

Murakeresztur (H) - Kotoriba (HR) cross-border infrastructure development

Transboundary Environmental Impact
Assessment (documentation under the Espoo
Convention)

November 2022

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Executive summary

In 1996, on the initiative of Croatian and Hungarian authorities, a „Mura Sub-Regional Transport Development Plan” was developed to establish international road connections in the region. The design study of the road bridge and the connecting road on the Hungarian side was completed in the early 2000's with PHARE funding. Based on previous studies, the permit design was prepared under the INTERREG project SL-HU-CR/05/4012-106/2004/01/HU-39 in 2007, but in the absence of an intergovernmental agreement between the two countries, the road, the cycle road and Mura bridge did not receive a construction permit.

In 2015, the Transport Development Coordination Centre carried out feasibility study entitled “Exploration of Border Intersection Segments of Projects in Line with the KÖZOP and Assessment of their Network Effects on the Hungarian-Croatian Border Section” (KÖZOP-3.5.0.-09-11-2012-0003), in which the project in question was also examined.

The planned border crossing will provide a new, significantly shorter connection between Murakeresztúr and Kotoriba, and on a larger scale between Nagykanizsa and Kapronca (HR). Currently the shortest road between these settlements is 48 km long, passing through the border crossing at Letenye. The planned road will reduce this distance to 3 km and will not only provide better connections to the settlements in the border area but will also provide a new alternative for long distance traffic. The development will shorten travel distances in the area, which will lead to a modal shift.

An INTERREG HU-HR application for the revision of the feasibility study and the related environmental documentation was submitted in December 2019 to the Monitoring Committee and was deemed eligible at its meeting on 15 January 2020.

RODEN Mérnöki Iroda Kft (hereinafter “Designer”) won the public procurement tender for the implementation of the investment, on the basis of which NIF – Nemzeti Infrastruktúra Fejlesztő Ltd (hereinafter “NIF”) commissioned the preparation of the study design. The design contract was signed in January 2021. The contract includes the revision of the Feasibility Study, the preparation of the Environmental Impact Assessment, the Natura 2000 Impact Assessment, the preparation of the environmental documentation according to the Espoo Convention, as well as the documentation required to designate the border crossing point and the Preliminary Archaeological Documentation (ERD I.). However, it is not the responsibility of the Designer to carry out the environmental permitting, which will be done independently by NIF Ltd.

Following the preparatory studies, the selection of the road from the worked options was taken in August 2020 and the environmental impact assessment and related documents were prepared for the selected route.

In terms of legal obligations, the planned infrastructure development activity is subject to an environmental impact assessment (EIA) in accordance with Annex 3 of Government Decree 314/2005 (XII. 25.), depending on the decision of the Environmental Authority on the preliminary assessment, as follows:

- Based on Annex 3, point 87(c), given that the planned new road crosses both protected area and Natura 2000 site and as such is subject to prior assessment without size limitation.

The Investor decided to make an Environmental Impact Assessment (EIA) prepared to comply with the requirements of the European Union, NIF Ltd.

The road is planned to be built within the administrative boundaries of the municipalities of Molnári (H), Murakeresztúr (H) and Kotoriba (HR) with the following main parameters:

- Road category: design class K.V.A,
- Design speed: 90 km/h (single carriageway),

- Road length: approx. 1700m,

Other technical parameters:

- Number of lanes: 2 lanes,
- Lane width: 3.5 m,
- Road surface width: 7.5 m,
- Road shoulder width: 2 m,
- Total road width: 11m,

Technical characteristics of the cycle road to the border and the cycle path linking the municipality of Murakeresztúr (informative data) to the cycle road:

- Road category: design class K.VII,
- Length of the cycle track on the Hungarian side: approx. 3420 m (1700 m cross-border road, connecting path to Murakeresztúr: 1720 m).

The road is illustrated in the figure below.



Two level-crossings are planned on the route:

- 0+000 km section: starting junction 3835 j. road three-way roundabout,
- 0+930 km section: service road junction.

The following structures are planned on the route:

- Section 0+558 km: frame element with a 2 m opening above Berek Stream
- Section 1+197 km: bridge (Árapasztó Bridge)
- Section 1+466 km: bridge (Mura Bridge, arch bridge).

A new cycle road is also planned on the north side of the new Mura Bridge. The cycle road will connect to the Eurovelo 6 section and will be linked to the municipality of Murakeresztúr parallel to the new planned road.

The impact assessment covers the establishment, implementation (operation), and abandonment of the investment, including the related facilities. In addition, the Natura 2000 impact assessment documentation and the documentation according to the Espoo Convention (assessing cross-border impacts), and the non-technical summary were prepared.

Prior the inspection, NIF and the Designer provided the Expert with the basic data as well as the relevant plans previously prepared for the project. The environmental impact assessment is based on the Study Plan and its annexes approved in August 2020.

Based on the studies carried out, cross-border impacts are expected only on landscape, wildlife and soils but their level is not significant. Regarding other environmental elements, no cross-border impacts are expected.

From a landscape point of view, the main impact will be the appearance of the new Mura bridge in the landscape, as it will be higher than the existing railway bridge. Based on our studies, the top of the Mura bridge structure will be visible at a distance of about 500 m from the North and South, that is reduced to 350-400 m from the Croatian side. The bridge structure will be visible from road 6835 to the East, but not from Murakeresztúr.

From the wildlife point of view, the following areas on the Croatian side have been identified as being affected by the planned investment:

- Mura-Drava Regional National Park;
- Mura Special Conservation Area (Site Code: HR2000364);
- Mura-Drava-Danube Biosphere Reserve.

Of the habitats that are being lost, the Willow-Poplar Floodplain Forest (J4) is the priority candidate habitat of the SCI: **91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, *Alnion incanae*, *Salicion albae*)**. Altogether **180 m²** of the Natura 2000 area is affected on the Hungarian side, **930 m²** on the Croatian side. The affectedness here means the cutting of some trees from the strip of woodland on both side of the Mura. Overall, the impact of the development will be **eliminating**, as existing habitats will be lost in the close vicinity of the proposed road development. During the operational phase, the impact of the proposed development will be **tolerable** for wildlife.

In terms of soil, eliminating impact is expected in the areas affected by earthworks. The impact of extraction and compaction will be **tolerable** during construction. The operation is **neutral** from the point of view of the soil, as under normal operating conditions there will be no soil contamination or damage.

The present assessment has not identified any preventing, significant, irreversible or unmitigable impacts that would prevent the installation and operation of the project on the Croatian side.

1 Description of the activity

1.1 Technical parameters

Based on the Road Technical Specification e-UT 03.01.11 “Design of Public Roads (RTS)” and in accordance with previous studies, the main parameters of the road leading to the border, the cycle path and the Mura bridge crossing the border:

Technical characteristics regarding the road leading to the border (informative data):

- Road category: design class K.V.A,
- Design speed: 90 km/h (single carriageway),
- Road length: approx. 1700m,

Other technical parameters:

- Number of lanes: 2 lanes,
- Lane width: 3.5 m,
- Road surface width: 7.5 m,
- Road shoulder width: 2 m,
- Total road width: 11m,

Technical characteristic of the cycle path to the border and the independent cycle path linking the municipality of Murakeresztúr (informative data):

- Road category: design class K.VII,
- Length of the cycle track on the Hungarian side: approx. 3420 m (1700 m cross-border road, 1720 m connection road to Murakeresztúr).

1.2 Site layout

1.2.1 Horizontal tracking

The initial intersection of the proposed purple trail is located on route 6835 j. after the structure above the Gyurgyánci Stream.

The initial intersection is a three-way roundabout with two intersections on both directions of route 6583 j., and the third intersection is the proposed new road.

The section between the initial junction and the Mura flood protection embankment will pass through the hydrogeological protection zone B of the Molnar-Mura aquifer. The road shoulders and trenches should therefore be constructed with watertight pavement.

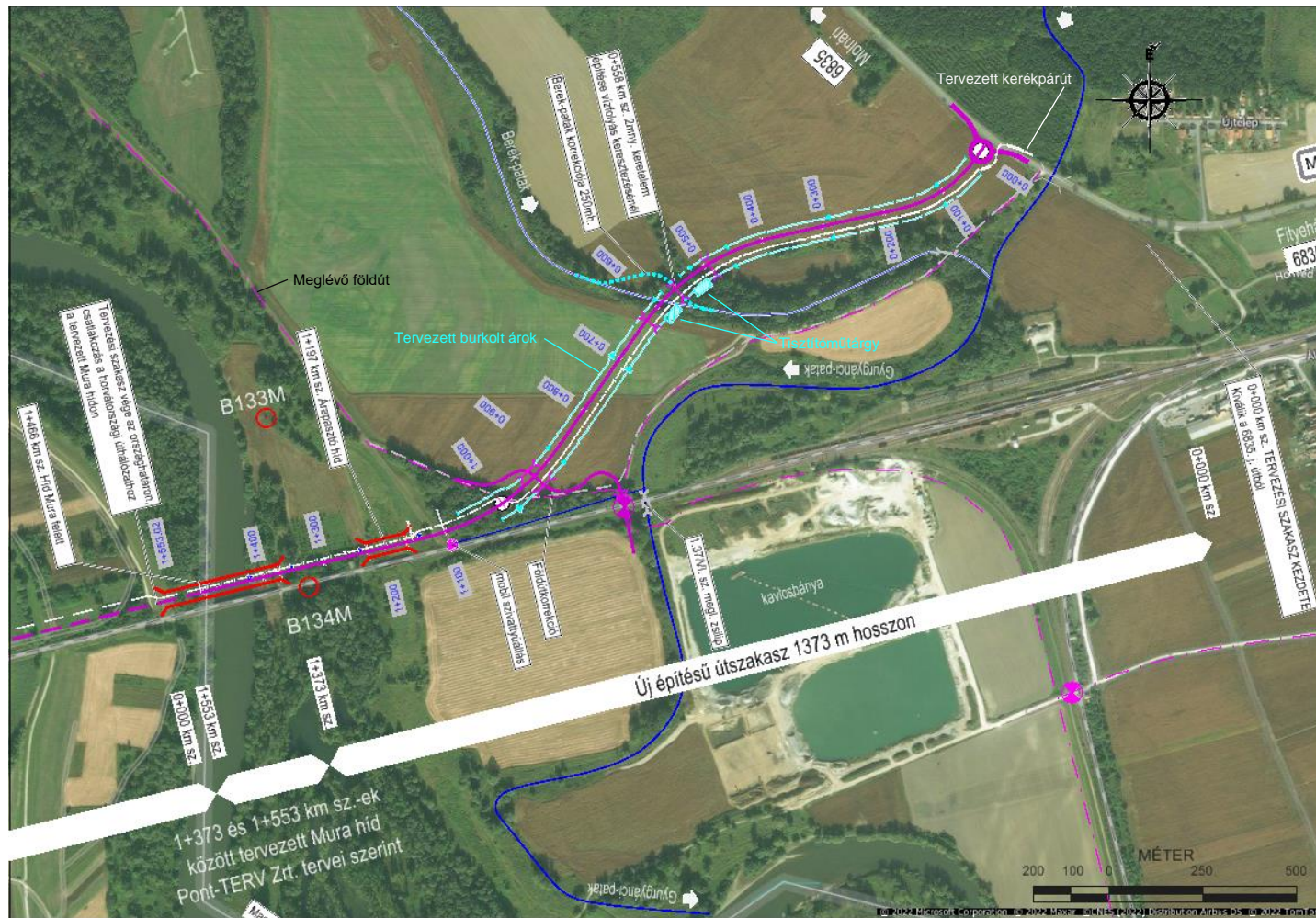
The planned road flows through agricultural land until it crosses the Berek Stream. In the vicinity of the crossing, the stream will need to be corrected for about 250 m to improve the planned trail and the stream crossing angle. The streambed up to the Gyurgyánci Stream needs to be upgraded. To prevent groundwater contamination, oil and sand traps should be installed upstream of the discharge point. To reduce the number of structure and for ease the handling, only the downstream side will be used. At the crossing of the Berek Stream at 0+558 km, a minimum 2 m wide frame element culvert is planned.

The trail then goes through a field again and then crosses the dirt road providing access to the area and the Mura flood protection dam in the 1+000 km section. This needs to be corrected so that it can be accessed via the new road. During the correction, a 1 meter parallel pipe culvert is planned to be installed for the passage of the foundations.

After the dirt road crossing, the track will follow an arc of radius $R=300$ m to the North of the railway line, from where it runs parallel to the railway line and bridge at an axial distance of 30 m until the end of the design section (section 1+553 km).

The trail crosses the Mura flood protection embankment at 1+119 km and enters the Mura Landscape Protection Area and HUBF20043 Mura Nature Conservation Area. After the flood protection embankment, it crosses the Mura tidal barrier at section 1+197 km via a bridge over the flood barrier. The route will then lead to a high embankment between section 1+373 and 1+553 km through the planned bridge over the Mura.

Figure 1.1: Location of the planned area



1.2.2 Vertical alignment

The planned 2x1 lane road passes through a plain area. From the initial section to the 1+000 km section, it crosses a 2-3 m high embankment. The route begins to rise before crossing the Mura flood protection embankment and from there it rises all the way to the planned Árapasztó bridge. It goes through a 6-8 m high embankment until the Mura bridge. The flood level of the Mura-river was also taken into account when drawing the height line.

1.3 Design of the cross-section

General cross section of the Murakeresztúr – Kotoriba road:

- Number of lanes: 2x1 lanes,
- Lane width: 3.50 m,
- Road width: 7.50 m,
- Total road width: 11.0 m,
- Stop lane width: 0.25 m,
- Road shoulder width: 2 m,

General cross section of 3x1 lane cycle track (Molnári-Órtilos bicycle track):

- Number of lanes: 3x1 lanes,
- Road width: 3.30 m,
- Total road width: 4.30 m,
- Road shoulder width: 0.50 m,

General cross section of 2x1 lane cycle track (border bicycle path):

- Number of lanes: 2x1 lanes,
- Road width: 2.55 m,
- Total road width: 3.55 m,
- Road shoulder width: 0.50 m,

Paved section of parallel dirt road (flood protection service road):

- Number of lanes: 2x1 lanes (only on the paved section)
- Lane width: 3.00 m,
- Road width: 6.00 m,
- Total road width: 8.00 m,
- Road shoulder width: 2.00 m,

Unpaved section of parallel dirt road (flood protection service road):

- Total road width: 4.00 m.

1.4 Traffic Interchange

For the planned route two junctions are planned as follows:

- Section 0+000 km: starting junction 3836 j, road three-way roundabout,
- Section 0+930 km: level junction: service road junction, left-turn lane level junction.

1.5 Structures

The following structures are planned on the route.

Table 1.1: Planned structures on the road

Km section	Status	Type	Name
0+558	planned	Frame element with 2 metres opening	over Berek Stream
1+197	planned	bridge	Árapasztó Bridge
1+466	planned	bridge	Mura Bridge

Source: Data supply by designers, April 2022

1.5.1 Frame element with an opening width of 2 metres over Berek Stream

The road is planned to cross the stream on a 2 m wide reinforced concrete frame element. Construction of a bridge over the Berek Stream is not necessary.

1.5.2 Árapasztó bridge

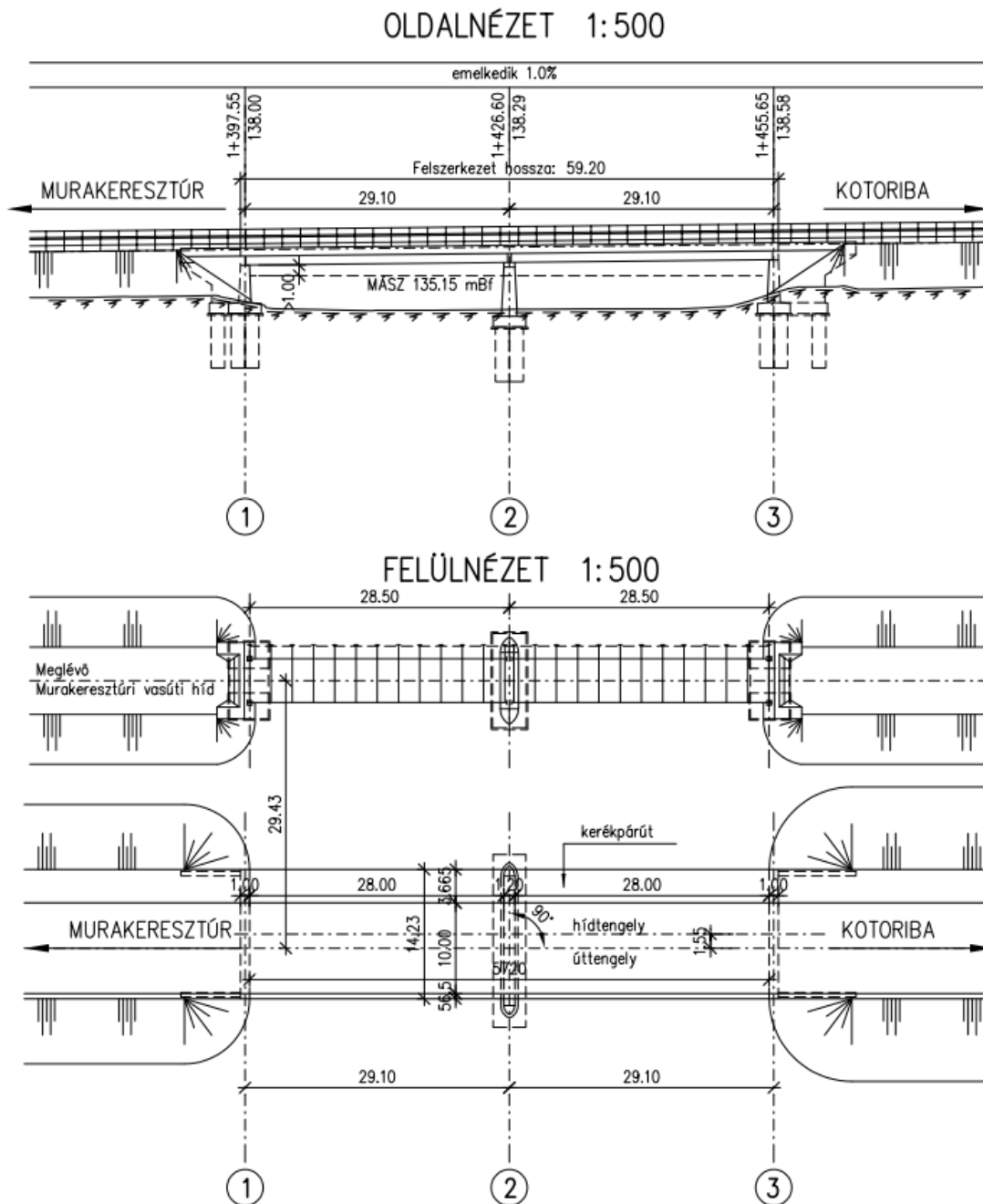
The track structure of the double-span bridge is made with prefabricated prestressed reinforced concrete bridge beams. The structure incorporates a 20-23 cm thick reinforced concrete plate. The superstructure is closed by a reinforced concrete cross beam cast in concrete above the supports.

On both sides of the slab, the service and cycle paths will be placed on top of a monolithic reinforced concrete kerb.

The bridge abutment and pier are solid monolithic reinforced concrete construction supported by drilled piles or well foundations. Both ends of the pillar were planned to be arced.

The design of the proposed bridge over the Árapasztó Stream is illustrated on the figure below.

Figure 1.2: Side and top view of the planned Árapasztó bridge



Source: Murakeresztúr (H) – Kotoriba (HR) border infrastructure development – Bridge Construction Study (PONT-Terv Zrt. August 2021)

1.5.3 Mura bridge (steel arch bridge)

The riverbed is spanned by a “basket-ear” arch bridge with an orthotropic steel deck structure suspended by cables in a grid layout. The arches have a cabinet cross-section, with a wider upper and lower belt, stiffened by longitudinal ribs. Their net height at the top is 26.60 m. The arches are inclined at a slope of 1:4, so that the 19.00 m distance at the bottom is reduced to 5.70 m at the top. The arches are connected by Vierendeel braces spaced 13.75-20.00 m apart.

The track suspended from the arches by cables laid in a grid geometry. The hangers are evenly spaced on the arches at 5.00 m intervals. The track structure is composed of bent steel trapezoidal ribs, the track plate working in conjunction with them and the cross support which support the ribs. The payload is transmitted from the cross girders to the closed cross-section struts located at the

1.6 New network elements to be developed alongside the road

1.6.1 Related road corrections

In connection with the construction of the planned road, the correction of road 6835 will be necessary at the starting section. Due to the construction of the roundabout with 3 exits, it is necessary to slightly modify the road 6835 100 m before and 100 m after the planned roundabout. The planned roundabout will be built on arable land.

1.6.2 Correction of intersecting and parallel dirt roads

One dirt road correction is planned in the planning stage, the flood protection service roads need to be corrected at the crossing of the planned road at the 0+930 km section.

Length of the planned dirt road correction: 330 m.

1.6.3 Cycle routes

A network of cycle paths is planned for the area covered by the planned trail. The planned cycle road will enter the area via the Mura River flood protection embankment from Molnári. The cycle road will leave the existing access road to the flood protection embankment and follow its route toward Murakeresztúr. The cycle path splits in two directions in the area of the existing railway crossing of the Gyurgyánci Stream. One direction crosses the railway with a level crossing and continues along the delta track on the south side of the railway, which also serves as a flood protection embankment. The other direction follows the existing service dirt road to Route 6835.

In the area of the crossing of the bicycle road and the new road, the new road runs in a high embankment due to the height constraints of the flood protection structure, so it is advisable to cross the new road with the planned bicycle path at separate level. During the study design, a connection for cyclists on the south side of the new road after the crossing was planned with a separate cycle route to Croatia.

During the preparation of the EIA, the cycle road was moved to the northern side of the new bridge at the request of the concerned municipalities, in order to avoid cyclist being trapped between the road and the railway.

Based on this, before the cycle road passes under the new road at a separate level, it connects to the cycle path coming from the Mura dam. It will then cross the new road essentially parallel to the new road on the right-hand side of its section towards Croatia.

In the case of planning the new road section, it is advisable to run the section of the bicycle path in the direction of 6835 road parallel to the new road to 6835 road.

1.6.4 Railway crossing

No railroad crossing is planned for this development.

1.7 Location of the development

In the Hungarian section the road runs in the southern administrative area of Zala County, in the suburbs of Murakeresztúr and Molnári villages. In Croatia, the end point of the section of the project is located outside the municipality of Kotoriba, including the Mura River basin, its flood plain and flood protection embankment.

2 Impacts and impact areas

2.1 Impacts

Table 2.1 shows the impacts and the environmental elements or systems affected in the different phases of the proposed activity.

Table 2.1: Possible environmental impact processes

Impact factors	Affected party	Direct impacts	Indirect impacts
Construction			
Site preparation, site reservation	Air, noise	Increase in immissions due to emissions	Disturbance to wildlife, humans Harm to health
	Ground, soil	Quantitative reduction Reduction of existing pollution	Vegetation degradation Avoiding groundwater pollution
	Surface water	Not affected	Not affected
	Wildlife	Habitat and living space lost Disturbance	Biodiversity loss Seasonal decline in headcounts
	Landscape	Changes in landscape and land use	Cityscape change
	Built environment	Change of property boundary Archaeological site disturbance/exploration Potential deterioration of historic monuments Increase in employment	Functionality gaps in some areas Destruction of values/protection of cultural heritage Socio-economic welfare increases
Substructure and superstructure works (material handling, emissions from construction machinery, damage to roadside areas)	Air, Noise	Increase in immissions due to emissions	Disturbance to wildlife, humans Harm to health
	Ground, soil	Changes in soil structure and compactness	Changes in soil water balance
	Air	Temporary air pollution	Soil and water pollution
	Wildlife	Habitat and living space lost	Migration, degradation
	Built environment	Noise and vibration disturbance	Changes in the condition of buildings
Construction waste generation, storage	Landscape	Aesthetic impact, landscape change	-
	Ground, soil	Soil pollution	Water quality degradation
Operation			
Traffic (growing or reorganising)	Air, Noise	Noise and vibration disturbance on and around the railway line Reduction of noise and air pollution on the main road network	Physiological changes
	Wildlife	Disturbance, loss of living space Mortality	Migration, degradation
	Built environment	Noise and vibration disturbance on and around the railway line Noise and vibration reduction on the main road network	Physiological changes
Railway track and stops as facilities	Wildlife	Loss of habitat Restriction of migration and emigration	Population degradation Genetic drift Emergence of new species
	Air	Microclimate change	Ecosystem change
	Surface water	Not affected	Not affected
	Landscape	Changes in landscapes and land use	Changes in urban landscape and structure, new functions and land uses

Impact factors	Affected party	Direct impacts	Indirect impacts
	Built environment	Change in the condition of buildings Creation of new structures (new station)	New investments in the area Changes in urban character Changes in settlements links Economic growth of the area
Maintenance	Ground, soil	Soil pollution	Deterioration of water quality
	Wildlife	Disturbance, habitat loss	Habitat degradation
Abandonment			
Demolition works	Same as for construction	Same as construction	Same as construction
Regeneration	Wildlife	Habitat and living space expansion More areas close to nature	Biodiversity growth
	Landscape	Changes in landscapes and land use	Landscape and landscape structure change
Accident			
Incidents/Accidents	Ground, soil	Accidental soil pollution	Reduction in usability
	Surface water	Accidental water pollution	Deterioration of quality of life, living space
	Air	Accidental air pollution	Soil and water pollution due to sedimentation Adverse physiological effects
	Built environment	Noise and vibration disturbance	Adverse physiological effects
	Wildlife	Habitat and living space lost Mortality	Degradation

2.2 Impact areas

2.2.1 Landscape protection

From the purpose of our study, affected parties are the system of the habitats affected by the road, people living and visiting the affected settlements, as well as those who will use the built road in the future. When choosing the ideal track of the road, the primary consideration is given to the preservation of valuable areas, habitats, and landscape elements. While during the design, the focus is given to users of the road and those who suffer by the impacts (e.g. integration into the landscape).

From the point of view of landscape protection, the extent of the impact area is primarily influenced by topography, vegetation cover, land development and the proposed measures. The direct impact area is the part of the landscape unit whose landscape, unique landscape value, and landscape use method are directly affected by the investment. This cannot be expressed by a uniform distance, the area of direct influence varies depending on all of these.

The road indirectly affects all the areas from where the road is visible and those landscape elements that are visible from the given section. The visual impacts may vary depending on the impact factors (interventions) and the individual impact bearers (landscape elements). All areas where any impact of the investment is perceived (regional development, land use change, landscape protection, landscape rehabilitation) must be considered as an indirect impact area.

Area of direct impact

From the point of view of landscape protection, the area of direct impact is defined as the area that are specifically used by the installation.

Area of indirect impact

The area of indirect impact from where the road is visible, and those landscape elements that are visible from the planned section. The visual effects may vary depending on the impact factors (interventions) and the individual impact bearers (landscape elements). The individual measures may also differ according to the sensitivity of the landscape, the intensity of the interventions and the extent of the impacts. The area where any impact of the investment can be felt (land development, change in land use, landscape protection, landscape rehabilitation), which is possible even at a distance of several kilometres, should be considered as an area of indirect impact.

Visual impacts may also change as the area of impact is much wider for large structures (e.g. Mura bridge, Árapasztó bridge, roundabout, etc.) than that of the road. The impact on the landscape can be a development factor in the vicinity of the intersections, as these areas may increase in value because of the easier access.

2.2.2 Wildlife and ecological system

The impacted species and affected areas are the natural or semi-natural habitats on and near the site, the animals that live, feed, breed, rest, hide and migrate there, the species found in the floodplain between the Mura flood protection embankments, in the Mura River and the Berek Stream.

Area of direct impact

The area of direct impact (construction area) stretches to the expropriation/land acquisition boundary.

Area of indirect impact

The area of indirect impacts is marked by the 100 meter-zone of areas covered by natural or semi-natural vegetation from the axis of the proposed road.

In the vicinity of intersections, water flows and corrected sections of the planned paved roads and agricultural roads, the impact area adapts to the facilities and are wider.

2.2.3 Geological environment, groundwater

In terms of the geological, soil and groundwater environment, the affected receptors are the soil and geological environment of road embankments, ditches, topsoil, groundwater, and in some cases groundwater and aquifers adjacent to the road.

Areas of impact

In the case of soils, the **area of direct impact** is the zone marked by the expropriation boundary, service roads outside the boundary, landfills established during construction, and temporary land occupations. The **indirect impact area** is limited to a strip of land approximately 50 m wide from the boundary of the installations.

For the geological environment, similar direct and indirect areas can be delineated.

In case of groundwater, the area of the embankment and the ditch can be considered as the area of direct impact. The area of indirect impact is the area affected by groundwater flow, the extent of which depends on the groundwater level, the direction of groundwater flow and the composition of the soil.

2.2.4 Surface waters

The affected surface waters are the watercourses located in the vicinity of the road and the watercourses crossed by it. The most significant flows are the Mura River, Árapasztó River and the Berek Stream.

Areas of impact

The area of direct impact of surface water at the crossing of watercourses and the point of discharge of runoff from the road into the receiving water body. It extends 25-50 m on the upstream side, and 50-100 m on the downstream side, depending on the nature of the water flow.

In the case of river basin correction, the whole corrected section is part of the impact area. In case of accidental pollution, the impacted area can be much larger. The whole catchment area and the area affected by changes in surface runoff can be considered as indirectly affected by surface water.

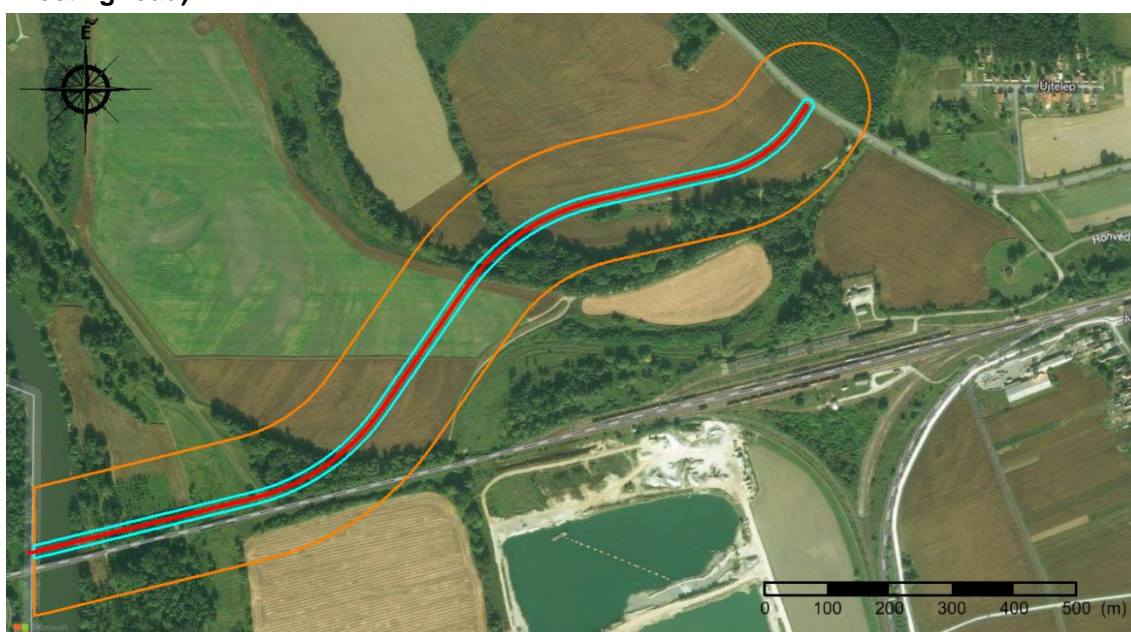
2.2.5 Air quality

From an air quality point of view, the affected parties are the population living in the immediate and indirect vicinity of the road and the wildlife in nature conservation areas sensitive to air quality.

Areas of impact

Due to dusting during construction and emissions from machinery, the estimated extent of the impact area is 100 meters. The impact area during operation is a buffer of 20 meters along the road axis (according to Article 2. § 12c) c) of Government Decree 306/2010, also depending on wind speed.

Figure 2.1: Air protection area of impacts (orange: construction, turquoise: operational, red connecting road)



Source: IMMI

There are no facilities to be protected on the impact areas. (The nearest affected areas start at distance of 290 meters in Újtelep, and 580 meters in Murakeresztúr.) Note that although the effects continue on the other side of the border, the system of requirements for the area of impact may differ beyond the national border, so the contour of the area of impact only reaches the national border.

Dusting is detectable within 100 m of the road axis along the road during construction (this is the distance that PM₁₀ sized particles are expected to travel in the event of adverse meteorological conditions), and during operation the average NO_x load is below 1 µg/m³ beyond 10 m from the road axis (instrumental detection limit).

2.2.6 Noise and vibration

People living in and visiting the area affected by the planned road, people working in the area and the ones using the planned road are considered to be affected.

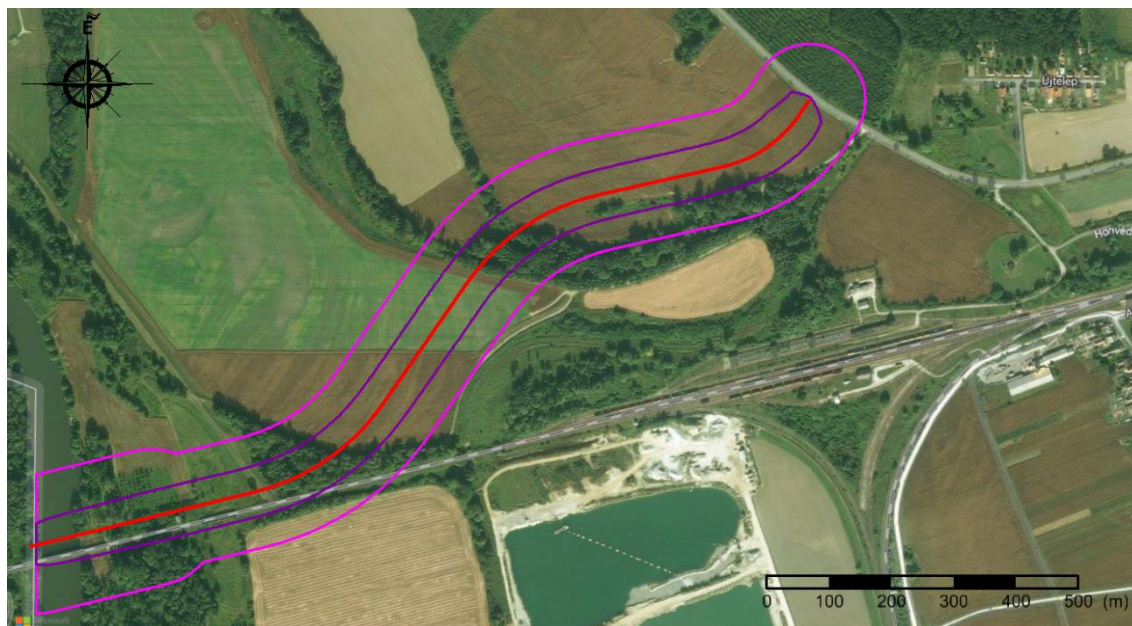
Areas of impact

In terms of noise and vibration, we distinguish between direct and indirect areas of impacted. The direct impact area is defined by Government Decree 284/2007 (X. 29.).

Areas of indirect impact is related to the implementation and operation of the investment, where the effect of noise and vibration protection apply. In particular, this includes the vicinity of transport and access routes where noise and vibration exposure will be increased due to construction and implementation (operation).

The construction area is 90 meters from the axis in the case of the road, and 110 meters from the axis in the case of the bridge.

Figure 2.2: Noise protection zone (magenta: construction, purple: operational, red: road)



Source: IMMI, Bentley Microstation

Note that although the effects continue on the other side of the border, the system of requirements for the area of impact may differ beyond the national border, so the contour of the area of impact only reaches the national border.

Along the connecting road, during construction, the expected construction noise will decrease to 60 dB at 90 meters from the axis, and during operation, the expected traffic noise will decrease to 50 dB at 40 meters from the axis.

2.2.7 Built environment and settlements

From the point of view of the protection of the built environment, the affected settlements are the settlements and buildings for humans living. In addition, among the effects on the built environment, we consider the protection of built and physical monuments of cultural heritage (monuments, archaeological sites).

Areas of impact

The area of direct impact extends to the houses and structures that are affected by the investment structurally or otherwise. The area of indirect impacts includes all built structures that are affected by the more distant (spatial and temporal) effects of the investment.

Area of direct impact: the actual physical land occupation of the trail during construction (the expropriation boundary line) and all other buildings or structures located within a 25 metres zone from the road axis. The direct impact area of operation is the entire area managed by the Road Servicing Institution.

Area of indirect impact: during construction it is the road network elements involved in the transport operation and temporary landfills or treatment areas for the storage of demolished, excavated materials. The periphery of the settlements can be considered an area of indirect impact during both construction and operation. During the operational phase, roads 6835 and 6833 may also be considered as indirect impact areas, with a slight increase in traffic due to the new border crossing. At the same time, the construction of the new railway crossing will reduce traffic in the built-up area of Murakeresztúr, as commuting to the mining area on the south side of the railway can be solved using the new railway crossing. The development has a positive effect on the inner area of Murakeresztúr.

2.2.8 Social, economic, and environmental health impacts

Affected by the investments can be defined in a narrower sense by the users of the new road and those living in the vicinity of the road; in the broader sense, the population and economic actors of Nagykanizsa-Murakeresztúr (H) – Kotoriba-Kapronca (HR).

The socio-economic and environmental health impacts primarily concern the population living and working in Molnári and Murakeresztúr and, more broadly, in the Mura region in the Nagykanizsa-Kapronca corridor.

3 Estimation and evaluation of cross-border impacts

3.1 Expected changes in the status of environmental elements and system

Spatial data for Croatia are taken from the following documents:

- Feasibility Study Level Exploration of Cross-border Sections of Projects Matching KÖZOP, Examination of Their Network Effects on the Hungarian-Croatian Border Section (KÖZOP 3.5.0-09-11-2012-0003) – III. Milestone Murakeresztúr-Kotoriba connecting road Documentation as a basis for environmental licensing, July 2015;
- Feasibility study of Transport connectivity with Hungary (Kotoriba-Murakeresztúr) – Proposal of scoping, Hrvatske ceste d.o.o., November 2021.
- The delineation and information about the Natura 2000 area is based on the available public database (<https://natura2000.eea.europa.eu/>)

3.1.1 Landscape protection

From the point of view of landscape protection, the planned bridges can primarily have an impact that crosses national borders. The Mura Bridge will significantly affect the landscape not only the Hungarian side, but also on the Croatian side of Mura, as a new landscape element, a new artificial facility, will appear next to the existing railway bridge.

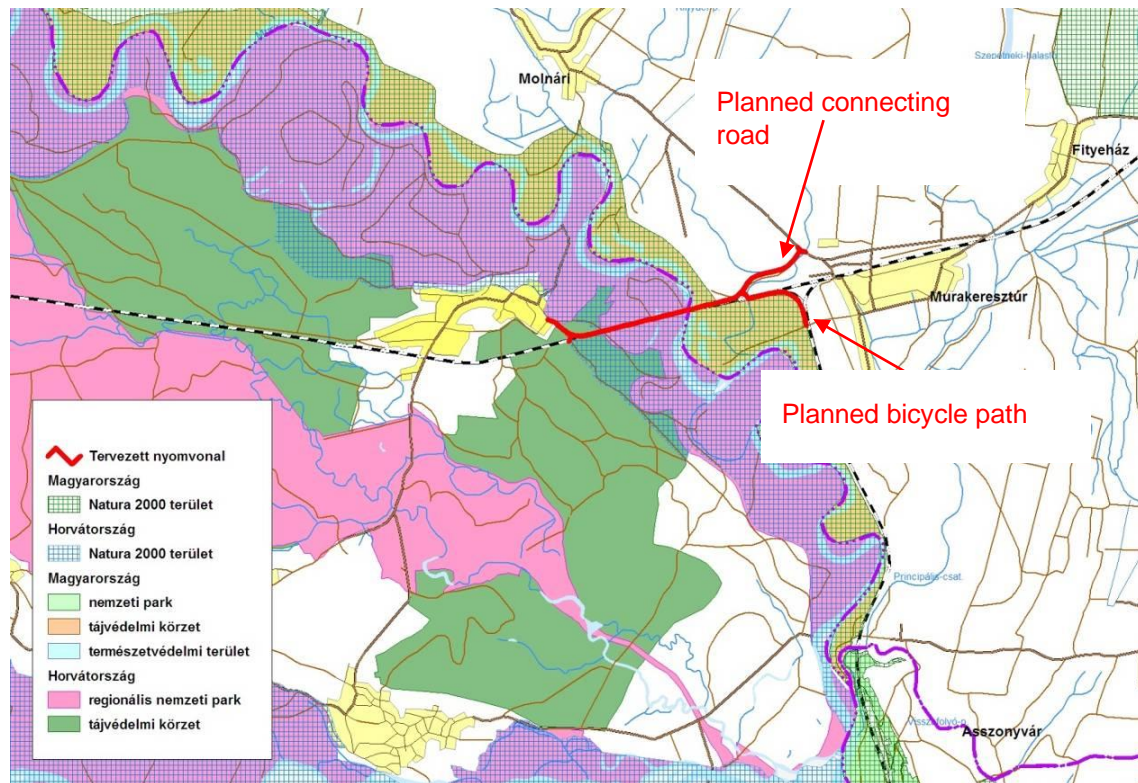
On the Croatian side, the construction and operation of the planned road is expected to have less impact on existing land uses, land cover, landscape ecology and spatial functions of the area, as the Croatian section will be built almost entirely along and parallel to the existing railway bridge largely on the existing road track.

3.1.2 Wildlife

An important factor for the cross-border impact is the presence of protected area on the Croatian side of the border. According to the information available, the following sensitive nature conservation areas are located on the Croatian side of the border:

- Mura-Drava Regional National Park;
- Mura Special Conservation Area (SiteCode: HR2000364);
- Mura-Drava-Danube Biosphere Reserve.

Figure 3.1: Protected area along the Mura between Murakeresztúr (H) and Kotoriba (HR)



Source: Murakeresztúr (H) - Kotoriba (Kotor) (HR) feasibility study - Trenecon COWI, 2015

From the point of view of wildlife protection, similar effects can be expected in Croatia as in Hungary, both during construction and operation. On the Croatian side, the Natura 2000 area will be slightly affected by the construction of the bridge between 1+500 – 1+630 km. On the Croatian side, the trees on the edge of the willow grove (J4, TDO:3, Natura 2000 habitat type: 91E0* - Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*) floodplain reaches the path of the bridge. The trees in the section along the bridge's path are a few white willows (*Salix alba*) and green maples (*Acer negundo*). Moving northwards along the river, the willow grove widens out to become a beautiful floodplain softwood. Between the sections 1+550 and 1+580 km, the bridge passes over a grassland with tall weeds (OF, TDO: 2), where the dominant plant species are big nettle (*Urtica dioica*), tall goldenrod (*Solidago gigantea*), European dewberry (*Rubus caesius*). The grassland patch is surrounded by the floodplain grove. The bridge on the Croatian side comes up on a concrete retaining wall in front of the dam. Here, too, the dam is covered with semi-dry grassland, but common milkweed (*Asclepias syriaca*) is spreading there to a significant extent. The dominant grass species are bulbous oat grass (*Arrhenatherum elatius*), meadow fescue (*Festuca pratensis*), meadow foxtail (*Alopecurus pratensis*), couch grass (*Elymus repens*). It is poorer in dicotyledon than the dam on the Hungarian side.

The railway is bordered by a strip of pedunculated oak (*Quercus robur*), green maples (*Acer negundo*), noble poplar (*Populus euramericana*) and black locust (*Robinia pseudoacacia*) with dense shrub layer. Typical shrub: elderberry (*Sambucus nigra*), common dogwood (*Cornus sanguinea*), blackthorn (*Prunus spinosa*). Behind the rows of trees there are small orchards and gardens.

Bridge construction technology

In the case of single-span steel arch bridge, the stringer and the arch girder of the bridge are assembled on the shore and then pushed into position using trolleys and arch stiffening racks. For the assembly a 190 m long and 41 m wide area is required on the Croatian side. In the case of the assembly area to be built on the Croatian side, it uses the featureless semi-arid grassland on the dam (OC, TDO:2) and the mixed forest patch with non-native tree species following the grassland (RDb, TDO:2) and the abandoned small plot orchard (T8, TDO:1). In this case, the floodplain forest (J4,

TDO:3), which is also a Natura 2000 designated habitat (91E0*), is not used, and the construction is carried out using the offset method from the dam. **In view of the above, in the latter planning phases (construction permit plan, construction plan), the exact design and location of the assembly area must be agreed with the Croatian partner (Hrvatske ceste d.o.o.) based on the more precise plans.**

The total expected construction time for the bridge is 2.5 years, of which construction works affecting the riverbed will take approx. 5 months, from 1 December to 1 May, as recommended by the Ministry of Water Affairs.

The continuation of the road and bicycle path to Kotoriba is expected to run alongside the existing railway track, which crosses the formerly dammed and now filled Mura riverbed at two points. Currently, the backwater can be considered a wetland of minor importance and is of local value. The crossing can be solved by building a bridge with least amount of habitat loss. The route of the road to be built would affect small plots of land and old orchards, which do not represent a noteworthy nature conservation value.

3.1.3 Soil and water protection

On the Croatian side, according to our current information, there are no aquifers or water supply wells near the planned route¹.

Under normal operating conditions, no cross-border effects occur during construction or operation. From the point of view of soil quality, this is only possible if an incident occurs directly on the boundary, and from the point of view of groundwater protection, if an incident occurs close to the boundary, but not more than 50 m from it.

Stormwater runoff without significant pollutant loads is discharged into the Gyurgyánci Ditch and the Mura River as final receiver, the latter being the Hungarian-Croatian border river in the area. Under normal operation, the proposed activity will not cause any transboundary impact on surface water. In the unexpected case of a significant release of hazardous substances in the vicinity of the border crossing point, transboundary pollution cannot be completely excluded. However, the transport of hazardous substances by road is expected to be at most retail quantities.

3.1.4 Noise and vibration

There is no sensitive area to be protected on the Croatian side within a strip of several hundred meters from the point of view of noise and vibration protection, hence no cross-border effects should be expected during construction.

Along the connecting road, the expected construction noise is reduced to 60 dB at 90 m from the axis during construction and the expected traffic noise is reduced to 50 dB at 40 m from the axis during operation in the years after.

3.1.5 Air quality

There is no sensitive area from air quality protection point of view on the Croatian side of the border, in a strip of several hundred meters, hence no transboundary impacts are expected during construction.

Dusting along the connecting road during construction will be detectable within 100 m of the axis (PM₁₀ particles are expected to travel this distance in case of unfavourable meteorological conditions) and during operation the average NO_x load will be below 1 µg/m³ (instrumental detection limit) beyond 10 m from the road axis.

¹ Murakeresztúr (H) - Kotoriba (Kotor) (HR) Infrastructure Development – Feasibility Study - Tenecon COWI, 2015

3.1.6 Built environment

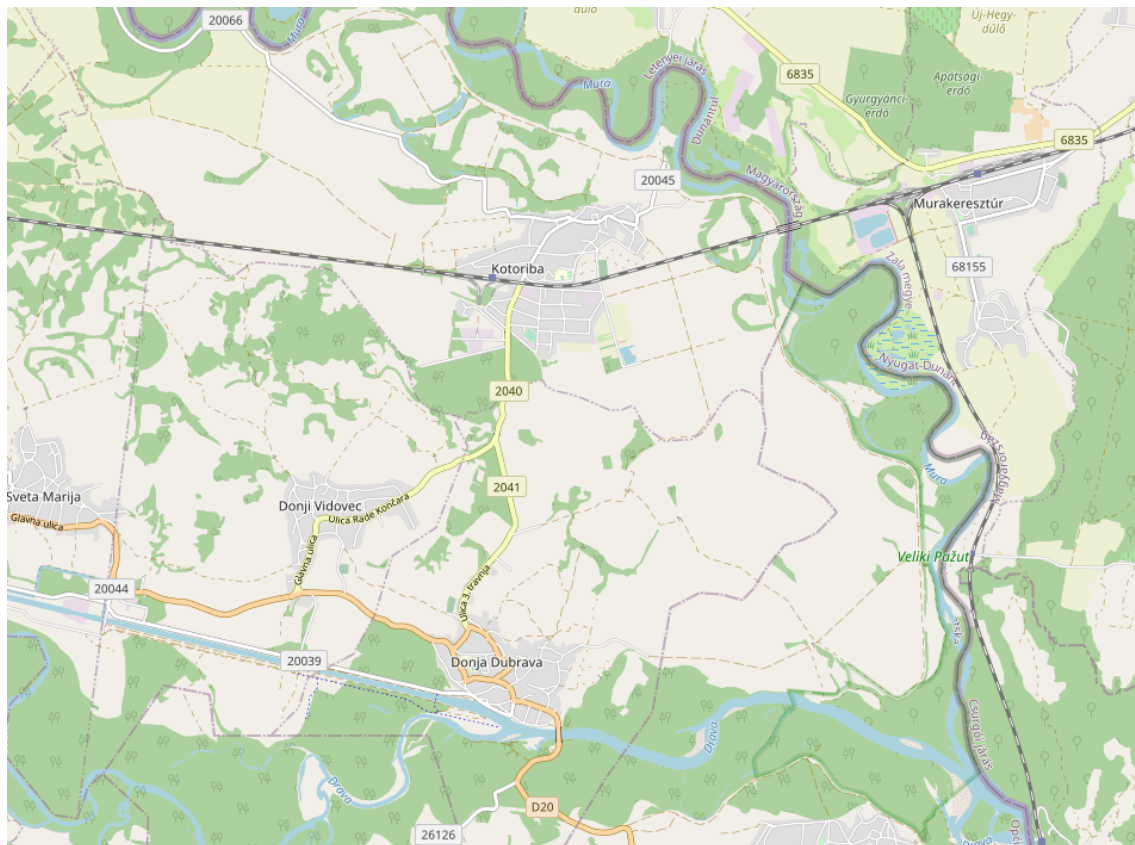
There are no buildings or settlements on the Croatian side of the border, within a strip of several hundred meters, so no cross-border effects expected.

3.2 Connecting road

The planned road continues on the Croatian territory after the border. On the Croatian side, the planning area is also affected by the following road network elements:

- D20 (Hodošan (D3) - Prelog - Donja Dubrava - Đelekovec - Drnje (D4(1))
- Local roads Ž2040 and Ž2041 connecting Kotoriba with the D20.

Figure 3.2: Road network of the further planning area in Croatia



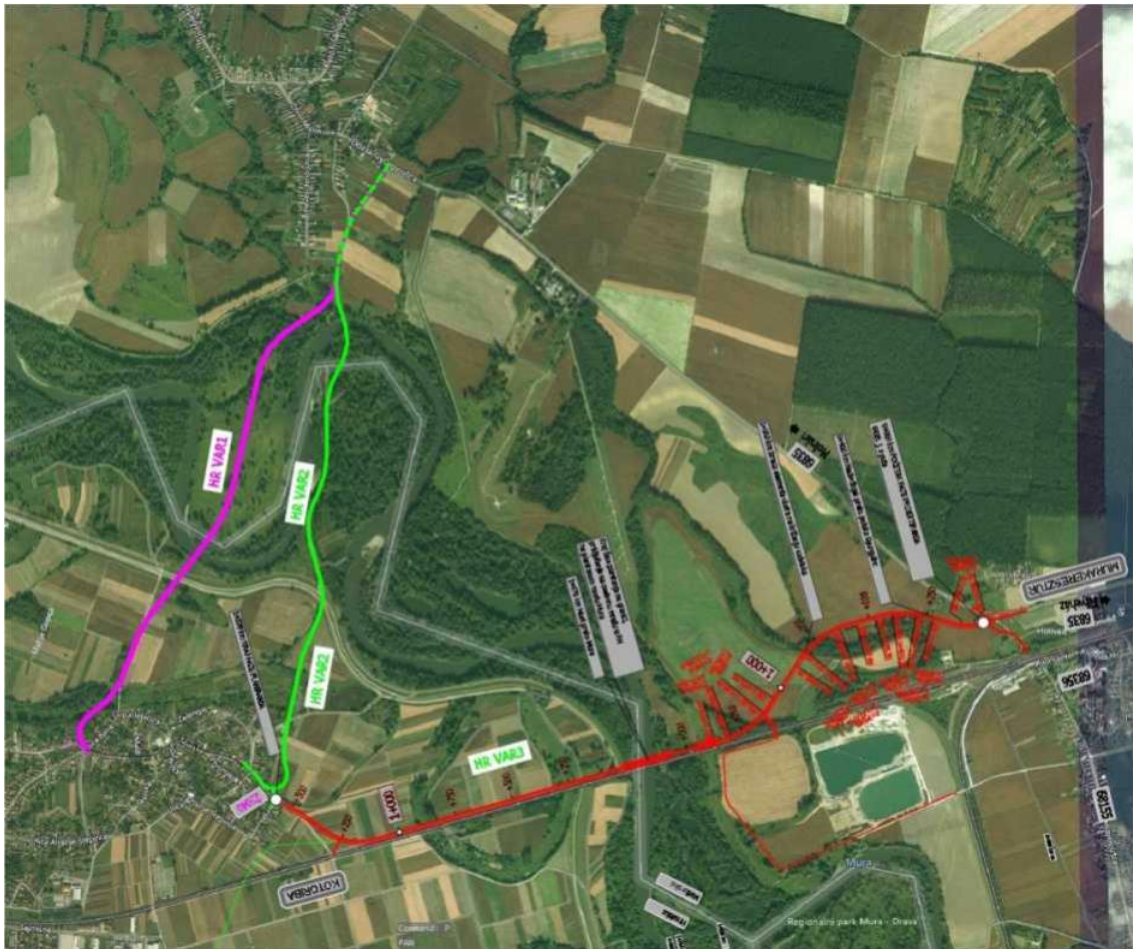
Source: www.openstreetmap.org

As shown in the figure above, a new road section needs to be built on the Croatian side between Kotoriba and the planned Mura bridge. According to the current plans, the planned road can be connected to several points in the municipality of Kotoriba, with or without a railway crossing, by running along the north side of the railway line.

The Croatian partner Hrvatske ceste d.o.o. prepared a Preliminary Feasibility Study regarding the further planning, in which 3 routes proposed for further planning were examined (see figure below). All three versions affect the following protected areas, to different extent:

- Significant landscape in the area of Muraköz County;
- Mura - Drava Regional Park;
- Natura 2000 Site of Special Importance for Nature Conservation HR2000364 Mura;
- Mura-Drava-Danube Biosphere Reserve area.

Figure 3.3: Croatian versions assessed by Hrvatske ceste d.o.o.

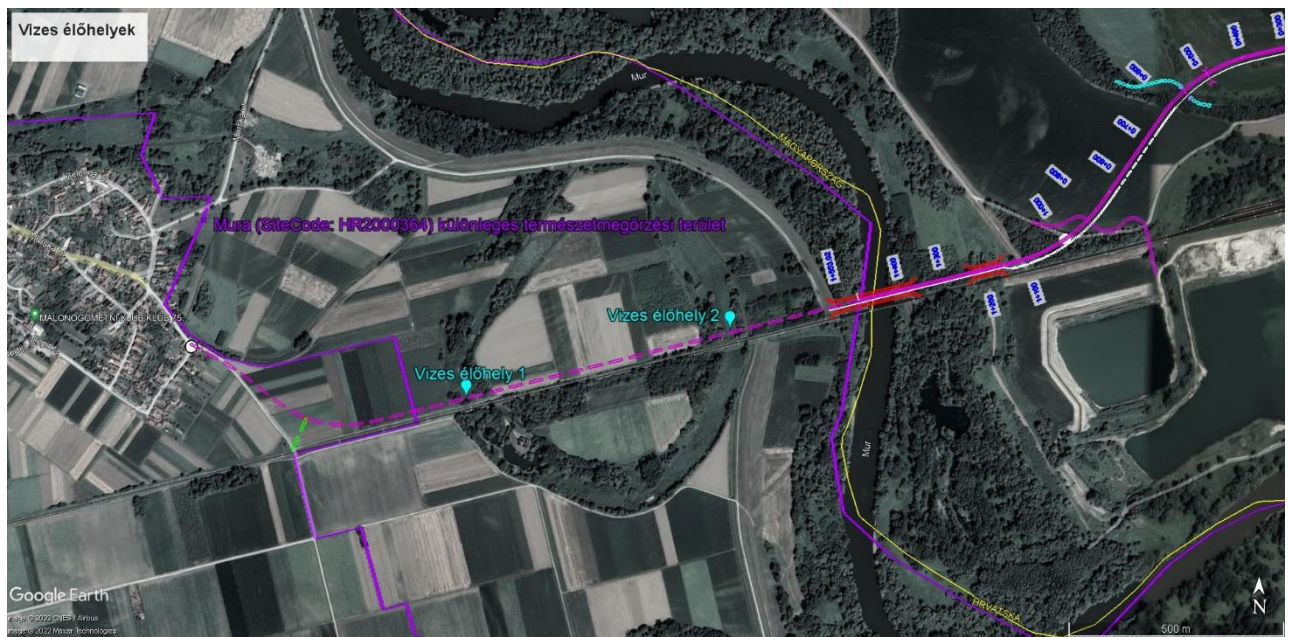


Source: Feasibility Study of Transport Connectivity with Hungary (Kotoriba - Murakeresztur) - Proposal Of Variant Solutions, Hrvatske ceste d.o.o., 2021. November

In the documentation provided, the following has been identified for further planning from an environmental point of view:

- The preferred option for Croatia is Hr VAR1, as:
 - Involves the use of the smallest protected area and Natura 2000 site on the Croatian side.
 - The route roughly follows the route of an existing agricultural road and runs along the mosaic edge of cultivated land.
 - Involves minimal use of forest land on the cultivated areas.
- Croatia may also benefit from HR VAR3, as:
 - Of the 3 versions, the Natura 2000 area is affected for a longer distance than HR VAR1, but for a shorter distance than HR VAR2.
 - It runs parallel to the existing railway line.
 - There is the disadvantage that the continuation affects two additional wetlands and forest areas (see figure below).

Figure 3.4: Location of wetlands on the Croatian side



Source: MMH and google.earth.pro

Picture 3.1: View of wetland 1 photographed from the existing dirt road towards north



Source: Field visit September 2021

Picture 3.2: View of wetland 2 photographed from the existing dirt road towards north



Source: Field visit September 2021

The HR VAR2 option was rejected by the study, as it crosses more than 2 km of protected areas and would require significant forest area.

4 Mitigation measures

4.1 Measures to prevent and reduce adverse impacts

4.1.1 Landscape and townscape protection

- It is necessary to rehabilitate the damaged surface left during construction on the entire section of the planned route. The rehabilitation is to be carried out within the expropriation area or on other work areas used during construction, ensuring the land use patterns are similar to that of before construction taking ecological basic conditions into account.
- The necessary utility replacements in the areas shall be completed prior to rehabilitation. During rehabilitation works, extra care should be taken in the vicinity of utilities to avoid damage to them.
- In the expropriated areas, planting works can be carried out after the rehabilitation of abandoned dirt roads and ditches.
- The rehabilitation of damaged surfaces remaining as a result of construction of facilities (e.g. constructive works related to water management) necessary for the implementation of other activities related to the investment must also be ensured.
- Provision shall be made for the replacement of woody vegetation that will be cut down as a result of construction.
- In terms of landscape protection, planting should be carried out without invasive species preferably applying endemic species.
- In the following design phases, the planned Mura bridge should be design in a colour scheme that is in harmony with the landscape, avoiding bright colours.

4.1.2 Wildlife protection

- Due to the impact of fewer marker habitats, it is advisable to create the installation area for the bridge on the Croatian side. Regarding the precise design of the assembly area, in the later planning phases (construction permit plan, construction plan), a documented consultation with the Croatian side is also required.
- The bulbs of summer snowflake (*Leucojum aestivum*) and snowdrop (*Galanthus nivalis*) affected by the trail shall be relocated to an area providing suitable protection and growing conditions for them after the spring flowering period. The translocation shall be subject to a translocation plan, which shall be subjected to a specific procedure for approval by the nature conservation authority. The location of the translocation must be agreed in advance with the Balaton-Highlands National Park Directorate.
- In nature conservation areas of high conservation value (grasslands, forests, forest strips, tree belts) and in the Mura Landscape Protection Area and Nature 2000 areas, the work must be agreed in advance with the Balaton-Highlands National Park Directorate, and it is recommended to ensure continuous supervision by a nature conservation specialist.
- Excavation affecting natural areas: forests, grasslands, forest strips, tree belts, the Mura Landscape Protection Area and Natura 2000 sites, as well as cutting the trees along the entire section must be carried out in non-vegetation season (between 1 October and 1 March). If the excavation and tree and shrub removal cannot be carried out within the prescribed timeframe, the contractor must cooperate with the National Park Authority and consult with wildlife specialist and representative of the National Park Authority before the work is carried out. After a joint survey of the site of the works, the extent, nature and location of the planned interventions have been formally recorded, any necessary wildlife protection measures have been taken and, if it is established during the consultation that no damage to nature conservation is to be expected, the work may be authorized under constant nature conservation supervision. If damage to nature conservation is expected, the restriction must be in place.

- Before felling (even outside the vegetation period), old dead trees should be assessed by the National Park Directorate and a wildlife protection expert to check for overwintering mammals, nesting animals, bat colonies etc. If the result of the survey positive, the National Part Directorate must be involved in deciding on further wildlife protection steps (e.g. rescue or, in certain specific cases, even the suspension of works at the site(s) in question of there no other solution).
- As proposed by the Water Authority, the construction phase affecting the riverbed is acceptable for fish fauna and aquatic macroscopic invertebrate fauna in between 1 December and 1 May. By December, the fish will have already started to overwinter, but during the winter dormancy period it is almost certain that they will not choose the fast drifting section for the river in the immediate vicinity of the bridge (which will be affected by the works for some 10 meters) for hibernation site. The work in winter and early spring will not affect fish spawning and is therefore not expected to have a detrimental affect on either spawning or on the offspring, as long as the deadlines are met.
- Landfills, material extraction sites, temporary sites are not allowed in natural areas and Natura 2000 areas.
- The location of the assembly area designated for bridge construction must be agreed in advance with the National Park Directorate. Habitats located outside the assembly area cannot be used.
- During the operating period, lawn areas affected by disturbance of the soil surface during construction must be mowed regularly (at least twice a year) in order to prevent the establishment and spread of invasive species. This does not apply to areas affected by afforestation and agricultural land used for construction.
- Regular mowing of the entire length of the roadside ditches is necessary during the operating period to prevent the establishment and spread of invasive species.
- The following measures are necessary to protect against the spread of invasive plants:
 - black locust (*Robinia pseudoacacia*) – During the clearing of vegetation from the work area, the seed stock in areas infected with black locus can be stimulated by strong sunlight and intensive germination will begin the following year. Its spread can be prevented by chemical herbicides.
 - green maple (*Acer negundo*) – Its spread can be prevented by cutting down the seed-bearing trees.
 - American ash (*Fraxinus pennsylvanica*) – Its spread can be prevented by cutting down the seed-bearing trees.
 - Milkweed (*Asclepias syriaca*) – Soil infected with its roots cannot be reused. Its spread can be prevented by chemical herbicides.
 - himalayan balsam (*Impatiens glandulifera*) – Control by regular mowing in the pre-ripening period. Chemical eradication should only be carried out with an official permit and at an appropriate protective distance from wetlands.
 - Bohemian knotweed (*Fallopia x bohemica*) – Mainly spreads by rhizomes, therefore the earth from this area must not be used elsewhere during earthworks! It can be controlled by chemical herbicides and mechanical eradication (the former is limited by the proximity of the river). It is the most difficult weed to control of the region.
 - Canadian goldenrod (*Solidago canadensis*) – It is well controlled by mowing, but cannot be completely removed, as there are always productive shoots remaining on the edges.

If the protection recommendations are followed, no preventive or compensatory measures are necessary.

4.1.3 Soil and groundwater protection

- In the hydrogeological protection area “B” of the Molnári-Mura water base, it is necessary to establish a covered (watertight) rainwater drainage ditch;
- For the Mura bridge, the use of gravel pile foundation technology is recommended, which is the least disruptive to the unobstructed flow of groundwater;

- It is recommended to deposit the removed (excavated) upper fertile layer separately and to use it in future landscaping (humus removal);
- A soil protection plan should be developed in the following design phases;
- Temporary storage of construction waste, fuel storage, assembly area can be located in an area less sensitive to contamination and not threatened by high groundwater levels on the protected side of the Mura River flood protection embankment. No assembly area, machine storage, material storage shall be located in this area. If this is still unavoidable for the construction, especially for the construction of the bridge, the operation with hazardous or polluting material should be carried out on some kind of insulating sheet (e.g. polyethylene sheeting) and/or secondary containment should be used;

4.1.4 Surface water protection

- The installation must be carried out in accordance with industrial good practice at all times, both during construction (implementation) and operation.
- During construction, care must be taken to ensure the continuous drainage of surface water and to prevent fuel dripping from construction equipment.
- In order to avoid accidental pollution, the regular maintenance, washing and refuelling of machineries must be carried out at a properly made, preferably designated site for this purpose.
- On the downstream side of the Mura River, it is proposed to create a maintenance area, temporary storage space, depot and to design it in such a way that no possible contamination is discharged into the watercourse (Gyurgyánci Stream and Berek Stream).

4.1.5 Air quality protection

- It is recommended to use the nearest possible extraction sites or asphalt mixing plants.
- During construction works, watering the area is recommended in order to minimize dusting.
- It is recommended to cover the transported material on the trucks.
- During construction work, it is necessary to use a wheel washer and/or clean the mud from the paved road (by machine or manual force) for transport vehicles driving up to the main road from the unpaved construction area (in reasonable weather conditions) in order to minimize dust.
- During construction work, the extracted and deposited humus layer must be watered or possibly covered so that it does not cause dusting.
- During construction work, machinery in a suitable technical condition shall be used, which complies with the provisions of the Decree No. 6/1990 (IV. 12.) of the Ministry of Transport, Building and Urban Development on the technical conditions for the registration and operation of road vehicles.

4.1.6 Noise and vibration protection

Recommended mitigation measures during construction:

- Construction work should preferably only take place during daytime.
- Use modern machinery and maintain them to minimise the resulting noise level.
- Minimise transport routes, preferably using roads with higher traffic volumes, avoiding urban sections and, in the case of urban sections, favouring sections with fewer facades to protect and/or better road quality.

4.1.7 Protection of the built environment and cultural heritage

- Preliminary manual excavation is recommended in the case of utilities in an uncertain position.

