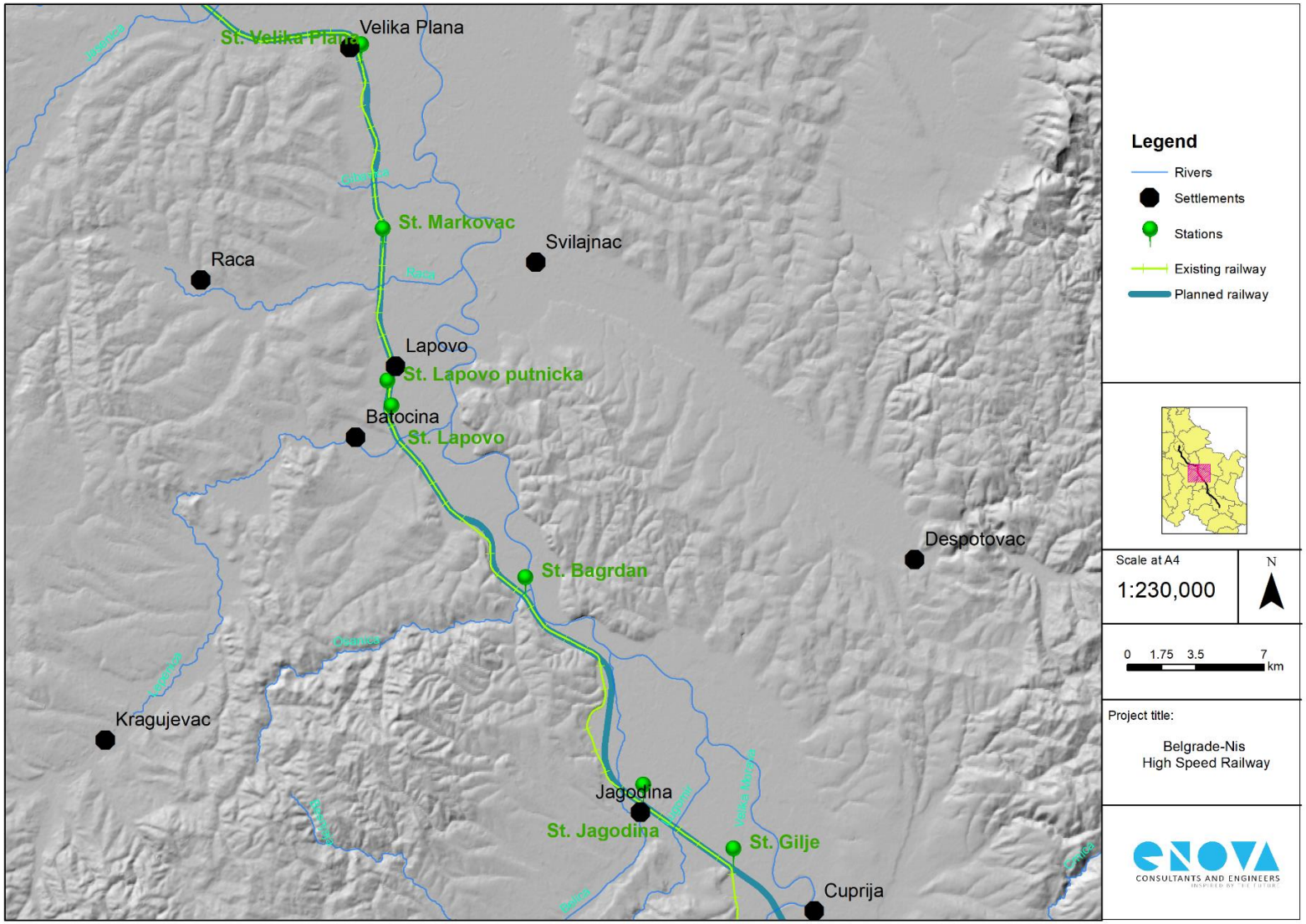


Figure 54: Position of watercourses in the Project area in relation to the existing and planned railway route (Velika Plana-Gilje subsection)

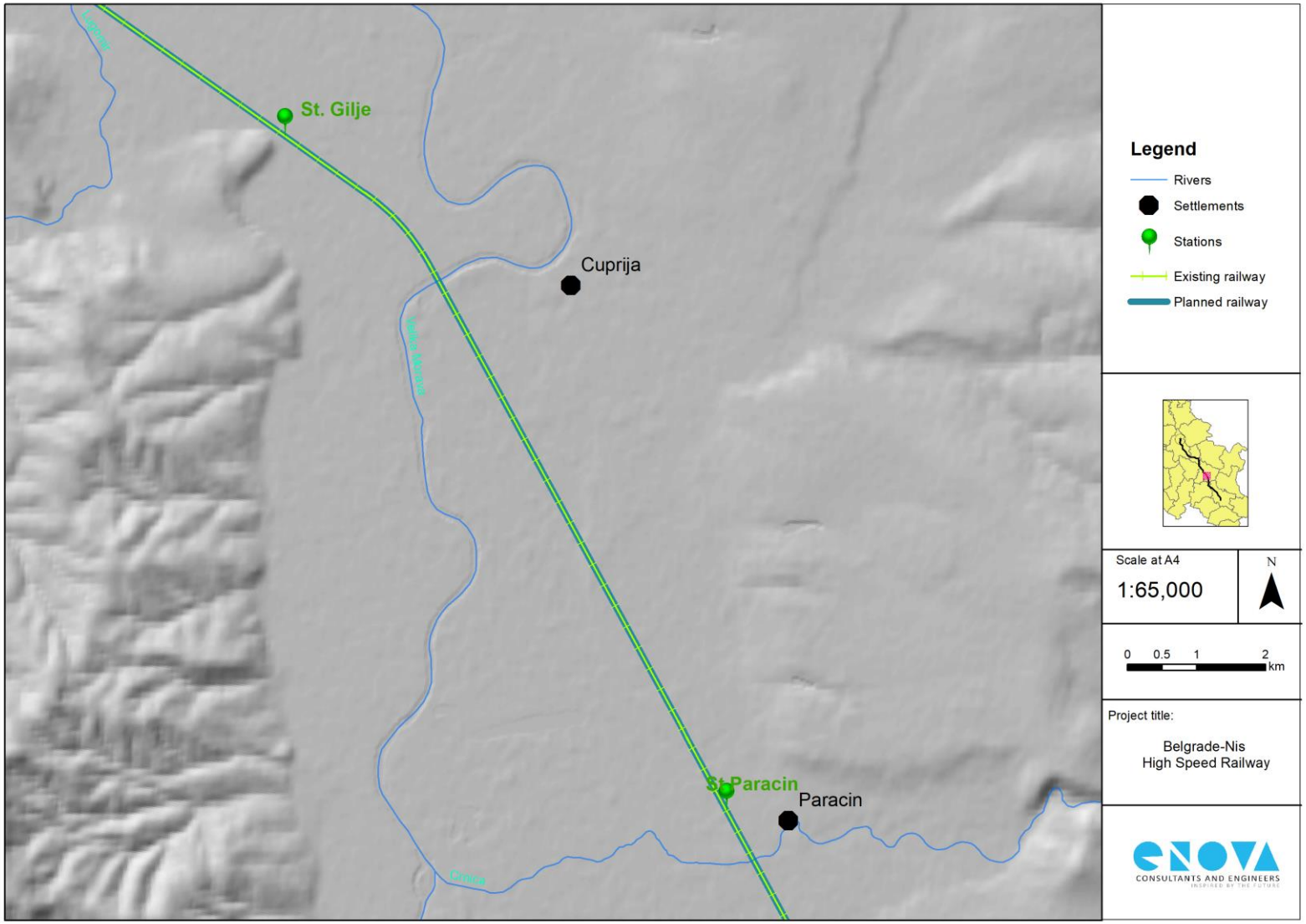


Figure 55: Position of watercourses in the Project area in relation to the existing and planned railway route (Gilje-Paracin subsection)

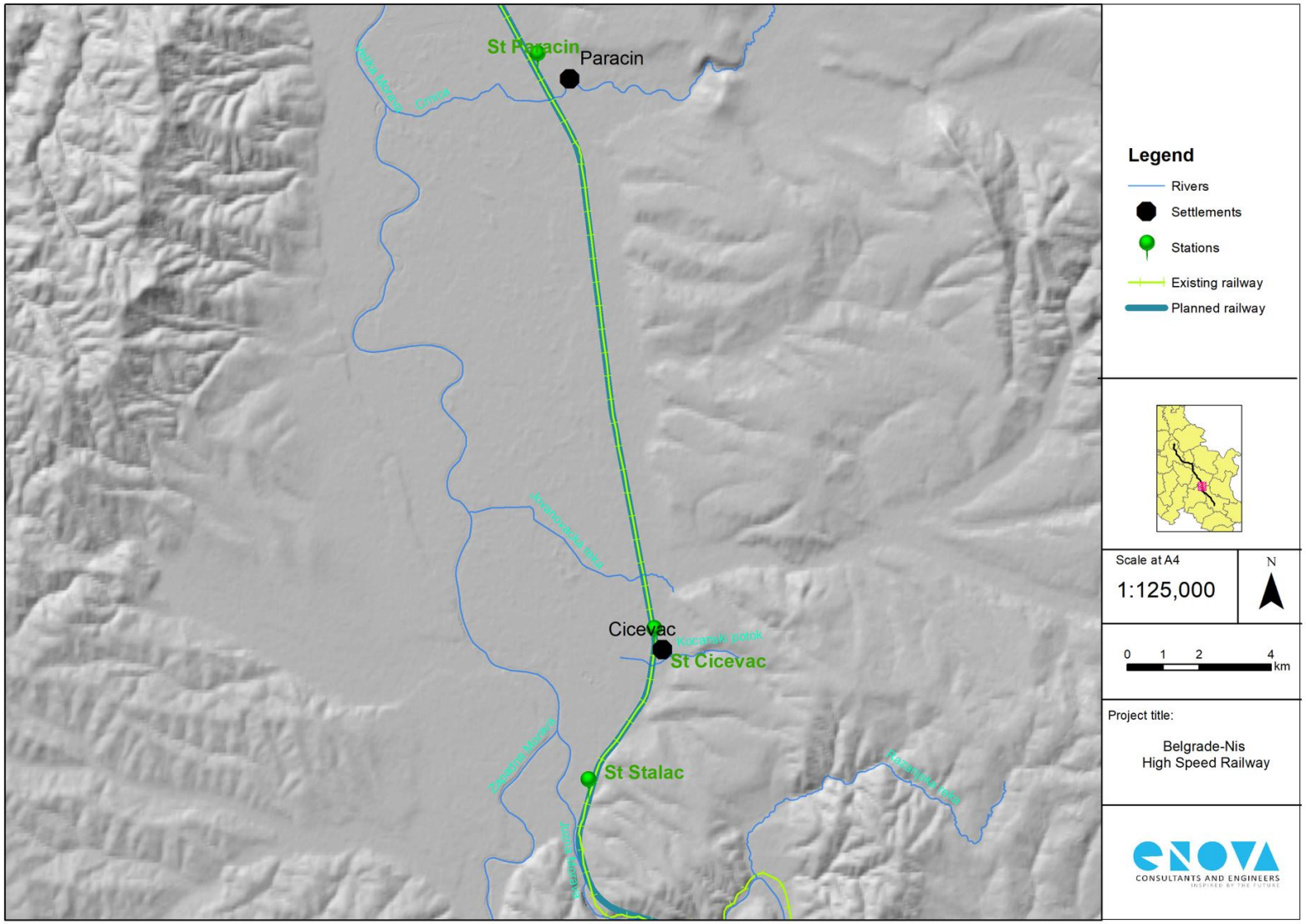


Figure 56: Position of watercourses in the Project area in relation to the existing and planned railway route (Paracin-Stalac subsection)

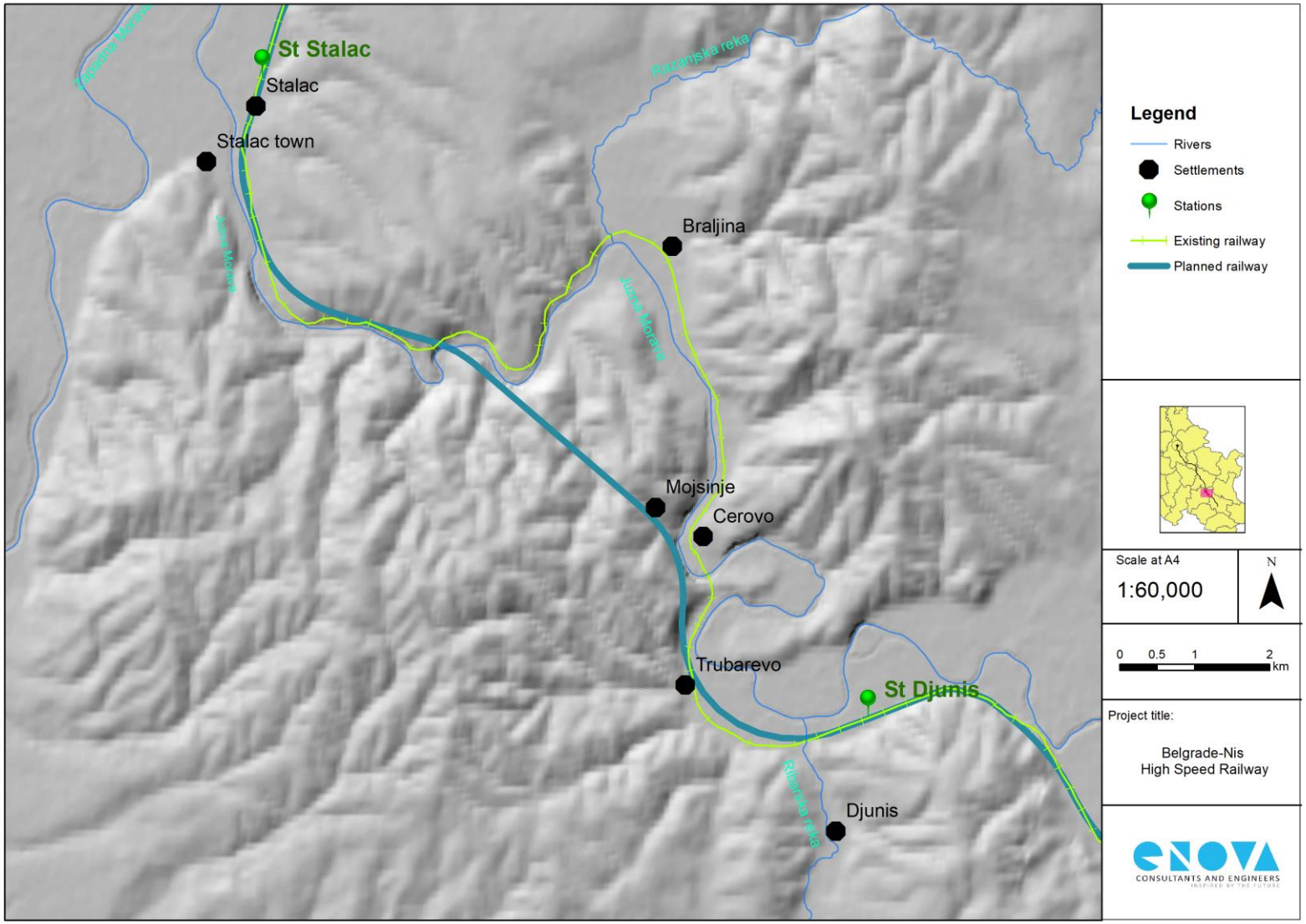


Figure 57: Position of watercourses in the Project area in relation to the existing and planned railway route (Stalac-Djunis subsection)

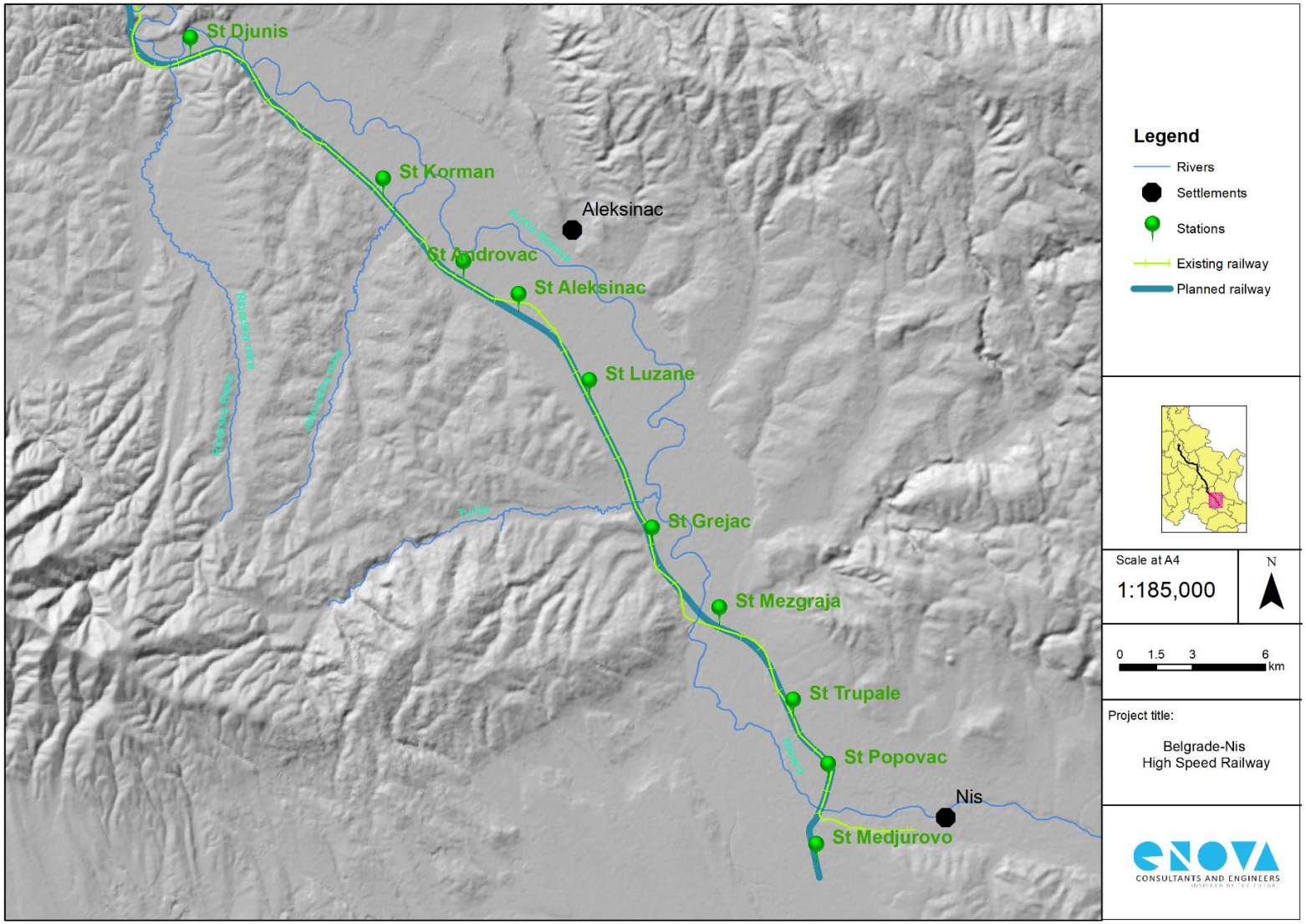


Figure 58: Position of watercourses in the Project area in relation to the existing and planned railway route (Djunis-Medjurovo subsection)

7.4.2 Surface Water Quality

Based on the *Decree on the categorisation of watercourses*[85], the Velika Morava River is officially classified to IIa subclass of watercourses, and the Juzna Morava River to IIa and IIb subclasses of watercourses. The water classification explanation is given in the following table.

Table 34: Water classification according to national legislation

Class	Class characteristics
Class I	This class includes water which, in its natural state or after disinfection, can be used or utilized to supply settlements with drinking water, in the food industry and for the breeding of noble species of fish (salmonids).
Class II	This class includes waters suitable for bathing, recreation and water sports, for the breeding of less noble species of fish (cyprinids), as well as waters which, in addition to normal treatment methods (coagulation, filtration and disinfection), can be used to supply water to beverages and in the food industry. Class II waters are divided into subclasses: > Subclass IIa — which includes waters that, in addition to normal treatment methods (coagulation, filtration and disinfection), can be used to supply settlements with drinking water, for bathing and in the food industry. > Subclass IIb — which includes waters that can be exploited or used for water sports, recreation, for breeding less noble species of fish (cyprinids) and for watering livestock.
Class III	This class includes water which may be used or used for irrigation and in industry other than the food industry.
Class IV	This class includes waters that can be used or utilized only after special treatment.

Having in mind the watercourses on the route of the railway from Belgrade to Nis and the cities through which the railway passes, the water measuring stations close to the route on the Velika Morava River, Juzna Morava River and Nisava River have been identified. In order to analyse the existing water quality, the data of the Environmental Protection Agency of the RoS for 2020 were used.

The map of measuring stations for determining the quality of surface waters in the RoS is given in the following figure.

[85] "Official Gazette of the SRS", No. 5/68

Figure 59: Surface waters monitoring network stations – surface watercourses (Project area - red ellipse)

Velika Morava River. The waters in the immediate catchment area of the Velika Morava River are highly polluted as the area is densely populated, industrially developed and situated at lower altitudes so act as a recipient of all waters from the catchment especially its left tributaries coming from th Sumadija which are highly polluted. One of the most polluted tributaries of Velika Morava is the river Lepenica. the river Lepenica is crossed by the railway. The valleys of the Velika Morava River are economically very attractive areas, so further environmental degradation can be expected.

The National Monitoring Network Water has three monitoring stations on the Velika Morava River in the areas of Bagrdan, Ljubicevski Most and Salinac (Figure 60). Considering that the Bagrdan monitoring station is the closest to the future railway line, the water quality results for that station from 2020 are presented below[86].

[86] Ministry of Environmental Protection, Results of surface and groundwater quality monitoring in 2020, 2021

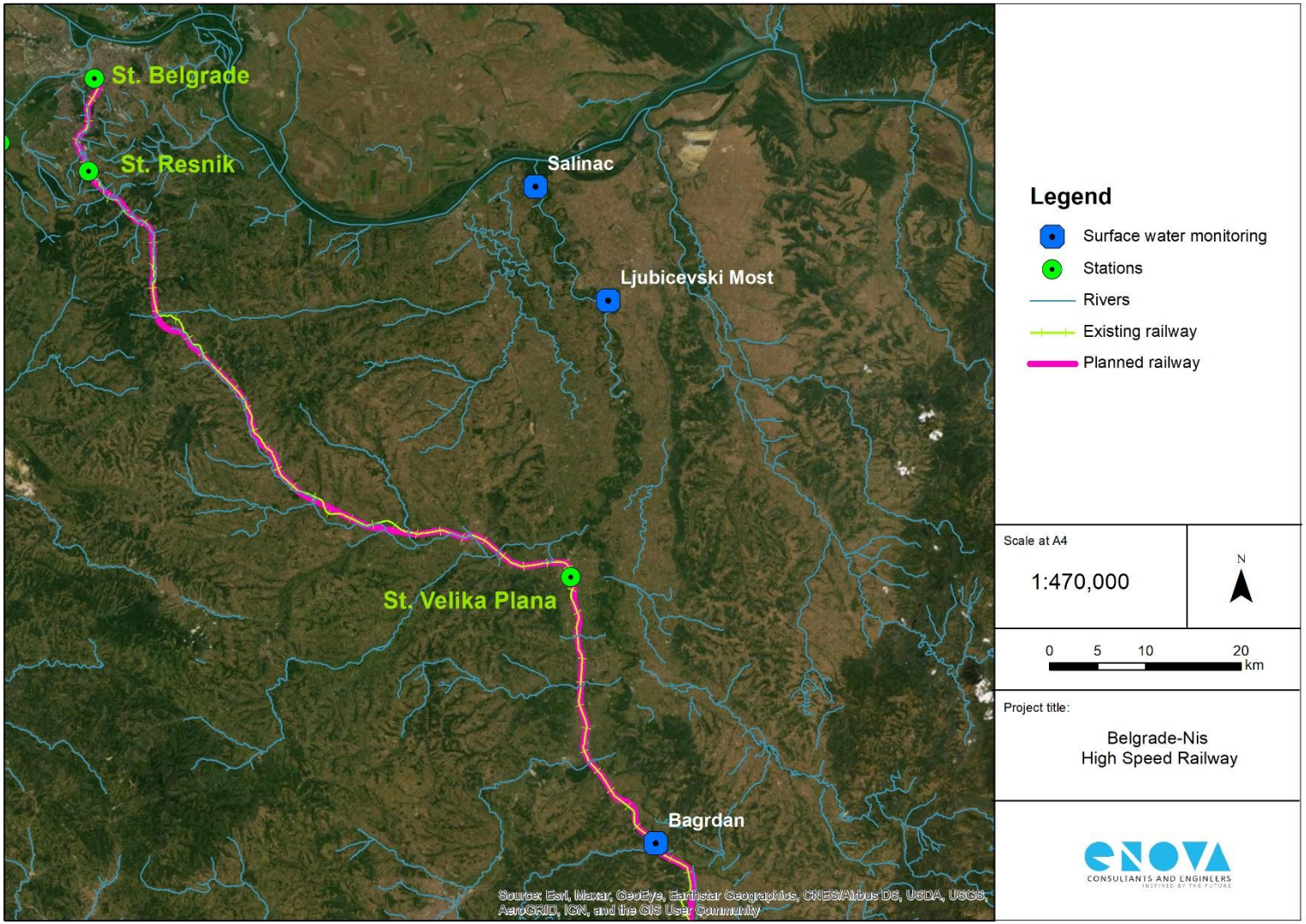


Figure 60: Location of Bagrdan, Ljubicevski Most and Salinac monitoring stations

Table 35: Results of water quality monitoring at Bargdan station (Velika Morava)

Month	Parameter																						
	Water temperature, °C	Turbidity, NTU	Suspended matter, mg/l	Dissolved oxygen (O_2), mg/l	Alkalinity, mmol/l	Total hardness, mg/l	Dissolved CO_2, mg/l	pH	Electrical conductivity, µS/cm	Ammonium (NH_4-N), mg/l	Nitrites (NO_2-N), mg/l	Nitrates (NO_3-N), mg/l	Organic nitrogen (N), mg/l	Total phosphorus (P), mg/l	Potassium (Ca), mg/l	Magnesium (Mg), mg/l	Chlorides (Cl), mg/l	Sulphates (SO_4), mg/l	Iron (Fe), µg/l	Zinc (Zn), µg/l	Copper (Cu). µg/l	Lead (Pb), µg/l	Mercury (Hg), µg/l	Boron (B), µg/l	Biological oxygen consumption, mg/l
I	1.9	12.60	<4	12.77	4.14	236	1.3	8.00	525	0.12	0.038	1.30	2.5	0.323	67	17	17.0	31	-	-	-	-	-	-	2.6
II	7.2	14.40	11	10.80	3.22	182	11.4	7.68	363	0.28	0.012	1.30	0.8	0.239	49	14	15.6	28	-	-	-	-	-	-	2.5
III	15.8	17.10	7	8.52	3.04	191	1.8	7.92	352	0.12	0.011	1.00	0.8	0.304	54	14	14.8	23	821.0	28.0	6.8	4.6	<0.07	54	2.2
IV	17.5	3.86	12	8.99	3.50	216	2.6	7.84	382	0.19	0.029	1.20	0.7	0.406	54	20	11.0	20	289.0	6.2	3.3	1.4	<0.07	57	3.5
V	19.7	-	15	7.42	3.27	178	5.5	7.94	346	0.10	0.048	1.20	0.9	-	53	11	13.5	22	329.6	27.3	51.9	7.6	<0.07	19	1.9
VI	21.8	27.60	18	7.92	3.04	208	1.8	8.12	423	0.09	0.048	1.00	7.0	0.453	58	20	11.3	27	1,315.0	17.0	1.4	3.6	<0.07	106	2.8
VII	21.5	263.00	31	7.43	2.90	180	2.2	7.80	330	0.30	0.040	0.80	1.0	0.552	49	14	9.7	18	761.0	27.0	6.0	2.6	<0.07	18	4.8
VIII	20.5	22.30	20	10.72	3.80	228	0.0	8.43	442	0.19	0.008	0.80	0.4	0.209	69	14	14.0	28	838.0	24.4	8.6	4.2	<0.07	63	4.8
IX	13.5	47.20	19	8.80	3.56	216	1.8	7.83	432	0.36	0.058	1.10	1.1	0.714	56	19	15.4	27	842.0	26.0	7.6	1.8	<0.07	69	4.8
X	7.8	7.80	<4	10.60	4.00	230	3.1	7.91	434	0.14	0.012	3.00	0.3	0.184	59	18	12.0	29	431.0	13.0	7.2	2.0	<0.07	62	2.0
XI	6.4	7.92	5	10.92	3.83	233	1.3	7.92	452	0.28	0.035	1.60	-	0.266	61	20	16.1	26	-	-	-	-	-	-	4.7

When compared with the limit values defined by the *Regulation on limit values of pollutants in surface and groundwater and sediment and deadlines for their achievement*[87], the results indicate exceedance of the limit value of dissolved oxygen throughout the year and total phosphorus most of the year except in October.

[87] "Official Gazette of RS", No. 50/12

Juzna Morava River. Water quality monitoring was performed on the following locations: Ristovac, Klisura and Mojsinje (Figure 61). Considering that the Mojsinje monitoring station is the closest to the future railway line (at min 0.05 – 0.1 km from the railway), the results of measuring water quality at this station in 2020 are presented in Table 36[88].

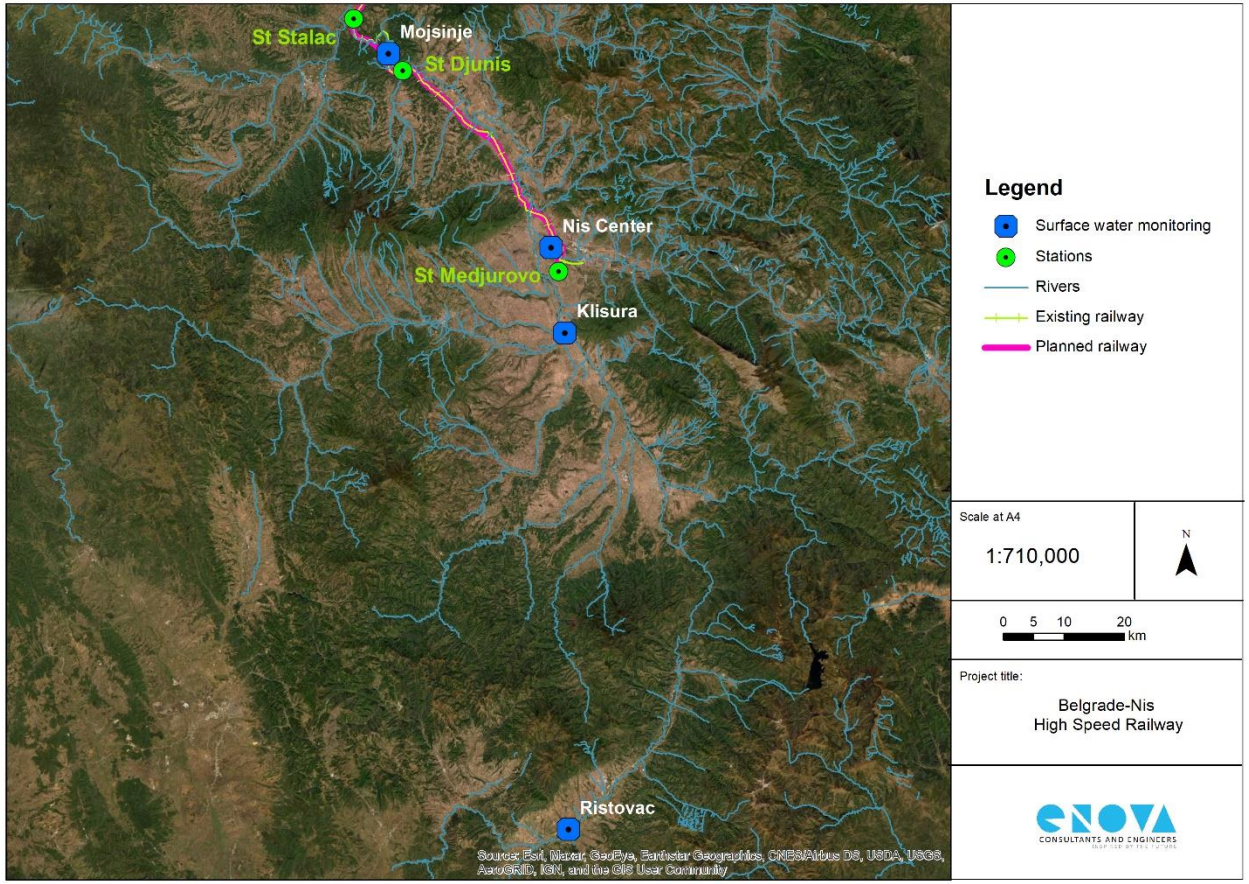


Figure 61: Location of Ristovac, Klisura, Mojsinje and Nis Center monitoring stations

[88] Ministry of Environmental Protection, Results of surface and groundwater quality monitoring in 2020, 2021

Table 36: Results of of water quality monitoring at the Mojsinje station (Juzna Morava)

Month	Parameter																							
	Water temperature, °C	Turbidity, NTU	Suspended matter, mg/l	Dissolved oxygen (O_2), mg/l	Alkalinity, mmol/l	Total hardness, mg/l	Dissolved CO_2, mg/l	pH	Electrical conductivity, µS/cm	Ammonium (NH_4-N), mg/l	Nitrites (NO_2-N), mg/l	Nitrates (NO_3-N), mg/l	Organic nitrogen (N), mg/l	Total phosphorus (P), mg/l	Potassium (Ca), mg/l	Magnesium (Mg), mg/l	Chlorides (Cl), mg/l	Sulphates (SO_4), mg/l	Iron (Fe), µg/l	Zinc (Zn), µg/l	Copper (Cu). µg/l	Lead (Pb), µg/l	Mercury (Hg), µg/l	Boron (B), µg/l	Biological oxygen consumption, mg/l
I	2.2	11.6	6	12.02	3.44	194	8.0	8.0	429	0.14	0.050	1.5	2.3	0.328	50	17	14.6	32	-	-	-	-	-	-	2.9
II	5.5	39.6	21	11.00	2.88	160	1.3	8.0	373	0.14	0.043	1.4	1.0	0.220	42	14	9.0	28	-	-	-	-	-	-	2.9
III	8.6	39.4	53	10.82	2.02	116	1.3	8.0	275	0.16	0.032	1.0	0.3	0.499	26	12	9.0	22	-	-	-	-	-	-	2.5
IV	15.7	34.6	23	8.05	2.56	144	1.3	8.0	314	0.10	0.030	1.0	0.5	0.178	36	13	10.4	25	1,182	38.6	4.9	7.6	<0.07	46	2.3
V	19.8	11.3	<4	7.78	2.58	146	1.3	8.0	336	0.10	0.036	1.2	0.3	0.410	34	15	10.4	22	476	17.0	7.8	4.1	<0.07	24	2.3
VI	19.5	48.2	12	7.20	3.08	178	1.8	8.0	388	0.14	0.038	1.3	0.6	0.427	46	15	11.8	27	-	-	-	-	-	-	2.7
VII	25.3	11.6	<4	7.02	3.34	190	1.3	8.1	411	0.12	0.040	1.3	0.2	0.198	50	16	11.8	28	-	-	-	-	-	-	2.6
VIII	17.6	29.9	29	8.30	2.56	146	1.3	8.0	308	0.10	0.033	0.9	<0.1	0.117	36	14	10.4	20	120	12.8	6.2	<0.5	<0.07	55	1.8
IX	17.9	8.11	8	7.22	4.28	234	1.8	7.9	516	0.14	0.041	1.4	1.7	0.403	58	22	13.3	35	178	9.0	6.5	1.3	<0.07	68	2.1
X	13.1	11.8	<4	8.12	3.88	216	1.2	8.0	501	0.14	0.041	2.4	0.5	0.163	56	18	15.6	37	131	4.0	4.0	1.0	<0.07	93	2.2
XI	6.8	11.1	8	10.10	2.64	140	1.3	8.0	333	0.10	0.033	1.0	-	0.138	40	10	10.5	18	-	-	-	-	-	-	1.6

When compared with the limit values defined by the national legislation, the results indicate exceedance of the limit value of dissolved oxygen throughout the year and total phosphorus most of the year except in April, June and August. Also, exceedance of the limit value of suspended matters in March and August were registered. The increased content of suspended matters and of dissolved oxygen is probably caused by inadequate treatment of industrial wastewater.

Nisava river. Nisava is a tributary of the Juzna Morava. In terms of quality, it belongs mainly to the III class of river waters, almost on the entire course from the Bulgarian border to the mouth, with a somehow greater degradation of water in the Nis valley, where there are 25 pollutants identified. The tributaries of the Nisava have similar water quality. The railway crosses the Nisava River at a distance of approx. 2 km from the monitoring station. Considering that the Nis Center monitoring station (location presented in Figure 61 above) is the closest to the future railway line, the results of measuring water quality at this station in 2020 are presented in Table 37[89].

Table 37: Results of measurement of parameters on the Nisava River, Nis Center monitoring station

Month	Parameter																							
	Water temperature, °C	Turbidity, NTU	Suspended matter, mg/l	Dissolved oxygen (O_2), mg/l	Alkalinity, mmol/l	Total hardness, mg/l	Dissolved CO_2, mg/l	pH	Electrical conductivity, µS/cm	Ammonium (NH_4-N), mg/l	Nitrites (NO_2-N), mg/l	Nitrates (NO_3-N), mg/l	Organic nitrogen (N), mg/l	Total phosphorus (P), mg/l	Potassium (Ca), mg/l	Magnesium (Mg), mg/l	Chlorides (Cl), mg/l	Sulphates (SO_4), mg/l	Iron (Fe), µg/l	Zinc (Zn), µg/l	Copper (Cu). µg/l	Lead (Pb), µg/l	Mercury (Hg), µg/l	Boron (B), µg/l	Biological oxygen consumption, mg/l
I	5.0	12.2	7	9.66	4.34	253	2.6	7.9	565	0.20	0.150	3.00	1.4	0.599	63	20	23.4	27	-	-	-	-	-	-	4.2
II	7.0	20.0	<4	9.20	3.66	200	2.2	7.8	463	0.16	0.121	2.00	2.8	0.400	50	18	10.8	34	-	-	-	-	-	-	4.0
III	12.5	17.2	6	8.80	3.96	222	1.8	8.0	488	0.16	0.092	2.00	0.5	0.394	61	17	10.4	35	645	24.5	5.8	1.1	<0.07	45	5.1
IV	14.5	16.8	<4	7.14	3.78	220	1.8	7.9	467	0.18	0.090	2.00	<0.1	0.372	56	19	14.6	29	1,022	65.0	3.5	4.9	<0.07	<10	3.7
V	17.5	39.6	5	7.10	4.08	230	1.8	7.9	495	0.26	0.094	2.40	0.6	2.460	62	18	15.8	37	351	18.0	3.1	3.2	<0.07	68	4.4
VI	22.8	18.9	7	4.82	4.44	244	1.8	7.8	516	0.28	0.108	2.60	1.1	0.196	62	22	13.3	35	-	-	-	-	-	-	4.8
VII	21.3	22.1	10	5.52	3.66	212	2.2	7.8	435	0.26	0.108	2.40	0.4	0.331	53	19	14.6	33	-	-	-	-	-	-	3.7
VIII	15.6	16.6	<4	4.21	3.48	202	2.2	7.8	432	0.84	0.110	3.00	0.9	0.421	52	17	13.3	30	168	12.0	2.4	<0.5	<0.07	20	4.2
IX	11.6	24.6	9	8.06	3.18	184	1.8	7.9	394	0.22	0.102	2.40	1.8	1.467	43	18	11.8	30	118	10.0	3.7	0.7	<0.07	28	5.1
X	9.5	18.3	<4	7.50	3.98	245	1.8	7.8	521	0.24	0.106	2.60	0.5	0.366	69	18	19.8	45	33	17.0	4.5	<0.5	<0.07	38	4.1
XI	7.5	16.3	16	8.34	3.92	242	1.8	7.9	506	0.28	0.118	2.80	-	1.200	68	18	20.8	36	-	-	-	-	-	-	4.2

[89] Ministry of Environmental Protection, Results of surface and groundwater quality monitoring in 2020, 2021

Comparing the annual values with the limit values defined by the national legislation, exceedance of the limit value of dissolved oxygen in all months (except June-August period), as well as total phosphorus (except in June) were recorded. Also, exceedance of the limit value of suspended matters were registered in May, while exceedance of the limit value of biological oxygen consumption were registered in March, June and September. The results of physical-chemical, chemical and microbiological analysis of surface water samples are compared with the limit values of quality classes prescribed by the *Regulation on limit values of pollutants in surface and groundwater and sediment and deadlines for reaching them*[90]. Accordingly, ecological status of surface water is identified and presented in (Table 38) using the following legend:

	Excellent ecological status
	Good ecological status
	Moderate ecological status
	Poor ecological status
	Bad ecological status

[90] "Official Gazette of RS", No. 50/12

Table 38: Assessment of the surface water quality status according to the appropriate parameters

Monitoring station	Parameter																												
	General		Oxygen regime					Nutrients						Salinity				Metals							Microbiological parameters			
	pH	Suspended matter, mg/l	Dissolved oxygen (O_2), mg/l	Oxygen saturation, %	Biological oxygen consumption, mg/l	Chemical oxygen consumption[91], mg/l	Total organic carbon, mg/l	Total nitrogen, mg/l	Nitrates, mg/l	Nitrites, mg/l	Ammonium ion, mg/l	Total phosphorus, mg/l	Orthophosphates, mg/l	Chlorides, mg/l	Sulphates, mf/l	Total mineralisation, mg/l	Electrical conductivity at 20°C, µS/cm	Arsenic, µg/l	Boron, µg/l	Copper, µg/l	Zinc, µg/l	Total chrome, µg/l	Iron, µg/l	Total manganese, µg/l	Faecal coliforms, cfu/100 ml	Total coliforms, cfu/100 ml	Intestinal enterococci, cfu/100 ml	Number of aerobic heterotrophs[92], cfu/100 ml
Bagrdan																													
Mojsinje																													-
Nis Center																													-

[91] Permanganate method
[92] Kohl method

7.4.3 Groundwater

Groundwater distribution and vulnerability

There are no precise data on the abundance and territorial distribution of groundwater sources in the Project area. The estimated potential of groundwater reserves in Central Serbia is 9,930 m^3/s. On the territory of central Serbia, the largest part of groundwater reserves is located in the areas of alluvial springs, primarily in the valley of the Velika Morava. The filtration characteristics of the sand-gravel layer along the entire length of the alluvium are favourable, and the water supply sources are mainly formed in the area of lower Pomoravlje.

The use of groundwater is organised mainly through wells for the needs of individual households, while larger quantities for water supply are provided from the sandy sediments of the Neogene. The catchment area of Velika Morava River is rich in the occurrence of mineral and thermal waters.

Based on the hydrogeological properties of individual lithological formations as well as on the structural types of porosity, the following types can be distinguished in this area: phreatic (compacted) type issued, artesian, fissure, karst, fissure-karst, and in some parts of the terrain complex type issued, as well as arid terrains. In some parts of the terrain, it is difficult to draw sharp boundaries between these issues. Also, there is the appearance of mineral waters on these terrains. The phreatic (compacted) type has a fairly large distribution within the study area. It was formed mainly within the alluvial, deluvial and terrace sediments of Quaternary age; within the Pliocene sediments, as well as within the Tertiary formations of the Middle and Upper Miocene age.

Groundwater vulnerability to overexploitation in the Project area is assessed as low to medium, except for the area of Krusevac, where groundwater vulnerability is assessed as medium to high[93].

Groundwater quality monitoring

In order to analyse the existing groundwater quality in the Project area, the data published by the Environmental Protection Agency of the RoS were used.

The following figure shows a map of measuring stations in the RoS, for determining the quality of groundwaters (piezometers marked in red).

[93] D. Polomcic, Z. Stevanovic, P. Dokmanovic, P.Papic, Groundwater supply in Serbia – current state and perspectives, 2011

Figure 62: Network of groundwater monitoring stations (project area - red ellipse)

For the purpose of groundwater quality analysis in the Project area, 7 measuring stations are found to be relevant (Table 39).

Table 39: List of monitoring stations relevant to groundwater quality analysis

Monitoring station name	Monitoring station code (*as indicated in the Figure 62 above)	Name of groundwater body	Water basin
Borca-dubok	9NP163	Kolubara – neogene	Danaube
Velika Plana-Zabari	1NPPD-143	Velika Morava aluvion – right bank	Morava
Markovac-Svilajnac	1NPPD-152	Velika Morava aluvion – right bank	Morava
Bukovace-Glogovac (close to Jagodina)	1NPPD-163	Velika Morava neogene – south	Morava
Obreze-Ratare (close to Paracin)	1NPPL-181	Velika Morava neogene – south	Morava
Varvarin-Cicevac	1NPPL-194	Levac	Morava
Zitkovac brickyard near Aleksinac	3NP504	Juzna Morava neogene – north	Morava

Locations of these monitoring stations are presented in Figure 63, while the results of groundwater quality monitoring in 2020 are presented in Table 40.

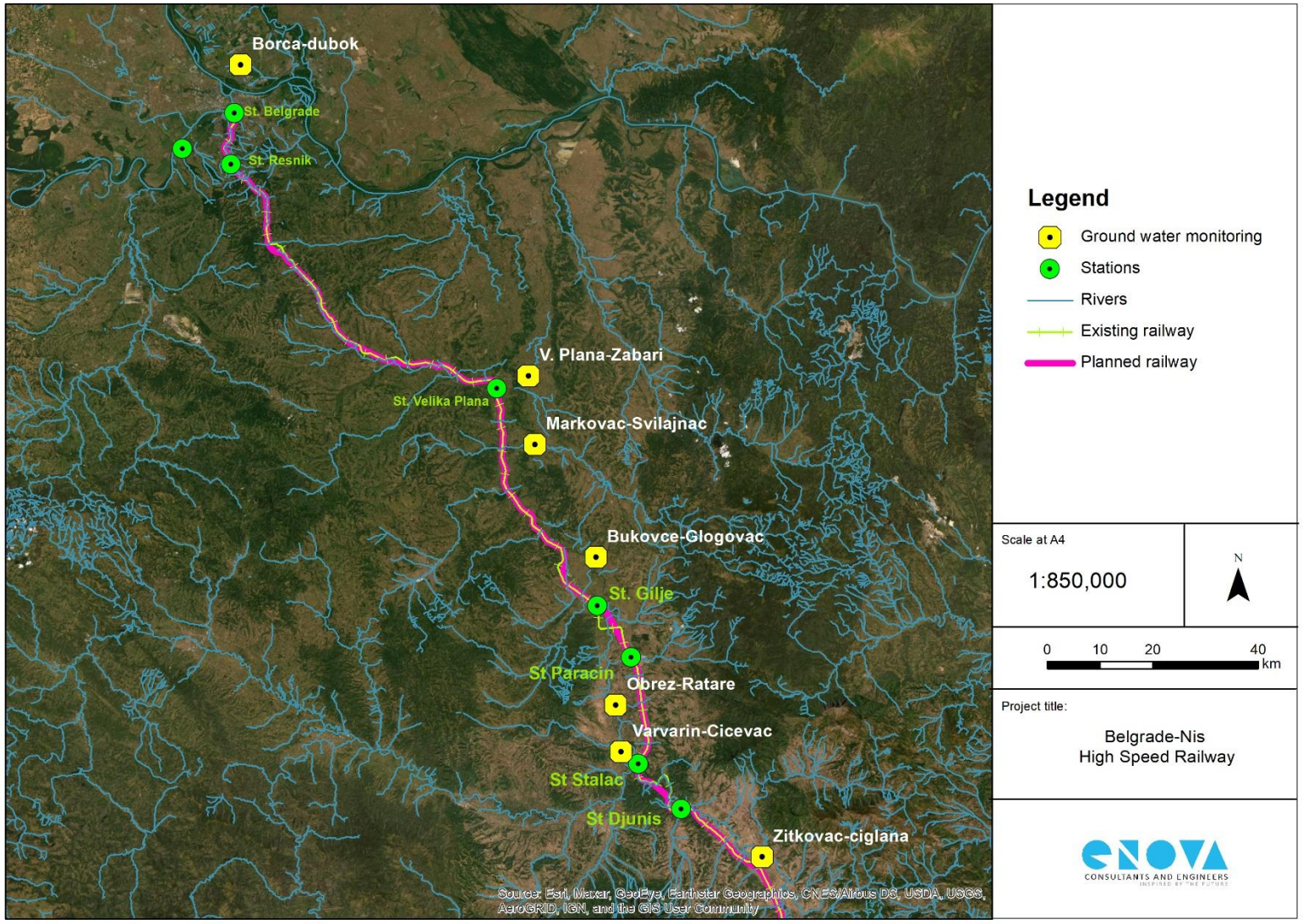


Figure 63: Location of groundwater monitoring stations

Table 40: Results of groundwater quality monitoring in 2020 at measuring points near the Project area of influence

Monitoring station		Borca-dubok	Velika Plana-Zabari	Markovac-Svilajnac	Bukovace-Glogovac	Obreze-Ratare	Varvarin-Cicevac	Zitkovac brickyard
Sampling date	dd/mm/yy	08/10/2020	10/09/2020	10/09/2020	26/08/2020	26/08/2020	27/08/2020	27/10/2020
Water depth in the piezometer	cm	360	428	590	455	521	1,502	625
Water temperature	°C	15.7	13.6	14.3	12.4	13.2	13.9	13.0
Dissolved oxygen (O_2)	mg/l	3.49	2.49	1.88	3.50	5.89	3.44	3.61
Alkalinity	mmol/l	11.10	8.90	9.60	8.08	11.00	7.34	9.94
Total hardness	mg/l	594	500	492	480	720	404	580
Dissolved CO_2	mg/l	4.8	16.1	22.0	10.1	9.7	15.8	13.2
pH		7.27	7.38	7.05	7.20	7.30	7.40	7.70
Electrical conductivity	µS/cm	1,257	945	910	1,101	1,515	897	1,319
Total dissolved salts	mg/l	716	548	529	606	879	497	726
Ammonium (NH_4-N)	mg/l	1.80	0.05	0.03	0.04	0.04	0.04	0.08
Nitrites (NO_2-N)	mg/l	0.100	<0.004	0.037	0.014	0.027	0.032	0.038
Nitrates (NO_3-N)	mg/l	2.70	0.30	4.60	1.90	1.80	3.60	1.50
Total nitrogen (N)	mg/l	5.5	0.8	5.2	6.5	20.7	7.4	2.9
Total phosphorus (P)	mg/l	0.483	0.309	0.102	0.010	0.081	0.010	0.656
Calcium (Ca++)	mg/l	146	105	130	117	136	112	152
Magnesium (Mg++)	mg/l	56	58	41	46	112	30	49
Chlorides (Cl-)	mg/l	87.0	40.4	17.7	23.4	68.8	17.5	22.4
Sulphates (SO_4--)	mg/l	32	76	57	114	170	68	130
Iron (Fe)	µg/l	1,350.0	1,546.0	39.0	567.0	58.0	300.0	57.0
Zinc (Zn)	µg/l	817.0	27.5	35.7	117.8	5.8	51.0	117.0
Copper (Cu)	µg/l	4.9	5.4	5.7	4.5	3.7	4.5	3.3
Chrome (Cr) – total	µg/l	4.6	2.0	0.5	4.1	0.7	3.3	0.7
Lead (Pb)	µg/l	3.2	0.6	0.5	2.3	0.7	0.5	2.5
Mercury (Hg)	µg/l	0.09	0.07	0.07	<0.07	<0.07	<0.07	<0.07
Aluminium (Al)	µg/l	771.0	58.0	12.0	304.0	90.0	457.0	19.0
Cobalt (Co)	µg/l	1.2	<0.5	1.8	0.7	<0.5	<0.5	<0.5
Chemical oxygen demand (HPKMn)	mg/l	13.4	2.8	3.0	3.2	3.2	2.5	2.4

Comparing the values of the parameters presented in Table 40, with the limit values defined by the *Groundwater Directive 2006/118/EC*[94], it is concluded that the values are mostly within the threshold values, except for the Borca-dubok measuring station, where an increased concentration of ammonium was recorded, and the concentration of nitrite was on the edge of the limit value.

Mineral springs

In the wider Project area, there are springs of mineral water such as the one on the south-eastern edge of Smederevska Palanka known as "Palanacki kiseljak". The water is clear, odourless, with a significant amount of gas. The water temperature is 12 °C and can vary up to 14 °C. Also, there are sources of acidic water in several other places including "Jasenicki kiseljaci", a thermo-mineral springs in the Ostrovicka valley (between the southern slopes of Svrljiske planine and Suva planina), and Lomnicki kiseljak, Ribarska Banja and Kulinska Banja formed within the cracks in the crystal shales of Jastrebac massif . Another quite significant occurrence of acidic water is in the southwestern suburbs of Mladenovac known as "Mladenovac Selters". Less mineralized water is also found in Koracicka Banja, west of Mladenovac. Mineral waters of "Palanacki kiseljak" and "Mladenovac selters" are used for general consumption due to their pleasant taste.

Regarding geothermal water resources, the area of Belgrade is rich in these springs (Figure 64). Geothermal sources in the Project area are mainly used for heating[95].

[94] https://ec.europa.eu/environment/water/water-framework/groundwater/pdf/com_swd_annex_iii.pdf?fbclid=IwAR2pGL3FerTTC904dic4zsaUYQnDE1IFUebY5YUboKelYqYq21SGENhk2bc

[95] Oudech S. and Djokic I., Geothermal Energy Use, Country Update for Serbia, 2015

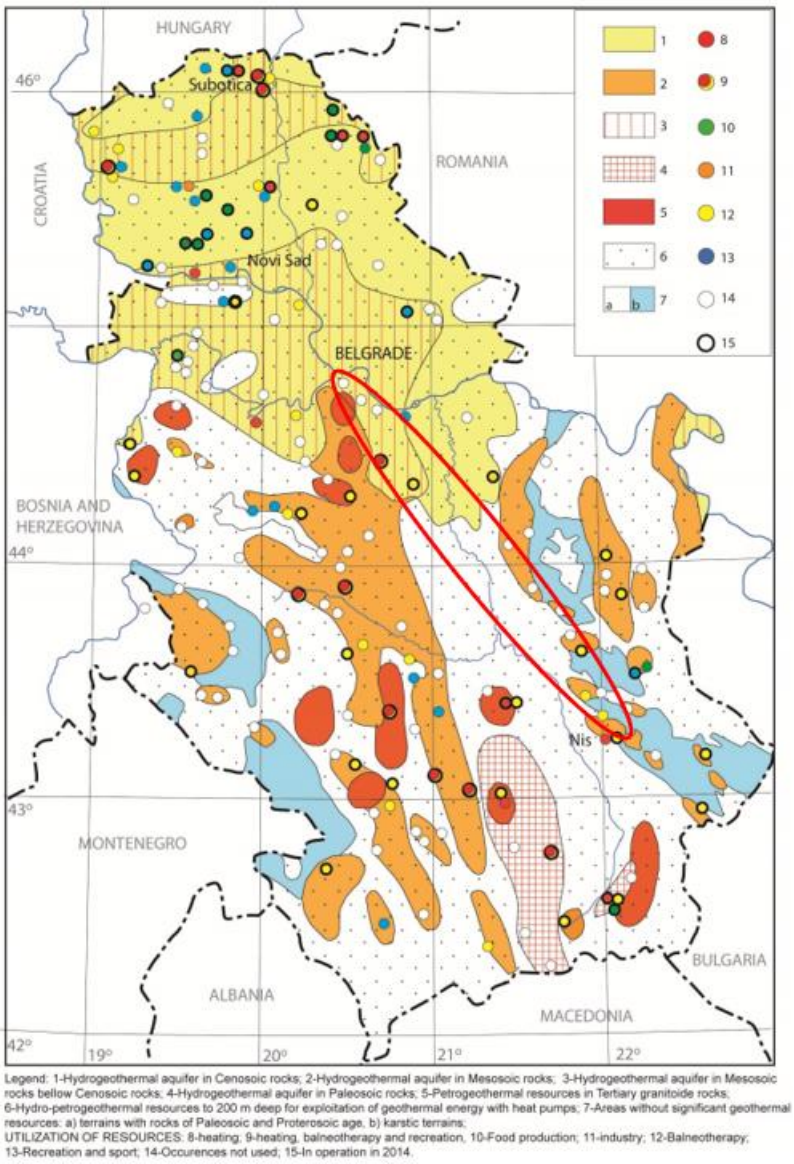


Figure 64: Presence and use of geothermal springs in RoS (the Project area is marked in red ellipse)

7.4.4 Water Supply

About 60% of the population in the RoS is covered by organised water supply systems. 27 to 30 m^3/s of drinking water is consumed in the country, of which Belgrade accounts for about 8 m^3. Surface water accounts for 27% of drinking water supply and 88% of all water uses. Groundwater provides 63% of the raw water used for drinking water supply. Although drinking water in RoS is of good quality, a long period without investment caused increased deterioration of water supply systems. According to the study "Drinking water supply for the population of Serbia", conducted by the Institute of Public Health of Serbia, every third water supply system is under microbiological risk, every fourth due to physical and chemical malfunction, while every fifth water supply system is under risk of both factors[96].

The water balance in RoS for the period 2004-2019 is shown in Figure 65[97].

[96] https://www.vreme.com/mozaik/srbija-medju-vodama/
[97] Bogdanovic P., Petrovic M., Petrovic N., Water Supply in Serbia 2015-2019 (https://utvsi.com/vodovodi-u-srbiji-2015-2019-godine/)

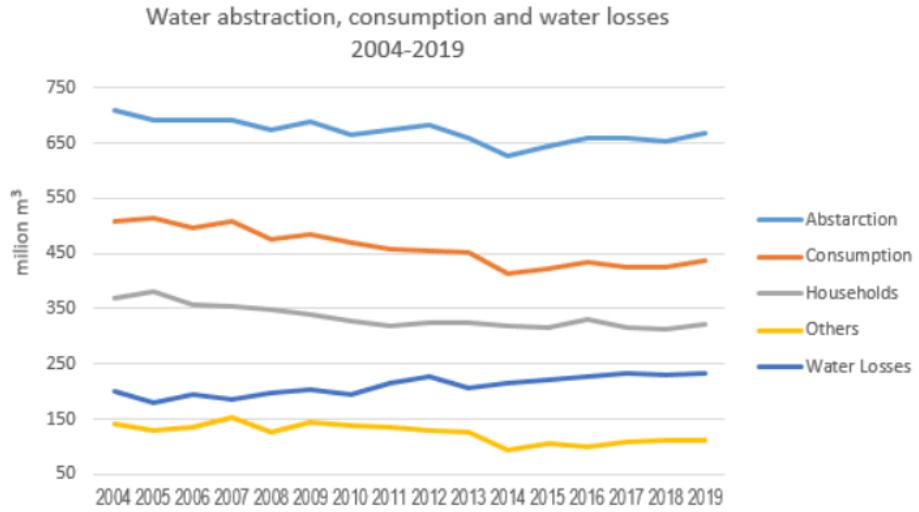


Figure 65: Water balance for the RoS (2004-2019)

Water supply system in **Belgrade** is based on treatment of raw groundwater, primarily from the Sava River but also from Danube. The water supply system consists of 135,000 main connections, 15,000 hydrants, 27 tanks with a capacity of 240,000 m^3, 142 wells, 28 storage tanks, 28 pumping stations with a capacity of 36 MW, and 5 treatment plants: Makis, Bele vode, Banovo brdo, Bezanija and Vinca. The projected capacity of the groundwater treatment plants is 8,060 l/s, and the surface water treatment plants is 3,580 l/s[98]. The total annual water production[99] is approx. 250 million m^3. The distribution network is divided into five height zones. The results of water quality analysis performed at two levels (during the production process and in the service of sanitary water control) show that water from the Belgrade water supply system is hygienically safe to drink.

The settlement of **Resnik** is supplied with water from the Belgrade water supply system. In July 2020, the connection of households to the newly installed water supply network in the municipality of Rakovica was also performed[100].

Part of the settlement of **Ralja**, which also has its own spring, is connected to the water supply system of the Belgrade municipality of Sopot. In recent years, water reductions have increased due to high temperatures and an increasing number of inhabitants. About 2,000 houses in Kovina settlement near Ralja are still not connected to the city's water supply system.

With the construction of the Drazenovac reservoir in 2014, approx. 80% of the inhabitants of **Ripanj** were connected to the city water supply system of Belgrade[101]. In 2017, an 8 km long distribution pipeline was built, which closed the water supply ring around Ripanj. Thus, all settlements in this area receive a stable water supply, and it is possible to continue the construction of the secondary network in the parts of Ripanj where it has not been built yet[102].

Water supply in the settlement of **Sopot** is provided from the city network managed by the Public Utility Company (PUC) "Sopot". Water is provided from 3 pools, 11 wells, 6 hydrophores, 2 pumping stations and one catchment with a total capacity of 61.8 l/s. The water quality control is performed at least 3 times per month at

[98] https://www.beograd.rs/lat/gradska-vlast/2144-jkp-beogradski-vodovod-i-kanalizacija_3/
[99] https://www.waterworld.com/drinking-water/potable-water-quality/article/16200775/renewing-belgrades-water-infrastructure
[100] https://www.blic.rs/vesti/beograd/povremena-iskljucenja-vode-u-naseljima-resnik-i-suncani-breg/mb3qfcy
[101] https://www.danas.rs/vesti/beograd/gradjani-ripnja-dobili-vodu/
[102] https://www.beograd.rs/lat/beoinfo/1733454-distributivni-cevovod-zatvara-prsten-u-ripnju/

17 different sampling points on the entire territory of the municipality of Sopot. Water wells are monitored and controlled by 24-hour video surveillance and controller that monitors the level of chlorine in the water and air[103].

Water supply in the municipality of **Mladenovac** is provided through a network that supplies water to the town of Mladenovac and the villages of Kovacevac, Vlacka, Granice and Rajkovac. The springs included in water supply system are Vlacka (Kokorin), Rajkovac, Serava, Mladenovac, Koracica, Selters and Granice, Meduluzje and Kovacevac (Brestovica) and indvidual wells. A large number of springs are conditioned by small capacities and rapid reduction of yield. A total of 85 exploitation and exploration wells exist, of which 42 are in use with a maximum capacity of 130 l/s. The local water networks exist in Senaja, Sepsin, Dubona, Americ, Koracica, Velika Ivanca and Velika Krsna, which are managed by local communities or groups of citizens. The villages of Markovac, Pruzatovac, Mala Vrbica, Meduluzje, Jagnjilo and Rabrovac are supplied with water exclusively through wells. In May 2022, the works on the construction of another well for the needs of water supply of the inhabitants of this municipality began. The water capacity will be increased by about 20 l/s, which will solve the problem of water supply in the summer months. It is planned to connect Mladenovac to the Makis-Mladenovac main water supply system in 2024[104].

The municipality of **Smederevska Palanka** is provided by the water from spring conglomeration located at the localities of Rudina, Singer and Bulina voda. In 2015, the works on the water factory of Trnovce spring system were completed. The factory uses water from about 16 m deep 18 exploration and exploitation wells, which capture water from the gravelly-sandy deposits of the Velika Morava River. The total capacity of the spring is 120 l/s, out of which 70 l/s is distributed by pipeline to Smederevska Palanka. The total length of the water supply network is 130 km with a total of 10,380 connections[105]. Most households in the surrounding villages of Smederevska Palanka use private wells for water supply.

The water supply of **Velika Plana** is based on two systems: (i) the local system consisting of Livade with wells and Trnovce with eight wells, and (ii) the regional Mlavsko-Moravski water supply system using water from alluvium of Velika Morava River and supplying Smederevska Palanka and Velika Plana. The public water supply system covers the entire municipality, except the settlements of Kupusina and Radovanje that have their own water supply systems, capturing water from two springs.

In the village of **Markovac**, the households are exclusively using individual water wells[106].

The citizens of the **Lapovo** municipality are supplied with drinking water from the Garevine source, which is managed by PUC Morava[107]. As a permanent solution for the municipality of Lapovo, the Spatial Plan of the RoS and the Baseline Study on Water Management in the RoS[108] foresees connecting Lapovo to the Ibarsko-Sumadija regional water supply system[109]. The city's water supply network passes under the existing railway line.

Batocina Municipality is using a source located in the area of the village of Jasik, in the alluvial plateau of the middle course of the Velika Morava River. The Jasik spring has two exploitation wells, as well as a collection tank with a pressure pipeline. Some parts of Batocina are also supplied with water from the Kragujevo water supply system[110] including the village of **Brzan** that was connected in 2018.

The urban area of **Jagodina** is supplied with water from the public water supply system, while rural areas mainly use individual water wells. PUC “Standard” Jagodina manages the spring in the village of Ribare near Jagodina

[103] https://www.sopot.org.rs/directory/javno-komunalno-preduzece-sopot/
[104] https://www.beograd.rs/lat/beoinfo/1795261-bolje-vodosnabdevanje-za-stanovnike-opstine-mladenovac/
[105] http://www.jkpvodovodsp.rs/
[106] Petrovic Pantic T., Mandic M., Samolov K., Hydrogeology and Water Problems in the Area of Kosmaj, Mladenovac, Smederevo and Smederevska Palanka
[107] https://www.jkspmorava.rs/%d0%b2%d0%be%d0%b4%d0%b0/
[108] Developed in accordance with the Law on Waters of RoS.
[109] http://www.lapovo.rs/main/infrastruktura/
[110] http://jkpvik-kg.com/osnovni-podaci/

with modern plant for drinking water production, the city water supply network in a length of 36 km, and the village water supply network in a length of 64 km[111].

The city of **Paracin**, together with **Cuprija**, has been supplied with water for almost 40 years from the Sveta Petka spring, which is located in the village of Izvor, about 16 km east of Paracin. In the wider vicinity of Paracin, there is a spring that includes four wells with a yield of about 35 l/s. Currently, Paracin consumes 70 l/s from the wells. The industrial enterprises in Paracin mainly use water from their own springs[112]. The public water supply network covers approx. 70% of the rural area. The rest of the population uses their own wells. The length of water pipes of the public water supply system in Paracin is 280 km[113]. The city's water supply network passes under the existing railway line. The situation is similar in the municipality of Cuprija, where the public water supply covers the urban area and a smaller number of rural settlements, while water supply in other villages is provided by individual wells.

The settlement of **Stalac** is connected to the Rasina-Pomoravlje regional water supply system. The system receives water through the artificial accumulation of "Celije". The catchment area of the Celije Lake is 598 km^2, while the average distance of Stalac from this lake is 45 km. In addition to this, there are two water springs Seliste (above Stalac settlement, at ca. 213 m asl) and Toplik (near the occasional stream Toplik, at ca. 257 m asl), which are important for the water supply of the municipality of Cicevac[114]. More information on the use of these two springs is not available.

In **Djunis** settlement, water is supplied either through smaller rural systems that serve a group of households or single water intake systems/wells that serve individual households. These rural water supply systems are managed by the local communities; thus the monitoring of water quality, exploitation, control, protection and use is their responsibility. Individual wells are the responsibility of their owners. There are some plans to connect Djunis to the Rasina-Pomoravlje water supply system[115] but concrete activities have not started yet.

The settlements **Braljina**, **Mojsinje** and **Trubarevo** do not have organised water supply. Due to topographic and demographic-development characteristics, these settlements will most probably continue to use local water supply systems.

Water supply in the municipality of **Aleksinac** is provided from the Bovan water system and the Bresje water treatment plant. Aleksinac and 19 settlements of the municipality are connected to the public water supply system. The total length of water supply pipeline, without connections, is about 260 km[116]. The public water supply network covers all settlements near the railway line.

The city of **Nis** is supplied with water through three territorially separate and functionally very dependent water supply systems. The system supplies water to about 240,000 people and the highly branched Nis industry, with a volume of 103,377 m^3/day. The villages around Nis have their own rural water supply networks. The Moravian water supply system, as part of the Nis water supply system, supplies drinking water to the village of **Trupale**. The necessary amount of water is provided by capturing the karst springs Pester and Toplik and by building wells in the alluvium of the Toponicka River[117]. The villages of **Mezgraja**[118] and **Medjurovo**[119] are also connected to the Nis water supply system.

Water supply sanitary protection zones

[111] http://www.jpstandard.rs/Vodovod.aspx
[112] http://www.paracin.autentik.net/vode/vode.php
[113] http://rtvparacin.rs/sistem-javnog-snabdevanja-preko-centralnog-vodovoda-u-paracinu/
[114] Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Stalac-Djunis
[115] http://www.vodovodks.co.rs/vodovodni-sistem-2/2596-dir-r-v-d-v-d-s-s-r-dnici-bish-z-v-li-gr-lj-n-i-dunis
[116] http://www.vodovodal.rs/o-vodovodu/
[117] https://jkpnaissus.co.rs/vodovod-danas/
[118] https://niskevesti.rs/jkp-naissus-iskopi-u-dimitrovgradskoj-ulici/
[119] https://niskevesti.rs/jkp-naissus-osam-kuca-bez-vode-zbog-havarije-na-vododovoj-mrezi-u-gornjem-medjurovu/

In the Belgrade area, the railway line passes through a smaller part of the wider B zone of sanitary protection, that is already urbanised by residential buildings. The rest of the route does not pass through any sanitary protection zones[120].

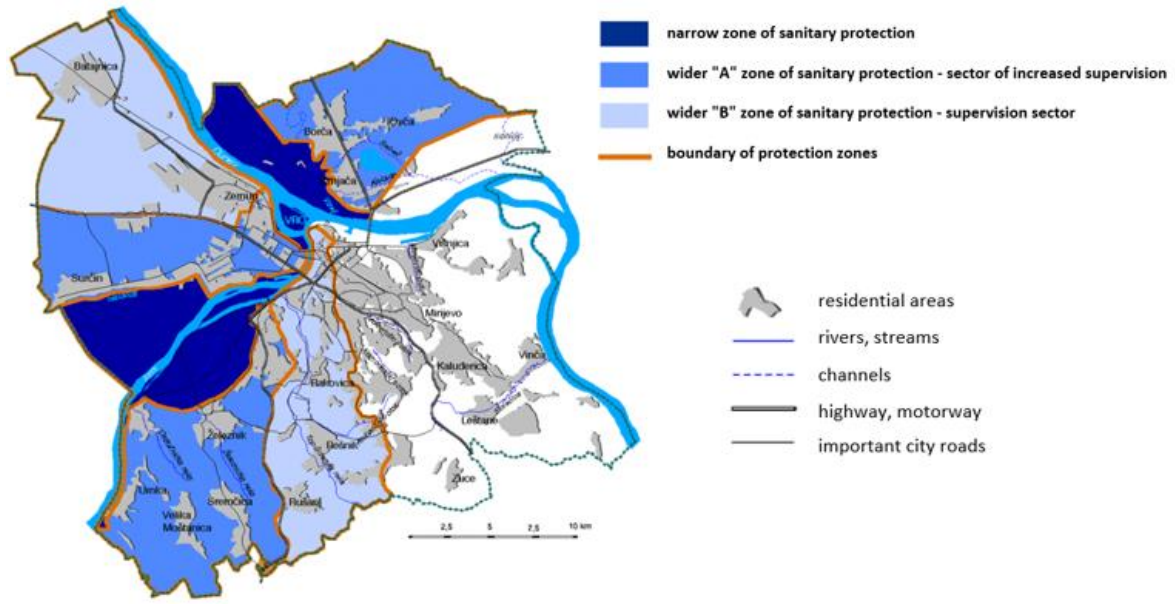


Figure 66: Water supply sanitary protection zones – Belgrade area

The next wider sanitary protection zone through which the railway route passes is the zone of underground spring Gorunja in Paracin. The section Gilje-Paracis is already reconstructed, and no additional works are planned.

The existing railway route passes near the wider protection zone of the underground spring Garevine in Lapovo, while Lapovo spring is at the distance of around 1 km from the existing alignment. To avoid any negative impacts, the measures prescribed by the *Rulebook on the manner of determining and maintaining the sanitary protection zones of water supply sources*[121] should be applied. Springs in Mladenovac and Smederevska Palanka are more than 1 km from the railway route.

For a more detailed examination of the presence of underground water, as well as potential individual springs, it is necessary to carry out detailed hydrogeological investigations in the phase of Main Design development.

[120] https://www.zdravlje.org.rs/ekoatlas/volb/08.gif
[121] "Official Gazette of RS", No. 92/08

7.5 Geology

7.5.1 Geological characteristics

The RoS is a part of the Eurasian Plate. In a tectonic sense, Serbia is part of an orogenic system that is composed of the Alpine, Carpathian, and Dinaride orogenic belts. The Project area spreads over several sheets of basic geological maps: Paracin, Krusevac, Aleksinac, Nis, Belgrade, Pancevo, Smederevo, Pozarevac and Lapovo. Throughout the Project area, formations of different geological ages are represented:

- The old Proterozoic sediments, which are most represented on the geological sheets of Nis, Paracin, Aleksinac and Krusevac. Sediments of Proterozoic-Paleozoic age consist mainly of serpentinites and various crystalline shales of a high degree of metamorphism. The presence of quartzite, gneiss, granite and migmatite has been also detected.
- The Mesozoic formations, which consist of sediments of Triassic, Jurassic and Cretaceous age. The diabase formation is of great importance, while flysch and limestone sediments are also characteristic.
- The Tertiary consists mainly of Neogene deposits, but Paleogene sediments also occur. These are dacites, andesites and quartzlates, while Miocene deposits are also characteristic of this area. It is a complex of conglomerates, sandstones, marls, sand clays and limestones.
- Youngest Quaternary sediments, which are of Quaternary age, and they consist of river, lake, swamp and Aeolian sediments. Alluvial sediments stand out due to the large number of rivers in the Project area.

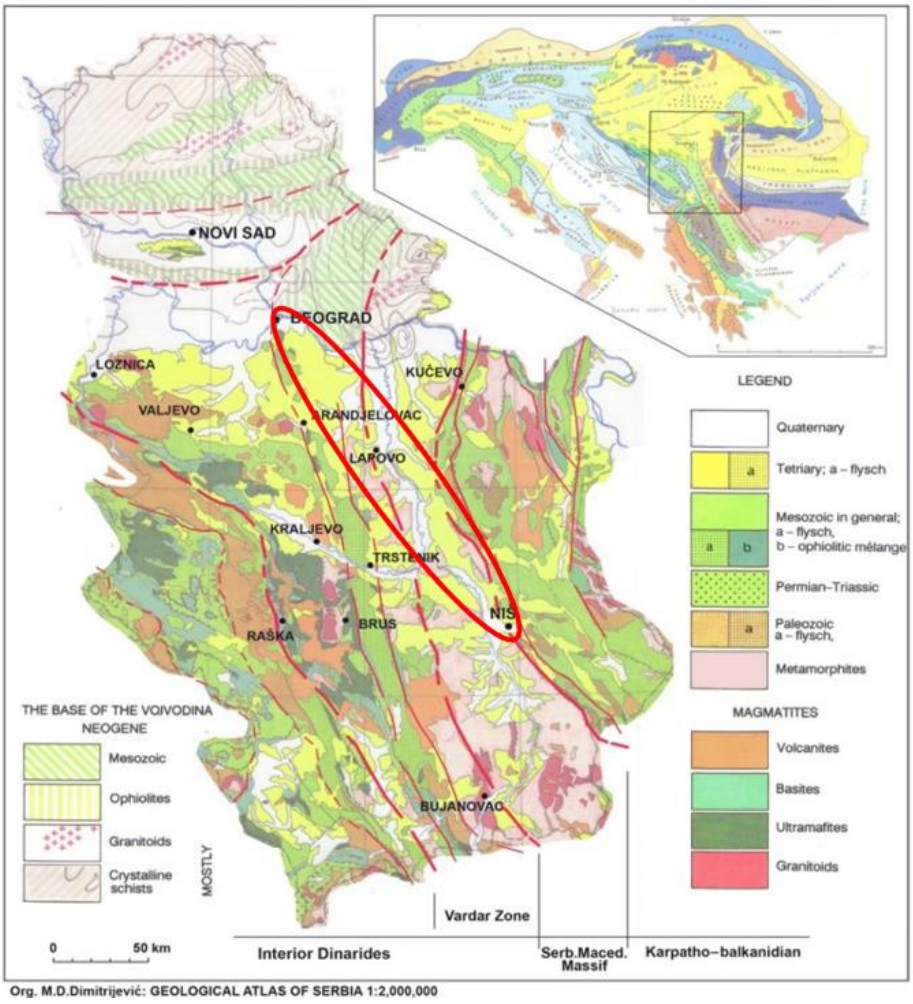


Figure 67: Geological map of RoS (project area - red ellipse)

In the geomorphological view, the terrain is slightly wavy, ie flattened to shore-hilly. An exception is the canyon Juzna Morava through which the railway passes from Stalac to Braljine. More information regarding geomorphology is given in Chapter 7.7.

7.5.2 Seismology

The RoS is prone to seismic activity varying from moderate to strong earthquakes. Based on the seismological hazard map (RSZ 2010) for a return period of 475 years[122], the Project area is located in zone VII-VIIIº MSK scale, with seismicity coefficient between 0.10 and 0.20.

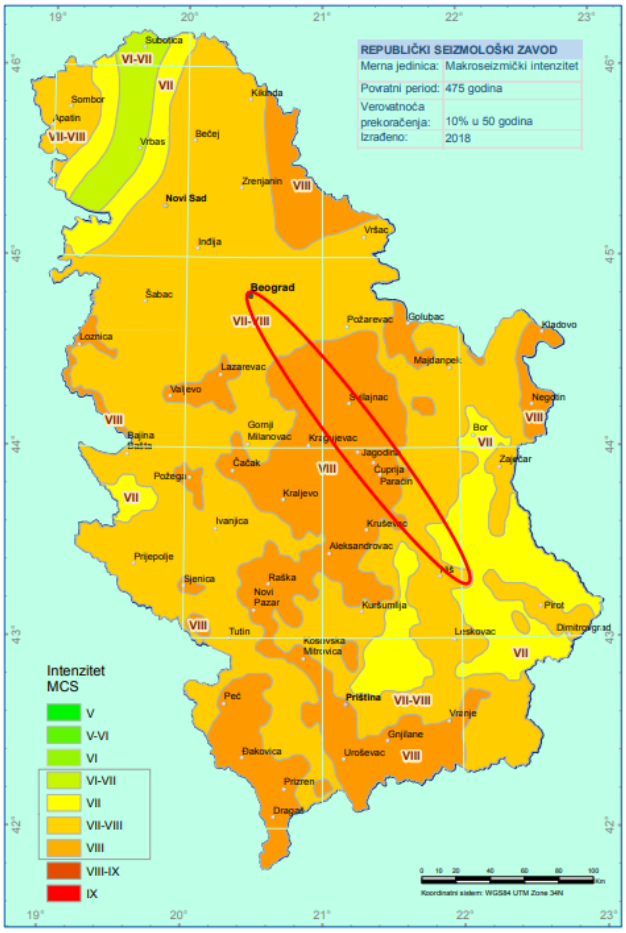


Figure 68: Seismic hazard map for a return period of 475 years (project area - red ellipse)

The first part of the route of the existing line is in the zone of VII-VIII degrees of seismic scale, and the rest is mainly in the zone VIII of seismic scale. The intensity of earthquakes recorded so far in the Project area[123] did not exceed 6.0 MWu[124].

The last strong earthquake that hit the Project area occurred in Krusevac (May 10, 2022) and was of magnitude ML[125] 4.6[126]. Several minor earthquakes were registered in the period 21-26 June 2022 in the area of Kragujevac. The strongest earthquake was of intensity ML 3.2[127].

[122] http://www.seismo.gov.rs/Seizmicnost/Karte_hazarda_l.htm
[123] http://www.seismo.gov.rs/Seizmicnost/Karta_epicentara_l.pdf
[124] Moment magnitude scale
[125] Richter scale
[126] https://ba.n1info.com/regija/zemljotres-uznemirio-gradjane-kusevca/
[127] https://www.novosti.rs/drustvo/vesti/1129870/najnovije-vesti-zemljotres-kragujevac

Regarding seismic landslides, the Project area is in a region with a recorded level of “low risk” and above from seismically triggered landslide events. This conclusion is based on postprocessed data from the International Centre for Geohazards /NGI for the Global Assessment Report on Risk Reduction (GAR). Landslide risk is locally influenced by other factors, e.g. local slope and vegetation conditions, long term precipitation trends and human actions, such as excavation of slopes, deforestation, mining etc. The project siting, design and construction features ensure that the structures are stable and will not increase landslide risk.

7.6 Soil

7.6.1 Soil types

In the area of the RoS, and even in the Project area itself, there are several soil types. Figure 69 presents soil map of the RoS. The Project area is mainly characterised by fluvial and fluvioglacial soils. The main soil types are alluvium, alluvium in cultivation and alluvial meadow land.

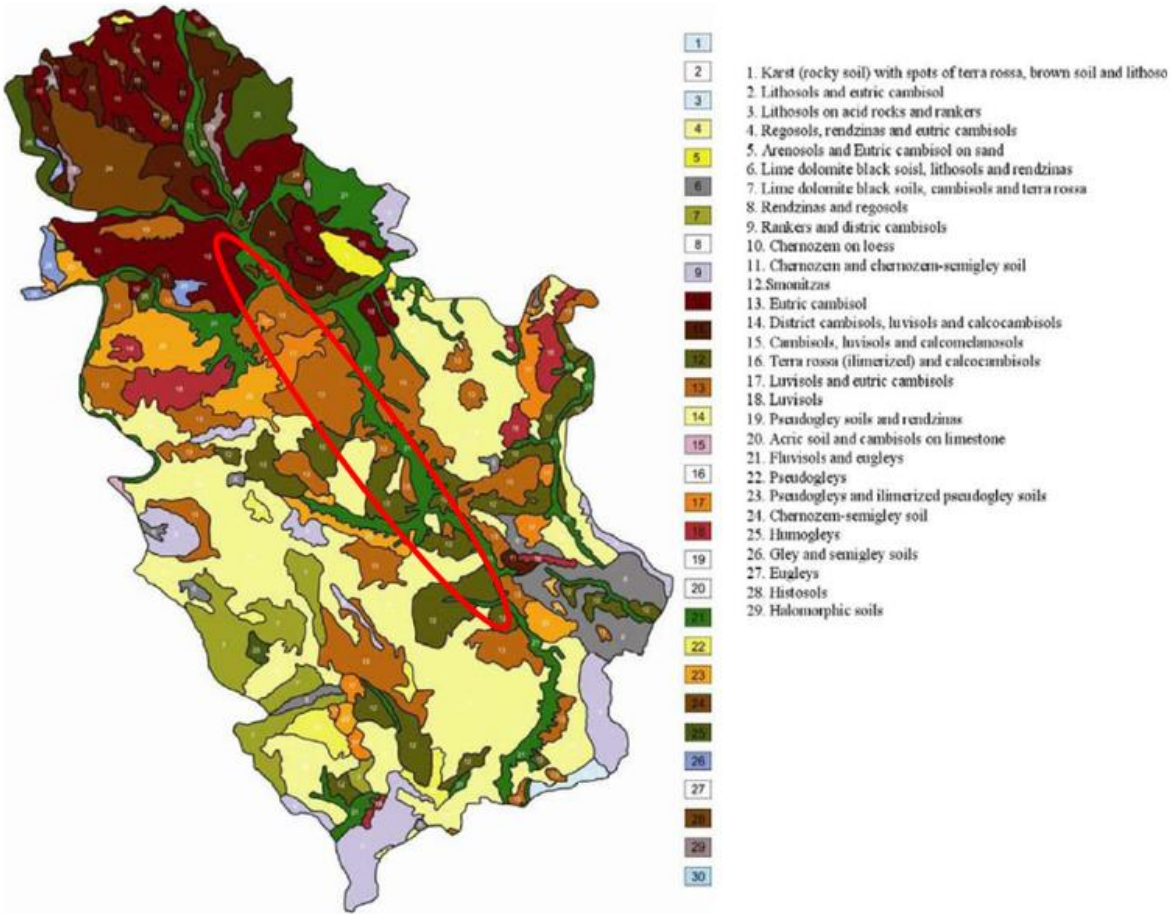


Figure 69: Soil map of RoS (project area - red ellipse)

A large number of soil types in the Project area is a consequence of the geological base, the richness of flora and fauna, climatic and hydrological diversity, as well as the human activities. The railway route passes through the following areas:

- Loess terraces and lake terraces below an altitude of 500 m. The production value of this soil varies depending on the humus content, depth and mechanical composition of the substrate. The best groves are on wood and tertiary sediments, which are excellent agricultural land, especially for fruit growing

and viticulture, while groves on basic eruptive rocks are good forest soils, and they are less suitable for agriculture. This type of soil is found on 5% of the total length of the railway route.

- Alluvial deposits (alluvial meadow soils), as a very heterogeneous group of soils, which are formed as fresh sediment in the field of the Velika Morava River. By its nature, this sediment can vary from gravel through sand to the finest clay particles. Sedimentation conditions change both during the year and during the longer evolution of the river valley. Alluviums can be very fertile soil of high quality for agriculture and are typical for the habitats of natural willow and poplar forests, or pediculate floodplain forests.

Typical soils found in the Project area, are cambisol and vertisol, while pseudogley occurs in the area of the city of Belgrade, and chernozem in the area of Nis. Cambisol is a land of oak forests (sessile oak, malt and cera). Cambisol has significant amounts of humus, so it is very suitable for farming, fruit and wine growing. It is widespread in the valleys of Velika Morava River and Juzna Morava River. Vertisol is a soil type that is formed on a clay base and in climatic conditions that suppose a change of wet and dry periods. They are often very deep, from 60 to 150 m, and somewhere they reach a depth of up to 250 m. In the wetter part of the year, they are sticky. In summer, they dry out and often crack. Vertisol is typical for the valleys of Velika and Juzna Morava Rivers. The natural vegetation consists mainly of deciduous forests, which are mostly destroyed. The crops that thrive on this land are industrial plants, mostly sunflower and sugar beet. Pseudogley is a soil type that forms near large plain rivers, but also in areas where there is a thicker layer of clay and characterised by poor production abilities. Chernozem is the most fertile soil type and has therefore been turned into arable land on which many cultivated plants grow[128].

Figure 70: Land use in the Project area

Erosion is particularly pronounced in the coastal part of the Velika Morava River, where in the period of high waters coast erodes to case changes in morphology of the riverbed. This phenomenon is partially mitigated by the flood protection structure and landscaping of the coast. Due to erosion, the Juzna Morava River is rich in sediment.

7.6.2 Soil quality monitoring

SRI is not required to conduct regular soil quality monitoring, but it does perform monitoring in case of accidents (e.g., spillage of hazardous substances) at the request of the Ministry of Environmental Protection. The most recent soil quality monitoring was conducted in May 2021[129] when a pure sulfuric acid spill occurred.

[128] https://geotesla.wordpress.com/2019/11/21/sastav-i-karakteristike-tla-srbije/
[129] Mining and Metallurgy Institute Bor, Monitoring Report 45837, June 2021

7.6.3 Land use

The land use map of RoS is presented in the following figure.

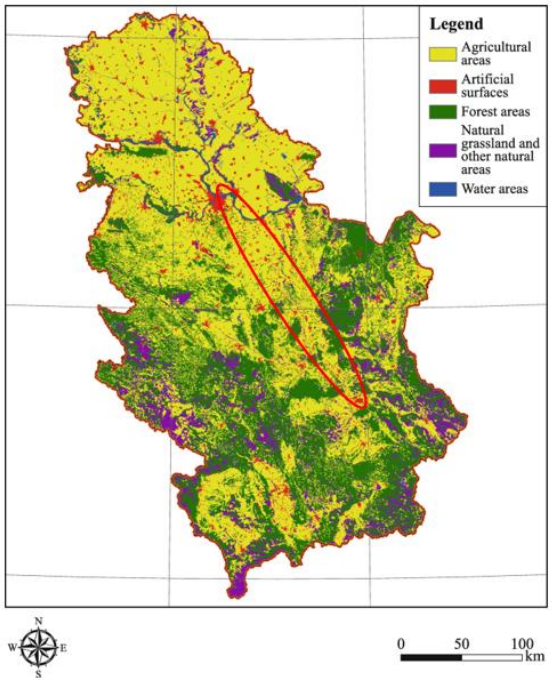


Figure 71: Land use in RoS (Project area - red ellipse)

As presented in Figure 71[130], the Project area is mostly covered by agricultural land (arable land, sown crops and fields), followed by forests. The Project area is predominantly lowland-agricultural areas and hilly (orchards and vineyards) and belongs to the type of land called alluvial land. Alluvial deposits in the valley of Velika Morava River and Juzna Morava River have great agricultural value and belongs to the second class of agricultural land. Their morphological, physical and chemical properties provide favourable conditions for the development of agricultural crops. The railway route, especially on Velika Plana-Nis section, is surrounded by gardens and yards, and woody vegetation is predominantly represented by different types of fruits and walnuts, while coniferous species are mostly present at train stations. Vegetation along watercourses is also greatly influenced by agricultural activities.

Corine Land Cover maps for each Project subsection are presented in the following figures.

[130] Manic E., Nikitovic V. and Djurovic P., The Geography of Serbia, 2021

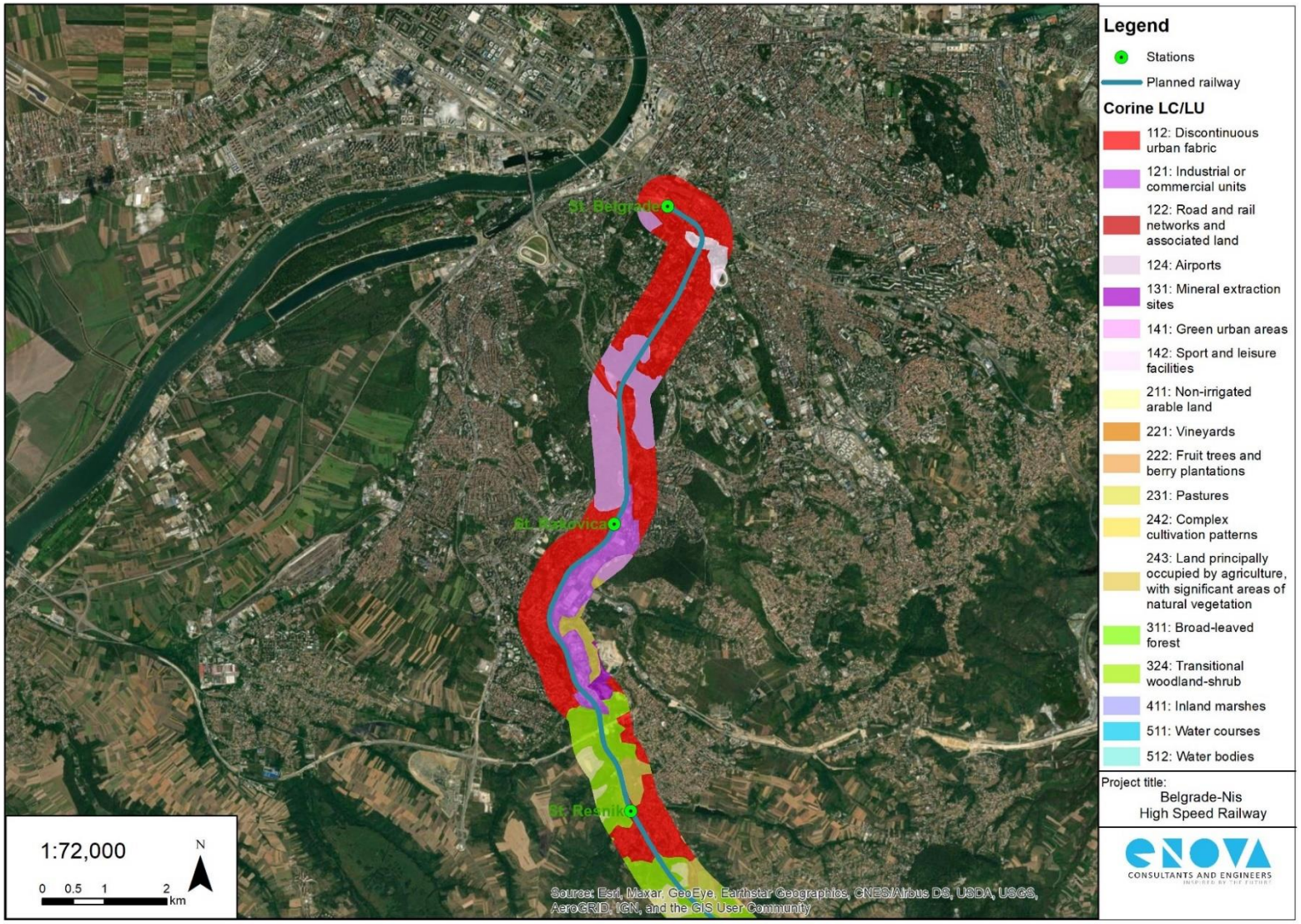


Figure 72: *Corine Land Cover map (Belgrade-Resnik subsection)*

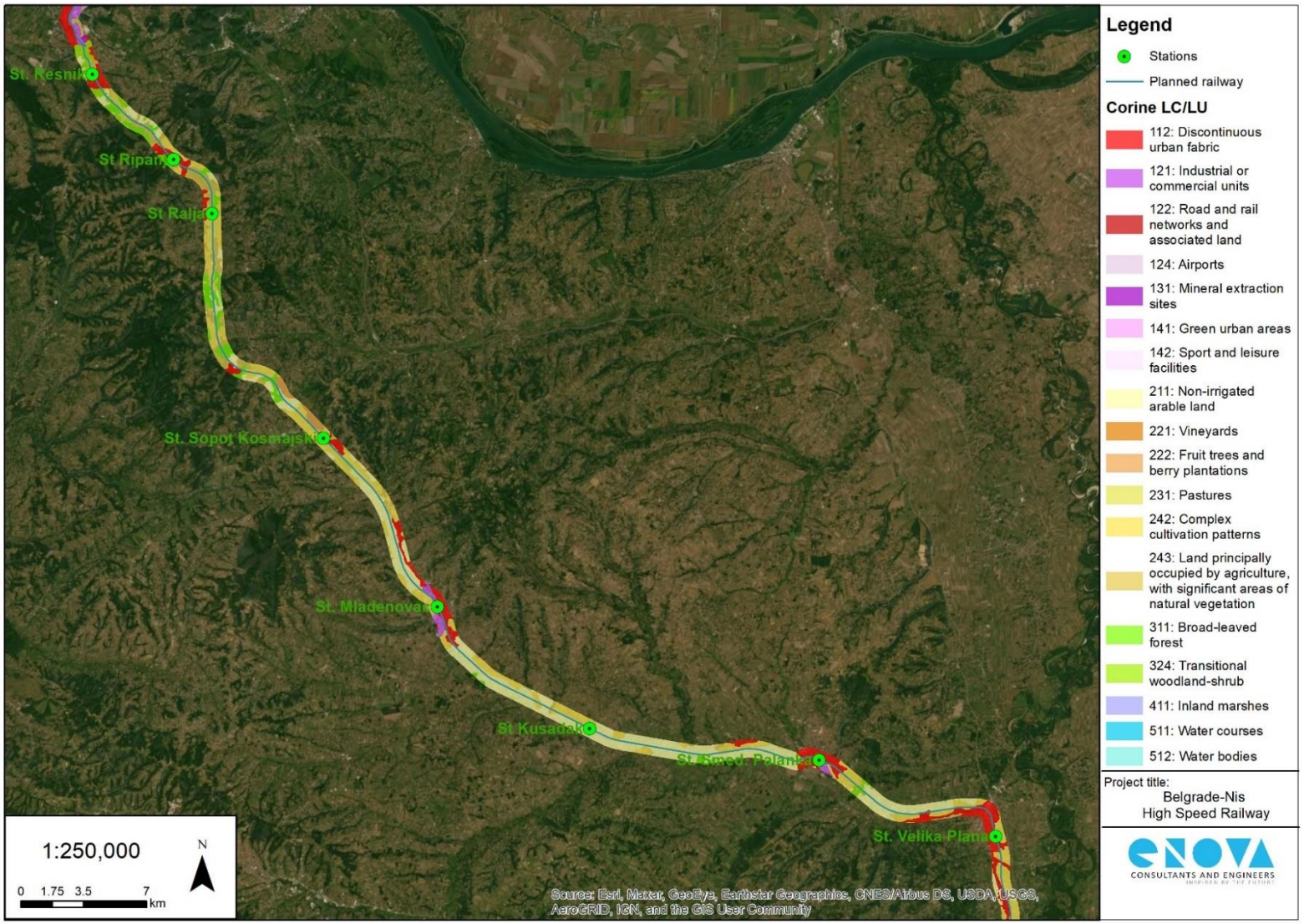


Figure 73: Corine Land Cover map (Resnik-Velika Plana subsection)

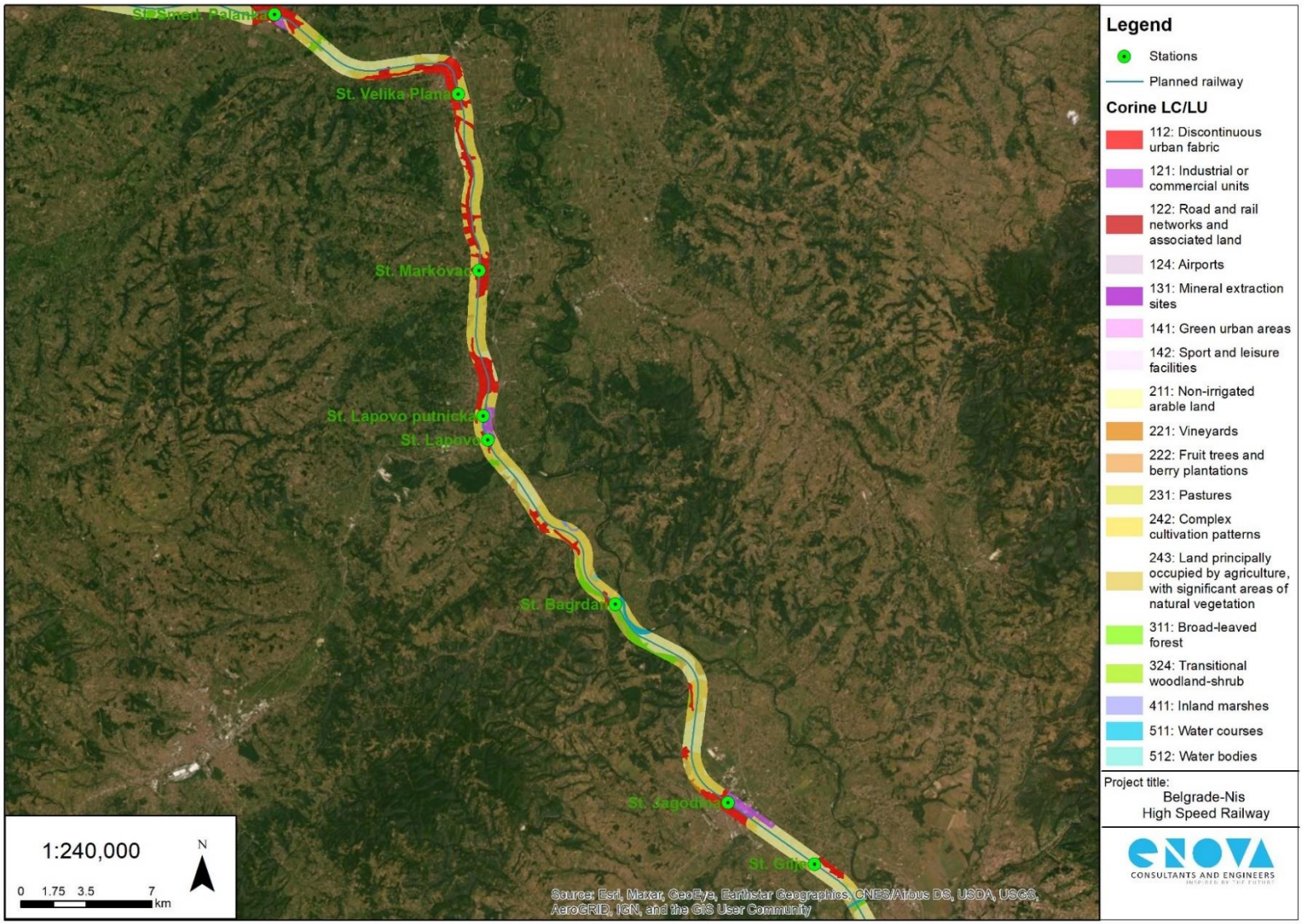


Figure 74: Corine Land Cover map (Velika Plana-Gilje subsection)

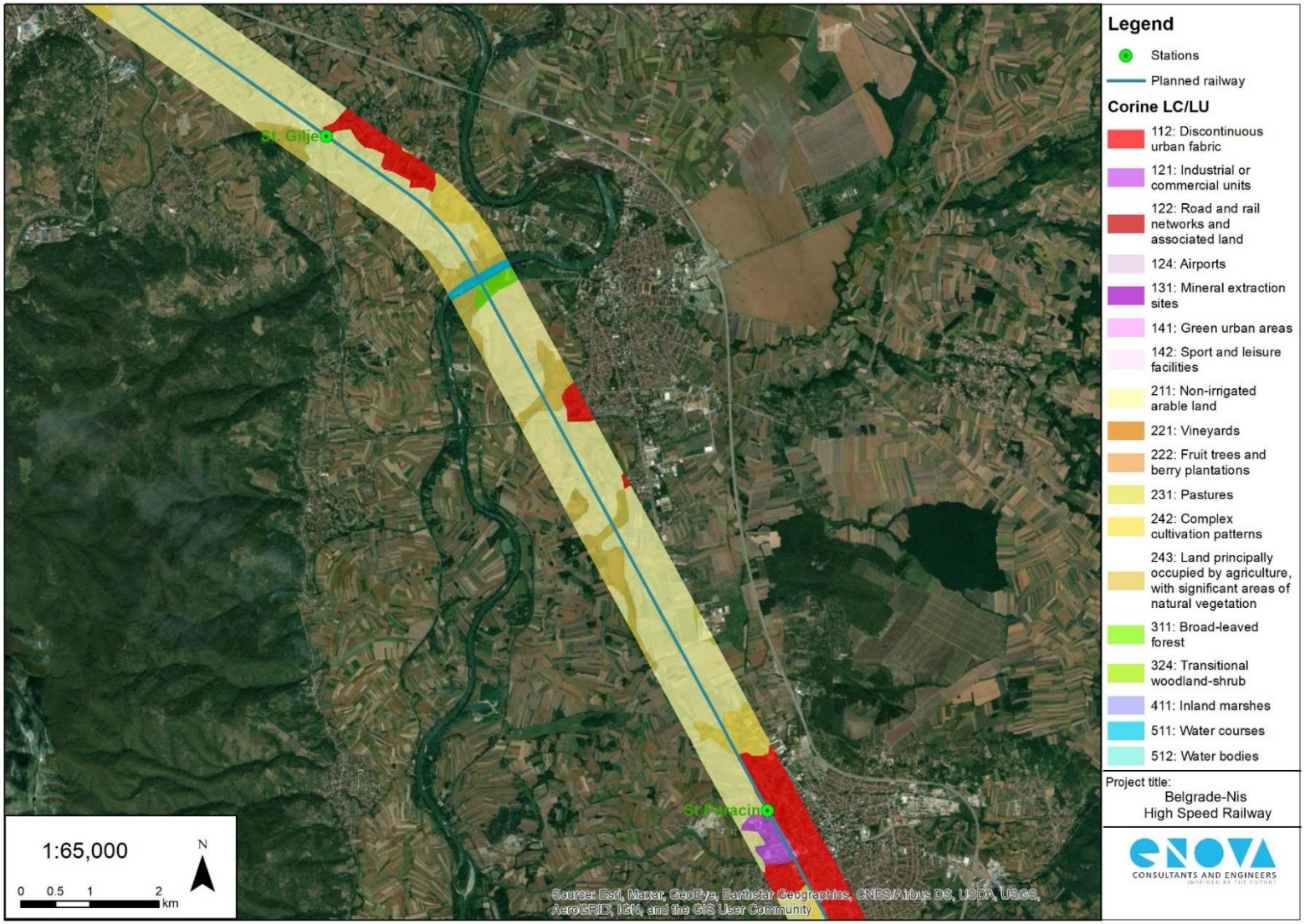


Figure 75: Corine Land Cover map (Gilje-Paracin subsection)

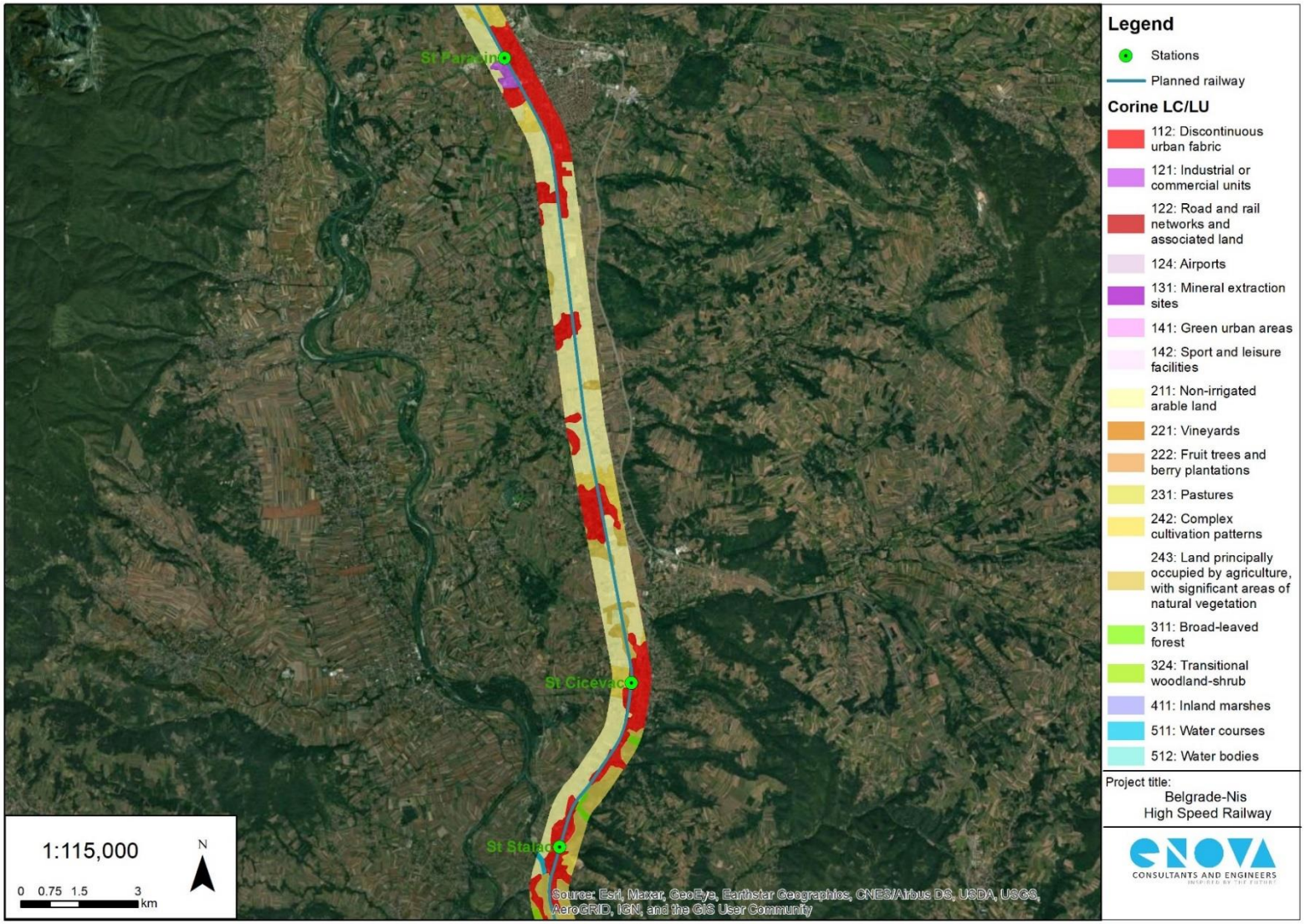


Figure 76: Corine Land Cover map (Paracin-Stalac subsection)

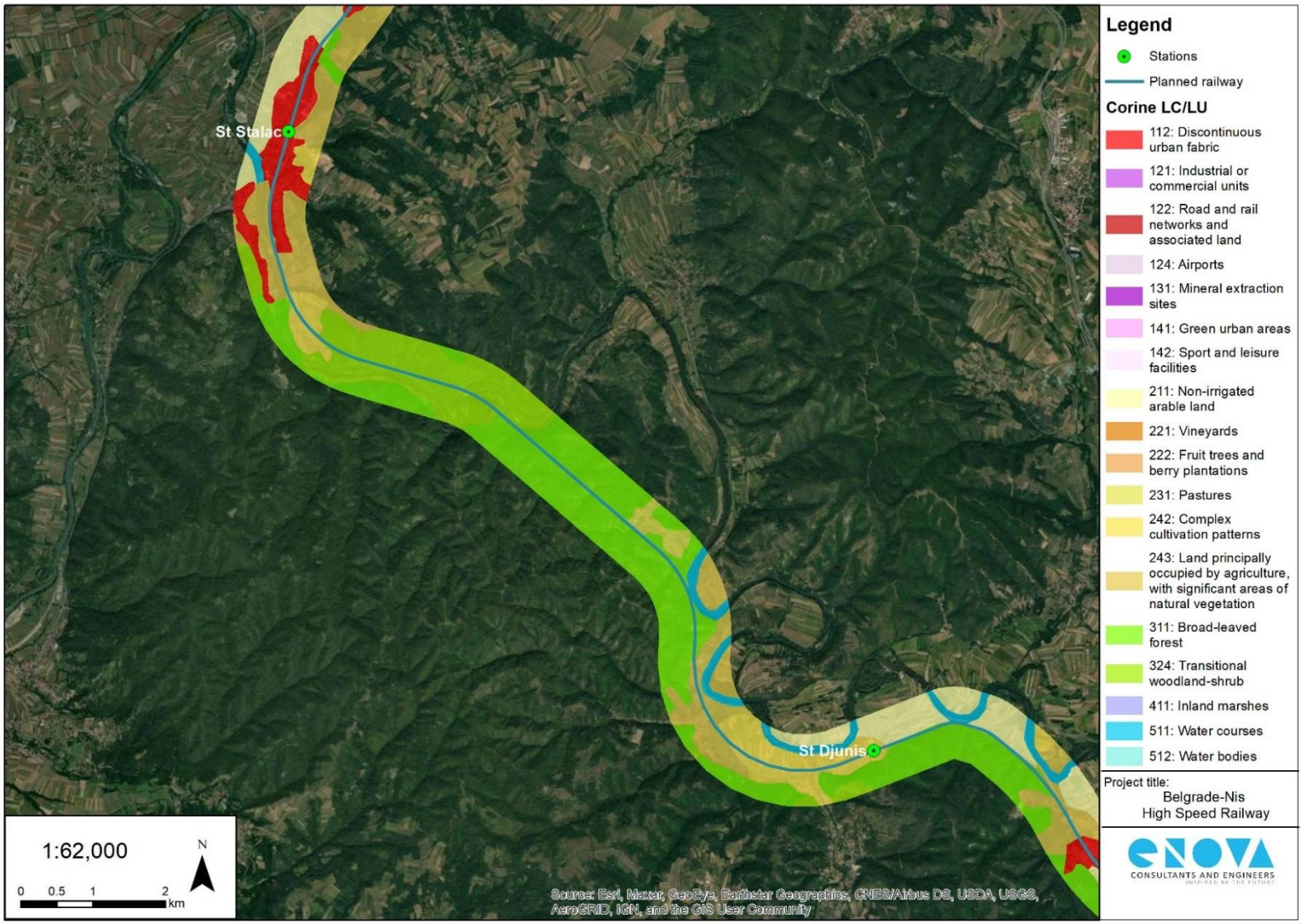


Figure 77: Corine Land cover map (Stalac-Djunis subsection)

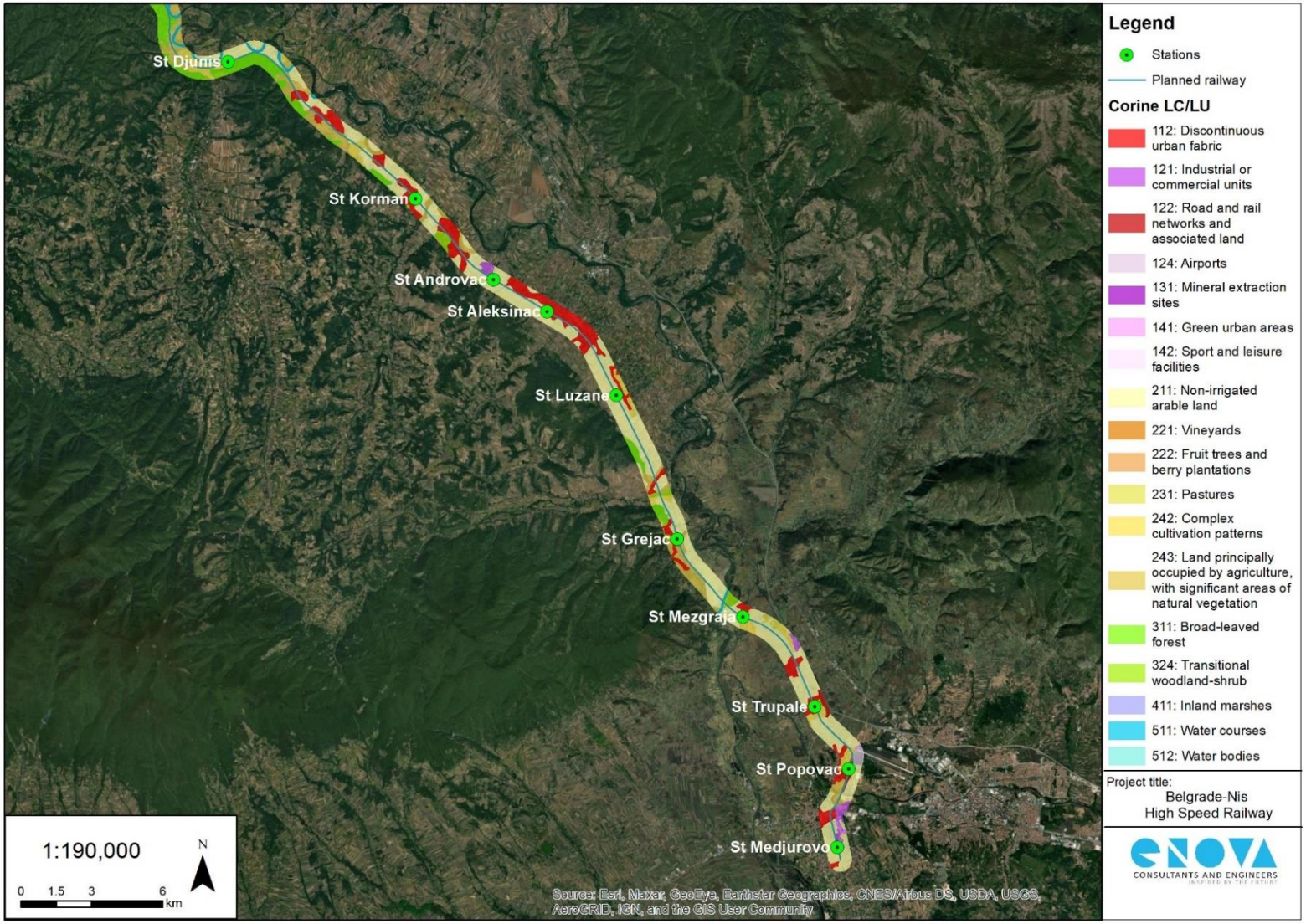


Figure 78: Corine Land Cover map (Djunis-Medjurovo subsection)

7.7 Landscape and Visual

Note: Since a conceptual design including technical specifications and future railway alignment for the subsections Resnik-Ostruznica and Crveni Krst (Red Cross)-Nis Center-Nis Marshalling yard have not yet been developed, a detailed landscape and visual analysis was not possible, but a preliminary description of the location and characteristics of these subsections is given in section 3.10 of this Assessment Report.

The terrain from Belgrade to Nis is slightly undulating, from the valley to the hilly areas. The Project area landscape is characterised by (i) the valley of the Velika Morava River and the hills on the left bank of the Velika Morava River, Bagrdan George and the Juzna Morava valley, (ii) arable land used for agricultural purposes, and (iii) urbanised populated areas. Altitude varies between 120 and 500 m above sea level. Four groups of visual receptors are identified: (i) residential receptors, (ii) people that work in the countryside, (iii) recreational receptors, and (iv) people traveling along the railway.

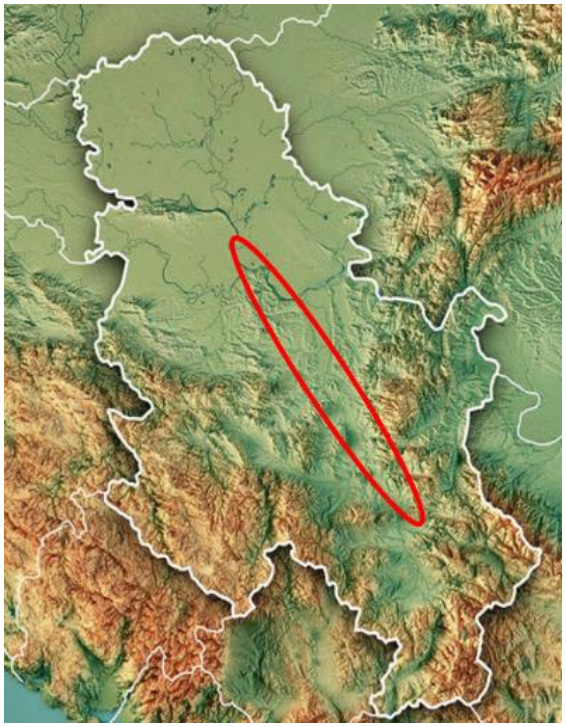


Figure 79: Tophographic map of RoS (Project area - red ellipse)[131]

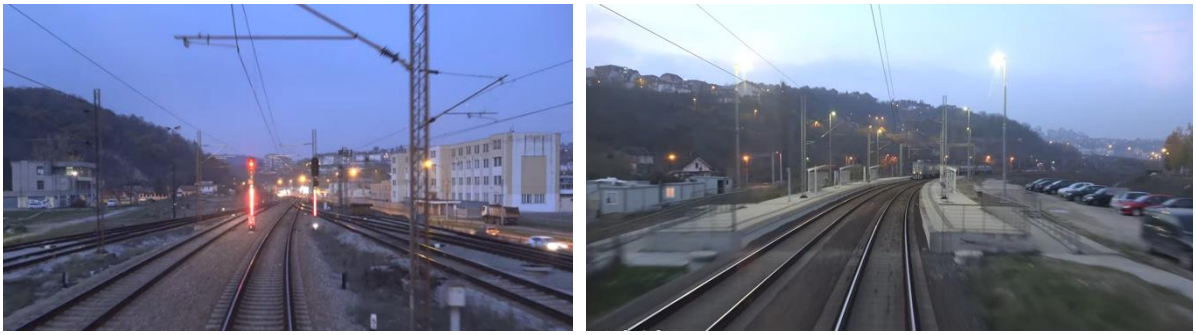
For the purpose of this assessment, five landscape and visual values character areas have been identified:

- Belgrade-Resnik subsection, characterised by a high level of urbanisation,
- Resnik-Jagodina subsection, characterised by predominantly rural areas,
- City of Jagodina, characterised by a high level of urbanisation,
- Jagodina-Nis subsection, characterised by predominantly rural areas,
- City of Nis, characterised by a high level of urbanisation.

Belgrade-Resnik subsection. The highest concentration of the population on the railway alignment is around the city of Belgrade, including the suburban settlement of Resnik. Therefore, this subsection is characterised by a significant number of individual residential buildings and collective housing facilities. On this subsection, the

[131] https://fineartamerica.com/featured/serbia-country-3d-render-topographic-map-border-frank-ramspott.html

railway route mainly follows the course of the Topciderska River. To the west of this subsection is the Sava River. Agricultural activities are not represented in this subsection. Figure 80 shows the urban character of this area[132].



a) Entering into city of Belgrade b) Resnik

Figure 80: Landscape and visual values at the entrance to city of Belgrade and Resnik

Resnik-Jagodina subsection. The Resnik-Jagodina subsection has a rural character. Settlements along the route are scattered, with a lower number of inhabitants who are usually engaged in agriculture. A certain number of individual residential facilities are also characterised by auxiliary facilities in the yard, such as stables and nursery gardens. The railway route mostly follows the course of Velika Morava River. Given the subsection low altitude, the area is considered suitable for growing crops including vegetables, grapes and grain. The lowland landscape character of the observed area, along with the types of agricultural activities, is presented in the following pictures.

Figure 81: Landscape and visual values on the Resnik-Jagodina subsection (source: ENOVA)

[132] https://www.youtube.com/watch?v=zdUUQX7b6uE&t=6517s

Although this area is characterised by a predominantly rural character, a significant number of residential facilities are located right next to the railway alignment.


Figure 82: Residential facilities next to the railway alignment on Resnik-Jagodina subsection (source: ENOVA)

City of Jagodina. The City of Jagodina is characterised by a high level of urbanisation[133]. The railway alignment passes through a large number of residential and commercial facilities. The area along the railway alignment is not arable. As for the rest of the Project area, Jagodina is characterised by a lowland relief. The landscape of Jagodina[134], as well as the railway station in Jagodina[135], are shown in the following figures.


a) City of Jagodina b) Jagodina railway station

Figure 83: Landscape and visual values in the city of Jagodina

Jagodina-Nis subsection. From Jagodina to Nis, settlements along the railway alignment are scattered and have rural character, with a lower number of inhabitants who are usually engaged in agriculture. The area around the railway is mainly uninhabited. From Jagodina to Stalac, the railway route mostly follows the course of Velika Morava River, while from Stalac to Nis the railway route follows the course of Juzna Morava River and Nisava River. The existing natural vegetation systems are scrubs and agricultural land used for food production. Agricultural plots are mainly used for growing crops including vegetables, grapes and grain.

[133] 71,852 inhabitants according to the 2011 census; and city area of 470 km^2
[134] https://www.youtube.com/watch?v=C8E8AHmOjvI
[135] https://www.youtube.com/watch?v=zdUUQX7b6uE&t=6517s

Figure 84: Landscape and visual values on Jagodina-Nis subsection (source: ENOVA)

Specific landscape character area is from Stalac to Djunis settlement, characterised by presence of Mojsinje mountains. The dominant vegetation is broadleaved forest. The landscape is uninhabited because of harsh mountainous conditions. Figure 85 shows landscape and visual values near Stalac and Djunis settlements[136].

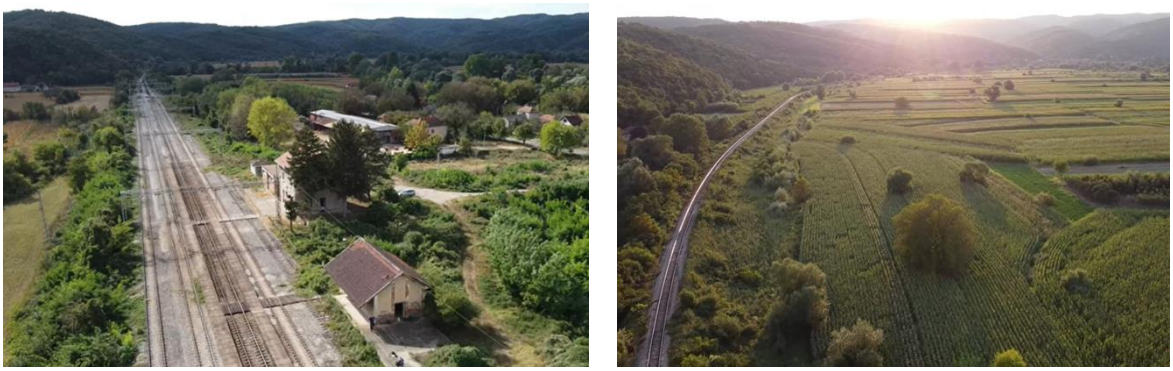
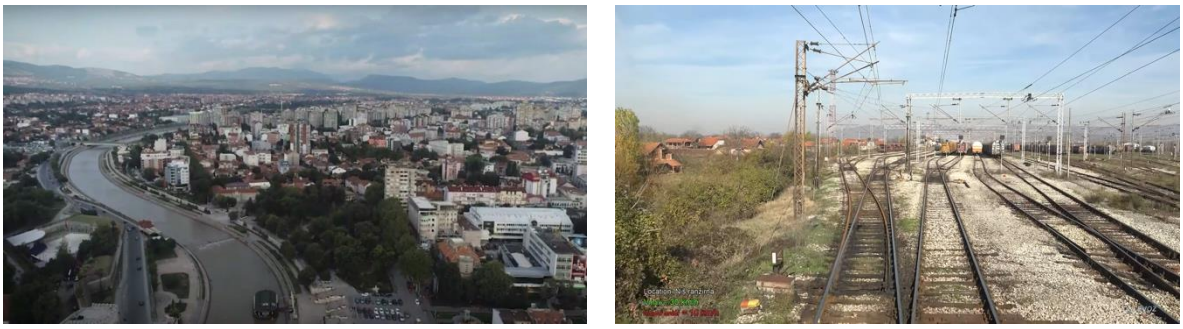


Figure 85: Landscape and visual values near Stalac and Djunis settlements (source: ENOVA)

City of Nis. In Nis Center, the railway alignment passes through a densely populated area and crosses the Nisava River. From the Nis Center to Nis Marshalling yard, the subsection passes through the business-industrial area, near sporadic and linear type of settlements. On the stretch from the Nis Marshalling yard to the Crveni Krst, the railway line passes near significant number of agricultural land plots and business facilities on the left and "Konstantin Veliki" airport on the right. The Suva Mountain in Nis extends in the direction northwest-southeast. The highest point in the city area is "Sokolov kamen" on the Suva Mountain (1,523 m asl). Figure 86 shows the landscape of the city of Nis[137] and landscape near the Nis Marshalling yard railway station[138].



a) Nis Center b) Nis Marshalling yard

Figure 86: Landscape and visual values in Nis

[136] https://www.youtube.com/watch?v=g2O_aGOncMA
[137] https://www.youtube.com/watch?v=1c0rFDa4Wo8
[138] https://www.youtube.com/watch?v=zdUUQX7b6uE&t=6517s

7.8 Materials and Waste

As a part of the negotiations for accession to the EU, the RoS has begun the process of establishing a waste management system and adapting it to the EU goals. The progress has been made in harmonising waste management regulations with the EU requirements, in institutional strengthening and reaching regional agreements for the establishment of joint waste management, as well as in the construction of a number of sanitary landfills. The *Law on Waste Management*[139] defines the waste types, waste management planning, obligations and responsibilities regarding waste management, management of special waste streams, permission requirements and procedures, reporting, supervision and other relevant aspects of waste management.

In 2020, 2.92 million tons of municipal waste were generated in the RoS. 558,568 tons of waste (19% of the generated municipal waste) were disposed at the regional sanitary landfills. In the RoS, the average coverage of municipal waste collection is 86.4%. The recycling rate is 15.7%[140].

Existing municipal waste collection system

Waste collection services in the RoS are mainly under the jurisdiction of PUC established by the municipalities. In some municipalities there are agreements with strategic partners on waste collection or disposal. Collection is organised in urban areas, while rural areas are less covered. Certain problems in rural areas arise due to inadequate infrastructure, accessibility and organisation. Most local governments have mechanisation and vehicles for waste collection. However, there is a lack of adequate equipment for separate waste collection.

Currently, the main problems with the municipal waste collection system include:

- Insufficient number and structure of waste collection containers,
- Inadequate distribution of containers,
- Lack of appropriate vehicles for waste transport,
- Inadequate frequency of waste transport,
- Inadequate vehicle routes.

In urban areas of cities and municipalities, collection is usually carried out once a day or twice a week. In rural areas and in areas where each household has its own waste bin, the most common collection frequency is once a week. In urban areas, a 1.1 m³ container is most commonly used for municipal waste, while in some urban areas there are 3 m³ and 5 m³ underground containers. In semi-urban areas, 120 l and 240 l bins are most commonly used (each household has its own waste bin). In rural areas, where there are no residential buildings, waste is collected from households in plastic bags or 240/140/80 l bins. Hazardous household waste is not collected separately from the mixed municipal waste stream. Separate collection of recyclable materials, except for packaging waste from households, has not yet been properly implemented.

Construction of three plants for controlled incineration of municipal waste is planned in the RoS. The construction of one plant is underway in Belgrade and it is planned to become operational in 2022, while the design of plants for controlled incineration of municipal waste and production of electricity and heat from non-recyclable waste in Nis and Kragujevac is in progress.

In the Project area, regional sanitary landfills are used for the disposal of non-hazardous waste, and they are sanitary-technically arranged locations where waste generated in public areas, in households, in production and service activities, in turnover or use, which does not have the properties of hazardous substances and cannot be processed or rationally used as an industrial raw material or energy fuel, is being disposed. There is no waste

[139] "Official Gazette of RS", No. 36/09, 88/10, 14/16 and 95/18
[140] Ministry of Environmental Protection, Report on the State of the Environment in RoS in 2020, 2021

treatment before landfilling. In addition to these landfills, a large number of unsanitary, municipal landfills and dumps are in use.

By the end of 2021, a total of ten regional sanitary landfills and two more that are not of the regional type have been built in the RoS in accordance with the EU standards. Operational regional sanitary landfills in the Project area, with quantities of waste disposed in the period 2016-2020 are presented in Table 41[141].

Table 41: Quantities of disposed waste at sanitary landfills in the Project area

Sanitary landfill	Quantities of disposed waste [tons]				
	2016	2017	2018	2019	2020
"Vrbak" Lapovo	49,749	41,266	35,264	68,166	57,396
"Gigos" Jagodina	74,113	62,893	61,660	75,360	69,042

In 2021, the new sanitary landfill Vinca was put into operation in Belgrade.

In addition to regional sanitary landfills, there are more than 120 municipal landfills that do not comply with environmental standards and that accept municipal waste that is collected in an organised manner. Once the complete waste management infrastructure is built, these landfills will be closed and recultivated. There are still a large number of illegal dumps (over 3,500) which are beyond the control of municipal utility companies. About 20% of the generated municipal waste in the RoS is dumped on illegal landfills, outside the control of municipal PUCs. In most cases, illegal dumps are located in rural areas and are a consequence of the lack of funds for the expansion of the waste collection system, but also insufficient organisation of waste management at the local level.

Construction and demolition waste

In the RoS, there is currently no practice of separate collection of waste from construction and demolition activities, and there is no scheme for recycling of this waste type. Only small amount of construction and demolition waste is recycled. Although there is a general legal obligation for the waste producer to collect the generated waste separately and sort it in accordance with future treatment, this provision is not in force due to the absence of a bylaw. Thus, the waste of high economic value, such as metal waste, is mostly recycled, while other potentially recyclable materials are disposed on landfills or more often end up on illegal dumps. Quality standards for treated construction and demolition waste do not exist.

The collection and disposal of construction and demolition waste is subject to the polluter pays principle, which means that the waste producer is solely responsible for the legal and safe disposal (final disposal or recycling) of the waste generated. Mineral construction waste, as well as mixed construction waste, is mostly disposed on inadequate local landfills.

In case of large infrastructure works, temporary location of a spoil landfill is agreed in between the project developer and the Contractor. Such landfills are not subject to permitting.

Situation with waste along the railway route

The locations of improperly disposed construction and municipal waste were observed along the entire route of the Corridor, especially near railway stations and stops. Illegal construction waste dumpsites were noticed next to the railway line in Belgrade and Gilje, and illegal municipal waste dumpsites near Mladenovac and Trubarevo.

[141] Ibid.

The spent wooden sleepers were spotted at several locations along the railway line, inadequately disposed. Municipal waste was mostly observed between railroads at locations of stations and stops.

Figure 87: Waste along the railway line – illegal construction waste dumpsite in Belgrade (left) and Gilje (right)

Figure 88: Waste along the railway line – wooden sleepers disposed along the railway line (left) and municipal waste along the railway line (right)

Current SRI waste management activities

The Sector for Environmental Protection within SRI develops three-year Waste Management Plans (WMP). The last version was published in May 2018 and is currently updated. The WMP defines the procedures for waste identification and managing, prevention of waste generation, rational use of natural resources, elimination of dangers and its harmful effects, as well as procedures and methods for waste disposal. In addition, the WMP defines in more detail the waste management methods in relation to the guidelines from the *Rulebook on the method of recording, storage, movement and sale of inactive stocks and materials obtained in the work process in the SRI*. The final disposal of (hazardous) waste is organised in cooperation with licenced waste management companies or the waste is sold on the market through tendering procedure.

The wooden sleepers that will be replaced during reconstruction are considered as hazardous waste. In accordance with the *Ordinance on the manner of storage, packaging and marking of hazardous waste*, the current practice is to temporarily store wooden sleepers on a solid stable base with equipment for collecting spilled liquids and degreaser. The options for their final disposal have not yet been defined, and SRI is working together with the Ministry of Environmental Protection to find the best option.

The following table presents the annual quantities of waste generated by SRI operations for the entire railway infrastructure under its management. The same types of waste can be expected as the result of the future operation and maintenance of the Belgrade-Nis section, only in smaller quantities.

Table 42: Annual Report on Waste Generation of Waste Producer – SRI for 2021

Waste type	Quantity of waste produces [t]
Waste engine oil	1.510
Waste sludge from the bottom of the oil tank	9.947
Metal packaging contaminated with fats and oils	0.020
Absorbents, filter materials, wipes, and protective clothing	0.480
Waste tires	4.970
Old waste railway wagons	1,151.140
Commercial plastic waste	0.670
Waste transformers with PCB oil	0.580
Parts of computers, monitors, keyboards; electric and electronic waste	7.265
Spent batteries and accumulators (Pb)	11.024
Spent batteries and accumulators (Ni-Cd)	6.260
Tiles and ceramics	0.330
Glass, plastic, and wood that contain hazardous substances or are contaminated with hazardous substances (waste impregnated wooden railway sleepers)	6,782.460
Copper, bronze, brass	0.130
Aluminium – old waste; Aluminium – sheet metal waste; Aluminium rope – old	0.159
Iron and steel (rails, track accessories, switch parts, bridge iron)	5,756.080
Asbestos-containing building materials	0.063
Paper and cardboard	0.010

Regarding waste management, all types of waste generated in 2021 are finally disposed of by engaging third parties[142].

Construction waste generation

The main types of waste generated during the construction of the Belgrade-Nis section will be waste generated from terrain preparation for the construction of the new railway and the dismantling of the existing railway. The expected types of generated waste materials are:

- trees,
- humus,
- excavated material,
- low platforms,
- road construction,
- used rails,
- used railways and switch sleepers,
- used copper cables,
- used catenary poles,
- dirty gravel and
- other track accessories (ties, screws, washers, mostly steel parts that are very similar to the composition of the rails).

However, quantities of generated waste during construction activities are not known.

Project waste management activities

[142] Note: A third party is engaged when a sufficient amount of a certain waste type is generated.

In the construction phase, responsibility for waste management activities will be transferred to Contractors. During the operation and maintenance phase, waste management is the responsibility of SRI. However, if waste is to be disposed, testing is performed to determine (non)hazardous properties based on which the disposal method is decided upon. The disposal of special waste categories is done in cooperation with authorised companies.

Wooden sleepers, that will be replaced during (re)construction activities are categorised as hazardous waste due to the chemical coating that prevents the disassembling of the wood splitter, but also because they were periodically sprayed with herbicides for control of vegetation growth around the tracks. The management of wooden sleepers is still an area of concern since their sale on the waste market is forbidden. Currently they are stored at designated locations along the railway line. However, they should be temporarily stored on a solid stable base with equipment for collecting spilled liquids and degreaser. The options for their final disposal have not yet been defined, and SRI is working together with the Ministry of Environmental Protection to find the best solution.

Some waste categories are reused or recycled. Railway tracks and electrical cables are either reused on the secondary railway network or sold on the waste market for further recycling. Ballast is washed and reused or disposed at nearby local landfills. These options will also be considered for the waste that will be generated by the activities within this Project.

7.9 Climate and Climate Change

7.9.1 Climate Characteristics

The Project area has a continental to moderate continental climate, characterised by warm and dry summers and cold winters. Meteorological stations that are in the Project area (Belgrade, Cuprija, Nis) or close to the Project area (Krusevac – approx. 13 km from railway alignment), were used for the climate characteristics analysis. The recorded average monthly temperatures and their climate assessment in relation to the reference period 1981-2010 are shown in the following table[143].

Table 43: Average monthly and average annual temperature in the Project area in 2021 [°C]

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
Belgrade	4.3	6.5	7.2	10.6	17.4	24.3	26.6	24.0	19.4	11.7	8.9	4.1	13.7
Cuprija	3.1	4.6	5.4	9.6	16.9	21.9	25.2	22.2	17.4	10.2	8.2	3.4	12.3
Krusevac	3.3	5.0	5.2	9.6	16.9	21.6	24.5	22.4	17.6	9.9	8.4	3.6	12.3
Nis	3.4	5.7	5.7	10.0	17.1	21.5	25.3	23.4	18.1	10.7	8.9	3.9	12.8

Legend: very cold | cold | normal | warm | very warm | extremely warm

Based on the values of average annual temperatures on monitoring stations in the Project area in 2021, the year is assessed as warm in Krusevac and Nis and very warm in Belgrade and Cuprija compared to the reference period 1981-2010. The measured average annual air temperature in Belgrade (13.7 °C) is the 12th warmest since the beginning of the meteorological station's operation (1888). The deviation of the average annual air temperature compared to the reference period 1981-2010 is 1.2 °C. In 2021, 45 tropical nights were registered

[143] Republic Hydrometeorological Service of Serbia, Annual Bulletin for Serbia 2021, Belgrade 2022

in Belgrade, which is 28 more than the average. A cold wave was registered during the period from April 4 to April 11 in Belgrade and Krusevac, lasting five to six days.

In the south of Serbia and in some central parts, the year 2021 has been assessed as rainy to very rainy. The recorded average monthly rainfalls and their climate assessment in relation to the reference period 1981-2010 are shown in the following table[144].

Table 44: Average monthly and average annual rainfall in the Project area in 2021 [mm]

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
Belgrade	68.6	34.4	49.3	50.7	93.4	34.2	63.1	38.2	9.4	73.4	122.8	157.8	795.3
Cuprija	124.6	23.6	57.9	48.7	37.8	36.9	148.8	14.7	20.9	45.6	41.2	125.5	726.2
Krusevac	113.6	16.8	85.7	59.7	57.2	33.7	124.8	20.0	39.5	62.7	29.6	92.4	735.7
Nis	178.6	28.6	59.7	42.7	29.4	30.2	39.7	39.6	23.3	49.2	45.6	106.5	673.1

Legend: extremely rainy | very rainy | rainy | normal | dry | very dry | extremely dry

Based on the values of average annual rainfall in the Project area in 2021, the year is assessed as normal in Belgrade and Cuprija, and rainy in Krusevac and Nis compared to the reference period 1981-2010. Although the changes on an annual basis are not extreme, several extremely rainy months in the Project area and one extremely dry month in Nis were recorded.

According to the latest available data from the Republic Hydrometeorological Institute from 2020[145], the average annual humidity, the average air velocity, the number of insolation hours and the average high of snow cover are presented in Table 45.

Table 45: Climatological data in the Project area in 2020

Station	Average annual humidity [%]	Average air velocity [m/s]	Insolation [h]	Average high of snow cover [cm]
Belgrade	67	1.9	2,254.1	8
Cuprija	76	1.3	2,155.4	4
Krusevac	76	1.6	2,153.6	17
Nis	70	1.2	1,940.6	6

The wind rose shows how many hours per year wind blows from the indicated direction[146]. The wind rose for monitoring stations in the Project area is shown in Figure 89.

[144] Republic Hydrometeorological Service of Serbia, Annual Bulletin for Serbia 2021, Belgrade 2022
[145] Republic Hydrometeorological Institute, Meteorological yearbook 1 – Climatological data for 2020, 2021
[146] https://www.meteoblue.com/en/weather/archive/windrose/belgrade_serbia_792680

a) Belgrade

b) Cuprija

c) Krusevac

d) Nis

Figure 89: Wind rose for monitoring stations in the Project area

7.9.2 Climate Change

Climate Change Observed

The analysis of mean temperature for the 1998-2017 period (left panel) and the 2008-2017 period (right panel) shows an increase in temperature compared to the mean temperature values for the 1961-1990 reference period. It can be concluded that there was an increase in temperature in the Project area between 1.0°C and 2.5°C compared to the reference period[147].

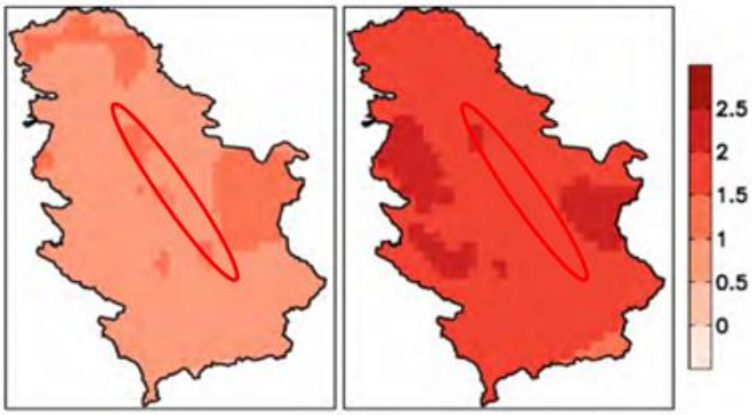


Figure 90: Spatial distribution of observed temperature changes (°C) in Serbia (project area - red ellipse)

[147] UNDP, Climate Changes Observed in Serbia and Future Climate Projection Based on Different Scenarios of Future Emissions, 2018

The recorded amounts of precipitation show an increase from 5% to 10% in the period 1998-2017 (left panel) and from 5% to 20% in the period 2008-2017 (central panel) compared to the reference period 1961-1990. On the other hand, the Project area is characterised by a decrease in the amount of precipitation in the summer period from 5% to 30% (right panel) compared to the reference period[148]. These changes in the amount of precipitation, as well as temperature, are an indication of the increasing frequency of floods in the winter and spring months, as well as the increasing frequency of droughts and fires in the summer months, which is analysed in detail in Chapter 7.9.3.

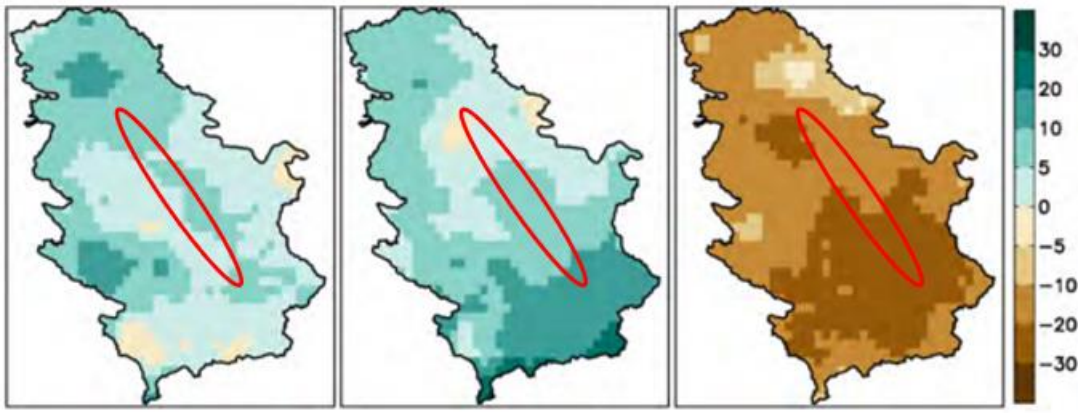


Figure 91: Spatial distribution of the observed precipitation changes (%) in RoS (the Project area is marked in red ellipse)

Future Climate Changes

Temperature change projections

By the end of 21st century, a continuous increase in average annual temperature in the Project area is expected. Seasonal analyses of average maximum and minimum temperatures have shown that temperature increase during the colder part of the year may be slightly less than the temperature increase during the warmer part of the year. Increase in average annual temperatures for Serbia, according to the RCP4.5 scenario, is shown in Figure 92[149].

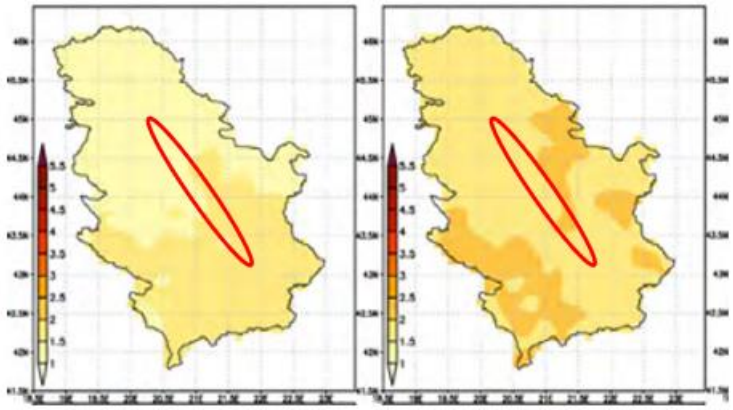


Figure 92: Average annual temperature (°C) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to the RCP4.5 (the Project area is marked in red ellipse)

[148] Ibid.
[149] Ibid.

As a result of more intense GHG emissions, a more intense increase in temperature is anticipated by the RCP8.5 scenario[150].

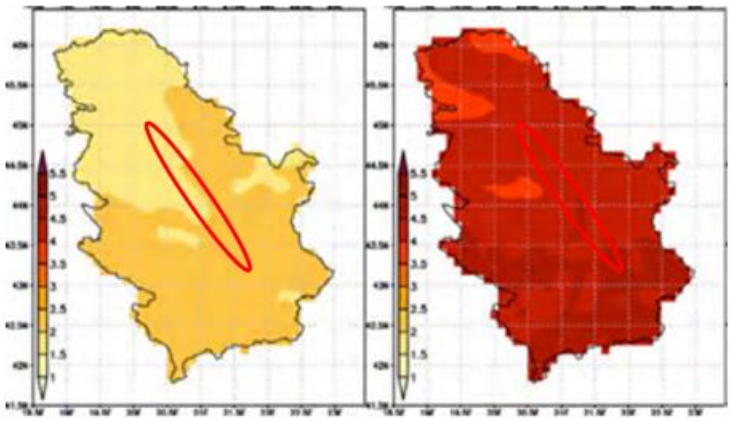


Figure 93: Average annual temperature (°C) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to the RCP8.5 (the Project area is marked in red ellipse)

Based on the shown maps it can be concluded that the average annual temperature in the Project area is expected to increase up to 2.5°C according to the RCP4.5 scenario and up to 4.5°C according to the RCP8.5 scenario, by the end of the century. As a result of temperature increase, the number of frost and ice days will progressively decrease in the future, while the number of hot and tropical days will continue to increase.

Changes in precipitation

Based on climate models for RoS, precipitation is predicted to increase by 10% according to the RCP4.5 scenario (Figure 94) and stay the same or decrease by 15% according to the RCP8.5 scenario (Figure 95) by the end of the century[151].

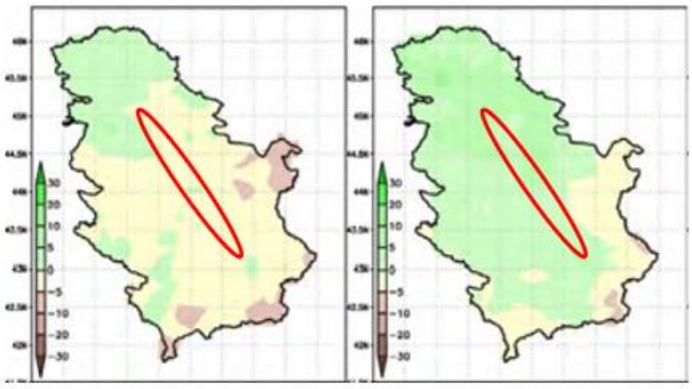


Figure 94: Anomaly of average annual precipitation (%) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to RCP4.5 (the Project area is marked in red ellipse)

[150] Ibid.
[151] Ibid.

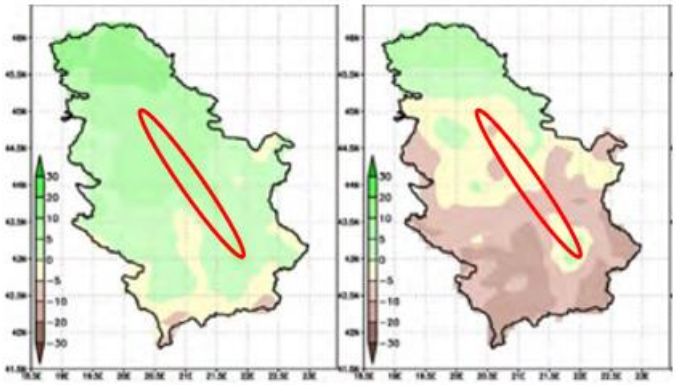


Figure 95: Anomaly of average annual precipitation (%) for the period 2046-2065 (left panel) and for the period 2081-2100 (right panel) according to RCP8.5 (Project area - red ellipse)

It is expected that changes in precipitation will be more seasonal than annual, with more frequent heavy precipitation events and higher precipitation accumulation.

7.9.3 Climate Risks

Over the past two decades, climate-related extreme events have caused major physical losses with significant impacts on Serbia's economy. Key natural hazards for the period 2007-2020 with the number of people affected[152] are shown in Figure 96.

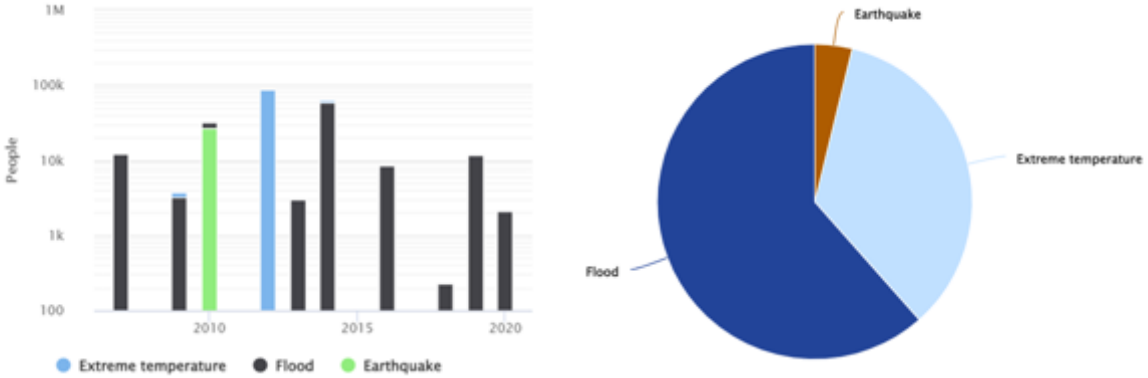


Figure 96: Key natural hazards in RoS for 2007-2020

The most dominant climate change impact in the wider area are floods, especially in the vicinity of the Velika and Juzna Morava Rivers. Other climate change incidents are extreme temperatures, droughts, wildfires and landslides.

The integral vulnerability map of the natural hazards on the territory of the RoS is presented in Figure 97.

[152] https://climateknowledgeportal.worldbank.org/country/serbia/vulnerability

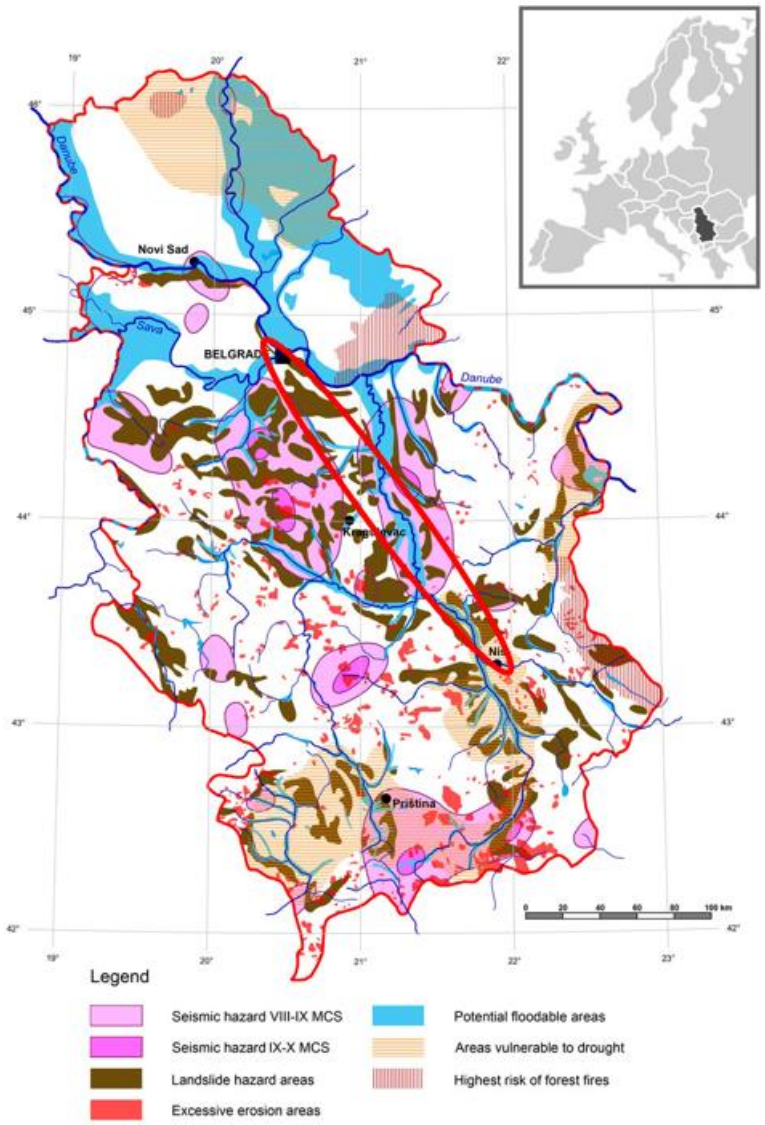


Figure 97: Integral vulnerability map of the natural hazards on the territory of Serbia (project area - red ellipse)

Floods. Based on the Preliminary Flood Risk Assessment for the RoS[153], the entire watercourse of the Juzna Morava River and Velika Morava River, as well as the course of Nisava from the mouth to Dimitrovgrad are assessed as a flood prone area. The municipality of Cuprija has been designated as an area under significant impact of flood. The future railway alignment mainly follows the course of the Velika Morava River, Juzna Morava River and Nisava.

[153] https://www.rdvode.gov.rs/doc/6.2.1%20Znacajna%20poplavna%20podrucja%20za%20teritoriju%20Republike%20Srbije.pdf

Figure 98: Railway route cross Velika Morava River (Cuprija municipality)

Figure 99: Juzna Morava River near the current and future railway route (Trubarovo settlement)

Figure 100: The location where the railway currently crosses Juzna Morava River (left) and the location where the future railway route will cross Juzna Morava River (right) in the settlement of Mezgraja

Based on the flood modelling, the river flood hazard is classified as high, which means that potentially damaging floods are expected to occur at least once in the next 10 years[154].

[154] https://thinkhazard.org/en/report/2648-serbia/FL

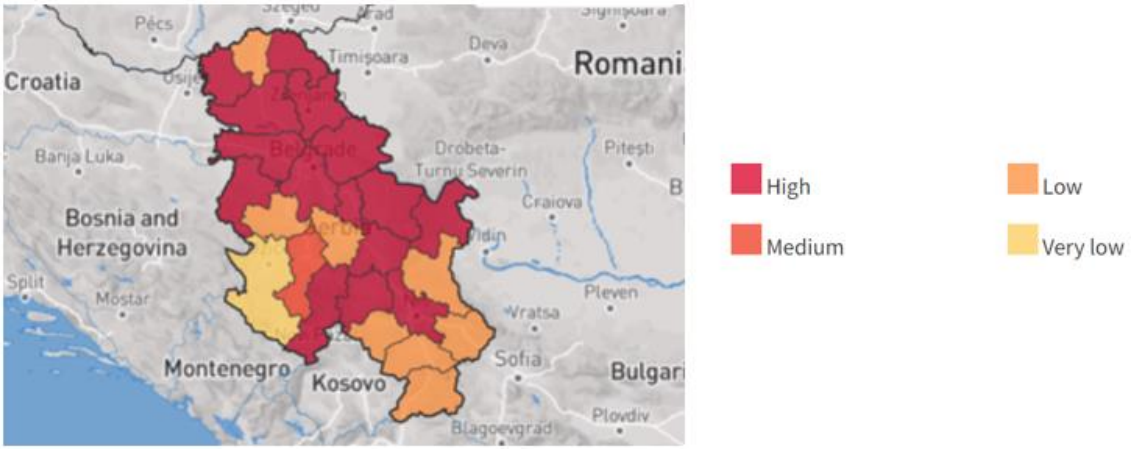


Figure 101: River flood hazard map of RoS

The most severe floods in RoS occurred in May 2014, when some parts of Corridor X were also under water. The Project section was flooded on the Jagodina-Cuprija subsection, as shown in Figure 102[155].

Figure 102: Subsection Jagodina-Cuprija affected by floods in 2014

The May floods in 2014 also affected the Belgrade settlements of Rakovica and Resnik[156], as well as Curpija[157].

Figure 103: May floods in 2014 in the Rakovica settlement (left) and Cuprija settlement (right)

[155] SRI, Study after the May Floods, June 2014
[156] https://www.blic.rs/vesti/beograd/borba-protiv-poplava-u-rakovici-foto/jsd4sv4
[157] https://www.youtube.com/watch?v=NKDjKem7HDE

Although the area between the settlements of Cerovo and Djunis was significantly affected (mainly houses and agricultural land), the impact on the Stalac-Djunis subsection was not identified[158]. According to available data, 361 mm of precipitation was recorded at the Krusevac meteorological station in spring of 2014, which is twice the average value and more than the record of the highest spring precipitation from 1970[159].


Figure 104: Flooded buildings and agricultural areas along the Stalac-Krusevac road in 2014[160]

In April 2015, an overflow of the Velika Morava River in Velika Plana occurred, when residential buildings were flooded[161].

Figure 105: Floods in Velika Plana in 2015

The area of Krusevac was again hit by devastating floods in May 2016, when the average monthly level of precipitation in May was reached within a period of 4 days (2-5 May)[162]. As a result, the Juzna Morava River overflowed in the settlement of Djunis. The road Krusevac-Djunis was flooded.


Figure 106: Flooded buildings and Krusevac-Djunis road in 2016[163]

[158] Ibid.
[159] Republic Hydrometeorological Service of Serbia, Extraordinary Climatological Bulletin of Precipitations for the period 1-26 May 2014, 26 May 2014
[160] https://www.youtube.com/watch?v=UjH1SfJfzz4
[161] https://www.youtube.com/watch?v=Yi6YE-qwsQQ
[162] Republic Hydrometeorological Service of Serbia, Extraordinary Climatological Bulletin of Precipitations for the period 2-5 May 2016, 6 May 2016
[163] https://www.blic.rs/vesti/drustvo/zbog-poplava-bez-saobracaja-na-putu-krusevac-djunis/ypvpfdy

The overflow of the Juzna Morava River in the settlement of Djunis occurred again in spring of 2018 because of large precipitation in a short time and melting of snow. As a result, the state road Krusevac-Nis was flooded[164]. In June 2020, the surroundings of Krusevac were again hit by significant floods.

Due to the heavy rainfall that hit Cuprija in July 2021, a state of emergency was declared. As a result of the floods, residential buildings and local roads were flooded[165].

Figure 107: Floods in Cuprija in July 2021

Following the 2014 floods, the Serbian Government approved a National Disaster Risk Management Program developed a long-term risk management system, including the generation of flood risk information. The country is aligning its water legislation with the EU; the EU Floods Directive is almost fully transposed into the *Law on Water*[166] in RoS.

Erosion and landslides. There is approx. 3,000 active and potentially active landslides in Serbia. The occurrence of landslides and erosion in the Project area is mainly related to the previous occurrence of droughts and floods. Most of them cause the damage on local roads and highways and a few of them cause the damage on residential buildings. After the 2014 floods, a preliminary map of the possibility of landslides occurrence was made. According to this map, the possibility of landslides occurrence was assessed as 'likely' to 'very likely' in Belgrade and central Project area, while going towards Nis it decreases and is assessed as 'unlikely' (Figure 108)[167].

[164] https://pink.rs/vesti/60873/poplave-i-klizista-prete-i-krusevackom-kraju-izlila-se-ribarska-reka-u-unisu-poplavljen-drzavni-put
[165] https://www.novosti.rs/srbija/vesti/1019350/vanredna-situacija-cupriji-zbog-obilnih-poplava-uzrokovanih-padavinama
[166] "Official Gazette of RS", No. 30/10, 93/12, 101/16 and 95/18
[167] https://www.juznevesti.com/Drushtvo/Karta-potencijalnih-klizista.sr.html

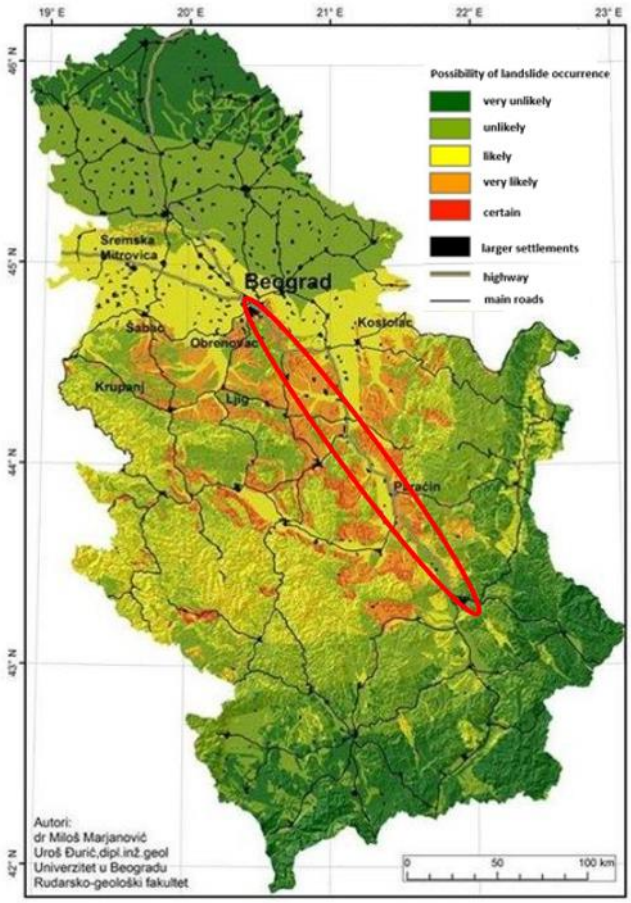


Figure 108: Map of potential landslides occurrence (project area - red ellipse)

After the floods that affected the Project area and the surroundings of Krusevac in 2014 and 2018, several landslides were activated that endangered the local roads.

Figure 109: Landslide on a local road near Krusevac after the 2018 floods[168]

No significant impact of the landslides on the Belgrade-Nis railroad was recorded.

Droughts. The RoS ranks fifth in the risk of drought globally, while it is among the three European countries with the highest risk of drought[169]. Droughts have been more frequent since 1990, especially during summer months. The six-monthly Standardised Precipitation-Evapotranspiration Index (SPEI) (from March to August) averaged across the RoS for period from 1950 to 2017 is presented in Figure 110.

[168] https://www.pressek.rs/srbija/krusevac-proradilo-pet-klizista/
[169] https://www.statista.com/chart/25101/countries-by-drought-risk/

According to the 2020 UNCCD Drought Initiative[170], the RoS was hit by 5 droughts in the period 2000-2017, which negatively affected agriculture, population health and energy production from hydropower plants[171].

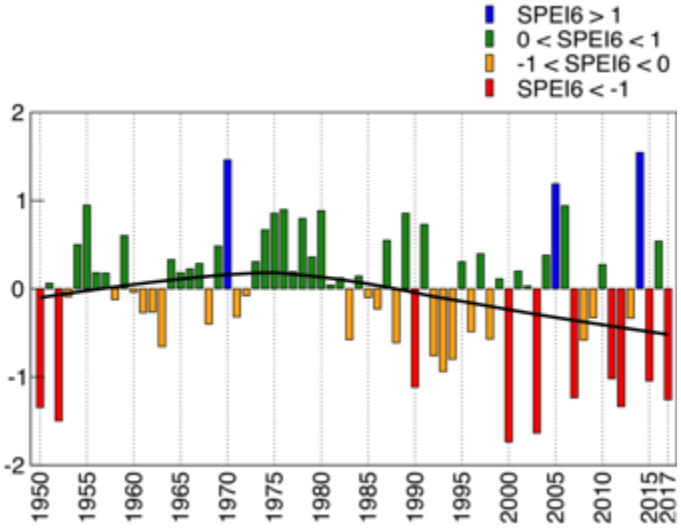


Figure 110: SPEI for a 6-month period – from March to August since 1950

For the event with most negative consequences, drought and heat wave risk is assessed as high[172].

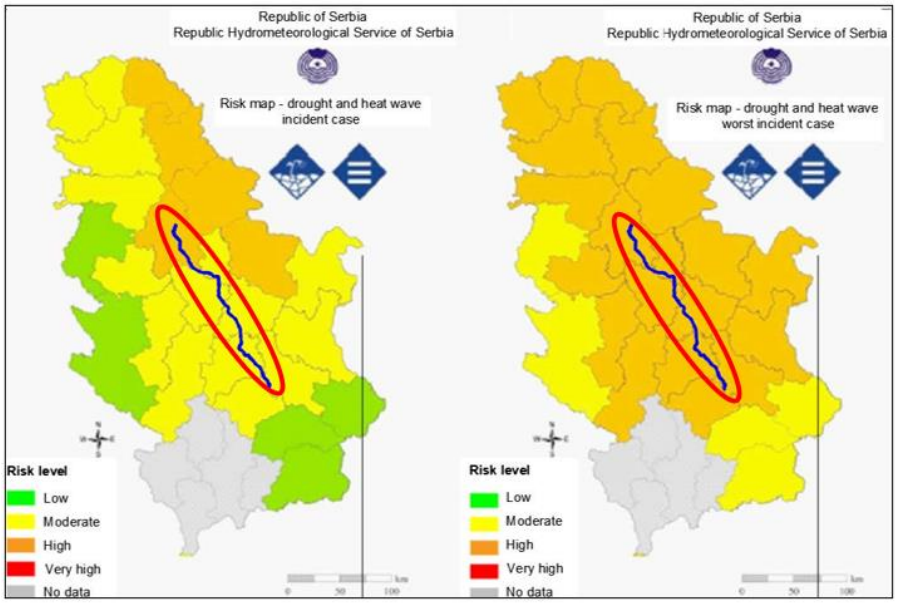


Figure 111: Drought and heatwaves risk maps for RoS for most probable event (left) and for the event with most negative consequences (right) (project area – red ellipse)

Fires. Statistical data show that the frequency of fires, as well as the total area affected by fires in the RoS, is increasing. The State Enterprise "Srbija sume" *(Serbia Forests),* which manages state forests and forest lands, reported 880 forest fires with 16,459.78 ha of affected area in the period 2000-2007. During the drought episode in 2012, 282 forest fires were recorded and 6,799.9 ha of forests burned (10,652.98 ha total burned area). The

[170] Ibid.
[171] United Nations Convention to Combat Desertification, Drought Initiative – Republic of Serbia, February 2020
[172] Prepared by Republic Hydrometeorological Service of Serbia (source: PPPF9, Scoping Report, 2022)

distribution of forest fires by size for the period 2012-2017 is shown in Figure 112. Based on the map, it can be concluded that the Project area was mainly affected by a small number of fires in the observed period[173].

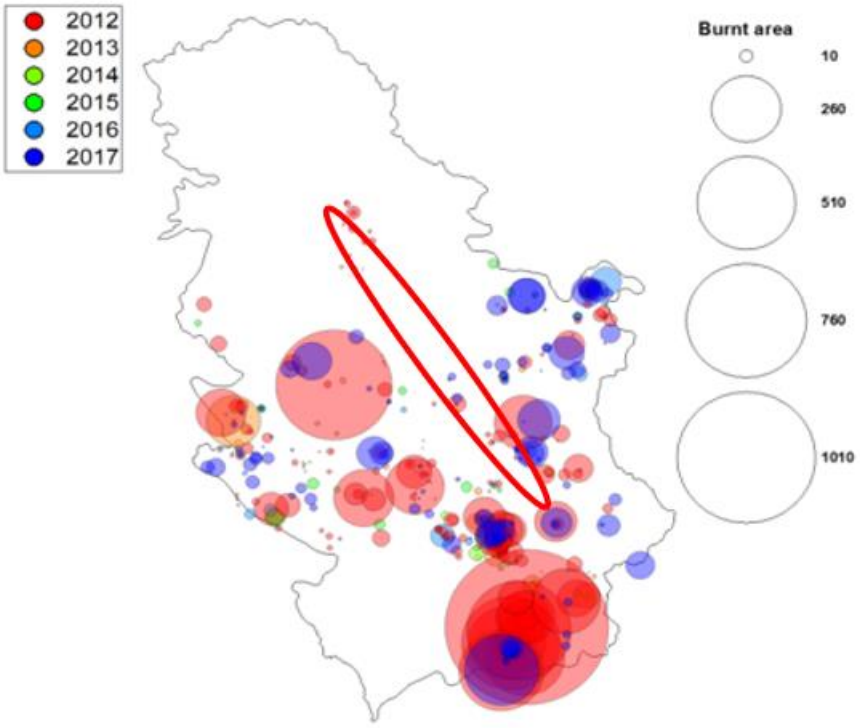


Figure 112: Distribution of forest fires by size for the period 2012-2017 in the RoS (project area – red ellipse)

According to the European Environmental Agency, projected forest fire risk changes under two climate scenarios, and an increase in the number of fires in the RoS is expected. According to the RCP 4.5 scenario, the expected increase in the number of fires is between 10-15%, while according to the RCP8.5 scenario the expected increase in the number of fires is 20%[174].

Earthquakes. In the last 100 years, the Project area was hit by several earthquakes, which were mostly of minor intensity. However, several major earthquakes caused significant material damage. There is no information regarding the impacts of the earthquakes on the Begrade-Nis railway section.

7.10 Cultural Heritage

Assessment methodology

The baseline data for this chapter has been obtained through:

- Visits to the Project area and discussions with municipal/city authorities in the Project area (as described in detail in (Chapter 5.1 - Approach to Assessment),
- Review of publicly available registries with georeferenced data on cultural heritage (such as the Information System of Immovable Cultural Property managed by Institute for Protection of Cultural Heritage of Serbia),
- Use of Google Earth imagery, and

[173] University of Belgrade, Faculty of Forestry, Final report for the project "Improvement of forest fire protection systems in the Republic of Serbia", November 2017
[174] https://www.eea.europa.eu/data-and-maps/indicators/forest-fire-danger-3/assessment

> Review of the official opinions of cultural heritage institutions provided during the issuing of Location Conditions for the subsection Stalac-Djunis in 2021.

For the purpose of this assessment, a distance of approx. 1000 m to the left and right from the axis of the proposed new railway route was taken into account. Occasionally there is reference to cultural heritage assets beyond this study area, where appropriate, such as where such assets are particularly significant and/or where they contribute to current understanding of the cultural heritage within the area of the Project. It should be noted that this baseline chapter does not cover area of the planned access roads (except for Stalac-Djunis) as their locations are currently not known, but this will be assessed in section-specific ESIAs.

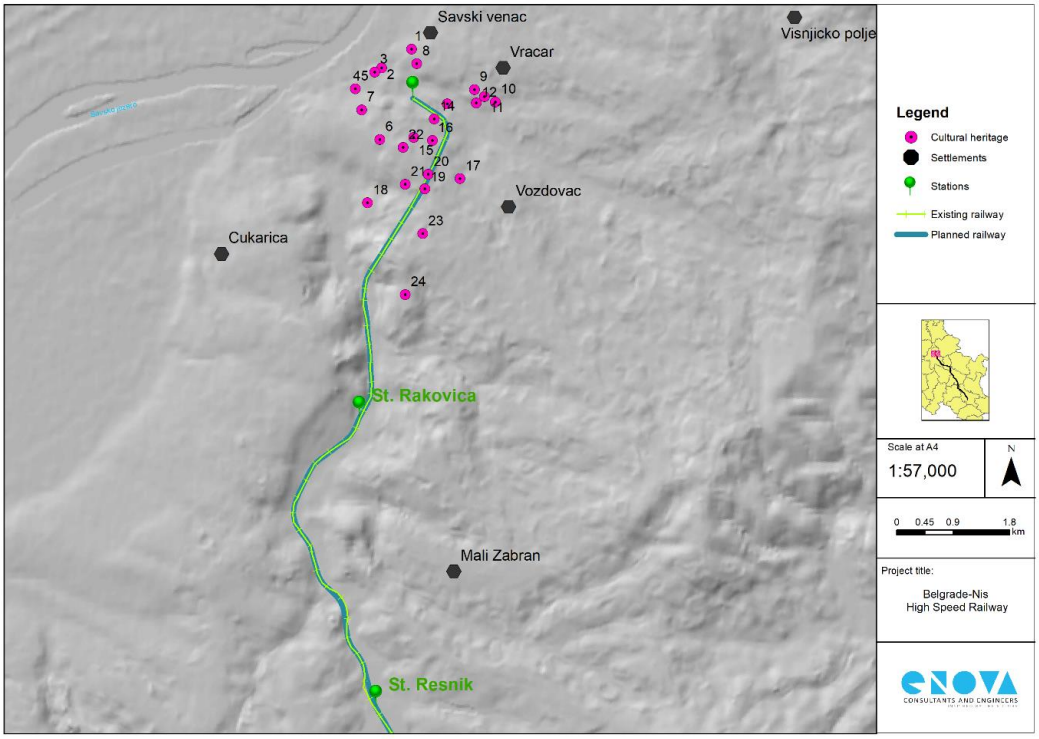
Identified cultural heritage assets

The key national institutions responsible for their protection are the Ministry of Culture and Information and the Institute for Protection of Cultural Heritage of Republic of Serbia.

The Institute keeps a central registry of all cultural heritage assets in the country. There are currently 2,621 such assets registered (of which 196 archaeological sites). The total number of classified immovable cultural properties is 782, of which 200 are of 'exceptional importance' and 582 of 'great importance'.

Based on all available and collected information[175], the cultural and archaeological sites in the study area were identified, and their distance from the planned new railway route established. It should be emphasized that for the purposes of construction of the Corridor, according to the proposed route, it will not be necessary to relocate any identified cultural or archaeological site. **The table below shows all the identified cultural heritage sites presented by subsections along the planned railway line.** The numbers on the maps correspond to the numbers in the description.

Table 46: List of cultural and archaeological sites that may be affected by the planned route, per each subsection

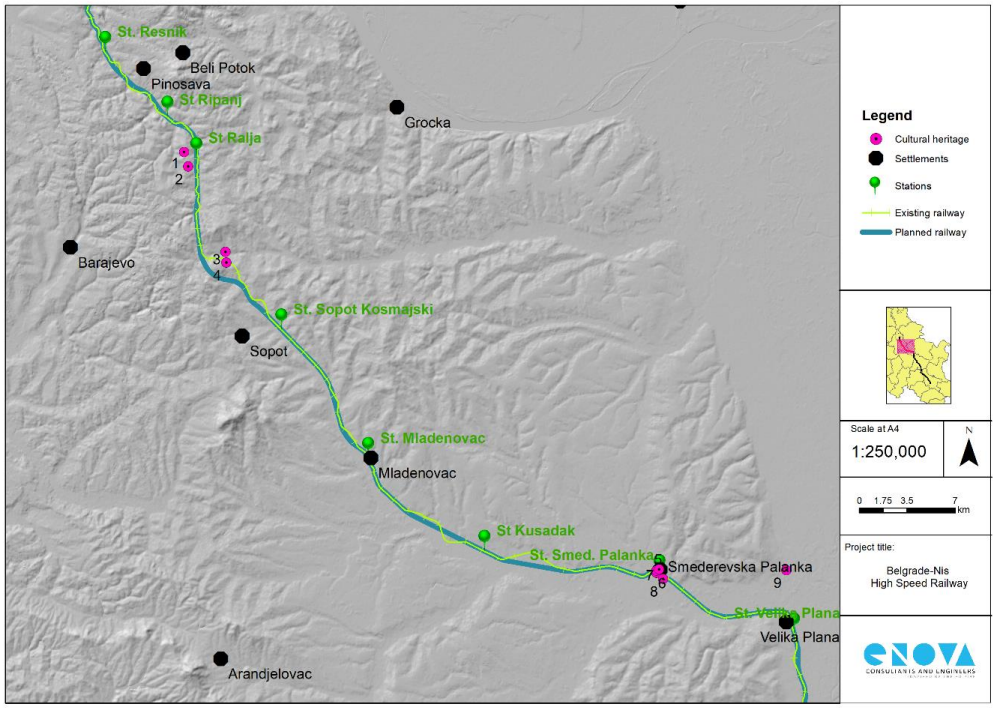
Subsection	Description
Subsection Belgrade-Resnik	

[175] Source: https://nasledje.gov.rs/index.cfm?jezik=Engleski and official opinions of cultural heritage institutions for the subsection Stalac-Djunis.

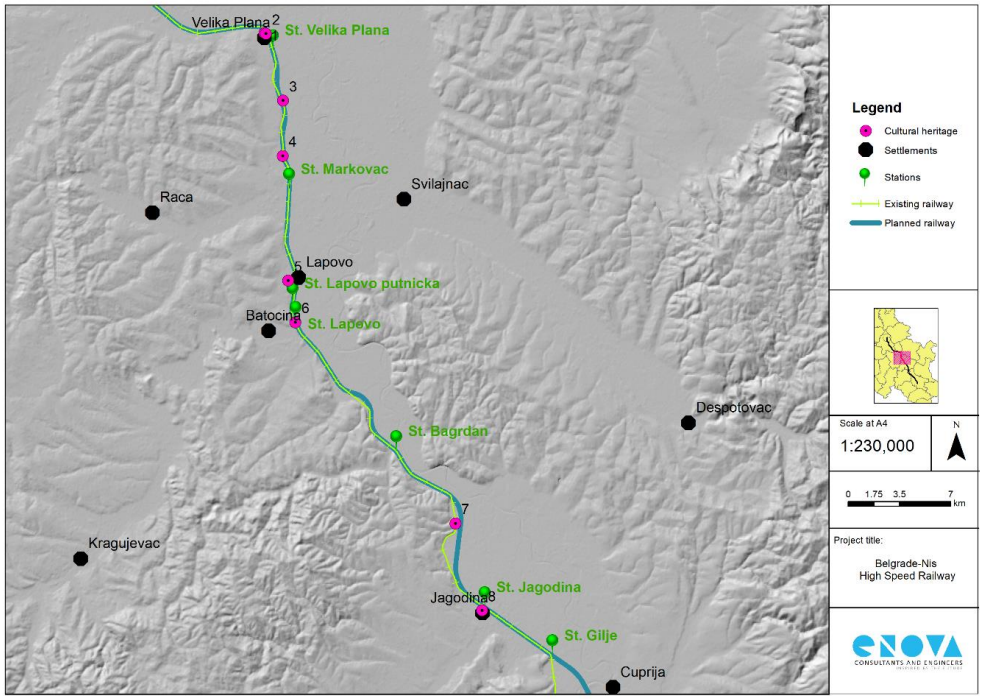
Subsection	Description
	Name: Ministry of Social Policy and Public Health Building in Belgrade (1) **Type:** Immovable Cultural Property **GPS coordinates:** 44.80053354536359, 20.45366072078341 **Impact description:** This facility is located north from the railway station in Belgrade at a distance of approx. 900m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Steam mill (2) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79780931938, 20.44765325743954 **Impact description:** This facility is located north-west from the railway station in Belgrade at a distance of approx. 900m. No significant impact on this facility is expected during the implementation of the Project. **Name:** The building of the State Printing Office (3) **Type:** Immovable Cultural Property **GPS coordinates:** 44.797201069464194, 20.446234892305018 **Impact description:** This facility is located north-west from the railway station in Belgrade at a distance of approx. 900m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Milan Vapa's Paper Mill in Belgrade (4) **Type:** Immovable Cultural Property **GPS coordinates:** 44.7947733171564, 20.44239632131593 **Impact description:** This facility is located west from the railway station in Belgrade at a distance of approx. 900m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Museum of Toma Rosandić (5) **Type:** Immovable Cultural Property **GPS coordinates:** 44.7947733171564, 20.44239632131593 **Impact description:** This facility is located west from the railway station in Belgrade at a distance of approx. 900m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Dusan Tomić's Villa (6) **Type:** Immovable Cultural Property **GPS coordinates:** 44.78751784368754, 20.44740516866838 **Impact description:** This facility is located south from the railway station in Belgrade at a distance of approx. 850m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Monastery "Vavedenje Presvete Bogorodice" (7) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79175766407497, 20.443668048059198 **Impact description:** This facility is located south-west from the railway station in Belgrade at a distance of approx. 800m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Doctor's Tower (8) **Type:** Immovable Cultural Property of Great Importance **GPS coordinates:** 44.79843103484269, 20.45474248424688 **Impact description:** This facility is located north from the railway station in Belgrade at a distance of approx. 500m. No significant impact on this facility is expected during the implementation of the Project. **Name:** Karađorđev Park and Monument and the Cemetery of The Liberators of Belgrade in 1806 (9) **Type:** Immovable Cultural Property of Great Importance **GPS coordinates:** 44.794769484635125, 20.466420076848205 **Impact description:** This facility is located north-east from the railway station in Belgrade at a distance of approx. 700m. No significant impact on this facility is expected during the implementation of the Project. **Name:** "Kuća Flasar" in Belgrade (10) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79300697537578, 20.470618446925883 **Impact description:** This facility is located north-east from the railway station in Belgrade at a distance of approx. 800m. No significant impact on this facility is expected during the implementation of the Project.

Subsection	Description
	Name: House of Architect Momir Korunović (11) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79378353670561, 20.468435243391106 **Impact description:** This facility is located north-east from the nearest point of the existing and planned railway route at a distance of approx. 800m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact on this facility is expected during the implementation of the Project. **Name:** "Fiat" auto repair Building in Belgrade (12) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79284915995947, 20.466791687008975 **Impact description:** This facility is located north-east from the nearest point of the existing and planned railway route at a distance of approx. 800m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact on this facility is expected during the implementation of the Project. **Name:** Dragomir Glisić's Endowment (13) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79270131434407, 20.46094574378573 **Impact description:** This facility is located north from the nearest point of the existing and planned railway route at a distance of approx. 200m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel. During the implementation of the project, it is possible to expect impacts from vibrations. **Name:** Church of the Holy Archangel Gabriel (14) **Type:** Immovable Cultural Property **GPS coordinates:** 44.79050338487189, 20.458322958974993 **Impact description:** This facility is located south from the nearest point of the existing and planned railway route at a distance of approx. 100m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel. During the implementation of the Project, construction related impacts such as noise, vibration and dust are possible to expect. The access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the church authorithies to minimise any impacts. **Name:** Museum of 4th July 1941 (15) **Type:** Immovable Cultural Property of Exceptional Importance **GPS coordinates:** 44.78785716123169, 20.454237450761113 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 500m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact on this facility is expected during the implementation of the Project. **Name:** Branislav Nušić's House (16) **Type:** Immovable Cultural Property **GPS coordinates:** 44.78740805769235, 20.457974780370115 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 200m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel. During the implementation of the project, it is possible to expect impacts from vibrations. **Name:** Building of illegal party publications (17) **Type:** Immovable Cultural Property of Exceptional Importance **GPS coordinates:** 44.78196779614434, 20.463570653387535 **Impact description:** This facility is located east from the nearest point of the existing and planned railway route at a distance of approx. 500m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact on this facility is expected during the implementation of the Project. **Name:** Topcider park (within which there are also located at a distance of 1000m from the route: Prince Miloš's Residence - Immovable Cultural Property of Exceptional Importance, Church of Topcider - Immovable Cultural Property of Exceptional Importance, Church Inn Topcider - Immovable Cultural Property of Exceptional Importance) (18) **Type:** Spatial Cultural-Historical Site - Immovable Cultural Property of Exceptional Importance **GPS coordinates:** 44.77840496607027, 20.44496123533891

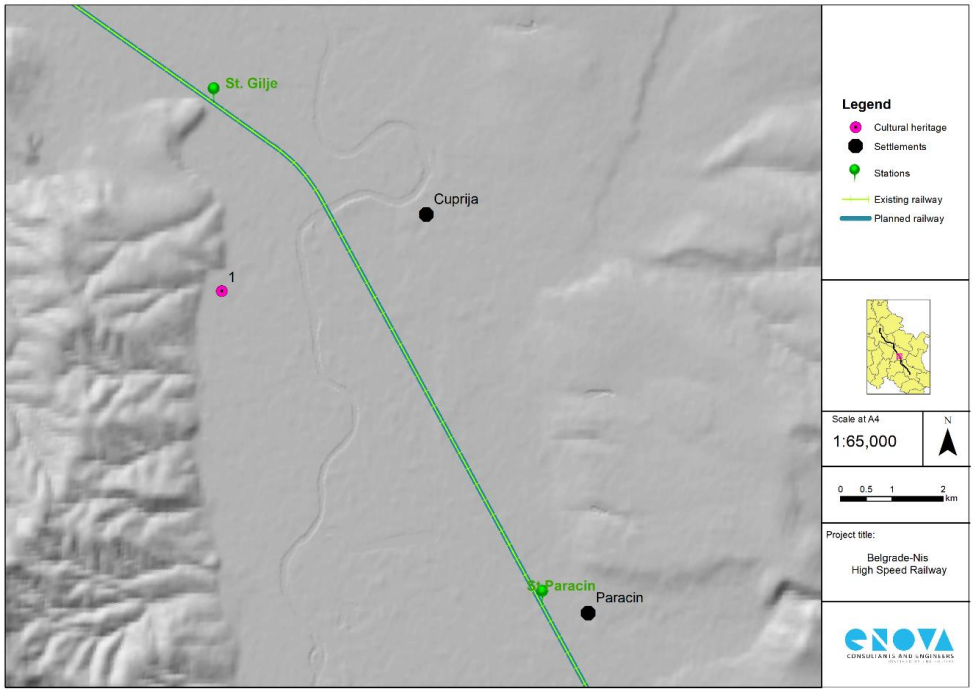
Subsection	Description
	Impact description: This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 500-800m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact is expected during the implementation of the Project. **Name:** Stevka Milićević's Villa (19) **Type:** Immovable Cultural Property **GPS coordinates:** 44.7804879304367, 20.456559324677748 **Impact description:** This facility is located near the existing and planned railway route at a distance of approx. 50m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel. During the implementation of the Project, it is possible to expect impacts from vibrations. **Name:** Šterić Villa (20) **Type:** Immovable Cultural Property **GPS coordinates:** 44.7825522753053, 20.457169748939403 **Impact description:** This facility is located above the existing and planned railway route. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel. During the implementation of the Project, it is possible to expect impacts from vibrations. **Name:** Dr. Aleksandar Belić's House (21) **Type:** Immovable Cultural Property **GPS coordinates:** 44.7810991178217, 20.452587638521365 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 300m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact is expected during the implementation of the Project. **Name:** Olga Moss' Villa (22) **Type:** Immovable Cultural Property **GPS coordinates:** 44.7863938351363, 20.4521067976121 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 600m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact is expected during the implementation of the Project. **Name:** Merchant Dušan Lazić's House in Belgrade (23) **Type:** Immovable Cultural Property **GPS coordinates:** 44.77402601089612, 20.456184702040034 **Impact description:** This facility is located east from the nearest point of the existing and planned railway route at a distance of approx. 500m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel, and no significant impact is expected during the implementation of the Project. **Name:** The Royal Dedinje Compound (within which there is also Church of "Svetog Andreja Prvozvanog") (24) **Type:** Immovable Cultural Property **GPS coordinates:** 44.76527555285545, 20.452710120818423 **Impact description:** This complex is located east from the existing and planned railway route at a distance of approx. 500m. It is important to note that the route of the old and newly planned route in this part passes through the existing tunnel. No significant impact is expected during the implementation of the Project on the Royal Compound, however considering that the Church of "Svetog Andreja Prvozvanog" is located at a distance of 50m above the existing tunnel it is possible to expect impacts from vibrations.

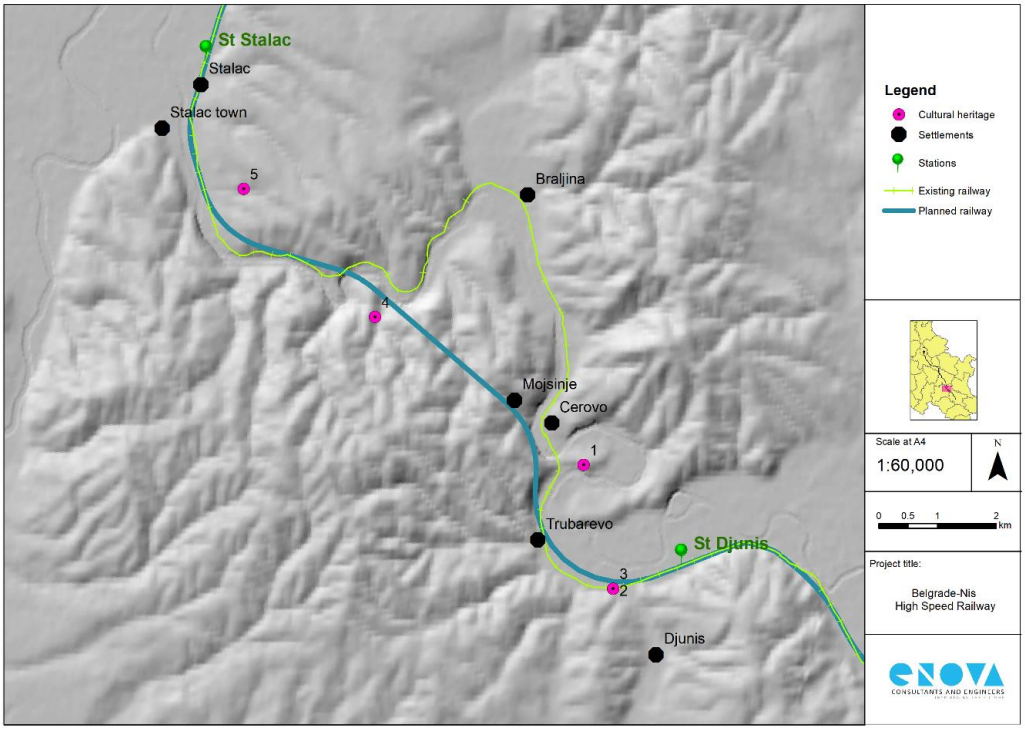
Subsection	Description
Subsection Resnik-Velika Plana	 **Name:** Church of the Holy Trinity in Ripanj (1) **Type:** Immovable Cultural Property **GPS coordinates:** 44.64072163250835, 20.520875780853412 **Impact description:** This facility is located west from the nearest point of the existing route at a distance of approx.. 900m. The newly planned route deviates from the existing railway line and approaches the building at a distance of approx. 850m. However, this is not so significant because, given the distance, no impact on this building is expected during implementation of the Project. **Name:** Archaeological Site in Ripanj (2) **Type:** Immovable Cultural Property **GPS coordinates:** 44.63130336107599, 20.524552362371324 **Impact description:** Although this archaeological site, according to the data available on the Information System of Immovable Cultural Property managed by the Institute for Protection of Cultural Heritage of Republic of Serbia, is not located directly on the railway route but at a distance of approx.. 500m, the precise boundaries of this site are not known. Therefore, it will be necessary to determine the precise boundaries of this archaeological site and obtain the opinions of competent institutions in order to be able to assess possible impacts. In any case, supervision of all earthworks by an archaeologist will be required during the implementation of the Project. **Name:** Radosavljević Inn in Donja Ralja (3) **Type:** Immovable Cultural Property **GPS coordinates:** 44.57527426875203, 20.559557023016126 **Impact description:** This facility is located east from the nearest point of the existing route at a distance of approx. 350m. The newly planned route deviates from the existing railway line and moves away from it at a distance of more than 1500m. It is also important to note that the newly planned route in this part passes through a tunnel. Taking into account the above, no impact is expected on this facility during the implementation of the Project **Name:** Pantić's Inn in Gornja Ralja (4) **Type:** Immovable Cultural Property **GPS coordinates:** 44.56817144003345, 20.560185730251746 **Impact description:** This facility is located next to the existing route. However, the newly planned route deviates from the existing railway line and moves away from it at a distance of more than 1300m. It is also important to note that the newly planned route in this part passes through a tunnel. Taking into account the above, no impact is expected on this facility during the implementation of the Project **Name:** Church "Svetog Preobraženja Gospodnjeg" (5) **Type:** Immovable Cultural Property

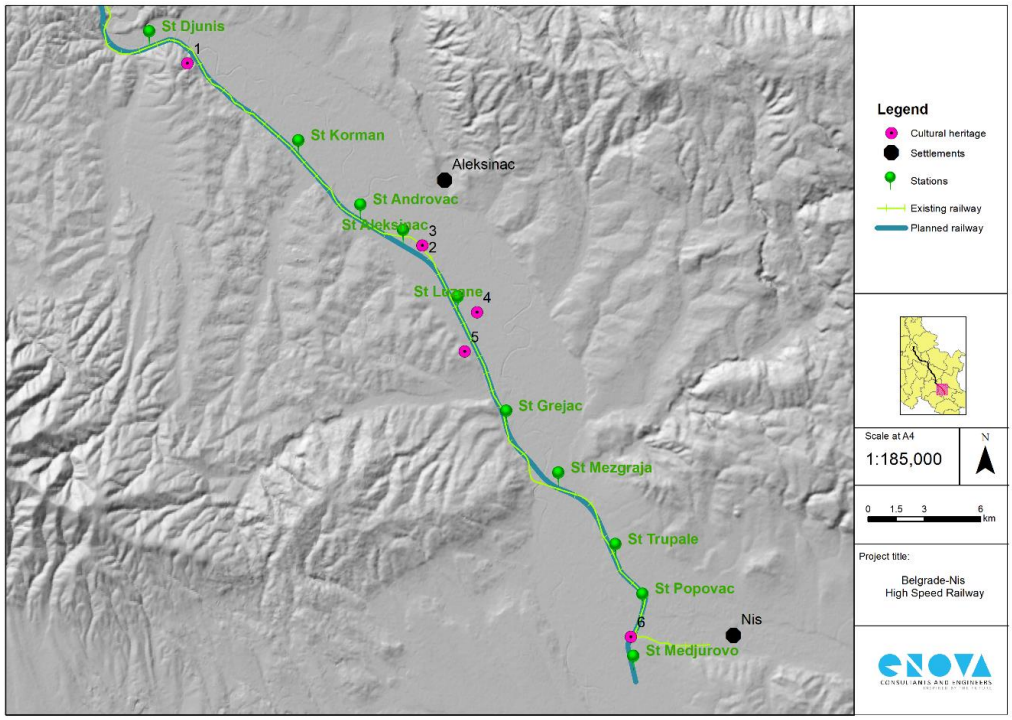
Subsection	Description
	GPS coordinates: 44.36476114251832, 20.956618917538915 **Impact description:** This facility is located north from the nearest point of the existing and planned railway route at a distance of approx. 80m. During the implementation of the Project, construction related impacts such as noise, vibration and dust are possible to expect. The access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the church authorities to minimise any impacts **Name:** National Museum Building in Smederevska Palanka (6) **Type:** Immovable Cultural Property **GPS coordinates:** 44.36639867936907, 20.95657943137186 **Impact description:** This facility is located north from the nearest point of the existing and planned railway route at a distance of approx. 250m. The access road leading to this facility could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works to minimise any impacts. Beside this no other impact is expected during implementation of the Project. **Name:** Gymnasium Building in Smederevska Palanka (7) **Type:** Immovable Cultural Property **GPS coordinates:** 44.367197012299734, 20.95892848102256 **Impact description:** This facility is located north from the nearest point of the existing and planned railway route at a distance of approx. 400m. The access road leading to this facility could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works to minimise any impacts. Beside this no other impact is expected during implementation of the Project. **Name:** Memorial workshop "Josip Broz Tito" (8) **Type:** Immovable Cultural Property **GPS coordinates:** 44.3608628189944, 20.96264541343386 **Impact description:** This facility is located south from the nearest point of the existing and planned railway route at a distance of approx. 100m. During the implementation of the Project, construction related impacts such as noise, vibration and dust are possible to expect. The access road leading to this facility could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works to minimise any impacts. **Name:** Building in which Josip Broz Tito resided (9) **Type:** Immovable Cultural Property **GPS coordinates:** 44.36659854304986, 20.96494174695572 **Impact description:** This facility is located north from the nearest point of the existing and planned railway route at a distance of approx. 550m. No significant impact is expected during the implementation of the Project.

Subsection	Description
Subsection Velika Plana-Gilje	 **Name:** Old Slautherhouse Building (1) **Type:** Immovable Cultural Property **GPS coordinates:** 44.33523598549101, 21.07587626428769 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 250m. The access road leading to this facility could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works to minimise any impacts. Beside this no other impact is expected during implementation of the Project. **Name:** Building at Miloša velikog Street no. 79 (2) **Type:** Immovable Cultural Property **GPS coordinates:** 44.33490287309797, 21.077016184942064 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 200m. The access road leading to this facility could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works to minimise any impacts. Beside this no other impact is expected during implementation of the Project. **Name:** Church of "Vaznesenja Hristovog" (3) **Type:** Immovable Cultural Property **GPS coordinates:** 44.293843424131644, 21.09165326602661 **Impact description:** This facility is located east from the nearest point of the existing and planned railway route at a distance of approx. 100m. During the implementation of the Project, construction related impacts such as noise, vibration and dust are possible to expect. The access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the church authorities to minimise any impacts **Name:** Church of "Sveti Georgije" (4) **Type:** Immovable Cultural Property **GPS coordinates:** 44.25998130601992, 21.09119160404953 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 80m. During the implementation of the Project, construction related impacts such as noise, vibration and dust are possible to expect. The access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important

Subsection	Description
	for the Contractor to liaise with the relevant authorities and plan the works in accordance with the church authorities to minimise any impacts **Name:** The Temple of "Sveta Paraskeva" (5) **Type:** Temple **GPS coordinates:** 44.1834513457405, 21.09572561330059 **Impact description:** This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 550m. The access road leading to this Temple could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the authorities to minimise any impacts. **Name:** Railway station of Lapovo (6) **Type:** Immovable cultural heritage **GPS coordinates:** 44.157983267918496, 21.101881457074917 **Impact description:** This facility is located next to the existing and newly planned railway route. During the implementation of the Project, construction related impacts such as noise, vibration and dust are possible to expect. The access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the church authorities to minimise any impacts **Name:** Church of "Uspenje Presvete Bogorodice" (7) **Type:** Church **GPS coordinates:** 44.03440493976444, 21.237775971257218 **Impact description:** This facility is located next to the existing route at a distance of approx. 50m. The newly planned route deviates from the existing railway line and moves away from it at a distance of 350m. Taking into account the above, no impact is expected on this facility during the implementation of the Project. **Name:** Church of **"**Svetih apostola Petra i Pavla" (8) **Type:** Church **GPS coordinates:** 43.98096249543831, 21.260175438069364 **Impact description:** This facility is located south from the nearest point of the existing and planned railway route at a distance of approx. 250m. The access road leading to this church could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the church authorities to minimise any impacts.

Subsection	Description
Subsection Gilje-Paracin	 **Name:** Church of "Svetog Preobrazenja Gospodnjeg" (1) **Type:** Church **GPS coordinates:** 43.92029836640061, 21.321611744352197 **Impact description:** This facility is located west from the nearest point of the existing route at a distance of approx. 80m. The newly planned route deviates from the existing railway line and moves away from it at a distance of more than 2500m. Taking into account this fact, no impact is expected on this facility during the implementation of the Project.
Subsection Paracin-Stalac	 **Name:** Memorial to the Fallen Warriors in the First World War (1) **Type:** Immovable Cultural Property **GPS coordinates:** 43.8596160289158, 21.41139660540538 **Impact description:** This facility is located east from the nearest point of the existing and planned railway route at a distance of approx. 600m. No impact is expected on this facility during the implementation of the Project.

Subsection	Description
	Name: National Library "Dr Vićentije Rakić" (2) **Type:** Immovable cultural heritage **GPS coordinates:** 43.86227483968178, 21.40745382396907 **Impact description:** This facility is located east from the nearest point of the existing and planned railway route at a distance of approx. 300m. No impact is expected on this facility during the implementation of the Project.
Subsection Stalac-Djunis	 **Name:** Archaeological site Medieval Town of Trubarevo – wider protection zone (1) **Type:** Archaeological site **GPS coordinates:** 43.62089399867514, 21.494314766517665 **Impact description:** The Institute for Protection of Cultural Monuments in Kraljevo has included this site among the three sites that are in vicinity of the railway and will need additional protection measures. This is a well-known archaeological site where the Institute has carried out previous archaeological research and conservation of found remains of walls. The narrower protection zone of the site is currently located at a distance of approx. 500m from the existing railway route. It sits on the southern side of the Gradište peak, surrounded by the Juzna Morava River on three sides, and on the existing Belgrade-Niš railway on the fourth (western) side. From the new railway, it will be approx. 1 km away (specifically, from planned Tunnel no. 5). The wider protection zone is currently in the immediate vicinity approx. 50m of the existing railway, but the new railway route will be moved 200m away from the site. However, it is important to emphasize that the new route in this part (200m away) passes through Tunnel no. 5, and that the distance from the closest point of wider protection zone from the entrance/exit of the tunnel will be approx. 700m. The Institute has defined that professional supervision by an archaeologist over the execution of all earthworks on this part of the route is necessary to protect the site. **Name:** Church of "Sveti Pantelejmon" (2) (cemetery church) **Type:** Cultural heritage under preliminary protection **GPS coordinates:** 43.60190782148431, 21.500427605818654 **Impact description:** The Institute for Protection of Cultural Monuments in Kraljevo has included this church among the three sites that are in vicinity of the railway and will need additional protection measures. The church was built at the beginning of the 20th century. It is located at approx. 50m from the existing railway from which it is separated by a local road. The new route of the railway is planned at a distance of about 100m from the church. The Institute has defined that professional supervision by an archaeologist over the execution of all earthworks on this part of the route is necessary to protect the site.

Subsection	Description
	Name: Archaeological site "Nikoljac" (3) **Type:** Archaeological site **GPS coordinates:** 43.60190782148431, 21.500427605818654 **Impact description:** The Institute for Protection of Cultural Monuments in Kraljevo has included this site among the three sites that are in vicinity of the railway and will need additional protection measures. The site is very close to the Church of "Sveti Pantelejmon" (see above), and is located at a distance of approx. 50m from the existing railway from which it is separated by a local road. The new route of the railway is planned at a distance of 150-180m from this site. The Institute has defined that professional supervision by an archaeologist over the execution of all earthworks on this part of the route is necessary to protect the site. **Name:** Church of "Sveta Nedelja" (4) **Type:** Church **GPS coordinates:** 43.643710220111195, 21.45052107401714 **Impact description:** This site is not listed in the official opinion of the Institute for Protection of Cultural Monuments in Kraljevo. The church dates back to the Middle Ages and is one of the rarest churches/monasteries (out of total of 77) that have been preserved in its original condition from that period. It is located near the planned exit of Tunnel no. 3 and entrance of Tunnel no. 4, as well as the planned access road to Tunnel no. 4. Due to this proximity, it will be necessary to pay particular attention to prevent cutting off of access to the existing road infrastructure which leads to the Church. **Name:** Church of "Svetih Arhangela" (5) **Type:** Church **GPS coordinates:** 43.66342415309899, 21.42293849092932 **Impact description:** This site is not listed in the official opinion of the Institute for Protection of Cultural Monuments in Kraljevo. The church dates to the 17th Century. The cultural event "Pod krilima Arhangela" (Under the Wings of Archangel) is held here every year in July. The church is currently located north-east from the existing railway at approx. 650m. Since the newly planned route follows the existing route in that area (to the point where Tunnel no. 1 is planned), the distance to the new alignment will remain the same.
Subsection Djunis-Medjurovo	 **Name:** Monastery of "Sveti Nestor" (1) **Type:** Monastery **GPS coordinates:** 43.597403048049806, 21.539857582056374

Subsection	Description
	Impact description: This facility is located west from the nearest point of the existing and planned railway route at a distance of approx. 300m. The access road leading to this monastery could potentially be affected by heavy traffic, as it is assumed that this road will be used for the passage of machinery during construction works. It is therefore important for the Contractor to liaise with the relevant authorities and plan the works in accordance with the authorities to minimise any impacts. No additional impacts is expected on this facility during the implementation of the Project. **Name:** Temple of " Sveti Arhangel Gavrilo" in Žitkovac (2) **Type:** Temple **GPS coordinates:** 43.509336342054084, 21.69385032348698 **Impact description:** This temple is located north-east from the nearest point of the existing route at a distance of approx. 100m. The newly planned route deviates from the existing railway line and moves away from it at a distance of more than 550m. Taking into account this fact, no impact is expected on this temple during the implementation of the Project. **Name:** The new orthodox church in Žitkovac (3) **Type:** Church **GPS coordinates:** 43.509336342054084, 21.69385032348698 **Impact description:** This church is located north-east from the nearest point of the existing route at a distance of approx. 100m. The newly planned route deviates from the existing railway line and moves away from the church at a distance of more than 550m. Taking into account this fact, no impact is expected on this church during the implementation of the Project. **Name:** Church of "Sveti Arhangel Gavrilo" in Lužane (4) **Type:** Church **GPS coordinates:** 43.47711873291058, 21.7294468 **Impact description:** This church is located north-east from the nearest point of the existing route at a distance of approx. 900m. No impact is expected on this church during the implementation of the Project **Name:** Church of "Sveti Ilija" (5) **Type:** Church **GPS coordinates:** 43.45836136364094, 21.721114155221382 **Impact description:** This church is located west from the nearest point of the existing route at a distance of approx. 600m. No impact is expected on this church during the implementation of the Project. **Name:** Archaeological Site Bubanj (6) **Type:** Archaeological Site **GPS coordinates:** 43.32094051785168, 21.828670390795264 **Impact description:** Although this archaeological site, according to the data available on the Information System of Immovable Cultural Property managed by the Institute for the Protection of Cultural Heritage of Republic of Serbia, is not located directly on the railway route but at a distance of approx. 100m, the precise boundaries of this site are not known. Therefore, it will be necessary to determine the precise boundaries of this archaeological site and obtain the opinions of competent institutions in order to be able to assess possible impacts. In any case, supervision of all earthworks by an archaeologist will be required during the implementation of the Project.
Subsection Resnik-Ostruznica	No cultural heritage facilities were identified along the railway route during the preliminary analysis but this will be confirmed during the ESIA stage.
Subsection Crveni Krst-Nis Center-Nis Marshalling Yard	There are many cultural heritage sites near this Project section. However, since a conceptual design including technical specifications and future railway alignment for Crveni Krst (Red Cross)-Nis Center-Nis Marshalling yard have not yet been developed it is not possible to identify with certainty all the cultural heritage monuments and impacts on them at this stage of the project assignment. This will be done in the ESIA stage.

In addition to the heritage assets identified above, the Project has the potential to impact previously unrecorded remains which may be affected by the disturbance during construction phase. There is high potential for encountering such chance finds, considering that Serbia is known for its ample archaeological and cultural heritage sites.

Intangible cultural heritage

Intangible cultural heritage (ICH) is defined by the 2003 UNESCO Convention as:

Intangible cultural heritage means the practices, representations, expressions, knowledge, skills - as well as the instruments, objects, artefacts and cultural spaces associated therewith - that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. ICH is manifested inter alia in the following domains: (a) oral traditions and expressions, including language as a vehicle of the intangible cultural heritage; (b) performing arts; (c) social practices, rituals and festive events; (d) knowledge and practices concerning nature and the universe; (e) traditional craftsmanship.

Serbia is a signatory to the 2003 UNESCO ICH Convention and an active participant. The National Assembly of Serbia passed the *Law on Ratification of the Convention* in 2010. The Ministry of Culture and Information is the body in charge of implementing the Convention, and has an advisory body for Ich (the National Committee on ICH). Serbia has a Centre for the Intangible Cultural Heritage of Serbia established in 2012, and one of its core duties is to maintain the National Registry of Intangible Cultural Heritage[176].

Serbia has 4 ICH elements inscribed in the *UNESCO List of Representative List of the Intangible Cultural Heritage of Humanity*:

- 2020: Zlakusa pottery making, hand-wheel pottery making in the village of Zlakusa (note: this village is located in western Serbia in the municipality of Užice at a distance of over 100 km from Belgrade and Nis)
- 2018: Singing to the accompaniment of the Gusle
- 2017: Kolo, traditional folk dance
- 2014: Slava, celebration of family saint patron's day

There is also an on-going 2022 nomination for: Social practices and knowledge related to the preparation and use of the traditional plum spirit ("sljivovica").

Discussions with local communities during the development of this assessment Report included a question on intangible cultural heritage. However, none of the local communities identified any significant traditional practices that could be affected, including those listed above under UNESCO protection. This will need to be further confirmed in future ESIA stages.

7.11 Socio-Economic Baseline Conditions

7.11.1 Actions Undertaken to Inform the Social Analysis

Consultations with municipal/city authorities. For the purpose of better understanding community profile and the needs and concerns of the communities along the Corridor, site visits and consultations were conducted during the development of this Assessment Report with the following municipal/city authorities and Local Community Offices in June 2022:

- Municipality of Cuprija
- Municipality of Velika Plana
- Municipality of Paracin
- Municipality of Lapovo
- Municipality of Batocina
- Municipality of Aleksinac
- Municipality of Smederevska Palanka
- Municipality of Cicevac
- City of Krusevac
- City of Jagodina

[176] The digital version of the National Registry is available on http://nkns.rs/cyr/elementi-nkns

- City of Nis
- Local Community Braljina
- Local Community Djunis

Note: Other municipalities were not available for consultations during the period of developing this Report, but will be consulted in future ESIA stages for each section.

Consultations with NGOs. Additionally, initial stakeholder engagement activities with NGOs were carried out in June 2022. These are described in more detail under Chapter 6.1 (Previous Stakeholder Engagement Activities).

Visits to selected points of the Corridor and discussions with local residents. A series of interviews were conducted with local residents at selected critical parts along the route in May 2022. The objective of these consultations was to understand the Project impacts and residents' concerns. The selected sites are:

Topic	Reason for selection	Selected points
Closure of stations and halts	To understand use of the current stations/halts and specific impacts of station/halt closure	> Mala Plana station > Staro Selo halt > Sikirice-Ratare halt > Braljina station
Densely populated area	To understand direct impacts of railway construction on the population living in densely populated settlements	> Lapovo
Roma population	To understand the impacts of the Project on Roma people	> Aleksinac > Mladenovac
Level crossings planned for closure	To understand current use of level crossings and impacts of their closure on local residents	> Mala Plana > Grejac > Lapovo
Settlement where tunnels will be constructed	To understand the impacts of tunnel construction in terms of potential temporary impacts (noise, vibration, dust, etc.) and restrictions caused due to tunnel construction	> Settlement in the vicinity of the planned tunnel no. 11, near Kusadak station (section Resnik-Velika Plana)

7.11.2 Socio-economic Baseline by Subsection

Note: Since a conceptual design including technical specifications and future railway alignment for the subsections Resnik-Ostruznica and Crveni Krst (Red Cross)-Nis Center-Nis Marshalling yard have not yet been developed, a detailed socio-economic analysis was not possible, but a preliminary description of the location and characteristics of these subsections is given in section 3.10 of this Assessment Report.

Belgrade-Resnik

This subsection is 11.3 km long, and is the most densely populated subsection. Both the existing and planned railway lines are located within the municipalities of **Savski Venac** and **Rakovica** – both within the City of Belgrade. The existing double-track railway line is retained on the entire subsection. There are currently 3 level crossings which will all be retained.

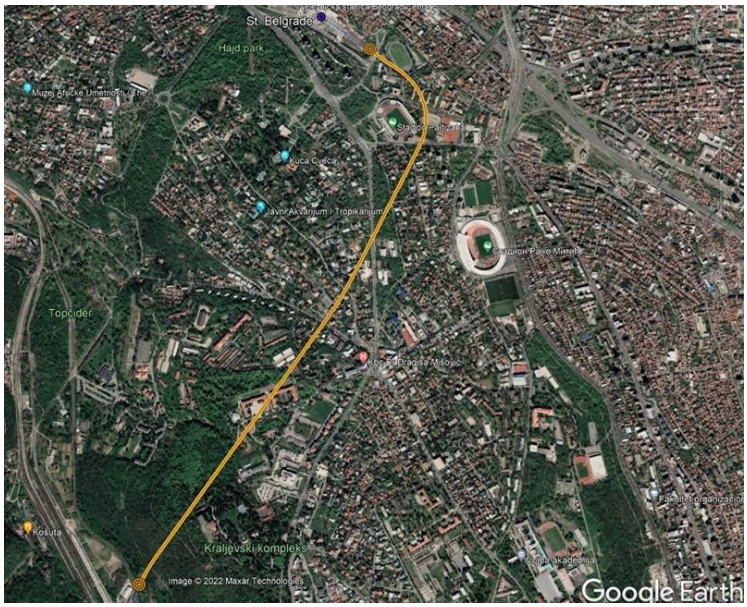
The list of current and planned stations and halts is given below. None are planned for closure.

Current stations and halts	*Planned stations and halts*	*Stations and halts which will be closed*
Belgrade Centre (station)	Belgrade Centre (station)	None
Rakovica (station)	Rakovica (station)	
Resnik (station)	Resnik (station)	
Knezevac (halt)	Knezevac (halt)	
Kijevo (halt)	Kijevo (halt)	

Populated areas along the railway line are shown in the photographs below.

Populated areas along the railway line (source: ENOVA and Google Earth)

The starting point of this subsection is a densely populated urban area. This area has various functions such as residential (single-family units and apartments buildings), administrative (government services), educational, industrial, etc. Numerous state institutions, ministries, educational institutions, parks, etc. are located in this area – it should be noted that the railway line in this part passes through an existing tunnel (Tunnel no. 1) – see figure below which shows the starting point of the subsection with Tunnel no. 1.



The second part of the subsection is after the exit of Tunnel no. 1 and up to Resnik station. A significant part of the area consists of forests and parks, such as Kosutnjak and Miljakovacka forests. Kosutnjak is one of the most popular sports and recreation places in Belgrade which covers an area of 330 ha. Besides this recreational place, two stadiums (Partizan and Rajko Mitic Stadium) and various sports centres and clubs characterise this area. In particular, the sports centre Rakovica is at around 50 m from the railway.

Sports and recreation centre within Kosutnjak, source: Google Earth

The route continues through another densely populated area starting from the Rakovica station, with an industrial zone located at about 100 m from the railway line.

Industrial zone, source: Google Earth

The last part of the subsection (from Tunnel 2 to Resnik station) is an uninhabited area.

Savski Venac has around 39,000 inhabitants, and Rakovica has 108,000 inhabitants[177]. Population density is 34.5 inhabitants per km^2. Due to the current trend of migration from the countryside to urban areas, the number of inhabitants in this area is expected to increase. The census data show that the highest proportion of the population are Serbs (over 90%). Roma people account for 1.65% in these municipalities. No Roma settlements have been identified along the railway line.

As this area is highly developed, there is hardly any agricultural land within this subsection (only sporadic and very small-scale farming along the existing railway line). No particular use of natural resources on this subsection has been identified.

As this area is mostly highly urbanised and developed, the railway is only one of the means of transport for local residents. However, for the surrounding settlements, the railway plays a more important role as it is often the only reliable connection to the municipalities within the City.

Resnik-Velika Plana

This subsection is 74.1 km long. Both the existing and planned railway lines are located within the City of Belgrade (city municipalities of **Rakovica**, **Vozdovac**, **Cukarica**, **Sopot** and **Mladenovac**) and the Municipalities of **Smederevska Palanka** and **Velika Plana**. There are currently 34 level crossings, and only one will be retained.

The existing railway route passes through and/or near the following 11 settlements: Resnik, Ripanj Kolonija, Ripanj, Ralja, Djurinci, Vlaska, Mladenovac, Kusadak, Glibovac, Smederevska Palanka and Velika Plana. All planned route deviations affect agricultural or forest land. In addition, the new railway route crosses over the playground of primary school “Vojvoda Putnik” in Ripanj.

The list of current and planned stations and halts is given below. 2 halts and 5 stations are planned to be closed, and their approximate vicinity to the nearest station is indicated in the last column.

[177] According to the most recent official census of population (2011)

Current stations and halts	*Planned stations and halts*	*Stations and halts which will be closed*	*Proximity of stations/halts planned to be closed to the nearest stations/halts*
Resnik (Station) Ripanj Kolonija (Halt) Ripanj (Station) Klenje (Station) Ripanj Tunnel (Station) Ralja (Station) Sopot Kosmajski (Station) Vlasko Polje (Station) Mladenovac (Station) Kovacevac (Station) Rabrovac (Halt) Kusadak (Station) Ratare (Halt) Palanka (Station) Mala Plana (Station) Velika Plana (Station)	Resnik (Station) Ripanj (Station) Ralja (Station) Sopot Kosmajski (Station) Mladenovac (Station) Kusadak (Station) Palanka (Station) Velika Plana (Station) *Note: 3 railway stations are planned at new locations instead of the existing stations: Ripanj, Ralja and Sopot Kosmajski.	Ripanj Kolonija (Halt) Klenje (Station) Ripanj Tunnel (Station) Vlasko Polje (Station) Kovacevac (Station) Rabrovac (Halt) Mala Plana (Station)	- Ripanj Kolonija (Halt) is 1.1 km from the nearest station Ripanj - Klenje (Station) is 700 m from the nearest station Ralja - Ripanj Tunnel (Station) is 4 km from the nearest station Ralja - Vlasko Polje (Station) is located in the middle between two nearest stations Sopot Kosmajski and Mladenovac at 5.8 km - Kovacevac (Station) is 5 km from the nearest station Kusadak (newly planned station) - Rabrovac (Halt) is 5 km from the nearest station Kusadak (newly planned station) - Mala Plana (station) is 4.8 km from the nearest station Velika Plana

The starting point of the subsection is at the location of Resnik station, with a densely populated settlement around the station. After that, the railway route goes through uninhabited areas dominated by forests and shrubs, while the rest of this subsection is dominated by arable land where small-scale agricultural activities (vegetable cultivation, arable farming, animal husbandry) are common, presumably mainly for private needs due to their small scale. Large scale livestock breeding (pigs and cattle) is well developed in the area of Velika Plana but not located in the immediate vicinity of the railway line.

Shrubs along the subsection, source: ENOVA

Arable land along the subsection, source: ENOVA

Farms on offline parts of the new railway, source: ENOVA

There are also some industrial activities (production of metal profiles and construction materials, fodder production, trade, production of railway cars, etc).

Larger settlements that have been developed around other railway stations as well: Mladenovac, Smederevska Palanka and Velika Plana.

Higher population density is present in the largest settlements/towns (Resnik, Mladenovac, Smederevska Palanka and Velika Plana), while sparsely distributed settlements are mainly in the vicinity of other railway stations.

City of Mladenovac, source: ENOVA

City of Velika Plana, source: ENOVA

According to information provided by local authorities in Velika Plana and Smederevska Palanka consulted during the development of this Assessment Report, these towns have approximately 41,000 and 35,000 inhabitants respectively, with an equal proportion of women and men. There are many elderly residents in both towns, spread throughout the towns and mainly supported by the Red Cross and the Centre for Social Work.

The railway plays an important role for the local communities in this subsection. A small number of local residents work for the railway. The railway is predominantly used by students and employed persons, with no significant difference between women and men. As alternative means of transport, the residents in this area use private cars and intercity buses.

Roma people live in the settlements of Staro Selo and Velika Plana, while in Smederevska Palanka they are present in both urban and rural areas. However, no Roma settlements have been identified along the railway line in these settlements. Another town with significant presence of Roma people is Mladenovac, who have migrated to Mladenovac from other parts of the country. Mladenovac was one of the selected points and visited during the development of this Report. It was found that Roma people live near the railway station (in construction site containers that were used for construction works in the past). They do not use the railway as a means of transport, but use the railway facilities (station, platforms, etc.) during the day for personal needs such as sitting, resting, etc. The photographs below taken during site visits show the areas where Roma people live near the Mladenovac station.

Structures where Roma people live in the vicinity of Mladenovac station, source: ENOVA

Young Roma people near burned rail cars in Mladenovac station, source: ENOVA

The settlement of Mala Plana was visited to better understand community concerns due to the planned closure of a level crossing (with the nearest level crossing 734 m away) and a station. Residents living very near the station were interviewed. It was reported that the station is actively used to travel to Belgrade and Paracin. There are around 10 passengers per train from this station. The population is mostly elderly, and this station is important to them. Since the houses are very near the railway, the residents expressed hope that noise barriers would be installed. The level crossing is not only used by residents of this settlement, but also by people from the surrounding places to reach agricultural land and forests for timber harvesting. The level crossing is currently crossed by different types of cars, agricultural machinery and large trucks loaded with logs for the heating and wood industry.

Mala Plana Station, source: ENOVA

Mala Plana divided by railway tracks with structures in close proximity to the tracks, source: ENOVA

On this subsection, a specific agricultural area near Kusadak station was additionally visited as a selected point due to its proximity to a planned tunnel (Tunnel no. 11), to understand the impacts of tunnel construction in terms of potential temporary impacts (noise, vibration, dust, etc.) and restrictions caused due to tunnel construction. Interviews were conducted with families living on farms. The families reported that they had heard about the Project through the media, but were not familiar with the details. They expressed support for Project implementation as they believe it will contribute to the economic growth and development of this region. They also have no particular concerns with construction activities or impacts (dust, noise, increased traffic, etc.). In this area, men mostly work in jobs in larger cities, while women run rural households. Children travel to schools in private vehicles or school buses.

Agricultural land near the site where tunnel exit no. 11 is planned to be constructed, source: ENOVA

Velika Plana-Gilje

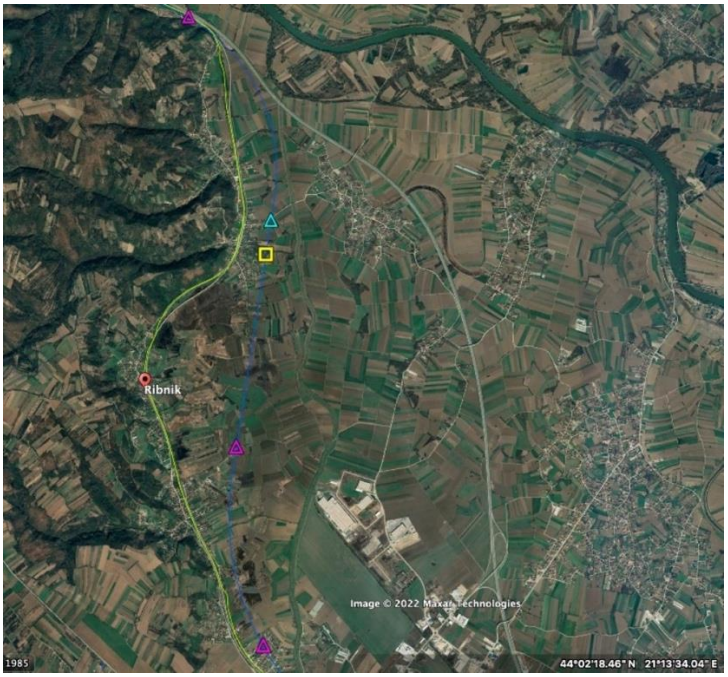
The planned subsection is 49.7 km long. Both the existing and planned railway lines are located within the municipalities of **Velika Plana, Lapovo, Batocina, Jagodina** and **Cuprija**. There are currently 23 level crossings which will all be closed, and replaced by 23 overpasses and 9 underpasses.

The list of stations and halts which are currently in function and those which are planned to be closed is shown below. A total of 7 halts are considered for closure, and their approximate vicinity to the nearest station is indicated in the last column.

Current stations and halts	*Planned stations and halts*	*Halts which will be closed*	*Proximity to the nearest station*

Velika Plana (Station) Staro Selo (Halt) Novo Selo (Halt) Markovac (Station) Lapovo Varos (Halt) Lapovo (Station) Brzan (Halt) Milosevo (Halt) Bagrdan (Station) Laniste (Halt) Bukovce (Halt) Jagodina (Station) Gilje (Halt)	Velika Plana (Station) Markovac (Station) Lapovo Varos (Halt) Lapovo (Station) Bagrdan (Station) Jagodina (Station)	Staro Selo (Halt) Novo Selo (Halt) Brzan (Halt) Milosevo (Halt) Laniste (Halt) Bukovce (Halt) Gilje (Halt)	- Staro Selo (Halt) is 3.5 km from the nearest station Velika Plana, - Novo Selo (Halt) is 2.6 km from the nearest station Markovac, - Brzan (Halt) is 4.6 km from the nearest station Lapovo - Milosevo (Halt) is 4.2 km from the nearest station Bagrdan - Laniste (Halt) is 5.9 km from the nearest station Bagrdan - Bukovce (Halt) is 3.8 km from the nearest station Jagodina - Gilje (Halt) is located in the middle between two nearest stations Jagodina and Gilje, at 3 km

The majority of the subsection will remain along the same route with several minor deviations and one more significant deviation after the Bagrdan station (shown in the map below). All deviations affect surrounding agricultural land.



The existing railway route passes through and/or near the following 11 settlements: Velika Plana, Staro Selo, Novo Selo, Markovac, Lapovo, Brzan, Milosevo, Bagrdan, Novo Laniste, Ribnik and Jagodina. The new railway route will avoid and/or will be moved away from 4 settlements: Staro Selo (partially), Milosevo (partially), Novo Laniste and Ribnik. The most populated settlements are: Markovac, Lapovo, Milosevo and Jagodina.

The starting point of the subsection is in Velika Plana which is a densely populated area. After Velika Plana, the route mainly follows rural, agricultural areas with smaller settlements built along the railway line. In this part of

the subsection the predominant activity of locals is arable farming, while livestock breeding is practised in Milosevo selo (the area of Jagodina). The industrial economic activities are production of car parts, production of metal profiles and construction materials, production of PVC pipes, chemical industry, wood processing, paper manufacturing, trade, etc.

In Lapovo, there is a level crossing that is planned to be closed. An underpass is planned to be constructed. This location was visited to better understand current use of level crossings by the local population. During discussions with residents, it was determined to be used intensively by cars, trucks and agricultural vehicles. Although there is no sidewalk or pedestrian marking, the crossing is also used by pedestrians. Residential houses are located at a distance of 150 to 200 m from this crossing.

Level crossing in Lapovo and its surroundings, source: ENOVA

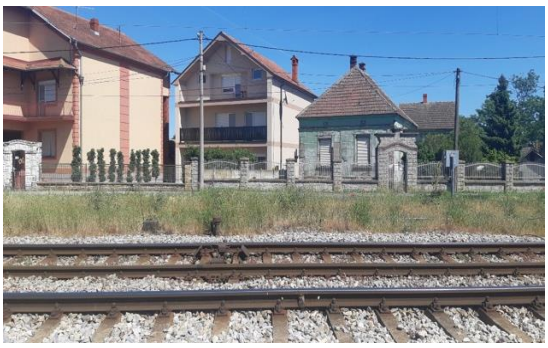
Residential houses near the level crossing in Lapovo, source: ENOVA

According to local authorities consulted during the development of this Assessment Report, the smaller settlements along the subsection have been affected by migration to larger cities (Belgrade, Nis and Krusevac), which has contributed to an increase in the number of elderly population. These areas are particularly characterised by a considerable proportion of single elderly households. Vulnerable groups are spread throughout the municipalities/cities and are mainly supported by the Red Cross and the Centre for Social Work. Additional support is provided through a public kitchen where food is prepared and distributed to needy households (in Cuprija).

Roma population lives in some of the settlements but not along the railway line. In addition to the Roma people, the ethnic minority of Vlachs is also present in the City of Cuprija and the surrounding villages.

As railway traffic has declined, only a small number of locals work for the railway. The railway is mainly used by students and employed persons but is considered underused by local residents. Additionally, the farmers in Cuprija transport their products to market via the railway. As an alternative to the railway, locals predominantly use private cars, as the bus service does not work well. Representatives of municipal/city authorities have expressed hope that Project implementation will lead to this entire area becoming livelier and more active. Furthermore, the reconstruction of the railway line is expected to increase the safety of pedestrians, as there have been many accidents in the past when trespassing the railway tracks (e.g., in Lapovo).

Paths used by pedestrians for trespassing the railway tracks, source: ENOVA



Road and houses along the railway line, source: ENOVA

The Staro Selo settlement was visited as one of the selected points along the subsection, as there is a halt that will be closed. There is also a primary school ("Karadjordje") in this settlement, which is in close proximity of the planned railway route. Discussions were held with local residents and school staff. It was reported that the halt is rarely used as people rely more on buses and private vehicles for traveling to work and school. The residents support the railway reconstruction, and particularly support fencing of the railway line due to the proximity of the school.

Houses around the Staro Selo halt

Paracin-Stalac

The planned subsection is 21.2 km long. Both the existing and planned railway lines are located within the municipalities of **Paracin** and **Cicevac.** The line remains in the same railway corridor on the entire subsection. There are currently 12 level crossings and only one will be retained. 4 underpasses and 6 overpasses are planned.

The list of current and planned stations and halts is given below. 3 halts are planned to be closed, and their approximate vicinity to the nearest station is indicated in the last column.

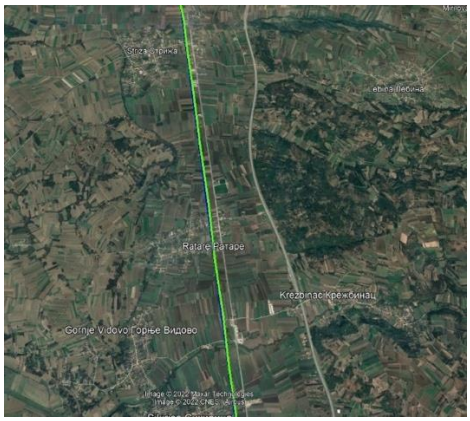
Current stations and halts	*Planned stations and halts*	*Stations and halts which will be closed*	*Proximity to the nearest station*
Paracin (Station) Sikirica/Ratari (Halt) Drenovac (Halt) Cicevac (Station) Lucina (Halt) Stalac (Station)	Paracin (Station) Cicevac (Station) Stalac (Station)	Sikirica/Ratari (Halt) Drenovac (Halt) Lucina (Halt)	- Sikirice/Ratari halt is around 7 km to the Paracin station, and around 8 km from the Cicevac station. - Drenovac halt is closest to the Cicevac station, around 5 km. - Lucina halt is about halfway between Cicevac station (distance: 2 km) and Stalac station (distance: 2.5 km).

The existing and the planned railway route passes through and/or near the following 8 settlements: Paracin, Striza, Ratare, Sikirica, Drenovac, Cicevac, Lucina and Stalac.

The Project area is mixed urban and rural. The starting point of the subsection is the Paracin station, where a densely populated settlement (called Paracin) has developed around the station – see photograph below showing the Paracin settlement. After the Paracin station, there is large industrial zone with numerous business facilities, around 50 m from the railway line. Paracin has a long tradition in producing glass, cement, confectionary products, arable farming, livestock breeding, etc. One of the leading manufacturers of confectionery (chocolates, biscuits, etc.) called Pioneer has a factory in Paracin. In addition, as the Crnica river flows through the town of Paracin, sport fishing is practised by the locals.

Settlement of Paracin

After the Paracin settlement, there is a large industrial zone with numerous business facilities, around 50 m from the existing and planned railway line. From this location onward, there is a great number of arable land plots along the railway line with a less densely populated, sporadic and linear type of settlements. In fact, the entire area until Cicevac is arable land (see figure on the right below). Cicevac is a larger settlement with a railway station. From Cicevac to Stalac, arable land is again the dominant type of area.



Project area between Paracin and Cicevac (with arable land on both sides of the railway line)

Arable land along the railway line, source: ENOVA

Close to the end of the subsection (before the entrance into the Stalac settlement), there are some industrial facilities – see photograph below.

Industrial facilities before Stalac settlement, source: Google Earth

The highest proportion of population is in Paracin, while Cicevac and Stalac are less densely populated. The City of Paracin with its surrounding villages has about 50,000 inhabitants. The proportion of Roma people in Paracin is between 5 and 7% but there are no Roma settlements along the railway line. Vulnerable groups are supported by the Red Cross and the Centre for Social Work through various types of assistance. Next to the railway line is also an informal settlement Ribnica, where vulnerable people live. The residents of this settlement are displaced persons (Serbs from Kosovo), who have been living here in temporary structures since 1999. The temporary structures were used by SRI in the past.

One of the three halts that will be closed is Sikirice/Ratari, which was visited during the development of this Assessment Report. Interviews with residents were conducted. It was reported that the halt is rarely used (several passengers a day) as people rely more on private cars or buses to travel to work and school. The halt has a building in which a family has been living for many years. The same family uses a land plot behind the halt's building for growing vegetables. The two photographs below show the halt building and the land plot used by the family living in the building.

Sikirica/Ratari halt structure, source: ENOVA

Land plot used by the family who lives in the Sikirica/Ratari halt structure, source: ENOVA

The Municipality of Paracin has a department responsible for maintenance of the railway. According to municipal representatives, the railway is underused for passenger transport because of delays in arrivals and poor services. The most frequent users of the railway are students and employed persons, used equally by both women and men. Although the area of Paracin is well connected to other cities by buses, locals also use cars as an alternative means of transport.

Stalac-Djunis

The planned subsection is 17.7 km long. Both the existing and planned railway lines are located within the Municipality of **Cicevac** and the City of **Krusevac**. The Project plans almost complete abandonment of the existing railway route and use of a new corridor. There are currently 8 level crossings which will all be closed.

The list of stations and halts which are currently in function and those which will be closed is shown below. One station and 2 halts will be closed, and their proximity to the nearest stations is indicated in the last column.

Current stations and halts	*Planned stations and halts*	*Stations and halts which will be closed*	*Proximity to the nearest station*
Stalac (station) Djunis (station) Braljina (station) Cerovo (halt) Trubarevo (halt)	Stalac (station) Djunis (station)	Braljina (station) Cerovo (halt) Trubarevo (halt)	- Braljina (station) is located in the middle between two nearest stations Stalac (at 10 km) and Djunis (at 8.5 km), - Cerovo (Halt) is at 5 km from the next nearest station Djunis, - Trubarevo (Halt) is at 2.7 km from the next nearest station Djunis

The Project area is largely a rural, sparsely populated area which is unevenly populated, as is characteristic for hilly and mountainous terrains. The largest settlements are towns of Stalac and Djunis (the starting and end points of the railway line) where the two stations are planned to be reconstructed. Both are located in the lower and flat parts of the terrain with residential, industrial and public facilities but it should be noted that the railway line passes through only the outskirts of Djunis, so the only larger settlement in the Project area is Stalac. Between them are small villages with mostly scattered groups of individual houses. Along the railway line there are numerous uncultivated areas as well.

Existing railway line in Stalac, source: Google Earth

Agricultural land in Trubarevo, source: ENOVA

The existing railway route passes through and/or nearby the following 7 settlements: Stalac, Stalac Town, Braljina, Mojsinje, Cerovo, Trubarevo and Djunis. The least population density is in Braljina, Mojsinje and Trubarevo. The new railway route will be moved away from two settlements: Braljina and Cerovo.

The local population is mostly Serbian; Roma people make up around 2% of the population in Stalac and Djunis, but there are no Roma settlements along the railway. The population in villages is mostly elderly, and the most vulnerable households are elderly people living alone. This is particularly the case in villages which will lose direct access to the railway line (e.g., Braljina). The municipal social care centre keeps a registry of vulnerable households and provides cash assistance. In addition, the Red Cross cooperates with the social care centre and is very active in helping vulnerable people in the area.

Cerovo village, source: Google Earth

The station in Braljina which will be closed, source: ENOVA

In part of the Project area belonging to the Municipality of Cicevac, some public facilities are located along the existing railway line or near the railway station in Stalac (for e.g., near the station are the health centre in Stalac, a primary school and a children's playground; the post office is within the station itself). There are several cemeteries near the planned railway line (only in part of the Project area belonging to the Municipality of Cicevac) – one of the cemeteries is near the Stalac station (around 100 m). In part of the Project area belonging to the City of Krusevac, there are no public facilities nearby.

There are some industrial activities in Stalac (companies for construction materials and metals, and transport companies) and some small-scale industrial activities in Djunis (small metal workshops). Farming is the dominant economic activity in the Project area. It is a low-intensity activity as the majority of farmland plots are small (up to 3 hectares). The most frequently grown crops are corn, wheat and vegetables. Livestock breeding is not well developed. People engaged in agriculture currently use the level crossings on the existing railway to reach their farmland. The Stalac Gorge area is particularly known for its beekeeping activities.

Forest resources (at locations near Stalac station) are used by the local population for logging, as well as gathering of mushrooms and forest fruits, both for personal consumption. There are no commercial activities related to these resources. The Juzna Morava River is used for recreational fishing, but not significantly used for irrigation or other recreational activities.

The railway is of great importance for the local communities which developed around the existing railway line. Some local residents also work for the railway. People travel for school and work purposes. The railway is used equally by men and women. Only in Djunis, buses are used more often than the railway.

***NOTE**: A more detailed baseline for this subsection is provided in the Supplementary Study which is part of the Project's Disclosure Package.*

Djunis-Medjurovo

The planned subsection is 39 km long. Both the existing and planned railway lines are located within the Municipality of **Krusevac,** Municipality of **Aleksinac,** Municipality of **Crveni Krst** (City of Nis) and Municipality of **Palilula** (City of Nis). The new railway line generally follows the existing corridor. From Djunis to the Androvac station, the subsection has minor deviations. There are currently 32 level crossings and only one will be retained.

The list of current and planned stations and halts is given below. 8 halts will be closed, and their approximate vicinity to the nearest station is indicated in the last column.

Current stations and halts	*Planned stations and halts*	*Halts which will be closed*	*Proximity to the nearest station*
Djunis (Station) Vitkovac (Halt) Donji Ljubes (Halt) Gornji Ljubes (Halt) Korman (Station) Trnjani (Halt) Adrovac (Station) Aleksinac (Station) Nozrina (Halt) Luzane (Halt) Tesica (Halt) Grejac (Station) Supovacki Most (Halt) Mezgraja (Halt) Vrtiste (Halt) Trupale (Station) Crveni Krst (Station) Nis (Station)	Djunis (Station) Korman (Station) Androvac (Station) Aleksinac (Station) Luzane (Halt) Grejac (Station) Mezgraja (Halt) Trupale (Station) Crveni Krst (Station) Nis (Station)	Vitkovac (Halt) Donji Lubes (Halt) Gornji Lubes (Halt) Trnjani (Halt) Nazrina (Halt) Tesica (Halt) Supovacki Most (Halt) Vrtiste (Halt)	- Vitkovac (Halt) is located at approx. 4km from the nearest station Djunis, - Donji Lubes (Halt) is located in the middle between two nearest stations Djunis (at 6 km) and Korman (at approx 4.8 km), - Gornji Lubes (Halt) is located at 2.2 km from the nearest station Korman, - Trnjani (Halt) is located in the middle between two nearest stations Korman (at 2.2 km) and Androvac (at 2.5 km), - Nazrina (Halt) is located in the vicinity of station Luzane at distance of 600m, - Tesica (Halt) is located in the middle between two nearest stations Luzane (at 3.8 km) and Grejac (at 2.8 km), - Supovacki Most (Halt) is located at 1.4 km from the nearest station Mezgraja, - Vrtiste (Halt) is located in the middle between

			two nearest stations Mezgraja (at 3 km) and Trupale (at 2.2 km)

The existing railway route passes through and/or near the following 19 settlements: Djunis, Vitkovac, Donji Ljubes, Srezovac, Gornji Ljubes, Korman, Trnjane, Donji Androvac, Zitkovac, Moravac, Luzane, Tesica, Grejac, Veliki Drenovac, Supovac, Mezgraja, Vrtiste, Trupale and Nis.

The beginning of the subsection is in the outskirts of the Djunis settlement – this is a hilly and mountainous area, and is not inhabited. The railway line here follows the existing corridor. Between the railway line and the Juzna Morava River there are numerous arable land plots, as seen in the figure below.

A characteristic part of the subsection, showing that the majority of the route passes through arable land

The route then generally follows the existing line where arable land is the dominant type of land, and along which several smaller settlements have developed.

With minor deviations, the route partially moves away from three settlements: Zitkovac, Moravac and Veliki Drenovac, and fully moves away from the settlement of Supovac. The deviation in the Zitkovac settlement is shown in the map below (*blue line is the new route*).

Deviation of the planned route in the Zitkovac settlement

The end point of the subsection is Medjurovo, in the outskirts of the City of Nis.

As the subsection passes mostly through rural areas, the most common economic activity is small-scale farming. There are also some beekeeping activities along this subsection. A small apiary has been identified at the border between the local communities of Bankovac and Grejac (within the Municipality of Aleksinac), along the railway

line. There are around 30 beehives at this location. Going further along the railway line, there is another area with around 10 beehives. No larger industrial zones in the vicinity of the planned railway line have been identified.

The subsection is characterised by a steady decline in population due to employment and education opportunities in the larger cities. The dominant ethnic group are Serbs, while the Roma people are the second largest ethnic community (especially in Aleksinac). Aleksinac was visited to better understand impacts on Roma people. It was reported that Roma people use the railway to reach larger cities (such as Nis). They live in the town itself but do not live by the railway line. The closest Roma settlements to the railway (at around 300-400 m) are in Prcilovic settlement where there are two informal Roma settlements called Solunska 1 and Solunska 2, as reported by the NGO Roma Association Women Nada.

The planned route is near two primary schools on this subsection. One is in the settlement of Trnjane (primary school “Stojan Zivkovic Stole”), and the second in the settlement of Zitkovac (primary school “Vuk Karadzic”) – more than 50% of students in the second school belong to the Roma population.

At the same location, at a distance of about 150 m from the Grejac station, is a level crossing. The level crossing is planned to be closed, and the next crossing is 1,095 m away. This location was visited during the development of this Report to better understand the use of level crossings by local residents. It was found during discussions with the locals and the level crossing operator that this level crossing is operated manually and frequently used by 30 cars, trucks and agricultural machinery. Locals use this level crossing to get to their agricultural land plots and forests. In this area, people travel by car and rarely use the railway as a means of transport.

Level crossing in Grejac, source: ENOVA

8 Assessment of Impacts and Their Characterisation

8.1 Impacts on Biodiversity

The key baseline facts that guide the assessment of impacts on biodiversity are the following:

- The planned railway significantly overlaps with the existing railway.
- Literature data on habitats and species of Project area is scarce.
- Field surveys of chosen locations was performed based on literature review, habitat diversity and suitability, and expert opinion. Targeted surveys were performed because it was the only feasible way to visit as much as possible of the very large Project area and include the most ecologically interesting, sensitive and/or potentially species-rich sites along the planned railway in a short period of time. Due to the timing of the assignment, surveys covered the spring and early summer. Surveyed groups included: habitats, vegetation, flora, invertebrates, fish, amphibians, reptiles, birds and mammals. Despite timing constraints, experts have concluded that the findings collected during the 2022 surveys are highly representative of the Project area. Even though it will be necessary to conduct surveys for each subsection in the future, it is not expected that those results will significantly differ from the data collected in as a part of this assignment.
- Habitats along the planned motorway are predominantly habitats under significant anthropogenic pressure.
- There are no habitat types listed on Annex I to the Habitats Directive in the Project's AoI.
- Endangered, endemic, or protected plant species were not registered.
- Invasive plants are common, well established and could spread as the result of the project.
- Fauna is represented by a large number of species on Annexes II and/or IV of Habitats Directive, Resolution 6 of the Berne Convention and are of (inter)national conservation importance.
- A total of 67 features were analysed in Critical Habitat Assessment, 40 met the criteria for PBF and 27 for CH.
- Many smaller water bodies were registered along the highway and may be very important to fauna.
- Review of available data has shown that the railway will pass through 10 areas of concern and additional eight are in the Project's AoI.

Habitats and flora. Impacts on habitats and flora can arise in pre-construction, construction and operation phases.

One of the specificities of anthropogenic, artificial, or semi-natural habitats is their dynamic during each season, so the list of the identified habitats needs to be confirmed and adjusted or more elaborated through local, more detailed surveys for each section in the pre-construction phase.

Habitat loss is a moderate adverse impact that is likely to affect habitats during construction phase. This is an inevitable impact. The scale of works, and therefore magnitude of the impact, on the entire corridor is major, the sensitivity of habitats as a whole is medium. Small eutrophic ponds and pools have been identified as a main sensitive receptor. Rich aquatic invertebrate fauna, as well as birds and other organisms that find shelter and resources in the vegetation depend on the water level of this habitats, which might be affected during construction by drying out or disruption of connections between the rivers and the ponds. Additionally, aggressive cuttings can lead to changes in the water regime, which will directly influence all riparian and wetland vegetation. C3.2 - Water-fringing reedbeds and tall helophytes other than canes and G1.11 – Riverine *Salix* woodland are EUNIS habitat types found in Project's AoI that meet the criteria for PBF. This means that the future subsection-specific ESIAs must ensure there is no net loss of these habitat types.

The already high level of organic waste due to the intensive agriculture in the project area will likely be increased by the construction works, as the area of the relocation or the existing railway will be under construction for a longer period. Landfills and waste deposits fall under this category of impacts as well. While it is certain that this impact will be adverse for the natural species of the project area, species with high tolerance of unstable conditions, such as invasive species, will benefit from vegetation clearance and widen their distribution. The impacts have been assessed as minor.

Transportation infrastructure impact is often reflected in acceleration of habitat fragmentation. Current design of the railway plans for the whole railway to be fenced. This will affect habitat continuity; habitat fragmentation will therefore be most prominent in operation phase. The Project area is already under a spectrum of anthropogenic factors with similar effect, so it is difficult to evaluate the exact extent of the railway impact. Planned railway relocation that cuts the areas such as EUNIS habitat type E3, which has been identified in the Ribnik and Bukovce localities of the fifth polygon in Subsection 3: Velika Plana-Gilje will contribute to shrinking of this area due to the construction works and changes in humidity level once the railway is functioning. Broadleaved deciduous woodland G1 is identified in several localities during the survey. Although not completely preserved, these woodlands are of high value as habitats for many species. Most habitats are, however, of low sensitivity, which is why the sensitivity of all receptors for this impact is assessed as medium. Due to the existing railway, motorway and other infrastructure, the Project itself will not cause large increase in fragmentation and the impact magnitude is assessed as moderate.

Chemical pollution by inadequate use of herbicides may appear during operation. The magnitude of impact is minor and sensitivity low because tertiary vegetation dominates in railway vicinity.

Table 47: Summary of Project impacts on habitats and flora and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Pre-construction	Lack of up-to-date baseline data	Adverse	Major	Medium	Major	Significant
Construction	Habitat loss - most sensitive receptors are small waterbodies that may be affected by (i) drying out and (ii) disruption of connection with rivers	Adverse	Major	Medium	Major	Significant
Construction	Pollution by organic waste	Adverse	Moderate	Low	Minor	Significant
Construction	Spread of invasive species	Adverse	Moderate	Low	Minor	Significant
Operation	Habitat fragmentation	Adverse	Moderate	Medium	Moderate	Significant
Operation	Contamination caused by inadequate use of herbicides	Adverse	Minor	Medium	Minor	Significant

Fauna. The impacts on fauna are expected in pre-construction, construction and operation phase. Some impacts expected in construction phase may arise due to inadequate design and planning of works in the pre-construction phase. Therefore, such impacts will be classified as pre-construction impacts as they can be mitigated during that phase.

Potentially significant impact on fauna in the pre-construction phase can result from inadequate Project design and planning of works. As the Project is in its early phases, Main Design and other documents are not finalized and inputs are possible in order to minimize this impact. The current layout plans for relocation of railway for approx. 180 m at locality Vrtiste, Subsection 7: Djunis-Medjurovo. Ornithological survey has determined this area is of high ecological value and design change should be considered. Additionally, existing motorway and now the new high-speed railway, both with protective fences, will become obstacles for the movement of large mammals, so the construction of wildlife corridors must be considered. Lack of up-to-date baseline data on biodiversity may cause major impact if surveys are not conducted adequately.

During construction, the relocation of railway and establishment of construction sites and access roads will result in habitat loss and alteration. This is an adverse impact of different scale on each subsection, due to the significant difference in the magnitude of needed works. Fauna mortality may appear as well due to the constant movement of large machinery. As species of conservation concern as present in Project area, the sensitivity was assessed and medium and impact as moderate. Majority of such species are also assessed as PBFs or CHs. Habitats of species meeting those criteria shall not be impacted by construction of access roads or temporary structures unless there is no feasible alternative. A priority in biodiversity conservation is preventing net loss of PBF and ensuring net gain of CH. Due to this, targeted mitigation measures and strategies must be implemented in order to meet these goals. Construction works will cause significant noise and vibration of temporary nature, however, it can impact fauna and cause their dispersal and avoidance of construction areas. As a result of accidents or improper management of construction site, soil erosion, spillages and other forms of pollution with organic waste and chemicals may happen.

The most significant impacts in operation phase are habitat fragmentation and fauna mortality. It is very likely that fauna in general but especially birds, mammals and reptiles, will be under significant impact as they are under the highest risk from collision with trains and electrocution on powerlines. Their habitat will be fragmented and migratory routes potentially interrupted as well, as the planned railway will run in parallel to the existing motorway. The structures will both be fenced and represent a significant barrier in animal movement, especially large mammals. However, as described above, this impact of fragmentation and population isolation can be mitigated through Project design. Noise, vibration and pollution and minor impacts that will likely be caused by operation and maintenance of the railway.

On the other hand, some invertebrate species such as *Zerynthia polyxena* and *Z. cerisy,* and their host plants belonging to the genus *Aristolochia,* prefer habitats along railways and the construction will result in minor habitat gain.

Table 48: Summary of Project impacts on fauna and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Pre-construction	Inadequate Project design and planning of works	Adverse	Moderate	High	Major	Significant
Pre-construction	Lack of up-to-date baseline data	Adverse	Moderate	High	Major	Significant
Construction	Habitat loss and alteration – most significant in the sections where relocation is planned	Adverse	Moderate	Medium	Moderate	Significant
Construction	Mortality of fauna	Adverse	Moderate	Medium	Moderate	Significant
Construction	Noise and vibration	Adverse	Moderate	Medium	Moderate	Significant
Construction	Soil erosion, spillage and water run-off	Adverse	Moderate	Minor	Minor	Significant
Operation	Permanent habitat fragmentation	Adverse	Major	Medium	Major	Significant
Operation	Fauna mortality - collision with trains and electrocution on powerlines	Adverse	Moderate	Medium	Moderate	Significant
Operation	Habitat gain - species *Zerynthia polyxena* and *Z. cerisy* may be under positive impact because their host plant is commonly found along railways	Beneficial	Minor	Medium	Minor	Not significant
Operation	Fauna disturbance caused by noise, vibration and light pollution	Adverse	Moderate	Minor	Minor	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Operation	Environmental contamination by herbicides, pesticides and other harmful chemicals	Adverse	Moderate	Minor	Minor	Significant

Protected areas. Review of all areas of conservation in Serbia: officially protected areas, areas in the process of designation, ecological network of Serbia, Emerald sites, Ramsar sites, Important Bird Areas (IBAs), Important Plant Areas (IPAs), Prime Butterfly Areas (PBAs), proposed Special Protection Areas (pSPAs), proposed Sites of Community Importance (pSCIs), Biosphere Reserves (UNESCO) and UNESCO World Natural Heritage sites has shown that the project will pass through the following areas:

- Ecological network area Kosutnjak, Subsection 1
- Ecological network area Mojsinje Mountains and Stalac Gorge, Subsection 6
- Ecological corridors Juzna Morava, Velika Morava
- pSPA Barajevo, Subsection 2
- pSPA Gornje Pomoravlje (also IBA, code RS044), Subsections 3, 4 and 5
- pSPA Dobric-Nisava (also IBA, code RS048), Subsection 7
- pSCI Velika Morava, Subsection 3
- pSCI Juzna Velika Morava, Subsections 4, 5 and 6
- pSCI Avala sume, Subsection 2
- pSCI Nis, Subsection 7

The areas of concern located within the Project's AoI (1 km-wide buffer zone) are:

- Natural Monument Kosutnjak Forest – on the boundary of the new railway; designated for conservation of *Quercus* forests
- Natural Monument Rogot – Subsection 3, at 60 m west from the new railway; designated for conservation of the last remnants of the *Quercus robur* forest
- Special Nature Reserve Brzansko Moraviste – Subsection 3, at 160 m east from the new railway; aim is conservation of swamp which presents very rare habitat type in Serbia. The area is currently recognized as a natural area in the process of designation and therefore is not officially protected.
- Natural Monument Miljakovacka Forest – Subsection 1, at 300 m east from the new railway; designated for conservation of *Quercus cerris* and *Q. petraea* forests.
- Environmental network site Gornje Pomoravlje - located 420 m west of the Subsection 4 – in order to avoid confusion it is important to note that the railway will pass through the pSPA/IBA site of the same name but the boundaries of these two sites are not the same. The pSPA/IBA site is enlarged and elongated in comparison to the environmental network site.
- pSCI Rogot - 100 m west of the Subsection 3
- pSCI Kosutnjak - 10 m west of the Subsection 1
- pSCI Guberevacke sume – 480 m west of the Subsection 2

Considering the conservation values of these areas based on which they were designated, it is very unlikely the project will have any impact on the functioning of the areas and their status. Majority of the projected areas were established based on the woodland values. As there will be no vegetation clearings in those areas, no impact is expected. However; precaution must be of importance as reasons for designation not the only value those areas have and e.g. woodlands support a variety of species. No loss of habitats or species in these areas is permitted. Currently, the impact on these areas is comparable to the impacts already identified for the habitats,

flora and fauna as they can only be observed as a whole ecological network at this stage. The magnitude of impacts is smaller, but the sensitivity is equal or higher due to the status of these areas.

It is important to note that, at this stage of the Project, information on design of access roads are not yet known for the whole Belgrade-Nis section. There is a possibility that, due to the small distance of railway to some of the PAs, access roads may encroach protected areas. Construction of access roads in PAs may be allowed only if there is no other feasible alternative.

The *Law on Nature Protection* (Art. 130) states that the areas considered as a part of this assignment constitute the ecological network and that it will become a part of Natura 2000 upon Serbia's accession to the EU. Therefore, these areas should be treated as potential Natura 2000 sites and in accordance to the Habitats Directive. In order to fully assess the potential impacts the Project may have on the protected areas and other areas of concern, a separate Appropriate Assessment (AA) process will need to be performed in the future for each area separately. AA is currently included in the *Law on Nature Protection* of Serbia in Articles 8 to 10, but a specific Regulation should be adopted. An AA involves a case-by-case examination of the implications of a development or activity for a Natura 2000 site and its conservation objectives. It must be taken into consideration that majority of areas of concern mentioned above do not have management plans nor conservation objectives, therefore AA must be extensive and implement a different approach.

The key steps in the AA process include screening, which establishes whether a plan or project could have significant effects on a Natura 2000 site either on its own, or in combination with other plans or projects. Where potential impacts are identified, a complete AA is undertaken, which will inform and assist the planning authority in their decision to grant or refuse permission. The competent authority must determine whether the proposal will not adversely affect the integrity of the site(s). The relevant authority for questions regarding areas of concern is the Institute for Nature Conservation of Serbia.

8.2 Impacts on Air Quality

The key baseline facts that guide the assessment of impacts on air quality are the following:

- The pollution sources in the Project area are mainly traffic and heating.
- Heavy industry is not present in the Project area.
- The areas of Belgrade, Kragujevac and Nis are in the third (III) category, while the rest of the Project area is in the first (I) category of air quality.
- The dominant pollutants are suspended particles (PM10 and PM2.5).

The corridor impacts on the air quality are taking place during the construction phase and operational phase. The construction phase is more intensive in terms of pollutant emissions compared to the operational phase where the main source of air pollution are emissions from reconstruction and maintenance works. Since the railway will be fully electrified, no direct impacts of railway operation on air quality are expected.

The risk of emissions from construction site causing loss of amenity and/or health or ecological impacts is related to[178]:

- the activities being undertaken (earth works, number of vehicles etc.),
- the interval of these activities,
- the scope of the site,
- the meteorological conditions (wind speed, direction and rainfall),
- the proximity of receptors to the activities,

[178] Institute of Air Quality Management (2014) Guidance on the assessment of dust from demolition and construction, version 1.1. available at http://www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

- the adequacy of the mitigation measures applied to reduce or eliminate dust, and
- the sensitivity of the receptors to dust.

The two main receptors of concern, for which impacts assessment has been conducted for both Project phases as presented in Table 47, are human and ecological receptors.

Table 49: Summary of Project impacts on air quality and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	Reduction in **air quality** due to: (i) emissions of construction dust as a result of demolition works, earthworks, transport and disposal of excavated materials, (ii) emissions of exhaust gases from combustion processes in construction equipment and vehicles.	Adverse	Moderate	Medium	Moderate	Significant
Operation	Reduction **in air quality** due to reconstruction and maintenance works (as defined for construction phase).	Adverse	Minor	Medium	Minor	Significant
Operation	Reduction of total **GHG emissions** in the transport sector due to the expected modal shift from road to rail traffic.	Beneficial	Moderate	Medium	Moderate	Significant (as no suitable alternative to road traffic will exist and the increase in the use of road traffic may be expected)

8.3 Noise and Vibration Impacts

8.3.1 Noise impacts

Construction phase. There is no information on baseline noise levels in the Project area. However, in the preconstruction phase, the baseline noise levels in the observed area can be determined only by field measurements. The measurement of the outdoor noise indicators must be done in accordance with SRPS ISO 1996-1 and SRPS ISO 1996-2 standards.

The noise levels during the railway construction primarily depend on the organisation of works at the site, the number and type of construction machines used at the site, and their position and distance from residential and other sensitive buildings in the impact zone. At this Project stage, information on the organisation of the construction site, the technology of works and information on which tools, equipment and machinery will be used are not available. All calculation and analyses given here are based on default values from referenced standards and literature, while the exact values can be determined after the method and technology of construction works decided upon.

Typical noise levels from tools, equipment and machinery that may occur during railway construction are given on the basis of standards BS5228 (Code of practice for noise and vibration control on construction and open

sites – Part 1: Noise) and AS2436 (Guide to noise and vibration control on construction, demolition and maintenance sites), as shown in Table 50.

Table 50: Estimated sound power levels of construction tools, equipment or machinery

Construction tools, equipment or machinery	Estimated sound power levels L_w [dB(A)]
Bulldozer	114
Grader	105
Hydraulic excavator 20 t	107
Excavator 20 t	108
Dump track	109
Roller 18 t	101
Backhoe	96
Water cart	109
Mobile cranes	99
Auger Piling Rig	110
Impact Piling Rig	133
Track Works Sleeper/Track Layer Plant	114
Ballast Regulator	114
Rail Welding Machine (Generator)	107
Ballast Tamper	115

The levels of construction noise depend on a large number of factors, such as: intensity of construction activities; location of construction activities; type of tools, equipment and equipment used; existing local noise sources; terrain topography and weather conditions.

It is assumed that no tools, equipment or machine will run at full power all the time, when the noise levels they emit are the highest. Periods with full power engagement should be relatively short, and "average" power values will be used most of the time during construction works, when the sound power levels produced are lower than those listed in Table 50. Also, not all types of tools, equipment and machines will be present and engaged on the construction site at the same time.

For the purposes of analysing the impact of tools, equipment and machines during construction works on environmental noise levels, an assessment of sound propagation was performed at their maximum engagement in conditions of even distribution. The acoustic calculations did not take into account the obstacles to sound propagation, and in real conditions noise levels can be expected to be lower than estimated. The estimated sound pressure levels of tools, equipment and machines at distances of 50, 100, 250, 500, 1000, 2000 and 3000 meters are shown in Table 51[179].

Table 51: Estimated sound pressure levels of tools, equipment and machines for different distances [dB(A)]

Construction tools, equipment or machinery	Distance [m]						
	50	100	250	500	1000	2000	3000
Bulldozer	72	66	58	52	46	40	36
Grader	63	57	49	43	37	31	27
Hydraulic excavator 20 t	65	59	51	45	39	33	29
Excavator 20 t	66	60	52	46	40	34	30
Dump track	67	61	53	47	41	35	31
Roller 18 t	59	53	45	39	33	27	23
Backhoe	54	48	40	34	28	22	18
Water cart	67	61	53	47	41	35	31
Mobile cranes	57	51	43	37	31	25	21

[179] Alpha Coal Project (Rail), Noise and Vibration Assessment, 2010.

Construction tools, equipment or machinery	Distance [m]						
	50	100	250	500	1000	2000	3000
Auger Piling Rig	68	62	54	48	42	36	32
Impact Piling Rig	91	85	77	71	65	59	55
Track Works Sleeper/Track Layer Plant	72	66	58	52	46	40	36
Ballast Regulator	72	66	58	52	46	40	36
Rail Welding Machine (Generator)	65	59	51	45	39	33	29
Ballast Tamper	73	67	59	53	47	41	37

The calculated sound pressure levels shown in Table 52, which meet the requirements of the Serbian law for day and evening period maximum allowed noise levels for Zone 5 (Table 28) are coloured green.

NATM is a standard method for building tunnels in mountainous areas, which uses the geological stress from natural ground around a tunnelling site to build a tunnel safely. As a part of NATM technology blasting may be required for excavations of tunnels section. When an explosive is detonated, an air-blast overpressure occurs.

Using the following equation, the air-blast overpressure resulting from an explosion can be estimated:

$$P = K_a * \left(\frac{R}{Q^{\frac{1}{3}}}\right)^a \text{ [kPa]}$$

Where:

P – the pressure [kPa]

R – the distance from charge [m]

Q – the charge mass [kg]

K_a – the site constant. The AS2187.2 recommends for confined blasthole charges values to be commonly in the range of 10 to 100. A value of 55 has been adopted for this assessment.

a – site exponent. The AS2187.2 recommends for confined blasthole charges a good estimate of a = -1.45.

The estimated values of the air-blast overpressure in function of distance and charge mass are shown in Table 52.

Table 52: Estimated values of the explosion air-blast overpressure in function of distance and charge mass [Pa]

Charge mass [kg]	Distance [m]						
	50	100	250	500	1,000	2,000	3,000
0.5	135.3	49.5	13.1	4.8	1.8	0.6	0.4
1	189.2	69.2	18.3	6.7	2.5	0.9	0.5
2	264.5	96.8	25.6	9.4	3.4	1.3	0.7
5	411.8	150.7	39.9	14.6	5.3	2.0	1.1
10	575.7	210.7	55.8	20.4	7.5	2.7	1.5
15	700.3	256.3	67.9	24.8	9.1	3.3	1.8
50	1253.2	458.7	121.5	44.5	16.3	6.0	3.3
100	1752.0	641.3	169.8	62.2	22.8	8.3	4.6

The air-blast overpressure propagation can be increased with unfavourable meteorological conditions and decreased with topographic shielding.

The sound pressure levels of explosions air-blast overpressure from Table 52, expressed in decibels (reference value of sound pressure is $2*10^{-5}$ Pa) are shown in Table 53.

Table 53: Estimated values of the explosion air-blast sound pressure levels in function of distance and charge mass [dB]

Charge mass [kg]	Distance [m]						
	50	100	250	500	1,000	2,000	3,000
0.5	137	128	116	108	99	90	85
1	140	131	119	111	102	93	88
2	142	134	122	113	105	96	91
5	146	138	126	117	109	100	95
10	149	140	129	120	111	103	98
15	151	142	131	122	113	104	99
50	156	147	136	127	118	109	104
100	159	150	139	130	121	112	107

The Bureau of Mines Report of Investigations 8485 (1980), "Structure Response and Damage Produced by Air blast From Surface Mining" generally recommends a maximum safe overpressure of 134 dB for air blast recorded at residential structures[180]. The estimated sound pressure levels shown in Table 53, which meet the requirements of 134 dB are coloured green.

Operation phase. A noise caused by the operation of the railway usually occurs at the point of contact between the rail and the wheel. As the superstructure on the Belgrade-Nis line is in bad condition, the contact of the rail and the wheel during driving produces additional noise of significant intensity (shocks, creaks, etc.).

The dominant source of noise in the observed corridor is the traffic at sections where the railway intersect with highways, regional roads and local roads. Industrial plants are also emerging as a potential source of noise pollution. The amount of noise that will be emitted depends on the type of production process as well as the machines used.

Figure 113: Traffic on local roads near the railway alignment

The data on the future railway traffic for modelling and analysis of noise, vibration and low frequency noise were taken from the 2022 PFS, while the indicative traffic plan has defined the future number of trains on the Beograd-Nis railway line.

Passenger trains are divided into four categories: high-speed trains, international trains, regional trains, and local trains. The categories differ in the maximum speed and in the predicted stopping points (stations). All the passengers' trains will be operated by Electric Multiple Unit (EMU).

- The high-speed trains will operate between Belgrade and Nis, with maximum speed up to 200 km/h. The planned operational time is between 06.00 and 22.00 hours. In total, 17 pairs of high-speed trains should operate daily.
- The international trains will operate between Belgrade and Sofia (Bulgaria) and between Belgrade and Skopje (North Macedonia), with maximum speed up to 200 km/h. The itineraries will be distributed

[180] Nicholson R.F, Determination of blast vibrations using peak particle velocity at Bengal Quarry, in St Ann, Jamaica.Master's thesis.Lulea University of Technology, 2005.

evenly during the day (from 06.00 to 22.00 hours). In total, 6 pairs of international trains should operate daily.

- The regional trains will operate on Belgrade-Stalac and Jagodina-Nis routes. On each route 7 pairs of trains are assumed. The routes will overlap on the section between Jagodina and Stalac, with 14 pairs of trains per day. Maximum speed of regional trains will be 160 km/h.
- The local trains will operate on routes: Belgrade-Velika Plana (18 pairs of trains per day), Belgrade-Mladenovac (6 pairs of trains per day), Velika Plana-Stalac (10 pairs of train per day), Jagodina-Aleksinac (9 pairs of trains daily) and Aleksinac-Nis (17 pairs of trains per day). The routes will overlap on the section between Jagodina and Stalac, with 27 pairs of trains per day. Maximum speed of local trains will be 120 km/h.

Freight trains are divided into three categories: international trains, direct trains and local (manipulative) trains. The maximum speed of the freight trains will be up to 120 km/h and will be operated by locomotive hauling.

- The international freight trains will be operated between Belgrade and Bulgaria and between Belgrade and North Macedonia, with 5 pairs of trains in each direction.
- The direct freight trains in domestic transport will be operated on the following routes: Belgrade Ranzirna (Marshalling)-Popovac (3 pairs of trains per day), Belgrade Ranzirna (Marshalling)-Lapovo Ranzirna (Marshalling) (1 pair per day), Belgrade Ranzirna (Marshalling)-Stalac (1 pair per day), Lapovo Ranzirna (Marshalling)-Popovac (1 pair per day) and Stalac-Popovac (1 pair per day).
- The local (manipulative) freight trains will be operated on the following routes: Belgrade Ranzirna (Marshalling)-Lapovo Ranzirna (Marshalling) (1 pair per day), Lapovo Ranzirna (Marshalling)-Stalac (1 pair per day) and Stalac-Popovac (1 pair per day).

Given the uneven distribution of freight transport, the daily number of freight trains can be changed, as flows of goods cannot be fully predicted in detail. The detail analysis of all flows of goods and “fine tuning” of the number of freight trains should be done within the next phases of design.

The speed limits on the proposed Belgrade-Nis railway line, divided by subsection, are shown in Table 54.

Table 54: Speed limits on Belgrade-Nis railway line

No	Name	Speed limit [km/h]
1	Belgrade Centre	100
2	Rakovica	
3	Kneževac	
4	Kijevo	
5	Resnik	200
6	Pinosava	
7	Ripanj Kolonija	160
8	Ripanj	200
9	Klenje	
10	Ripanj Tunel	160
11	Ralja	200
12	Sopot Kosmajski	
13	Vlasko Polje	160
14	Mladenovac	
15	Kovacevac	200
16	Rabrovac	
17	Kusadak	
18	Ratare	
19	Glibovac	

No	Name	Speed limit [km/h]
20	Palanka	
21	Mala Plana	
22	Velika Plana	
23	Staro Selo	
24	Novo Selo	
25	Markovac	
26	Lapovo Varos	
27	Lapovo Ranžirna (Marshalling)	
28	Lapovo	
29	Brzan	160
30	Milosevo	
31	Bagrdan	
32	Laniste	200
33	Bukovce	
34	Jagodina	
35	Gilje*	
36	Paraćin*	160
37	Sikirica/Ratari	200
38	Drenovac	
39	Cicevac	
40	Lucina	
41	Stalac*	
42	Djunis*	160
43	Vitkovac	
44	Donji Ljubes	
45	Gornji Ljubes	
46	Korman	200
47	Trnjani	
48	Adrovac	
49	Aleksinac	120
50	Nozrina	160
51	Lužane	
52	Tesica	200
53	Grejac	
54	Supovacki Most	
55	Mezgraja	
56	Vrtiste	
57	Trupale	
58	Crveni Krst	100
59	Nis	

*Note: The sections Gilje-Paracin and Stalac-Djunis are out of scope (as explained in Chapter 3)

For the purpose of this assessment, noise indicators were calculated and graphically presented in the form of noise maps by using “Predictor-LimA Software Suite - Type 7810” software package developed by Softnoise. “CNOSSOS-EU - Common Noise Assessment Methods” was used for calculation of noise generated by the rail traffic. This method complies with the Directives 2002/49/E3 and 2015/996/E3.

The acoustic simulations and calculation of noise indicators by using “Predictor-LimA Software Suite - Type 7810” software package were performed with the maximum dynamic error of 1.0 dB. Noise indicators were calculated in a grid of 10x10 m and at the height of 2.25 meters above the ground.

The calculations covered the corridor up to 300 meters to the left and right from the centreline of the newly designed railway line Belgrade-Nis.

For acoustic modelling and calculation, it is necessary to provide data about the terrain topography, soil types in terms of sound absorption, influence of obstacles to the propagation of sound, the track alignment including formation width, technical characteristics of railway line, railway transport data, acoustic zones through which a new railway line passes and meteorology condition. Since some of the data was not available, at this phase of the project design, they are substituted as follows:

- the topography (3D terrain model) is substituted by the EU- Digital Elevation Model (EU-DEM) model data. The EU-DEM provides Pan-European elevation data at 1 arc-second (+/-30 meters) postings. The EU-DEM provides full coverage of the EEA countries consisting of 33 member states and 6 cooperating ones (including Serbia). The DEM over Europe from the GMES RDA project (EU-DEM) is a Digital Surface Model (DSM) representing the first surface as illuminated by the sensors. The EU-DEM is a hybrid product based on SRTM and ASTER GDEM data fused by a weighted averaging approach. The EU-DEM fundamental accuracy for the RoS has the mean error of -2.65 m, the standard deviation of 1.76 m and the vertical accuracy of 3.18 m RMSE (Root mean square error). The EU DEM data accuracy is sufficient for the preliminary acoustic calculations and analyses.
- it is assumed that covered area has an absorption coefficient of 0 (which defines the composition of the ground). The adopted absorption coefficient represents compacted field and gravel, or hard ground with minimal absorption (the worst-case scenario).
- The calculation is done assuming no obstacles which resulted in farther sound propagation than would be normally expected (the worst-case scenario).

The 3D model of the railway substructure is formed based on the layout plan given in Annex 1 of the 2022 PFS. The longitudinal profile heights for the 3D model were taken as relative to the terrain heights (EU-DEM).

The technical characteristics of the railway line and the railway transport data were taken from the 2022 PFS and accompanying projects. The railway line is designed for maximum speed up to 200 km/h (for details please see Table 54). The proposed tunnels on the Belgrade-Nis railway line are shown in the Table 2 and the proposed bridges are shown in the Table 3.

Pursuing current tendencies in international transport in Europe, 2/3 of the freight wagons shall be fitted with composite brake pads and 1/3 of the freight wagons shall be fitted with iron-cast brake pads. The average freight trains with locomotive hauling will have 36 wagons.

The railway line Belgrade-Nis belong to the acoustical zone 5 (Table 28 and Table 29). The limit values for outdoor noise indicators are 65 dB(A) day and evening and 55 dB(A) night[181]. Day means time interval 06^{00} to 18^{00}, evening 18^{00} to 22^{00} and night 22^{00} to 06^{00}.

It is assumed, according to the CNOSSOS-EU model, that the meteorological conditions are homogeneous in which sound rays are straight segments (the worst-case scenario).

Only the noise generated by rail traffic on Belgrade-Nis line was considered in calculations of noise indicators and in further analyses.

The noise reduction measures at the source are implemented during the calculation process. Data on the new railway vehicles whose characteristics meet the requirements of the TSI for noise (EMU Stadler KISS and EMU

[181] Serbian environmental noise legislation is harmonised with European END Directive. In the Appendix 1, calculated noise level for day (06.00-18.00), evening (18.00-22.00) and night 22.00-06.00) are presented. They can be used for comparison with any standard. The national EIA must be based on the Serbian legislation. The international ESIA must be in accordance with Lenders' requirements (applicable EBRD PRs and EIB Standards). Only upon the approval of the national EIA by national authorities and international ESIA by Lenders, the project owner may start with the project implementation.

Flirt), freight wagons with composite brake pads and modern technical solutions of the railway substructure were used. Retrofitting freight trains with composite brake blocks have a noise reduction potential by 8-10 dB.

The calculated noise levels for day, evening, and night periods[182] for distances of 25, 50, 75, 100, 125, 150, 175, 200, 225 and 250 meters without use of noise barriers are shown in Appendix 1. The calculations were made on every kilometre on both sides of the railway. The calculated noise levels, which do not meet the requirements of the Serbian law for day, evening and night period maximum allowed noise levels for Zone 5 (Table 28) are coloured red. The calculated noise levels in the day, evening and night periods without use of noise barriers are graphically presented in Appendix 2.

A negative noise impacts can be expected up to 25 m during the day and evening periods, and up to 75 m during the night period. In order to reduce adverse impacts of traffic noise on environment and population, protection measures have to be planned and implemented at all locations where noise levels allowed by the law are exceeded.

Under the subsection specific ESIAs that will be developed in the later Project phases, it will be necessary to determine potential sensitive zones and noise receptors in the vicinity of the new railway. Currently there are no existing noise barriers along the railway that could minimise the noise impacts. The noise measurements needs to be performed by an accredited and authorised specialised organisation to set the baseline noise levels in sensitive zones. At this phase of the Project, several locations can be proposed which include two types of areas: (i) populated areas along the existing railway where the upgrade will be done from single to double-track railway, and (ii) populated areas along the new corridor where the alignment will be moved away from the existing railway. Starting from Belgrade to Nis, the following locations or wider areas can be proposed for measuring: Belgrade, Resnik, Djurinci, Mladenovac, Smederevska Palanka, Bresje, Velika Plana, Markovac, Lapovo, Brzan, Milosevo, Jagodina, Mijatovac, Cuprija, Paracin, Striza, Drenovac, Cicevac, Stalac, Drubarevo, Vitkovac, Donji Ljubes, Gornji Ljubes, Korman, Trnjane, Donji Adrovac, Zitkovac, Moravac, Grejac, Veliki Drenovac, Mezgraja, Vrtiste, Popovac and Deveti Maj. The exact sampling locations will be more precisely defined in the next Project phase for each subsection. Indicatively, the locations are shown on the following maps.

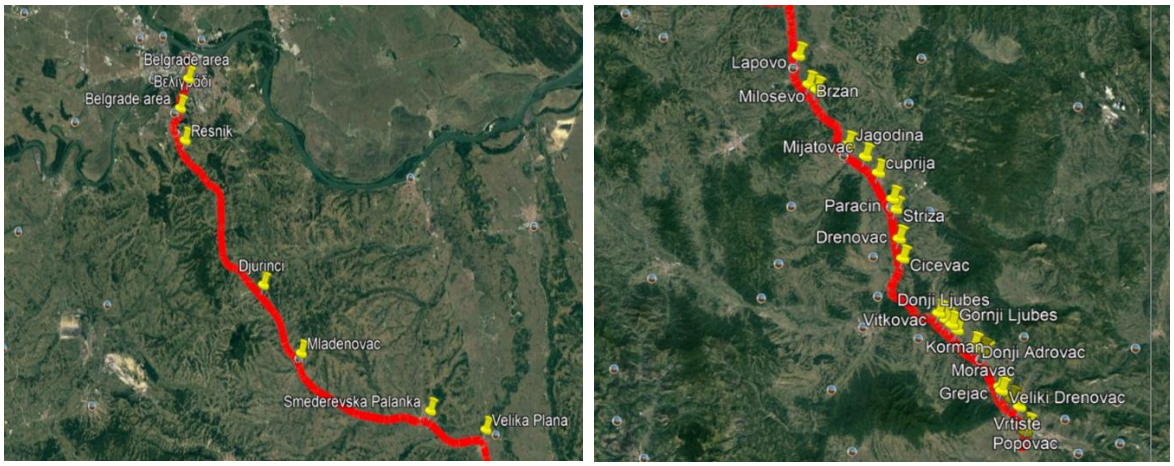


Figure 114: Indicative locations for noise measurement

According to the *Law on Railways*[183], in the zone of 8 m from the axis of the end track (6 m in the urban zone) on both sides, it is prohibited to build any structures except for those that serve some railway functions. Exceptionally, in the wider zone of 25 m from the last track axis on both sides, buildings which are not in the function of railway traffic can be built based on an official approval of the infrastructure manager, and provided

[182] Note: The volume and composition of traffic differs during the day, evening and night.
[183] "Official Gazette of RS", No. 41/18, Article 71

that the construction of these buildings is foreseen by the municipal urban plan[184]. The prescribed measures for the protection of these buildings are implemented by the building owner at his/her own expense.

Protection measures shall be planned and implemented only for residential structures and for noise-sensitive objects, such as kindergartens, primary and secondary schools, faculties, medical centres and hospitals. When planning and implementing protection measures, working hours of noise-sensitive buildings shall be taken into account. In addition to the existing structures, planned land purpose and potential development plans should be also taken into account in the calculation and optimization of noise protection measures.

Mitigation measures for the design, construction and operational phases are presented in the Project Framework ESMP.

8.3.2 Vibration impacts

Construction phase. The vibration and low frequency noise levels during railway construction primarily depend on the organisation of works at the site, the number and type of construction machines used at the site, and their position and distance from residential and other sensitive buildings in the impact zone. At this stage of the Project, information on the organisation of the construction site, the technology of works and information on which tools, equipment and machinery will be used are not available. All calculation and analyses given here are based on default values from referenced standards and literature, while the exact values can be determined after the method and technology of construction works decided upon.

Since the national laws do not stipulate the permissible values for vibrations and low frequency noise, the German standard DIN 4150-2 and 4150-3[185], the British standard BS 6472[186] and the Swiss Directive of the Federal Office for the -Environment[187] have been considered.

DIN 4150-2 provides the methodology for evaluation of vibrations within the frequency of 1 to 80 Hz, which is particularly critical for humans. The standard also specifies the maximum allowed vibrations to prevent impacts on people inside buildings. Reference values for the assessment of vibrations in dwellings and similar buildings are shown in Table 55.

Table 55: Reference values for assessment of vibrations in dwellings and similar buildings according to DIN 4150-2

Use	Day (6^{00}-22^{00})			Night (22^{00}-6^{00})		
	A_u	A_o	A_r	A_u	A_o	A_r
Mainly residential area	0.15	3	0.07	0.1	0.2	0.05

The vibration assessment is based on indicators KB_{Fmax} (maximum value derived from a running r.m.s. quantity with time constant fast) and KB_{FTr} (time-weighted mean quantity depending on traffic). The assessment procedure has two basic steps:

- Step 1: if $KB_{Fmax} \leq A_u$ the condition is satisfied.
- Step 2: when $KB_{Fmax} \leq A_0$ the condition is satisfied only if $KB_{FTr} \leq A_r$.

The following construction equipment will most likely be needed to carry out civil works: bulldozers, graders, excavators, scrapers, dumpers, rollers, backhoes, cranes and piles. For track works, the following will probably be needed: sleeper layer, track layer, ballast wagons, rail welding machine, tamper, excavators, and backhoes.

Typical vibration levels for some of the construction tools, equipment and machinery are shown in Table 56.

[184] This exclusion zone applies to future developments only.
[185] Structural Vibration - Human Exposure to Vibration in Buildings
[186] Guide to Evaluation of Human Exposure to Vibration in Buildings. Part 1: Vibration sources other than blasting
[187] BEKS 1999 - Assessment of vibration and structure-born noise from railway traffic

Table 56: Typical vibration levels of construction tools, equipment, and machinery[188]

Tool, equipment, or machinery	Estimated vibration level @10 m [mm/s]
Piling	12-30
Loader	6-8
Roller (15 t)	7-8
Compactor (7 t)	5-7
Roller	5-6
Dozer	2,5-4
Backhoe	1
Jackhammer	0,5

The energy of tools, equipment, and machines during the execution of works is transferred to the ground and transmitted in the form of vibrations. The transmission rate of vibrations depends on the geological characteristics of the soil, frequency, object construction and other factors, and, as a function of distance it decreases. Without data from a specific location, it is not possible to accurately calculate the rate of vibration reduction. A simplified method based on the following regression equation can be used for estimation purposes[189]:

$$PPV = PPV_{ref} * \left(\frac{D_{ref}}{D}\right)^{n}$$

where:

PPV – the peak particle velocity adjusted per distance [mm/s],

PPV_{ref} – the reference vibration level at a reference distance [mm/s],

n – the propagation coefficient based on soil class (1.5), and

D – the distance from construction activity to the receptor[m].

The calculated vibration values at a distance of 30, 50, 100 and 300 m for some tools, equipment and machines that will most likely be used for construction of the Belgrade-Nis section are shown in Table 57.

Table 57: Calculated vibration values [mm/s PPV]

Tool, equipment, or machinery	Calculated vibration level				
	10 m	30 m	50 m	100 m	300 m
Piling	21.0	4.0	1.9	0.7	0.2
Loader	7.0	1.3	0.6	0.2	0.1
Roller (15 t)	7.5	1.4	0.7	0.2	0.1
Compactor (7 t)	6.0	1.2	0.5	0.2	< 0.1
Roller	5.5	1.1	0.5	0.2	< 0.1
Dozer	3.5	0.7	0.3	0.1	< 0.1
Backhoe	1.0	0.2	0.1	< 0.1	< 0.1
Jackhammer	0.5	0.1	< 0.1	< 0.1	< 0.1

The calculated vibration levels shown in Table 57, which meet the preferred requirements of the standard BS 6472 for day period (Table 32) are coloured green, and those that meet the maximum requirements of the standard BS 6472 for day period (Table 32) are coloured yellow. The pile driving makes impulsive vibration and was evaluated accordingly.

[188] RTA Environmental Noise Management Manual, Roads and Traffic Authority of New South Wales (2001)
[189] Transit Noise and Vibration Impact Assessment Guide, The United States (US) Federal Transit Administration's

It can be concluded that the negative vibration impact can be expected at distances up to 50 m for the activities that engage loader and Roller (15t) machines. Other construction tools, equipment and machines will produce lower vibration levels, and the distances at which exceedances occur are smaller (up to 10 m for Piling, Backhoe, Jackhammer, Heavy roadheading and Heavy rockbreaking; and up to 30 m for Compactor (7 t), Roller and Dozer).

It is assumed that all tunnels will be built using the NATM (New Austrian Tunnelling Method). The only possible exception will be entrances and/or exits of some tunnels, which will be built by the cut-and-cover method (for which the same or similar machines will be used as for civil works).

The estimated maximum vibration levels that can occur during mechanical excavation of a tunnel (cut-and-cover) is shown in Table 58.

Table 58: Indicative maximum ground vibration levels for mechanical tunnel excavation methods [mm/s PPV][190]

Vibration source	Distance					
	5 m	10 m	20 m	30 m	40 m	50 m
Heavy roadheading	1,10	0,43	0,17	0,09	0,06	0,05
Heavy rockbreaking	4,50	1,30	0,40	0,20	0,14	0,10

The indicative maximum ground vibration levels for mechanical tunnel excavation methods shown in Table 58 which meet the preferred requirements of the standard BS 6472 for day period (Table 32) are coloured green, and those that meet the maximum requirements of the standard BS 6472 for day period (Table 32) are coloured yellow.

The estimated low frequency noise levels that can occur during mechanical excavation of a tunnel (cut-and-cover) are shown in Table 59.

Table 59: Indicative low frequency noise levels for mechanical tunnel excavation methods [dB(A)][191]

Low frequency noise source	Distance					
	5 m	10 m	20 m	30 m	40 m	50 m
Heavy roadheading	57	48	39	34	30	27
Heavy rockbreaking	67	58	50	45	40	37
Drilling (small percussive rig)	58	49	40	36	31	29

The indicative low frequency noise levels for mechanical tunnel excavation methods shown in Table 59 which meet the preferred requirements of the BEKS standard (which can be adopted for the low frequency noise assessment during construction works) for day period (Table 33) are coloured green.

The negative impact of low frequency noise during mechanical tunnel excavation (heavy rockbreaking) can be expected at distances up to 30 m. For all residential and other sensitive buildings which are in zones up to 50 m from the construction site (distance depends on the type of construction work and the tools, equipment and machines used), it is necessary to plan temporary mitigation measures to reduce the negative impact of vibration and/or low frequency noise. Furthermore, the construction of the railway is transient in nature, so the negative impacts of the vibration and low frequency noise will be reduced as the construction of the railway tracks progresses along the route away from sensitive receivers.

NATM is a standard method for building tunnels in mountainous areas, which uses the geological stress from natural ground around a tunnelling site to build a tunnel safely. NATM uses machines (e.g., drill jumbo, dump trucks, loaders) and explosives (blasting) to penetrate the ground. When an explosive is detonated, only a portion of the energy is consumed in breaking up and moving the rock. The remaining energy is dissipated in the form of seismic waves expanding rapidly outward from the blast, either through the ground (as vibration) or through the air (as air blast).

[190] Bus and Train (BaT) Tunnel, Environmental Impact Statement, Construction Noise and Vibration, Report Number 620, 2014
[191] Bus and Train (BaT) Tunnel, Environmental Impact Statement, Construction Noise and Vibration, Report Number 620, 2014

Using the following equation for the maximum particle vibration, resulting from an explosion, the maximum instantaneous charge can be found:

$$V = K_G * \left(\frac{R}{Q^{\frac{1}{2}}} \right)^{-B}$$

Where:

V – the peak vector sum ground vibration peak particle velocity [mm/s],

R – the distance from charge [m],

Q – the maximum instantaneous charge (MIC)[192] [kg],

B- constant related to the rock and site (usually -1.6), and

K_G – the ground constant[193].

The estimated values of the maximum instantaneous charge in function of distance and expected vibration levels are shown in Table 60.

Table 60: Estimated values of maximum instantaneous charge [kg]

Vibration level [mm/s PPV]	Distance to receiver [m]				
	10	30	50	100	300
0.10	0.00	0.01	0.02	0.08	0.76
0.20	0.00	0.02	0.05	0.20	1.82
0.28	0.00	0.03	0.08	0.31	2.77
2.80	0.05	0.49	1.37	5.47	49.21
5.00	0.11	1.02	2.82	11.29	101.58
8.60	0.22	2.00	5.56	22.23	200.09
10.00	0.27	2.42	6.71	26.85	241.61
15.00	0.45	4.01	11.14	44.56	401.07
20.00	0.64	5.75	15.96	63.85	574.64

The vibration impacts of blasting operations can be minimised by choosing the appropriate blast charge configurations; ensuring appropriate blast-hole preparation; optimizing blast design, location, orientation and spacing; and selecting appropriate blast times.

Operation phase. There is no information on baseline vibration levels. The analysis of the observed corridor indicates that the source of vibrations can be the existing railway and road traffic along the Corridor. Under the subsection specific ESIAs that will be developed in the later Project phases, it will be necessary to determine potential sensitive zones and vibration receptors in the vicinity of the new railway. The vibration measurements need to be performed by an accredited and authorised specialised organisation to set the baseline noise levels in sensitive zones. At this phase of the Project, several locations can be proposed for baseline measurements. Starting from Belgrade to Nis, the following locations or wider areas can be indicated as monitoring locations: Belgrade, Djurinci, Mladenovac, Smederevska Palanka, Bresje, Velika Plana, Markovac, Lapovo, Brzan, Jagodina, Mijatovac, Cuprija, Paracin, Strıza, Sikirica, Drenovac, Cicevac, Stalac, Trubarevo, Donji Ljubes, Gornji Ljubes, Korman, Trnjane, Donji Adrovac, Moravac, Grejac, Veliki Drenovac, Mezgraja, Vrtiste, Popovac and Deveti Maj. The above-mentioned locations are also indicatively presented in the maps above in the noise section. The microlocations shall be defined in the subsection specific ESIAs.

[192] Maximum instantaneous charge is the maximum amount of explosive in kg on any one specific delay detonator in any one blast hole.
[193] The standard AS2187.2 gives a ground constant for free face hard or highly structured rock K_G = 500; for free face average rock K_G = 1140; for heavily confined K_G = 5000. Free face is a rock surface that provides the rock with room to expand when blasted.

The input data on the future railway traffic for modelling and analysis of vibration and low frequency noise were taken from the 2022 PFS, as previously presented in Chapter 8.3.1.

The vibrations and low frequency noise levels that will be generated by railway traffic were calculated with the aid of VIBRA-1 (Ziegler Consultants and Swiss Rail) software package. Vibrations were calculated based on individual train passing, while the total impact was equal to a sum of standardised procedures in DIN 4150-2.

The values of assessed impacts due to vibrations and low frequency noise are specified solely for residential buildings. Permitted levels are given according to standards DIN 4150-2 and BEKS in bolded columns in Table 55 and Table 33. The calculated values are the best estimate according to the available data and are sufficient for this level of impact assessment.

The Belgrade – Nis railway line is divided into sections according to the parameters that condition the extent of vibrations and low frequency noise (speed, railway line characteristics and traffic mix).

The calculated values of vibrations and low frequency noise on the open track for day and night period on subsections are shown in Appendix 1. The given values refer to both the left and right side of the line unless otherwise indicated. The assessed values of vibrations and low frequency noise that do not meet the assessment procedure criteria are coloured in orange.

The running of trains over switches increases levels of vibrations and low frequency noise. This impact (impact from the first switch to end of the last switch) is considered in the switching areas of stations, assuming that the switches, which are spaced not more than 100 m apart, will have a continuous effect on increase of vibration and low frequency noise. The calculated values of vibrations and low frequency noise in the switch area for day and night period are presented in Appendix 1. The given values refer to both the left and right side of the line unless otherwise indicated. The assessed values of vibrations and low frequency noise that do not meet the assessment procedure criteria are coloured in orange.

On the Belgrade-Nis railway line there are 18 tunnels. The calculated values of vibrations and low frequency noise in the tunnel area for day and night period are also presented in Appendix 1. The given values refer to both the left and right side of the line unless otherwise indicated. The assessed values of vibrations and low frequency noise that do not meet the assessment procedure criteria are coloured in orange.

However, all calculated values are far below the levels that are reported to typically cause minor damages to buildings (5.0 mm/s) [194].

A negative vibration impact can be expected (i) on open tracks at distances up to 30 m, (ii) in stations' switch areas at a distance up to 40 m from the switch, and (iii) in tunnels at distances up to 30 m. For all residential and other sensitive buildings which are in zones from 25 to 30 m on open track sections, in zones from 25 to 40 m in stations switch areas and in zones from 25 to 30 m in the tunnel sections, it is necessary to plan mitigation measures to reduce the negative impact of vibration.

According to the *Law on Railways*[195], in the zone of 8 m from the axis of the end track (6 m in the urban zone) on both sides, it is prohibited to build any structures except for those that serve some railway functions. Exceptionally, in the wider zone of 25 m from the last track axis on both sides, buildings which are not in the function of railway traffic can be built based on an official approval of the infrastructure manager, and provided that the construction of these buildings is foreseen by the municipal urban plan. The prescribed measures for protection of these buildings are implemented by the building owner at his/her own expense.

[194] Railway induced vibration, State of the Art Report (UIC, 2017)
[195] "Official Gazette of RS", No. 41/18, Article 71

8.3.3 Impacts of micro-pressure effects in tunnels

When a high-speed train enters a tunnel, it generates a compression wave that propagates through the length of the tunnel to the exit portal at the speed of sound. Under some circumstances the pressure wave steepens within the tunnel, forming a pressure discontinuity within the tunnel. Part of this pressure wave is reflected internally at the tunnel exit, with the emitted part creating a very strong acoustic wave, which can be audible several kilometres away. This phenomenon is known as micro-pressure effect[196].

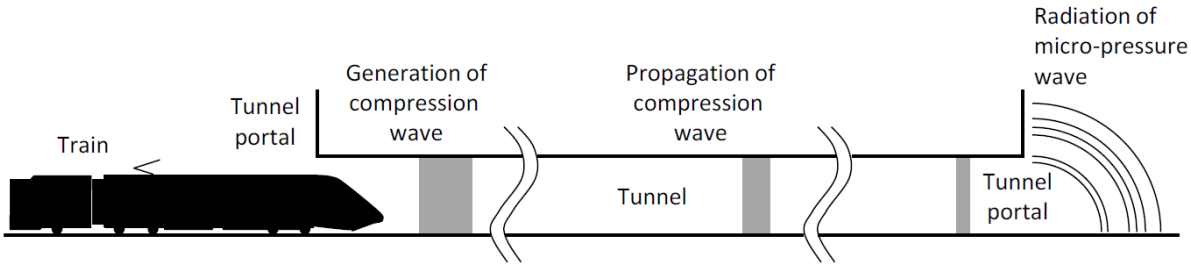


Figure 115: Generation of micro-pressure effects

The phenomenon of micro-pressure effect (tunnel boom) is unique to railway systems in which the train speeds are high enough to create a significant compression wave upon entry to the tunnel, and in which the tunnel is long enough to develop this compression wave into a pressure discontinuity. For the compression wave to develop into a pressure discontinuity within the tunnel, the wave must be exposed to nonlinear effects that may occur under certain conditions.

A theoretical model of micro-pressure effect must consider different stages in the development of the phenomenon. The first stage is the generation of the compression wave by the train at tunnel entrance. The parameters of this wave define the second stage, which is the nonlinear evolution of the initial pressure wave during its propagation along the length of the tunnel. This evolution results in wave steepening and in formation of a shock wave (pressure discontinuity) that reaches the tunnel exit. The third stage is sound radiation by vibrating air particles at the exit of the tunnel. This process defines acoustic waves radiated away from the tunnel portal.

The distance required for shock formation can be determined as:

$$L_{sf} = \frac{X*c}{\varepsilon*3*\pi}$$ [m], where ε is a factor expressed as $\varepsilon = \frac{\gamma+1}{2*\gamma} * \frac{\Delta p}{p_0}$

Δp – the value of peak pressure for the compression wave induced by the train,

X – a length based upon the development of a Gaussian shaped pulse (of the initial compression wave) to discontinuity (to the shock wave). The value of X is defined as $\sqrt{\frac{e}{2}}$, or 1.166, and

p_0 – 101.325 kPa (reference pressure or standard pressure).

In the case of the fully steepened pressure discontinuity, the peak pressure of the compression wave at the tunnel can be calculated by:

$$\Delta p = \frac{1}{2} * \rho_0 * V^2 * \frac{1-(1-R)^2}{\left(1-\frac{V}{c_0}\right)*\left[\frac{V}{c_0}+(1-R)^2\right]}$$ [Pa]

Where:

[196] V.V. Krylov, W. Bedder, „Calculations of sound radiation associated with 'tunnel boom' from high-speed trains“, EuroNoise 2015, 31 May - 3 June, Maastricht

V – the train speed [m/s],

R – the ratio of the cross-sectional area of the train to that of the tunnel,

ρ_0 – the mass density of air (which at 101.325 kPa and 15°C is approximately 1.225 kg/m), and

c_0 – sound velocity (343 m/s).

For typical single track tunnel cross section (Figure 116) with area of approximately 37 m^2, and Stadler KISS EMU (width 2.8 m and height 4.6 m) ratio of the cross-sectional area is R = 0,35.

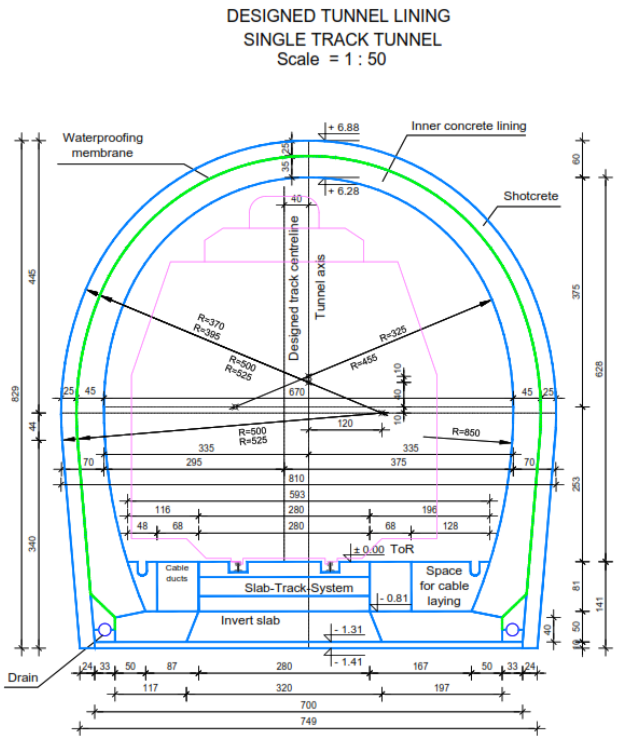


Figure 116: Single track tunnel – typical cross section

For train speed of V = 200 km/h (55.5 m/s), and the specific (above) values the result for the peak pressure of the compression wave at the tunnel, from the second equation, is:

$$\Delta p \approx 2{,}210 \text{ [Pa]}$$

The distance required for shock formation with γ = 1.4, can be determined from the first equation:

$$L_{sf} \approx 2{,}270 \text{ [m]}.$$

This is the worst-case scenario. In case of lower speed of the train and/or double track tunnel (with a larger cross section) the distance required for shock formation is even greater.

On the Belgrade-Nis railway line, on the sections with maximum speed up to 200 km/h the micro-pressure effect (tunnel boom) is expected only on the tunnel no. 7 with length of 2,600 m (from km 29+550 to km 32+150). The tunnel no. 1 with length of 3,070 m is on the section with maximum speed of 100 km/h, and tunnel no. 15 with length of 3275 m is on the section with maximum speed of 160 km/h.

8.3.4 Assessment of Impacts

The key baseline facts that guide the assessment of impacts on noise and vibration are the following:

- In some subsections, the railway is passing in close vicinity to commercial and residential objects.
- No baseline noise and vibration measurements in the Project area are available.
- Noise and vibration levels during the railway construction primarily depend on the organisation of works at the site, the number and type of construction machines used at the site, and their position and distance from residential and other sensitive buildings in the impact zone. Additional noise and vibrations are created during tunnel excavation (blasting, etc.)
- Noise and vibrations caused by the railway operation usually occurs at the point of contact between the rail and the wheel. Additional noise and vibrations are created by generation of micro-pressure effects in tunnels. The magnitude of impact greatly depends on the type, speed, and frequency of passing trains.
- Baseline assessment of noise and vibration done using calculations and modelling indicated that there are locations where noise and vibration levels will be above the limits prescribed by the national and international requirements.

The corridor impacts on noise and vibration are taking place during the construction phase and operational phase. The two main receptors of concern are "human receptors" that includes workers on site, local residents, and users of surrounding infrastructure, and "ecological receptors" referring to sensitive fauna disturbed by increase in noise and vibrations. Table 61 provides an overview of the identified possible impacts of increased noise and vibration levels on receptors and assessment of their significance.

Table 61: Summary of Project impacts on noise and vibration and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	Impact on workers, residents, and fauna from **increased levels of noise and ground-borne vibration** during construction works as a result of tunnelling, earthworks, pilling or potential blasting.	Adverse	Moderate	Medium	Moderate	Significant
Construction	**Structural damage** from vibration caused by equipment and operation methods employed including potential use of explosives.	Adverse	Moderate	Medium	Moderate	Significant
Operation	Impact on residents and biological functions from **increased levels of noise, vibration and micro-pressure effect** in tunnels from railway traffic.	Adverse	Moderate	Medium	Moderate	Significant
Operation	Impact on workers from **increased level of noise and vibration** from rolling stock and machinery during maintenance activities.	Adverse	Moderate	Medium	Moderate	Significant

8.4 Impacts on Water

The key baseline facts that guide the assessment of impacts on waters are the following:

- There are no precise data on the abundance and territorial distribution of groundwater sources in the Project area.
- On the territory of central Serbia, the largest part of groundwater reserves is located in the areas of alluvial springs, primarily in the valley of the Velika Morava.
- Groundwater vulnerability to overexploitation in the Project area is assessed as low to medium, except for the area of Krusevac, where groundwater vulnerability is assessed as medium to high.
- Based on the national monitoring results, the groundwater quality is assessed to be good.

- The most polluted waters are in the immediate catchment area of the Velika Morava River, which is the most densely populated.
- Based on the pH values, Velika Morava River, Juzna Morava River and Nisava River are classified in class I-IV, while based on the values of suspended matter, rivers are in class I-II[197].
- Lack of data on surface water quality right next to the railway alignment.
- The catchment area of Velika Morava River is rich in the occurrence of mineral and thermal waters.
- The water supply is organised mainly by water supply systems in urban areas and by wells for the needs of individual households in rural areas.
- The railway alignment will cross several rivers and streams, which will be under the direct impact of the railway construction and operation.

The main identified potential impacts in the construction phase are related to temporary decrease of groundwater levels and reduction in surface water and groundwater quality due to earth works and uncontrolled discharge of effluent or harmful substances into waters. Tunnel construction can impact the ground water regime and quality of surface waters if drainage water from tunnel tubes is directly discharged. Sediment release into river and disposal of municipal and other special waste categories into the rivers can also reduce the water quality.

In the operational phase, groundwater contamination can possibly occur due to drainage of water from the railway structures, discharge of wastewater from the railway stations, potential accidental spillages or leaks from freight trains or accumulation of heavy metals from herbicides along the railway line, as well as minor leaking of oil, grease, and other chemicals from the rolling stock. Natural flood plain capacity can be reduced due to the embankment passing along the low-lying flood plains. Accumulation of sediment around bridge piers can also impact the river morphology.

Table 62 provides a summary of impacts and assessment of their significance.

Table 62: Summary of Project impacts on waters and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	Negative impact on **groundwater regime** (direction of flow and velocity) as well as on **spring yield** due to the construction of tunnels.	Adverse	Moderate	Medium	Moderate	Significant
Construction	Reduction in **surface water quality** due to: (i) erosion, riverbed modification and sediment run-off, (ii) uncontrolled discharge of effluent from construction areas, (iii) inadequately and uncontrolled discharge/ treatment of sanitary wastewater from the workers domestic facilities, (iv) emissions of drainage water from tunnel tubes generated during construction activities (v) surface run-off and washout at worksites, (vi) works and maintenance of construction vehicles at the site, including accidental spillage of fuels or other harmful substances (vii) depositing of construction waste, municipal	Adverse	Moderate	Medium	Moderate	Significant

[197] Ministry of Environmental Protection, Results of surface and groundwater quality monitoring in 2020, 2021

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	waste and other special waste categories into the watercourses, (viii) sediment release into watercourses in case of depositing of spoil into the watercourses.					
Construction	Construction activities taking place in locations where the railway crosses the river (e.g., bridges) may temporarily disturb the **watercourse flow and connectivity**.	Adverse	Moderate	Medium	Moderate	Significant
Operation	Reduction in **surface water quality** due to: (i) discharge of untreated sanitary wastewater or contaminated run-off from station facilities, (ii) accumulation of sediment in the area of bridge piers, (iii) discharge of accidentally contaminated run-off from the track drainage system and during the bridge maintenance works, (iv) accidental spill of hazardous material resulting from railway traffic accidents, (v) contamination of surface water during application of herbicides.	Adverse	Moderate	Medium	Moderate	Significant

8.5 Impacts on Soil

The key baseline facts that guide the assessment of impacts on soil are the following:

- There are no precise data on geological features and terrain stability in the Project area.
- There are agricultural plots along railway alignment.
- SRI is not legally obliged to perform soil quality analysis along the railway structures except in cases of accidental spillage. Therefore, there is a lack of data on soil quality along the existing or future railway.

The impacts on soil are analysed for the construction phase and operational phase. The construction phase is more intensive in terms of potential disturbance of soil quality during construction activities. Considering the nature of the Project, negative impacts on soil during the operation phase are mainly expected in case of reconstruction and maintenance activities (e.g using herbicides in maintenance of right-of-way). Table 63 provides an overview of potential negative impacts and assessment of their significance.

Table 63: Summary of Project impacts on soil and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	**Terrain instability** as a result of: (i) deforestation, (ii) soil dewatering, (iii) using heavy machinery and equipment.	Adverse	Minor	Medium	Minor	Significant
Construction	Temporary disturbance to local **land use** due to land take for construction activities (transport and access roads, landfills, areas for workers), as well as negative impact of dust on **crops** nearby the construction site.	Adverse	Moderate	Medium	Moderate	Significant
Construction	Reduction in **soil quality** as a result of: (i) direct discharge of wastewater	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	from maintenance of construction vehicles at the site and sanitary waters from construction camp, (ii) accidental spillage of fuel and oils from equipment and other chemicals used on construction site (iii) inappropriate waste/spoil disposal, (iv) loss of fertile topsoil.					
Operation	Reduction in **soil quality** as a result of: (i) direct discharge of surface run-off, (ii) accidental fuel and oil spills, (iii) application of herbicides.	Adverse	Minor	Medium	Minor	Significant
Operation	Damage of railway infrastructure as a result of **terrain instability** (landslides and seismic activity).	Adverse	Minor	Medium	Minor	Significant

8.6 Landscape and Visual Impacts

The key baseline facts that guide the assessment of impacts on landscape and visual values are the following:

- The landscape is characterised by the valley of the Velika Morava River and the hills on the left bank of the Velika Morava River, Bagrdan Strait and the Juzna Morava valley; anthropogenically altered arable land and constructed parts of the route where it passes through populated areas.
- The Project area is mostly covered by agricultural land (arable land, sown crops and fields), followed by forests.
- The cities characterised by a large number of residential buildings are Belgrade, Jagodina and Nis, while the other places where the railway passes mostly have a rural character.
- The settlements are scattered and have a rural character, with a lower number of inhabitants who are usually engaged in agriculture.

The corridor impacts on landscape and visual values are analysed for the construction phase and operational phase. Construction phase of the railway will have a temporarily effect on the landscape of the Project area. The visual receptors include residents situated in the Project area, local people working in outdoor occupations (such as farmers on the agricultural areas and in the vineyards) and users of nearby infrastructure. Regarding operation phase, the people living in local cities and settlements are classified as the most sensitive receptors because of the permanent exposure to negative impacts on parts of the Project area that are near settlements or individual residential buildings. Knowing that the railway infrastructure is already present in landscape and that the alignment will mainly follow the existing route, significant impacts are not expected. This is confirmed through discussions with local communities who live along the railway their entire life. Another group of receptors are future railway users who might be positively impacted and enjoy scenery and the landscape around the railway. Table 64 provides an overview of potential negative impacts and assessment of their significance.

Table 64: Summary of Project impacts on landscape and visual values and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	Changes to the existing landscape and visual impacts due to the **construction works** and as a result of: (i) clearance of localised areas of tree and shrub vegetation and removal of land cover, (ii) increased level of "urbanisation" due to presence of construction	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	mechanisation, fences and other construction structures, (iii) demolition of properties along the railway alignment, (iv) adverse changes in land use along the railway route.					
Operation	Changes to the existing landscape and visual impacts due to the **presence of permanent railway structures**: (i) land cuts for tunnel structures and introduction of vertical structures in the rural environment, (ii) loss of the currently used agricultural land.	Adverse	Moderate	Negligible	Negligible	Not significant
Operation	Railway users might be positively impacted and enjoy scenery and the landscape around the railway.	Beneficial	Low	Major	Moderate	-

8.7 Materials and Waste Impacts

The key baseline facts that guide the assessment of materials and waste impacts are the following:

- Municipal waste collection is organised in urban areas, while rural areas are less covered.
- In the Project area, regional sanitary landfills are used for the disposal of non-hazardous waste. There is no waste treatment before landfilling. In addition to these landfills, a large number of unsanitary municipal landfills.
- There are still a large number of illegal dumps (over 3,500) which are beyond the control of municipal utility companies. In most cases, illegal dumps are located in rural areas.
- There is currently no practice of separate collection of waste from construction and demolition, and there is no scheme for recycling this waste type.
- The main types of waste generated during the construction of the Belgrade-Nis section will be waste generated from terrain preparation for the construction of the new railway and the dismantling of the existing railway. However, quantities of generated waste during construction activities are not known.
- Spent wooden sleepers are seen to be inadequately disposed along the Belgrade-Nis railway line (not on concrete surfaces, not covered). The wooden sleepers are considered as hazardous waste. Wooden sleepers will be separated from track accessories. The Contractor will be responsible for separating the wooden sleepers, while SRI will be responsible for their final disposal. The metal components of the track accessories will be reused/recycled. Waste sleepers to be stored on hard surface and covered against rainfall and fire.
- The landfill locations for waste generated during construction phase have not yet been determined.
- In the construction phase, responsibility for waste management activities will be transferred to Contractors. During the operation and maintenance phase, waste management is the responsibility of SRI.
- The Sector for Environmental Protection within SRI develops three-year Waste Management Plans (WMP), which defines the procedures for waste identification and managing, prevention of waste generation, rational use of natural resources, elimination of dangers and its harmful effects, as well as procedures and methods for waste disposal.

The materials and waste impacts are analysed for the construction phase and operational phase. There are a range of impacts which can occur from the mismanagement of waste generated in construction phase and

inappropriate sourcing of materials. By far the most significant waste stream which will be generated because of the Project construction phase is the soil/stone from excavation activities and railway infrastructures as a result of dismantling. In the operation phase, the likely waste types include many municipal types of waste from railway stations, and even hazardous wastes from maintenance-related activities. Operational waste volumes will be significantly less than those generated during the construction phase.

Materials and waste handling is primarily about identifying waste streams and adopting an appropriate approach in line with Good International Industry Practice (GIIP), which seeks to avoid the generation of waste in the first instance, rather than mitigating potential impacts to a defined baseline environment. Waste will be generated across the entire Project area and if properly managed, the area under impact will not go beyond the Project site. Table 65 provides an overview of potential negative impacts and assessment of their significance.

Table 65: Summary of materials and waste impacts and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	**Contamination of environment** due to leakage and spillage of wastes associated with poor spoil and waste handling, transportation, and storage/disposal arrangements of different type of waste generated during construction activities (demolition waste, excavated materials, food, packaging, office waste, sanitary waste).	Adverse	Moderate	Medium	Moderate	Significant
Construction	**Environmental damage** caused by improper materials/ chemicals management and accidental spillage.	Adverse	Moderate	Medium	Moderate	Significant
Operation	Contamination of environment due to leakage and spillage of wastes associated with poor waste handling, transportation and storage arrangements of waste generated during operation phase (municipal and packaging waste from passengers that will use the stations, track maintenance waste and ancillary infrastructure waste).	Adverse	Moderate	Medium	Moderate	Significant

8.8 Climate and Climate Change Impacts

8.8.1 GHG Emissions

Baseline GHG emissions

In 2016, fossil CO_2 emissions in the RoS were estimated to be 41,168,058 t with an increase of 2.27% compared to the previous year. CO_2 emissions per capita in are equivalent to 4.65 t per person. Emissions from transport correspond to 11.7% of total emissions[198].

[198] https://www.worldometers.info/co2-emissions/serbia-co2-emissions/

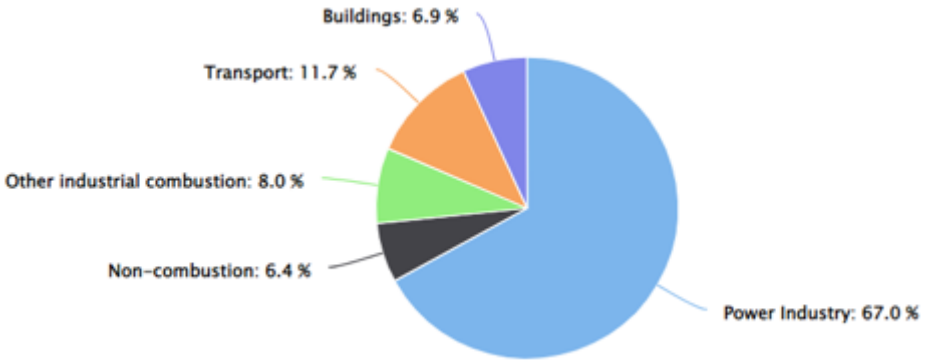


Figure 117: Fossil CO_2 emissions by sector in RoS in 2016

Project GHG emissions

The possible impacts of railway reconstruction on climate are related to emission of greenhouse gases (GHG) from the materials and equipment in the construction phase and rail transport in the operation phase. In order to determine the level of impact, a GHG assessment was carried out in line with the EBRD Protocol for Assessment of Greenhouse Gas Emissions (2017). The calculation of CO_2 emissions for the construction and operation phase of the railway is presented below.

Construction phase

The most significant CO_2 emissions during the construction phase come from materials extraction, material unloading (dust) and construction equipment (machines).

Calculation of CO_2 emissions from construction materials

Table 66: Materials that should be removed and materials needed for railway construction

Material	Quantity
Materials/structures to be removed	
Excavation (land removal) on the open railway	600,000 m^3
Excavation (land removal) as a result of tunnel construction	1,000,000 m^3
Materials needed for railway (re)construction	
Embankment	6,891,525 m^3
Concrete – lower part of railway infrastructure	169,004 m^3
Concrete – tunnel construction	248,654 m^3
Gravel	1,221,152 m^3

*Note: Quantities of materials that should be removed and materials needed for railway reconstruction are only defined for the Stalac-Djunis subsection. Considering that the future railway subsection Stalac-Djunis deviates the most from the existing route and taking into account other deviations on the Project section, the generated and required quantities of materials for the construction phase were assumed.

For the purpose of calculating emissions resulting from the dismantling of existing structures, materials removal and the use of materials for reconstruction activities, an online LIFE HULLEAS[199] software was used. The software was developed to evaluate the sustainability of railway projects. Figure 118 shows the results.

[199] https://www.life-huellas.eu/calc/index_en.php?fbclid=IwAR1dbQ_azWGGLkYkB0PZyVNgBtcyDu3MIQjEk3jaH-aelias54sXHyFJ3mQ

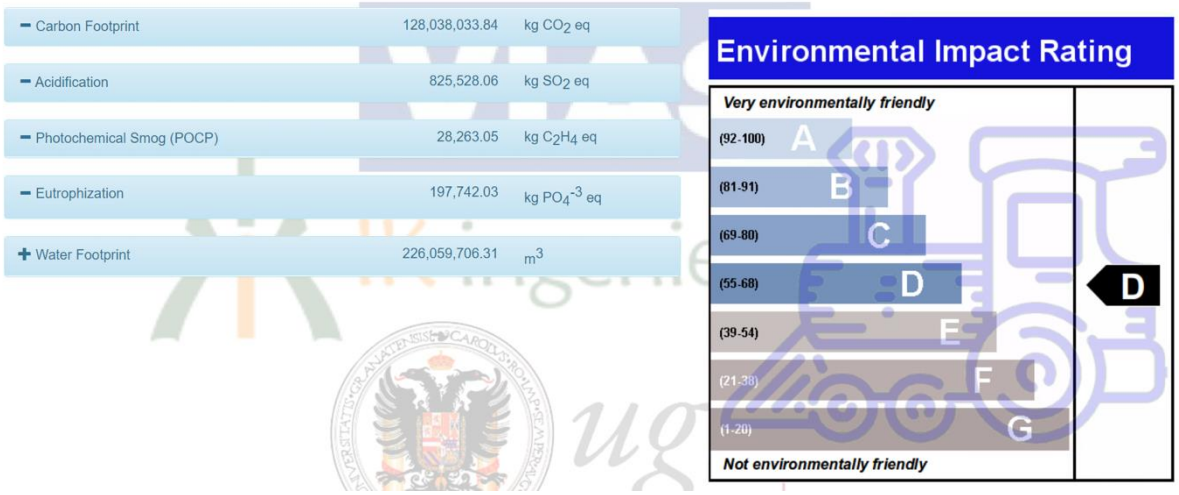


Figure 118: GHG emissions caused by material removal and material used for (re)construction of the railway, calculated through the LIFE HULLEAS online calculator

Dismantling of existing structures, removal of existing materials and use of materials for the (re)construction activities on the sections with the double-track railway will generate 128,038 tons of CO_2 emissions, which is approximately 0.31% of total annual CO_2 emissions in RoS. Considering that these are total generated emissions, and the estimated duration of the construction works is about 4 years, the estimated totalCO_2 emissions amount **512,152 tons**.

Calculation of CO_2 emissions from construction equipment

Input data related to the construction equipment includes the type of equipment, the number of units in operation and operation hours. The input data for the construction phase (type of equipment, number of units) are not defined in the available Project documentation. Since for the Stalac-Djunis subsection necessary input data are defined in the national EIA study, the assumption is made for the whole corridor based on the railway lenght[200]. The assumption is also that construction equipment will be utilised six hours a day, five days a week. In addition, it is assumed that diesel is type of fuel used in this equipment as it is the case in highway construction[201]. The average fuel consumption for each type of construction equipment is determined from manufacturers' catalogues or available scientific research (Table 67).

Table 67: Input data for calculating CO_2 emissions from construction equipment

Equipment used in the construction phase		
Type of equipment	Number of units	Consumption [l/h]
Loader	6	15[202]
Excavator	4	22[203]
Bulldozer	10	33.16[204]
Grader	4	8[205]
Rollers	4	4[206]

[200] Based on the proportion for the Stalac-Djunis subsection length and the entire corridor length
[201] M. H. Alzard, M. A. Maraqa, R. Chowdhury, Q. Khan, F. D. B. Albuquerque, T. I. Mauga & K. N. Aljunadi, Estimation of Greenhouse Gas Emissions Produced by Road Projects in Abu Dhabi, United Arab Emirates, 2019
[202] Mario Klanfar, Tomislav Korman, Tripmir Kujundzic, Fuel consumption and engine load factors of equipment in quarrying of crushed stone, 2016
[203] https://static1.squarespace.com/static/58877529414fb5283ed14a6b/t/5888f8df46c3c4d4d976a102/1485371615708/Fuel+Table+-+Compactors.pdf
[204] Ibid.
[205] https://www.scribd.com/document/271103107/Fuel-Consumption
[206] https://www.scribd.com/document/321246669/Fuel-Consumption-Sheet

Equipment used in the construction phase		
Type of equipment	Number of units	Consumption [l/h]
Steel vibrating roller	15	8[207]
Tank truck	4	33[208]
Truck mounted crane	2	4.5[209]
Truck mixer	6	27.39[210]
Dump truck	46	15.2[211]

The CO_2 emission factor per litre of diesel fuel is 2.49[212]. Based on input data, using the following formula, CO_2 emissions generated as a result of the use of construction equipment were calculated:

$$E_{equipment} = Number\ of\ units\ (-) \cdot Consumption\left(\frac{l}{h}\right) \cdot Number\ of\ working\ hours\ per\ day\left(\frac{h}{day}\right) \cdot Number\ of\ working\ days\ per\ year\ \left(\frac{day}{year}\right) \cdot Emission\ factor\ \left(\frac{kgCO_{2e}}{l}\right)$$

For indirect emissions, it is assumed that the same number of dump trucks is used to transport materials to the construction site. Based on the empirical data, an average distance from the material collection site to the unloading site of 50 km was assumed, and transportation frequency of 270 days per year. CO_2 emissions generated from using dump trucks for material transport is calculated as:

$$E_{transport} = Number\ of\ units\ (-) \cdot Consumption\left(\frac{l}{h}\right) \cdot Distance\ of\ the\ material\ collection\ site\ to\ the\ unloading\ site(km) \cdot Number\ of\ working\ days\ per\ year\ \left(\frac{day}{year}\right) \cdot Emission\ factor\ \left(\frac{kgCO_{2e}}{l}\right)$$

Using these two formulas, the total annual CO_2 emissions generated from the use of **equipment** during railway reconstruction are **29,847.08 tons**.

Taking into account that CO_2 emissions in RoS from the transport sector in 2016 amounted to 4,816,662.79 tons[213], the use of construction equipment for the construction of this subsection would contribute to an increase in total annual emissions from the transport sector by 0.62%.

Operation phase

Since the railway will be fully electrified, direct sources of CO_2 emissions in the operation phase do not exist or are negligible (e.g., train maintenance). On the other hand, the main source of indirect emissions in the operation phase is the use of electricity to power trains. The calculation of indirect CO_2 emissions is done for the base year (2022) and for three future projections – Project scenarios:

- Project scenario 1 – 2028, in case the railway has not been reconstructed
- Project scenario 2 – 2028, in case the railway has been reconstructed

[207] https://www.scribd.com/document/321246669/Fuel-Consumption-Sheet

[208] Calculated based on average consumption: https://www.webfleet.com/en_gb/webfleet/blog/do-you-know-the-diesel-consumption-of-a-lorry-per-km/ and average speed: https://www.matec-conferences.org/articles/matecconf/pdf/2017/01/matecconf_encon2017_02022.pdf

[209] https://www.internationalcranes.media/news/truck-cranes-trucks-away-/1138236.article#:~:text=Zoomlion%20says%20the%20crane%20has,to%204.5%20litres%20per%20hour

[210] Fuel consumption [l/h] is calculated based on fuel consumption [l/km] and maximum speed:

https://e-katalog.lkpp.go.id/public/files/upload/produk_lampiran/2015/03/23/14270970277981.pdf

[211] https://postconflict.unep.ch/humanitarianaction/documents/02_08-04_06-04_02-22.pdf

[212] https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf

[213] https://www.worldometers.info/co2-emissions/serbia-co2-emissions/

> Project scenario 3 – 2040, considering projected changes in rail frequency and energy use, in case the railway has been reconstructed.

The calculation of emissions was made based on energy consumption, the current electricity grid emission factor and projected future electricity grid emission factor (considering the planned increase in share of renewable energy sources). Direct data on energy consumption from trains is difficult to collect, due to the large number companies that use the existing infrastructure. Therefore, energy consumption is calculated using the appropriate mathematical formula. Input data for calculation of CO_2 emissions from railway operation is shown in Table 68.

Table 68: Input data for calculation of CO_2 emissions in operation phase

Inputs required		Current railway alignment		Future railway alignment
N_{stops}	Number of intermediate stops	69		37
L	Trip length [km][214]	229.8		228
v_{ave}	Average speed [km/h][215]	100		180
V_{max}	Maximum speed [km/h]	120		200
B_0	Constant equating to rolling resistance[216]	2022.	2025.	0.001
		0.003	0.004	
B_1	Constant equating to friction resistance[217]	2022.	2025.	0,15
		0,5	0,6	
B_2	Constant equating to aerodynamic resistance	0.95[218]		0.36[219]
g	Gravitational constant [m/s²]	9,81		
D_h	Change in height [m][220]	3.8		3.6
Trains				
N_p	Number of trains in passenger services	26		108
N_f	Number of trains in freight services	62		362[221]
m_p	Average passenger train weight [ton]	380[222]		400[223]
m_f	Average freight train weight [ton]	650[224]		700[225]
Average carbon emission factors (e) [gCO_2/kWh]:				
2022[226]		478		
2028[227]		462		

[214] Including the sections before Stalac and after Djunis in order to fit into the existing railway line.
[215] The average speed of 75 km/h is used since the average speed for Stalac-Braljina Section is 65 km/h and for Braljina-Djunis section is 85 km/h

[216] http://coachrobmuller.blogspot.com/2017/11/rolling-resistance-revisited.html

[217] https://www.iitg.ac.in/rkbc/me101/Presentation/L09-12.pdf

[218] https://www.simscale.com/blog/2017/06/air-resistance-vehicle-design/

[219] https://www.computer.org/csdl/magazine/cs/2019/03/08656573/187Q8FqILxC

[220] Height reduction in modern trains has been taken into account. http://www.railway-technical.com/trains/rolling-stock-manufacture.html; https://www.researchgate.net/figure/Train-model-a-different-lengths-of-trains-b-train-cross-section-c-CRH380A-and_fig1_320774107

[221] The value is assumed based on data from the PFS Study (2022) on the actual number of freight trains in 2020/21 and additionally the expected number of facultative freight trains. However, as emphasized in the PFS, the detailed analysis of all flow of goods and of the number of freight trains will be carried out within Feasibility Study.
[222] https://socialcompare.com/en/comparison/high-speed-trains

[223] It was assumed that there would be a minor increase in the train weight due to the expected increase in their length.

[224] Average value based on Preliminary Feasibility Study – Reconstruction and Modernisation of the Railway Line Belgrade-Nis, 2022
[225] It was assumed that there would be a minor increase in the train weight due to the expected increase in their length.
[226] Average value in the last 24h on 18 May, 2022: https://app.electricitymap.org/zone/RS
[227] Based on the difference in the share of renewable energy sources between 2016 and 2021: https://www.worldometers.info/electricity/serbia-electricity/
https://www.statista.com/statistics/1237596/serbia-distribution-of-electricity-production-by-source/#:~:text=Much%20of%20Serbia's%20electricity%20generation,of%20the%20country's%20power%20mix

Inputs required	Current railway alignment	Future railway alignment
2040[228]	359	

Firstly, the energy consumption of each train was calculated using the following formula[229]:

$$E' = \frac{(N_{stops} + 1)}{L} \cdot \frac{v_{max}^2}{2} + B_0 + B_1 \cdot v_{ave} + B_2 \cdot v_{ave}^2 + \frac{g \cdot D_h}{L}$$

Then the total energy consumption was determined, based on the number of trains, their weight and the length of the subsection:

$$E = E' \cdot L \cdot (N_p \cdot m_p + N_f \cdot m_f)$$

Multiplying the total energy consumption by the emission factor, the total emissions for different scenarios were calculated using the following formula:

$$Total\ emissions = E \cdot e$$

The results are presented in Table 69.

Table 69: CO_2 emissions as a result of train operation

Total CO_2 emissions – train operation [tons CO_2]			
Baseline	2022	Current railway status	17.980,39
Scenario 1	2028	Railway is not reconstructed	17.393,33
Scenario 2	2028	Railway is reconstructed	130.390,27
Scenario 3	2040	Railway is reconstructed	101.320,58

*Note: The calculation is made for the worst (general) scenario – the maximum estimated number of trains is used for each year.

In order to take into account the reduction of emissions due to the increase/decrease in number of passengers in railway traffic and the consequent decrease/increase in the number of passengers in the road traffic, a projection of the number of passengers in railway traffic was taken into consideration, as presented in the PFS.

Table 70: Number of passengers – projections[230]

Number of passengers		
2022	Current railway status	948,409
2028	Railway is not reconstructed	1,073,356
2028	Railway is reconstructed	2,237,636
2040	Railway is reconstructed	2,861,600

Also, in case of reconstruction, the use of railway infrastructure for the transport of goods is expected to increase, as calculated and presented in the PFS.

[228] https://balkangreenenergynews.com/rs/srbija-planira-da-duplira-udeo-obnovljive-energije-i-dostigne-40-odsto-do-2040/
[229] India GHG Program, India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport, 2015
[230] Projections of the number of passengers were made by interpolation and based on the available data on the number of passengers in 2018 (source: https://www.rts.rs/page/stories/sr/story/125/drustvo/3222685/srpske-zeleznice-godisnje-prevezu-tek-sedam-miliona-putnika.html) and the 2007 (source: General Design). Projections of the number of passengers in the future years are calculated based on the percentage increase in the number of passengers in the period of 3 and 18 years presented in the General Design. Considering that the majority of passengers on this route travel from Belgrade to Nis, it is assumed that the number of passengers on the section Stalac-Djunis is 2/3 of the total number of passengers from Belgrade to Nis.

Table 71: Quantity of goods transported – projections[231]

Goods transported [ton]		
2022	Current railway status	7,449,282
2028	Railway is not reconstructed	8,876,012
2028	Railway is reconstructed	9,691,000
2040	Railway is reconstructed	12,346,000

In order to calculate the mentioned decrease (or increase) of emissions in passenger road traffic, the input data shown in Table 72 were used.

Table 72: Inputs required to calculate emissions from passenger road traffic

Inputs required to calculate emissions from passenger road traffic	
Average car CO_2 emissions per passenger per kilometre [g CO_2/passenger-km]	182[232]
The shortest road distance Belgrade-Nis [km]	237
Average number of people in the car[233]	3

In order to calculate the reduction of emissions in freight road transport, the input data shown in Table 73 were used.

Table 73: Inputs required to calculate emissions from freight road traffic

Inputs required to calculate emissions from freight road traffic	
Average truck CO_2 emissions per kilometre [g CO_2/ km]	307[234]
Shortest road distance Belgrade-Nis [km]	237
Average truck capacity [ton]	10[235]

The decrease/increase in emissions was then calculated using the following formula for passenger road transport:

$$\Delta e = \frac{number\ of\ passengers\ in\ the\ baseline\ year - number\ of\ passengers\ in\ projected\ year}{average\ number\ of\ people\ in\ the\ car} \cdot average\ car\ CO_2\ emissions\ per\ passenger\ per\ kilometre \cdot the\ shortest\ road\ distance\ Stalac - Djunis$$

And for freight road traffic:

$$\Delta e = \frac{goods\ transported\ in\ the\ baseline\ year - goods\ transported\ in\ the\ projected\ year}{average\ truck\ capacity} \cdot average\ truck\ CO_2\ emissions\ per\ kilometre \cdot the\ shortest\ road\ distance\ Stalac - Djunis$$

The results of the change in emissions are shown in Table 74.

[231] Projections of the number of transported goods by years were calculated on the basis of data on the quantity of goods transported in the first quarter of 2022 and the quantity of goods transported in 2006 (source: General Design) and taking into account the length of the Belgrade-Nis railway section. Projections of the goods transported in the future years are calculated based on the percentage increase in the goods transported in the period of 3 and 18 years presented in the General Design. Considering that Belgrade and Nis are among the three largest cities in Serbia, it is assumed that 2/3 of the total transported goods on the Belgrade-Nis route pass through the Stalac-Djunis section.

[232] https://www.statista.com/statistics/1185559/carbon-footprint-of-travel-per-kilometer-by-mode-of-transport/

[233] Considering that most people use this section to transport to work.

[234] https://theicct.org/publication/co2-emissions-from-trucks-in-the-eu-an-analysis-of-the-heavy-duty-co2-standards-baseline-data/

[235] https://www.lynchtruckcenter.com/how-much-can-a-dump-truck-carry/

Table 74: Changes in emissions as a result of Project implementation

Changes is CO_2 emissions [tons CO_2]			
		Passenger road traffic	Freight road traffic
2022	Current railway status	0,00	0,00
2028	Railway is not reconstructed	-1,796.49	-10,380.74
2028	Railway is reconstructed	-18,536.51	-16,310.52
2040	Railway is reconstructed	-27,507.86	-35,628.03

Emissions as a result of train operation and potential modal shift from road to rail traffic are shown in Table 75.

Table 75: CO_2 emissions as a result of trains operation and modal shift from road to rail transport

Total CO_2 emissions – trains operation and modal shift from road to rail transport [tons CO_2]			
Baseline	2022	Current railway status	17.980,39
Scenario 1	2028	Railway is not reconstructed	5.216,10
Scenario 2	2028	Railway is reconstructed	95.543,25
Scenario 3	2040	Railway is reconstructed	38.184,69

Therefore, if the Project is not implemented, it is evident that there will be an increase in CO_2 emissions. On the other hand, by the Project implementation the **reduction in emissions in 2040 is expected to be 62%**. Considering the fact that RoS strives to become climate neutral by 2050, CO_2 emissions from rail transport could be equated to zero.

8.8.2 Climate Risk Assessment

Based on the previously presented information in Chapter 7.9, a climate risk assessment for the Project area was performed using the *World Bank Climate and Disaster Risk Screening Tools*[236]. A summary of the assessment of the exposure, impacts and risk of climate change on the Project is shown in Table 76, while a detailed output of these tools is given in Appendix 3.

Table 76: Climate risk assessment for current and future climate conditions

Issue	Guiding questions used to access issue	Timeframe	Hazard	Rating
Exposure of Project location to climate and geophysical hazards	What have been the historical trends in temperature, precipitation and drought conditions? How are these trends projected to change in the future in terms of intensity, frequency and duration? Has the location experienced climate and/or geophysical hazards in the past that may occur again in the future?	Current climate conditions	Extreme temperature	Moderate exposure
			Extreme precipitation and flooding	Moderate exposure
			Earthquake	Moderate exposure
			Landslides	Low exposure
			Wildfires	Low exposure
		Future climate conditions	Extreme temperature	Moderate exposure
			Extreme precipitation and flooding	Moderate exposure
			Earthquake	Moderate exposure
			Landslides	Low exposure
			Wildfires	Low exposure
Impacts on the Project's physical components	Does the Project design take into account recent trends and future projected changes in identified climate and geophysical hazards? Does the Project design consider how the structural integrity, materials, siting, longevity and overall effectiveness of transportation infrastructure, if applicable, may be affected? In particular, does the design "lock in" certain decisions for the future?	Current climate conditions		Moderate potential impact
		Future climate conditions		Moderate potential impact
Risk to the outcome/ service delivery of the Project	The ratings are derived on the basis of hazard information, subject matter expertise, contextual understanding of the Project, and modulated on the basis of adaptive capacity, including the Project's non-physical component, transportation sector context and broader development context. Potential impacts to subsectors are evaluated separately for the current and future timeframes to capture changes in the exposure from climate hazards over time.	Current climate conditions		Low Risk
		Future climate conditions		Low Risk

[236] https://climatescreeningtools.worldbank.org/

From the aspect of **GHG emissions**, as previously confirmed by the calculation, the Project implementation will contribute to the reduction of total GHG emissions in the transport sector. The negative impacts from emissions are expected in the construction phase.

Based on in-depth climate and climate change assessment conducted using the World Bank tool, an assessment of the more specific types of climate and climate change impacts and their significance on the Project for both construction and operation phases is presented in Table 77.

Table 77: Summary of Project impacts on climate and climate change impacts on Project, and their significance

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Project impacts on climate						
Construction	Environmental pollution due to **GHG emissions** form construction activities (construction materials used and equipment).	Adverse	Moderate	Medium	Moderate	Significant
Operation	Environmental pollution due to **GHG emissions** form reconstruction and maintenance activities.	Adverse	Minor	Medium	Minor	Not significant
Operation	Reduction of total **GHG emissions** in the transport sector due to the expected modal shift from road to rail traffic.	Beneficial	Moderate	Medium	Moderate	Significant (as there will be no alternative means of long-distance transport and consequently expected increase in use of cars, buses and other road transportation means)
Climate change impacts on the Project						
Construction	As a result of **floods**, especially in the areas exposed to flooding: Resnik, Rakovica, Jagodina, Cuprija, Cicevac, Stalac and Djunis: (i) damage to the existing railway infrastructure, (ii) damage of construction area, construction equipment and materials, (iii) construction delays.	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	As a result of **landslides**, especially in the previously mentioned areas exposed to flooding: (i) endangered the stability of the terrain that is the basis for the (re)constriction of the railway and construction equipment movement, (ii) physical damage of existing railway infrastructure, (iii) ecological catastrophe as a result of watercourse buried by a landslide.	Adverse	Moderate	Low	Minor	Significant
Construction	As a result of **droughts and fires**: (i) heat stroke and increased risk of fire, (ii) overheating and ignition of equipment containing hazardous substances, (iii) deformation of materials and melting of construction equipment, (iv) land subsidence during the construction activities resulting in slower vehicle movements and construction delays.	Adverse	Moderate	Low	Minor	Not significant
Operation	As a result of **floods**, especially in the previously mentioned areas exposed to flooding: (i) flooding of railway alignment, underpasses and tunnels and physical damage to railway infrastructure, (ii)	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	scour of structures, weakening and degrading materials, (iii) clogging of separators and other drainage channels with waste from watercourses, (iv) trains damaged by floods and disruption of railway flow.					
Operation	As a result of **landslides**, especially in the areas exposed to flooding: (i) terrain destabilisation (ii) physical damage to the transport infrastructure (iii) interrupted underground installations (water and wastewater system), (iv) trains damaged by floods and disruption of railway flow.	Adverse	Moderate	Low	Minor	Significant
Operation	As a result of **droughts and fires**: (i) physical damage of railway structures caused by materials expansion, (ii) fire smoke reduces the visibility and results in railway traffic closure, (iii) increase in GHG emissions (iv) depletion of water supplies in the event of drought, or increased use of groundwater can cause land subsidence, as well as damage to foundations and destabilisation of structure.	Adverse	Moderate	Low	Minor	Not significant

8.9 Impacts on Cultural Heritage

The key baseline facts that guide the assessment of impact on cultural heritage are following:

> The greatest number of cultural heritage sites are on the subsection Belgrade Resnik (24 sites in total), followed by the Resnik-Velika Plana Section (9 sites), Velika-Plana Gilje (8 sites), Djunis-Medjurovo (6 sites), Stalac-Djunis (5 sites) Paracin-Stalac (2 sites) and Gilje-Paracin (1 site).

> Regarding the two sections which are part of the railway nodes, there are no identified cultural heritage sites on the Resnik-Ostruznica subsection but numerous sites near the subsection Crveni Krst-Nis Center-Nis Marshalling yard.

> None of the identified cultural heritage sites are on the route itself and will thus not be directly impacted, but some are close to the location of planned construction works (up to 100 m).

> The following archaeological sites have been identified in the vicinity of planned railway route:

- Archaeological Site in Ripanj (subsection: Resnik-Velika Plana)
- Archaeological site Medieval Town of Trubarevo (subsection: Stalac-Djunis)
- Archaeological site "Nikoljac" (subsection: Stalac-Djunis)
- Archaeological Site Bubanj (subsection: Djunis-Medjurovo)

> In addition to the identified known assets, the Project has the potential to impact previously unrecorded remains which may be affected by the disturbance during construction phase. There is high potential for encountering such chance finds, considering that Serbia is known for its ample archaeological and cultural heritage sites.

The table below lists the identified cultural heritage impacts and risks.

Table 78: Summary of possible impacts on cultural heritage sites during construction and operational phase

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Construction	*Noise, vibrations and dust:* During the construction phase some cultural heritage sites located near construction sites up to 100m (described in more details in Chapter 7.10) could be affected by noise due to construction works.	Adverse	Moderate	Medium	Moderate	Significant
Construction	*Access roads:* Some access roads leading to cultural heritage sites could potentially be affected, as it is assumed that these roads will be used for the passage of machinery during construction works. Such an example is the Church of "Sveta Nedelja" which is located on subsection Stalac-Djunis near the planned exit of Tunnel no. 3 and entrance of Tunnel no. 4, as well as the planned access road to Tunnel no. 4. Due to this proximity, it will be necessary to pay particular attention to prevent cutting off of access to the existing road infrastructure which leads to the Church.	Adverse	Moderate	Medium	Moderate	Significant
Construction	*Possibility of chance finds:* Considering that Serbia is known for its archaeological sites, there is a high potential for encountering previously unknown heritage (chance finds) during construction works.	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Operation	*Possibility of chance finds during maintenance works:* Operational maintenance activities could lead to disturbances or damage to known cultural heritage or previously undiscovered buried heritage.	Adverse	Moderate	Medium	Moderate	Significant

8.10 Social Impacts and Risks

The key baseline facts that guide the assessment of social impacts are the following:

- The Corridor goes through or near both through:
- **urban/densely populated areas** (particularly in the section Belgrade-Resnik) with residential, industrial and public facilities, and
- **rural, sparsely populated areas** which mainly consist of agricultural areas with small-scale farming activities and some livestock breeding.
- The Corridor runs near industrial facilities at many locations, such as Rakovica and Paracin.
- Rural areas along the Corridor are characterised by low population density, negative demographic trends, underdeveloped infrastructure and high rates of rural poverty and unemployment. The most frequent category of vulnerable households in these areas is elderly people (particularly elderly people living alone).
- Most households along the railway line own small land plots that comprise of a residential structure and agricultural land. Along the railway line, residential and auxiliary structures are mostly made of brick and old. In densely populated settlements (such as Mala Plana and Smederevska Palanka), houses are relatively close to the railway without railway fencing on either side.
- Roma people live mostly in urban settlements such as Mladenovac, Aleksinac, Nis, etc. but not along the railway line, except in Mladenovac by the railway station (in fact, they live in construction site containers by the station).
- The majority of level crossings on the new railway line are planned to be closed. Most are actively used by the local population.
- On the existing railway line, some stations and halts are being considered for closure (it should be noted that the decision on closure of other stations/halts has not been officially made to date):

Belgrade-Resnik	No stations or halts will be closed
Resnik-Velika Plana	2 halts and 5 stations will be closed
Velika Plana-Gilje	7 halts will be closed
Paracin-Stalac	3 halts will be closed
Stalac-Djunis	1 station and 2 halts will be closed
Djunis-Medjurovo	8 halts will be closed

- Some of the stations/halts planned to be closed are located at a great distance from the next nearest station. For example, the Mala Plana station considered for closure is about 4.8 km to the nearest station (the Velika Plana station). All the distances are listed by each subsection in Chapter 7.11.2 (Socio-economic Baseline by Subsection).
- Some of the current halts (planned to be closed) may not be frequently used, which means that their closure will not have a significant impact on the local residents. For example, the Sikirice/Ratari halt was found to be rarely used (by only several passengers a day) as people rely more on private cars or buses to travel to work and school. The Staro Selo halt was also found to be rarely used. During the

future ESIA phases, it will be necessary to confirm the significance of impacts of station/halt closure and plan for adequate measures.

The social impacts of the Project are analysed for the pre-construction, construction and operational phase. The two tables below list the identified social impacts and risks separately during: a) pre-construction and construction; and b) operation.

Note: Cultural heritage impacts are separately addressed under Chapter 8.9. There is also a risk of adverse impacts on community wellbeing due to impacts associated with noise/vibrations and poor air quality - detailed assessments of air quality, noise and vibration effects are provided in Chapters 8.2 and 8.3, whereas impacts on water are described in Chapter 8.4.

Table 79: Summary of social impacts during pre-construction and construction

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Pre-construction	Closure of stations and halts. Closure of some stations and halts on the existing railway line will affect the local communities which rely on railway transport, especially in communities where vulnerable categories live (such as the elderly). Some of the communities may not have alternative transport options available. *Impacts of closure of stations/halts on local population was emphasised as a concern by some of the consulted municipal/city authorities.* *Note: As noted above in the introductory part, some of the current halts (planned to be closed) may not be frequently used, which means that their closure will not have a significant impact on the local residents. For e.g., the Sikirice/Ratari halt and Staro Selo halts were found to be rarely used as people rely more on private cars or buses to travel to work and school. During the future ESIA phases, it will be necessary to confirm the significance of impacts of station/halt closure and plan for adequate measures.*	Adverse	Major	High (for most settlements)	Major	Significant
Pre-construction	Closure of level crossings: People currently use the level crossings on the existing railway. The majority of level crossings will be closed, and replaced by underpasses/ overpasses which will to some extent mitigate these impacts. *Impacts on agricultural activities due to closure of level crossings was emphasised as a concern by*	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	most of the consulted municipal/city authorities. During the future ESIA phases, when the Detail Design is prepared (which will include a network of access roads), it will be necessary to confirm the significance of impacts of current level crossings closure and plan for adequate measures.					
Pre-construction	Land acquisition and resettlement: The Project will require acquisition of private land and relocation of households/businesses. Note: There are Roma people living by the Mladenovac station in construction containers, which will likely need to be relocated before construction can start.	Adverse	Major	High	Major	Significant
Construction	Temporary occupation of land, and land use/access restrictions: It may be necessary to temporarily occupy privately owned land plots for the purpose of construction of access roads and placement of staff, machines and material. Construction activities may cause damage to land plots, natural or other assets due to temporary disposal of excavation materials and heavy machinery parks. Temporary access restrictions are possible as construction works may provide obstacles and thus reduce the ability of local farmers, public facilities and businesses to operate as normal.	Adverse	Moderate	Medium	Moderate	Significant
Construction	Labour and working conditions: At this stage of Project preparation there are no estimates on how many workers will be employed by construction contractors. Worker accommodation will need to be provided but their locations have not been determined yet. This will be the responsibility of contractors. There are potential risks of lack of implementation of HR policies and procedures by contractors (informal work, child labour, forced labour, etc.).	Adverse	Moderate	Medium	Moderate	Significant
Construction	Increased employment opportunities. The Project is expected to generate temporary local employment as contactors will likely need low skilled workers to be employed on the construction sites. Thus, the possibility of employing	Beneficial	Minor	Medium	Minor	Not significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	unemployed persons from the nearest local communities is high, which will also have a positive impact on the local economy. *There is also a beneficial opportunity for the Roma population to work on construction, especially in Nis (where around 15,000 Roma live*).					
Construction	OHS risks. During the construction phase, workers will be exposed to many risks that are directly related to activities performed on construction sites, such as demolition and excavation, electrical workers, works at heights, etc.	Adverse	Moderate	Medium	Moderate	Significant
Construction	Worker influx and GBVH: There will be worker camps with a large number of workers on site as is typical for railway construction activities. Since the majority of the Project area is a rural area with small villages/communities, these households may have less absorptive capacity compared to large urban environments. Worker influx will be more significantly felt in smaller communities. Additionally, if the location of construction compounds/ workers' accommodation is not carefully selected and agreed through consultations with local communities, there may be the impacts on local communities, particularly if the construction compounds are to be located in proximity to such communities.	Adverse	Moderate	Medium	Moderate	Significant
Construction	Traffic safety risks and damage to local roads: An increased volume of traffic on the existing local road network due to construction works is expected, which is likely to lead to traffic limitations causing traffic delays and increased road safety risks. Local roads may be damaged by heavier traffic than is currently experienced. The contractors will be responsible for any repairs needed. There are many houses along the railway which will be very near the construction machinery and trucks once works begin. This will pose a risk to the safety of locals living in these areas.	Adverse	Moderate	Medium	Moderate	Significant

Table 80: Summary of social impacts during operation

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Operation	Worker influx and GBVH: The number of employees required during maintenance activities is expected to be low and therefore no significant impacts are expected related to worker influx and GBVH during this phase.	Adverse	Minor	Medium	Minor	Not significant
Operation	OHS risks. During the operational phase, there are OHS risks related to maintenance works, especially for track workers and workers at heights (e.g., during maintenance works on railway viaducts and bridges). There are also risks for crew members such as exposure to noise and vibration (noise from locomotives, rolling stock, and machinery, as well as to significant repetitive mechanical shocks and/or vibrations), fatigue (for locomotive engineers and other railway workers who work irregular work hours), electrical hazards (workers on overhead lines and conductor rails), etc. However, since the workers in the operation phase are expected to be experienced and skilled, their sensitivity is assessed as low.	Adverse	Moderate	Low	Minor	Not significant
Operation	Traffic safety: Road and railway safety will be improved during the operational phase as the number of level crossings will be minimised and the railway will be fenced. In addition, passengers who would otherwise travel by car will also see a safety benefit since the safety of railways is generally better than cars.	Beneficial	Moderate	Medium	Moderate	Significant
Operation	Impacts on employment due to closure of stations. The Project will require the closure of some stations along the existing railway line. It is expected that current staff working at these stations will be prequalified and reallocated to other jobs within SRI.	Adverse	Minor	Medium	Minor	Not significant
Operation	Negative gender risks. Gender related risks and impacts include effects of closure of stations/halts on women in rural areas since they often depend on transport service providers; risks of potential GBVH against women when using underpasses as pedestrians, especially at night. However, if alternative transport options are provided and underpasses designed with safety considerations taken into	Adverse	Moderate	Medium	Moderate	Significant

Phase	Type of impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	account, these risks will be minimised.					
Operation	Positive gender impacts. The Project has the potential to positively contribute to: safer public transport which is especially important for women as they often depend on transport service providers for travel; reconstruction of railway stations in line with European standards (the design features will likely contribute to greater perceptions of safety among women); more available, reliable and quicker transport for women who use the railway, particularly rural women; development of rural tourism and economic opportunities for women in rural areas.	Beneficial	Moderate	Medium	Moderate	Significant

8.11 Cumulative Impacts

Cumulative impacts which may arise from Project implementation are analysed from two aspects:

- cumulative impacts as a result of other projects developed or planned in the observed area, and
- cumulative impacts as a result of multiple actions and activities from railway construction and operation.

For the purpose of cumulative impacts analysis, other projects developed or planned in the observed area have been analysed by reviewing the *Spatial Plan of RoS 2021-2035,* the *Spatial Plan of the Railway Stalac-Djunis* and the *General Urban Plan of Belgrade 2041* (Draft, 2022). Additional information on planned projects in the observed area were gathered during site visits and through media search.

Table 81: Planned projects in the observed area

Project	Brief description	Time schedule
Construction of the Belgrade bypass, as a part of the planned state motorway	The bypass is currently under construction, and its total length will be approx. 69 km. Section B of this bypass includes the project area of Ostruznica, where the works are in progress[237].	Planned to be completed in December 2022.
Construction of the Belgrade metro	In the first two project phases, it is planned to build a metro connecting Zeleznik and Mirijevo, and then Mirijevo and Zemun. In the third project phase, it is planned to connect parts of the city that are not on these two lines, as well as to connect the metro with trains[238].	Preparatory works began in November 2021. The planned deadline for the completion of the first metro line is 2028, and the second line in 2030[239].
Construction of the Pojate-Preljina motorway (so-called Morava corridor)[240] with access roads	The planned highway length is 112.3 km, and it will pass through or near the towns of Cacak, Kraljevo, Vrnjacka Banja, Trstenik, **Krusevac**, **Stalac** and **Cicevac**.	The works started in December 2019 and are planned to be completed in 2024.
Reconstruction and electrification of Lapovo-	It is planned to modernise the basic railway routes in order to connect important economic centres.	Timeframe is not known.

[237] https://www.istinomer.rs/analize/dugo-putovanje-do-obilaznice-oko-beograda/
[238] https://www.ekspres.net/biznis/beogradski-metro-kad-pocinju-radovi-koliko-sve-kosta-kuda-ce-ici-3-11-2021
[239] https://www.danas.rs/bbc-news-serbian/beogradski-metro-i-obecanja-prva-linija-od-2028-godine-koliko-je-puta-do-sada-beograd-trebalo-da-dobije-metro/
[240] https://www.slobodnaevropa.org/a/30326583.html

Project	Brief description	Time schedule
Kragujevac-Kraljevo-Raska-Novi Pazar and Stalac-Krusevac-Kraljevo-Pozega railway lines[241]		
Construction of small hydropower plants on Velika Morava River and Zapadna Morava River – Construction of small hydropower plants in the settlement of Stalac	The construction of small hydropower plants is addressed as future infrastructure projects in the Spatial Plan of the RoS 2021-2035. The construction of 5 mini hydropower plant on the Juzna Morava in the settlement of Stalac is planned[242].	By the end of 2035. In September 2021, the Municipality of Cicevac issued a decision to ban this project on its territory so the project was suspended.
Reconstruction of the municipal road Stalac-Trubarevo[243]	Reconstruction of the 16.1 km long municipal road Stalac Town-Trubarevo is planned, together with the reconstruction and construction of a modern road surface in total length of approx. 9 km, with widening of the road to 6 m and enabling appropriate drainage and renewal of signalisation.	Timeframe is not known.
Construction of a chicken farm	According to information from December 2021, it is planned to build a chicken farm in Mali Stalac in the Municipality of Cicevac[244].	Project implementation stage is not known.
Construction of the Nis-Pristina (Kosovo) motorway	The length of the motorway from Nis to the administrative border near Merdare, which will be built by the RoS, is 77 km[245]. The construction of the Merosina loop, which is currently underway, may result in cumulative impacts (noise and dust) in the event of the simultaneous railway reconstruction.	The works started in December 2021 and are planned to be completed by 2026.
Implementation of the project “Clean Serbia”	The Project includes construction of the municipal (sewage) infrastructure and infrastructure for disposal of solid, municipal waste in the RoS, including settlements along the subject railway line.	2020-2025
Development of the Belgrade tourist economy	The General Urban Plan of Belgrade 2041 (Draft, 2022) plans the arrangement of the banks of the Sava River and the Danube, as well as the construction of bicycle paths. If these activities take place in parallel with the railway reconstruction in the area of the Belgrade junction, negative cumulative impacts in the form of dust and noise emissions can be expected.	By the end of 2041.
Increasing the competitiveness of agricultural production in RoS	The Spatial Plan of RoS 2021-2035 defines the reclamation of degraded lands and support for the promotion of the concept of urban agriculture in the northern and southern part of RoS as priority activities.	Continuously until the end of 2035.
Development of industrial production	In the Spatial Plan of RoS 2021-2035, an increase in the area of industrial zones in all regions within the project area is planned (e.g., in Belgrade from the existing 909 ha to an additional 1,074 ha). The type of industry is not specified.	Continuously until the end of 2035.
Development of regional water supply systems	The Spatial Plan of the RoS 2021-2035 defines the activities for the development of regional water supply systems, including the South Moravian, West Moravian, Rasina-Moravian water supply system.	Continuously until the end of 2035.
Development of the gas economy	In order to ensure a safe and reliable supply of natural gas, it is planned to explore the gas reservoir, as well as the construction of the main gas pipeline that includes the Velika Plana-Nis section.	By the end of 2035.

[241] Information from the Spatial Plan of the Special Purpose Area of the Infrastructure Corridor of the Railway Stalac-Djunis
[242] https://krusevacpress.com/opstina-cicevac-stop-izgradnji-mini-hidroelektrana/
[243] Ibid.
[244] https://www.novosti.rs/drustvo/vesti/1065210/nova-farma-700-000-evra-velika-investicija-malom-stalacu
[245] https://www.euronews.rs/biznis/biznis-vesti/30122/auto-put-od-nisa-do-pristine-vodi-ka-dracu-ko-ce-imati-vise-koristi-od-novog-puta/vest

Project	Brief description	Time schedule
Construction of the airport in Krusevac	In the Spatial Plan of RoS 2021-2035 the construction of new airport southeast of Krusevac is addressed.	By the end of 2035.
Construction of the Nis railway bypass	As part of railway Corridor X, the construction of the Nis bypass is also planned.	By the end of 2025.
Reconstruction of the Nis airport	The Spatial Plan of RoS 2021-2035 address the issue of reconstruction of the airport "Konstantin Veliki" in Nis. Activities are planned to improve services by building a new and reconstructing the existing infrastructure, in order to give the airport the status of an intermodal center.	By the end of 2035.

In the case that the Project implementation takes place with some of the previously listed, generation of negative cumulative impacts is possible such as: generation of a larger amount of dust, increased noise level, more significant and frequent interruptions in traffic etc.

Based on the presented baseline information in this document, as well as potential impacts and identified planned projects in the vicinity, a final assessment of cumulative impacts has been carried out (Table 82) utilising the following scale:

Positive cumulative impact	Positive cumulative impacts as a result of multiple actions and activities are expected.
Negligible cumulative impact	There are no significant cumulative impacts.
Minor cumulative impact	The expected impacts are small in scope and will be localised in the Project area.
Moderate cumulative impact	The expected impacts are significant and distributed throughout the Project area.
Major cumulative impact	The expected impacts are very significant and distributed throughout the Project (and wider) area.

Table 82: Potential cumulative impacts as a result of Project implementation

Issue	Project phase	Potential cumulative impact	Key receptors	Impact assessment
Air quality	Construction	> Increased emission of exhaust gases generated during the simultaneous work of construction machinery engaged on this Project and other projects in the Project area of influence (especially during the transport of construction materials, movement of construction equipment and excavation works). > Increased dust emissions from the movement of vehicles on local dirt roads, when two or more projects use the same local infrastructure.	> Population in cities and settlements along the route > Workers > Flora and fauna along the route > Agricultural land/crops	Moderate
	Operation	> The railway will be fully electrified, so air emissions are not expected. > Project implementation will have positive impacts on the environment due to the expected modal shift from road to rail traffic.		Negligible
Noise and vibration	Construction	> Increased noise/vibration levels generated by simultaneous use of construction machinery, especially in case of nearby road/motorway construction. > Increased noise/vibration levels generated by increased traffic through local settlements, when two or more projects use the same local infrastructure.	> Population in settlements along the route > Workers > Habitats and fauna along the route > Small-scale beekeeping along the railway	Moderate
	Operation	> With construction of noise barriers, negative impacts from railway/motorway operation are not expected. > No vibration impact is expected.		Negligible
Soil quality	Construction	> Increased concentration of hazardous substances in soils due to accidental spills on the construction sites active at the same time. > Impact on soil texture and soil subsidence in case machinery on different projects uses the same dirt road for movement.	> Groundwaters > Surface waters > Flora and fauna along the route > Population using the land for agricultural purposes	Minor
	Operation	> Increased concentration of hazardous substances in soil due to simultaneous use of pesticides in agriculture and maintenance of railway right of the way. > Increased concentration of hazardous substances in soil in case of simultaneous accidental spillage of hazardous substances from trains and vehicles on the motorway. However, the probability that this impact will occur is very low.		Moderate
Water quality	Construction	> Increased concentration of hazardous substances in water due to accidental spills on construction sites active at the same time. > Increase leakage from inappropriately disposed waste/spoil from construction activities.	> Surface waters > Groundwaters and aquifers	Moderate
	Operation	> Increased concentration of hazardous substances in water, leaching from the soil due to simultaneous use of pesticides in agriculture and maintenance of railway right of the way.		Moderate

Issue	Project phase	Potential cumulative impact	Key receptors	Impact assessment
		> Increased concentration of hazardous substances in water, directly discharged or leaching from the soil, in case of simultaneous accidental spillage of hazardous substances from trains and vehicles on the motorway. However, the probability that this impact will occur is very low.	> Local population and workers	
Biodiversity and nature	Construction	> Negative impact on biodiversity (habitat fragmentation and loss) due to simultaneous implementation of several linear projects that will require fencing (railway/motorway). > Negative impact on natural movement of animals as a result of temporary increase in population and equipment in the Project area.	> Habitats > Fauna	Moderate
	Operation	> Habitat fragmentation will remain as an impact in the operational phase. The significance is difficult to assess as habitat is already fragmented by the existing railway and other linear objects. With installation of wildlife passages, it can be minimized. However, as the planned railway is going to run in the vicinity of the existing motorway for the most subsections, and as it is going to be fenced, the cumulative impact on ecological connectivity and habitat fragmentation is moderate. > Fauna disturbance by noise and light will be marginal.		Moderate
Land use	Construction	> Only in case of simultaneous implementation with other projects, a negative cumulative impact on land use change (both temporary and permanent) can occur.	> Agricultural land > Local population	Minor
	Operation	> No cumulative impacts are likely during operation.		Negligible
Landscape	Construction	> Negative cumulative impact on landscape may occur due to simultaneous implementation of other projects in the vicinity – increased frequency in use of construction equipment and possible deforestation and removal of vegetation	> Forest and agricultural land > Visual receptors: Population in cities and settlements along the railway alignment	Moderate
	Operation	> Negative impact on landscape in the zone where new several projects intersect. The landscaping activities (revegetation of the area) will be mandatory to compensate for visual impacts arising from a proposed Project.		Moderate
Waste/materials use	Construction	> Negative impacts on water and/or soil due to inappropriately handled/disposed waste/spoil from multiple construction activities. > Inadequate materials storage on multiple construction sites can cause leakage of hazardous materials into water and/or soil. > Increased generation of municipal waste in workers camps that are active at the same time .	> Surface water > Soil > Population in settlements along the railway alignment	Moderate
	Operation	> During operation of the railway and roads/motorways, waste generation in greater quantities can be expected only in case of any major reconstruction activities occurring at the same time.		Negligible

Issue	Project phase	Potential cumulative impact	Key receptors	Impact assessment
		However, the probability of any environmental impacts caused by improperly disposed waste generated during maintenance activities is very low.	> Workers	
Community health and safety	Construction	> Negative cumulative impact on community health and safety can occur due to the simultaneous development of several projects in the observed area, which can lead to more frequent and prolonged interruptions in traffic flow and access to facilities. > A negative potential impact may occur in the summer months when more tourists visit the Project area, as well as during religious holidays when the frequency of vehicles is increased.	> Population > Local economy > Workers	Moderate
	Operation	> The main negative impacts that may occur during operation are related to traffic interruptions in case of train breakdowns and simultaneous disruption of road traffic due to construction works or accidents.		Minor
Employment and procurement opportunities	Construction	> The simultaneous implementation of multiple projects, there may be an increase in employment in the Project area.	> Local population > Local economy	Positive
	Operation	> Railway infrastructure modernisation is expected to lead to better connections with other parts of the country which opens opportunities for the development of the local economy. Along with the implementation of other projects, there will be possibilities of employment of the local population.		Positive

9 Management of Impacts and Risks

The purpose of this chapter is to provide a summary of the impacts/risks assessed in the previous chapter and a summary of the mitigation measures (which are elaborated in detail in the Framework ESMP).

Mitigation measures are proposed for impacts rated as *significant* in the previous chapter.

The two tables below present the summarised impacts/risks and mitigations for the: a) pre-construction and construction phase; and b) operation/maintenance phase.

PRE-CONSTRUCTION AND CONSTRUCTION

Topic	Phase	Summary of impacts/risks	Proposed further activities/ mitigation measures
Inadequate Project design and planning of works	Pre-construction	> Inadequate Project design and planning of works may impact habitats, flora and fauna	> Review of Project design and review the possibility of alterations in order to avoid and minimize the impact on biodiversity in the early stages of the project. Changes should be informed by biodiversity survey findings and may include recommendations for construction of wildlife passages (under/overpasses) and areas that must be avoided during construction of access roads or other structures.
Lack of up-to-date baseline data	Pre-construction	> Lack of up-to-date baseline data on flora and fauna may result in previously avoidable loss	> Detailed pre-construction surveys covering all four seasons must be performed for each subsection before the start of construction.
Potential effects on groundwater quality, flow and recharge	Pre-construction	> Negative impact on groundwater regime (direction of flow and velocity) as well as on spring yield due to the construction of tunnels > Reduction in groundwater quality	> The Contractor will undertake a detailed geotechnical investigation, as part of Main Design development and before the start of construction works.
Lack of data on surface water quality, groundwater quality, soil quality, and noise and vibration levels in the Project area (near the railway alignment)	Pre-construction	> There is no baseline data to be used to follow the impact of the Project implementation on the environment	> The Contractor will: > Conduct baseline groundwater analysis in piezometers previously used for hydrogeological research > Conduct baseline surface water quality measurements at the locations where the existing and proposed railways run over or nearby watercourses. Detailed locations and monitoring frequency will be defined in Project specific ESMPs for each subsection (next Project stage). > Conduct baseline soil quality monitoring along the railway alignment (at approx. 0.5-1.0 m from the alignment), at locations where the new railway follows the existing one. Detailed locations and monitoring frequency will be defined in Project specific ESMPs for each subsection (next Project stage). > Determine the noise and vibration baseline levels of the site and the surrounding area.

Topic	Phase	Summary of impacts/risks	Proposed further activities/ mitigation measures
Closure of stations and halts	Pre-construction	> Impacts on local communities which rely on railway transport, especially communities where vulnerable categories live and which may not have alternative transport options available	> Once the final decisions on closure of stations/halts are made and a detailed assessment of impacts of such closure is carried out within future ESIAs, SRI will liaise with local authorities on each subsection where such closure is planned, to agree on and organise alternative transport options such as minibus lines for these villages or other means of transport.
Closure of level crossings	Pre-construction	> Impacts on people currently using the level crossings on the existing railway, especially for agriculture purposes	> Once the detailed assessment of impacts of closure of level crossings and construction of overpasses/underpasses to replace level crossings is carried out, SRI will consult with the local authorities on the issues of sufficiency, dimensions and safety considerations of these structures. > Meetings will be held in local communities along the Project footprint in the final design stage, to clearly present all planned underpasses and overpasses, hear the views of local residents in relation to access to their land and make changes if possible, to accommodate their needs. > Before the start of construction, the same process will be organised to ensure that people affected by the Project are informed of design decisions including explanation of rationale for such decisions (from technical, financial, safety and other aspects) and that they have information about how and where they can access their land on the other side of the railway (construction site) and the contact details of the Contractor for any grievances.
Land acquisition and resettlement	Pre-construction	> Acquisition of private land and relocation of households/ businesses	> Development and implementation of site-specific Resettlement Action Plans in line with the Project's Resettlement Policy Framework (which is part of the Project's Disclosure Package).
Habitat loss and alteration	Construction	> Most sensitive receptors are small waterbodies that may be affected by (i) drying out and (ii) disruption of connection with rivers. The areas affected also include railway relocation areas	> Development and implementation of Construction Biodiversity Management Plan that must elaborate on methods and demarcation of vegetation clearance areas, areas designated for machinery movement, waste disposal and similar. In the places where the railway crosses marsh habitats, it is necessary to provide water culverts, so that the hydrographic regime of the surrounding habitats remains unchanged. > The Plan must also include measures to ensure no net loss of priority biodiversity features and net gain of critical habitats. Access roads and temporary facilities are not allowed in protected areas or EAAA of CH and PBF unless there is no other feasible location. In that case, additional mitigation must be implemented. Disposal of waste and spoil is not allowed in protected areas or EAAAs of PBFs and CHs.
Spread of invasive species	Construction	> Invasive plant species are common and well established in the Project area, the construction may facilitate their spread	> Preventive measures of invasive species eradication and control must be implemented. > Development and implementation of Construction Biodiversity Management Plan.

Topic	Phase	Summary of impacts/risks	Proposed further activities/ mitigation measures
Mortality of fauna	Construction	> Animals may collide with the large machinery moving on construction sites	> Main mitigation measure is fencing of the construction site. > Development and implementation of Construction Biodiversity Management Plan.
Noise and vibration impact on fauna during sensitive periods (breeding, nesting…)	Construction	> Construction works will produce noise and vibration that may temporarily affect flora and fauna	> Development and implementation of Construction Biodiversity Management Plan. The Plan must include measures relating to timing of works and minimization of noise and vibrations.
Pollution by organic waste, chemicals	Construction	> Use of herbicides, pesticides, spillages of chemicals and accumulation of organic waste at the construction site may cause adverse impacts on flora and fauna	> Use of herbicides, pesticides in vegetation clearance should be implemented when no other method is feasible. > Management of (organic) waste in a way that will not attract fauna in search of food and shelter. > Development and implementation of Construction Biodiversity Management Plan.
Air quality	Construction	> Reduction in air quality due to: (i) emissions of construction dust as a result of demolition works, earthworks, transport and disposal of excavated materials, (ii) emissions of exhaust gases from combustion processes in construction equipment and vehicles	> Development and implementation of a Construction Air Quality and Dust Management Plan, which will include set of measures to mitigate the negative impacts of railway construction on air quality. The plan will be focused on measures to control dispersion of dust, emissions of the machinery and measures for stockpile management.
Noise and vibration levels in the Project area of influence	Construction	> Impact on workers, residents, and fauna from increased levels of noise and ground-borne vibration during construction works as a result of tunnelling, earthworks, pilling or potential blasting > Structural damage from vibration caused by equipment and operation methods employed including potential use of explosives	> The Contractor will develop a Construction Noise and Vibration Management Plan, which will include the best construction practices to mitigate the negative impacts of noise and vibration. These will include activities like management of noisy construction equipment, implementation of adaptable working protocol, use of low or non-vibratory piling equipment, use of static force compaction, managing the blasting process to reduce blasting vibration, monitoring of the high-risk structures (houses located very close to the works, cultural-heritage objects, etc.) to ensure there is no structural damage done.
Water quality	Construction	> Reduction in water quality due to: (i) erosion, riverbed modification and sediment run-off, (ii) uncontrolled discharge of effluent from construction areas, (iii) inadequately and uncontrolled discharge/ treatment of sanitary wastewater, (iv) emissions of drainage water from tunnel tubes, (v) surface run-off and washout at worksites, (vi) works and maintenance of construction vehicles, (vii)	> The Contractor will be responsible for development and implementation of a Construction Water and Soil Management Plan and to mitigate construction impacts on both water and soil. Within the Plan, the Contractor will adequately identify the work corridor and limit haul routes for material supply, clearly indicating the no-go areas and sensitive locations. Suitable site drainage system will be constructed, and oil separators installed if required by the national authorities. Works within or adjacent to the watercourses will be avoided. > The Contractor will be responsible for development and implementation of a River Crossing Plan. The Contractor will include environmental requirements and control

Topic	Phase	Summary of impacts/risks	Proposed further activities/ mitigation measures
		depositing of waste, into the watercourses, (viii) sediment release into watercourses > Construction activities taking place in locations where the railway crosses the river (e.g., bridges) may temporarily disturb the watercourse flow and connectivity	measures during the construction works near the waterways, including the in-water works, as well as other requirements that will be set in the Water Consent issued by the Ministry of Agriculture, Forestry and Water Management-Water Directorate.
Terrain stabilisation and soil quality	Construction	> Reduction in terrain stabilisation as a result of: (i) deforestation, (ii) soil dewatering, (iii) using heavy machinery and equipment > Temporary disturbance to local land use due to land take for construction activities, as well as negative impact of dust on crops in nearby > Reduction in soil quality as a result of: (i) direct discharge of wastewater, (ii) accidental spillage of fuel and oils from equipment and other chemicals used on construction site (iii) inappropriate waste/spoil disposal, (iv) loss of fertile topsoil	> The responsibility of the Contractor is to develop and implement the Construction Water and Soil Management Plan, that will include among others: measures addressing the vegetation, topsoil and subsoil removal and handling to preserve the soil quality and prevent erosion, measures aimed at containing and removal of accidental spills and associated monitoring of groundwater and soil quality, measures that will minimize the risk of erosion such as building temporary drainage canals and embankments, measures addressing wastewater treatment.
Project impacts on landscape and visual values	Construction	> Changes to the existing landscape and visual impacts due to the construction works and as a result of: (i) clearance of localised areas of tree and shrub vegetation and removal of land cover, (ii) increased level of “urbanisation” due to presence of construction mechanisation, fences and other construction structures, (iii) demolition of properties along the railway alignment, (iv) adverse changes in land use along the railway route	> The Contractor will develop a Construction Planting Management Plan to cover landscaping actions and restore the construction site to its original condition. The Plan will outline the following measures: preserving the structural intensity of the soil, timing of planting activities, tasks to establish and maintain the trees, grass and vegetation in the Project area, woodland planting, use of species of local/regional provenance, compensatory planting for ecological habitats lost to ensure net gain of sensitive habitats.
Waste generation	Construction	> Contamination of environment due to leakage and spillage of wastes associated with poor spoil and waste handling, transportation, and storage/disposal arrangements of different type of waste generated during construction activities (demolition waste, excavated materials, food, packaging, office waste, sanitary waste).	> The Contractor will prepare a Construction Waste Management Plan to cover all activities associated with the production of wastes during construction and maximise reuse and recycling. The measures include, among others: identification of specific types and quantities of waste likely to arise during the construction process, appropriate segregation and storage of hazardous and no-hazardous waste materials, reuse of excavated material either as engineering fill material or in the environmental mitigation earthworks, formation of temporary landfills for construction waste in accordance with the national requirements.

Topic	Phase	Summary of impacts/risks	Proposed further activities/ mitigation measures
		> Environmental damage caused by improper materials/ chemicals management and accidental spillage	
Project impact on climate and climate change impacts on Project	Construction	> Environmental pollution due to GHG emissions form construction activities (construction materials used and equipment) > Negative impacts of landslides, floods, droughts and fires on construction materials and activities	> The Contractor is obliged to apply all the previously listed measures defined in the Construction Air Quality and Dust Management Plan, with the aim of reducing GHG emissions generated during the construction phase, and thus to reduce the negative impact of the Project on the climate. > The Contractor will develop and implement a Construction Emergency Preparedness and Response Plan to eliminate hazards and reduce potential negative impacts including those arising from climate changes (e.g., floods).
Impacts on cultural heritage	Construction	> Construction related impacts and nuisances such as noise, vibration and dust > Access roads leading to some cultural heritage sites could potentially be affected by heavy traffic, as it is assumed that these roads will be used for the passage of machinery during construction works > Possibility of chance finds	> SRI will ensure that relevant institutes for cultural heritage protection are consulted during the issuing of Location Conditions for each subsection. > The Contractor will develop a Cultural Heritage Management Plan which will cover the following: consultations with local authorities; supervision of all earthworks by an archaeologist; specific actions and measures to manage risks and impacts to cultural heritage sites as well as local cultural events in the Project area; and development of a Chance Find Procedure detailing necessary steps to be taken should any culturally significant assets be found.
Temporary occupation of land, and land use/access restrictions	Construction	> Temporary occupation of privately owned land for construction of access roads and placement of staff, machines and material > Damage to land plots, natural or other assets due to temporary disposal of excavation materials and heavy machinery parks > Temporary access restrictions and reducing the ability of local farmers, public facilities and businesses to operate as normal	> The Contractor will ensure access to all community infrastructure and roads in the Project area – in case of any unavoidable temporary access restrictions, the Contractor will inform local authorities and the public in advance of works commencing. > Any temporary occupation or damage to private assets will be compensated in line with subsection specific RAPs (to be developed based on the Resettlement Policy Framework which is part of the Project's Disclosure Package).
Labour and working conditions	Construction	> Potential risks of lack of implementation of HR policies and procedures by contractors (informal work, child labour, forced labour, etc.)	> The Contractor will develop a Construction Labour and Employment Plan, as well as a Construction Workers' Code of Conduct. > For workers' accommodation, the Contractor will develop a Workers' Accommodation Management Plan in line with IFC/EBRD Guidelines. > An independent labour audit at regular frequency during construction will be organised by SRI.
Increased employment opportunities	Construction	> Temporary local employment opportunities for nearest local communities	> The Contractor will, to the extent possible, employ local workers by providing preference to suitably qualified and experienced applicants from local communities that are in close proximity to the Project. Details of employment opportunities for

Topic	Phase	Summary of impacts/risks	Proposed further activities/ mitigation measures
		> Possible opportunity for employment of Roma population to work on construction, especially in Nis	locals, including how employment opportunities will be advertised, will be included in the Construction Labour and Employment Plan.
OHS	Construction	> Exposure of workers to risks related to activities performed on construction sites, such as demolition and excavation, electrical workers, works at heights, etc.	> The Contractor will develop a Construction Health, Safety and Security Plan, detailing measures to manage OHS hazards.
Worker influx and GBVH	Construction	> Worker camps with a large number of workers on sites > GBVH risks, especially in smaller communities	> Construction compounds will be selected in consultation with affected communities. Construction compounds should be located away from sensitive receptors to the extent possible to minimise any adverse impacts as a result of construction activities. > The Contractor will develop a Construction Workers' Code of Conduct which will also include provisions intended to combat GBVH.
Traffic safety risks and damage to local roads	Construction	> Increased volume of traffic on existing local road network due to construction works, likely leading to traffic limitations, delays and increased road safety risks > Potential damage to local roads by heavy traffic > Safety risks for households living along the railway	> The Contractor will prepare a Construction Traffic Management Plan to ensure all construction works, logistics and travel movements are planned to enable them to be delivered safely and in a manner that minimises congestion, road safety risks and disruption to all road users and local access. > Any damage caused by construction vehicles to public roads will be repaired in a timely manner.

OPERATION/MAINTENANCE

Topic	Phase	Summary of impacts/risks	Summary of mitigation measures
Habitat fragmentation	Operation	> Existing railway is already causing habitat fragmentation; however, the new railway will be fenced which will present an even bigger obstacle to fauna movement and habitat connectivity > The impact can be mitigated during Project design but the impact itself arises during operation	> The impact arises in operation phase but can be avoided/minimized during pre-construction. > Project design should review the need and possibility of including wildlife passages that will minimize this impact. During operation phase, the passages must be maintained in good condition and must be passable for animals. > SRI must develop Operational Biodiversity Management Plan that will address the management of connectivity during operation.
Fauna mortality	Operation	> Fauna mortality during the operation of the railway may be caused by collision with trains and electrocution on powerlines. The most sensitive groups are birds, mammals (bats) and reptiles	> SRI must develop Operational Biodiversity Management Plan that will list mitigation measures for fauna mortality such as bird panels, bird deterrants that will prevent perching on poles, repellents in areas of concern, monitoring of fatalities in order to identify problematic sections and improve mitigation. Construction of wildlife passages in problematic areas that shall be identified during pre-construction surveys will minimize the impact as well. The Plan must also ensure no net loss of PBF and net gain of CH.
Fauna disturbance	Operation	> Fauna disturbance during operation will mainly be caused by noise, vibration and light pollution	> SRI must develop Operational Biodiversity Management Plan that will address the issue of fauna disturbance through measures relating to lighting, technical requirements for noise and vibration management and similar.
Environmental contamination	Operation	> High concentration levels of toxic metals, PAHs, and herbicides could be found in the vicinity of railways. Potential accidents, such as leakages of different types of chemicals (e.g. petroleum products, biocides, fertilizers) from storage tanks may occur. These pollutants can end up in terrestrial and aquatic ecosystems leading to a series of adverse effects on biodiversity	> SRI must develop Operational Biodiversity Management Plan that will include guidelines for maintenance of railway right-of-way and adjacent areas in a way that will prevent contamination.
Air quality	Operation	> Reduction in air quality due to reconstruction and maintenance works (as defined for construction phase)	> SRI will develop and implement an Operational Air Quality Management Plan, which will address maintenance and reconstruction works that may include demolition and reconstruction activities.
Noise and vibration levels in the Project area of influence	Operation	> Impact on residents and biological functions from increased levels of noise, vibration and micro-pressure effect from railway traffic > Impact on workers from increased level of noise and vibration from rolling stock and machinery during maintenance activities	> SRI will develop an Operational Noise and Vibration Management Plan. The Plan will include annual noise and vibration monitoring in zones of residential and other sensitive buildings located in the immediate vicinity of the railway, as well as technical and visual control of noise barriers in accordance with relevant standards.
Water quality	Operation	> Reduction in water quality due to: (i) discharge of untreated sanitary wastewater or contaminated run-off from station facilities, (ii) accumulation of sediment in the area of bridge piers,	> The responsibility of SRI is to develop and implement an Operational Water and Soil Management Plan to prevent water and soil pollution. The focus of the Plan in on control of use of herbicides in the maintenance of right-of-way and harmful

Topic	Phase	Summary of impacts/risks	Summary of mitigation measures
		(iii) discharge of accidentally contaminated run-off from the track drainage system and during the bridge maintenance works, (iv) accidental spill of hazardous material resulting from railway traffic accidents, (v) contamination of surface water during application of herbicides	substances for maintenance of bridges (paints, de-icing fluids, track grease), regular control and maintenance of drainage structures, sediment traps, basin and treatment system.
Soil quality	Operation	> Reduction in soil quality as a result of: (i) direct discharge of surface run-off, (ii) accidental fuel and oil spills, (iii) application of herbicides > Damage of railway infrastructure as a result of terrain instability (landslides and seismic activity)	> The responsibility of SRI is to develop and implement an Operational Water and Soil Management Plan. Measures relevant to the soil protection are the following: controlled application of herbicides to reduce unnecessary overuse and to reduce the risk of leaching to soil and groundwater, regular maintain sediment traps and basins, drainage channels and treatment systems, regular maintain slope stability (cuttings and embankment), verge vegetation will be planted along the affected waterways to minimise soil erosion and reduce suspended matter in surface run-off. > In case of dismantling the existing railway (at locations where the new route deviates from the existing one) and land reuse for agricultural or sports-recreational purposes, it is first necessary to examine the soil quality to determine the possible level of contamination, and then conduct soil decontamination activities, if needed.
Waste generation	Operation	> Contamination of environment due to leakage and spillage of wastes associated with poor waste handling, transportation and storage arrangements of waste generated during operation phase (municipal and packaging waste from passengers that will use the stations, track maintenance waste and ancillary infrastructure waste)	> The SRI will update and continue to implement its three-year Operational Waste Management Plan in accordance with the national Law on Waste Management. The updated Plans shall include, among others, the following mitigation measures: public waste bins inside the stations' facilities will be provided, waste containers for use by the track maintenance personnel and railway station tenants will be provided and waste will be segregated, appropriate collection and disposal of waste products including oil from railway maintenance activities. Used oil should be sent for recycling to the Belgrade Oil Refinery.
Project impact on climate and climate change impacts on Project	Operation	> Negative impacts of landslides, floods, droughts and fires on railway infrastructure	> The SRI will prepare a detailed Operational Emergency Preparedness and Response Plan to achieve appropriate and effective emergency preparedness and response activities for foreseeable emergency events should they arise.
Cultural heritage	Operation	> Operational maintenance activities could lead to disturbances or damage to known cultural heritage or previously undiscovered buried heritage	> SRI will develop an Operational Cultural Heritage Management Plan to ensure that any maintenance activities with the potential to impact known cultural heritage assets are planned carefully and in liaison with relevant institutes for cultural heritage protection, and that those undertaking maintenance activities are aware of the potential for previously undiscovered buried heritage remains to exist when undertaking any intrusive below ground activity.
Gender aspects	Operation	> Effects of closure of stations/halts on women in rural areas who often depend on transport service providers	> SRI will develop a Gender Plan to mitigate gender related effects, including provisions on preventing any GBVH during regular railway operations or during

Topic	Phase	Summary of impacts/risks	Summary of mitigation measures
		> Risks of potential GBVH against women when using underpasses as pedestrians, especially at night	maintenance works; consultations with locally affected women on their issues about the operational phase of the Project – in particular perceptions of safety at stations and underpasses, etc.

10 Guidelines/Recommendations for Further Project Phases

Based on the conducted E&S analysis presented in the previous chapters, it may be concluded that the analysis did not identify any significant or insurmountable issues in terms of compliance with national, EU and Lenders' requirements which cannot be readily mitigated using generally standard measures. It is expected that the detailed subsection specific ESIAs will ensure that all risks/impacts are adequately identified and that appropriate mitigation measures are devised to address these risks/impacts. The only issue of higher risk is the potential negative impact on Vrtiste wetland habitats, but impacts can be avoided if the proposed modifications to the current design are evaluated and an alternative accepted – as described below. If such variant is not feasible, impacts could be minimised by extensive mitigation efforts.

Specific guidelines and recommendations for both the **design stage and the ESIA stage** are provided below:

Specific guidelines/recommendations for the design stage:

1. Biodiversity surveys have shown that locality Vrtiste, located along the subsection Djunis-Medjurovo, is of high ecological value. It is a rare wetland habitat in South Serbia. This habitat was created artificially by relocating the Nisava river, but few years later, after the semi-natural vegetation occupied the area, it has become an oasis for birds in context of nesting and migration. In just one day of field research 29 species of birds were recorded, some of which are very rare in southern Serbia and the entire country. Additionally, the species *Coenagrion ornatum,* listed in Annex II of the Habitats Directive is also present at the locality. Populations of this species are very rare and have local character; therefore, any changes in water regime caused by this project may have significant impact. At that locality, relocation of the railway by approx. 180 m is planned that will directly impact and very likely result in direct loss of some habitat and potential drying up of that wetland. **The Project design in this area needs to be reconsidered**. An alternative that follows the existing alignment should be proposed, analysed and evaluated in the context of feasibility and defined criteria in order to potentially avoid a major impact on biodiversity in the early stages of the Project.

Figure 119: Wetland habitats near Vrtiste (existing railway – green, planned railway – yellow, wetland habitats – red)

2. Access roads, worker accommodation or other (temporary) structures must not be built inside protected areas, ecologically appropriate areas of analysis of PBFs or CHs. This shall be permitted only if there is no other feasible alternative and must be accompanied by adequate and reciprocal mitigation and/or offsetting strategies to ensure no net loss/net gain.
3. The project design needs to comply with applicable national design standards, which will include designing appropriate environmental parameters (flood, ground stability) including climate change. The relevant EN European/Serbian (SRPS) standards for railway design will also be taken into account, along with Technical Specifications for Interoperability (TSIs), including but not limited to the TSI for persons with disabilities and with reduced mobility.
4. New access roads or realignment of existing roads must be designed with considerations to minimise impacts, taking into account the requirements of the Location Conditions (once issued for each subsection).
5. All planned bridges and culverts must have a satisfactory hydraulic profile for the passage of high waters. The railway structures must be protected from the harmful effects of water by building protective structures (stone embankments, retaining walls, stabilisation sills, etc.). At the crossing points of the railway line and the defensive embankment, it is necessary to enable the unhindered passage of construction machinery in order to maintain the embankment and watercourse bed (excavator, truck, mower) so that the lower edges of the bridge structure will be at least 3.0 m above the crown of the embankment.
6. Anticipate the protection of the railway embankment and a sufficient number of culverts on the Velika Plana-Gilje section, and especially Paracin-Stalac, where the railway line represents an obstacle for the smooth flow of water during floods.
7. The *Study of Technical Measures for Environmental Protection* must be developed as part of the Main Design (so-called Design for Construction Permit), which will cover noise issues through a separate chapter – Noise Study. The Project will include the noise barriers optimisation (location, height and length), as well as optimisation of the other noise protection measures. The Project shall cover the entire railway section Belgrade-Nis (it can be divided in the subsection according to the construction work organisation) with additional site evaluation of the individual properties and further refinement of the noise model. The design of noise barriers shall comply with provisions of the National and European legislation, and the Technical Specifications for Interoperability (TSI), as well as corresponding standards: SRPS EN 16272-1, SRPS EN 16272-2, SRPS EN 16272-3-1, SRPS EN 16272-3-2, SRPS EN 16727-1, SRPS EN 16727-2-1, SRPS EN 16727-2-2, SRPS EN 16727-3, SRPS EN 16951-1 and SRPS EN 16951-2. The acoustic panels that will be used for noise barriers shall have sound absorption of minimum 12 dB (class A4 in accordance with SRPS EN 16272-1) and soundproofing of minimum 25 dB (class B3 in accordance with SRPS EN 16272-2). All elements of noise barriers shall be grounded. The efficiency of the grounding system for the chosen type of noise barriers shall be verified by professional accredited institution. The lightning charge current test shall be carried out to reach the effective value of 40 kA and pulse duration of 100 ms minimum. The acoustic panels shall have service life of minimum 20 years without major changes in their acoustic and non-acoustic performances. The acoustic panels and/or complete noise barriers shall be suitable for the installation next to the railway lines with maximum permitted speeds up to 200 km/h. For residential buildings and other sensitive buildings for which protection by noise barriers is not economical or technically possible, and for buildings where exceeding noise level occurs even after installation of noise barriers, some other protection measures shall be planned such as replacement of doors and windows with better sound insulation.

Specific guidelines/recommendations for future ESIA development:

In addition to standard ESIA scope of work, the following specific guidelines and recommendations are given for the phase of ESIA development per subsections:

1. Analysis of impacts of planned **new access roads** and necessary deviations to existing roads once this information becomes available
2. Analysis of community severance impacts during both construction and operation phases
3. Visits to all settlements with **stations and halts** planned to be closed and carrying out consultations with these local communities to better understand use of these stations/halts and the impacts of closure, including whether these settlements have alternative transport options
4. Analysis of locations of all **level crossings** to be closed and locations of planned underpasses or overpasses and carrying out consultations with these local communities to understand impacts on local population, particularly impacts on agricultural activities per subsection
5. In addition to analysis of vulnerable categories, organising focus groups with **Roma people living in Mladenovac** where Roma people live by the railway station and may need to be relocated before construction can begin, and further consultations with the National Council of the Roma Minority in Serbia The railway will be fenced in full; therefore, **identification of locations of fauna passages** must be performed based on the baseline surveys covering all four seasons in order to minimize habitat fragmentation
6. Critical habitats and priority biodiversity features are present in the Project AoI, therefore the ESIA will need to ensure that the objectives of **no net loss/net gain** of such features are reached.