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2 Appendix 4 - Biodiversity Survey Reports

In March 2021, ENOVA was commissioned to conduct an environmental and social assessment referring to the Corridor X section Belgrade-Nis. Information on biodiversity of the area along the planned railway was obtained through field research and analysis of available literature and project documentation. The following field research has been done and results are included in Appendix 4 to the Environmental and Social Assessment Report:

- Habitats and flora
- Invertebrates
- Ichthyofauna (fish)
- Herpetofauna (amphibians and reptiles)
- Ornithofauna (birds)
- Mammals.

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.

3 Habitat and flora survey report

3.1 Methodology

The assessment was conducted by Aleksandra Trajkovic, MSc, PhD student, who is currently employed as a Research Trainee at the Department of Biology and ecology, Faculty of Mathematics and Sciences, University of Nis.

Given the large scale of the project, the preparational phase of the research study was dedicated to to finding and selecting appropriate areas that will provide a good inside into the status of habitats and vegetation along the entire section. As most of the available scientific articles bypass the narrow stripe of land around the railway, the information gathered through literature survey was miniscule and was used purely orientational. Based on the existing data about flora and habitats in relative proximity (2-5 km), as well as the heterogeneity of the assumed habitat types and vegetation cover, preliminary polygons were drafted using Google Earth Pro Satellite Imagery. The definite length of the chosen polygons was decided after visual inspection and sampling. A total of nine representative polygons was created and named by numbers in ascending order (Nis-Belgrade direction). 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.

The research plan contained preliminary sample and survey points, chosen based on the observable landscape compositional and configurational heterogeneity, the availability of relevant data, proximity to known sensitive habitat types and accessibility. After the field visit, the points were adjusted or replaced, if necessary, especially in the case of drastic differences between the assumed and the actual state. Each point was designated to either a sample (inventory) or a survey point (visual inspection for determining habitat type), in cases of agricultural land, unacessible areas, species-poor points, monodominance and private properties. A total of 27 sample points and 42 survey points is distributed along the project area, within the described polygons (See 4.1).

The floristic inventory for the sample points was conducted either directly in the field or by collecting voucher specimen for laboratory identification. The classification of the present habitat types follows EUNIS version 2012 (amended 2019), and the digitalization was perfomed using ArcGISPro.

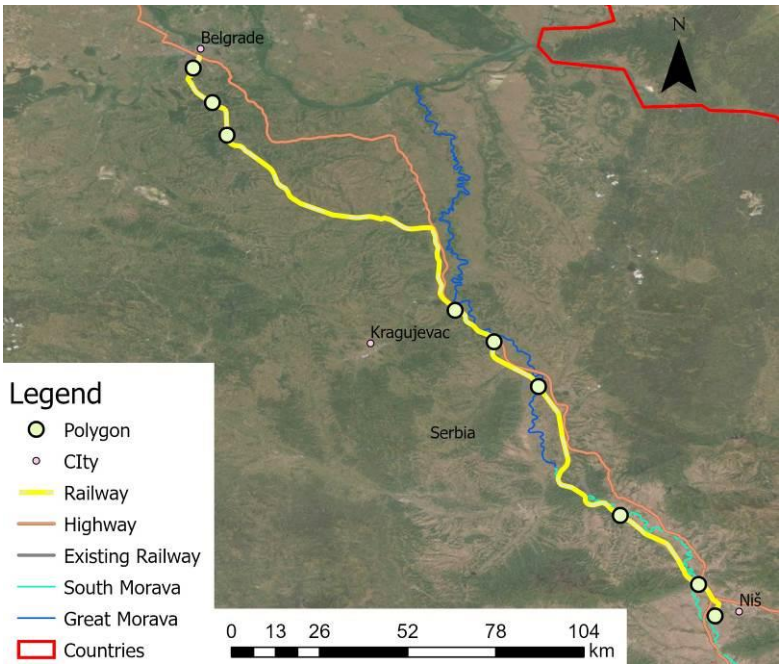


Figure 1: The location reference for surveyed polygons

Table 1: 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
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

No.	Longitude	Latitude
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

Table 2: 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
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

No.	Latitude	Longitude
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

3.2 Assumptions and Limitations

The total length of the Nis-Belgrade railway and the duration of the study the assessment of vegetation cover and habitat types was not possible for the entire project area (500m buffer zone). The existent railway, the vincinity of the A1 (E-75) highway, and the large percentage of agricultural land, already heavily modified the present habitats, leaving them mostly artificial or semi-natural. This uninevitably lead to the general scarcity of the literature data that could be, with certainty, directly used for the assessment of the mentioned buffer zone. Eventhough the rivers South and Great Morava did determine the landscape of the polygons 1–6, the intensive exploitation of sand and gravel, along with the disorganized watercourse management, resulted in severe habitat loss. Fieldwork confirmed that, eventhough some elements of the original habitats still exist, the extent of the natural vegetation patches does not qualify them for the assumed EUNIS classification.

Despite using The National Forest Inventory of Serbia for delimitation of private and state-owned woodland and forest properties, some of the planned sample points were modified into survey points due to the encountered fencing. A large number of small waterbodies of different origin along the South and Great Morava rivers are unaccesible, so the vegetation surrounding them had to be evaluated by using binoculars and by consulting the Sportfishing Association of Nis which kindly provided some insight into the year-round state of these changing habitats.




Figure 2: Physical limitations in the survey: fencing, no traspassing, private properties around state-managed forests, gas installations, factories, active sand and gravel separation

The calculation of losses in the project footprint zone, as well as the potential habitat loss (see 3.2) cannot encompass the complexity of the project when performed in the given spatiotemporal frame and it should be used as orientation. Factors that should be taken into consideration are rack of information about the framework of the reconstructional works in the existing sections of the railway, as well as the quality of the habitat in question and its response to previous disturbance (highway vincinity).

Other limitations were literature data deificiency, the on-going transition between two EUNIS versions habitat hierarechy (the newest version, EUNIS habitat types hierarchical view 2021/2022, provides more inclusive habitat types, especially in the domain of anthropogenic habitats and complexes which dominate in the project area, but the update is still incomplete), and the patchiness of the semi-natural habitats which poses a challenge in classification.

The described fieldwork research covered only the late-spring aspect due to the duration of the project assignment, which left many early-spring and summer flowering species unidentified because of the lack of necessary morphological characters.

3.3 Project Area of Influence

High level of degradation along the railway route, highway vincinity and the fact that the proposed railway route follows the existing railway in most sections indicated that the buffer zone of 500m on both sides will suffice for this assessment. This buffer will be referred to as “the project area” in the following chapters.

3.4 Habitats of the Project Area

Regarding the extent of the entire project area, the chosen polygons represent a realistic sample for assessing the habitats presence. As mentioned, the new railway route goes along two rivers, South and Great Morava. The area is abundant in small waterbodies that mostly originate from sand and gravel extraction, separations, watercourse management, but also natural meandering activity. Riverine vegetation and the abandoned meanders that are relatively frequent in the agricultural zone, surrounded by watercourse on one side and the beginning of hilly area on the other. It mostly consists delicate stripes of *Salix* and *Populu*s woodland, interspersed with invasive species, such as *Amorpha fruticosa*. Inactive extraction sites near the riverbanks are either vegetated with ruderal weeds or completely taken over by phreatophytes such as *Tamarix parviflora*. Because of the flooding nature of South and Great Morava River, as well as the dense network of underground waters in some parts of the project area, agriculture is well developed and diverse. Scaterred 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 a protected area, the forests are clearly degraded, species-poor and prone to invasions. Clearings are artificial, used for hay and regularly fertilitzed. The presence of *Robinia pseudoacacia*

and *Ailantus altissima* 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* and *Quercus cerris*. Reeds, such as *Typha* and *Phragmites* species occur in different habitats and communities, throughout the agricultural land, as remainings 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 completely aritifical and semi–artificial habitats with continouous fragmentation. Proximity of the highway, rich infrastructure, the existing railway as well as the inadequate management of waterbodies already disturbed the project area in great extent. Beside the residential unit and domestic gardens, several polygons include industrial sites, both factories and quarries. If combined for all polygons, a total of 36 EUNIS habitat types have been identified and digitally visualized.

Table 3: EUNIS habitat classification for the project area (combined for all polygons)

EUNIS	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 fertilised 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 thermophilous *Quercus* forests
G1.7C	Mixed thermophilous 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
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[1]. 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 4). 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 4: 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 5. 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 5: 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**
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**

[1] 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
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 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 3). 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 4).

Figure 3: Mixed thermophilous woodland G1.7C with Ruscus aculeatus, Polygon 1

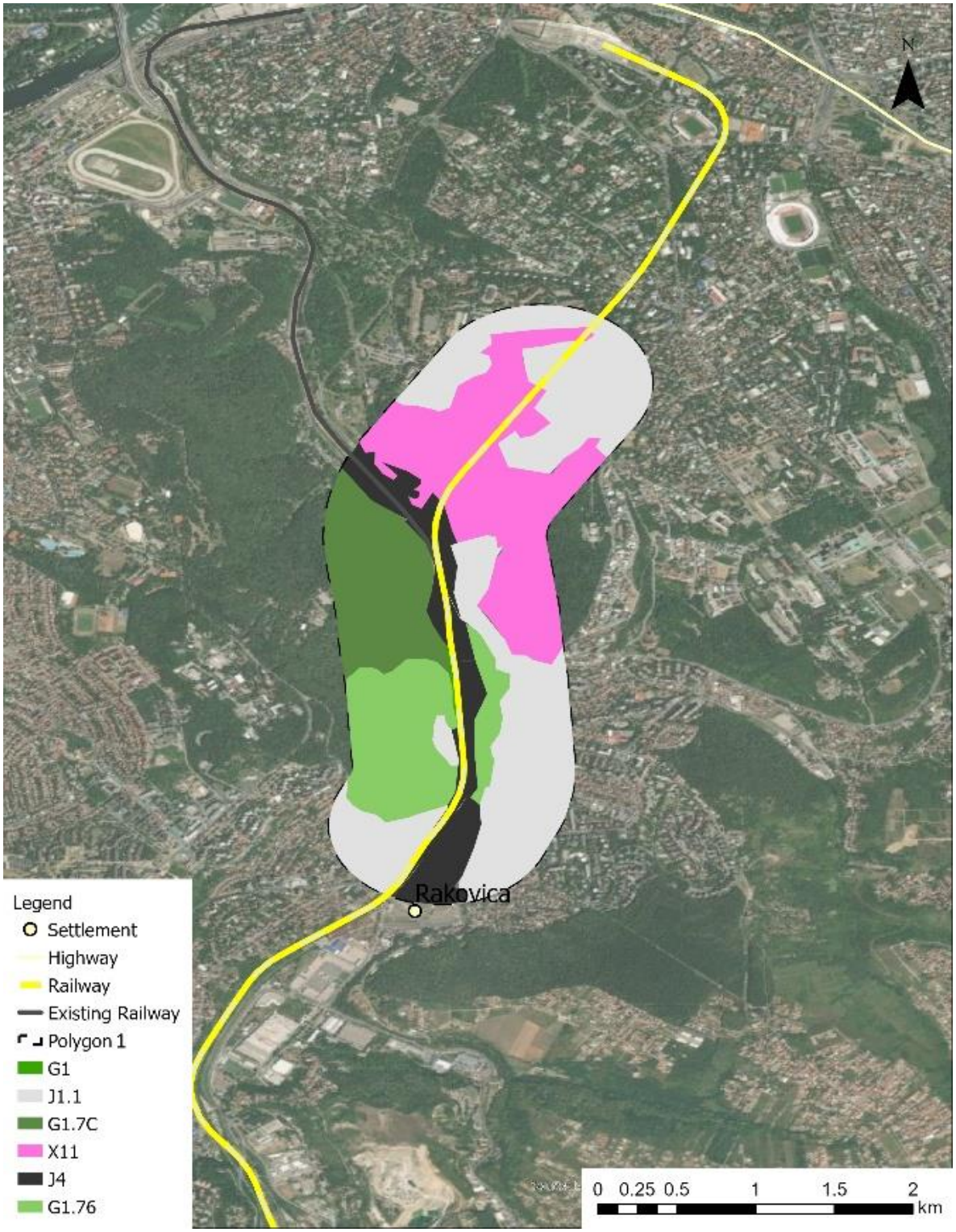


Figure 4: Habitat types registered in Polygon 1

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 5). 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 5: Typha bed in Polygon 2 inundated shore of Topciderska river (left) and broadleaved deciduous woodland (right)

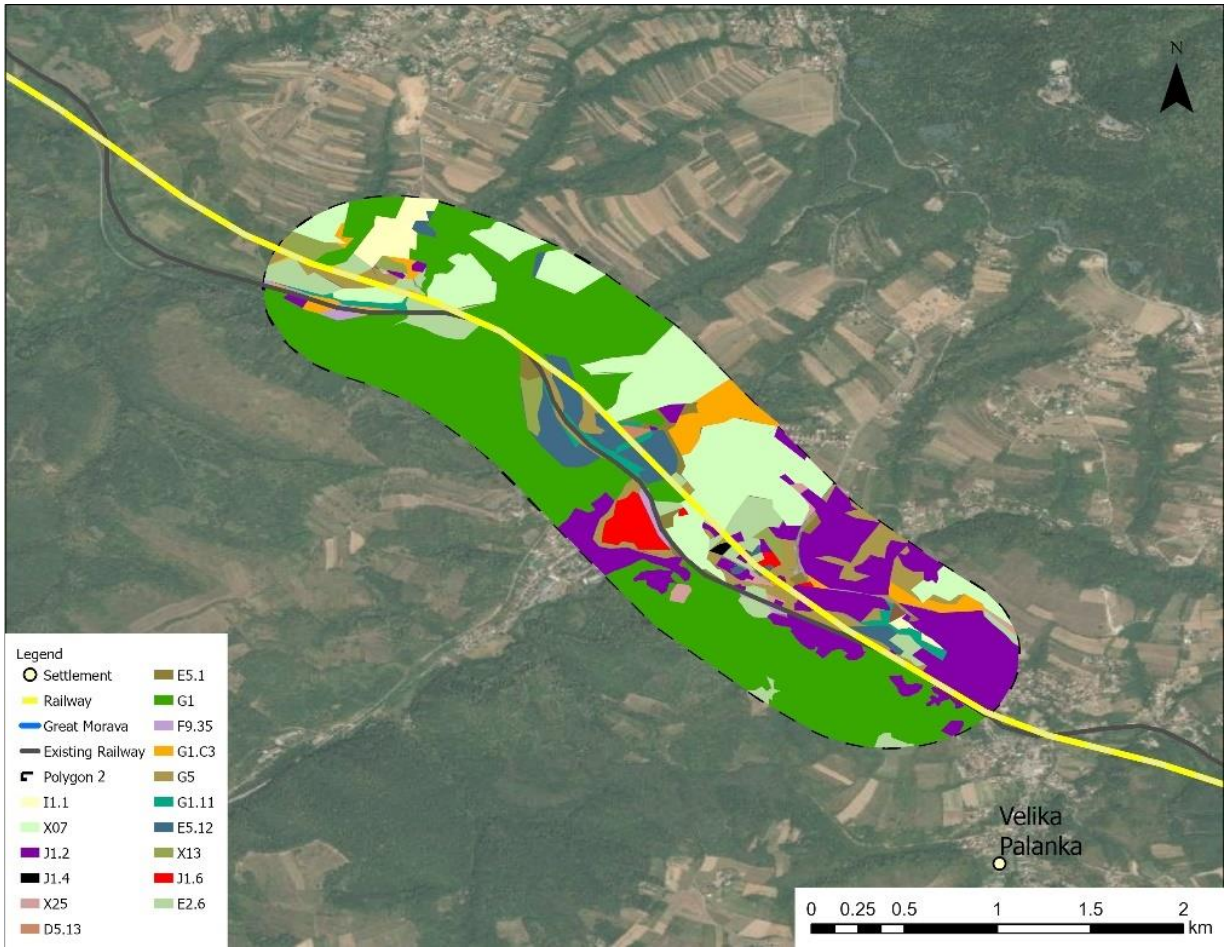


Figure 6: Habitat types registered in Polygon 2

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 7). 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 8).

Figure 7: Broadleaved decidious forests found within Polygon 3

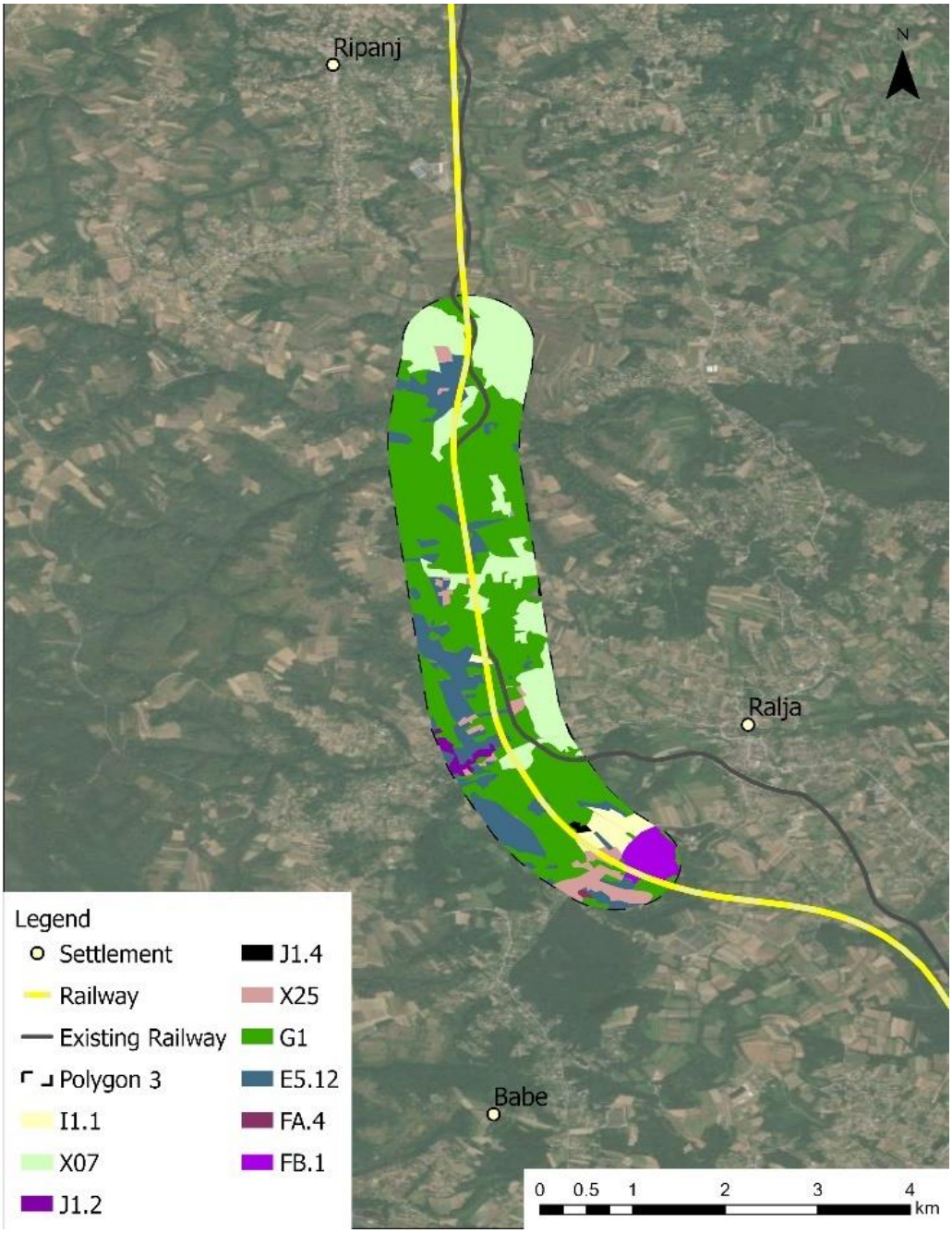


Figure 8: Habitat types registered in Polygon 3

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 9). 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 10).

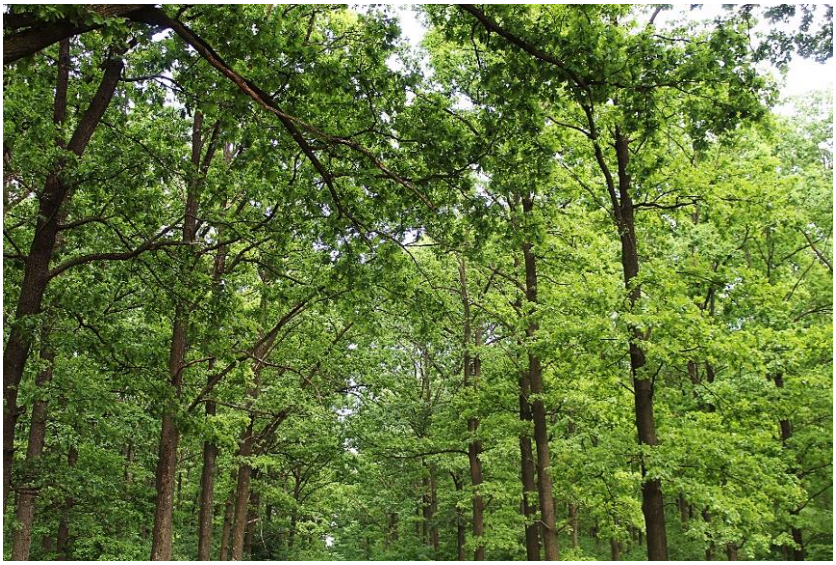


Figure 9: Nature monument Rogot (habitat type G1)

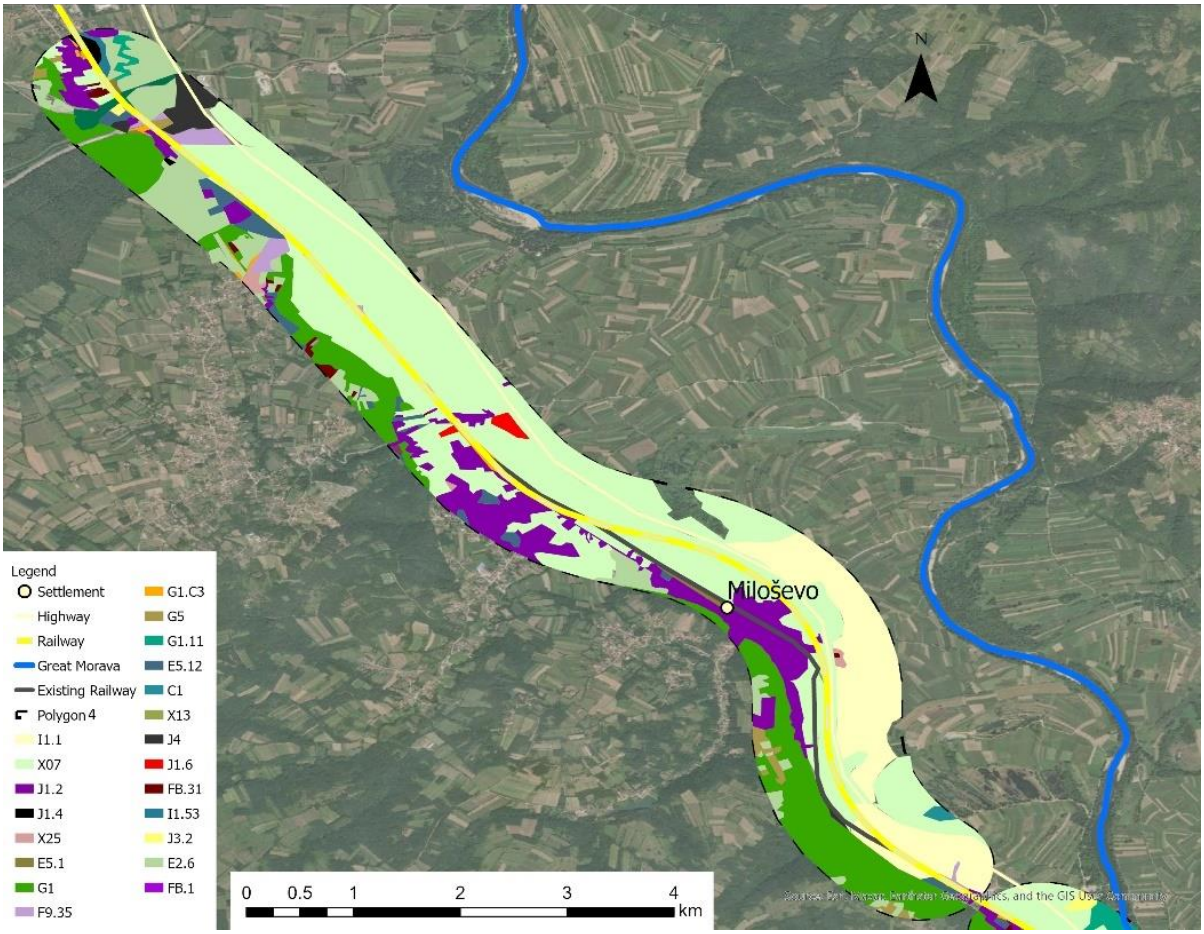


Figure 10: Habitat types registered in Polygon 4

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 11).

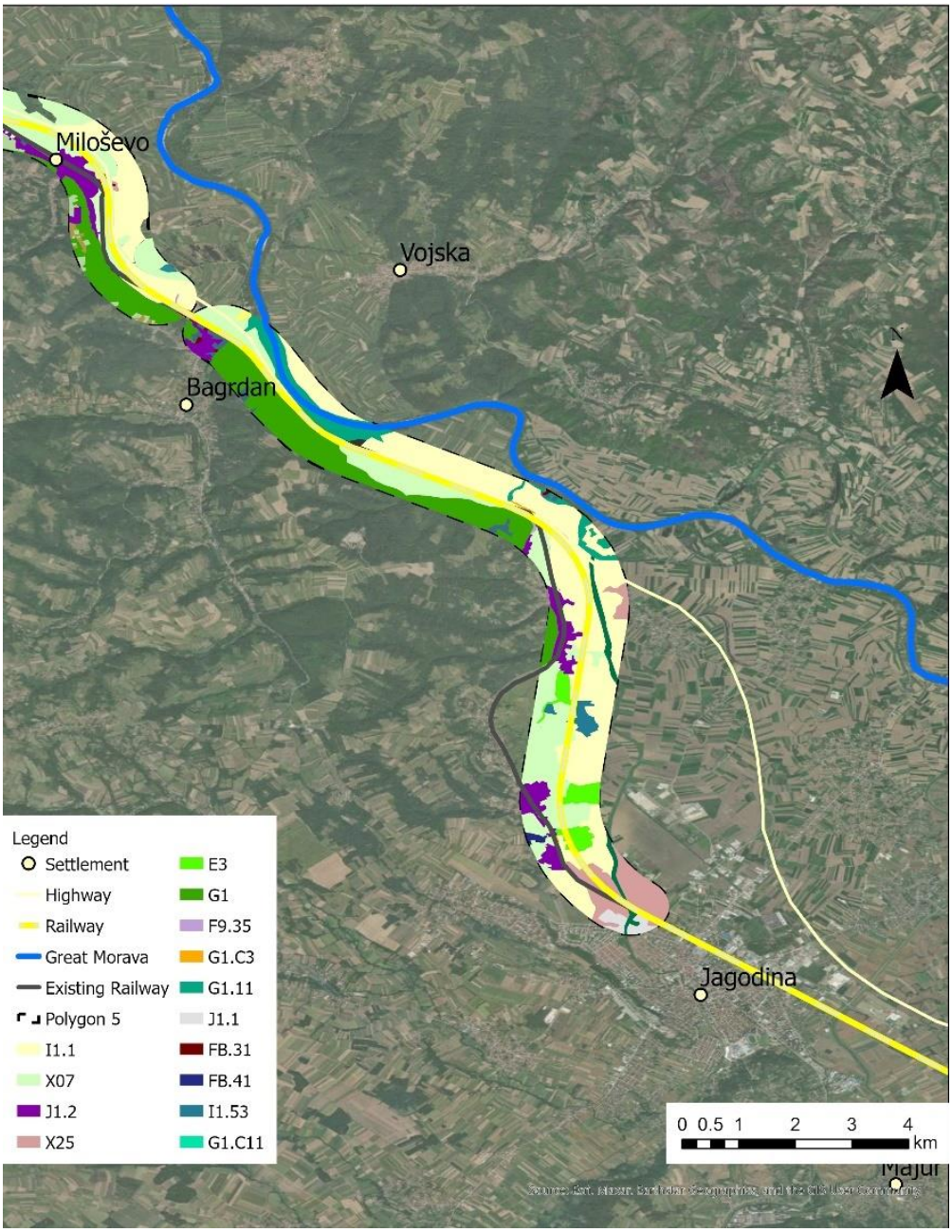


Figure 11: Habitat types registered in Polygon 5

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 13). Near the river, there is a large patch of poplar plantantions (G1.C11) with numerous small waterbodies scattered (

Figure 12). 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 12: Habitat type C1, eutrophic pond located in Polygon 6

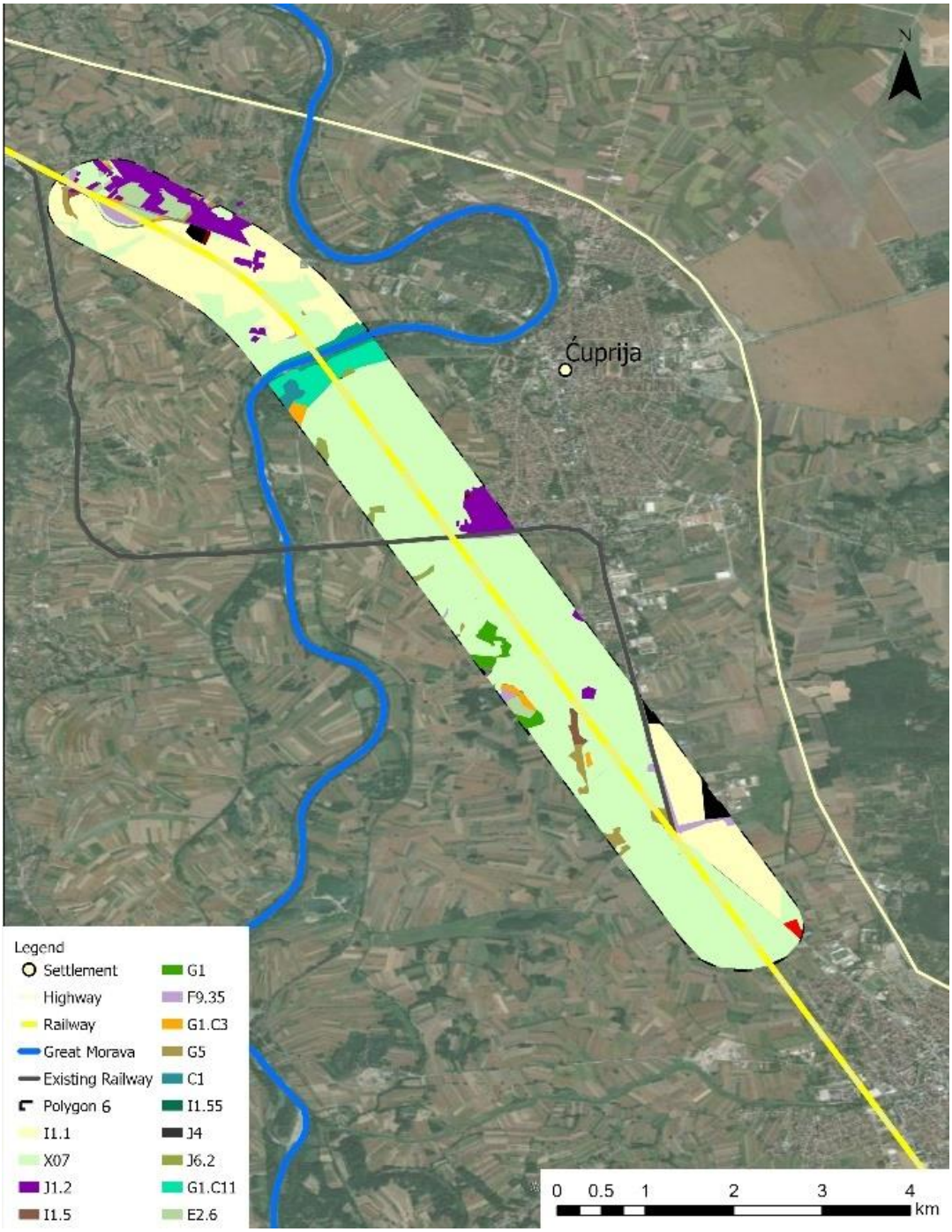


Figure 13: Habitat types registered in Polygon 6

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 14). 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 15).

Figure 14: EUNIS habitat G1 with thermophilous characteristics

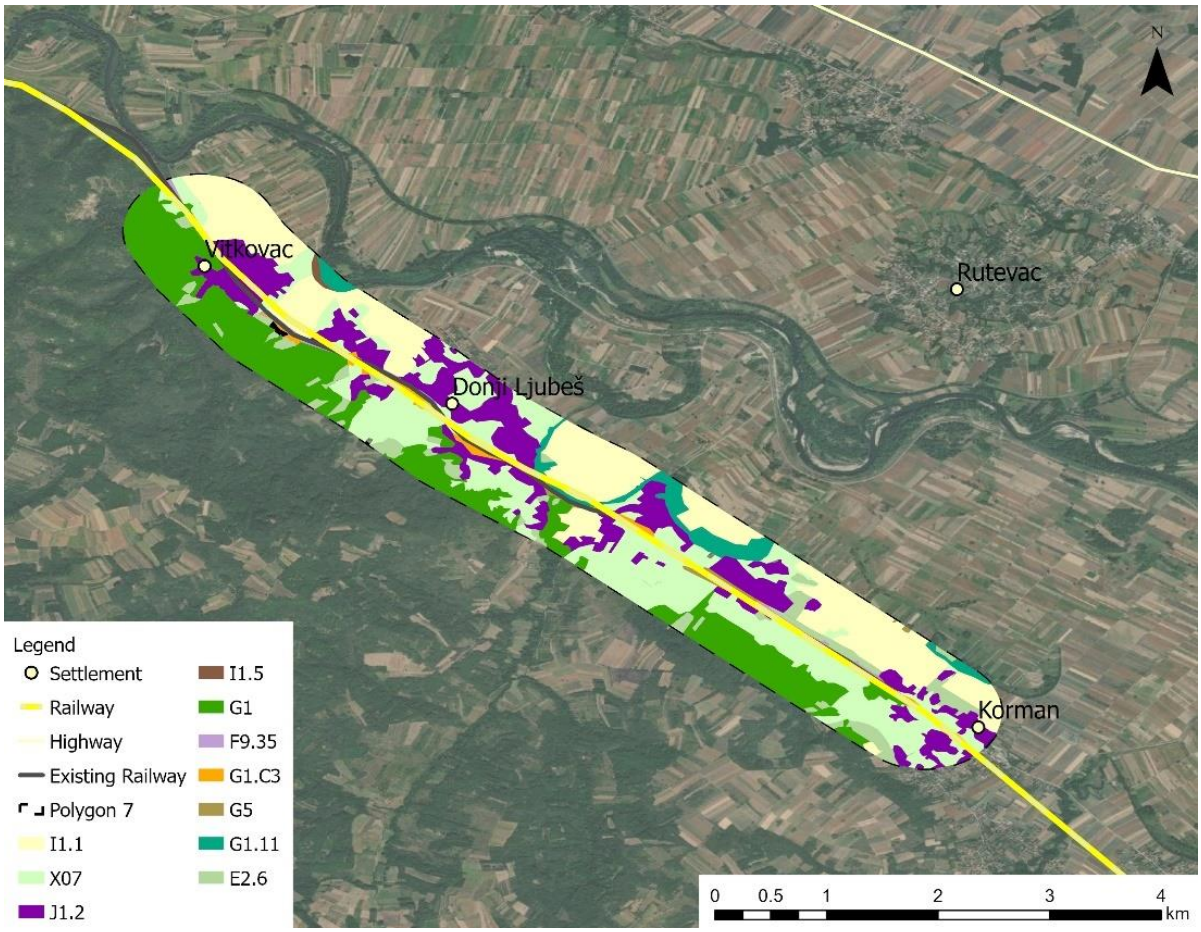


Figure 15: Habitat types registered in Polygon 7

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 16). 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 17).

Figure 16: Phragmites australis(left) and riverine woodland with large patches of the invasive Robinia pseudoacacia (right)

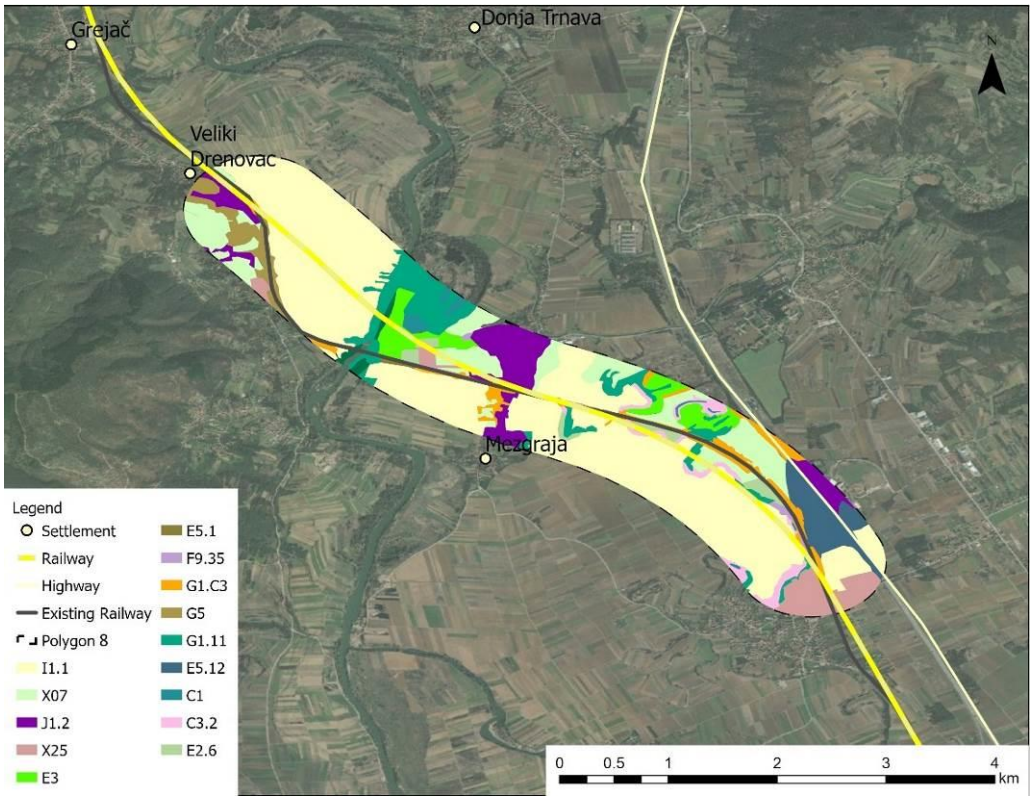


Figure 17: Habitat types registered in Polygon 8

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 18). 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 19). 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 18: Habitat type D5.13 - Typha bed normally without free-standing water

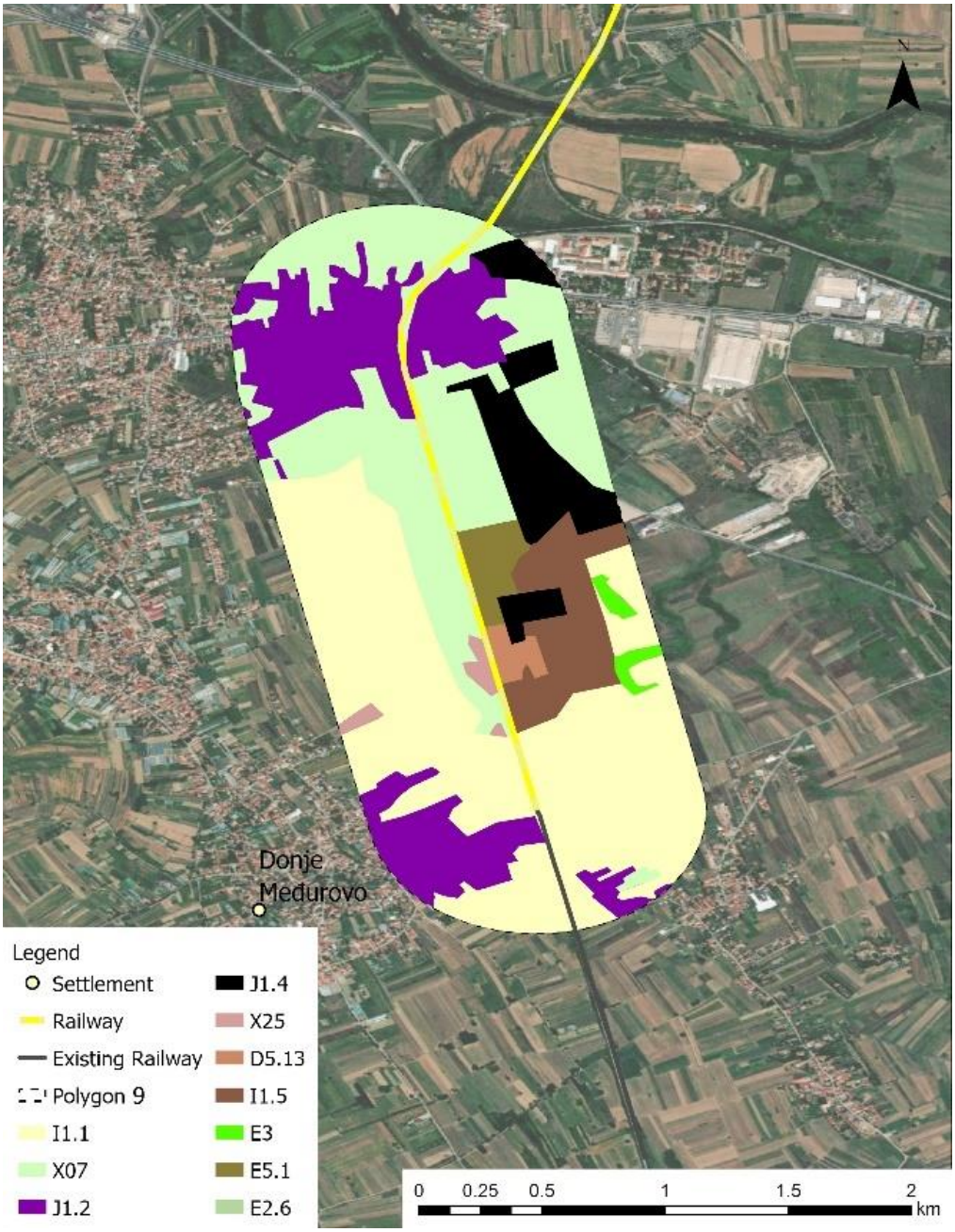


Figure 19: Habitat types registered in Polygon 9

3.5 Flora of the Project Area

For the purpose of creating this assessment, literature data was used only for reference in the research plan phase. Considering the narrow, but very elongated and highly disturbed buffer zone, which already withstood many disturbances, the scarcity of data or specific publications which will cover the area was expected. All recorded species are listed by poligons and sample points in the Table 6.

During the fieldwork research that lasted from 30.04.2022 to 05.06.2022, a total of 212 plant species was recorded by sampling. None of the encountered species are listed in The Red Data Book of Flora of Serbia. No strictly protected species were observed in the surveyed and sampled area. According to the *Rulebook on*

declaration and protection of protected and strictly protected species of plants, animals and fungi[2], some of the observed species are protected in terms of trading and commercial use (*Regulation on the control of the use and trade of wild flora and fauna*[3]):

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

Table 6: Recorded plant species, with reference to sample points and polygons

Poly	Date				
1	30.04.2022.				
SP	Common name	Latin name	SP	Common name	Latin name
1	Cattail	*Typha sp.*	2	Sow thistle	*Sonchus sp.*
2	Bladder sedge	*Carex vesicaria*		Yellow salsify	*Tragopogon dubius*
	Ragged robin	*Lychnis flos-cuculi*		Small white clover	*Trifolium nigrescens*
	Chamomile	*Matricaria chamomilla*		Vetch	*Vicia angustifolia*
	Tormentil	*Potentilla erecta*			
Poly	Date				
2	07.05.2022.				
SP	Common name	Latin name	SP	Common name	Latin name
3	Common agrimony	*Agrimonia eupatoria*	5	Yellow Pea	*Lathyrus aphaca*
	Common bugloss	*Anchusa officinalis*		Hoary cress	*Lepidium draba*
	Greater burdock	*Arctium lappa*		Matrimony vine	*Lycium barbarum*
	Birthwort	*Aristolochia clematitis*		Common mulberry	*Morus alba*
	Meadow brome	*Bromus violaceus*		Parsnip	*Pastinaca sp.*
	Knapweed	*Centaurea sp.*		Broadleaf plantain	*Plantago major*
	Cornflower	*Centaureus cyanus*		White poplar	*Populus alba*
	Old Man's Beard	*Clematis vitalba*		European aspen	*Populus tremula*
	Field bindweed	*Convolvulus arvensis*		Pedunculate oak	*Quercus robur*
	Common dogwood	*Cornus sanguinea*		Black locust	*Robinia pseudoacacia*
	Quince	*Cydonia oblonga*		Dog-rose	*Rosa canina*
	Cat grass	*Dactylis glomerata*		Bramble	*Rubus sp.*

[2] "Official Gazette of RS", No. 5/10

[3] "Official Gazette of RS", No. 31/2005, 45/2005 - corr., 22/2007, 38/2008, 9/2010

Poly	Date				
	Teasel	*Dipsacus sp.*		Patience dock	*Rumex patientia*
	Marsh horsetail	*Equisetum palustre*		White willow	*Salix alba*
	Common stork's-bill	*Erodium cicutarium*		Danewort	*Sambucus ebulus*
	Cypress spurge	*Euphorbia cyparissias*		Common nettle	*Urtica dioica*
	Common fumitory	*Fumaria officinalis*		Mullein	*Verbascum sp.*
	Cutleaf geranium	*Geranium dissectum*		Hungarian vetch	*Vicia pannonica*
	Little-robin	*Geranium purpureum*		European field pansy	*Viola arvensis*
	Wall barley	*Hordeum murinum*	6	Boxelder maple	*Acer negundo*
	Walnut	*Juglans regia*		Corncockle	*Agrostemma githago*
	Hoary cress	*Lepidium draba*		False indigo	*Amorpha fruticosa*
	Matrimony vine	*Lycium barbarum*		Common bugloss	*Anchusa officinalis*
	Common mallow	*Malva sylvestris*		Brome grass	*Bromus violaceus*
	Horehound	*Marubium peregrinum*		Common dogwood	*Cornus sanguinea*
	Parsnip	*Pastinaca sp.*		Cat grass	*Dactylis glomerata*
	Plum	*Prunus domestica*		Galium aparine	*Galium aparine*
	Pedunculate oak	*Quercus robur*		Jerusalem artichoke	*Helianthus tuberosus*
	Buttercup	*Ranunculus Polyyanthemos*		Wall barley	*Hordeum murinum*
	Black locust	*Robinia pseudoacacia*		Walnut	*Juglans regia*
	Dog-rose	*Rosa canina*		Alfalfa	*Medicago sativa*
	Bladder campion	*Silene vulgaris*		Common mulberry	*Morus alba*
	Salsify	*Tragopogon sp.*		Gray poplar	*Populus × canescens*
	Common wheat	*Triticum aestivum*		European aspen	*Populus tremula*
	Common Nettle	*Urtica dioica*		Patience dock	*Rumex patientia*
	Corn salad	*Valerianella locusta*		White willow	*Salix alba*
	Bigflower vetch	*Vicia grandiflora*		Smallflower tamarisk	*Tamarix parviflora*
	Vetch	*Vicia incana*		Small white clover	*Trifolium nigriscens*
	European field pansy	*Viola arvensis*		Hairy Tare	*Vicia hirsuta*
4	Cattail	*Typha sp.*	M	Boxelder maple	*Acer negundo*
5	Boxelder maple	*Acer negundo*		False indigo	*Amorpha fruticosa*
	Summer pheasant's-eye	*Adonis aestivalis*		Common reed	*Phragmites australis*
	False indigo bush	*Amorpha fruticosa*		White poplar	*Populus alba*
	Hedge bindweed	*Calystegia sepium*		Black poplar	*Populus nigra*
	European hornbeam	*Carpinus betulus*		European aspen	*Populus tremula*
	Rough chervil	*Chaerophyllum temulum*		Pondweed	*Potamogeton fluitans*
	Old man's beard	*Clematis vitalba*		Black locust	*Robinia pseudoacacia*
	Wild cucumber	*Echinocystis lobata*		White willow	*Salix alba*
	Little-robin	*Geranium purpureum*		Cattail	*Typha sp.*
	Walnut	*Juglans regia*			

Poly	Date				
3	13.05.2022.				
SP	Common name	Latin name	SP	Common name	Latin name
7	Boxelder maple	*Acer negundo*	8	Multiflowered Buttercup	*Ranunculus Polyyanthemos*
	Garlic mustard	*Alliaria petiolata*		Black locust	*Robinia pseudoacacia*
	False indigo bush	*Amorpha fruticosa*		Bramble	*Rubus sp.*
	Birthwort	*Aristolochia clematitis*		White willow	*Salix alba*
	Common dogwood	*Cornus sanguinea*		Elderberry	*Sambucus nigra*

Poly	Date				
	Flowering ash	*Fraxinus ornus*		Red clover	*Trifolium pratense*
	Cleavers	*Galium aparine*		Large yellow vetch	*Vicia grandiflora*
	Japanese knotweed	*Polyygonum cuspidatum*	9	Boxelder maple	*Acer negundo*
	Grey poplar	*Populus × canescens*		Corncockle	*Agrostemma githago*
	Buttercup	*Ranunculus sp.*		False indigo	*Amorpha fruticosa*
	Bastard cabbage	*Rapistrum perenne*		Birthwort	*Aristolochia clematitis*
	Wood stitchwort	*Stellaria nemorum*		Brome grass	*Bromus violaceus*
	Common comfrey	*Symphytum officinale*		Wild cucumber	*Echinocystis lobata*
	Field elm	*Ulmus minor*		Hoary grass	*Lepidium draba*
	Common nettle	*Urtica dioica*		Common poppy	*Papaver rhoeas*
8	European hornbeam	*Carpinus betulus*		Common reed	*Phragmites australis*
	Common dogwood	*Cornus sanguinea*		Pea	*Pisum sativum*
	Common hawthorn	*Crataegus monogyna*		Black poplar	*Populus nigra*
	Crosswort	*Cruciata laevipes*		Yellow mignonette	*Reseda lutea*
	Cleavers	*Galium aparine*		White willow	*Salix alba*
	Long-stalked crane's-bill	*Geranium columbinum*		Danewort	*Sambucus ebulus*
	Tuberous pea	*Lathyrus tuberosus*		Elderberry	*Sambucus nigra*
	Hoary cress	*Lepidium draba*		Common sowthistle	*Sonchus oleraceus*
	Matrimony vine	*Lycium barbarum*		Common wheat	*Triticum aestivum*
	Alfalfa	*Medicago sativa*		Common nettle	*Urtica dioica*
	Common mulberry	*Morus alba*		Mullein	*Verbascum sp.*
	Black poplar	*Populus nigra*		Vetch	*Vicia incana*
	Pedunculate oak	*Quercus robur*			

Poly	Date
4	14.05.2022. - 15.05.2022.

SP	Common name	Latin name	SP	Common name	Latin name
10	Chervil	*Chaerophyllum sp.*	12	Large pheasant's eye	*Adonis flammea*
	Old man's beard	*Clematis vitalba*		False indigo	*Amorpha fruticosa*
	Cat grass	*Dactylis glomerata*		Greater burdock	*Arctium lappa*
	Cleavers	*Galium aparine*		Birthwort	*Aristolochia clematitis*
	Wall barley	*Hordeum murinum*		Wormwood	*Artemisia sp.*
	Walnut	*Juglans regia*		Old man's beard	*Clematis vitalba*
	Broadleaf plantain	*Plantago major*		Wild cucumber	*Echinocystis lobata*
	Black poplar	*Populus nigra*		Flowering ash	*Fraxinus ornus*
	Black lotus	*Robinia pseudoacacia*		Cleavers	*Galium aparine*
	Patience dock	*Rumex patientia*		Hops	*Humulus lupulus*
	White willow	*Salix alba*		Common mulberry	*Morus alba*
	Elderberry	*Sambucus nigra*		American pokeweed	*Phytolacca americana*
	Common nettle	*Urtica dioica*		Prostrate knotweed	*Polyygonium aviculare*
11	Boxelder maple	*Acer negundo*		Black poplar	*Populus nigra*
	Yarrow	*Achillea millefolium*		Black locust	*Robinia pseudoacacia*
	False indigo	*Amorpha fruticosa*		Patience dock	*Rumex patientia*
	Sweet wormwood	*Artemisia annua*		White willow	*Salix alba*
	Brome grass	*Bromus sp.*		Elderberry	*Sambucus nigra*
	Old man's beard	*Clematis vitalba*		Figwort	*Scrophularia sp.*
	Cantabrican morning glory	*Convolvulus cantabrica*		Saw thistle	*Sonchus sp.*

Poly	Date				
	Common dogwood	*Cornus sanguinea*		Common comfrey	*Symphytum officinale*
	Cat grass	*Dactylis glomerata*		Common nettle	*Urtica dioica*
	Fescue	*Festuca sp.*		Orange mullein	*Verbascum phlomoides*
	Hops	*Humulus lupulus*	13	Shepherd's Purse	*Capsella bursa-pastoris*
	St John's-wort	*Hypericum perforatum*		Pondweed	*Potamogeton fluitans*
	Broom-leaved toadflax	*Linaria genistifolia*		Black locust	*Robinia pseudoacacia*
	Common mulberry	*Morus alba*		White willow	*Salix alba*
	Common poppy	*Papaver rhoeas*		Purple willow	*Salix purpurea*
	Common reed	*Phragmites australis*		Corn salad	*Valerianella locusta*
	Hoary plantain	*Plantago media*	14	Tree of Heaven	*Ailanthus altissima*
	Black poplar	*Populus nigra*		Milk Vetch	*Astragalus glycyphyllos*
	Populus tremula	*Populus tremula*		Chervil	*Chaerophyllum sp.*
	Plum	*Prunus domestica*		Common dogwood	*Cornus sanguinea*
	Black locust	*Robinia pseudoacacia*		Herb robert	*Geranium robertianum*
	Bramble	*Rubus sp.*		Hops	*Humulus lupulus*
	White willow	*Salix alba*		Common reed	*Phragmites australis*
	Elderberry	*Sambucus nigra*		Gray poplar	*Populus × canescens*
	Bladder campion	*Silene vulgaris*		White poplar	*Populus alba*
	Sow thistle	*Sonchus sp.*		Populus nigra	*Populus nigra*
	Common dandelion	*Taraxacum officinale*		White willow	*Salix alba*
	Yellow salsify	*Tragopogon dubius*		Purple willow	*Salix purpurea*
	White clover	*Trifolium repens*		Elderberry	*Sambucus ebulus*
	Bird vetch	*Viccia cracca*		Wild Sweet William	*Saponaria officinalis*
	Vetch	*Vicia incana*		Saw thistle	*Sonchus sp.*
12	Boxelder maple	*Acer negundo*		Hairy Tare	*Vicia hirsuta*

Poly	Date
5	17.05.2022.

SP	Common name	Latin name	SP	Common name	Latin name
15	Summer pheasant's-eye	*Adonis aestivalis*	17	Common dogwood	*Cornus sanguinea*
	Marsh mallow	*Althea officinalis*		Cat grass	*Dactylis glomerata*
	Purua grass	*Bolboschoenus sp.*		Teasel	*Dipsacus sp.*
	Brome grass	*Bromus sp.*		Hops	*Humulus lupulus*
	Bladder sedge	*Carex vesicaria*		Blackthorn	*Prunus spinosa*
	Cat grass	*Dactylis glomerata*		Blacklocust	*Robinia pseudoacacia*
	Teasel	*Dipsacus sp.*		Bramble	*Rubus sp.*
	European ash	*Fraxinus excelsior*		White willow	*Salix alba*
	Wall barley	*Hordeum sativum*		Danewort	*Sambucus ebulus*
	Yellow iris	*Iris pseudacorus*		Elderberry	*Sambucus nigra*
	Walnut	*Juglans regia*		Silver Linden	*Tilia tomentosa*
	Common mulberry	*Morus alba*		Corn	*Zea mays*
	Blackthorn	*Prunus spinosa*	18	Yarrow	*Achillea millefolium*
	Pedunculate oak	*Quercus robur*		Corncockle	*Agrostemma githago*
	Hairy buttercup	*Ranunculus sardous*		False indigo	*Amorpha fruticosa*
	Common comfrey	*Symphytum officinale*		Old man's beard	*Clematis vitalba*

Poly	Date				
	Tansy	*Tanacetum vulgare*		Cat grass	*Dactylis glomerata*
	Red clover	*Trifolium pratense*		Teasel	*Dipsacus sp.*
	Field elm	*Ulmus carpinifolia*		Marsh horsetail	*Equisetum palustre*
	Wych elm	*Ulmus glabra*		Caper spurge	*Euphorbia lathyris*
	Common Vetch	*Vicia sativa*		Cleavers	*Galium aparine*
16	Annual ragweed	*Ambrosia artemiisifolia*		Lady's bedstraw	*Galium verum*
	Mugwort	*Artemisia sp.*		Common reed	*Phragmites australis*
	Brome grass	*Bromus sp.*		American pokeweed	*Phytolacca americana*
	White goosefoot	*Chenopodium album*		Broadleaf plantain	*Plantago major*
	Field bindweed	*Convolvulus arvensis*		Hoary plantain	*Plantago media*
	Cat grass	*Dactylis glomerata*		White poplar	*Populus alba*
	Leafy spurge	*Euphorbia esula*		Black poplar	*Populus nigra*
	Cutleaf geranium	*Geranium dissectum*		European aspen	*Populus tremula*
	Wall barley	*Hordeum murinum*		Buttercup	*Ranunculus sp.*
	Hops	*Humulus lupulus*		Black locust	*Robinia pseudoacacia*
	Red deadnettle	*Lamium purpureum*		Blackberry	*Rubus fruticosus*
	Field forget-me-not	*Myosotis arvensis*		Willow	*Salix spp.*
	Black locust	*Robinia pseudoacacia*		Danewort	*Sambucus ebulus*
	Sow thistles	*Sonchus sp.*		Elderberry	*Sambucus nigra*
	Common danelion	*Taraxacum officinale*		Tansy	*Tanacetum vulgare*
	Common nettle	*Urtica dioica*		Common dandelion	*Taraxacum officinale*
	European field pansy	*Viola arvensis*		Red clover	*Trifolium pratense*
17	Birthwort	*Aristolochia clematitis*			

Poly	Date				
6	21., 22.05.2022.				
SP	**Common name**	**Latin name**	**SP**	**Common name**	**Latin name**
19	False indigo	*Amorpha fruticosa*	21	Common rock-rose	*Helianthemum nummularium*
	Birthwort	*Aristolochia clematitis*		Yellow iris	*Iris pseudacorus*
	Brome grass	*Bromus violaceus*		Tuberous pea	*Lathyrus tuberosus*
	Shepherd's Purse	*Capsella bursa-pastoris*		Chamomile	*Matricaria chamomilla*
	White goosefoot	*Chenopodium album*		White laceflower	*Orlaya grandiflora*
	Field bindweed	*Convolvulus arvensis*		Common reed	*Phragmites australis*
	Jimsonweed	*Datura stramonium*		Broadleaf plantain	*Plantago major*
	Annual fleabane	*Erigeron annuus*		Hoary plantain	*Plantago media*
	Common stork's-bill	*Erodium cicutarium*		Kentucky bluegrass	*Poa pratensis*
	Leafy spurge	*Euphorbia esula*		European aspen	*Populus tremula*
	Spurge	*Euphrobia sp.*		Blackthorn	*Prunus spinosa*
	Red deadnettle	*Lamium purpureum*		Buttercup	*Ranunculus sp.*
	Chamomile	*Matricaria chamomilla*		Bramble	*Rubus sp.*
	Alfalfa	*Medicago sativa*		Patience dock	*Rumex patientia*
	Long-headed poppy	*Papaver dubium*		Willow	*Salix sp.*
	Common reed	*Phragmites australis*		Common nettle	*Urtica dioica*
	Hoary plantain	*Plantago media*		Common Vetch	*Vicia sativa*
	Black poplar	*Populus nigra*	22	Field maple	*Acer campestre*
	Pondweed	*Potamogeton fluitans*		European horse-chestnut	*Aesculus hippocastanum*

Poly	Date				
	Patience dock	*Rumex patientia*		False indigo	*Amorpha fruticosa*
	Willow	*Salix spp.*		Cornelian cherry	*Cornus mas*
	Danewort	*Sambucus ebulus*		Common dogwood	*Cornus sanguinea*
	Elderberry	*Sambucus nigra*		Teasle	*Dipsacus sp.*
	Saw thistle	*Sonchus sp.*		European ash	*Fraxinus excelsior*
	Narrowleaf cattail	*Typha angustifolia*		Lemon balm	*Melissa officinalis*
	Hairy Tare	*Vicia hirsuta*		Wild mint	*Mentha longifolia*
	Vetch	*Vicia incana*		White poplar	*Populus alba*
20	Field maple	*Acer camestre*		Pedunculate oak	*Quercus robur*
	Tree of heaven	*Ailanthus altissima*		Black locust	*Robinia pseudoacacia*
	European hornbeam	*Carpinus betulus*		Dog-rose	*Rosa canina*
	Old man's beard	*Clematis vitalba*		Silver Linden	*Tilia tomentosa*
	Common hawthorn	*Crataegus monogyna*	23	Boxelder maple	*Acer negundo*
	Hops	*Humulus lupulus*		Yarrow	*Achillea millefolium*
	Purple gromwell	*Lithospermum purpurocaeruleum*		False indigo	*Amorpha fruticosa*
	Star-of-Bethlehem	*Ornithogalum sphaerocarpum*		Birthwort	*Aristolochia clematitis*
	Black locust	*Robinia pseudoacacia*		Old man's beard	*Clematis vitalba*
	Field elm	*Ulmus minor*		Cleavers	*Galium aparine*
	Common nettle	*Urtica dioica*		Hoary cress	*Lepidium draba*
21	Corncockle	*Agrostemma githago*		Chamomile	*Matricaria chamomilla*
	False indigo	*Amorpha fruticosa*		White willow	*Salix alba*
	Birthwort	*Aristolochia clematitis*		Balkan clary	*Salvia nemorosa*
	Brome grass	*Bromus sp.*		Wild Sweet William	*Saponaria officinalis*
	Cat grass	*Dactylis glomerata*		Common nettle	*Urtica dioica*
	Sun spurge	*Euphorbia helioscopia*		Mullein	*Verbascum sp.*
	Cleavers	*Galium aparine*		Hairy Tare	*Vicia hirsuta*
	Lady's bedstraw	*Galium verum*			

Poly	Date				
8	04.06.2022.				
SP	Common name	Latin name	SP	Common name	Latin name
24	Field maple	*Acer campestre*	25	European spindle	*Euonymus europaeus*
	Yarrow	*Achillea millefolium*		Fescue	*Festuca spp.*
	Common agrimony	*Agrimonia eupatoria*		Round-leaved bedstraw	*Galium rotundifolium*
	Milk vetch	*Astragalus glycyphyllos*		Cutleaf geranium	*Geranium dissectum*
	Brome grass	*Bromus sp.*		Fragrant helebore	*Helleborus odorus*
	Bellflower	*Campanula sp.*		Broadleaved sermountain	*Silphiodaucus prutenicus*
	Rough chervil	*Chaerophyllum temulum*		Tassel hyacinth	*Leopoldia comosa*
	Common dogwood	*Cornus sanguinea*		Wild pivet	*Ligustrum vulgare*
	Hazel	*Coryllus avellana*		Purple gromwell	*Lithospermum purpurocaeruleum*
	Common hawthrorn	*Crataegus monogyna*		Common honeysuckle	*Lonicera periclymenum*
	Crosswort	*Cruciata laevis*		Rose campion	*Lychnis coronaria*
	Annual fleabane	*Erigeron annuus*		Black Medic	*Medicago lupulina*
	European spindle	*Euonymus europaeus*		Wild mint	*Mentha longifolia*
	Cleavers	*Galium aparine*		Dog's mercury	*Mercurialis perennis*
	Cutleaf geranium	*Geranium dissectum*		Chinese lantern	*Physalis alkekengi*

Poly	Date				
	Fragrant hellebore	*Helleborus odorus*		Hoary plantain	*Plantago media*
	Wild privet	*Ligustrum vulgare*		Solomon's seal	*Polygonatum multiflorum*
	Rose campion	*Lychnis coronaria*		Silver cinquefoil	*Potentilla argentea*
	Wild mint	*Mentha longifolia*		Plum	*Prunus domestica*
	Hoary plantain	*Plantago media*		Turkey oak	*Quercus cerris*
	Silver cinquefoil	*Potentilla argentea*		Meadow buttercup	*Ranunculus acris*
	Plum	*Prunus domestica*		Kashubian buttercup	*Ranunculus cassubicus*
	Blackthorn	*Prunus spinosa*		Black locust	*Robinia pseudoacacia*
	Turkey oak	*Quercus cerris*		Field rose	*Rosa arvensis*
	Black locust	*Robinia pseudoacacia*		Toothed dock	*Rumex dentatus*
	Dog-rose	*Rosa canina*		Somerset Skullcap	*Scutellaria altissima*
	Blackberry	*Rubus fruticosus*		Rogwort	*Senecio sp.*
	Silver Linden	*Tilia tomentosa*		Charlock mustard	*Sinapis arvensis*
	Large-leaved linden	*Tilia platyphyllos*		Common comfrey	*Symphytum officinale*
	Purple clover	*Trifolium purpureum*		Greater meadow-rue	*Thalictrum aquilegifolium*
	Common nettle	*Urtica dioica*		Silver Linden	*Tilia tomentosa*
	Mullein	*Verbascum sp.*		Purple clover	*Trifolium purpureum*
	Bird vetch	*Vicia cracca*		Red clover	*Trifolium pratense*
	Hairy Tare	*Vicia hirsuta*		Wych elm	*Ulmus glabra*
	Hungarian vetch	*Vicia pannonica*		Bird vetch	*Vicia cracca*
25	Field maple	*Acer campestre*		Vetch	*Vicia dumetorum*
	Yarrow	*Achillea millefolium*		Large yellow vetch	*Vicia grandiflora*
	Black bent	*Agrostis gigantea*		Hairy Tare	*Vicia hirsuta*
	Sand leek	*Allium scorodoprasum*	26	Coralroot	*Cardamine bulbifera*
	Asarabacca	*Asarum europaeum*		Fireweed	*Chamaenerion angustifolium*
	Milk vetch	*Astragalus glycyphyllos*		Walnut	*Juglans regia*
	Common daisy	*Bellis perennis*		Prickly Lettuce	*Lactuca serriola*
	Brome grass	*Bromus violaceus*		Cheeses	*Malva sylvestris*
	Creeping bellflower	*Campanula rapunculoides*		Opium poppy	*Papaver somniferum*
	Rough chervil	*Chaerophyllum temulum*		Bramble	*Rubus sp.*
	Common hawthrorn	*Crataegus monogyna*		White willow	*Salix alba*
	Crosswort	*Cruciata laevipes*		Yellow salsify	*Tragopogon dubius*
	Cat grass	*Dactylis glomerata*		Cattail	*Typha sp.*
	Annual fleabane	*Erigeron annuus*		Common nettle	*Utrica dioica*
	Field eryngo	*Eryngium campestre*			

Poly	Date				
9	05.06.2022.				
SP	Common name	Latin name	SP	Common name	Latin name
27	Field maple	*Acer campestre*	27	Fragrant hellebore	*Helleborus odorus*
	Ground elder	*Aegopodium podagraria*		Creeping jenny	*Lysimachia nummularia*
	Tree of heaven	*Ailanthus altissima*		Pokeweed	*Phytolacca americana*
	Ramsons	*Allium ursinum*		Broadleaf plantain	*Plantago major*
	Greater burdock	*Arctium lappa*		Hoary plantain	*Plantago media*

Poly	Date			
	Common daisy	*Bellis perennis*	Heal-all	*Prunella vulgaris*
	Coralroot	*Cardamine bulbifera*	Turkey oak	*Quercus cerris*
	Wood sedge	*Carex sylvatica*	Butcher's-broom	*Ruscus aculeatus*
	Common dogwood	*Cornus sanguinea*	Hedge woundwort	*Stachys sylvatica*
	Annual fleabane	*Erigeron annuus*	Silver Linden	*Tilia tomentosa*
	European beech	*Fagus sylvatica*	Red clover	*Trifolium pratense*
	Flowering ash	*Fraxinus ornus*	Common nettle	*Urtica dioica*
	Cleavers	*Galium aparine*	Early dog-violet	*Viola reichenbachiana*
	Cornelian cherry	*Cornus mas*		

3.6 Identification of Impacts on Habitats and Flora

> Habitat fragmentation

Transportation infrastructure impact is usually reflected in acceleration of habitat fragmentation. The project area is already under a spectrum of anthropogenic factors with similar effect, so it is difficult to evaluate the exact extent the railway impact.

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 will, due to the construction works, and later, changes in humidity level once the railway is functioning will contribute to shrinking of this area.

Broadleaved deciduous woodland G1 is identified in several localities during the survey. Higher EUNIS category (Level 2) was assigned to these localities primarily due to the qualitative attributes of encountered communities. Although not completely preserved, these woodlands are of high value as habitats for many species.

> Drying out small waterbodies

Small eutrophic ponds and pools have been depicting the adaptive power of nature for decades in the Morava Valley area. Rich aquatic invertebrate fauna, as well as birds and other organisms that find shelter and resources in the water fringing vegetation depend on the water level of this habitats, which might be directly, through forced drying out, or slower, if the connections between the rivers and the ponds are disrupted. Additionally, aggressive cuttings can lead to changes in the water regime, which will directly influence all riparian and wetland vegetation.

> Pollution

The already high level of organic waste due to the intensive agriculture in the project area might be increased even more by the contructions works, as the area of the relocation or the existing railway will be under construction for a prolonged period of time. Landfills and wastedeposits fall under this category of impacts as well. While it is certain that this impact will be negative for the natural species of the project area, species with high tolerance of unstable conditions, such as invasive species, will benefit from vegetation clearence and widen their distribution.

3.7 Mitigation Measures for Habitats and Flora

3.7.1 Preconstruction phase

Because of the length of the railway Belgrade–Nis and the short timeframe for this assessment, the results from the survey must be widened to include both earl-spring and summer aspects. 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. Apart from the local habitat type assessment, the anticipated new EUNIS classification which should provide a significantly clearer assessment of man-made habitats and underline their value.

3.7.2 Construction phase

It is not possible to provide precise information on the mitigation measures in the construction phase since the survey was conducted without prior knowledge about the detailed plan of the reconstruction and relocation. This should be done once the number of necessary waste deposits, workload on each section, or types of passages are determined. Guideline for the construction phase must be oriented towards minimizing aggressive vegetation clearence, careful planning of the landfills, wastedeposits, work camps and routes for material transport and storage and monitoring of these efforts.

3.7.3 Operation phase

After the construction works are done, it is possible to enrich the landscape by partially replacing the vegetation cover through railway verges, these narrow stripes of planted species can provide shelter for many species, minimize noise and vibration pollution naturally, along with many other beneficial ecosystem services. At the sime time, the verges act like barriers for inasive spesies and allergen spreading.

3.8 Monitoring Measures for Habitats and Flora

3.8.1 Preconstruction phase

The data obtained from this survey and the results of the sectional assessments should be cross referenced to update the lists of identified habitats according to the newest EUNIS version, to ensure consistency in further environmental assessments or monitoring in the project area. The floristic inventory should be completed as well.

3.8.2 Construction phase

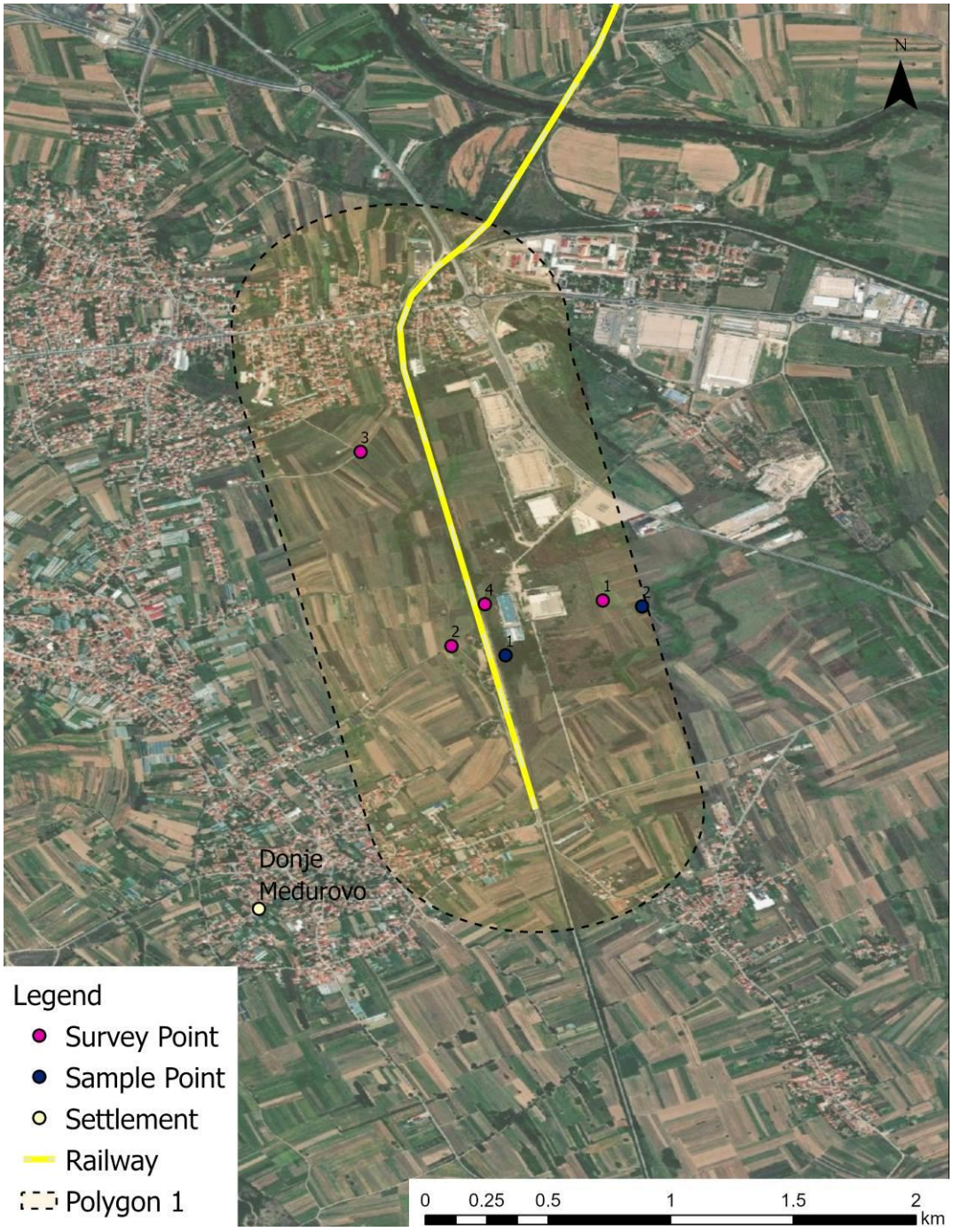
During the construction phase, it is necessary to monitor the implementation of the designed plan for minimizing habitat loss and unnecessary cuttings and adjust them if needed.

3.8.3 Operation phase

After the railway becomes functional, verges, if created, should be regularly maintained, and monitored on a regular basis, together with the rest of the immediate project area. Inasive species control should be implemented regularly as well.

3.9 Maps of Habitat and Flora Survey

Sample and survey points GIS vizualization for each polygon is shown below. Please note that the order has been reversed for the E&S Assessment Report in order to follow the Belgrade-Nis direction. Therefore Polygon 9 on maps is Polygon 1 in the Report, Polygon 8 is Polygon 2 etc.


N
3
4
1
2
2
1
Donje
Međurovo
Legend
Survey Point
Sample Point
Settlement
Railway
Polygon 1
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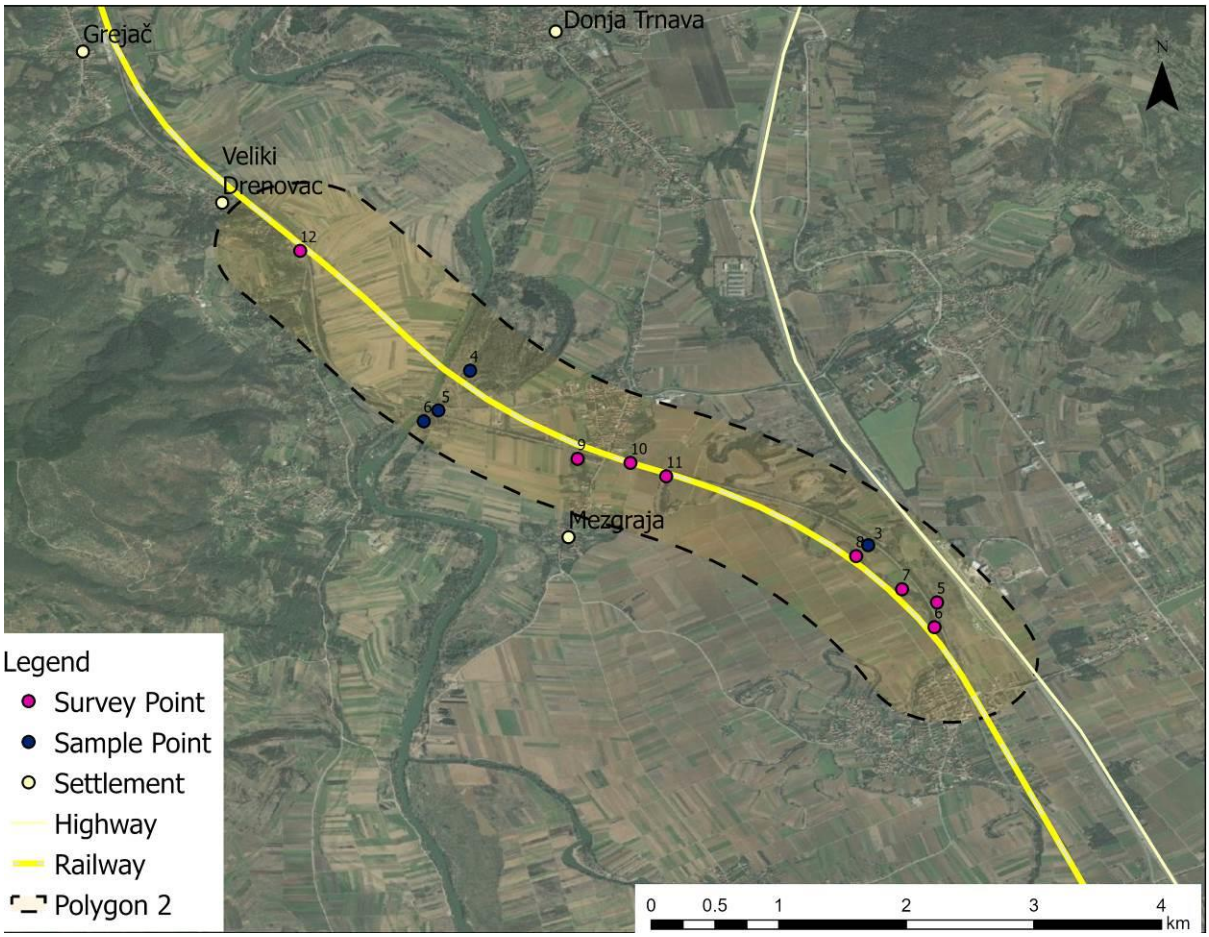
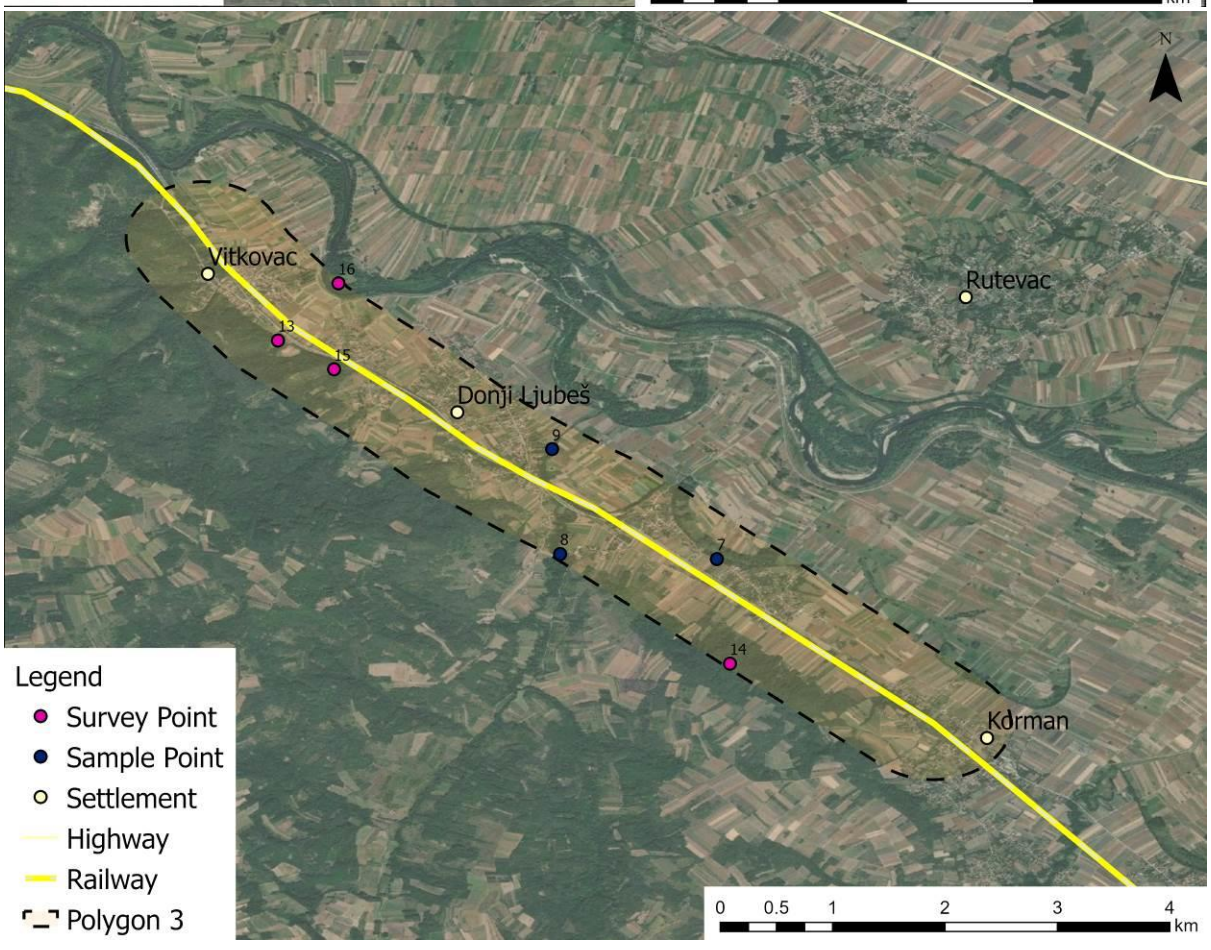
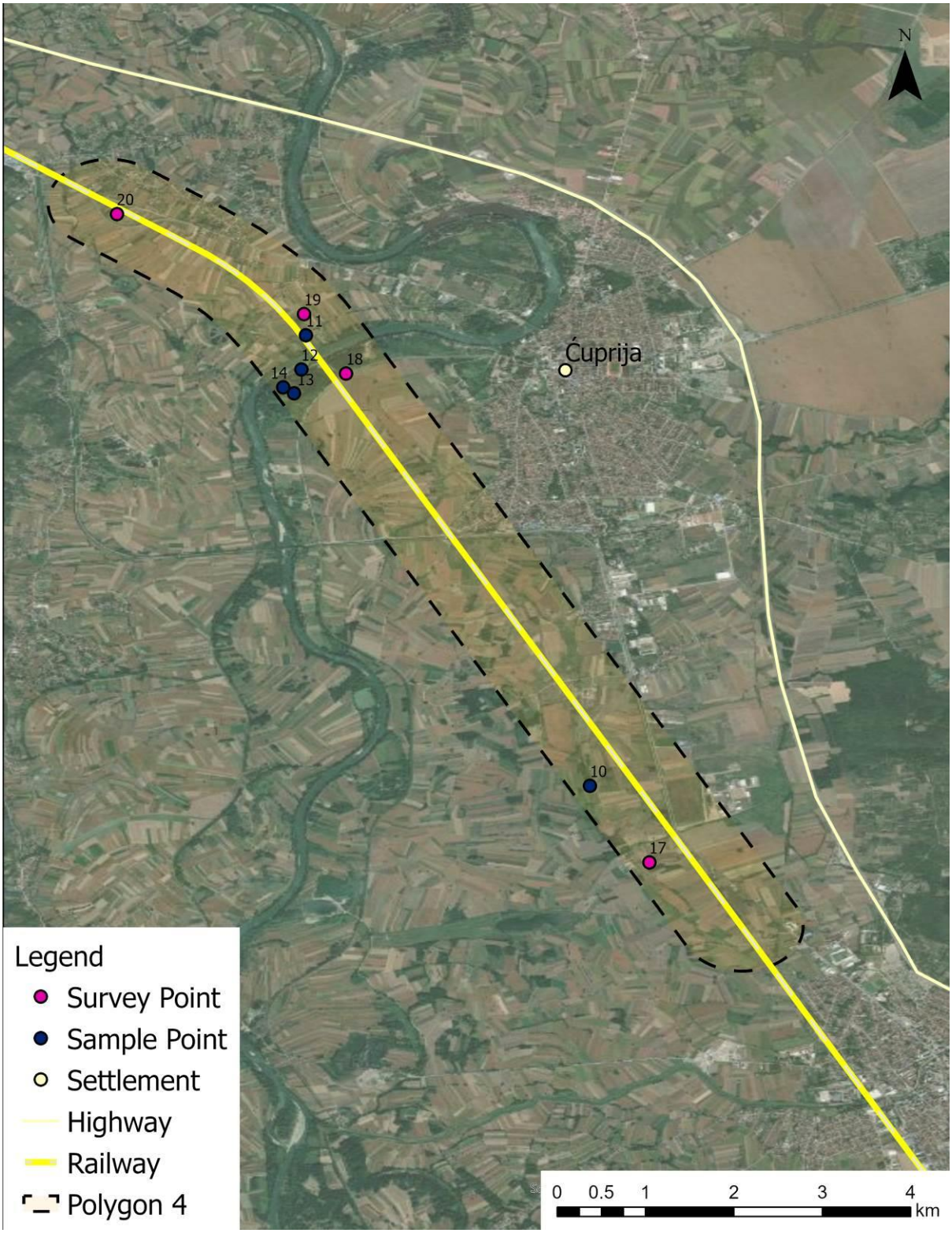
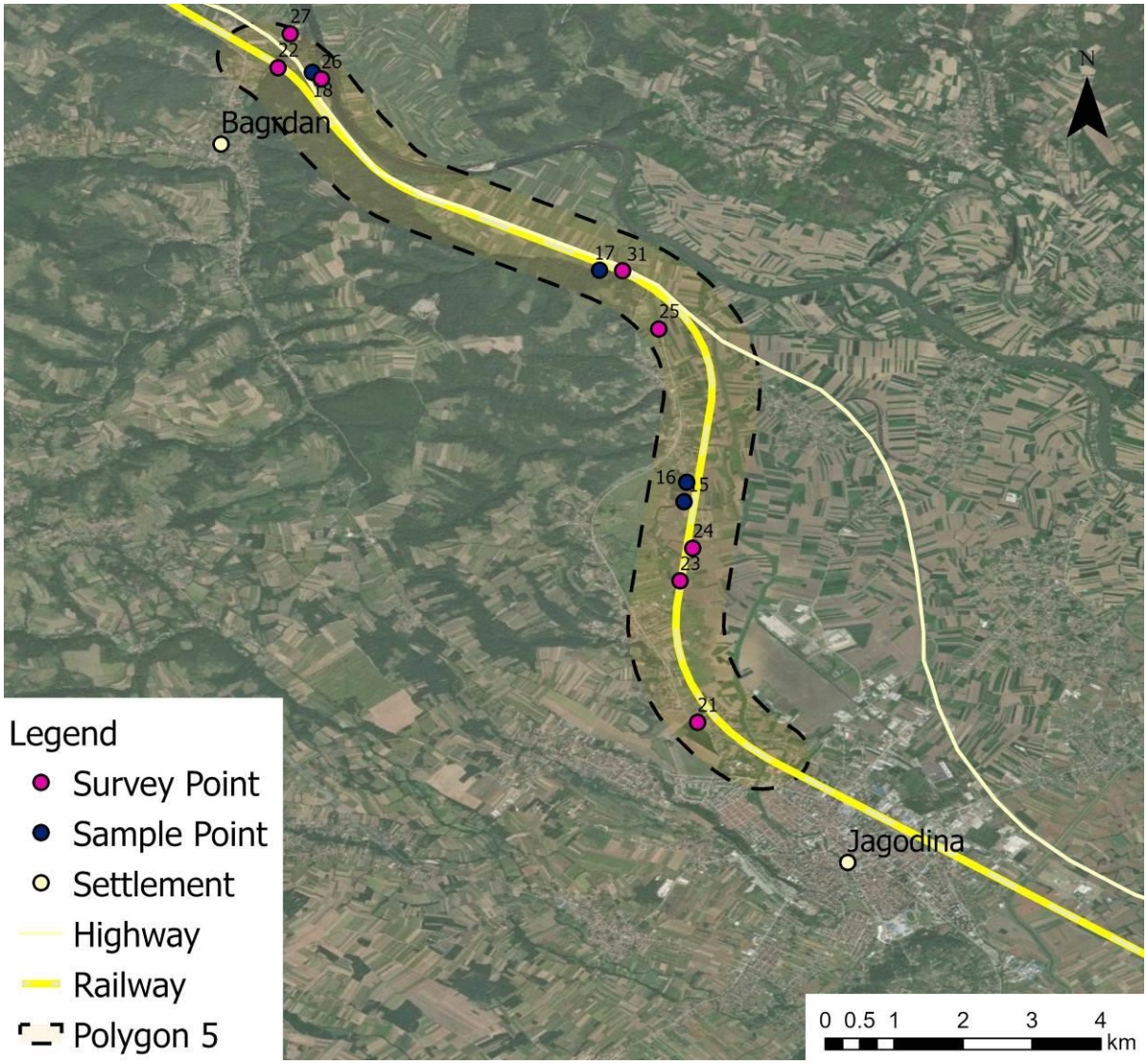
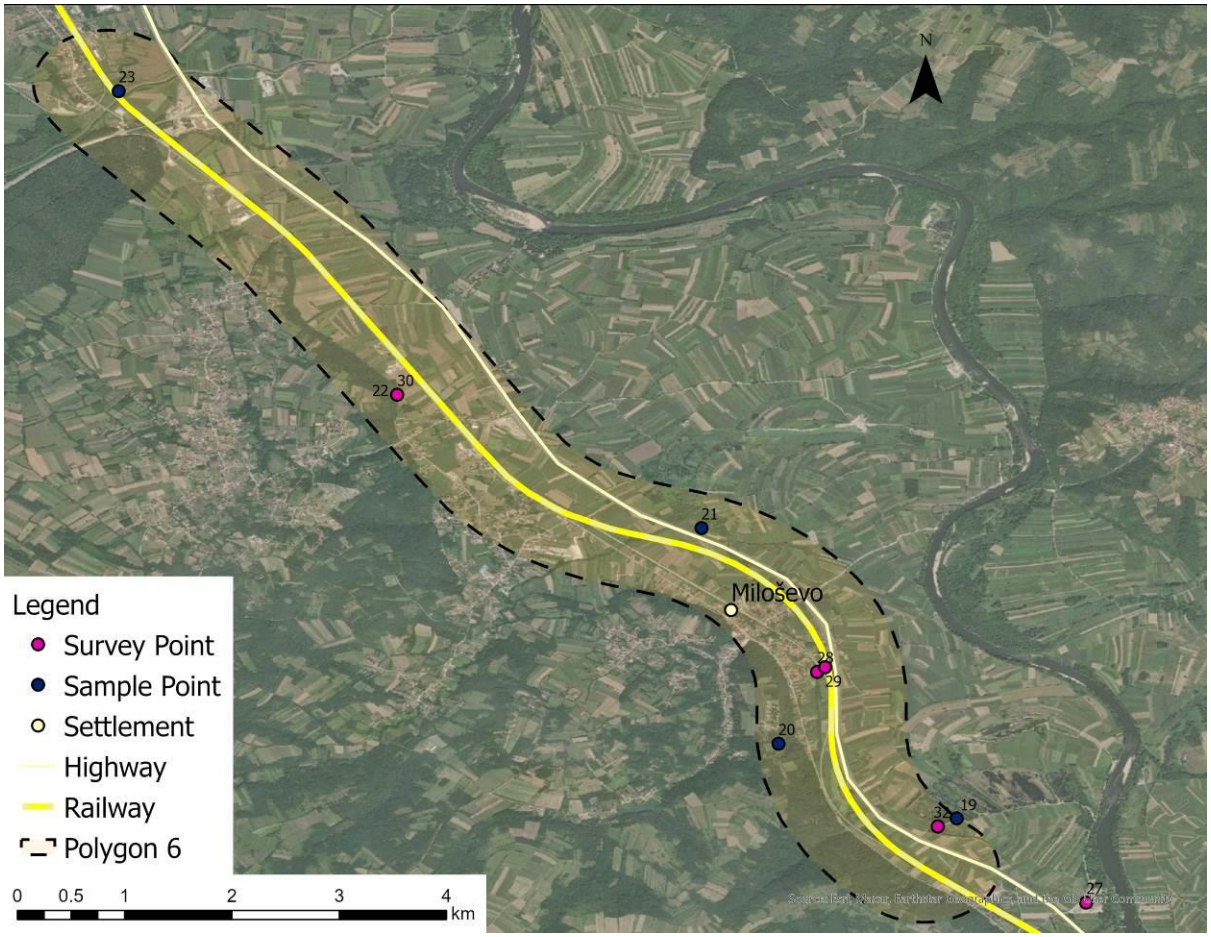
0.25
0.5
1
1.5
2
km

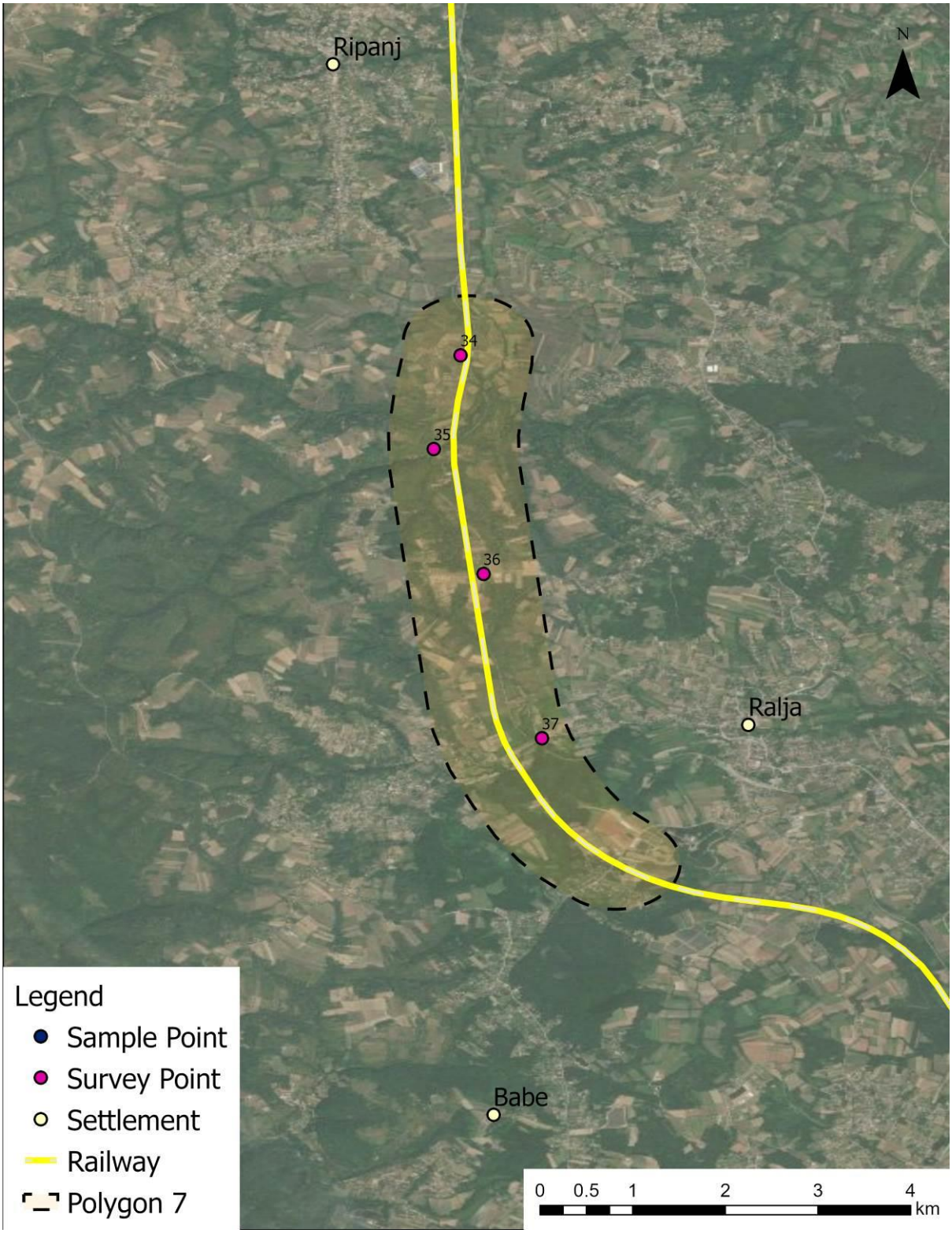

Grejač
Donja Trnava
Veliki Drenovac
Mezgraja
12
4
5
6
9
10
11
3
8
7
5
6
N
Legend
Survey Point
Sample Point
Settlement
Highway
Railway
Polygon 2
0
0.5
1
2
3
4
km

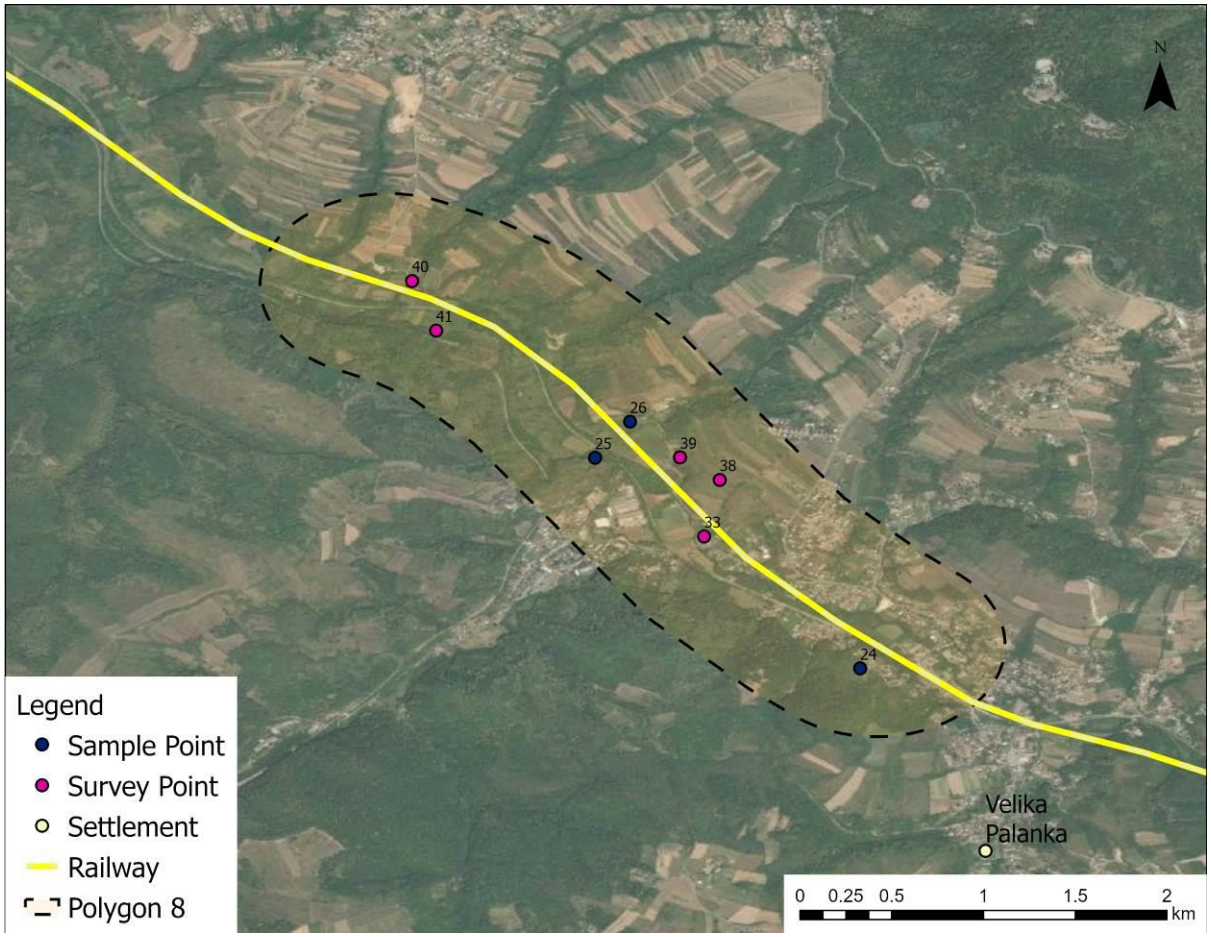

Vitkovac
16
13
15
Donji Ljubeš
9
8
7
14
Rutevac
Korman
N
Legend
Survey Point
Sample Point
Settlement
Highway
Railway
Polygon 3
0
0.5
1
2
3
4
km

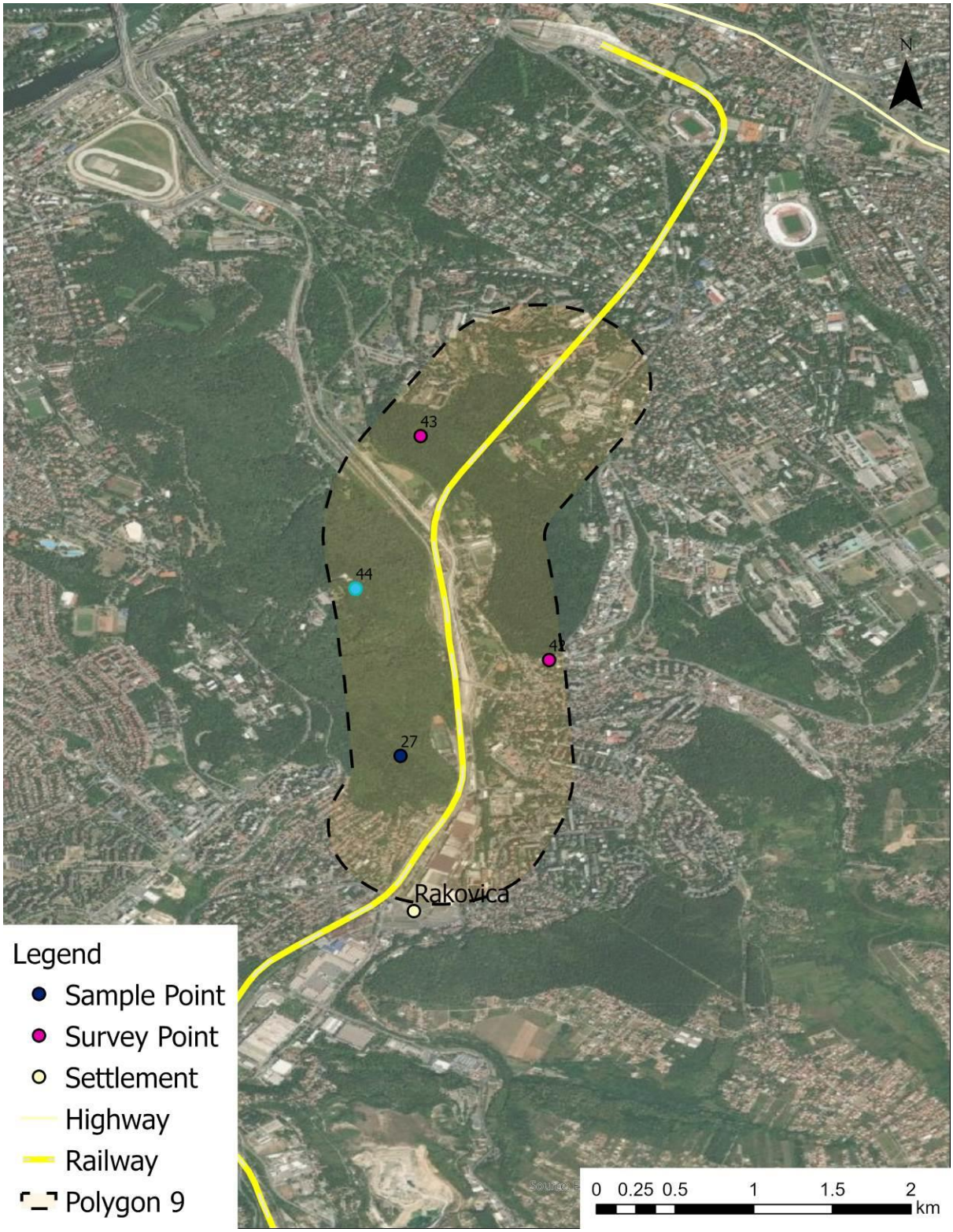

N
20
19
11
12
18
14
13
Ćuprija
10
17
Legend
Survey Point
Sample Point
Settlement
Highway
Railway
Polygon 4
0 0.5 1 2 3 4
km


27
22
26
18
Bagrdan
17
31
25
16
15
24
23
21
Jagodina
N
Legend
Survey Point
Sample Point
Settlement
Highway
Railway
Polygon 5
0 0.5 1 2 3 4
km


N
23
22
30
21
Miloševo
28
29
20
32
19
27
Legend
Survey Point
Sample Point
Settlement
Highway
Railway
Polygon 6
0
0.5
1
2
3
4
km


Ripanj
N
34
35
36
37
Ralja
Babe
Legend
Sample Point
Survey Point
Settlement
Railway
Polygon 7
0 0.5 1 2 3 4
km


N
40
41
26
25
39
38
33
24
Velika
Palanka
Legend
Sample Point
Survey Point
Settlement
Railway
Polygon 8
0 0.25 0.5 1 1.5 2
km



3.10 References for Habitat and Flora Survey

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https://upravazasume.gov.rs/

4 Invertebrate Survey Report

4.1 Methodology

If we exclude the area around large cities, we can say that, from the aspect of fauna of terrestrial invertebrates, the project area is poorly researched. In the Biologer database, only 162 literature data are available on the entire section of the railway from Nis to Belgrade (in the zone of 500 meters on both sides of the railway). Data within the project area from around Belgrade, i.e. in the area from Kosutnjak to Rakovica, given by Lazarevic (1897) and Andjus (2008) for diurnal butterflies and Curcic (2000) and Kosanin (1904) for dragonflies. In the area of Jagodina, Stankovic (2015) provides a good overview of recorded species of diurnal butterflies. One part of these findings refers to an earlier historical period, but the largest number of species that were recorded then is still present in the vicinity of Belgrade (Djuric, 2014; Popovic et al., 2020), so the findings can be taken into consideration.

If we consider the wider zone around the project area (a 10-kilometer zone around the project works), we can find the data in a larger number of scientific works that are given in Table 1. This can give us a good literature review of previous research in the wider environment of the project area, but findings must be carefully interpreted because the locations of species findings (1) are outside the project area or (2) the exact locality where the species was recorded is not known.

4.2 Assumptions and Limitations

Research of invertebrate fauna included several insect groups, namely butterflies, beetles and dragonflies. All insects were recorded during a field visit at given locations determined by overlaying satellite images and project infrastructure. If 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, so part of the summer and autumn fauna could not be recorded.

In addition to the field data collected as part of this project, available data from previous years have been reviewed in Biologer platform (Popovic et al., 2020) (which makes 317 finds within the project area – zone of 500 meters on both sides of the railway). In addition to field research, review of available literature was carried out, which was also digitized within the Biologer platform. This database includes almost all data published so

far on butterflies from the territory of Serbia, as well as a small amount of data on beetles, while literature data on dragonflies were not available for the purposes of this analysis.

Since it is not possible to georeference all literature findings with sufficient precision, for the purposes of this project, literature data up to 10 kilometers around the project area were specifically considered. In this way, we included the data provided in the UTM projection, on the MGRS grid of 10×10 kilometers (which represents a frequent practice in the available literature). The resulting list of species was then reviewed and analyzed by experts, highlighting species that have been recorded in 10-kilometer zone, that have a possibility of recording in the area that will be included in project activities.

4.3 Project Area of Influence

High level of degradation along the railway route, highway vincinity and the fact that the proposed railway route follows the existing railway in most sections indicated that the buffer zone of 500m on both sides will suffice for this assessment.

4.4 Invertebrates of the Project Area

The determination of the research area was conducted by reviewing satellite images of the habitats in Google Earth software and assigning 42 locations along the entire section of the railway that were later visited (Table 7). Areas representing more preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of importance for protection were selected. Experts were able to correct these locations during the research, so the real list of visited points is somewhat larger and is shown in Figure 20.

Table 7: List of assigned localities that were visited during field research

No.	E	N	Location	Municipality	City
1.	44.7176	20.4433	Resnik	Crayfish	Belgrade
2.	44.7071	20.4446	Resnik_2	Crayfish	Belgrade
3.	44.6831	20.4719	Pinosava	Leader	Belgrade
4.	44.6806	20.4831	Pinosava_2	Leader	Belgrade
5.	44.6709	20.4958	Ripanj	Leader	Belgrade
6.	44.6110	20.5348	Little Ivanca	Sopot	Belgrade
7.	44.5916	20.5342	Jaws	Sopot	Belgrade
8.	44.5655	20.5367	Parcans	Sopot	Belgrade
9.	44.5574	20.5561	Jaws_2	Sopot	Belgrade
10.	44.5459	20.5818	Sopot	Sopot	Belgrade
11.	44.5371	20.5394	Babe	Sopot	Belgrade
12.	44.5103	20.6311	Djurinci	Sopot	Belgrade
13.	44.4935	20.6524	Wallachia	Mladenovac	Belgrade
14.	44.4052	20.7260	Mladenovac	Mladenovac	Belgrade
15.	44.3940	20.7583	Kusadak	Smederevo Palanka	Smederevo Palanka
16.	44.3864	20.7709	Kusadak_2	Smederevo Palanka	Smederevo Palanka
17.	44.3749	20.8260	Farmers	Smederevo Palanka	Smederevo Palanka
18.	44.3691	20.8355	Farmers_2	Smederevo Palanka	Smederevo Palanka
19.	44.3441	20.9732	Smederevo Palanka	Smederevo Palanka	Smederevo 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	Batocina

No.	E	N	Location	Municipality	City
23.	44,1156	21,1552	Fast	Batocina	Batocina
24.	44.0245	21.2331	New yard	Jagodina	Jagodina
25.	44.0219	21.2406	New 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	Paracin	Paracin
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	Banknote	Aleksinac	Aleksinac
38.	43.3970	21.7743	Mezgraja	Red Cross	Nis
39.	43.3802	21.8060	Spinning wheel	Red Cross	Nis
40.	43.3673	21.8121	Vrtishte_2	Red Cross	Nis
41.	43.3244	21.8289	Milka Protic	Palilula	Nis
42.	43.3122	21.8284	The ninth of May	Palilula	Nis

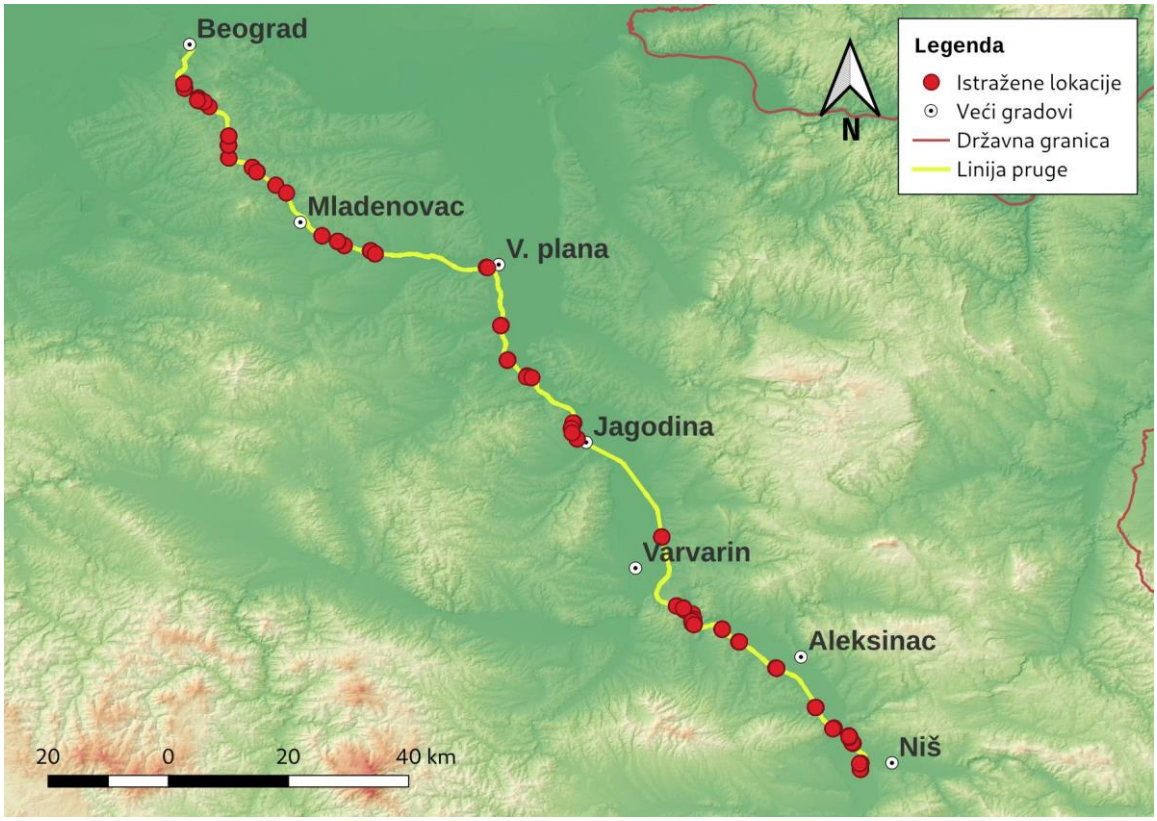

Figure 20: Terrain map showing the areas where the insect fauna research was carried out in relation to the railway line

The list of species follows the taxonomy of the Biologer platform (Popovic et al., 2020), which is given according to the species list of European diurnal butterflies (Wiemers et al., 2018) and the Fauna Europaea platform (Karsholt and van Nieukerken, 2013).

The conservation status assessment was based on the IUCN assessment, while for diurnal butterflies the species threat status was taken from the Red List of Butterflies of Europe (Van Swaay et al., 2010) and based on a more recent assessment of the conservation status of Serbian diurnal butterflies (Maes et al., 2018).

A total of 118 species of insects from the orders Lepidoptera, Coleoptera and Odonata were registered in the project area (literature and field), which is defined as a zone of 500 meters around the area where the project works will be carried out. An overview of all recorded species is given in Table 8.

Four recorded species should be excluded from the list, though. The species *Boloria selena* was recorded only by Lazarevic (1897) and we can consider it 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 (Popovic et al., 2020). 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 most likely extinct in the territory of the entire country (Maes et al., 2018). The species *Colias chrysotheme* was recorded only by Lazarevic (1897) and was not subsequently confirmed (Popovic and Verovnik, 2018). This butterfly is a specialist and inhabits dry steppe areas that are not present in the researched area, so it should not be taken into account.

Table 8: Species of invertebrates registered during field and/or desktop surveys of the Project area

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Lepidoptera							
Spotted Sulphur	*Acontia trabealis*	field data			II, IV		
Peacock butterfly	*Aglais io*	literature and field data					
Small tortoiseshell	*Aglais urticae*	literature data					
Nine-spotted moth	*Amata phegea*	field data					
Orange-tip	*Anthocharis cardamines*	literature and field data					
Lesser purple emperor	*Apatura ilia*	field data					SPS
Ringlet	*Aphantopus hyperantus*	literature data					
Black-veined white	*Aporia crataegi*	literature and field data					
Map	*Araschnia levana*	literature and field data					
Silver-washed fritillary	*Argynnis paphia*	literature and field data					
Brown Argus	*Aricia agestis*	literature and field data					
Weaver's Fritillary	*Boloria dia*	literature and field data					
Marbled Fritillary	*Brenthis daphne*	literature and field data					
Great Banded Grayling	*Brintesia circe*	literature and field data					
Green hairstreak	*Callophrys rubi*	field data					
Mallow Skipper	*Carcharodus alceae*	literature and field data					
Tufted Marbled Skipper	*Carcharodus flocciferus*	literature data	LC				
Holly blue	*Celastrina argiolus*	literature and field data					
Pearly heath	*Coenonympha arcania*	literature data					
Chestnut heath	*Coenonympha glycerion*	literature and field data					
Russian heath	*Coenonympha leander*	literature data					
Small heath	*Coenonympha pamphilus*	literature and field data					
Berger's Clouded yellow	*Colias alfacariensis*	field data					
Provençal short-tailed blue	*Cupido alcetas*	literature data					
Short-tailed blue	*Cupido argiades*	field data					

[4] *Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Serbia* ("Official Gazette of RS", No. 96/10)

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Small blue	*Cupido minimus*	field data					
Dingy skipper	*Erynnis tages*	literature and field data					
Marsh fritillary	*Euphydryas aurinia*	field data			II	II	
Niobe fritillary	*Fabriciana niobe*	literature and field data					
Purple hairstreak	*Favonius quercus*	literature data					
Green-underside blue	*Glaucopsyche alexis*	literature and field data					
Common brimstone	*Gonepteryx rhamni*	literature and field data					
Duke of burgundy	*Hamearis lucina*	literature and field data					
Silver-spotted skipper	*Hesperia comma*	literature data					
Scarce swallowtail	*Iphiclides podalirius*	literature and field data					
Queen of Spain fritillary	*Issoria lathonia*	literature and field data					
Lattice brown	*Kirinia roxelana*	field data					
Wall brown	*Lasiommata megera*	literature and field data					
Wood white	*Leptidea sinapis*	literature and field data					
White admiral	*Limenitis camilla*	literature data					
Southern white admiral	*Limenitis reducta*	field data					
Purple-shot copper	*Lycaena alciphron*	literature and field data					
Large copper	*Lycaena dispar*	literature and field data	NT		II, IV	II	SPS
Purple-edged copper	*Lycaena hippothoe*	literature data		DD			
Small copper	*Lycaena phlaeas*	literature and field data					
Lesser fiery copper	*Lycaena thersamon*	literature data					
Sooty copper	*Lycaena tityrus*	literature and field data					
Adonis blue	*Lysandra bellargus*	literature and field data					
Meadow brown	*Maniola jurtina*	literature and field data					
Marbled white	*Melanargia galathea*	literature and field data					
Heath fritillary	*Melitaea athalia*	literature and field data					
Glanville fritillary	*Melitaea cinxia*	field data					
Spotted fritillary	*Melitaea didyma*	literature and field data					
Knapweed Fritillary	*Melitaea phoebe*	literature and field data					
Lesser spotted fritillary	*Melitaea trivia*	field data					

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Drab Looper	*Minoa murinata*	field data					
Dryad	*Minois dryas*	literature data					
Pallas' sailer	*Neptis sappho*	field data					
Mourning cloak	*Nymphalis antiopa*	literature data					SPS
Large tortoiseshell	*Nymphalis polychloros*	literature and field data					
Compton tortoiseshell	*Nymphalis vaualbum*	literature data			II, IV	II	SPS
Large skipper	*Ochlodes sylvanus*	literature and field data					
Old world swallowtail	*Papilio machaon*	literature and field data					SPS
Speckled wood	*Pararge aegeria*	literature and field data					
Clouded Apollo	*Parnassius mnemosyne*	literature and field data	LC		IV	II	SPS
Grass Wave	*Perconia strigillaria*	field data					
Large blue	*Phengaris arion*	literature data	NT		IV		SPS
Large white	*Pieris brassicae*	literature and field data					SPS
Green-veined white	*Pieris napi*	literature and field data					
Cabbage white	*Pieris rapae*	literature and field data					
Silver-studded blue	*Plebeius argus*	literature and field data					
Reverdin's blue	*Plebeius argyrognomon*	literature and field data					SPS
Idas blue	*Plebejus idas*	literature data					
Comma	*Polygonia c-album*	literature and field data					
Amanda's blue	*Polyommatus amandus*	field data					
Meleager's blue	*Polyommatus daphnis*	field data					
Common blue	*Polyommatus icarus*	literature and field data					
Eastern bath white	*Pontia edusa*	literature and field data					
Speckled yellow	*Pseudopanthera macularia*	field data					
Eastern baton blue	*Pseudophilotes vicrama*	field data	NT				SPS
Large Grizzled skipper	*Pyrgus alveus*	literature data					
Safflower skipper	*Pyrgus carthami*	literature data					
Grizzled skipper	*Pyrgus malvae*	literature and field data					
Gatekeeper	*Pyronia tithonus*	literature data					
Sloe hairstreak	*Satyrium acaciae*	field data					SPS

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Ilex hairstreak	*Satyrium ilicis*	field data					
Black hairstreak	*Satyrium pruni*	literature and field data		NT			
Blue spot hairstreak	*Satyrium spini*	literature data					
White-letter hairstreak	*Satyrium w-album*	literature data					SPS
Orbed red-underwing skipper	*Spialia orbifer*	literature data					
Essex skipper	*Thymelicus lineola*	literature and field data					
Small skipper	*Thymelicus sylvestris*	literature data					
Pygmy	*Thyris fenestrella*	field data					
Four-spotted moth	*Tyta luctuosa*	field data					
Red admiral	*Vanessa atalanta*	literature and field data					
Painted lady	*Vanessa cardui*	literature and field data					
Eastern festoon	*Zerynthia cerisy*	literature and field data	NT				
Southern festoon	*Zerynthia polyxena*	literature and field data			IV		SPS
Coleoptera							
-	*Abax carinatus*	literature data					
-	*Abax parallelepipedus*	literature data					
Scilly Shoulder Blade	*Abax parallelus*	literature and field data					
-	*Acmaeoderella flavofasciata*	field data					
-	*Agapanthia gasped*	field data					
-	*Agapanthia viti*	field data					
-	*Agonum antennarium*	field data					
-	*Amara aenea*	field data					
-	*Amara saphyrea*	literature data					
-	*Anacaena globulus*	field data					
-	*Anisoplia tempestiva*	field data					
-	*Anthaxia scorzonerae*	field data					
Varied carpet beetle	*Anthrenus verbasci*	field data					
-	*Apalus bipunctatus*	field data					
-	*Aphodius fimetarius*	field data					
Iris flea beetle	*Aphthona nonstriata*	field data					

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Rapeseed pollen beetle	*Brassicogethes aeneus*	field data					
Violet tanbark beetle	*Callidium violaceum*	field data					
-	*Calosoma inquisitor*	literature data					
-	*Cantharis livida*	field data					
-	*Cantharis pellucida*	field data					
Sailor beetle	*Cantharis rustica*	field data					
-	*Carabus coriaceus*	field data					
-	*Carabus ullrichii*	literature data					
-	*Carinatodorcadion aethiops*	field data					
-	*Carinatodorcadion fulvum*	field data					
Rose chafer	*Cetonia aurata*	field data					
Blue mint beetle	*Chrysolina coerulans*	field data					
Plantain leaf beetle	*Chrysolina haemoptera*	field data					
-	*Chrysolina rossia*	field data					
-	*Chrysolina sturmi*	field data					
Spotted willow leaf beetle	*Chrysomela vigintipunctata*	field data					
Green tiger beetle	*Cicindela campestris*	field data					
-	*Cydnopus pilosus*	field data					
Ant bag beetle	*Clytra laeviuscula*	field data					
-	*Clytus rhamni*	field data					
Seven-spot ladybird	*Coccinella septempunctata*	field data					
-	*Cortodera villosa*	field data					PS
-	*Cryptocephalus anticus*	field data					
-	*Cryptocephalus bipunctatus*	field data					
Hazel pot beetle	*Cryptocephalus coryli*	field data					
-	*Cryptocephalus violaceus*	field data					
Lesser stag beetle	*Dorcus parallelipipedus*	field data					
-	*Elaphrus aureus*	literature data					
Tansy leaf beetle	*Galeruca tanaceti*	field data					
-	*Gnaptor spinimanus*	field data					

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Harlequin	*Harmonia axyridis*	field data					
-	*Harpalus distinguendus*	field data					
-	*Helophorus aquaticus*	field data					
-	*Hister quadrimaculatus*	field data					
April beetle	*Holochelus aequinoctialis*	field data					
-	*Hydrobius fuscipes*	field data					
-	*Labidostomis lucida*	field data					
-	*Lachnaia sexpunctata*	field data					
Colorado potato beetle	*Leptinotarsa decemlineata*	field data					
-	*Longitarsus lycopi*	field data					
European stag beetle	*Lucanus cervus*	field data	NT		II	III	SPS
Scarlet malachite beetle	*Malachius aeneus*	field data					
Green malachite Bbeetle	*Malachius bipustulatus*	field data					
-	*Melinopterus prodromus*	field data					
European oil beetle	*Meloe proscarabaeus*	field data					
Violet oil beetle	*Meloe violaceus*	field data					
Beech longhorn beetle	*Morimus asper*	field data			II	III	SPS
-	*Musaria affinis*	field data					
-	*Mycterus tibialis*	field data					
-	*Nebria brevicollis*	literature data					
-	*Neodorcadion bilineatum*	field data					
-	*Oberea euphorbiae*	field data					
-	*Oedema femorata*	field data					
-	*Oedemera podagrariae*	field data					
European rhinoceros beetle	*Oryctes nasicornis*	field data					SPS
Mediterranean spotted chafer	*Oxythyrea funesta*	field data					
-	*Pachytodes erraticus*	field data					
-	*Pedestredorcadion pedestre*	field data					
-	*Pentodon idiota*	field data					
-	*Phosphuga atrata*	field data					

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
-	*Phyllobius glaucus*	field data					
Barley flea beetle	*Phyllotreta vittula*	field data					
-	*Plagionotus floralis*	field data					
-	*Pseudoophonus rufipes*	field data					
Fairy-ring longhorn beetle	*Pseudovadonia livida*	field data					
22-spot ladybird	*Psyllobora vigintiduopunctata*	field data					
-	*Pterostichus melas*	field data					
-	*Pygopleurus diffusus*	field data					
Common red soldier beetle	*Rhagonycha fulva*	field data					
-	*Silpha obscura*	field data					
-	*Stenopterus rufus*	field data					
-	*Stenurella bifasciata*	field data					
-	*Stenorella melanura*	field data					
-	*Stromatium unicolor*	literature data					
24-spot ladybird	*Subcoccinella vigintiquatuorpunctata*	field data					
Ant beetle	*Thanasimus formicarius*	field data					
-	*Trichodes crabroniformis*	field data					
-	*Trichodes favarius*	field data					
-	*Tropinota hirta*	field data					
Elm-leaf beetle	*Xanthogaleruca luteola*	field data					
Odonata							
Southern migrant hawker	*Aeshna affinis*	field data	LC				
Small hawker	*Aeshna isoceles*	field data	LC				
Blue emperor	*Anax imperator*	field data	LC				
Lesser Emperor	*Anax parthenope*	field data	LC				
Hairy hawker	*Brachytron pratense*	field data	LC				
Banded demoiselle	*Calopteryx splendens*	field data					
Beautiful demoiselle	*Calopteryx virgo*	field data	LC				
Ornate bluet	*Coenagrion ornatum*	field data	LC		II		
Azure bluet	*Coenagrion puella*	field data	LC				

English name	Latin name	Data type	Conservation status				
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[4]
Variable bluet	*Coenagrion pulchellum*	field data	LC				
Dainty bluet	*Coenagrion scitulum*	field data	LC				
Downy emerald	*Cordulia aenea*	field data	LC				
Broad scarlet	*Crocothemis erythraea*	field data	LC				
Common bluetail	*Ischnura elegans*	field data	LC				
Small bluetail	*Ischnura pumilio*	field data	LC				
Broad-bodied chaser	*Libellula depressa*	field data	LC				
Blue chaser	*Libellula fulva*	field data	LC				
Green-eyed hooktail	*Onychogomphus forcipatus*	field data	LC				
White-tailed skimmer	*Orthetrum albistylum*	field data	LC				
Black-tailed skimmer	*Orthetrum cancellatum*	field data	LC				
Keeled skimmer	*Orthetrum coerulescens*	field data	LC				
Blue featherleg	*Platycnemis pennipes*	field data	LC				
Large red damsel	*Pyrrhosoma nymphula*	field data	LC				
Common winter damsel	*Sympecma fusca*	field data	LC				
Southern darter	*Sympetrum meridionale*	field data	LC				
Ruddy darter	*Sympetrum sanguineum*	field data	LC				

HD – Habitats Directive, BC – Berne Directive, SPS – strictly protected species, PS – protected species

An overview of all conservation-important species of butterflies and beetles recorded in literature data for an area extending 10 kilometers from the project infrastructure is given in Table 9. This list of species should be interpreted more carefully, given that literature findings can often be far from the zone of influence of project activities, and that some of the literature references are insufficiently precise to be able to georeference the exact location where the species was originally found.

Table 9: Overview of significant species of butterflies and beetles recorded in literature for the wider project area, species that could be recorded in the immediate area of project activities are given in bold

Group	Species	No. of findings	Legal protection	Conservation status
Butterflies	***Apatura ilia***	25	Strictly protected	
Butterflies	*Apatura iris*	1	Strictly protected	
Butterflies	***Argynnis pandora***	22	Strictly protected	
Butterflies	*Boloria selena*	9	Strictly protected	Endangered in Serbia (EN)
Butterflies	***Hipparchia volgensis***	3	Strictly protected	
Butterflies	*Iolana iolas*	5	Strictly protected	Near threatened in Europe (NT), Endangered in Serbia (EN)
Butterflies	*Limenitis populi*	1	Strictly protected	Near Threatened in Serbia (NT)
Butterflies	***Melitaea aurelia***	14	Strictly protected	Near Threatened in Europe (NT)
Butterflies	***Melitaea diamina***	5	Strictly protected	
Butterflies	***Nymphalis antiopa***	25	Strictly protected	
Butterflies	***Nymphalis xanthomelas***	12	Strictly protected	Near Threatened in Serbia (NT)
Butterflies	***Papilio machaon***	50	Strictly protected	
Butterflies	*Phengaris alcon*	1	Strictly protected	
Butterflies	***Pieris brassicae***	26	Strictly protected	
Butterflies	***Plebeius argyrognomon***	22	Strictly protected	
Butterflies	*Polygonia aegea*	4	Strictly protected	Possibly extinct in Serbia (CR Possibly Extinct)
Butterflies	***Pseudophilotes vicrama***	4	Strictly protected	Near Threatened in Europe (NT)
Butterflies	***Satyrium acaciae***	11	Strictly protected	
Butterflies	***Satyrium w-album***	19	Strictly protected	
Butterflies	***Thecla betulae***	4	Strictly protected	
Butterflies	*Colias myrmidone*	15	Strictly protected; Annexes 2 and 4 of the Habitats Directive, Appendix 2 of the Berne Convention	Possibly extinct in Serbia (CR Possibly Extinct), Endangered in Europe (EN)
Butterflies	***Lycaena dispar***	39	Strictly protected; Annexes 2 and 4 of the Habitats Directive, Appendix 2 and Resolution 6 of the Berne Convention	Globally Near Threatened (NT)
Butterflies	***Nymphalis vaualbum***	19	Strictly protected; Annexes 2 and 4 of the Habitats Directive, Appendix 2 and Resolution 6 of the Berne Convention	
Butterflies	*Apatura metis*	4	Strictly protected; Annex 4 of the Habitats Directive	Vulnerable in Serbia (VU)
Butterflies	***Phengaris Arion***	12	Strictly protected; Annex 4 of the Habitats Directive	Globally Near Threatened (NT) and Endangered in Europe (EN)
Butterflies	***Zerynthia polyxena***	58	Strictly protected; Annex 4 of the Habitats Directive	
Butterflies	***Parnassius mnemosyne***	25	Strictly protected; Annex 4 of the Habitats Directive,	Near Threatened in Europe (NT)

Group	Species	No. of findings	Legal protection	Conservation status
			Appendix 2 of the Berne Convention	
Butterflies	***Carcharodus floccifera***	12		Near Threatened in Europe (NT)
Butterflies	***Carcharodus lavatherae***	2		Near threatened in Europe (NT), Near threatened in Serbia (NT)
Butterflies	*Chazara briseis*	1		Near Threatened in Europe (NT)
Butterflies	***Cupido decoloratus***	2		Near Threatened in Europe (NT)
Butterflies	***Hipparchia fagi***	18		Near Threatened globally (NT), Near Threatened in Europe (NT)
Butterflies	*Hipparchia seeds*	4		Insufficient data to assess status in Serbia (DD)
Butterflies	***Hipparchia statilinus***	2		Near threatened in Europe (NT), Near threatened in Serbia (NT)
Butterflies	*Hipparchia syriaca*	4		Insufficient data to assess status in Serbia (DD)
Butterflies	*Hyponephele lycaon*	1		Near Threatened in Serbia (NT)
Butterflies	*Kretania sephirus*	1		Near Threatened in Serbia (NT)
Butterflies	*Leptidea juvernica*	1		Insufficient data to assess status in Serbia (DD)
Butterflies	*Libythea celtis*	1		Near Threatened in Serbia (NT)
Butterflies	***Lycaena hippothoe***	3		Insufficient data to assess status in Serbia (DD)
Butterflies	***Satyrium pruni***	7		Near Threatened in Serbia (NT)
Butterflies	*Thymelicus acteon*	1		Near Threatened in Europe (NT)
Butterflies	***Zerynthia cerisy***	8		Near Threatened in Europe (NT)
Beetles	***Oryctes nasicornis***	1	Strictly protected	
Beetles	***Lucanus cervus***	1	Strictly protected; Annex 2 of the Habitats Directive, Appendix 3 and Resolution 6 of the Berne Convention	
Beetles	***Cerambyx cerdo***	2	Strictly protected; Annexes 2 and 4 of the Habitats Directive	
Beetles	*Rosalia alpina*	1	Strictly protected; Annexes 2 and 4 of the Habitats Directive, Appendix 2 and Resolution 6 of the Berne Convention	
Beetles	***Bolbelasmus unicornis***	2	Annexes 2 and 4 of the Habitats Directive	
Beetles	***Agapanthia kirbyi***	1	Protected	
Beetles	***Cortodera flavimana***	3	Protected	

The following significant species can be expected within the project area:

- *Argynnis pandora* - a strictly protected butterfly species in Serbia, listed as last concern (LC) at global, European and national level. The species is relatively widespread in Serbia and can be found within the researched area, but it has not been recorded since the flight period of the species does not coincide with the period when field research was carried out.
- *Hipparchia volgensis* - a strictly protected butterfly species in Serbia, rated as last concern (LC) at global, European and national level. The species is relatively widespread in Serbia and can be found within the researched area, but it has not been recorded since the flight period of the species does not coincide with the period when field research was carried out.

- *Melitaea aurelia* - a strictly protected species of butterfly in Serbia, assessed as last concern (LC) at global and national level, and as near threatened (NT) at European level. The species is relatively widespread in Serbia and can be found within the researched area, but it has not been recorded since the flight period of the species does not coincide with the period when field research was carried out.
- *Melitaea diamina* - a strictly protected butterfly species in Serbia, rated as last concern (LC) at global, European and national level. The species is a specialist and mainly inhabits wet habitats where the food plant from the genus *Valeriana* grows. Smaller, local populations can be expected within the researched area, but it has not been recorded since the flight period of the species does not coincide with the period when field research was carried out.
- *Nymphalis xanthomelas* - a strictly protected species of butterfly in Serbia, assessed as last concern (LC) at global and national level, and as near threatened at the European level. The species has a limited distribution on the territory of Serbia, but individuals can also be found in a wider area. It inhabits slightly warmer habitats with willow and in Serbia it is most often found in gorges. Overwintering individuals can be found in the spring; however the species has not been registered in the research area.
- *Thecla betulae* - a strictly protected butterfly species in Serbia, rated as last concern (LC) at global, European and national level. It inhabits thickets, but also agricultural habitats with blackthorn (*Prunus spinosa*) growing between plots, as its caterpillars develop on this plant. Findings are rare as the butterfly is found singly, so smaller local populations can be expected. It has not been recorded since the flight period of the species does not coincide with the period when field research was carried out.
- *Carcharodus lavatherae* - a strictly protected butterfly species in Serbia, rated as last concern (LC) at global, European and national level. It mostly inhabits rocky areas and pastures, and the caterpillars feed on plants from the genera *Lavatera* and *Stachys*. Smaller local populations can be expected in the research area, but it has not been recorded since the flight period does not coincide with the period when field research was carried out.
- *Cupido decoloratus* - not protected by law, nor threatened at global and national level - last concern (LC), however listed as near threatened species in Europe (NT). It inhabits slightly drier and warmer meadows and pastures, and the caterpillars feed on plants from the Fabaceae family. It is relatively common in Serbia, so it can be expected within the research area. The species flies during the period when field surveys were carried out, however it has not been registered within the researched area.
- *Hipparchia fagi* - not protected by law, nor threatened at the national level -last concern (LC), however listed as near threatened species at global and European level (NT). The species is relatively common in Serbia and inhabits wooded habitats. It can be expected within the researched area, but it has not been recorded since the flight period does not coincide with the period when the field research was carried out.
- *Hipparchia statilinus* - not protected by law, nor threatened at the global level -last concern (LC), but listed as near threatened species at European and national level (NT). It inhabits dry habitats, stony pastures, bushes and meadows. It can be expected locally within the research area, but larger populations of this butterfly are not expected.
- *Cerambyx cerdo* - a strictly protected species of longhorn beetle in Serbia, listed on Annexes 2 and 4 of the Habitats Directive. It is listed as a vulnerable species at global level (VU), near threatened in Europe (NT), while the conservation status is not known on the territory of Serbia. Considering its status, the species is relatively widespread in Serbia, and it feeds on oak, so local populations are expected in the part of the researched area with preserved oak forests.

- *Bolbelasmus unicornis* - it is not protected in Serbia, but it is listed on Annexes 2 and 4 of the Habitats Directive. It is not endangered at the global and European level, and its conservation status is not known on the territory of Serbia. The distribution of this species is limited and extremely local. It grows on truffles, so smaller, local populations can be expected in areas with well-preserved oak forests.
- *Agapanthia kirbyi* – a protected longhorn beetle species in Serbia. It is not endangered at global and European level, and its conservation status is not known on the territory of Serbia. It is widely distributed in Serbia, and it feeds on mullein (*Verbascum* spp.), so it can be expected in the research area.
- *Cortodera flavimana* – a protected longhorn beetle species in Serbia. It is not endangered at global and European level, and its conservation status is not known on the territory of Serbia. It is widely distributed in Serbia, so it can be expected in the research area.

4.5 Identification of Impacts on Invertebrates

Overall, 23 species of conservation importance were recorded in the research area. During the project activities, negative impact on the populations of these species is expected due to the direct destruction of the habitat, which is irreversible for most species. This effect will be greatest in the area where the railway route has been moved in relation to the existing railway infrastructure. A special negative effect is expected on wetland habitats, where a change in the hydrographic regime could lead to water loss and drying up of wet meadows and wetlands.

The species that will be most exposed to negative impacts due to the change in the hydrographic regime are *Lycaena dispar, Euphydryas aurinia, Lycaena hypopothoe* and *Coenagrion ornatum*. The greatest negative effect can be expected for the populations of the species C. ornatum, whose populations are extremely local and rare, and any changes in the water regime may lead to the permanent extinction of this species within the research area. A significant negative effect is also expected for the species *L. hyppothoe*, since the populations of this butterfly have become extremely local and few due to the destruction of lowland wet meadows. The impact on the populations of *L. hyppothoe* will be greatest in the ridge area of Jagodina and in wet habitats around Rakovica, Resnik and Ripanj, where the relocation of the existing railway line is planned, which may lead to a permanent loss of populations of the mentioned species in the investigated area.

A neutral or slightly positive effect can be expected for the species *Zerynthia polyxena* and *Zerynthia cerisy*, since their host plant is also found along roads and railways, so the project activities will have a negative impact only in the early stages of railway infrastructure construction. After that, regular maintenance of the vegetation along the railway line can encourage the growth of birthwort (*Aristolochia clematitis*) and provide secondary habitats where the mentioned butterfly species can reproduce.

Due to the change in the route of the railway in the area of the Mojsinje Mountains, a negative impact is expected on the populations of beetles *Morimus asper funereus* and *Lucanus cervus*. This effect will be limited, considering that the digging of the tunnel is planned, which will not significantly threaten the natural vegetation of this area. Also, the project covers only the eastern part of the Mojsinje Mountains, so the effect will be limited only to part of the mountain massif.

The negative impact on other species can be assessed as local, since it affects only a small part of the populations of more widely distributed species.

4.6 Mitigation Measures for Invertebrates

Considering the threat of lowland wet meadows and swamps, the basic measure to mitigate the negative effect is to maintain the existing habitats hydrographic regime of the habitat. Project works should not include the construction of new canals and gullies for drainage, and in places where the railway crosses marshy habitats, it is necessary to provide culverts for water, so that the hydrographic regime of the surrounding habitats remains

unchanged. All interventions in flooded areas, on wet meadows and within wetland habitats should be reduced to the necessary minimum and, upon completion of the works, allow the return of the hydrographic regime to its original state. This applies especially to the sections Rakovica-Resnik-Ripanj and Jagodinski rit.

At the locality near the village of Vrtiste, where the presence of the Coenagriom ornatum species is confirmed, interventions that could disturb the flow of the river shouldn't be allowed. It is necessary to provide adequate water culverts and prevent negative impacts on the habitat that is in immediate vicinity. During the execution of works, it is necessary to fence off natural habitats (with tape or fence) on both sides of the railway and to prevent accidental or intentional interventions in these habitats. The operations must be carried out as soon as possible, after which it is necessary to establish the initial hydrographic regime.

Works on the existing section of the railway must be carried out in such a way as not to disturb the existing natural and semi-natural habitats on both sides of the railway.

4.7 Monitoring Measures for Invertebrates

Monitoring measures must include monitoring the abundance of the *Coenagrion ornatum* population at the Vrtiste locality. Monitoring of this species can be done by 1) sampling larvae at given points, 2) recording the presence of adults along a given transect line, or 3) using the marking method of and recapturing adults. The best data can be obtained by the marking and recapture method, since it gives us an accurate insight into the total number of the population of this species, while other methods only provide data on the relative number of populations and the percentage change in number from year to year. Monitoring should be conducted before the execution of the works, as well as after the completion of the works, which would provide further guidelines for the conservation of this significant species.

In addition, monitoring measures can include more detailed mapping of Lycaena hyppoothoe populations, which is present in the research area. The distribution of this species in Serbia is poorly studied, and data collected through targeted research can provide a basis for assessing its conservation and population status in the researched area. This would lead to proposing possible further measures for monitoring in case such monitoring is justified.

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5 Fish Survey Report

5.1 Methodology

Field survey. In period from 17th to 20th of May 2022 fishing survey was carried out on research 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). Field research at the aforementioned locations 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 Villager VGI2400 (230 V, 8.7 A, 2.0 kW) electrofishing device. A 100 m long transect was performed on each sampling point (SP) in order to cover all types of habitats.

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 on feet. Because of high water level rubber boat was used in order to sample fish at Velika Morava river. All fish caught are stored in a large bucket, before being individually counted, measured, weighed and released in the river. Fish species identification was performed using ID keys provided in chapter References.

Bibliographic data about fish in research area. The relevant literature (e.g. previous and continuing assessments, publications and reports) was assessed for the presence of ichthyofauna species of conservation concern in the project area, as well as the project area's and area of influence's ecological conditions.

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).

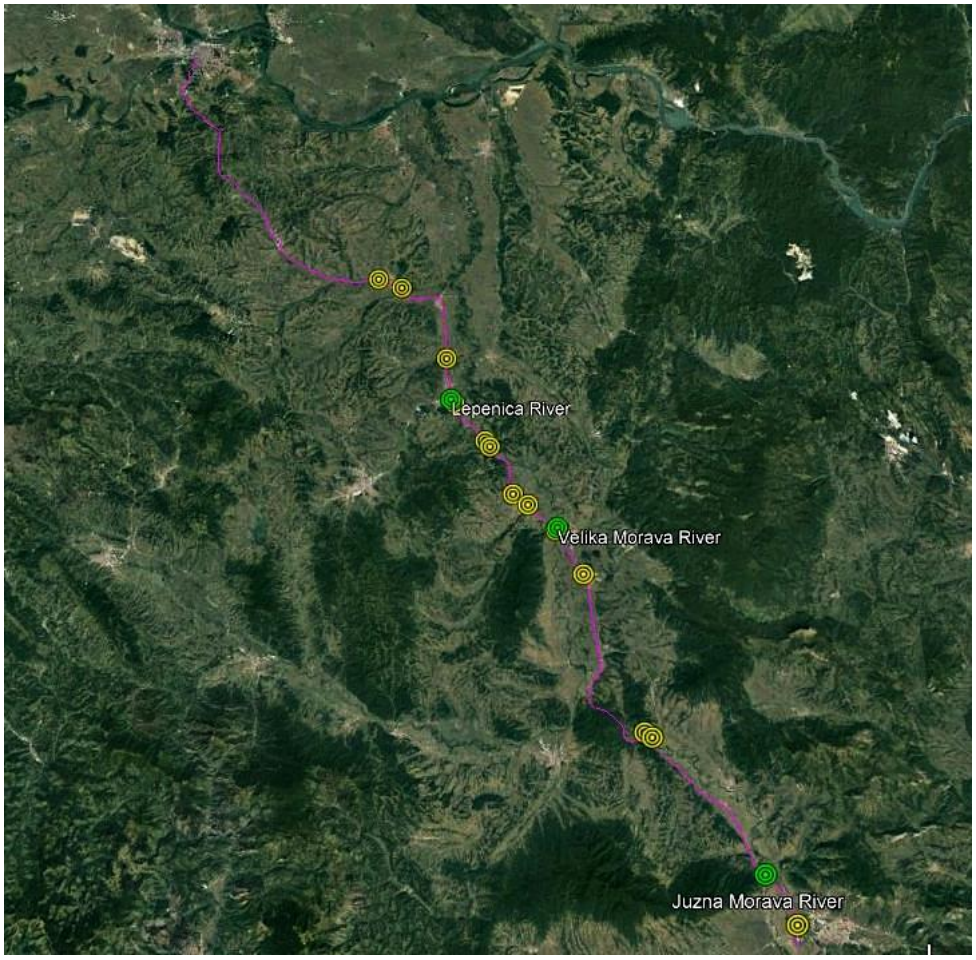

Figure 21: Localities analysed in literature review (yellow) and during field visits (green, labelled)

The degree of endangerment of species documented during project research as well as species from literary sources in the study area was compared to the classification of fish endangerment under the IUCN Red List of Threatened Species, the European Habitats Directive, Bern Convention, Bonn Convention and CITES Convention, as well as with the endangerment status according to the *Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi in Republic of Serbia*[5] and *Order on measures for preservation and protection of fish stock in Republic of Serbia*[6].

The following standard abbreviations were used:

- IUCN – International Union for Conservation of Nature
- IUCN conservation status abbreviations:
  - CR – Critically Endangered
  - EN – Endangered
  - VU – Vulnerable
  - NT – Near Threatened
  - LC – Least Concern
  - DD – Data Deficient
  - NE – Not Evaluated
- HD - Habitat Directive

[5] "Official Gazette of RS", No. 98/16

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

5.2 Assumptions and Limitations to Fish Survey

Due to the specifics and characteristics of the examined watercourses, the safety aspects of field work, duration of field research and sampling period, as well as the credibility of literature data the presented results should not be taken as final.

5.3 Project Area of Influence on Fish

Project area of influence covers a part of the watercourse of 500 meters upstream and 500 meters downstream from the area of impact. Given the impact of the planned operations on ichthyofauna and the fact that direct project impacts will be limited to the railway track, it was established that a protected area of 500 m on either side of the railway is sufficient.

For field surveys, a broad area of influence (AOI) was sufficient, while biodiversity elements must take species biology and ecosystem integrity into account. The project's AOI was expanded to represent the area's natural aspects as well as the biology of the species discovered.

5.4 Results of Fish Survey

The fish fauna (Osteichthyes) research in the proposed section Belgrade - Nis (except for the sector Stalac - Djunis) were 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 conduct the literature data analysis.

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).

Table 10: Literature records and field findings of fish species

Scientific Name	Common Name	Location	Conservation Status					Protection Measures in Serbia		
			IUCN Red List	HD	BC	Bonn C.	CITES	IUCN Status in Serbia	Rulebook	Order
Fam. Centrarchidae										
Lepomis gibbousus	Pumpkinseed	Velika Morava (Bagrdan, Cuprija)	LC	-	-	-	-	Alien species	-	-
Fam. Cobitidae										
Cobitis elongata	Balkan spined loach	Jasenica, Lugomir, Juzna Morava (Gornja Toponica), Velika Morava (Cuprija)	LC	II	III	-	-	LC	SPS	Ban on fishing
Cobitis elongatoides	Danubian spined loach	Jasenica, Kubrsnica, Raca, Lugomir, Velika Morava (Cuprija)	LC	II	III	-		LC	SPS	-
Sabanejewia balcanica	Balcan spined loach	Osanica, Lugomir, Juzna Morava (Gornja Toponica), Nisava	LC	II	III	-	-	LC	SPS	Ban on fishing
Fam. Cottidae										
Cottus gobio	Bullhead	Crnica, Lugomir	LC	II	III	-	-	LC	SPS	-
Fam. Cyprinidae										
Abramis brama	Common bream	Jasenica, Juzna Morava (Praskovce, Vitkovac, Gornja Toponica)	LC	-	-	-	-	LC	PS	L, MLM, ODU
Alburnus alburnus	Common bleak	Jasenica, Kubrsnica, Lugomir, Velika Morava (Bagrdan, Cuprija), Crnica, Juzna Morava (Praskovce, Vitkovac, Gornja Toponica), Nisava	LC	-	-	-	-	LC	-	-
Alburnoides bipunctatus	Schneider	Jasenica, Crnica, Lugomir, Velika Morava (Bagrdan), Juzna Morava (Gornja Toponica), Nisava	LC	-	III	-	-	LC	PS	-
Barbus balcanicus	Danube barbel	Jasenica, Kubrsnica, Raca, Velika Morava (Bagrdan, Cuprija), Osanica, Lugomir, Crnica, Juzna Morava	LC	V	III	-	-	LC	PS	MLM, ODU

Scientific Name	Common Name	Location	Conservation Status					Protection Measures in Serbia		
			IUCN Red List	HD	BC	Bonn C.	CITES	IUCN Status in Serbia	Rulebook	Order
		(Praskovce, Vitkovac, Gornja Toponica), Nisava								
Barbus barbus	Common barbel	Jasenica, Osanica, Lugomir, Velika Morava (Bagrdan, Cuprija), Juzna Morava (Praskovce, Vitkovac, Gornja Toponica), Nisava	LC	V	-	-	-	LC	PS	L, MLM, ODU
Blicca bjoerkna	White bream	Juzna Morava (Gornja Toponica)	LC	-	-	-	-	LC	-	-
Carassius gibelio	Prussian carp	Jasenica, Kubrsnica, Velika Morava (Bagrdan, Cuprija), Juzna Morava (Praskovce, Vitkovac), Lugomir	LC	-	-	-	-	Alien species	-	-
Chondrostoma nasus	Common nase	Jasenica, Crnica, Velika Morava (Bagrdan), Lugomir, Juzna Morava (Praskovce, Vitkovac), Nisava	LC	-	III	-	-	LC	PS	L, MLM, ODU
Cyprinus carpio	Eurasian carp	Jasenica, Juzna Morava (Praskovce, Vitkovac)	VU	-	III	-	-	LC	PS	L, MLM, ODU
Gobio obtusirostris	Danube gudgeon	Jasenica, Kubrsnica, Raca, Osanica, Velika Morava (Bagrdan), Lugomir, Juzna Morava (Praskovce, Vitkovac, Gornja Toponica), Nisava	LC	-	-	-	-	LC	PS	MLM
Leuciscus aspius	Asp	Jasenica, Velika Morava (Bagrdan, Cuprija), Juzna Morava (Praskovce, Vitkovac, Gornja Toponica)	LC	II, V	III	-	-	LC	PS	L, MLM, ODU
Leuciscus idus	Ide	Jasenica	LC	-	-	-	-	LC	PS	L, MLM, ODU
Pseudorasbora parva	Stone moroko	Jasenica, Velika Morava (Bagrdan), Osanica, Lugomir	LC	-	-	-	-	-	Alien species	-
Rhodeus amarus	European bitterling	Jasenica, Kubrsnica, Velika Morava (Bagrdan, Cuprija),	LC	II	III	-	-	LC	SPS	Ban on fishing*

Scientific Name	Common Name	Location	Conservation Status					Protection Measures in Serbia		
			IUCN Red List	HD	BC	Bonn C.	CITES	IUCN Status in Serbia	Rulebook	Order
		Lugomir, Juzna Morava (Gornja Toponica), Crnica, Nisava								
Rutilus rutilus	Roach	Jasenica, Velika Morava (Bagrdan, Cuprija), Juzna Morava (Praskovce, Vitkovac, Gornja Toponica)	LC	-	-	-	-	LC	-	-
Scardinius erythrophthalmus	Rudd	Juzna Morava (Praskovce, Vitkovac, Gornja Toponica)	LC	-	-	-	-	LC	-	-
Squalius cephalus	Chub	Jasenica, Kubrsnica, Raca, Velika Morava (Bagrdan, Cuprija), Osanica, Crnica, Lugomir, Juzna Morava (Praskovce, Vitkovac, Gornja Toponica) Nisava	LC	-	-	-	-	LC	PS	L, MLM, ODU
Vimba vimba	Vimba bream	Jasenica, Velika Morava (Bagrdan, Cuprija), Crnica, Juzna Morava (Praskovce, Vitkovac, Gornja Toponica)	LC	-	III	-	-	LC	PS	MLM, ODU
Fam. Esocidae										
Esox lucius	Northern pike	Juzna Morava (Praskovce,Vitkovac, Gornja Toponica)	LC	-	-	-	-	LC	PS	L, MLM, ODU
Fam. Gobiidae										
Neogobius fluviatilis	Monkey goby	Velika Morava (Bagrdan, Cuprija)	LC	-	-	-	-	Alien species	-	-
Neogobius melanostomus	Round goby	Velika Morava (Bagrdan, Cuprija)	LC	-	-	-	-	Alien species	-	-
Fam. Nemachelidae										
Barbatula barbatula	Stone loach	Raca, Lugomir, Nisava	LC	-	-	-	-	LC	-	-
Fam. Percidae										
Perca fluviatilis	European perch	Velika Morava (Bagrdan, Cuprija), Juzna Morava	LC	-	-	-	-	LC	PS	MLM

Scientific Name	Common Name	Location	Conservation Status					Protection Measures in Serbia		
			IUCN Red List	HD	BC	Bonn C.	CITES	IUCN Status in Serbia	Rulebook	Order
		(Praskovce, Vitkovac, Gornja Toponica), Nisava								
Sander lucioperca	Pike-perch	Velika Morava (Bagrdan, Cuprija)	LC	-	-	-	-	LC	PS	L, MLM, ODU
Zingel zingel	Zingel	Juzna Morava (Praskovce, Vitkovac)	LC	V	III	-	-	VU	SPS	Ban on fishing
Fam. Siluridae										
Silurus glanis	Wels catfish	Velika Morava (Bagrdan, Cuprija), Juzna Morava (Praskovce, Vitkovac, Gornja Toponica)	LC	-	III	-	-	LC	PS	L, MLM, ODU

BC - Bern Convention, Bonn C. – Bonn Convention, CITES - CITES Convention, SPS – Strictly protected species, PS -Protected species, L - Prohibition of hunting during spawning, MLM - Minimum hunting measure, ODU - Daily catch limit, * - protection refers to the territory of Vojvodina, there are no special protection measures for this species in the rest of Serbia

The results of field research at two localitides (Gornja Toponica – Juzna Morava river; Cuprija – Velika Morava river) are given in Table 11 and Table 12.

Table 11: Composition of ichthyofauna in the Juzna Morava river (near Gornja Toponica) on a given transect

Species	Common name	Number of individuals
A. alburnus	Common bleak	1
A. bipunctatus	Schneider	1
B. balcanicus	Danube barbel	1
B. barbus	Common barbel	1
C. elongata	Balkan spined loach	1
R. amarus	European bitterling	11
S. balcanica	Balcan spined loach	1

Table 12: Composition of ichthyofauna in the Velika Morava river (near Cuprija) on a given transect

Species	Common name	Number of individuals
A. alburnus	Common bleak	1
C. elongata	Balkan spined loach	2
N. melanostomus	Round goby	5
R. amarus	European bitterling	2
S. glanis	Wels catfish	3
S. cephalus	Chub	2
V. vimba	Vimba bream	3

The third site for field research was the river Lepenica. In the part of the flow about 3 km upstream from the mouth of the Velika Morava, 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 are not registered.

Figure 22: Fish sampling on Lepenica River

All the rivers analyzed 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*[7], 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 abovementioned Rulebook, Juzna Morava, Velika Morava and Nisava rivers belong to the second type of water bodies, i.e. large rivers with a predominance of middle sediments. These rivers are strong recipients of various types of pollution (communal, industrial, and agricultural

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

runoff), because they mainly flow through urbanized and industrial areas. In some rivers, the pollution was so great that there were no fish in them (rivers Lepenica and Belica). Also, the existing Belgrade-Nis railway already crosses most of them.

According to the IUCN Status in Serbia, there are only one species among the found in the surveyed area that fall in the Vulnerable (VU) category. The largest number of fish species (25) is in the category Least Concern (LC). Five species are invasive, non-native.

The results of the analysis indicate the confirmed or possible presence of species enlisted in the IUCN in Serbia and they are as following:

- Vulnerable (VU) fish species: Zingel – *Zingel zingel* (Linnaeus, 1766)
- Least Concern (LC) fish species: Balkan spined loach – *Cobitis elongata* (Heckel & Kner, 1858); Danubian spined loach – *Cobitis elongatoides* (Băsecu & Mayer, 1969); Balcan spined loach - *Sabanejewia balcanica* (Karaman, 1922); Bullhead - *Cottus gobio* (c); Common bream – *Abramis brama* (Linnaeus, 1758); Common bleak – *Alburnus alburnus* (Linnaeus, 1758); Schneider – *Alburnoides bipunctatus* (Bloch, 1782); Danube barbel – *Barbus balcanicus* (Kotlík, Tsigenopoulos, Ráb & Berrebi, 2002); Common barbel – *Barbus barbus* (Linnaeus, 1758); White bream - *Blicca bjoerkna* (Linnaeus, 1758); Common nase – *Chondrostoma nasus* (Linnaeus, 1758); Eurasian carp – *Cyprinus carpio* (Linnaeus, 1758); Danube gudgeon – *Gobio obtusirostris* (Valenciennes, 1842); Asp – *Leuciscus aspius* (Linnaeus, 1758); Ide – *Leuciscus idus* (Linnaeus, 1758); Europen bitterling – *Rhodeus amarus* (Bloch, 1782); Roach – *Rutilus rutilus* (Linnaeus, 1758); Rudd - *Scardinius erythrophthalmus* (Linnaeus, 1758); Chub – *Squalius cephalus* (Linnaeus, 1758); Vimba bream – *Vimba vimba* (Linnaeus, 1758); Northern pike – *Esox lucius* (Linnaeus, 1758); Stone loach – *Barbatula barbatula* (Linnaeus, 1758); European perch – *Perca fluviatilis* (Linnaeus, 1758); Pike – perch – *Sander lucioperca* (Linnaeus, 1758) and Wels catfish – *Silurus glanis* (Linnaeus, 1758).

Also, some 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). Therefore, 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.

Habitats with developed underwater vegetation should not be disturbed, 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 IUCN status in Serbia, all are listed in Annex I of Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Sebia, which means that they are strictly protected species. Such habitats can be found especially in large rivers - South 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), so they should not be disturbed and changed.

Of the 26 native fish species that inhabit the investigated localities, nine 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 II of the Habitats Directive: *C. elongata, C. elongatoides, S. balcanica, C. gobio* and *R. amarus*; in Annex V: *B. balcanicus, B. barbus* and *Z. zingel*, while the species *L. aspius* is found in both Annex II and Annex V. For most of these species the population size for total distribution is not estimated. As a result, it is impossible to say with certainty whether these local populations are considered as habitats of significant importance for the (inter)national persistence of such species.

5.5 Identification of Impacts on Fish

> Habitat alteration

Construction of bridges and railways near water bodies will lead to habitat alteration and regulation of watercourses. Habitats suitable for the residence and reproduction of fish could be lost. Also, this can disrupt fish migrations.

> Soil erosion, washing and leaking of solids

As a result of the (re)construction and establishment of the railway, soil erosion, washing and leaking of solids from surrounding area can increase amount of suspended solids in surface waters. This can affect fish respiration, hinder their movement, predator detection, and foraging of visual predators.

> Pollution

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. These pollutants can end up in aquatic ecosystems leading to a series of adverse effects on fishes.

> Noise and vibrations

Trains and construction machinery will produce noise and vibrations. As a cosequence, fishes can experience stress, leading to various changes in their behavior and reproduction.

> Impact on coastal vegetation

Removal of coastal vegetation (aquatic vegetation and roots of woody plants in the water) will destroy habitats that are suitable for the residence and spawning of certain fish species (eg. bitterling, perch)..

5.6 Mitigation Measures for Fish

5.6.1 Preconstruction phase

Get acquainted with the laws of the Republic of Serbia. Identification of specific fish habitats will be necessary if the aim is to reduce the negative impact of the railway on fish populations. Consider the necessity of building the bridges, as well as the construction of a drainage system that will prevent the leaching of pollutants from railways into aquatic ecosystems.

5.6.2 Construction phase

During construction phase the following measures need to be applied: avoid work during the spawning period and migrations (during April and May); minimize watercourse regulation, habitat and river bed alerations; minimize the impact on coastal vegetation; prevent erosion and minimize washing and leaking of solids from surrounding area (by grass plantation, interception and drainage, application of mulch coverage, use of lattice plots, concrete prefabricated panes or gypsum); reduce noise level (using noise barriers).

5.6.3 Operation phase

As a result of rail traffic, railway noise pollution is expected. In order to reduce noise level rail dampers, under-sleeper pads—USPs, rail fastenings, and/or noise barriers should be used. Leaching of pollutants from railways and their entry into watercourses could be prevented by the construction of a drainage system.

5.7 Monitoring Measures for Fish

5.7.1 Preconstruction phase

It is necessary to conduct a detailed research of population trends, especially of endangered and migratory species. It is necessary to conduct field research throughout the year, including the spawning period (during April and May) for recorded fish species. Identify special fish habitats in the impact zone will be of great importance.

5.7.2 Construction phase

During the construction phase, field study should be conducted at all sites where constructions will be conducted, as well as upstream and downstream from the mentioned localities.

5.7.3 Operation phase

Monitoring of fish stocks should be carried out every three years from the completion of construction phase.

5.8 Maps of Fish Survey

Figure 23: Location of field research of ichthyofauna on Juzna Morava river, on the site of Gornja Toponica

Figure 24: Location of field research of ichthyofauna on Velika Morava river, on the site of Cuprija

Figure 25: Location of field research of ichthyofauna on Lepenica river, on the site of Batocina

5.9 Photographs from the Fish Survey

Figure 26: Fish sampling on Juzna Morava river (near Gornja Toponica)

Figure 27: Fish sampling on Velika Morava river (near Cuprija)

5.10 References for Fish Survey

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6 Herpetofauna Survey Report

2.1 Methodology

The research of amphibians and reptiles in the area defined by the Project “Environmental and Social Assessment Belgrade-Nis - Amphibians and Reptiles” was realized in two phases: the first phase is the collection of literature data and the second phase is the collection of data in the field.

Literature data on the 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.

The degrees of endangerment of species were checked for all species according to: IUCN Red List of Threatened Species, the European Habitats Directive (Council Directive 92/43/EEC), Bern Convention, and CITES Convention, as well as with the endangerment status according to the Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Serbia[8].

Since the total length of the railway section 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. Also sites that are in a protection regime or sites characterized by habitat mosaic and less anthropogenic impact were selected (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). The position of the selected localities in relation to the Belgrade-Nis railway is shown in Figure 28.

Field research was conducted in the period from March 26 to May 21, 2022 (a total of 11 field days). 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 was collected, and the specifics of the habitat were recorded. The field guide *Reptiles and amphibians to the Reptiles and Amphibians of Britain and Europe* (Arnold and Ovenden, 2002) was used to determine the species.

[8] “Official Gazette of RS", No. 98/16

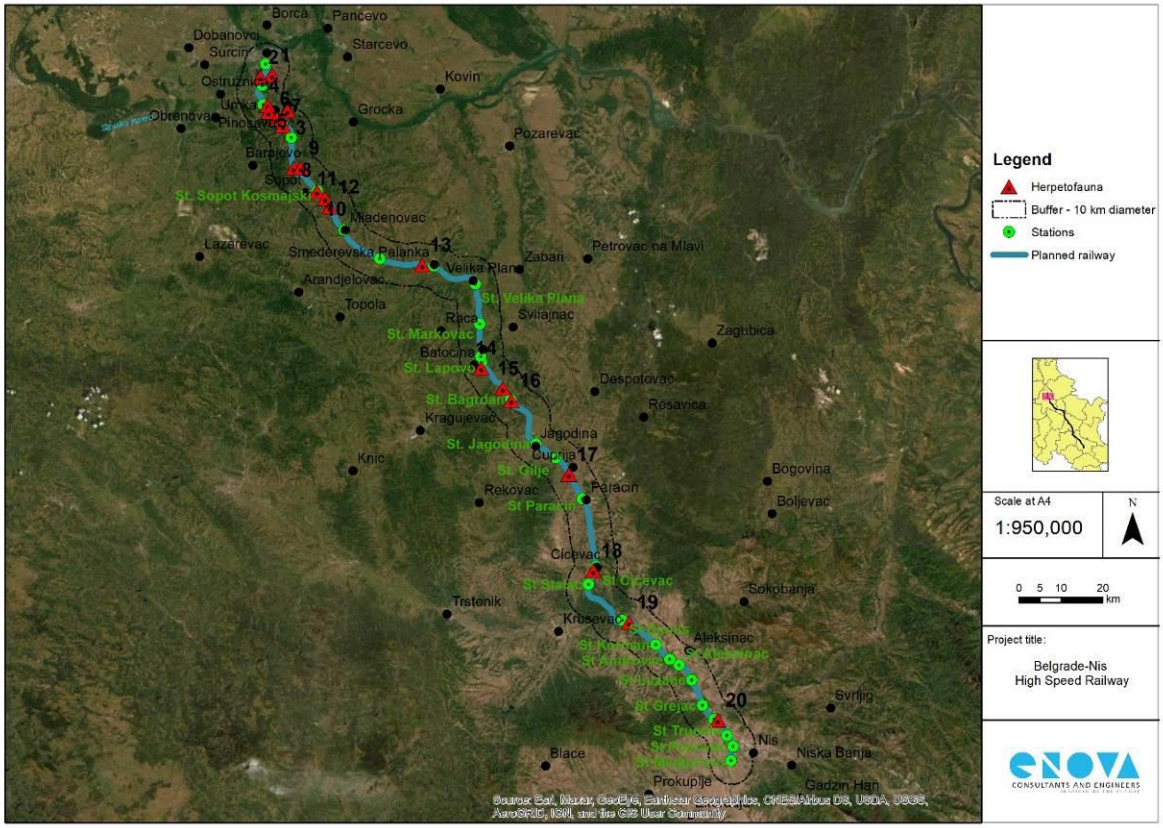


Figure 28: Position of surveyed localities in relation to the planned railway route

Table 13: 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

6.1 Assumptions and Limitations to Herpetofauna Surveys

The main limiting factor for this research was the short research period (one season and a small number of field days). Although amphibians and reptiles are often studied together, they are two different groups and require different study methodologies. Amphibians and reptiles have different habitat preferences and temperature conditions (reptiles prefer clear and sunny weather, while amphibians prefer rainy and cloudy weather). In addition, amphibians and reptiles have different periods of activity, for example reptiles are more active in the morning and afternoon when the optimum temperature is for basking, feeding, while amphibians are more active at lower temperatures at dusk and at night when their ribbits are heard. Some species of amphibians have explosive reproduction that lasts for a couple of days at the beginning of spring, after that it is difficult to find them (it is impossible to visit all localities in those few days). During the day, while visiting the transect, it is possible to see active animals in only one part of the transect, so it is difficult to estimate the size of amphibian and reptile populations.

Literary data are missing for some areas (mostly around Velika Morava), so even if amphibians and reptiles have not been observed in these localities, it does not mean that they do not live there.

In some places there are private estates (agricultural areas or yards) where it was not possible to conduct field research.

Most of these shortcomings would be addressed through a longer period of monitoring of the Project affected areas.

6.2 Project Area of Influence on Herpetofauna

Project area of influence covers 500 m on both sides of the railway. The biggest impact will be next to the railway, but for some types the impact can be felt up to 500 meters from the railway.

6.3 Results of Herpetofauna Survey

Based on literature data, 16 of the 22 amphibian species present in Serbia inhabit the Belgrade-Nis high-speed railway corridor, of which four species have been recorded in the field (*Pelophylax kl. esculentus, Pelophylax ridibundus, Rana dalmatina* and *Salamandra salamandra*). The most numerous are individuals from the genus *Pelophilax* and the species *Rana dalmatina*.

Based on literature data, 15 of the 26 reptile species present in Serbia inhabit Belgrade-Nis high-speed railway corridor, and during this 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*.

Table 14: Literature and field data on the distribution of amphibians and reptiles in the Project area

English name	Latin name	Location(s), if found, and Literature reference	Conservation status					Suitable habitat in area
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[9]	
Amphibians								
European fire-bellied toad	*Bombina bombina*	Vukov et al. 2013	LC	LC	II, IV	II	SPS	Yes
Yellow-bellied toad	*Bombina variegata*	Vukov et al. 2013	LC	LC	II, IV	II	SPS	Yes
Common toad	*Bufo bufo*	Avala Vukov et al. 2013	LC	LC		III	SPS	Yes
European green toad	*Bufotes viridis*	Vukov et al. 2013	LC	LC	IV	II	SPS	Yes
European tree frog	*Hyla arborea*	Vukov et al. 2013	LC	LC	IV	II	SPS	Yes
Balkan spadefoot toad	*Pelobates balcanicus*	Vukov et al. 2013	LC	VU	IV	II	SPS	Yes
Common spadefoot toad	*Pelobates fuscus*	Vukov et al. 2013	LC	DD	IV	II	SPS	Yes
Edible frog	*Pelophylax kl. esculentus*	Kosutnjak, Resnik, Djurinci, Smederevska Palanka, Rogot r. Lepenica, Bagrdan, Djunis, Mezgraja Vukov et al. 2013		LC	V	III	PS	Yes
Pool frog	*Pelophylax lessonae*	Vukov et al. 2013	LC	DD	IV	III	PS	Yes
Marsh frog	*Pelophylax ridibundus*	Kosutnjak, Resnik, Djurinci, Smederevska Palanka, Rogot r. Lepenica, Bagrdan, Djunis, Mezgraja Vukov et al. 2013	LC	LC	V	III	PS	Yes
Agile frog	*Rana dalmatina*	Pinosava, Avala, Rogot, Batocina Urosevic et al. 2018	LC	LC	IV	II	SPS	Yes
Smooth newt	*Lissotriton vulgaris*	Vukov et al. 2013	LC	LC		III	SPS	Yes
Fire salamander	*Salamandra salamandra*	Avala Vukov et al. 2013	LC	LC		III	SPS	Yes
Danube crested newt	*Triturus dobrogicus*	Vucic et al. 2020	NT	NT	II	II	SPS	Yes
Balkan crested newt	*Triturus ivanbureschi*	Vucic et al. 2020		VU	II, IV	II	SPS	Yes
Macedonian crested newt	*Triturus macedonicus*	Vucic et al. 2020		LC	II, IV	II	SPS	Yes
Reptiles								

[9] *Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Serbia* ("Official Gazette of RS", No. 96/10)

English name	Latin name	Location(s), if found, and Literature reference	Conservation status					Suitable habitat in area
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[9]	
	Anguis colchica	Urosevic et al. 2020	LC	DD		III		Yes
Slow worm	*Anguis fragilis*	Pinosava Urosevic et al. 2020	LC	LC		III		Yes
Smooth snake	*Coronella austriaca*	Tomovic et al. 2015	LC	LC	IV	II	SPS	Yes
Caspian whipsnake	*Dolichophis caspius*	Resnik, Avala, Cicevac Tomovic et al. 2015	LC	DD	IV	III	SPS	Yes
Grass snake	*Natrix natrix*	Kosutnjak, Resnik, Avala, Vlaska, Smederevska Palanka Tomovic et al. 2015	LC	LC		III	SPS	Yes
Dice snake	*Natrix tessellata*	Resnik, Bagrdan, Cuprija Tomovic et al. 2015	LC	LC	IV	II	SPS	Yes
Aesculapian snake	*Zamenis longissimus*	Avala, Bagrdan Tomovic et al. 2015	LC	LC	IV	II	SPS	Yes
Kotschy's gecko	*Mediodactylus kotschyi*	Urosevic et al. 2021	LC	CR	IV	II	SPS	Yes
Meadow lizard	*Darevskia praticola*	Avala Corovic et al. 2018	NT	NT		II	SPS	Yes
European green lizard	*Lacerta viridis*	Pinosava, Ralja, Avala, Djurinci, Vlaska, Smederevska Palanka, Glibovac, Rogot Batocina, Brzan, Milosevo, Bagrdan, Cuprija, Cicevac, Stalac, Djunic, Mezgraja, Vrtiste Urosevic et al. 2015	LC	LC	IV	II		Yes
Wall lizard	*Podarcis muralis*	Kosutnjak, Resnik, Pinosava, Bela reka, Ripanj, Bajfordova Suma, Ralja, Avala, Beli potok, Djurinci, Vlaska, Bagrdan, Cuprija, Cicevac, Stalac, Djunis, Vitkovac, Mezgraja, Vrtiste Urosevic et al. 2015	LC	LC	IV	II		Yes
European copper skink	*Ablepharus kitaibelii*	Ljubisavljevic et al. 2015	LC	LC	IV	II	SPS	Yes
Nose-horned viper	*Vipera ammodytes*	Bagrdan Tomovic et al. 2019a	LC	LC	IV	II	PS	Yes
Pond turtle	*Emys orbicularis*	Djurinci, Rogot river Lepenica Golubovic et al. 2017	NT	DD	II, IV	II	SPS	Yes
Hermann’s tortoise	*Testudo hermanni*	Cicevac, Djunis, Vitkovac, Mezgraja, Vrtiste Golubovic et al. 2017	NT	NT	II, IV	II	PS	Yes

English name	Latin name	Location(s), if found, and Literature reference	Conservation status					Suitable habitat in area
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook[9]	

HD - Habitats Directive, P - Protected, SPS - Strictly protected

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.

The most common species of reptiles (*Podaris muralis, Lacerta viridis, Natrix natrix, Natrix tessellata, Testudo hermanni, Dolichophis caspius, Emys orbicularis*) are also the most endangered, and special attention should be paid to the species *Testudo hermanni* which is slow and can get stuck in tracks or drains. next to the railway. Killed individuals (*Testudo hermanni*, but also faster and more agile species such as *Dolichopis caspius, Podarcis muralis, Lacerta viridis*) were found on the railway during field research.

Although the most commonly found individuals of the genus *Pelophylax* and individuals of *Rana dalmatina*, 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 area of impact of the Project may be endangered by the implementation of the Project, because they use the same water surfaces for reproduction or nutrition. There are a large number of water surfaces in the immediate vicinity of the railway and special attention should be paid to them.

Most species of amphibians and reptiles in the project's impact area are under some protection regime at the national or international level.

Based on the Rulebook references in the table, all amphibian species are strictly protected except three species of the genus *Pelophylax* which are protected. Most reptiles are strictly protected, except *Testudo hermanni* and *Vipera ammodytes* which are protected, while the species *Lacerta viridis, Podarcis muralis* and *Anguis fragilis* are unprotected. For this Rulebook, a proposal for changes was sent to the Institute for Nature Protection last year, according to which all species of amphibians and reptiles will be protected or strictly protected.

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

Based on the Red Book of Amphibians and Reptiles of Serbia, most species have the LC category, except *Pelobates balcanicus* (VU, CR), *Pelobates fuscus* (DD, CR), *Pelophylax lessonae* (DD, VU), *Triturus dobrogicus* (NT, VU), *Triturus ivanbureschi* (VU, VU), *Dolichophis caspius* (DD, VU), *Mediodactylus kotschyi* (CR, EN), *Darevskia praticola* (NT, EN), *Ablepharus kitaibelii* (LC, EN), *Testudo hermanni* (NT, VU).

Based on the Habitats Directive, most 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*.

All species of amphibians and reptiles are found in Annexes I and III of the Bern Convention.

Testudo hermani is on CITES II.

6.4 Identification of Impacts on Herpetofauna

Amphibians and reptiles are among the most endangered groups of vertebrates, and the main endangering factors are habitat destruction and pollution. Some of the possible impacts of the Project on amphibians and reptiles are listed below.

Direct killing of individuals and destruction of habitats (on railways, access roads, during excavations or construction). For example, increasing the speed of trains will reduce the chances of individuals crossing the track safely (especially for *Testudo hermanni*).

Creating a barrier (habitat fragmentation) leads to the isolation of individuals in the population and changes in the genetic structure of the population.

Disturbance of animals due to the operation of machines (noise, vibration) leads to an increase in stress levels which can result in lower reproductive success and a reduction in survival rates.

Changing the water regime - reducing the flood zone can negatively affect the reproductive centers of amphibians as well as water snakes and pond turtles.

The construction of inadequate canals for drainage of water and drainage ditches along the railway can be traps for amphibians and reptiles.

Different types of pollution during the project can affect the mortality of amphibians and reptiles. For example, municipal waste (cans and bottles) can be traps for herpetofauna and can increase the chance of fire. Suspension of soil particles or pesticides can adversely affect amphibians and reptiles that are bound to aquatic habitats.

Destruction of vegetation (mechanically or with the help of herbicides) near railways or aquatic habitats can negatively affect amphibians and reptiles because they use these places to hide or search for food.

6.5 Mitigation Measures for Herpetofauna

6.5.1 Preconstruction phase

Identification of hotspots of amphibians and reptiles (reproductive centers, sunbathing and hibernation sites) for planned sections of the railway, their clear marking if they are at an appropriate distance from the work site or timely translocation of individuals to appropriate habitats nearby.

Fence the places so that the individuals are not trapped in the place of the planned works, but so that they can move towards natural habitats. Vegetation should be removed so that individuals can escape to natural habitats.

Determine the optimal places for the construction of the passage, which will alleviate the fragmentation of the habitat of reptiles and amphibians.

6.5.2 Construction phase

Work near ponds and canals (reproductive centers) should not be performed during the reproductive period of amphibians (spring). Do not remove shrubby or grassy vegetation outside the work zone, because they are a shelter and feeding place for reptiles. Do not bury ditches and depressions near the railway, because these may be places of temporary ponds where amphibians breed. Concreting canal and riverbanks should be avoided. Minimize water regime regulation and erosion. Excavated soil or felled trees should not be disposed of in amphibians' and reptiles' natural habitats.

In case snakes or nests with eggs (turtles, snakes) are found during earthworks, stop the works and contact the competent authority (Institute for Nature Protection) to move them safely.

6.5.3 Operation phase

During the works, install appropriate directing fences so that amphibians and reptiles would not enter the work zone. Fences and tunnels should be monitored and maintained in order to prevent amphibian and reptile mortality and site connectivity in the area. Install sound barriers to mitigate noise levels near amphibian reproductive centers.

6.6 Monitoring Measures for Herpetofauna

6.6.1 Preconstruction phase

Monitoring of potentially present species should be done before construction begins. Monitoring of amphibian reproductive centers and identification of established migration corridors (from reproductive centers to feeding or hibernation sites) of amphibians and reptiles on defined sections of the railway.

Assess population sizes (especially for the most endangered species) and the quality of the surrounding habitat where individuals could take refuge if local habitat destruction occurs. Monitor the quality of air, water, noise and vibration levels that will be used for further comparisons during the implementation of the Project.

6.6.2 Construction phase

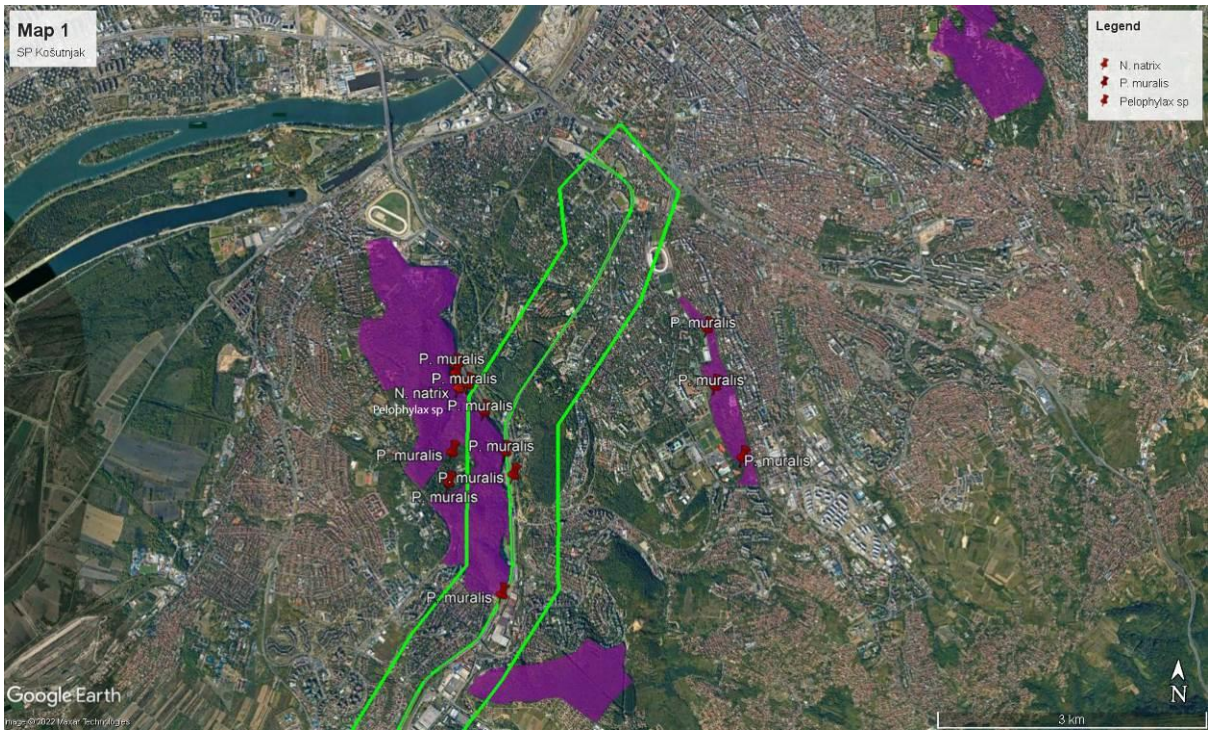
Monitor whether amphibians and reptiles are present in the work zone, and whether individuals are killed at the work site. Monitor population parameters. If animals are present in the work zone, they need to be moved and the efficiency of directing fences and passages must be checked.

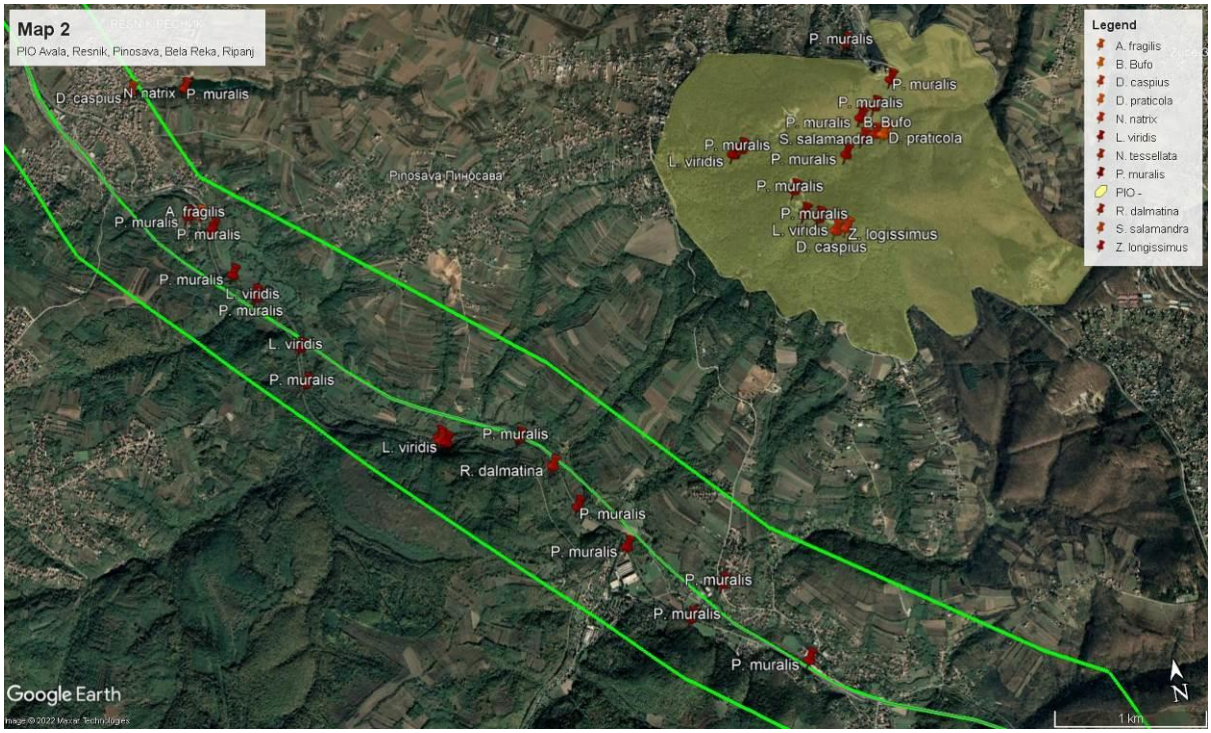
Monitor habitat parameters and levels of air pollution, water that will be affected by construction, earthworks and transport. In case of unforeseen habitat disturbance, it is necessary to translocate the individuals to adequate habitats.

6.6.3 Operation phase

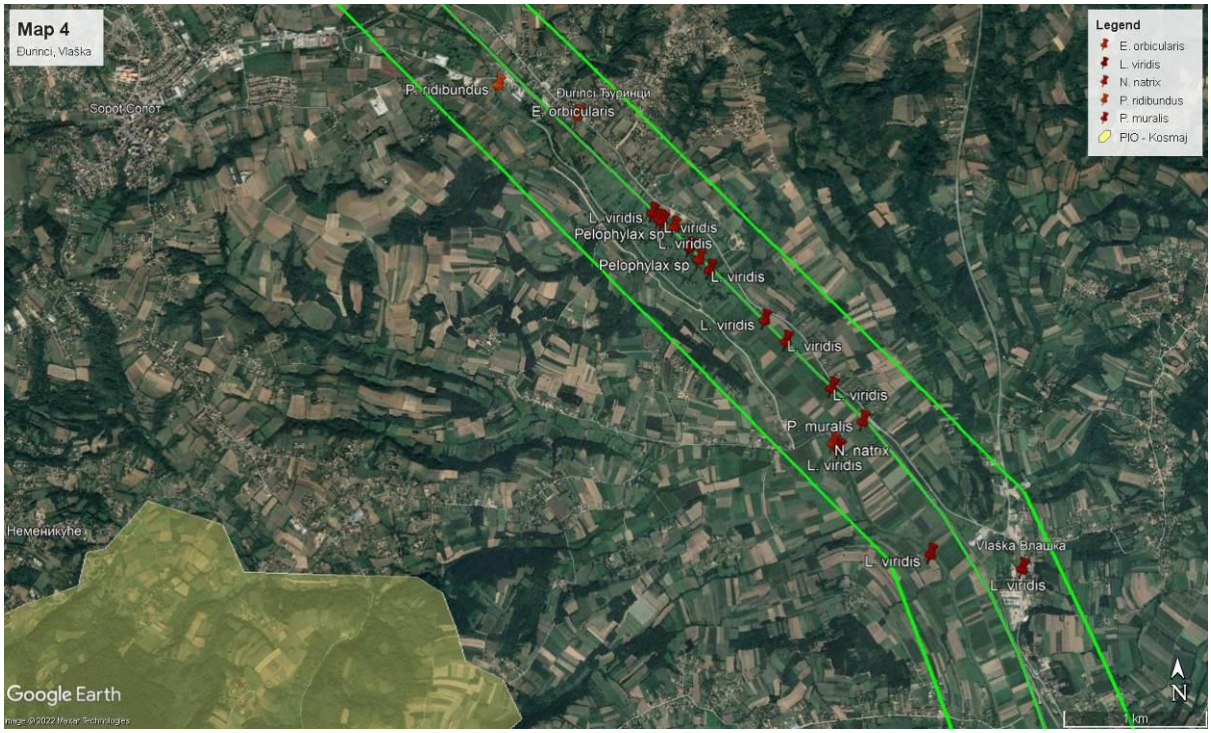
Monitoring the effectiveness of mitigation measures. Monitoring of population parameters and habitat quality of amphibians and reptiles. Monitoring should be intensified in the first few years to better assess the effects on amphibian and reptile populations in the Project impact zone. Observed unforeseen anomalies can be subsequently mitigated.

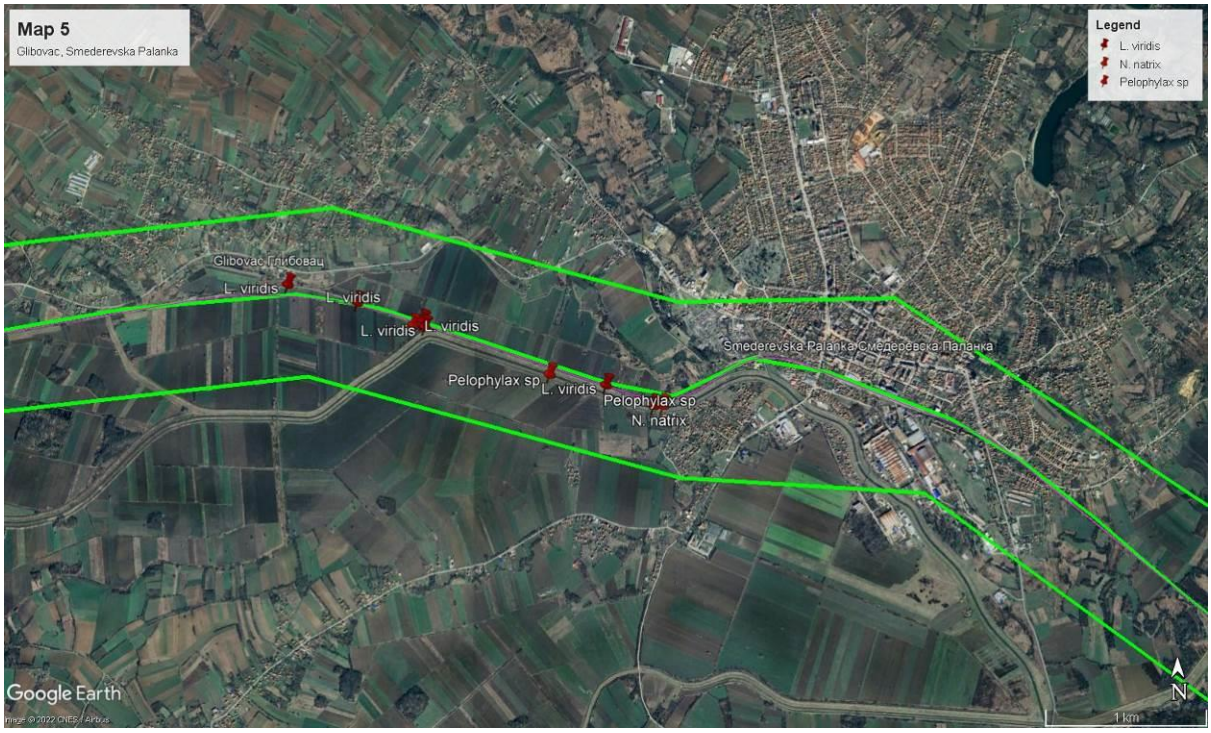
6.7 Maps of Herpetofauna Survey



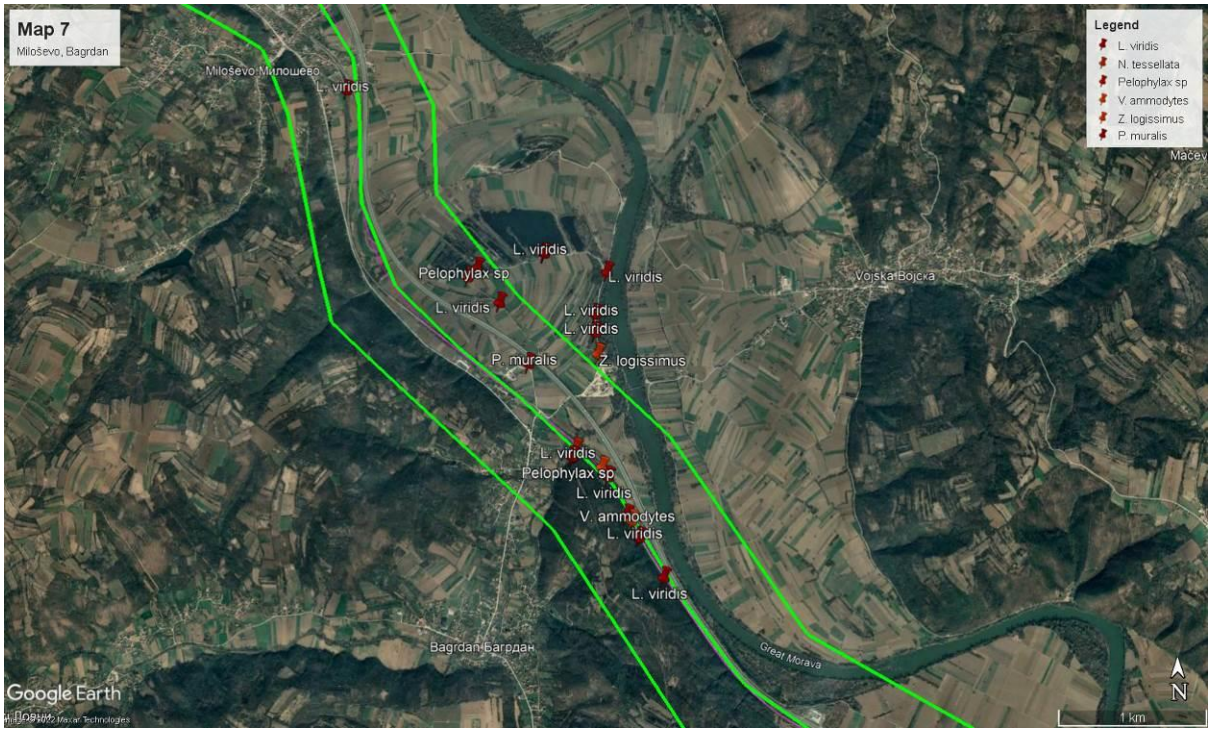



Map 3
Ralja
Legend
L. viridis
P. muralis
L. viridis
P. muralis
L. viridis
P. muralis
P. muralis
Ralja Раља
P. muralis
Parcani Парцани
Google Earth
N
1 km

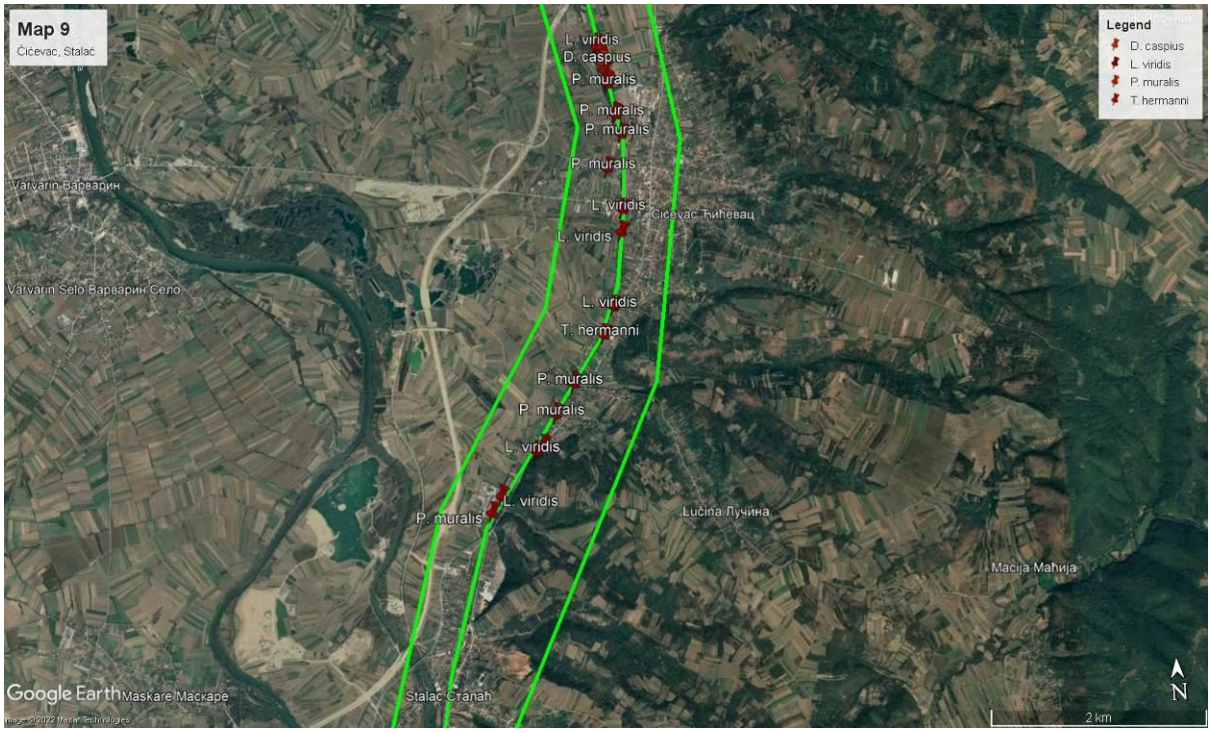

Map 4
Đurinci, Vlaška
Legend
E. orbicularis
L. viridis
N. natrix
P. ridibundus
P. muralis
PIO - Kosmaj
Sopot Сопот
P. ridibundus
Đurinci Ђуринци
E. orbicularis
L. viridis
Pelophylax sp
L. viridis
Pelophylax sp
L. viridis
L. viridis
L. viridis
L. viridis
P. muralis
N. natrix
L. viridis
Неменикуће
Vlaška Влашка
L. viridis
L. viridis
Google Earth
N
1 km


Map 5
Glibovac, Smederevska Palanka
Legend
L. viridis
N. natrix
Pelophylax sp
Glibovac Глибовац
L. viridis
L. viridis
L. viridis
L. viridis
Smederevska Palanka Смедеревска Паланка
Pelophylax sp
L. viridis
Pelophylax sp
N. natrix
Google Earth
1 km
N


Map 6
SP Rogot, Batočina, Brzan
Legend
E. orbicularis
L. viridis
P. ridibundus
R. dalmatina
SP - Rogot
KRIVAJA КЕЊАЈА
L. viridis
E. orbicularis
L. viridis
E. orbicularis
L. viridis
R. dalmatina
L. viridis
L. viridis
L. viridis
L. viridis
L. viridis
L. viridis
R. dalmatina
L. viridis
L. viridis
L. viridis
NASELJE MORAVA НАСЕЉЕ МОРАВА
L. viridis
ĐUNIS ЂУНИС
Great Morava
Brzan Брзан
Google Earth
1 km
N


Map 7
Miloševo, Bagrdan
Legend
L. viridis
N. tessellata
Pelophylax sp
V. ammodytes
Z. logissimus
P. muralis
Miloševo Милошево
Mačev
Vojska Војска
Bagrdan Багрдан
Great Morava
Google Earth
1 km
N


Map 8
Ćuprija
Legend
L. viridis
N. tessellata
P. muralis
Ćuprija Ћуприја
Google Earth
1 km
N


Map 9
Ćićevac, Stalac
Legend
D. caspius
L. viridis
P. muralis
T. hermanni
L. viridis
D. caspius
P. muralis
P. muralis
P. muralis
P. muralis
L. viridis
Ćićevac Ћићевац
L. viridis
Varvarin Варварин
Varvarin Selo Варварин Село
L. viridis
T. hermanni
P. muralis
P. muralis
L. viridis
L. viridis
P. muralis
Lučina Лучина
Macija Мачија
Maskare Маскаре
Stalac Сталаћ
Google Earth
2 km
N

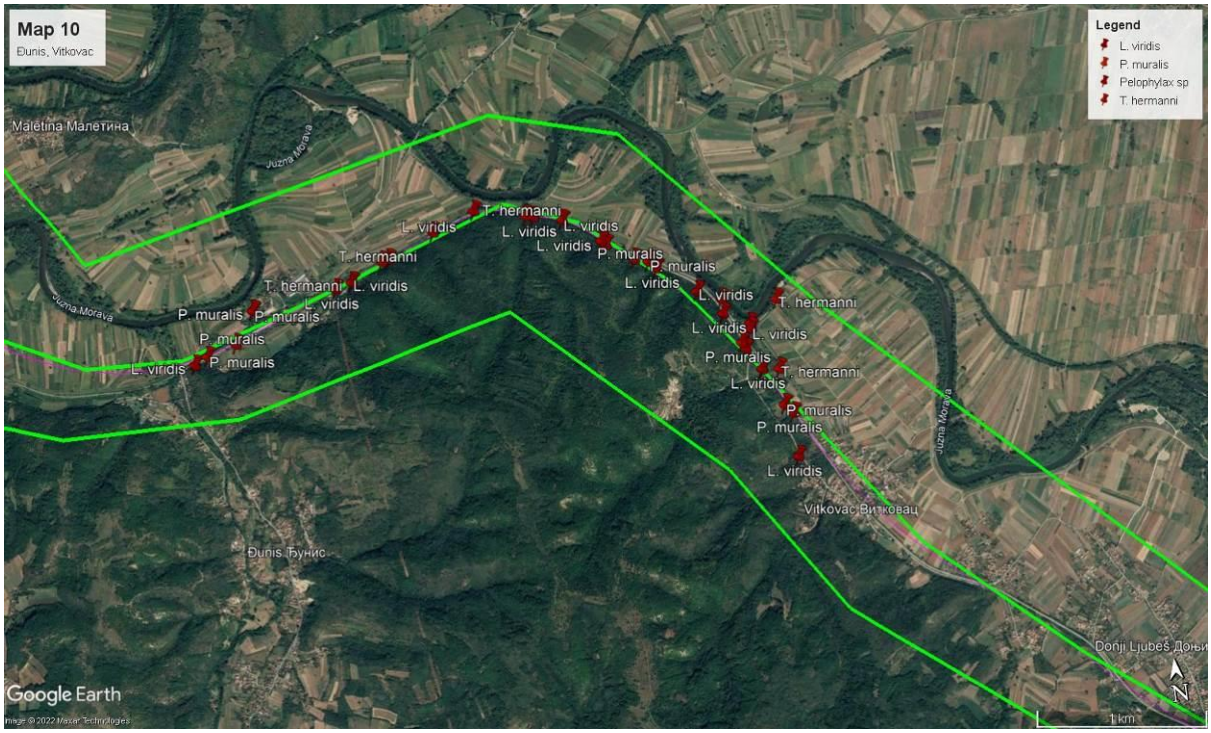

Map 10
Đunis, Vitkovac
Legend
L. viridis
P. muralis
Pelophylax sp
T. hermanni
Maletina Малетина
Južna Morava
T. hermanni
L. viridis
L. viridis
L. viridis
T. hermanni
P. muralis
P. muralis
L. viridis
T. hermanni
L. viridis
Južna Morava
P. muralis
P. muralis
P. muralis
L. viridis
P. muralis
L. viridis
T. hermanni
L. viridis
L. viridis
P. muralis
T. hermanni
L. viridis
P. muralis
P. muralis
L. viridis
Vitkovac Витковац
Đunis Гунис
Donji Ljubeš Доњи
Google Earth
1 km
N

Table 15: Table of all field records

Species	Latitude	Longitude	Locality
P. muralis	44.760468	20.436953	Kosutnjak
P. muralis	44.7635	20.437237	Kosutnjak
N. natrix	44.769805	20.437633	Kosutnjak
Pelophylax sp	44.769805	20.437633	Kosutnjak
P. muralis	44.771267	20.43714	Kosutnjak
P. muralis	44.772102	20.437113	Kosutnjak
P. muralis	44.77019	20.438986	Kosutnjak
P. muralis	44.76757	20.441355	Kosutnjak
P. muralis	44.76364	20.444517	Kosutnjak
P. muralis	44.761402	20.445747	Kosutnjak
P. muralis	44.749487	20.444733	Kosutnjak
D. caspius	44.706546	20.455205	Resnik
N. natrix	44.70605	20.460302	Resnik
N. tessellata	44.70605	20.460302	Resnik
Pelophylax sp	44.70605	20.460302	Resnik
P. muralis	44.70605	20.460302	Resnik
A. fragilis	44.697308	20.460058	Pinosava
P. muralis	44.6973	20.45911	Pinosava
P. muralis	44.69628	20.461132	Pinosava
R. dalmatina	44.69605	20.460907	Pinosava
A. fragilis	44.692974	20.462425	Pinosava
P. muralis	44.692974	20.462425	Pinosava
P. muralis	44.691414	20.46417	Pinosava

Species	Latitude	Longitude	Locality
L. viridis	44.691204	20.464296	Pinosava
L. viridis	44.687454	20.467552	Pinosava
P. muralis	44.68508	20.467678	Pinosava
P. muralis	44.680237	20.478739	Pinosava
R. dalmatina	44.679993	20.478828	Pinosava
L. viridis	44.679817	20.47935	Pinosava
P. muralis	44.679268	20.485811	Pinosava
R. dalmatina	44.67717	20.488344	Pinosava
P. muralis	44.674374	20.489893	Pinosava
P. muralis	44.67141	20.493572	Bela reka
P. muralis	44.668163	20.501192	Ripanj
P. muralis	44.666477	20.497953	Ripanj
P. muralis	44.66278	20.507317	Ripanj
P. muralis	44.776596	20.472101	Bajfordova Suma
P. muralis	44.770942	20.47347	Bajfordova Suma
P. muralis	44.763989	20.477597	Bajfordova Suma
P. muralis	44.57044	20.557259	Ralja
P. muralis	44.570507	20.551334	Ralja
P. muralis	44.572033	20.561508	Ralja
P. muralis	44.57361	20.540987	Ralja
L. viridis	44.57214	20.540175	Ralja
L. viridis	44.579468	20.536673	Ralja
L. viridis	44.694427	20.508965	Avala
S. salamandra	44.694301	20.52287	Avala
B. Bufo	44.695589	20.521266	Avala
P. muralis	44.69464	20.509766	Avala
P. muralis	44.69121	20.513391	Avala
L. viridis	44.6896	20.513838	Avala
P. muralis	44.68919	20.514963	Avala
D. caspius	44.68822	20.516203	Avala
Z. logissimus	44.688248	20.517181	Avala
P. muralis	44.69322	20.518972	Avala
P. muralis	44.69557	20.521093	Avala
R. dalmatina	44.694187	20.520906	Avala
N. natrix	44.694424	20.522156	Avala
D. praticola	44.694477	20.52334	Avala
P. muralis	44.696186	20.522648	Avala
P. muralis	44.697735	20.524569	Avala
P. muralis	44.70086	20.521368	Beli Potok
P. ridibundus	44.52333	20.609882	Djurinci
E. orbicularis	44.521145	20.617401	Djurinci
L. viridis	44.514404	20.624414	Djurinci
P. muralis	44.51399	20.62502	Djurinci
L. viridis	44.5138	20.62536	Djurinci

Species	Latitude	Longitude	Locality
Pelophylax sp	44.513428	20.626448	Djurinci
L. viridis	44.512054	20.627867	Djurinci
Pelophylax sp	44.511242	20.628742	Djurinci
L. viridis	44.510517	20.62971	Djurinci
L. viridis	44.507122	20.634716	Djurinci
L. viridis	44.505707	20.636677	Vlaska
L. viridis	44.502583	20.640755	Vlaska
P. muralis	44.50039	20.643536	Vlaska
N. natrix	44.49896	20.640757	Vlaska
L. viridis	44.498585	20.641289	Vlaska
L. viridis	44.491797	20.649291	Vlaska
L. viridis	44.49083	20.657509	Vlaska
L. viridis	44.369329	20.913067	Glibovac
L. viridis	44.36824	20.918736	Glibovac
L. viridis	44.36711	20.924063	Glibovac
L. viridis	44.3633	20.938839	Smederevska Palanka
N. natrix	44.36209	20.943398	Smederevska Palanka
Pelophylax sp	44.362087	20.942646	Smederevska Palanka
Pelophylax sp	44.36395	20.934303	Smederevska Palanka
L. viridis	44.366776	20.924234	Glibovac
Pelophylax sp	44.366875	20.923283	Glibovac
R. dalmatina	44.144753	21.104387	Rogot Batocina
R. dalmatina	44.139267	21.095896	Rogot Batocina
L. viridis	44.13428	21.087727	Rogot Batocina
L. viridis	44.139793	21.090544	Rogot Batocina
E. orbicularis	44.14647	21.10053	Rogot Lepenica
E. orbicularis	44.14798	21.103445	Rogot Lepenica
L. viridis	44.148987	21.109203	Rogot Batocina
L. viridis	44.142727	21.117067	Rogot Batocina
L. viridis	44.139786	21.12134	Rogot Batocina
L. viridis	44.139095	21.12193	Rogot Batocina
L. viridis	44.137405	21.12343	Rogot Batocina Brzan
L. viridis	44.14277	21.117376	Rogot Batocina
P. ridibundus	44.144638	21.114754	Rogot Batocina
L. viridis	44.144638	21.114754	Rogot Batocina
L. viridis	44.146152	21.112461	Rogot Batocina
L. viridis	44.147392	21.110159	Rogot Batocina
L. viridis	44.133832	21.127168	Brzan
L. viridis	44.103006	21.165042	Milosevo
P. muralis	44.085056	21.181538	Bagrdan
L. viridis	44.088966	21.178972	Bagrdan
Pelophylax sp	44.09063	21.176163	Bagrdanske bare
L. viridis	44.091225	21.176964	Bagrdanske bare
L. viridis	44.09214	21.182917	Bagrdanske bare

Species	Latitude	Longitude	Locality
Pelophylax sp	44.09214	21.182917	Bagrdanske bare
L. viridis	44.09089	21.188488	Bagrdanske bare Velika Morava
L. viridis	44.08818	21.187426	Bagrdan
L. viridis	44.087	21.187424	Bagrdan
Z. logissimus	44.08565	21.18764	Bagrdan V Morava
L. viridis	44.079178	21.185352	Bagrdan
Pelophylax sp	44.079178	21.185352	Bagrdan
L. viridis	44.07793	21.188463	Bagrdan
V. ammodytes	44.07524	21.19046	Bagrdan
L. viridis	44.074196	21.191082	Bagrdan
L. viridis	44.071762	21.193169	Bagrdan
L. viridis	44.07558	21.190018	Bagrdan
V. ammodytes	44.078537	21.187931	Bagrdan
N. tessellata	44.079704	21.18566	Bagrdan
P. muralis	43.916225	21.364517	Cuprija
P. muralis	43.91611	21.361542	Cuprija
P. muralis	43.91837	21.3588	Cuprija
L. viridis	43.918396	21.358597	Cuprija
N. tessellata	43.91899	21.358442	Cuprija
L. viridis	43.919376	21.3582	Cuprija
L. viridis	43.92171	21.356422	Cuprija
L. viridis	43.92476	21.354269	Cuprija
L. viridis	43.92824	21.351606	Cuprija
L. viridis	43.93045	21.350388	Cuprija
N. tessellata	43.93396	21.34858	Cuprija
L. viridis	43.92398	21.355167	Cuprija
L. viridis	43.922375	21.35625	Cuprija
L. viridis	43.92043	21.364515	Cuprija
L. viridis	43.901519	21.37203	Cuprija
P. muralis	43.729706	21.43671	Cicevac
D. caspius	43.731815	21.436071	Cicevac
L. viridis	43.73345	21.43558	Cicevac
T. hermanni	43.733147	21.435747	Cicevac
L. viridis	43.733086	21.43619	Cicevac
T. hermanni	43.733078	21.436281	Cicevac
P. muralis	43.730946	21.436436	Cicevac
P. muralis	43.730003	21.4366	Cicevac
L. viridis	43.72694	21.437279	Cicevac
P. muralis	43.72683	21.43743	Cicevac
P. muralis	43.725033	21.437939	Cicevac
P. muralis	43.72198	21.435934	Cicevac
L. viridis	43.71815	21.43747	Cicevac
L. viridis	43.716106	21.437105	Cicevac
L. viridis	43.709488	21.435568	Cicevac

Species	Latitude	Longitude	Locality
T. hermanni	43.70703	21.43413	Cicevac
P. muralis	43.7029	21.43011	Cicevac
P. muralis	43.700306	21.42765	Cicevac
P. muralis	43.69766	21.42583	Cicevac Stalac
L. viridis	43.697166	21.425035	Stalac
L. viridis	43.69344	21.420479	Stalac
P. muralis	43.69207	21.419233	Stalac
L. viridis	43.602913	21.506088	Djunis
P. muralis	43.60327	21.507051	Djunis
P. muralis	43.603714	21.509188	Djunis
P. muralis	43.60533	21.51072	Djunis
L. viridis	43.605865	21.516888	Djunis
T. hermanni	43.60611	21.518118	Djunis
L. viridis	43.60611	21.518118	Djunis
T. hermanni	43.607033	21.520967	Djunis
L. viridis	43.608112	21.524435	Djunis
L. viridis	43.608932	21.52754	Djunis
T. hermanni	43.6083	21.531216	Djunis
L. viridis	43.60819	21.53176	Djunis
L. viridis	43.60782	21.533787	Djunis
L. viridis	43.60647	21.536356	Djunis
P. muralis	43.60625	21.536663	Djunis
P. muralis	43.60531	21.538555	Djunis
P. muralis	43.605083	21.539541	Djunis
L. viridis	43.60468	21.540043	Djunis
L. viridis	43.603203	21.542719	Djunis
L. viridis	43.601883	21.544378	Djunis
P. muralis	43.600246	21.54543	Djunis
L. viridis	43.59989	21.545662	Djunis
L. viridis	43.59875	21.546635	Djunis
P. muralis	43.59875	21.546635	Djunis
P. muralis	43.596745	21.54789	Vitkovac
P. muralis	43.596268	21.548439	Vitkovac
T. hermanni	43.59865	21.547865	Vitkovac
L. viridis	43.59399	21.54837	Djunis
L. viridis	43.600914	21.546217	Djunis
T. hermanni	43.602263	21.548335	Djunis
L. viridis	43.60119	21.546185	Djunis
Pelophylax sp	43.602654	21.544403	Djunis
T. hermanni	43.60695	21.520466	Djunis
P. muralis	43.605328	21.510715	Djunis
L. viridis	43.39172	21.782888	Mezgraja
T. hermanni	43.39137	21.784481	Mezgraja
T. hermanni	43.39102	21.786234	Mezgraja

Species	Latitude	Longitude	Locality
P. muralis	43.39102	21.786234	Mezgraja
T. hermanni	43.390495	21.78682	Mezgraja
P. muralis	43.390495	21.78682	Mezgraja
P. muralis	43.390434	21.788254	Mezgraja
L. viridis	43.39053	21.788404	Mezgraja
P. muralis	43.388813	21.793829	Mezgraja
Pelophylax sp	43.388145	21.797106	Mezgraja
P. muralis	43.387726	21.797882	Mezgraja
P. muralis	43.386875	21.799873	Mezgraja
P. muralis	43.385975	21.801413	Mezgraja
P. muralis	43.38438	21.80376	Vrtiste
L. viridis	43.38367	21.804834	Vrtiste
L. viridis	43.38151	21.80601	Vrtiste
T. hermanni	43.38151	21.80601	Vrtiste
L. viridis	43.380463	21.806622	Vrtiste

Figure 29: Pinosava-Ripanj locality

Figure 30: Ranja-Avala locality

Figure 31: Glibac-Smederevska Palanka locality

Figure 32: Nature Monument Rogot, Lapovo-Brzan locality

Figure 33: Some of the found herpetofauna species, in order: Zamenis longissimus, Vipera ammodytes, Dolichophis caspius, Emys orbicularis

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7 Bird Survey Report

7.1 Methodology

Field research of ornithofauna was conducted during the nesting season, in May and June 2022, by ornithologist Slobodan Markovic. The equipment included Nikon binoculars with 8x42 magnification, Vortex with 10x42 magnification and Diamondback binoculars with 20-60x60 magnification, to observe birds on water surface. Photo data was created using Panasonic LUMIX DZFZ82 digital camera. The NaturaList application was used to collect data in the field (https://data.biolovision.net/). For each observation, 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 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 (Table 16) were completed. Transects were visited in the early 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 railway and the protected areas or IBAs (Important Bird Areas). It was found that the new railway does pass through 2 IBAs, Gornje Pomoravlje and Dobric-Nisava.

Table 16: 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

7.2 Assumptions and Limitations to Bird Survey

The biggest limitation was the very short duration of the research, with only 13 field days for over 200km of route length. Within the given time frame, we successfully covered the nesting season of birds, which was treated as a priority, while the seasons of migration (spring and autumn) and wintering of birds (November-February) could not be completed.

There is an apparent lack of literature data. Numerous scientific publications focused on the municipal area through which the railway passes, however, due to the specifics of the project area we were working on (500m buffer zone along the sides of the railway), it was not possible to use the data from these publications directly.

During the field visit of Transect 1, Nis, the construction work (repair of the existing railway) began. The works took place during the bird nesting season, which could be very unfavourable for the birds of the present aquatic habitats. Wet meadows on both sides of the railway are occupied by the birds that use the seasonally wet, flooded habitats for both nesting and migration.

7.3 Project Area of Influence on Birds

It is estimated that the works on the railway will have a direct impact on the environment within the buffer zone of 500m on both sides, which was the focus of the field research. There was no need to increase the project area, as it is unlikely that the impact can exceed this limit. The new railway follows the existing railway for the majority of its length.

7.4 Results of Bird Survey

During May and in the beginning of June, ornithofauna research was performed at 21 locations along the route of railway Belgrade-Nis, for the total of 13 field days. Research was also conducted on the direct impact zone, 500m on both sides of the railway. A total of 1017 data entries was collected, with 2163 specimens of 85 bird species.

Table 17 summarizes the collected species data. Standardized categories were used to display the endangerment categories of the species, based on the IUCN Red List of Endangered Species and the Red Book of Fauna of Serbia III- Birds.

- CR – Critically Endangered
- EN – Endangered
- VU – Vulnerable
- NT – Near Threatened
- LC – Least Concern
- DD – Data Deficient
- NE – Not Evaluated

Table also includes species mentioned in the EU Birds Directive:

- Annex I
- Annex II
- Annex III

Table 17: Bird survey results

English name	Latin name	Location(s)	Conservation status				Suitable habitat in area
			IUCN global red list	BD	Red Book of Serbia	Rulebook[10]	
Northern Goshawk	*Accipiter gentilis*	Ripanj 2	LC		VU	PS	Yes
Eurasian Sparrowhawk	*Accipiter nisus*	Vrtiste, Ripanj 1, Velika Plana 2, Cuprija 2, Pojate, Cicevac	LC		LC	SPS	Yes
Great reed warbler	*Acrocephalus arundinaceus*	Donje Medjurovo, Vrtiste, Velika Plana 3	LC		LC	SPS	Yes
Marsh Warbler	*Acrocephalus palustris*	Velika plana 3, Cuprija 2	LC		LC	SPS	Yes
Eurasian Reed Warbler	*Acrocephalus scirpaceus*	Vrtiste	LC		LC	SPS	Yes
Common Sandpiper	*Actitis hypoleucos*	Mezgraja, Stalac	LC		EN	SPS	No
Long-tailed Bushtit	*Aegithalos caudatus*	Batocina 1, Batocina 2, Velika Plana 3, Djurinci 2, Ripanj 1, Ripanj 2, Stalac, Cuprija 2	LC		LC	SPS	Yes
Eurasian Skylark	*Alauda arvensis*	Mezgraja	LC	IIB	LC	SPS	Yes
Common Kingfisher	*Alcedo atthis*	Brzan, Mezgraja, Stalac, Cuprija 2	LC	I	LC	SPS	Yes
Mallard	*Anas platyrhynchos*	Brzan, Mezgraja, Stalac, Cuprija 2	LC	IIA; IIIA	LC	PS	Yes
Common Swift	*Apus apus*	Brzan, Kosutnjak 1	LC		LC	SPS	Yes
Grey Heron	*Ardea cinerea*	Donje Medjurovo, Brzan, Velika Plana 1, Velika Plana 3, Vrtiste, Mezgraja, Stalac, Cuprija 2	LC		LC	PS	No
Purple Heron	*Ardea purpurea*	Brzan, Vrtiste	LC	I	VU	SPS	No
Long-eared Owl	*Asio otus*	Velika Plana 2	LC		LC	SPS	Yes
Little Owl	*Athene noctua*	Donje Medjurovo, Velika Plana 2, Cicevac	LC		LC	SPS	Yes
Common Buzzard	*Buteo buteo*	Donje Medjurovo, Brzan, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Kosutnjak 2, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
Common Linnet	*Linnaria cannabina*	Velika Plana 1	LC		LC	SPS	No
European Goldfinch	*Carduelis carduelis*	Brzan, Velika Plana 1, Velika Plana 2, Velika Plana 3, Kosutnjak 1, Kosutnjak 2	LC		LC	SPS	Yes

[10] *Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Serbia* ("Official Gazette of RS", No. 96/10)

English name	Latin name	Location(s)	Conservation status				Suitable habitat in area
			IUCN global red list	BD	Red Book of Serbia	Rulebook[10]	
European Greenfinch	*Chloris chloris*	Brzan, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Kosutnjak 1, Stalac, Cicevac	LC		LC	SPS	Yes
Eurasian Treecreeper	*Certhia familiaris*	Kosutnjak 1	LC		LC	SPS	Yes
Cetti's Warbler	*Cettia cetti*	Vrtiste	LC		VU	SPS	Yes
Little Ringed Plover	*Charadrius dubius*	Stalac, Cuprija 2	LC		LC	SPS	Yes
White Stork	*Ciconia ciconia*	Donje Medjurovo, Batocina 1, Velika Plana 1, Velika Plana 2, Velika Plana 3, Kosutnjak 1, Mezgraja, Cuprija 2	LC	I	LC	SPS	Yes
Black Stork	*Ciconia nigra*	Velika Plana 3, Cicevac	LC	I	NT	SPS	No
Western Marsh Harrier	*Circus aeruginosus*	Brzan, Batocina 1, Vrtiste	LC	I	NT	SPS	Yes
Hawfinch	*Coccothraustes coccothraustes*	Kosutnjak 2	LC		LC	SPS	Yes
Feral Rock Dove	*Columba livia / domestica*	Donje Medjurovo, Brzan, Batocina 1, Velika Plana 1, Velika Plana 2, Velika Plana 3, Kosutnjak 1, Kosutnjak 2, Stalac, Cicevac, Pojate, Cuprija 2	LC		NA	PS	Yes
Common Wood Pigeon	*Columba palumbus*	Donje Medjurovo, Brzan, Batocina 1, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Kosutnjak 2, Mezgraja, Stalac, Pojate, Cuprija 1, Cuprija 2	LC	IIA; IIIA	LC	PS	Yes
Northern Raven	*Corvus corax*	Donje Medjurovo, Ripanj 1, Vrtiste, Kosutnjak 2, Mezgraja	LC		LC	PS	Yes
Hooded Crow	*Corvus cornix*	Donje Medjurovo, Brzan, Batocina 1, Velika Plana 3, Djurinci 1, Kosutnjak 1, Kosutnjak 2, Mezgraja, Stalac, Cuprija 2	/	IIB	LC	PS	Yes
Rook	*Corvus frugilegus*	Donje Medjurovo, Brzan, Velika Plana 2, Velika Plana 3, Vrtiste, Pojate, Cuprija 1	LC	IIB	LC	PS	Yes
Western Jackdaw	*Corvus monedula*	Donje Medjurovo, Velika Plana 2, Kosutnjak 1, Kosutnjak 2	LC	IIB	LC	PS	Yes
Common Cuckoo	*Cuculus canorus*	Brzan, Batocina 1, Batocina 2, Velika Plana 2, Djurinci 1, Ripanj 1, Ripanj 2, Vrtiste, Mezgraja, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
Eurasian Blue Tit	*Cyanistes caeruleus*	Ripanj 1, Kosutnjak 2, Cuprija 2	LC		LC	SPS	Yes
Common House Martin	*Delichon urbicum*	Velika Plana 2	LC		LC	SPS	Yes

English name	Latin name	Location(s)	Conservation status				Suitable habitat in area
			IUCN global red list	BD	Red Book of Serbia	Rulebook[10]	
Great Spotted Woodpecker	*Dendrocopos major*	Batocina 1, Batocina 2, Velika Plana 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Kosutnjak 2, Stalac, Pojate, Cuprija 2	LC		LC	SPS	Yes
Middle Spotted Woodpecker	*Leiopicus medius*	Cicevac	LC	I	LC	SPS	Yes
Lesser Spotted Woodpecker	*Dryobates minor*	Batocina 2, Velika Plana 1, Stalac	LC		LC	SPS	Yes
Syrian Woodpecker	*Dendrocopos syriacus*	Cicevac	LC	I	LC	SPS	Yes
Black Woodpecker	*Dryocopus martius*	Mezgraja	LC	I	LC	SPS	Yes
Little Egret	*Egretta garzetta*	Cuprija 2	LC	I	LC	SPS	No
Corn Bunting	*Emberiza calandra*	Donje Medjurovo, Velika Plana 1, Mezgraja, Paracin	LC		LC	SPS	Yes
Yellowhammer	*Emberiza citrinella*	Batocina 2, Velika Plana 2, Velika Plana 3, Djurinci 2, Ripanj 2	LC		LC	SPS	Yes
Ortolan Bunting	*Emberiza hortulana*	Brzan, Velika Plana 1, Velika Plana 3, Mezgraja, Pojate, Paracin, Cuprija 1	LC	I	LC	SPS	Yes
European Robin	*Erithacus rubecula*	Pojate	LC		LC	SPS	Yes
Eurasian Hobby	*Falco subbuteo*	Mezgraja, Stalac, Cicevac	LC		LC	SPS	Yes
Common Kestrel	*Falco tinnunculus*	Donje Medjurovo, Brzan, Batocina 1, Velika Plana 1, Velika Plana 3, Djurinci 1, Vrtiste, Kosutnjak 1, Kosutnjak 2, Stalac, Pojate, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
Common Chaffinch	*Fringilla coelebs*	Brzan, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 2, Kosutnjak 1, Kosutnjak 2, Stalac, Cicevac	LC		LC	SPS	Yes
Crested Lark	*Galerida cristata*	Brzan, Batocina 1, Velika Plana 1, Velika Plana 3, Pojate, Paracin	LC		LC	SPS	Yes
Common Moorhen	*Gallinula chloropus*	Vrtiste	LC	IIB	LC	PS	Yes
Eurasian Jay	*Garrulus glandarius*	Brzan, Batocina 2, Velika Plana 2, Velika Plana 3, Djurinci 1, Ripanj 1, Ripanj 2, Mezgraja	LC	IIB	LC	PS	Yes
Barn Swallow	*Hirundo rustica*	Donje Medjurovo, Brzan, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 2, Vrtiste, Kosutnjak 1, Mezgraja, Stalac, Cicevac, Pojate, Cuprija 1	LC		LC	SPS	Yes

English name	Latin name	Location(s)	Conservation status				Suitable habitat in area
			IUCN global red list	BD	Red Book of Serbia	Rulebook[10]	
Red-backed Shrike	*Lanius collurio*	Brzan, Djurinci 2, Ripanj 1, Batocina 1, Batocina 2, Cicevac, Cuprija 1, Cuprija 2, Djurinci 1, Donje Medjurovo, Mezgraja, Pojate, Ripanj 2, Stalac, Velika Plana 1, Velika Plana 2, Velika Plana 3, Vrtiste	LC	I	LC	SPS	Yes
Lesser Grey Shrike	*Lanius minor*	Brzan, Velika Plana 1, Cicevac, Pojate, Cuprija 1	LC	I	LC	SPS	Yes
Savi's Warbler	*Locustella luscinioides*	Vrtiste	LC		LC	SPS	Yes
Common Nightingale	*Luscinia megarhynchos*	Donje Medjurovo, Brzan, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
European Bee-eater	*Merops apiaster*	Brzan, Velika Plana 1, Djurinci 1, Cuprija 1	LC		LC	SPS	Yes
Black Kite	*Milvus migrans*	Vrtiste	LC	I	EN	SPS	No
Western Yellow Wagtail	*Motacilla flava*	Velika Plana 1, Velika Plana 3, Stalac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
Spotted Flycatcher	*Muscicapa striata*	Ripanj 1	LC		LC	SPS	Yes
Black-crowned Night Heron	*Nycticorax nycticorax*	Velika Plana 2, Velika Plana 3, Mezgraja, Cuprija 2	LC	I	LC	SPS	No
Eurasian Golden Oriole	*Oriolus oriolus*	Brzan, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Djurinci 1, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
Eurasian Scops Owl	*Otus scops*	Kosutnjak 1	LC		LC	SPS	Yes
Great Tit	*Parus major*	Donje Medjurovo, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Kosutnjak 2, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes
House Sparrow	*Passer domesticus*	Donje Medjurovo, Velika Plana 2, Djurinci 1, Kosutnjak 2, Stalac, Cicevac, Cuprija 1	LC		LC	PS	Yes
Eurasian Tree Sparrow	*Passer montanus*	Donje Medjurovo, Batocina 1, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Kosutnjak 1, Kosutnjak 2, Mezgraja, Cicevac, Paracin	LC		LC	PS	Yes

English name	Latin name	Location(s)	Conservation status				Suitable habitat in area
			IUCN global red list	BD	Red Book of Serbia	Rulebook[10]	
Grey Partridge	*Perdix perdix*	Donje Medjurovo, Mezgraja	LC	IIA; IIIA	VU	PS	Yes
European Honey Buzzard	*Pernis apivorus*	Batocina 2	LC	I	LC	SPS	No
Common Pheasant	*Phasianus colchicus*	Donje Medjurovo, Brzan, Batocina 2, Velika Plana 1, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 1, Vrtiste, Mezgraja, Stalac, Cicevac, Paracin, Cuprija 1, Cuprija 2	LC	IIA; IIIA	NA	PS	Yes
Common Chiffchaff	*Phylloscopus collybita*	Batocina 1, Batocina 2, Ripanj 1, Vrtiste, Kosutnjak 2, Cicevac, Pojate, Cuprija 2	LC		LC	SPS	Yes
Eurasian Magpie	*Pica pica*	Donje Medjurovo, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Ripanj 2, Kosutnjak 2, Stalac, Cicevac, Cuprija 1, Cuprija 2	LC	IIB	LC	PS	Yes
European Green Woodpecker	*Picus viridis*	Ripanj 1, Kosutnjak 1, Kosutnjak 2, Cicevac	LC		LC	SPS	Yes
Whinchat	*Saxicola rubetra*	Batocina 1	LC		LC	SPS	Yes
Common Stonechat	*Saxicola torquatus*	Velika Plana 1, Cuprija 1	LC		LC	SPS	Yes
Eurasian Nuthatch	*Sitta europaea*	Batocina 2, Kosutnjak 1, Kosutnjak 2	LC		LC	SPS	Yes
Common Tern	*Sterna hirundo*	Stalac	LC	I	VU	SPS	No
Eurasian Collared Dove	*Streptopelia decaocto*	Donje Medjurovo, Batocina 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Vrtiste, Kosutnjak 1, Kosutnjak 2, Stalac, Cicevac, Pojate	LC	IIB	LC	PS	Yes
European Turtle Dove	*Streptopelia turtur*	Batocina 1, Velika Plana 1, Velika Plana 3, Ripanj 1, Ripanj 2, Mezgraja, Stalac, Pojate	VU	IIB	VU	PS	Yes
Common Starling	*Sturnus vulgaris*	Donje Medjurovo, Velika Plana 2, Djurinci 1, Ripanj 1, Vrtiste, Kosutnjak 1, Kosutnjak 2, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC	IIB	LC	PS	Yes
Eurasian Blackcap	*Sylvia atricapilla*	Donje Medjurovo, Brzan, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Kosutnjak 1, Kosutnjak 2, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1	LC		LC	SPS	Yes
Common Whitethroat	*Sylvia communis*	Donje Medjurovo, Brzan, Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 3, Djurinci 1, Djurinci 2, Ripanj 1, Ripanj 2, Vrtiste, Mezgraja, Stalac, Cicevac, Pojate, Paracin, Cuprija 1, Cuprija 2	LC		LC	SPS	Yes

English name	Latin name	Location(s)	Conservation status				Suitable habitat in area
			IUCN global red list	BD	Red Book of Serbia	Rulebook[10]	
Common Blackbird	*Turdus merula*	Batocina 1, Batocina 2, Velika Plana 1, Velika Plana 2, Velika Plana 3, Djurinci 2, Ripanj 1, Vrtiste, Kosutnjak 1, Kosutnjak 2, Stalac, Pojate, Cuprija 1	LC	IIB	LC	SPS	Yes
Mistle Thrush	*Turdus viscivorus*	Kosutnjak 2	LC	IIB	LC	SPS	Yes
Eurasian Hoopoe	*Upupa epops*	Batocina 1, Djurinci 1, Ripanj 1	LC		LC	SPS	Yes
Northern lapwing	*Vanellus vanellus*	Donje Medjurovo, Brzan, Velika Plana 1, Velika Plana 3	NT	IIB	LC	SPS	Yes

BD - Birds Directive, P - Protected, SPS - Strictly protected

During the field research, the presence of 85 species was recorded. The field research covered only the nesting period. Out of the total species number, 76 species are considered to be nesting birds of the researched area. The created ornithological list does not represent a complete ornithological list of this area due to the limitations in area coverage and research duration. Eventhough only about 10% of the complete railway lenght was visited, the ornithological list should not be drastically larger. Much of the study area, along the railway, consists of uniform habitats, with a large percentage of 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.

According to the IUCN global endangered list, Northern lapwing has NT status and European Turtle Dove 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 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 four localities, railway relocation is planned only on Velika Plana 1 and Brzan locality, possibly across the nesting sites. At sites Donje Medjurovo and Velika Plana 3, the railway retains its position, and it is unlikely that it will disturb the birds. Although globally endangered, in Serbia, Northern lapwing has the LC status, but it is in danger due to the loss of natural wetlands. At the sites where the individuals were found, the influence of the anthropogenic factor (highways, settlements, agriculture) is already very extensive, so the new railway should not pose further threats to the individuals. National population is estimated at 2,100-2,800 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 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. The temporary loss due to the construction of the railway should not be a big problem, with the recommendation to avoid works during the nesting period (April-June). 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 behavior, indicate that it is a migration, and that individuals do not nest in these localities. Additional research on the migration route, with special attention to localities where the railway passes through the IBA areas (Dobirc-Nisava and Gornje Pomoravlje) is highly recommended.

Six species have VU status at the national level, Northern Goshawk, Cetti's Warbler, Common Tern, Grey Partridge, Purple Heron, and European Turtle Dove. Out of the six, only the Purple heron is not considered a nesting bird of the researched area. Northern Goshawk was recorded in one locality, Ripanj 2, 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. Cetti's Warble was recorded in Vrtiste locality, one singing male in a suitable habitat. Cettis Warble is rare bird in Serbia, with the estimated number of individuals in Serbia is 20-110 pairs. Common Tern was recorded on Velika Morava, 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. National population of Common tern is estimated at 216-280 pairs. Grey Partridge has the VU national status. It was recorded on two sites in the south of Serbia, where the species is locally very common, national population is declining and it is estimated at 20,000-28,000 pairs.

Sixteen bird species are listed on Annex I of the EU Birds Directive:

- Common Kingfisher (*Alcedo atthis*), recorded at four locations. Habitats near water winth sand clifs are suitable for nesting. National population is estimated (NPE) at 2,700-4,000 pairs.
- Purple heron (*Ardea purpurea*), recorded at two localitons on migration. NPE at 645-900 pairs and it is almost all population in Vojvodina.
- White stork (*Ciconia ciconia*), recorded at eight locations, 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 found. NPE at 1,240-1,410 pairs.
- Two species also recorded on migration, Black stork (NP 135-172 pairs), recorded at two locations and Little egret (*Egretta garzetta*), with NPE at 1,000-1,500 pairs, recorded at one location.
- Three species from the Picidae family, each one 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 2,400-3,200 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*) was 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 preffer 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 theire 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 five locations. All records were in a suitable habitat. Various mosaic habitats along the railway are sutible for this species. NPE at 730-1120 pairs.
- Black-crowned Night-heron (*Nycticorax nycticorax*), recorded at four 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 from the locations where it was seen. NPE at 2,800-3,820 pairs.
- European Honey-buzzard (*Pernis apivorus*), recorded only on one location at migration. NPE at 700-900 pairs.
- three more species are on Annex I Birds directive, Western Marsh Harrier, Common Tern and Black Kite (elaborated on above).

At the Vrtiste site (Figure 34), the project plan shows a railway relocation, which will go through one of the rare wetlands in southern Serbia. This habitat was created artificially by relocating the river Nisava, but after a few years, after the semi-natural vegetation occupied the area, it has become an oasis for birds of aquatic habitats in migration, and nesting as well. 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 and Purple Heron on migration.
- Savi's warbler (*Locustella luscinioides*) one singing male. Estimated population for South Serbia is 0 pairs.
- Cetti's Warbler one singing male. Estimated population for South Serbia is 10-55 pairs.
- Great Reed Warbler (*Acrocephalus arundinaceus*), nine 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*), two individuals in apropriate habitat. Possible breeding. Estimated population for South Serbia is 0 pairs.

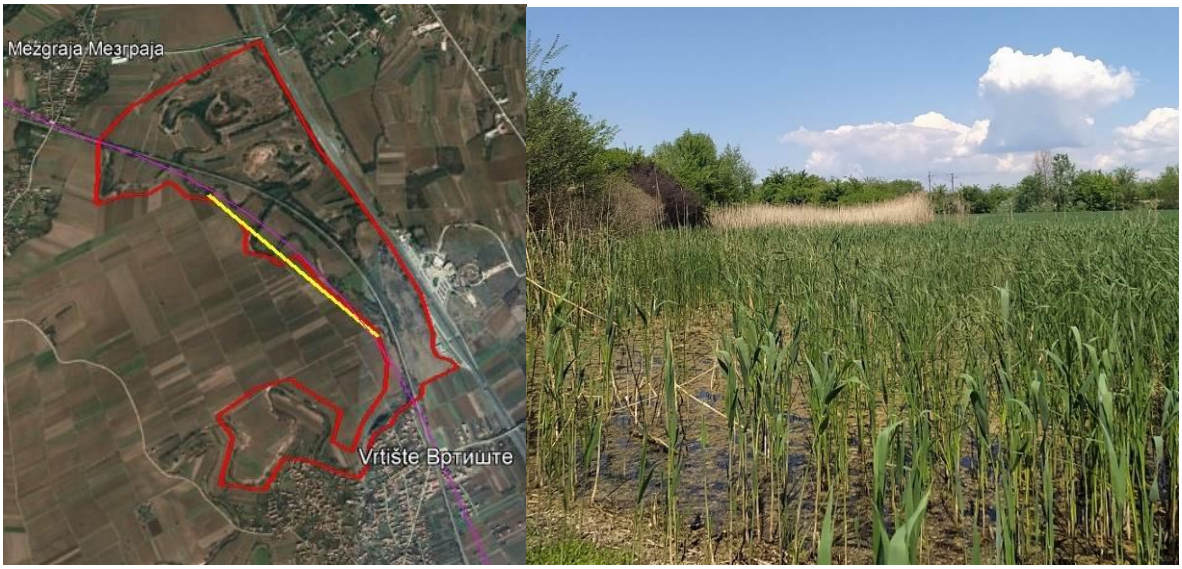


Figure 34: Wetland area on the locality Vrtiste on the left (wetland habitats - red line, transect - yellow line, planned railway - purple line)

At the site of Donje Medjurovo, three individuals of three species were found to have died from electrocution, Common Kestrel (*Falco tinnunculus*), House Sparrow (*Passer domesticus*) and Feral Rock Dove (*Columba livia f. domestica*). The individuals were found under electric poles on the railway, with clear traces that indicate suffering from electric shock (Figure 35).

Figure 35: Common Kestrel that suffered from electrocution

7.5 Identification of Impacts on Birds

> Destruction of dense vegetation along the railway. Habitat loss.

Although the majority of wetland habitats in the southern part of the route were created artificially, many songbirds and shrikes have become accustomed to these habitats. The destruction of this habitats will have a negative impact on the species that are mostly widespread in Serbia.

> Negative impact of noise during reconstruction.

High level of noise during the reconstruction works will negatively affect the nesting of a large number of mentioned species of birds, especially songbirds.

> High-speed railway will result in collisions of birds with a train.

In sections where the railway will be adjusted for high speeds, especially if it is near some agricultural areas, there is a great danger of a collision of birds of prey with the train. The biggest impact will be on owls, which hunt in low flight near agricultural areas.

> Electrocution and electrocollision

Electric poles on the tracks pose a great danger primarily for birds of prey, but also for all other birds. The danger is obvious in places where there are no trees or other vegetation near the railway, so the electric poles are the highest points where birds usually rest or from which they hunt.

> Destruction of old and dilapidated buildings (residential buildings, old railway stations) along the railway, which owls and sparrows use for nesting.

*Figure 36: Little owl (*Athene noctua*), typical breeding site for this species, Donje Medjurovo locality*

> Reconstruction of railway will be long a process, during which the present organic waste from the construction sites can attract carnivores, especially jackals.

7.6 Mitigation measures for Birds

Such a large construction project will require different mitigation measures in different phases of the repair works on the railway. Mitigation measures will also differ from one locality to another, according to the habitat in which the works are performed.

7.6.1 Preconstruction phase

Before construction, it is necessary to conduct detailed research studies of individual subsections of the railway. In order to make a complete ornithological list, birds present during migration and wintering, and the nesting birds should be included. It is necessary that any future repair works on the section of the Belgrade-Nis railway are performed before or after the nesting period of birds which takes place from the beginning of April till the end of June.

7.6.2 Construction phase

Mitigation measures related to the construction phase refer to the protection of birds from collisions with the train by building protective panels and the isolation of electrical poles.

High-speed railway for trains that reach speeds of up to 200 km/h, will certainly have a negative impact on birds. The most endangered will be birds of prey, but also birds that migrate near water surfaces. By building protective panels in certain locations, this negative impact can be reduced. It is necessary to build protective panels along the entire length of the bridges that will cross the river Juzna Morava, but also for the renovation of the existing ones that cross Velika Morava River. Protective panels can protect large birds of water habitats, but they can also be beneficial for preserving the property of the Serbian railways, because a collision at high speed can cause great material damage.

The suffering of birds from electrocution on electric poles is a big problem[11], so better electrical insulation of electric poles in critical locations is necessary. The critical locations are the ones in which the electric pole is the highest object (scarce vegetation cover etc.) so the birds take up positions on their top. In addition to better insulation, there are mechanisms to prevent birds from staying on electric poles. The described problem is mostly related to electrocution of birds of prey, which are common in the project area around the railway. Smaller songbirds are affected as well.

7.6.3 Operation phase

During this phase, attention should be paid to the bird mortality, and appropriate protection measures should be put in place on each subsection where frequent mortality is observed, with the help of ornithological experts.

7.7 Monitoring measures for Birds

7.7.1 Preconstruction phase

The field research was limited, and it covered only one part of the nesting season in a small area. Before any works on the construction of the high-speed railway are performed, it is necessary to form a complete ornithological list on the given area. Continuous monitoring in IBA areas, where the ornithological list may differ during the autumn migration is necessary, as well as an investigation of the rare species nesting sites at Vrtiste.

7.7.2 Construction phase

During the construction phase, it is important to monitor if a nesting pair of strictly protected bird species may be disturbed. Therefore, reconstruction works are not recommended during April, May and June.

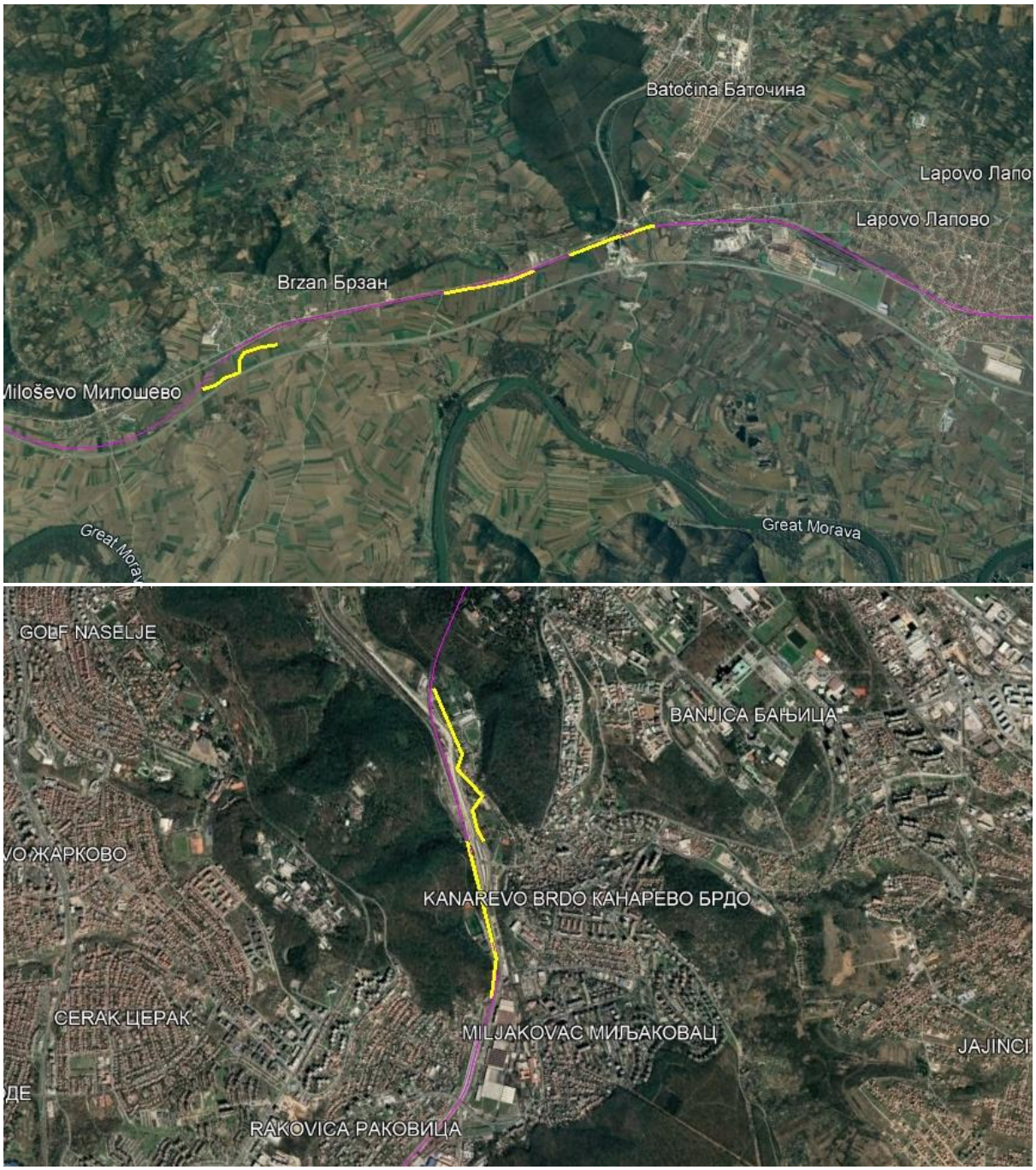
7.7.3 Operation phase

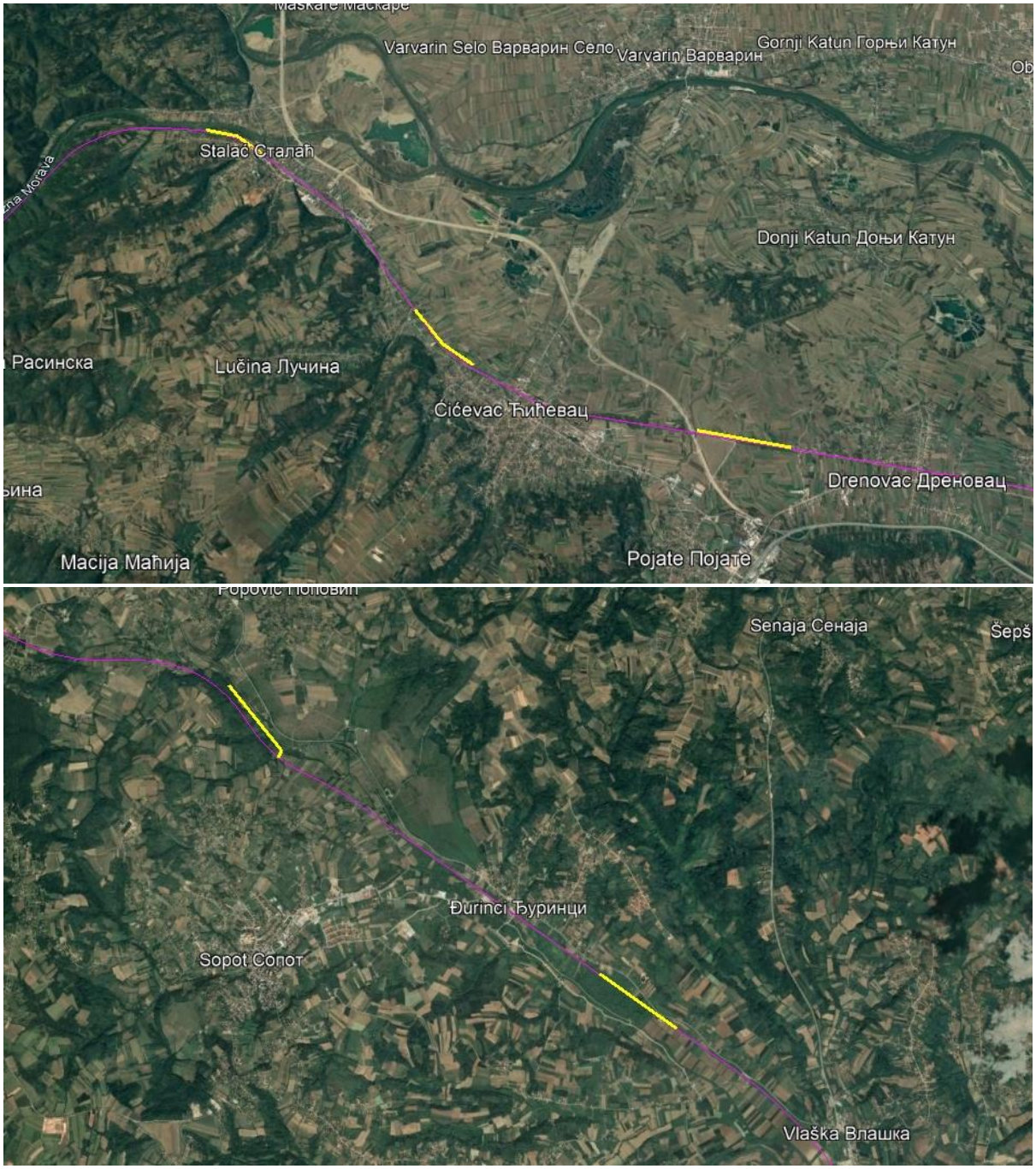
It is recommended to continuously monitor the impact of the railway on birds for the next 5 years after the construction of the railway. New populations of birds along the railway (on directly destroyed habitat) but also the mortality of birds along the railway should be monitored as well. Based on the findings, new measures should be designed and implemented.

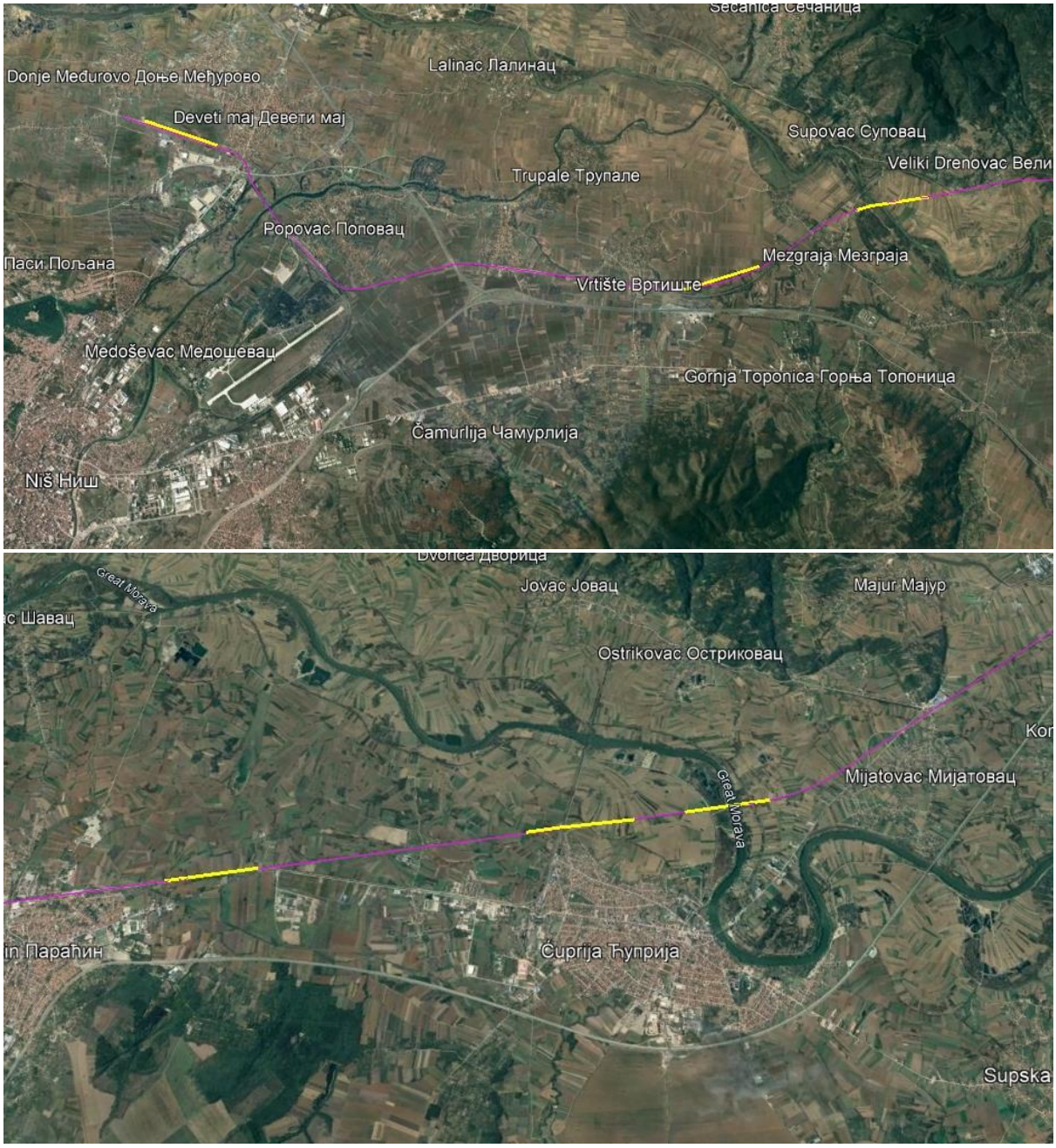
[11] Article in Serbian: RTS :: Tuzan kraj ribara Olija – Finskog orla ubila struja u Grdelickoj klisuri [Sad ending for the osprey – Finnish eagle electrocuted in Grdelic Gorge].

7.8 Bird Survey Maps

Positions of visited field transects on the new railway




Varvarin Selo Варварин Село
Varvarin Варварин
Gornji Katun Горњи Катун
Stalać Сталаћ
Donji Katun Доњи Катун
Lučina Лучина
Ćićevac Ћићевац
Drenovac Дреновац
Macija Мачија
Pojate Појате
Senaja Сенаја
Đurinci Ђуринци
Sopot Сопот
Vlaška Влашка


Donje Međurovo Доње Међурово
Lalinac Лалинац
Deveti maj Девети мај
Supovac Суповац
Veliki Drenovac Вели
Trupale Трупале
Popovac Поповац
Паси Пољана
Mezgraja Мезграја
Vrtište Вртиште
Medoševac Медошевац
Gornja Toponica Горња Топоница
Čamurlija Чамурлија
Niš Ниш
Great Morava
Jovac Јовац
Majur Мајур
Ostrikovac Остриковац
Mijatovac Мијатовац
Ćuprija Ћуприја
Supska


Ripanj Рипањ
Rakinac Ракинац
Mala Plana Мала Плана
Staro Selo Старо Село
Velika Plana Велика Плана
Great Morava
Veliko Orasje Велико Оране

7.9 Photographs from Bird Survey

Figure 37: Vrtiste locality

Figure 38: Marsh harrier, locality Brzan

Figure 39: IBA Gornje Pomoravlje

7.10 References for Bird Survey

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8 Mammal survey report

8.1 Methodology

Field research of the planned Project area was conducted by Slobodan Markovic. Field research has been undertaken during six field visitis during May and June 2022 (Field research of ornithofauna was conducted during the nesting season, in May and June 2022, by ornithologist Slobodan Markovic. The equipment included Nikon binoculars with 8x42 magnification, Vortex with 10x42 magnification and Diamondback binoculars with 20-60x60 magnification, to observe birds on water surface. Photo data was created using Panasonic LUMIX DZFZ82 digital camera. The NaturaList application was used to collect data in the field (https://data.biolovision.net/). For each observation, 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 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 (Table 16) were completed. Transects were visited in the early 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 railway and the protected areas or IBAs (Important Bird Areas). It was found that the new railway does pass through 2 IBAs, Gornje Pomoravlje and Dobric-Nisava.

Table 16), from early morning to late night. Field visits were adjusted with the optimal weather conditions of no wind, and no rain. The methodology included 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 analyze data from the available scientific literature. However, it was not possible to use any literature data, due to the specifics of the project area we covered in this assessment. All available scientific papers on mammalian distribution are related to local geographical concepts or protected areas.

Localities for fied research were predetermined by the researcher based on suitable habitats, habitat diversity and on the activities of local hunting associations. Locations were visited during day and till the late evening.

Data were collected in the field with the help of local hunting associations and local population.

Table 18: Coordinates and brief descriptions of field survey localities

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.
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.

8.2 Assumptions and Limitations to Mammal Surveys

There were limitations in the duration of the field research. There were only six field days for a large Project area, as the railway route is over 200 km long. For the territory of Serbia, there is a very small amount of published data on the distribution of mammals. For the purpose of creating this document, and for obtaining general attributes of the project area, no useful literature on mammalian distribution was found.

8.3 Project Area of Influence on Mammals

Large mammals can occupy large territories and travel several to 10 kilometers a day. As the habitats in the vincinity of the railway have been under the strong anthropogenic factor continuously for the last few decades (highway, big cities, villages, local roads) the reconstruction of the railway will not significantly change the habitats for mammals.

8.4 Results

During May and June research of mammals at the project area was performed at six locations. Each location was researched during one whole field day. Research was conducted on the direct impact zone of the railway, together with a radius of at least 1 km around the give coordinates. During field research, nearby settlements were visited and hunters and and other locals were interviewed to obtain more data of mammalian distribution and presence in the area.

During this research, a total of 15 species of mammals was collected. Data about nine species was collected during field work and data about 15 species was collected during interviews. Table 17 summarizes the collected species data. Standardized categories were used to display the endangerment categories of the species, based on the IUCN Red List of Endangered Species. National endangerment categories of the species are also indicated in the table, based on Diversity of mammal (Mammalia) fauna of Yugoslavia (Savic et al., 1995).

- IUCN categories:
  - CR – Critically Endangered
  - EN – Endangered
  - VU – Vulnerable
  - NT =LR:nt – Near Threatened
  - LC =LR:lc – Least Concern
  - DD – Data Deficient
  - NE – Not Evaluated
  - NA – Not applicable
  - LR:cd – Conservation-dependent species

- Bern convention:
  - II – Annex II
  - III – Annex III

- HD – European Habitats Directive:
  - II – Annex II

- IV – Annex IV
- (*) - priority species.

Table 19: Mammal survey results

No.	English name	Latin name	Loc 1		Loc 2		Loc 3		Loc 4		Loc 5		Loc 6		IUCN		BC	HD	Suitable habitat?	Rulebook [12]
			ILP	FW	ILP	FW	ILP	FW	ILP	FW	ILP	FW	ILP	FW	Global	Serbia				
1	Roe deer	Capreolus capreolus	+	+	+		+		+	+	+		+	+	LC	LR:cd	III		Yes	P
2	Wild boar	Sus scrofa	+		+		+				+		+		LC	LR:lc			Yes	P
3	European hare	Lepus europaeus	+	+	+	+	+	+	+		+		+	+	LC	LR:cd	III		Yes	P
4	Wildcat	Felis silvestris	+												LC	LR:cd	II	IV	Yes	P
5	Red fox	Vulpes vulpes	+		+	+	+		+			+	+		LC	LR:nt			Yes	P
6	Golden Jackal	Canis aureus	+		+		+	+	+		+	+	+		LC	LR:nt			Yes	P
7	European badger	Meles meles	+	+	+				+				+		LC	LR:cd	III		Yes	P
8	Northern white-breasted hedgehog	Erinaceus roumanicus	+		+				+	+	+		+		LC	LR:nt			Yes	P
9	European mole	Talpa europaea	+	+	+				+	+	+		+		LC	LR:nt			Yes	P
10	Red squirrel	Sciurus vulgaris	+	+	+	+	+	+	+		+	+	+		LC	LR:nt	III		Yes	P
12	Least weasel	Mustela nivalis	+		+		+		+		+		+		LC	LR:nt			Yes	P
13	Beech marten	Martes foina	+		+				+				+		LC	LR:nt	III		Yes	P
14	Muskrat	Ondatra zibethicus							+	+					NA	LR:lc			Yes	-
15	Wolf	Canis lupus	+												LC	VU	II	II, IV*	No	SP

ILP - Interview with locals and hunters, FW - Data collected from field work, BC – Berne Convention, HD – Habitats Directive, + - Species present, P - Protected, SP - Strictly protected

[12] *Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi Republic of Serbia* ("Official Gazette of RS", No. 96/10)

During the research, the presence of 15 species was recorded. Research was conduct during summer when the vegetation density reaches its maximum (e.g. crop fields and forests), which made data collecting difficult. Habitats near the railway are under the very extensive influence of several anthropogenic factors (highways, settlements, agriculture). Present habitats are very fragmented.

Acording to the IUCN global endangered list, 14 of 15 species have LC status and only Muskart (*Ondatra zibenthicus*) has NA status. Muskart was registered on the locality Velika Plana (Loc 4). Prior to the encounter with the species, locals identified 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 during severe winters, it can be seen near populated areas. Wolf is listed on Annex II and IV of the Habitat Directive. The influence of the habitat fragmentation (highways, settlements, roads) is already very extensive, so the new railway should not pose further threats to the posible individuals in this area. Based on conditions of the habitat, the area near new railway has no potential to sustain any population of wolfs.

In the locallity Veliki Drenovac, 14 species were recorded, mostly because of the forests in the area of the Mt. Mali Jastrebac. The 13 of 14 species are in suitable habitat and with further research of this area the list of mammal species would certainly 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. Wildcat is only recored in locality Veliki Drenovac.

European hare (*Lepus europaeus*), Roe deer (*Capreolus capreolus*), Red fox (*Vulpes vulpes*) and Red squirrel (*Sciurus vulgaris*) are species that are very common in 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.

One specimen of European badger (*Meles meles*) was found dead on local unpaved road (Figure 40), probably hit by a car or a truck. According to the local ihabitants, badger is not a rare species in this area.

Figure 40: Badger roadkill on a local unpaved road

The described 15 species certainly do not represent a complete list of mammals in the wider area of the Project. Surveyed habitats are right next to the railway, but with existing fragmentation of habitats due to the highway vincinity, settlements and other infrastructure, we can conclude that the project area has no potential to sustain large mammals as most natural habitats are already degraded. When we look at project area from the aspect of the transit area for mammals, there should not be too many changes for mammals, mostly because the railway does not deviate from the existing route too much. As we already mentioned, the habitats near the railway are under continuous fragmentation.

8.5 Identification of Impacts on Mammals

> Habitat fragmentation

Habitat fragmentation is the biggest problem with large construction projects such as the railway reconstruction and partial relocation. However, in this case, it is mostly a matter of reconstruction of the already existing railway, so the impact on the fragmentation fragmentation will be miniscule. Highway with the protective fences, and now the new high-speed railway with protective fences as well, will become obstacles for the transition of large mammals, so the construction of wildlife corridors must be considered along the railway.

> Habitat destruction

Destruction of habitats in the immediate vicinity of the railway reconstruction. This destruction can have an impact on the period when individuals raise their young and use these habitats for hiding and feeding.

> Negative impact of noise and vibration during reconstruction

High level of noise and vibration during the reconstruction works will disturb the mammals, forcing them to (temporarily) migrate towards more adequate localities.

> Collision with high-speed trains

Along the sections where the railway will be adjusted for high speeds, there is a risk of collisions with the train. A protective fence should protect mammals but must be constantly maintained in the operational phase.

> Accumulation of organic waste

Reconstruction of railway will be long a process, during which the present organic waste from the construction sites can attract carnivores, especially jackals.

8.6 Mitigation measures for Mammals

8.6.1 Preconstruction phase

From end of March to begining of June, most of the large mammal species raise their young. This is why the constructions phases should adjust to that. High noise and vibration of construction work sites can have a devastating impact on the development and survival rate of the young.

In this phase It will be very important to create a definite plan for building wildlife corridors. Wildlife corridors will be very important to reduce the impact of habitat fragmentation.

8.6.2 Construction phase

All construction sites must be fenced by safety fence so no mammals can enter and get hurt in that area. High noise and vibration may affect negatively but that effect will not be significant.

8.6.3 Operation phase

During this phase, special attention should be directed towards moratillity of the large mammals in the area. As we gather data on the mammal mortality across and along the railway, we could plan and implement appropriate protection measures on each section where increased moratility rate is observed.

8.7 Monitoring measures for Mammals

8.7.1 Preconstruction phase

In the preconstruction phase, it is not necessary to perform wildlife monitoring activities on large mammals.

8.7.2 Construction phase

During the construction phase, the destruction of vegetation and habitats should be monitored carefully along the line of railway reconstruction in order to prevent accidents.

8.7.3 Operation phase

It is recommended to continuously monitor the impact of the railway on mammals for the next 5 years after the construction of the railway. It is necessary to collect data on mortality of mammals along the railway so the measures can be implemented or improved.

8.8 Photographs from Mammal Survey

Figure 41: Roe deer pictured at Ripanj locality

Figure 42: European hare pictured at Brzan locality

Figure 43: Red fox found dead at Sopot locality

Figure 44: Locality Veliki Drenovac

Figure 45: Locality Paracin

Figure 46: Locality Brzan

Figure 47: Locality Sopot

Figure 48: Locality Ripanj

Figure 49: Locality Velika Plana

8.9 References for Mammal Survey

Savic, I. R., Paunovic, M., Milenkovic, M., Stamenkovic, S. (1995). *Diverzitet faune sisara (Mammalia) Jugoslavije, sa pregledom vrsta od medjunarodnog znacaja*. In: Stevanovic, V., Vasic, V. (eds.): Biodiverzitet Jugoslavije sa pregledom vrsta od medjunarodnog znacaja. Bioloski fakultet i Ecolibri, Beograd, 517-554.

9 Ecologically appropriate areas of analysis

Ecologically appropriate areas of analysis (EAAAs) should encompass wider distributions of potentially affected biodiversity features and the ecological patterns, processes, and functions that are necessary for maintaining them throughout this distribution. EAAAs typically extend well beyond a project's anticipated physical footprint and may also extend beyond the project area of influence. For some wide-ranging species, the EAAA should incorporate any important areas of aggregation, recruitment, and other habitat features, connectivity or ecosystem processes that are needed to maintain viable populations of the species. EAAAs facilite Critical

Habitat Assessment that is provided in full in the E&S Assessment Report. The CHA provides information on the most valuable biodiversity elements – priority biodiversity features (PBFs) and critical habitats (CHs). There mustn't be any net loss of PBFs and there must be net gain of CHs if the Project proceeds. The following maps show EAAAs for all species and groups where it was possible to complete identification during this stage of the Project. As the planned railway is almost 250 km long, for some groups it is very difficult to map EAAAs at this point in the Project cycle.

In the following figures, EAAAs are barked in bright green, while the planned railway is marked in bright yellow.

9.1 EAAAs of habitats

C3.2 - Water-fringing reedbeds and tall helophytes other than canes, PBF. 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.

Figure 50: EAAA of habitat type C3.2 north of Vrtiste, subsection 7

G1.11 - Riverine *Salix* woodland, PBF. G1.11 includes *Salix* spp. scrub or arborescent formations, lining flowing water and submitted to periodic flooding, developed on recently deposited alluvion. This habitat type was recorded on subsections 2, 3, 5 and 7.

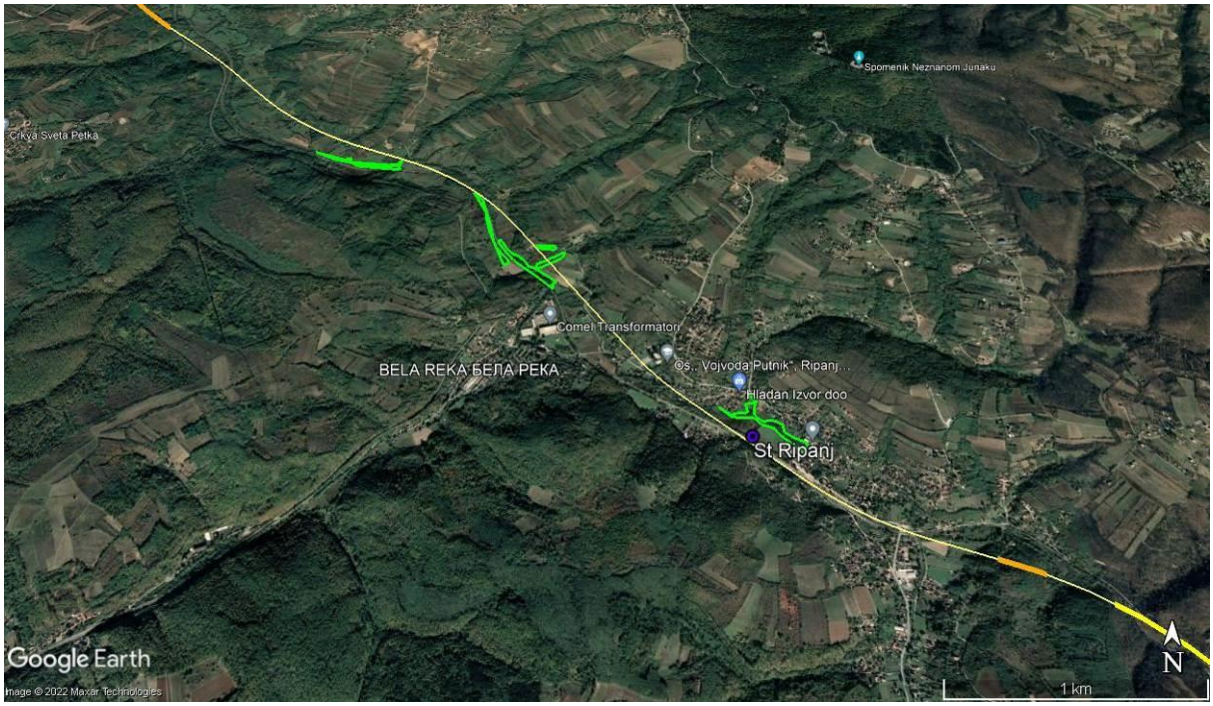

Figure 51: EAAA of G1.11 along subsection 2, near Ripanj

Figure 52: EAAA of G1.11 along subsection 3, near Lapovo

Figure 53: EAAA of G1.11 along subsection 3, near Bagrdan

Figure 54: EAAA of G1.11 along subsection 4, east of Cuprija

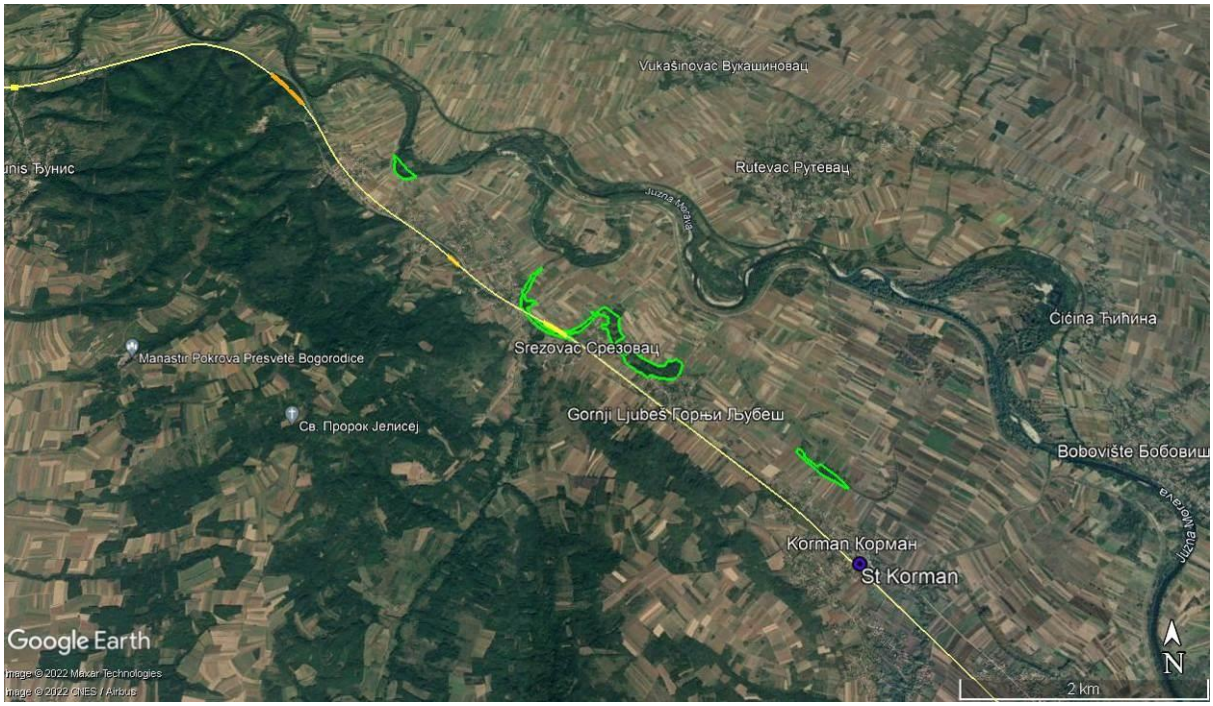

Figure 55: EAAA of G1.11 along subsection 7, between Djunis and Korman

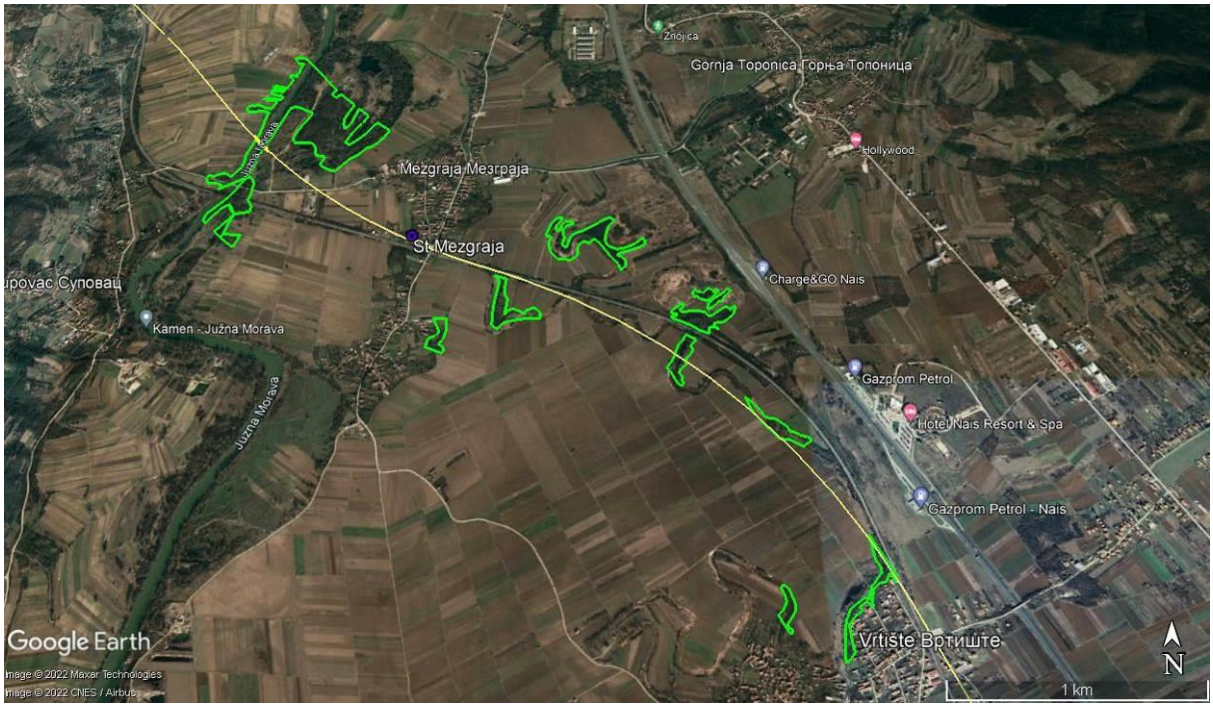

Figure 56: EAAA of G1.11 along subsection 7, between Mezgraja and Vrtiste

9.2 EAAAs of invertebrates

Euphydryas aurinia (Marsh fritillary), PBF. 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. This species is widely distributed. During the last few years, it has significantly expanded its area in the territory of Serbia. The size of the population within the investigated area is rather small. It can be found on one locality along subsection 7.

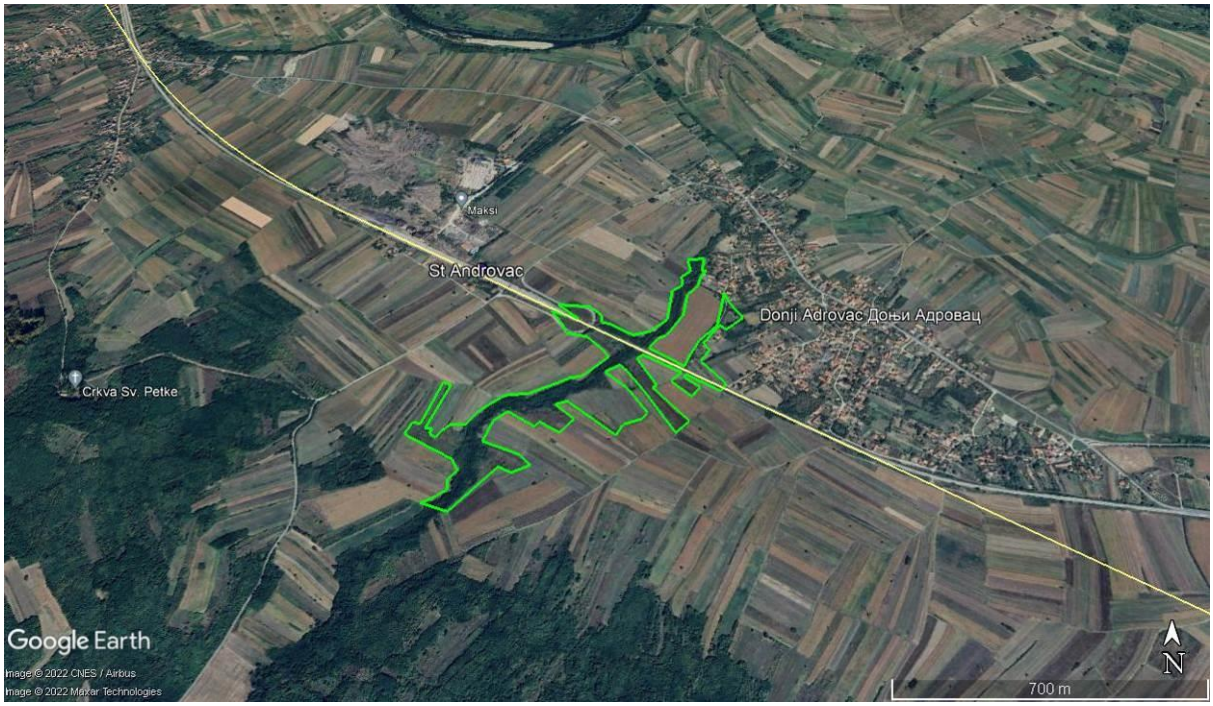

Figure 57: EAAA of Euphydryas aurinia *along subsection 7, near station in Adrovac*

Lycaena dispar (Large copper), CH. It is listed in Annexes II and II of the Habitats Directive, Annex 2 and Resolution 6 of the Berne Convention, and is globally Near Threatened (NT). It inhabits marshy habitats, areas near streams, rivers and wet, marshy meadows. This species is widely distributed. It can be found 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.

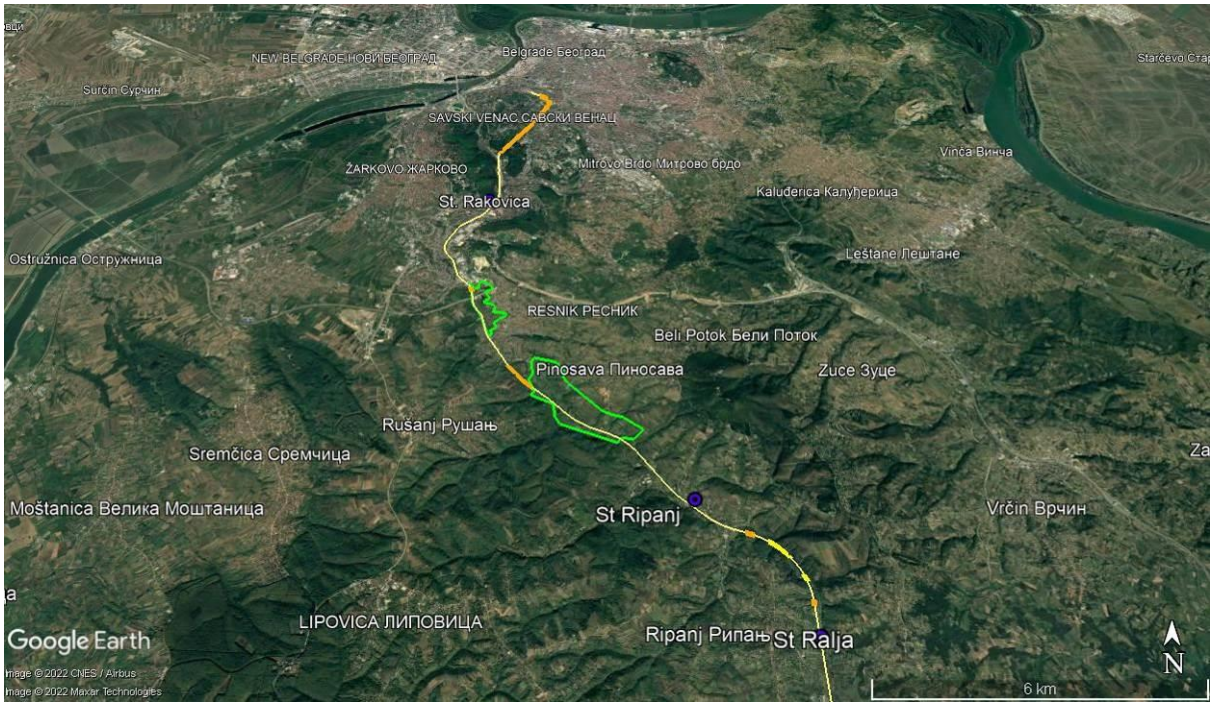

Figure 58: EAAA of Lycaena dispar along subsections 1 and 2, near Resnik and Ripanj

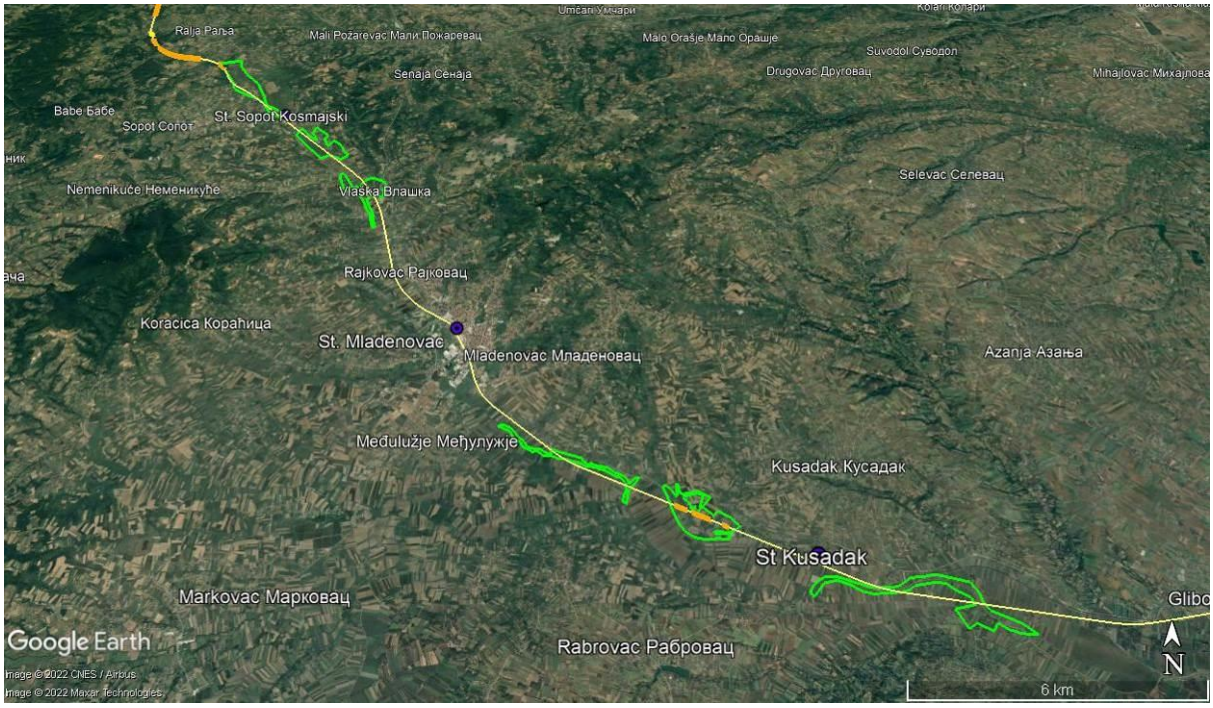

Figure 59: EAAA of Lycaena dispar along subsection 1 and 2, between Kosmaj and Glibovac

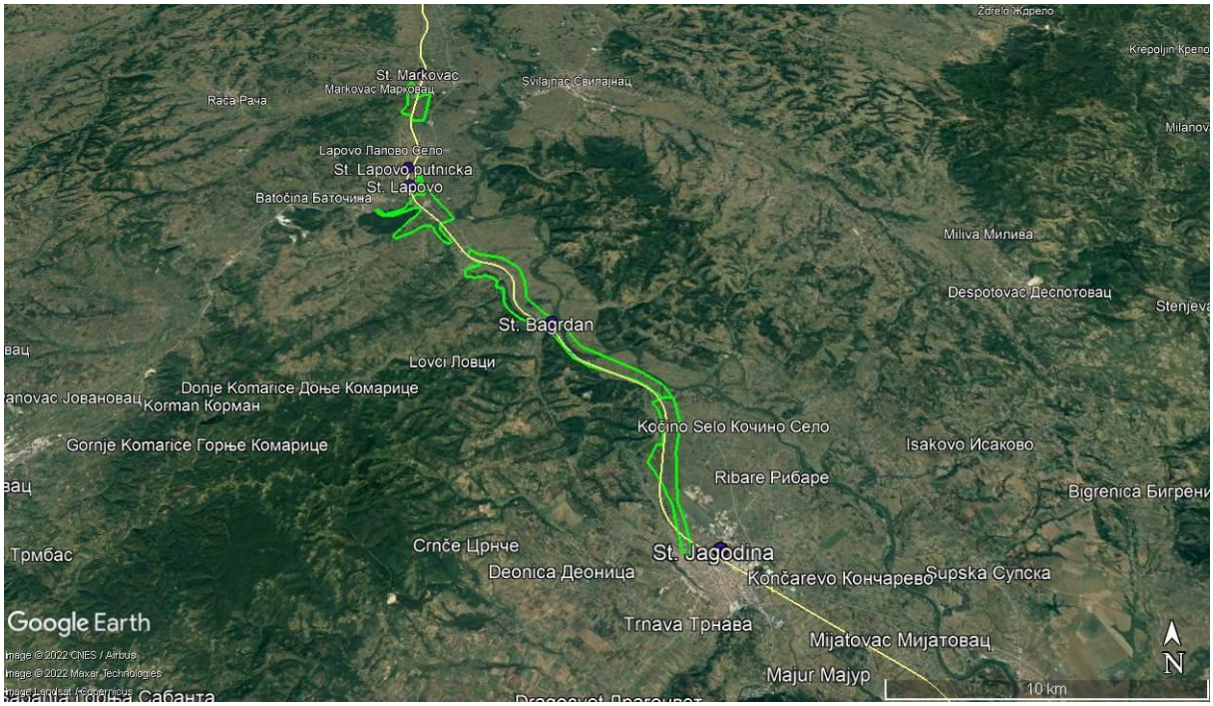

Figure 60: EAAA of Lycaena dispar along subsection 3, between Markovac and Jagodina

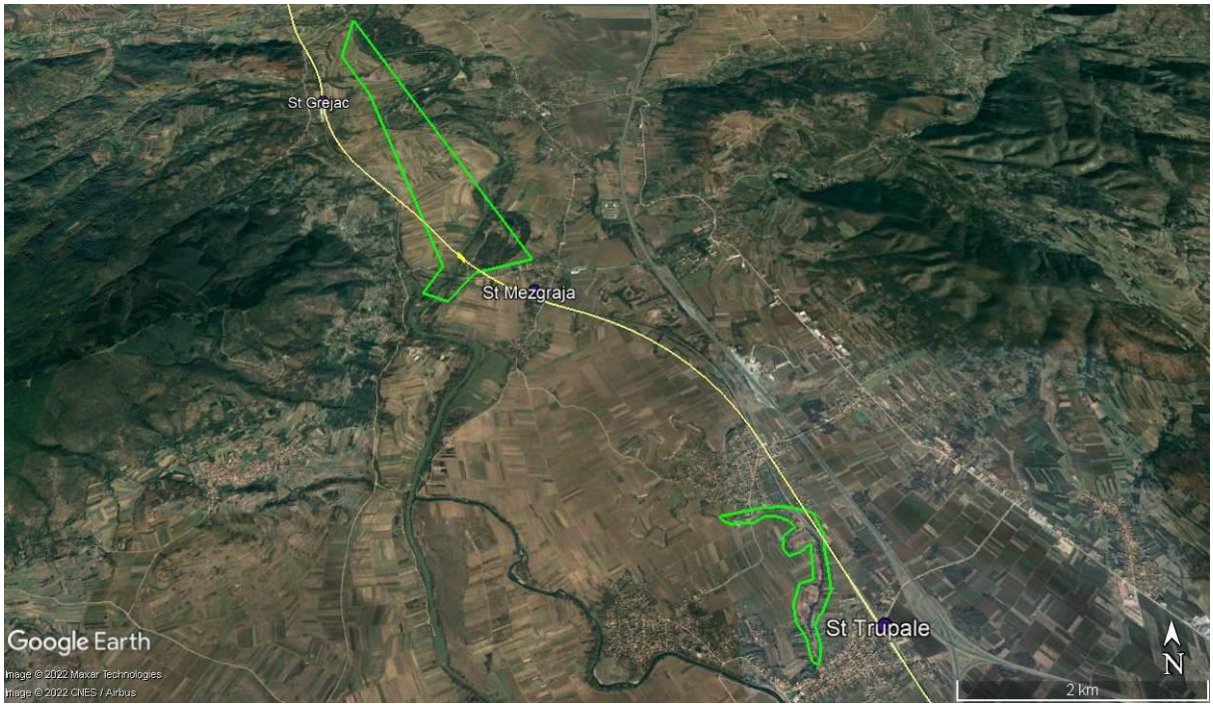

Figure 61: EAAA of Lycaena dispar along subsection 7, near Mezgraja and south of Vrtiste

Nymphalis vaualbum (Compton tortoiseshell), CH. 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 inhabits forest habitats, but populations in Serbia are mostly associated with slightly cooler areas in the beech belt. It is rare in Europe and permanent populations are mostly found in the territory of Serbia and Bulgaria. 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.

Figure 62: EAAA of Nymphalis vaualbum along subsection 1, east of Resnik

Phengaris arion (Large blue), CH. The species 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. It is found in the hilly regions of the whole of Serbia. It can be expected at many locations along the railway but it is assumed that the number of populations within the investigated area is small.

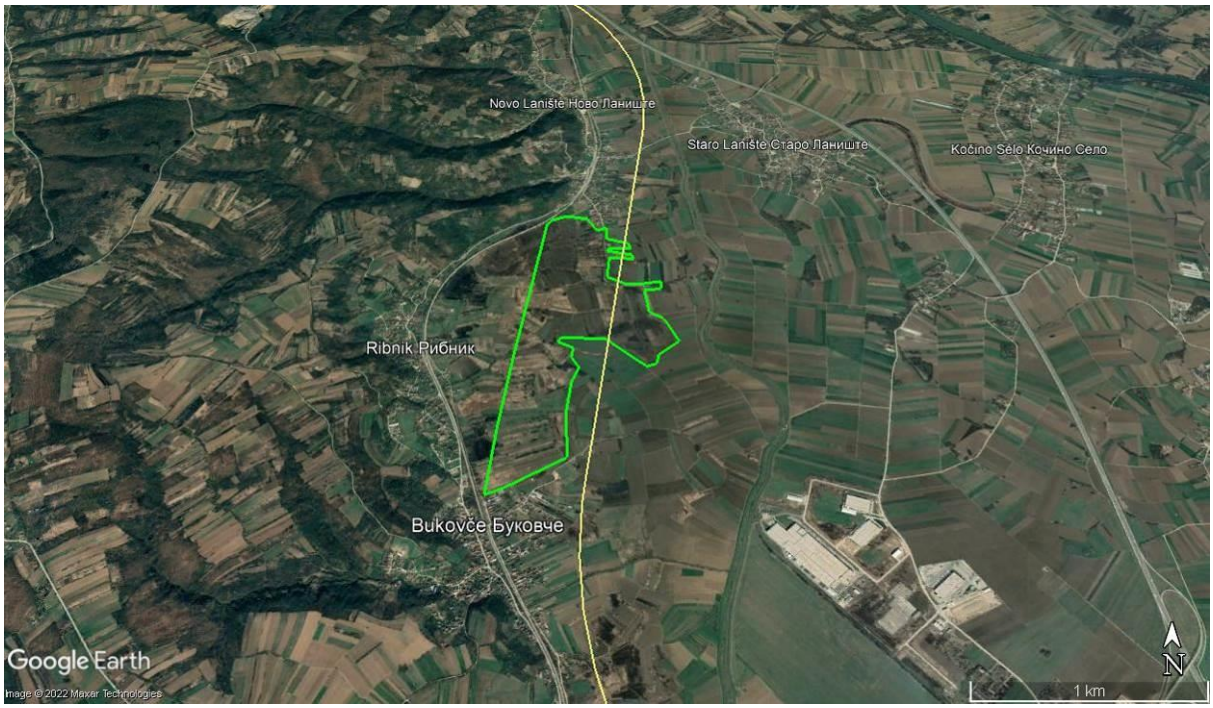

Figure 63: EAAA of Phengaris arion along subsection 3, between Novo Laniste and Bukovce, north of Jagodina

Parnassius mnemosyne (Clouded Apollo), CH. The species 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 inhabits forest roads, clearings, forest edges, clearings, and the belt along the upper forest border in the mountains. In Serbia, it is not found in

the plains of Vojvodina. It can be expected at many locations along the railway. It is assumed that the populations of this species are small to moderate in abundance in the investigated area.

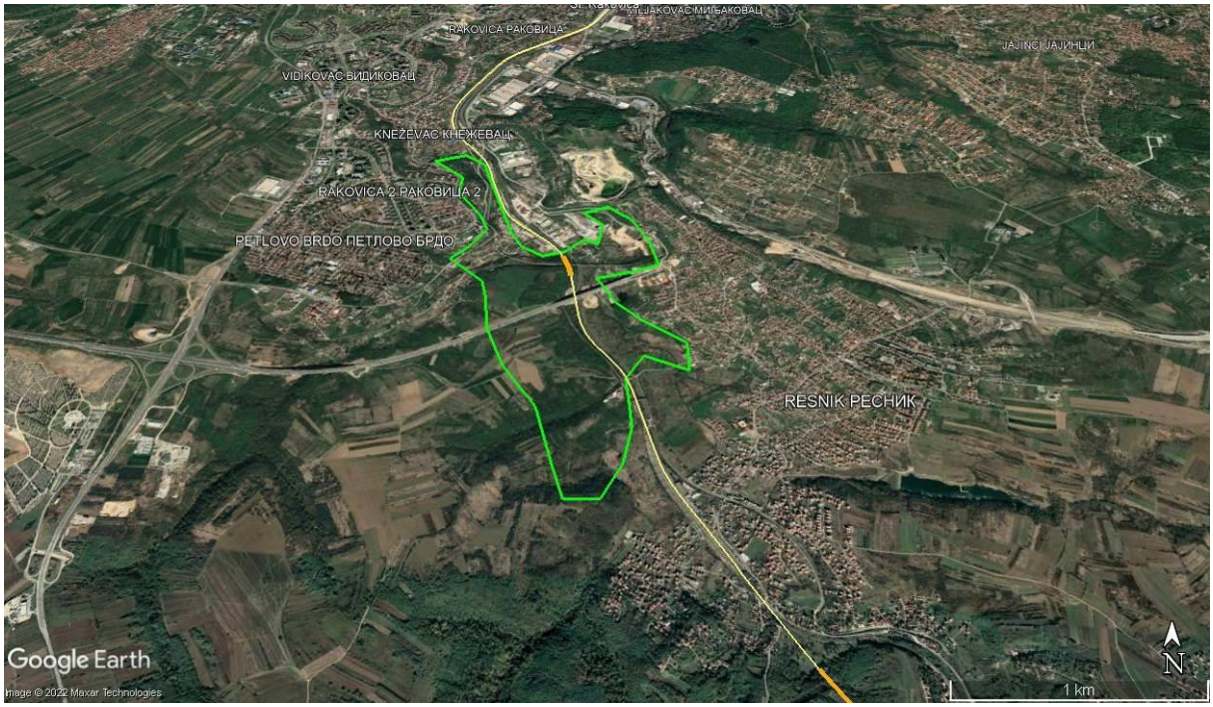

Figure 64: EAAA of Parnassius mnemosyne along subsections 1 and 2, near Resnik

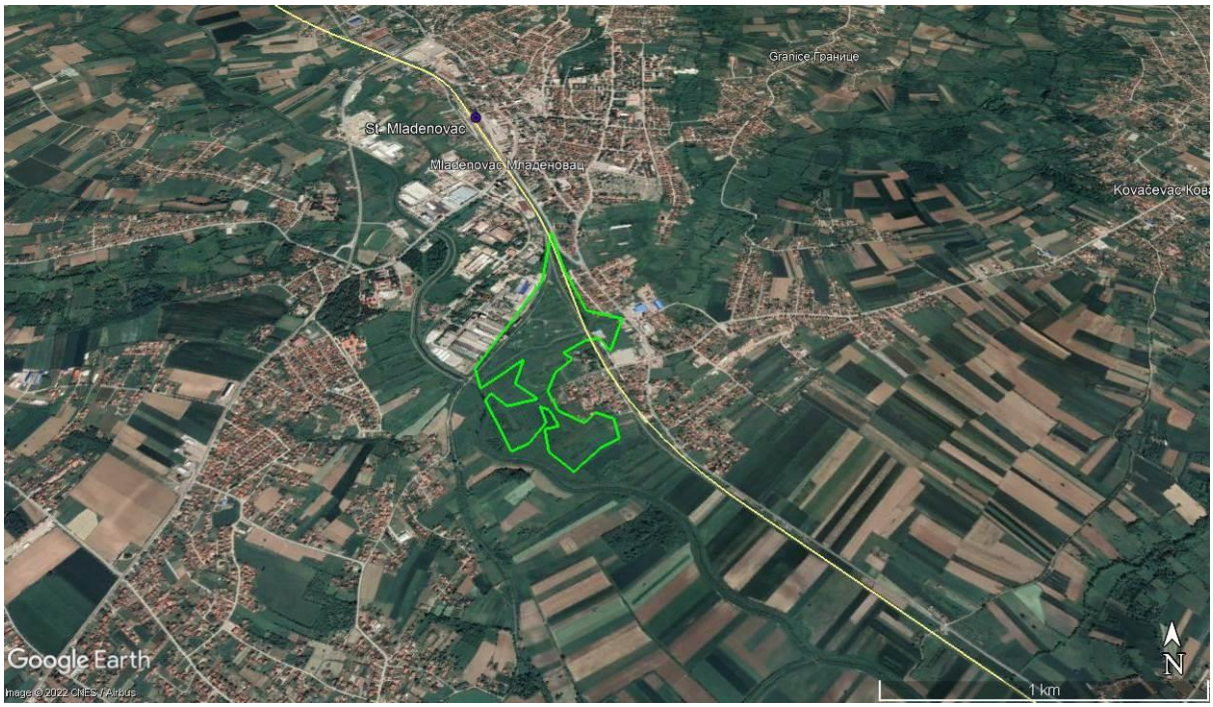

Figure 65: EAAA of Parnassius mnemosyne along subsection 2, south of Mladenovac

Figure 66: EAAA of Parnassius mnemosyne along subsection 7, near Vrtiste

Zerynthia polyxena (Southern festoon), CH. The species 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. It is found throughout Serbia. It can be expected at many locations within the investigated area. There are significant populations of this butterfly in the researched area.

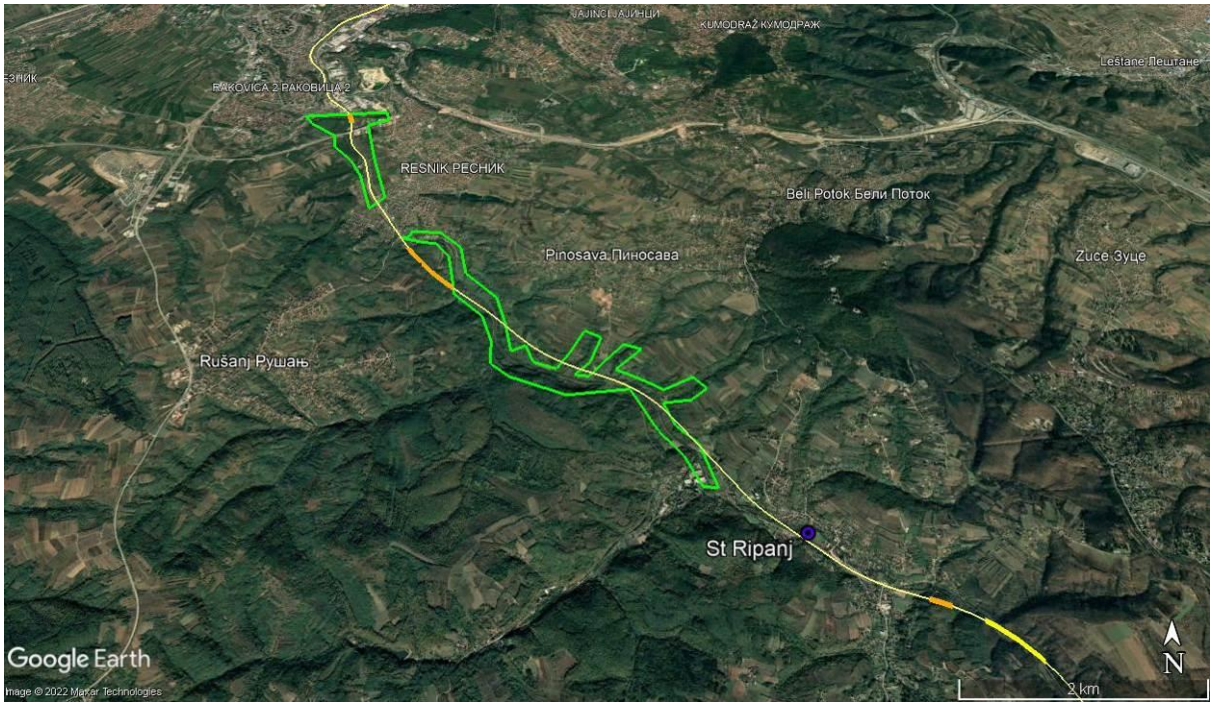

Figure 67: EAAA of Zerynthia polyxena along subsections 1 and 2, between Resnik and Ripanj

Figure 68: EAAA of Zerynthia polyxena along subsection 2

Figure 69: EAAA of Zerynthia polyxena along subsection 2, south of Mladenovac

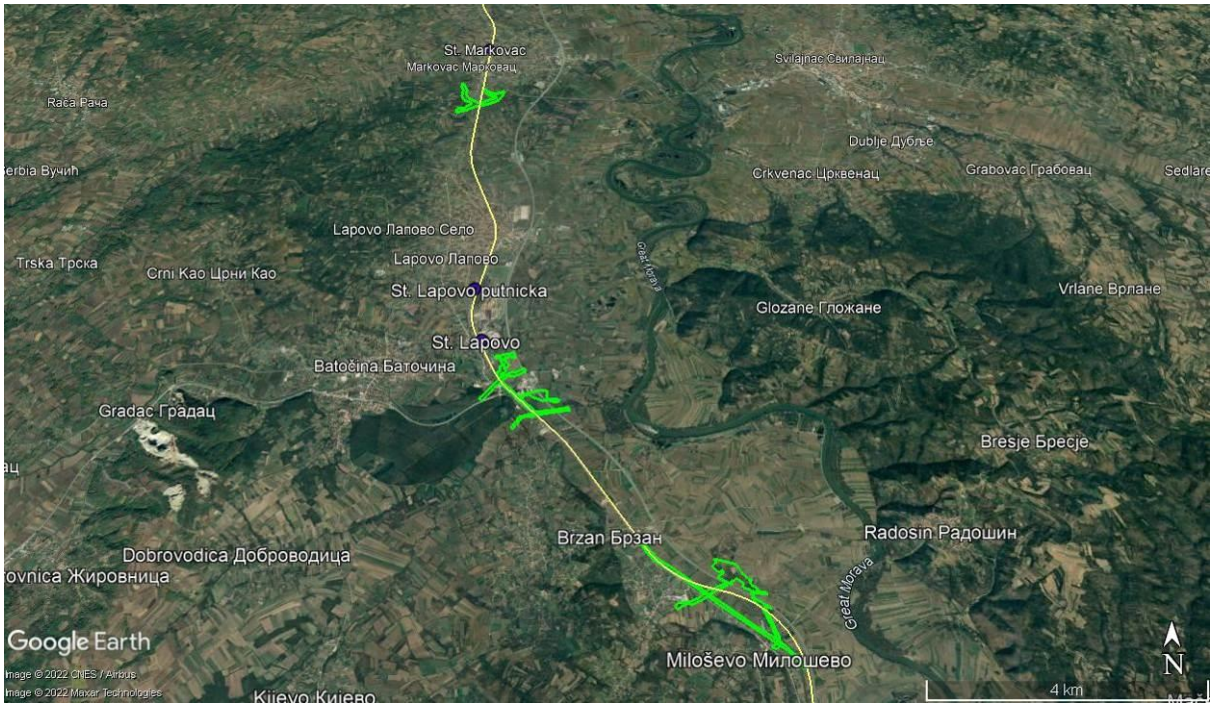

Figure 70: EAAA of Zerynthia polyxena along subsection 3, between Markovac and Milosevo

Figure 71: EAAA of Zerynthia polyxena along subsection 3, near Jagodina

Figure 72: EAAA of Zerynthia polyxena along subsection 5

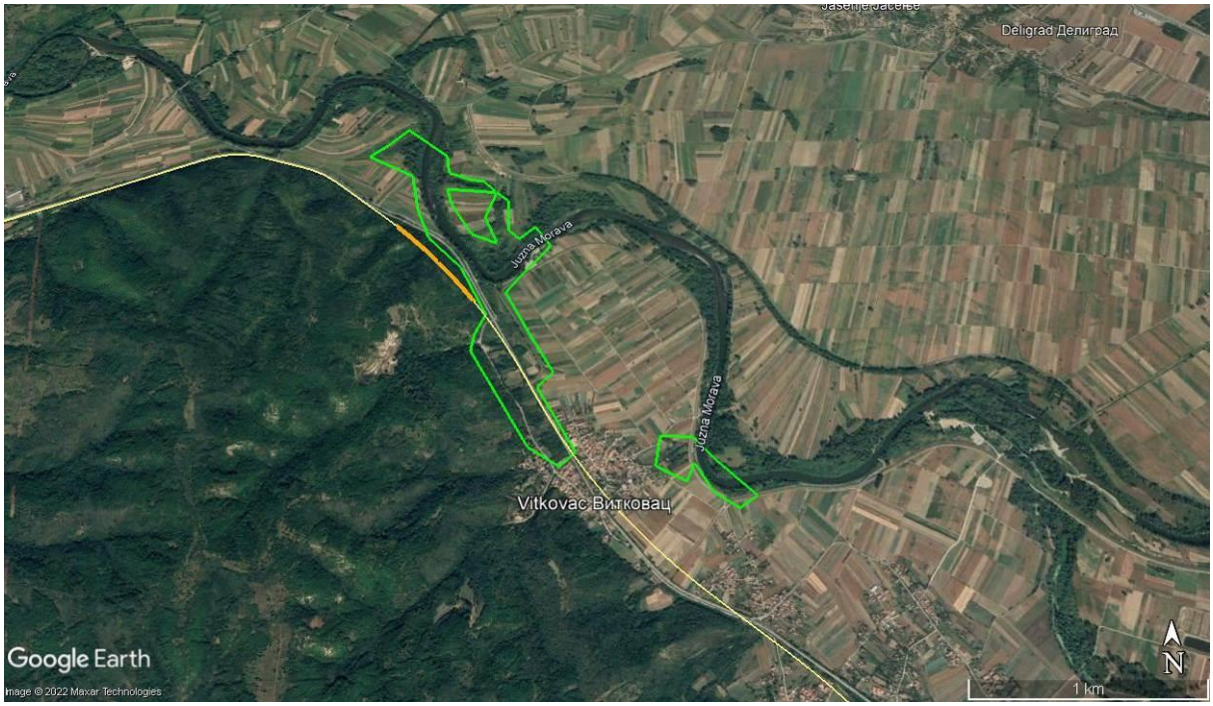

Figure 73: EAAA of Zerynthia polyxena along subsection 7, near Vitkovac

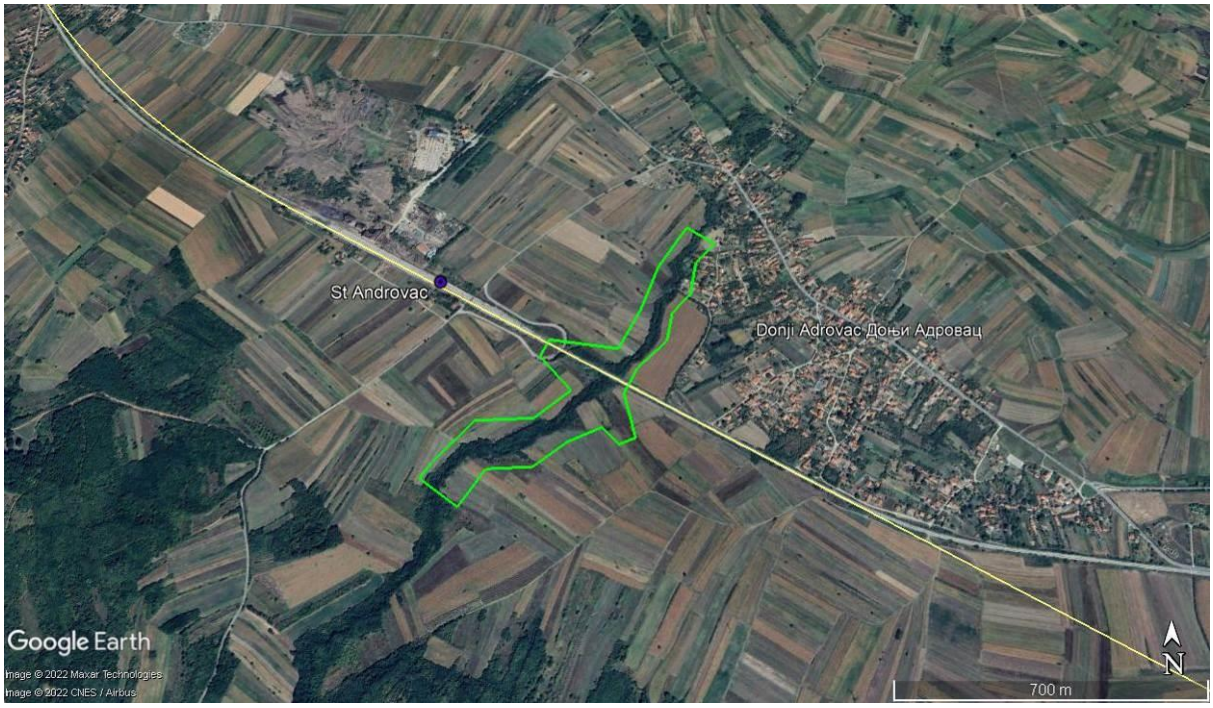

Figure 74: EAAA of Zerynthia polyxena along subsection 7, near Adrovac

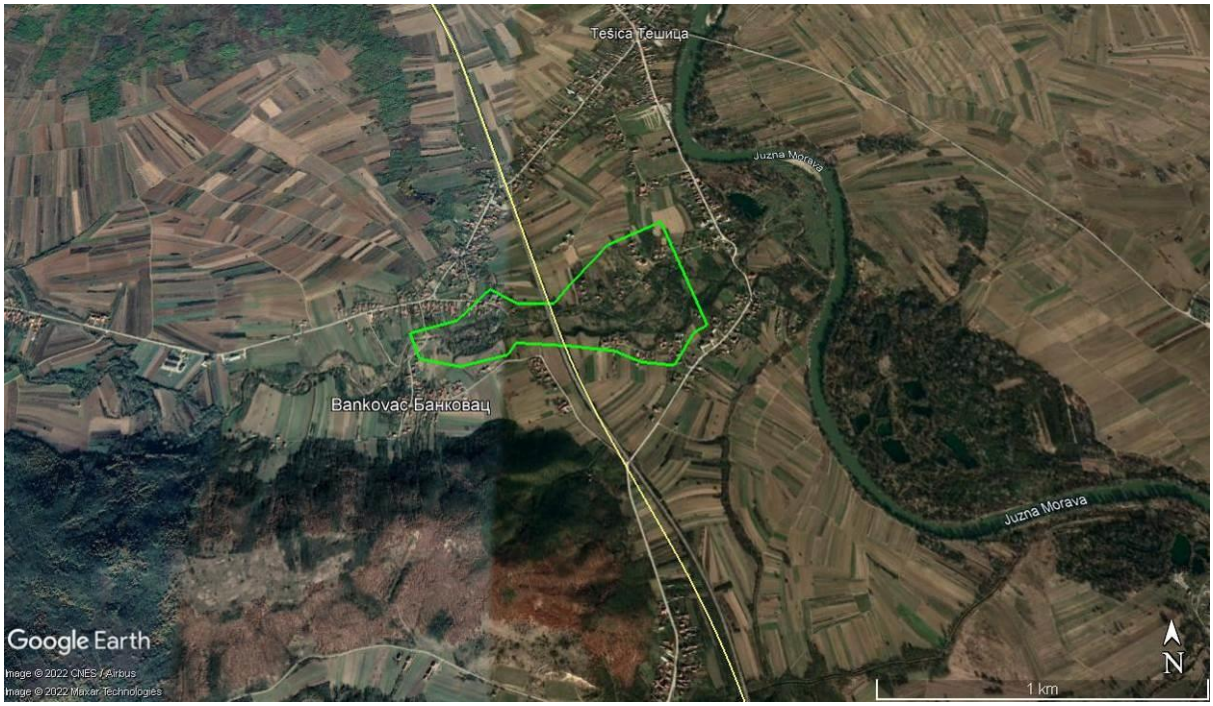

Figure 75: EAAA of Zerynthia polyxena along subsection 7, near Bankovac

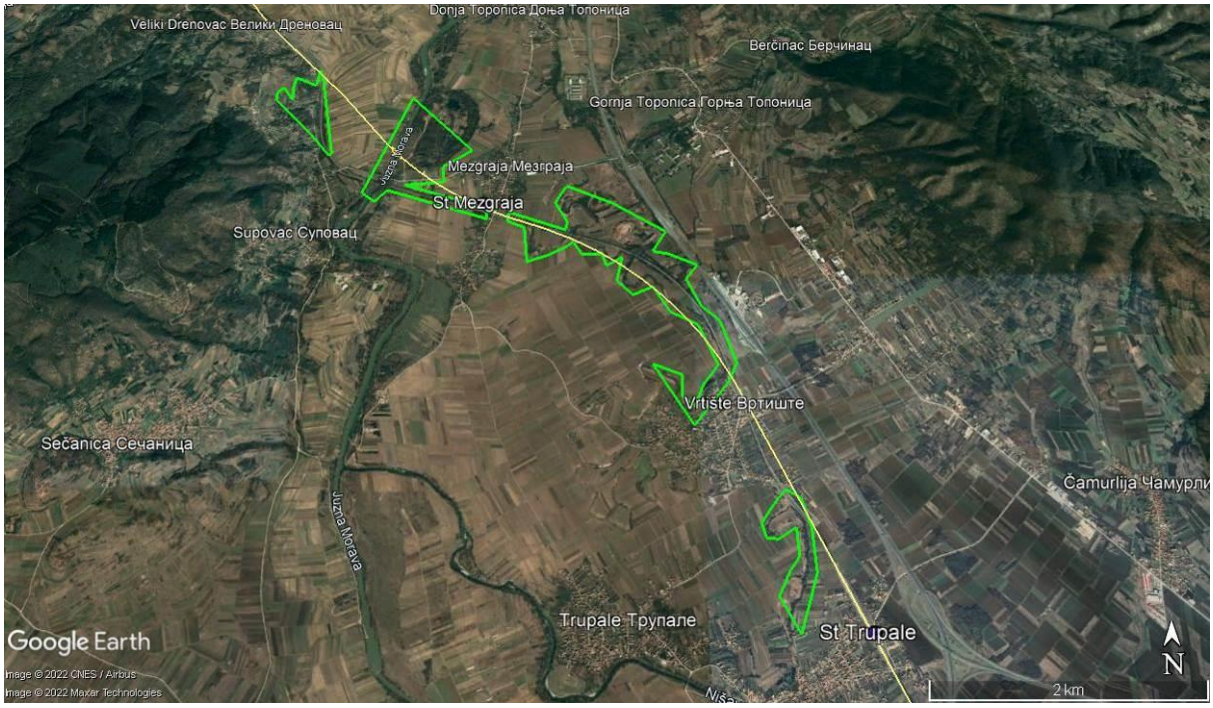

Figure 76: EAAA of Zerynthia polyxena along subsection 7, between Veliki Drenovac and Trupale

Figure 77: EAAA of Zerynthia polyxena along subsection 7, west of Nis

Lucanus cervus (Stag beetle), PBF. The species is found in Annex 2 of the Habitats Directive and in Annex 3 and Resolution 6 of the Berne Convention. 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. Found on subsections 5 and 6.

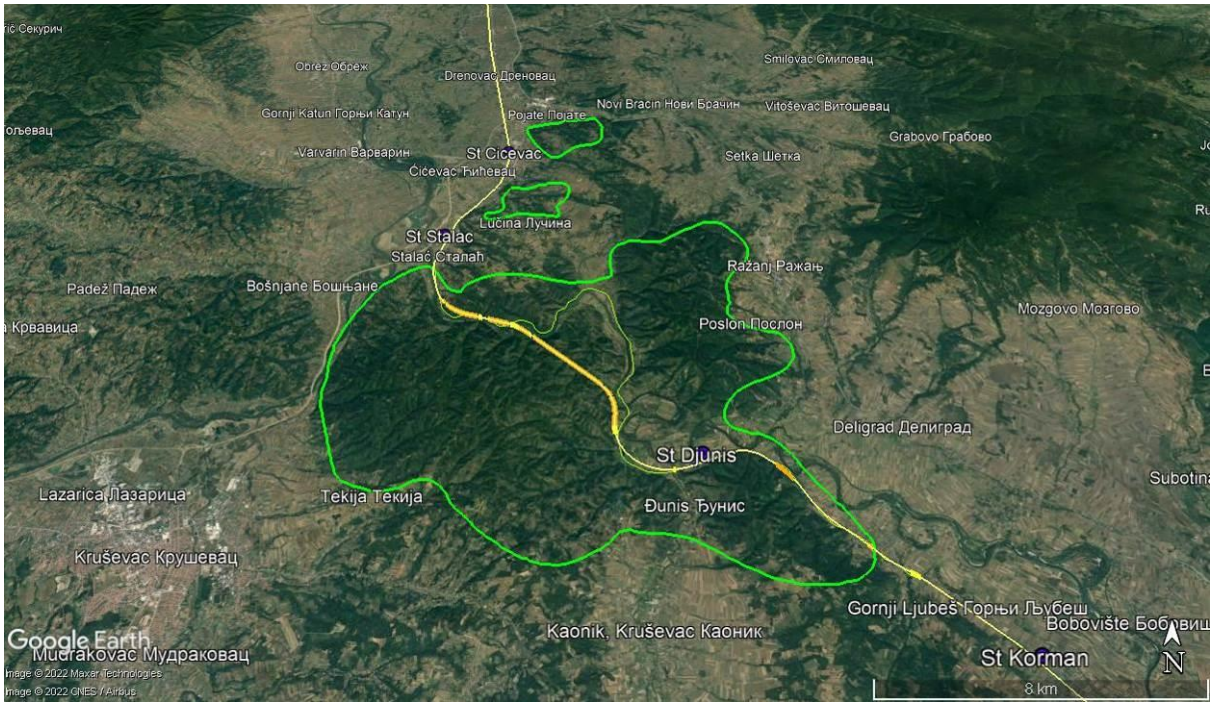

Figure 78: EAAA of Lucanus cervus along subsections 5 and 6

Morimus asper (Beech Longhorn Beetle), PBF. It is on Annex II of the Habitats Directive. 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.

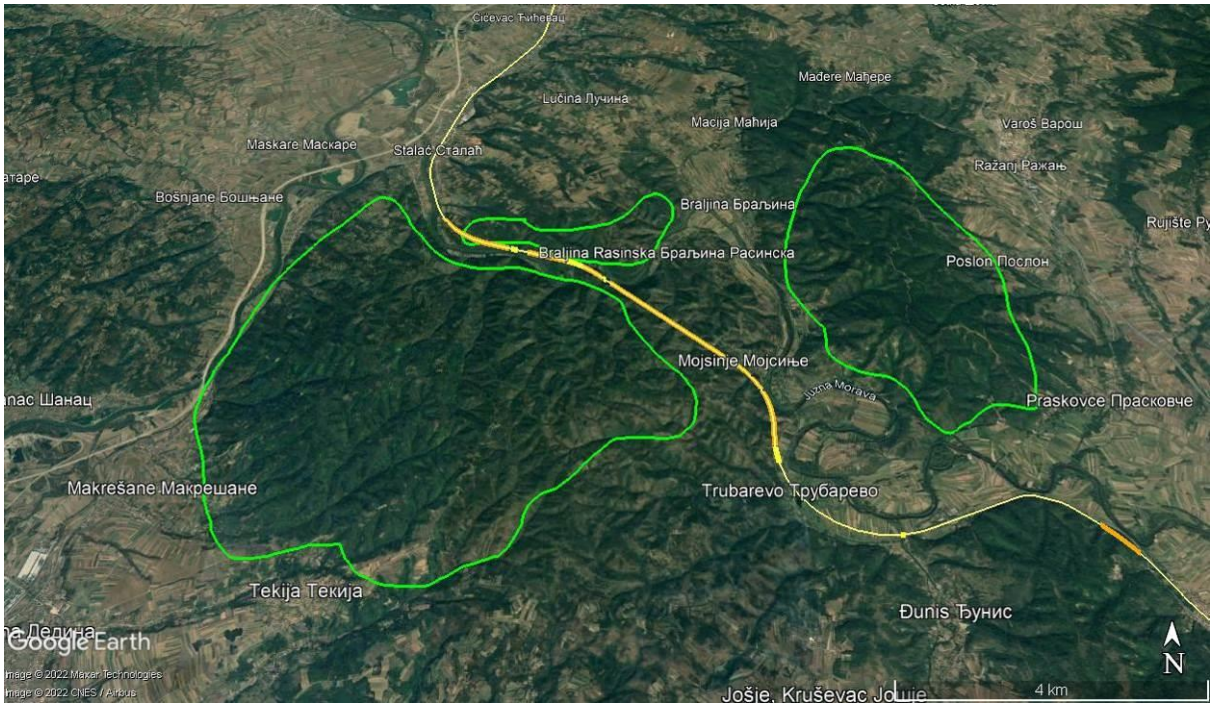

Figure 79: EAAA of Morimus asper along subsection 6

Coenagrion ornatum (Ornate bluet), PBF. 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.

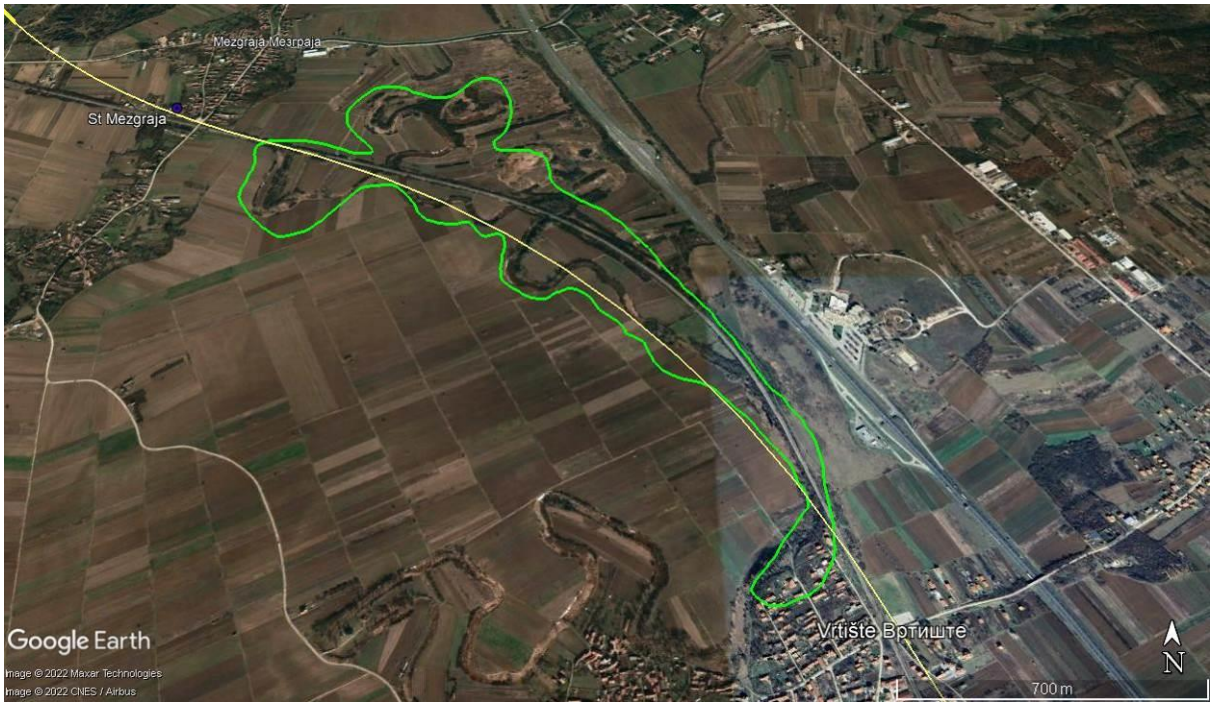

Figure 80: EAAA of Coenagrion ornatum in Vrtiste, subsection 7

9.3 EAAAs of fish

EAAAs of fish have been aggregated at this stage of the project, as the field and literature survey has shown a lot of similarities between surveyed rivers and it comprises of the following water bodies the railway will cross: 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) as mentioned in the Chapter 3.

9.4 EAAAs of herpetofauna

EAAAs of herpetofauna at this stage of the project are very difficult to map for the project of this length and this scope of works, because large majority of the found species can be found along the entire route – amphibians near water bodies and reptiles virtually everywhere on and around the railway.

9.5 EAAAs of birds

Accipiter gentilis (Northern goshawk), PBF. 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. 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.

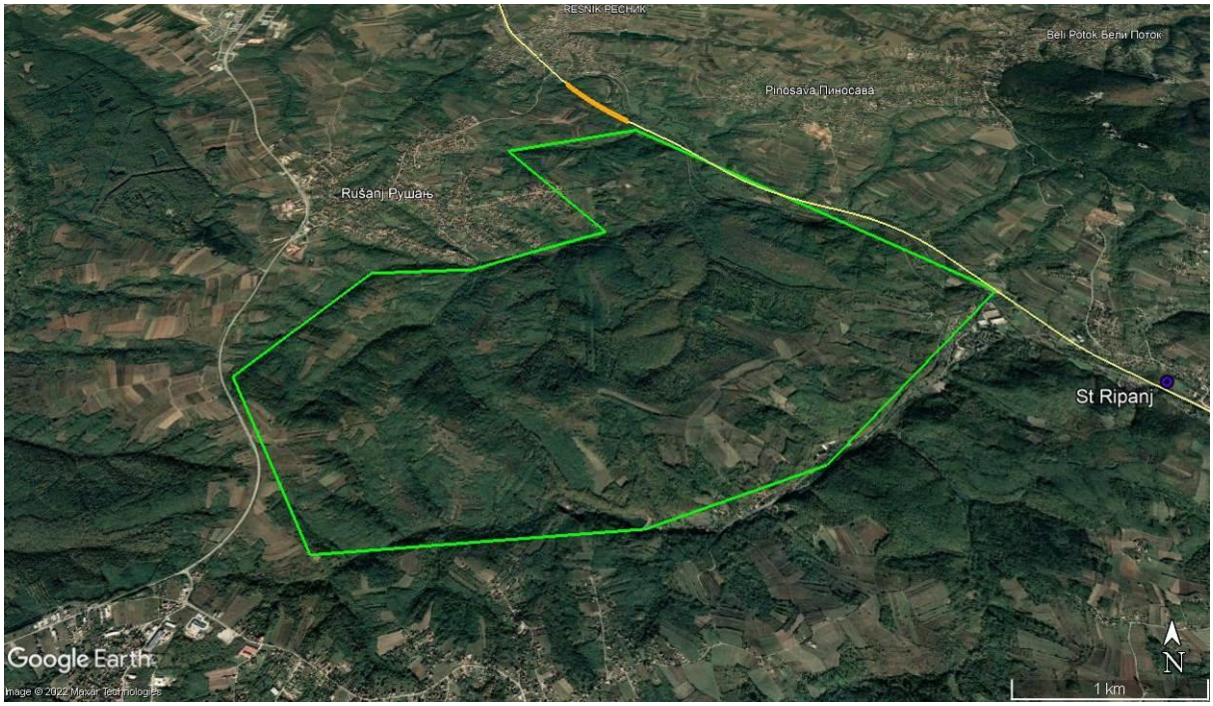

Figure 81: EAAA of Accipiter gentilis on the right side of the railway, beginning of subsection 2

Alcedo atthis (Common Kingfisher), PBF. 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.

Figure 82: EAAA of Alcedo atthis along the shorelines of Juzna Morava River north of Mezgraja, subsection 7

Cettia cetti (Cetti's Warbler), PBF. 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.

Figure 83: EAAA of Cettia cetti in Vrtiste, subsection 7

Circus aeruginosus (Western Marsh Harrier), PBF. National population is estimated at 349-468 pairs. It was recorded on localities along subsections 3 and 7.

Figure 84: EAAA of Circus aeruginosus in Brzansko Moraviste, subsection 3

Figure 85: EAAA of Circus aeruginosus in Vrtiste, subsection 7

Leiopicus medius (Middle Spotted Woodpecker), PBF. 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).

Figure 86: EAAA of Leiopicus medius south of Cicevac, subsection 5

Dendrocopos syriacus (Syrian Woodpecker), PBF. The species inhabits semi-open habitats of plains and hills, old orchards, tree lines, bans, hedges, parks and gardens. 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).

Figure 87: EAAA of Dendrocopos syriacus south of Cicevac, subsection 5

Dryocopus martius (Black Woodpecker), PBF. 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).

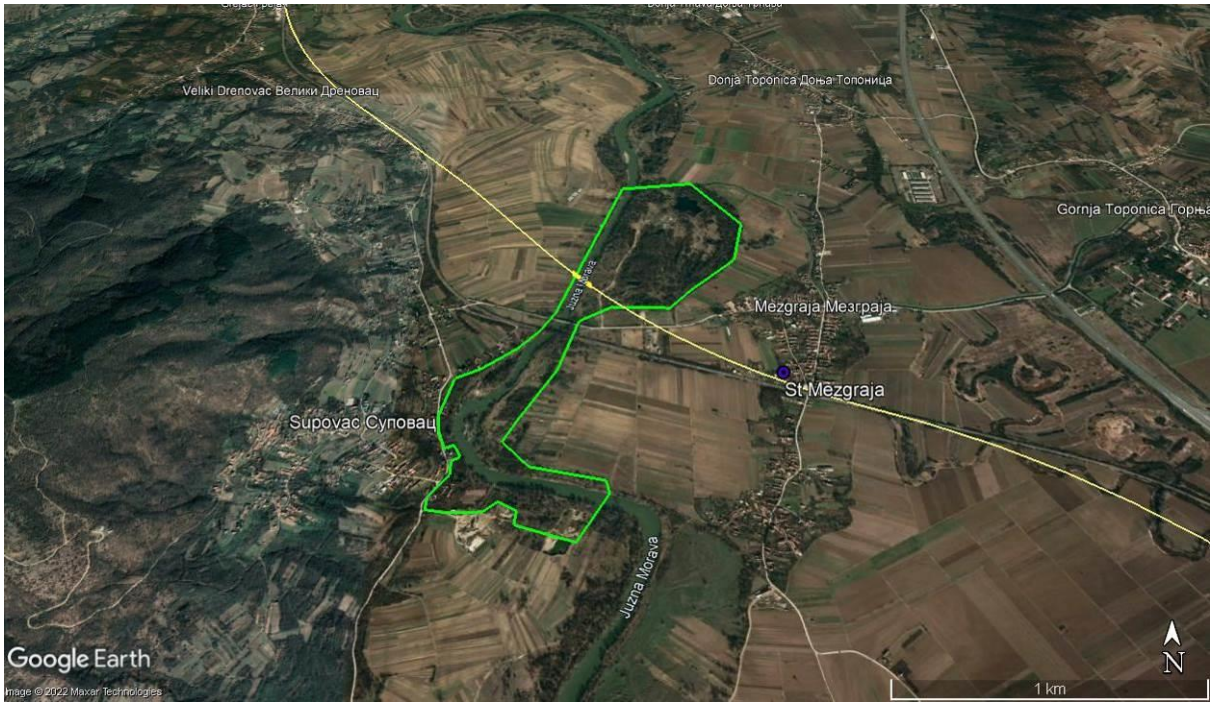

Figure 88: EAAA of Dryocopus martius west of Mezgraja, subsection 7

Emberiza hortulana (Ortolan Bunting), PBF. 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.

Figure 89: EAAA of Emberiza hortulana south of Velika Plana, subsection 3

Figure 90: EAAA of Emberiza hortulana southeast of Brzan, subsection 3

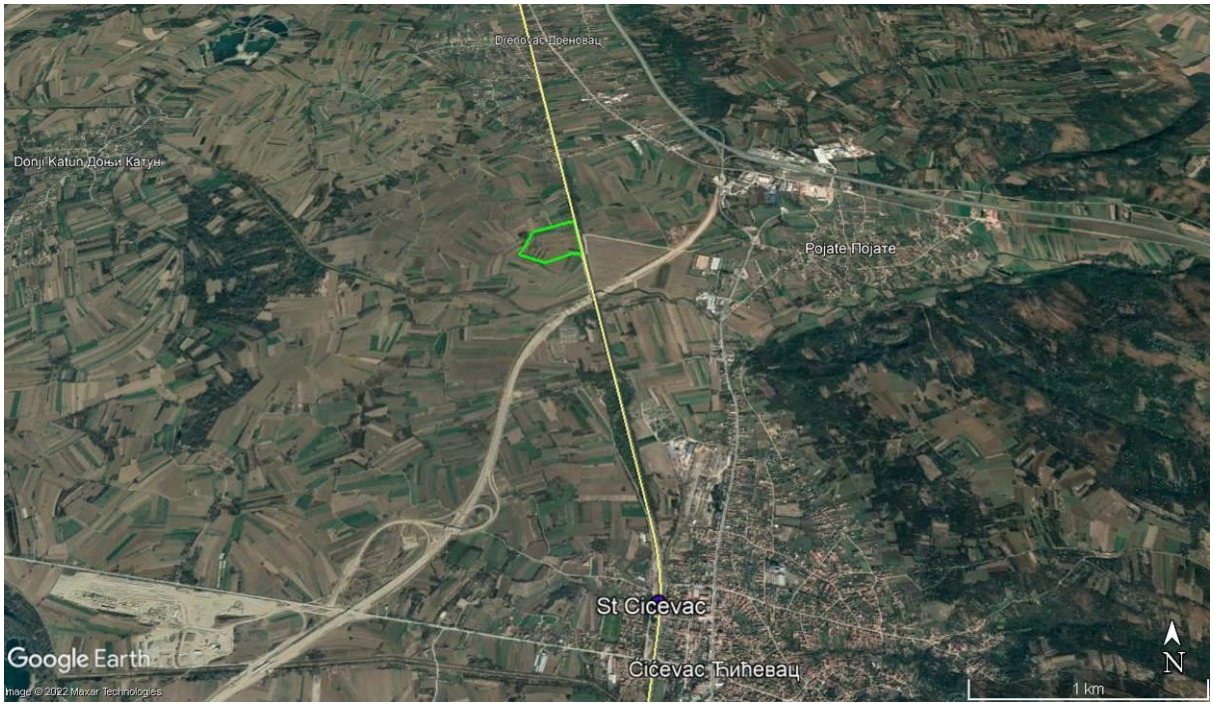

Figure 91: EAAA of Emberiza hortulana north of Cicevac, subsection 5

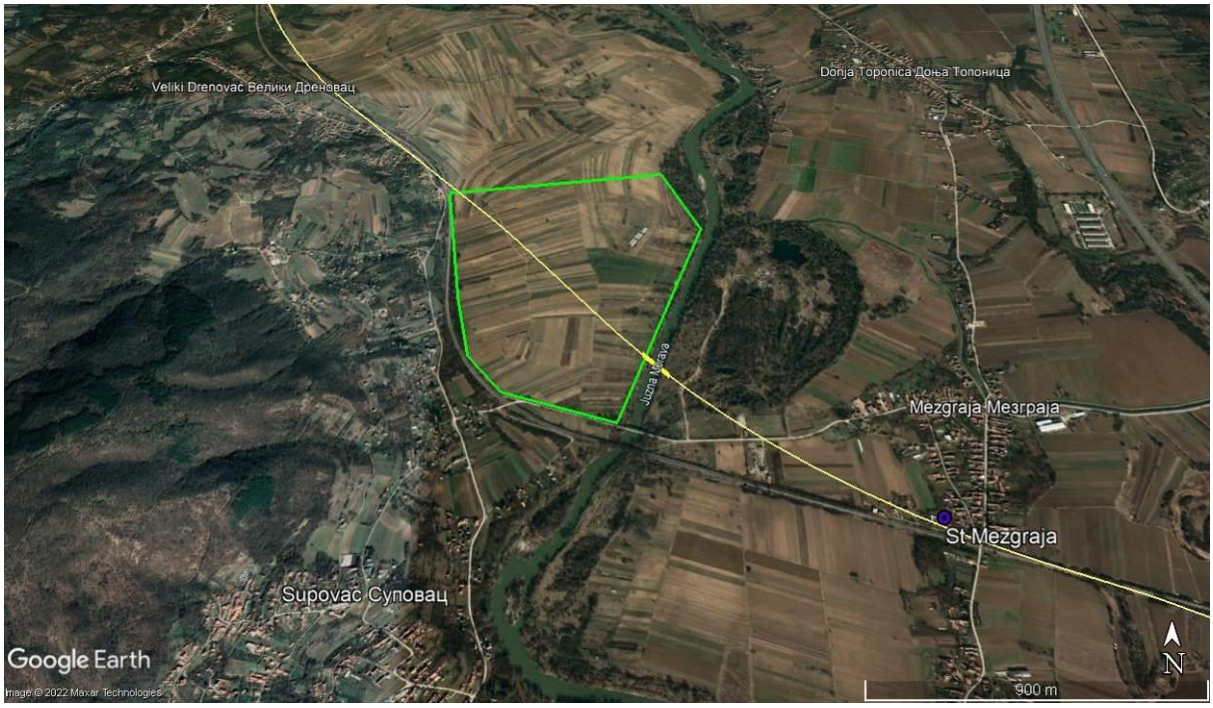

Figure 92: EAAA of Emberiza hortulana near Mezgraja, subsection 7

Lanius collurio (Red-backed shrike), PBF. 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. EAAA is area along the entire corridor.

Lanius minor (Lesser Grey Shrike), PBF. 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.

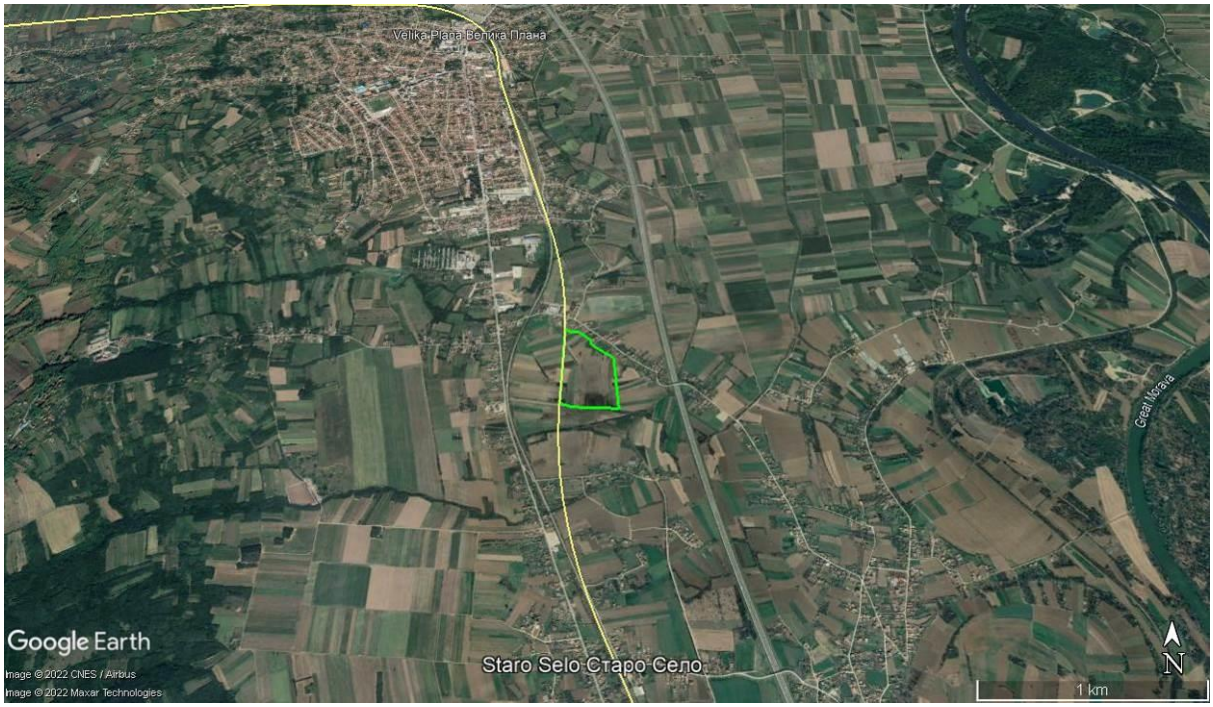

Figure 93: EAAA of Lanius minor south of Velika Plana, subsection 3

Figure 94: Figure 70: EAAA of Lanius minor near Brzan, subsection 3

Figure 95: Figure 70: EAAA of Lanius minor around Cicevac, subsection 5

Nycticorax nycticorax (Black-crowned Night Heron), PBF. 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.

Figure 96: EAAA of Nycticorax nycticorax colony northeast of Velika Plana, subsections 2 and 3

Perdix perdix (Grey Partridge), PBF. 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.

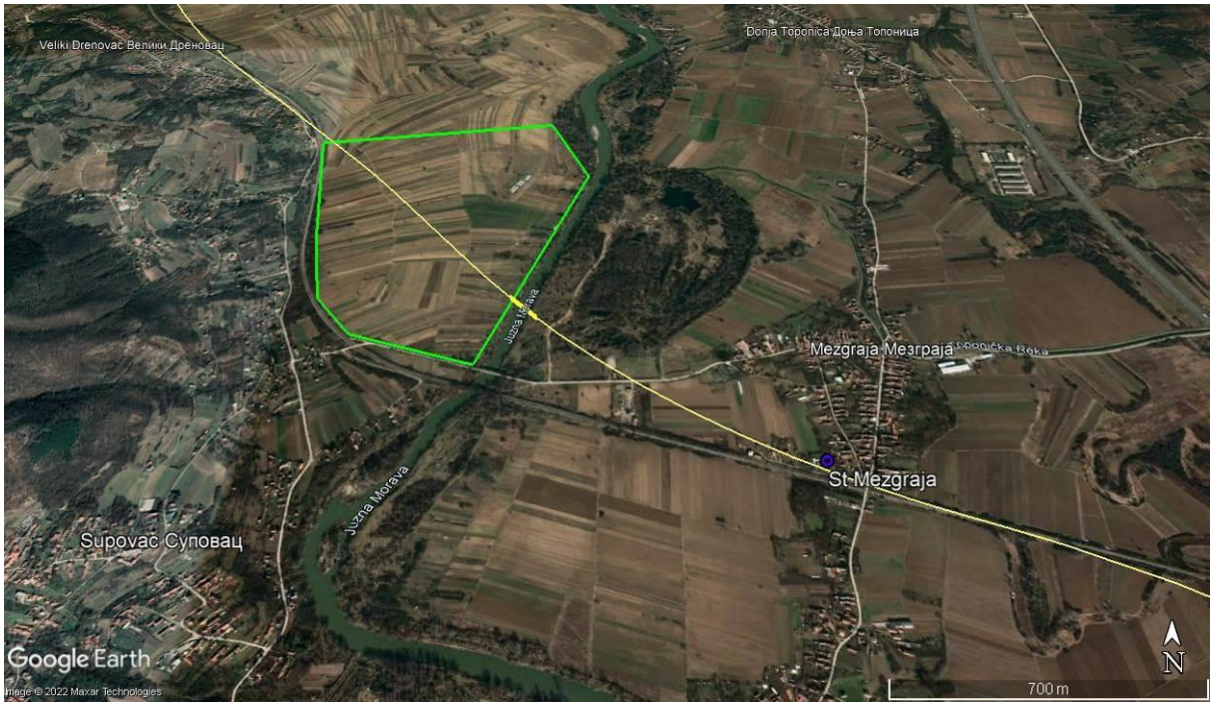

Figure 97: EAAA of Perdix perdix found in one locality near Mezgraja, subsection 7

Pernis apivorus (Honey buzzard), PBF. 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. 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.

Figure 98: EAAA of Pernis apivorus near Batocina, subsection 3

Sterna hirundo (Common Tern), PBF. 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.

Figure 99: EAAA of Sterna hirundo in Stalac, subsection 6

Streptopelia turtur (Turtle dove), PBF. 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 considered a nesting bird in all localities. Mosaic habitats of dense vegetation along the railway and agricultural areas are excellent nesting places and represent EAAA of the species. However, European Turtle doves' nest all over Serbia and such habitats are not unique, therefore there is a realistic possibility is will be found along all subsections. National population is estimated at 49,000-68,000 pairs.

9.6 EAAAs of mammals

The surveyed area is not suitable for large mammals, but small mammals such as red fox, squirrel, European heare and roe deer are very common along the route. However, Mt. Mali Jastrebac close to the village Veliki Drenovac on subsection 7 was identified as a spot of somewhat higher mammal diversity. Still, habitats in direct contact to the route are not suitable for breeding or feeding of large mammals and mammals of conservation concern.

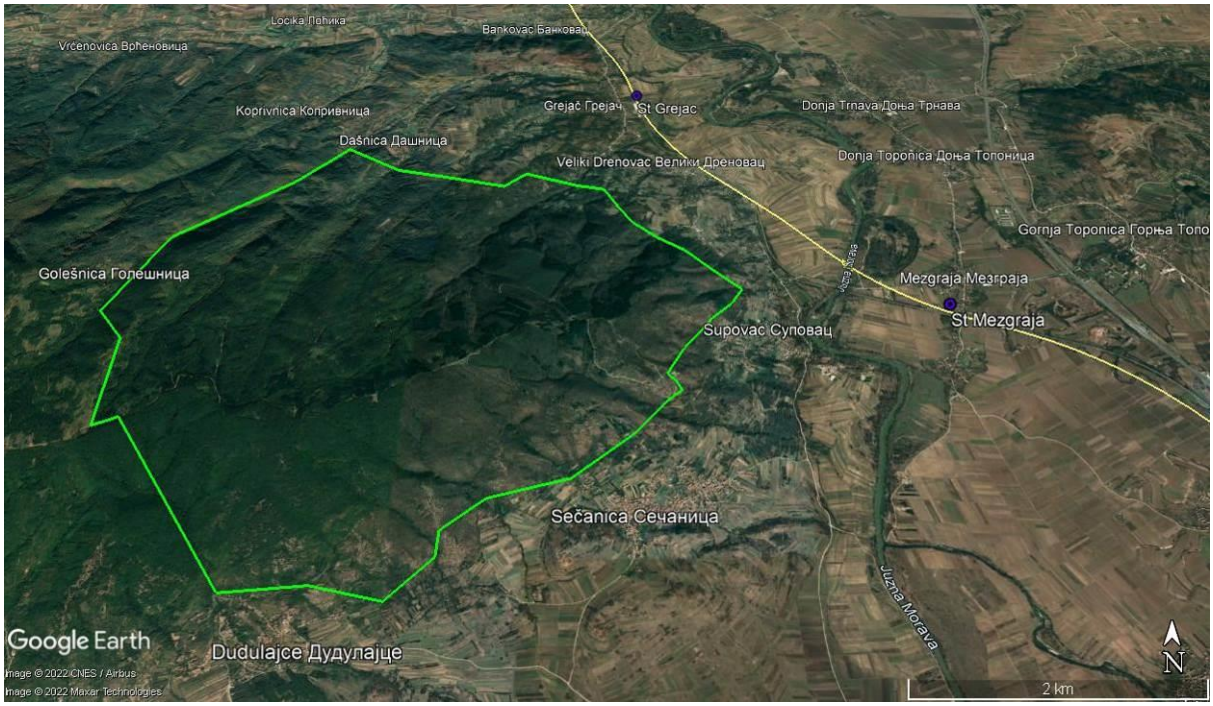

Figure 100: Mt. Mali Jastrebac and EAAA of mammals, besides species occurring along the route