APPENDIX - 10

Hydrotechnical Regulation of the Zapadna Morova River Within the Infrastructure Corridor of Highway E-761 ESIA Basic Information and Key Points

КОРИДОРИ СРБИЈЕ

HYDROTECHNICAL REGULATION OF THE ZAPADNA MORAVA RIVER WITHIN THE INFRASTRUCTURE CORRIDOR OF HIGHWAY E-761

E S I A

Basic information and key points

Belgrade, May 2020.

HYDROTECHNICAL REGULATION OF THE ZAPADNA MORAVA RIVER WITHIN THE INFRASTRUCTURE CORRIDOR OF HIGHWAY E-761

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A B B R E V I A T I O N S

CoS	Corridors of Serbia Ltd.
SV	PWMC Srbijavode
JCWI	Jaroslav Černi Water Institute
GD2007	General Design of the regulation of the Zapadna Morava River, 2007
ZM	The Zapadna Morava river
km	Motorway Chainage
r. km	River Chainage of the Zapadna Morava River
Q100	Flood discharge of return period 100 years
RS	PE ”Roads of Serbia”
HI	Highway Institute
CIP	Institut of transportation CIP
LPC	Law on Planning and Construction
RHMS	Republic Hydrometeorological Service of Serbia
HTS2016	Hydrotechnical Study of the E-761 highway corridor, section Pojate-Preljina
SPSPA2013	Spatial Plan for the Special Purpose Area of the E-761 highway infrastructure corridor
PHD2012	Preliminary and Main Designs of the E-761 highway, Pojate – Preljina (2012-2013)
GDH2008	General Design and Pre-feasibility Study of the E-761 highway Pojate-Kraljevo-Preljina
PD HTR	Preliminary Design of hydrotechnical regulation of the Zapadna Morava River along the E-761 highway route
PD	Preliminary design
DCP HTR2020	The Construction permit designs for hydrotechnical works and structures (2020)
HTR ZM	Hydrotechnical regulation of the Zapadna Morava within the infrastructure corridor of the E-761 highway
ESIA	Environmental and Social Impact Assessment study

1 INTRODUCTORY REMARKS

1.1 Introductory remarks

This document is prepared by the following companies: Corridors of Serbia Ltd. (CoS), PWMC "Srbijavode" (SV) and the Jaroslav Cerni Water Institute (JCWI).

This document serves to provide information with all relevant facts regarding the hydrotechnical regulation of the Zapadna Morava River for the purpose of the E-761 highway construction from Pojate to Preljina, which are important for the drafting of the Environmental and Social Impact Assessment study (ESIA) and its successful completion.

The highway length from Pojate to Preljina is approx. 110 km, while the length of the Zapadna Morava on this stretch is approx. 138 km. Highway E-761 is divided into several sectors and sections (Figure 1):

1. Reach: Pojate - Kruševac (km 0+229,75 - km 27+600) - SECTOR 1, Sections 1, 2 i 3;
2. Reach: Kruševac (Koševi) - Adrani (km 27+600 - km 81+476,66) - SECTOR 2, Sections 4, 5, 6 i 7;
3. Reach: Adrani – Mrčajevci (km 79+000 - km 97+000) - SECTOR 3, Section 8;
4. Reach: Mrčajevci – Preljina (97+000 - km 109+663,80) - SECTOR 3, Section 9.

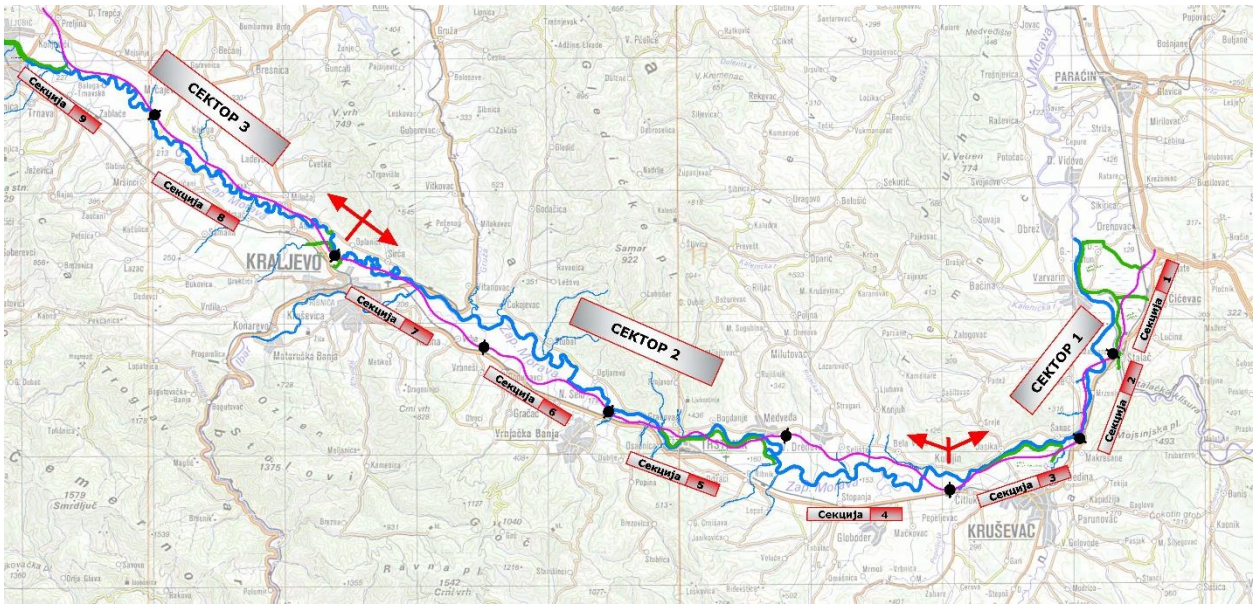


Figure 1. The Zapadna Morava along the E-761 corridor

The participants relevant for the development and adoption process of the ESIA Study are listed below:

1. **RAMBOLL** is one of the leading consulting companies in the world and covers the fields of engineering and architecture. RAMBOLL has been engaged by the financial institutions that are financing the Highway Project Pojate - Preljina, to revise the ESIA Study on their behalf.
2. **2U1K MUHENDISLIK VE DANISMAILIK A.S.** is a Turkish consulting company that provides services in the field of environmental engineering. 2U1K company has been hired to prepare the ESIA Study for the purpose of Highway Project Pojate - Preljina.
3. **BECHTEL-ENKA Bechtel Corporation–ENKA İnşaat ve Sanayi A.Ş Consortium** is the Contractor in charge of the construction of the E-761 highway, under the contract made with the Government of the Republic of Serbia - the Ministry of Construction, Transport and Infrastructure as the Employer.

4. **Company Corridors of Serbia Ltd.** performs the investment activities on behalf of the Employer (the Republic of Serbia) on the construction of the highway Pojate - Preljina.
5. **PWMC SRBIJAVODE** is, based on the Conclusion of the Government of the Republic of Serbia, appointed to act on behalf of and on the account of the Republic of Serbia, to design and manage the project of flood protection improvement, i.e. the river training within the scope of the Spatial Plan of the Special Purpose Area of the infrastructure corridor highway E-761 of Pojate -Preljina
6. **JAROSLAV ČERNI WATER INSTITUTE** is, together with PWMC Srbijavode, the designer of the hydrotechnical regulation of the Zapadna Morava River along the E-761 highway between Pojate and Preljina.
7. **JP MORGAN** is a world leader in financial services with a business presence in more than 100 countries around the world. JP Morgan is a possible financier of the construction of Pojate-Preljina highway by opening of the credit line to the Republic of Serbia for its construction.
8. **MIGA** is a Multilateral Investment Guarantee Agency within the World Bank Group.

RAMBOLL company has performed a review of the ESIA Study, that was prepared by 2U1K, and prepared a Report on ESIA review. Number of remarks on the content, the drafting methodology, as well as on the background data and documents used in ESIA Study were presented in the RAMBOLL Report.

This document provides the basic information and explanations, as well as the guidelines for further procedures related to the ESIA Study, guided by the remarks of RAMBOLL and the discussion at the meeting held on April 30th 2020.

2 RAMBOLL'S REMARKS ON THE ESIA STUDY

RAMBOLL's basic remark is that the ESIA must meet the specific requirements of relevant international standards and recommendations, as this is a prerequisite for projects financed from the international funds (credit lines). RAMBOLL has assessed the fulfilment of standards in various fields and gave recommendations on what should be done to satisfy those standards and create prerequisites for project financing.

Parts of the ESIA study related to the hydrotechnical regulation of the Zapadna Morava River for which it has been concluded that they do not fulfil standards are presented in Table 1, together with the relevant recommendations.

Tabl 1. Summary of RAMBOLL's recommendations

Relevant domain/Area	**Recommendations**
SURFACE AND GROUNDWATERS	It is necessary to upgrade the analysis of impact of river regulation in relation to the detailed designs, as well as the results of more detailed hydraulic modelling (2D)
LAND AND AQUATIC ECOLOGY	A critical and comprehensive baseline habitat analysis needs to be carried out and future status after motorway construction evaluated A comprehensive analysis of baseline status of ecosystem services needs to be carried out and future status after motorway construction evaluated
CUMULATIVE IMPACTS	An analysis of the impact of regulation of watercourses and potential hydropower facilities in the basin is necessary
ANALISYS OF ALTERNATIVES	Robust analysis of river regulation work alternatives is needed. The hydrological studies and projects used are not considered sufficiently thorough (robust) and are not suitable as a basis for ESIA according to IFI standards. A thorough independent technical audit of these reports is recommended.

For each recommendation, Ramboll gives a more detailed explanation.

In general, RAMBOLL's remarks and recommendations on the ESIA documentation are justified and appropriate.

It should be noted that remarks made by Ramboll should be considered in light of the following facts:

1. ESIA Study considers only the impacts in the corridor 1000 m width along the highway route itself and does not treat the relevant impacts in the subject areas for river training zone, which is also part of the highway project.
2. Consultants that prepared ESIA Study did not have access to complete existing documentation for river training works (preliminary designs, other relevant studies, etc.), as well to the relevant data on the existing status of watercourses.

3. The existing documentation (level of details and scope) regarding the river training that could be available to 2U1K company is insufficient for the needs of the ESIA and does not fulfil the relevant international standards.
4. In order to create the basic preconditions for fulfilling the requirements and standards of IFI's, it is necessary to conduct additional study-research activities that would present the current status in river training zone. Scope of these analyses should be defined in cooperation between all interested parties stakeholders in order to remove any potential doubts about the results validity.

3 PREVIOUS ACTIVITIES ON THE DEVELOPMENT OF THE PROJECT OF HYDROTECHNICAL REGULATION OF THE ZAPADNA MORAVA

In relation to the subject of this document, it is necessary to point out all the previous activities related to the hydrotechnical regulation of the Zapadna Morava River and the chronology of project development (Table 2).

Table 2. Overview of activities/technical designs in the period from 2007 to 2020

Activity/Design	**Design subject**
General Design of the regulation of the Zapadna Morava River (2007)	Based on the conducted extensive field survey, the issue of the protection against the adverse effects of the Zapadna Morava river was integrally considered within the GD2007.
General Design and Pre-feasibility Study of the E-761 highway Pojate-Kraljevo-Preljina, km 000+000.00 - km 109+612.72 (2008)	Within the GDH2008, the three variant solutions of the highway route from Pojate to Preljina were analysed. All analysed routes pass through the ZM valley, with changes on the certain sections.
Preliminary and Main design of the E-761 highway, Pojate - Preljina (2012-2013)	Preliminary and Main Designs of the E-761 highway were prepared in 2012-2013 by the HI (section Adrani - Preljina) and CIP (section Pojate - Adrani), and the Investor was PE "Roads of Serbia". Designs were prepared in line with the previous LPC and were not submitted to revision or technical control.
Spatial Plan for the Special Purpose Area of the E-761 highway infrastructure corridor, section Pojate – Preljina (2013)	The SPSPA2013 state that the almost entire length of the planned highway in situated in the Zapadna Morava floodplain, as well as the highway route is intersecting the Zapadna Morava river bed at several places, and in some zones the highway route is significantly approaching to the river bed of the Zapadna Morava.
Hydrotechnical Study of E-761 highway corridor, section Pojate-Preljina (2016)	HTS2016 was conducted in order to harmonize the highway design with the water regime, existing water structures and water management plans, in accordance ith the SoW outlined by the SV, the Ministry competent for water management and the RS. As requested in the SoW, the hydraulic model for ZM developed in GD2007 was used to define the basic parameters of flow regime for the altered hydrological conditions (occurred after the floods in May 2014).
New SPSPA and harmonized Preliminary Designs of the E-761 highway and hydrotechnical regulation of the Zapadna Morava River, 2017-2020	The procedure of amending the SPSPA was carried out, due to: - objective reasons based on the information obtained during the detailed field survey carried out for the purposes of further elaboration of project documentation; - the alignment of the SPSPA with HTS2016; - the reconsideration of the road structures locations and the accompanying contents of highway and the harmonization with the new legislation (the new LPC was adopted in 2014). The new technical solutions were developed at the preliminary design level, through the constant harmonization of the highway designers and designers of hydrotechnical structures on the Zapadna Morava.
The Construction permit designs for hydrotechnical works and structures (2020)	The preparation of DCP HTR2020 is in progress. According to the time schedule, the design for Sector 1 will be completed during May 2020, and upon the performed technical review, which is mandatory under the Law on Planning and Construction, the Investor will receive a construction permit. The design for Sector 3 will be finalized by the end of May 2020, and the construction permit is expected at the end of June 2020. The drafting of the Sector 2 design will follow the acceptance of the Preliminary Design, for the same sector, by the National Review Commission.

The more detailed information for each of the listed activities/designs is provided below.

3.1 General Design of regulation of the Zapadna Morava River (GD2007)

In 2007, Jaroslav Černi Water Institute was contracted by PWMC Srbijavode to prepare General Design of regulation of the Zapadna Morava River (GD2007). Main objective of GD2007 was an integral overview of the protection against the adverse effects of Zapadna Morava River, based on the comprehensive field investigations.

Scope of the activities conducted for the preparation of the GD2007 included detailed field prospection, bathymetric survey of river profiles at approx. 500 m distance, inspection of the status of river structures, embankments and bridges, and sampling of 60 sediment samples from the river bed.

A detailed **morphological analysis** (analysis of changes of the river route and the river bed) was performed based on the geodetic survey data from 1961 and 2007.

Hydrological analysis included the analysis of small, medium and large waters based on the data from daily observations at the hydrological stations, in the period 1954-2005. The data from the hydrological stations RHMS Jasika and Trstenik, located downstream from the mouth of the Ibar River (right tributary of Zapadna Norava, which is due to the river basin area and the water quantity larger than the upstream part of the Zapadna Morava), i.e. Miločaj and Kraljevo, located upstream from the mouth of the Ibar River, were analyzed.

The duration curves and the mean discharge, as well as the distributions of probabilities of minimum and maximum annual discharges were defined. To define the extreme values of annual discharges of the different probabilities of occurrence, the standard procedure of testing and the adjustment of theoretical distribution functions to basic data is applied. Pearson III and log – Pearson III distribution functions were used. The quality of adjustment is calculated by the χ^2 test and the Kolmogorov test.

Hydraulic calculations were performed by using the 1D HEC – RAS Model for steady-state flow conditions. The hydromorphological model of the river valley was developed from the recorded river profiles of the main river bed and the "draft topographic map", with geometry of wider riparian area. Geodetic survey data of all existing bridges were included in the model.

Digital terrain model (DTM) of the Velika Morava Valley was not available in 2007, not even the georeferenced maps of scale 1:25000 were up-to-date. For this reason, based on the topographic map with content of 1969-71 and the data on the current river route (based on satellite images), embankments and other infrastructure facilities, a "draft topographic map" was prepared.

Hydraulic calculation was performed for the characteristic discharges (small, medium and large flows of the different return periods). The sections for calculation of the ZM (determined by the position of hydrological stations and the mouths of significant tributaries) were determined, for which the discharges were considered to be constant (Table 3).

Table 3. Characteristic sections and discharges of the Zapadna Morava River (m^3/s)

Section	River chainage of Zapadna Morava	Manning coeff.	Characteristic discharges							
			Duration curves		Q_{sr}	Q_{pk}	return period (years)			
		N	$Q_{mv90\%}$	$Q_{10\%}$			10	20	50	100
Confluence with J. Morava-mouth with Rasina	0 – 12.1	0.0036	29.19	241.5	114.03	245	1163	1364	1656	1975
Mouth with Rasina-h.s. Trstenik	12.1 – 55.32	0.0038	27.8	230	108.6	230	1043	1244	1536	1781
h.s. Trstenik- Mouth with Ibar	55.32 -87.7	0.0050	24.9	226	106.5	226	1121	1321	1602	1828
Mouth with Ibar- Mouth with Čemernica	87.7 -138	0.0038	8.44	91.2	44.4	95	634	759	930	1067

Friction coefficient of the main river bed was determined by the calibration process based on the discharge curves at the hydrological stations. Friction coefficient on the inundation zones was estimated based on the land cover type.

The results of the hydraulic calculations were the water levels, velocities and traction forces, as well as morphological indicators for the characteristic discharges. Flood zone for Q100 was determined by projecting of calculated water levels on the terrain defined in a "draft topographic map".

In GD2007, it was planned to continue the works on protection against the harmful effects of water in the ZM valley, taking into account the need to leave a wide river corridor, in accordance with the modern approach of the regulation of watercourses.

Main goals for the protection against the harmful effects of water in the ZM valley were set more than 50 years ago. These are: (a) protection of valuable assets in the riparian zone from flooding; (b) protection of roads and bridges; and (c) stabilization of the river route and control of fluvial erosion. However, it is stated that, despite the fact that certain scope of training works have been performed in the previous period, the significant damage from the harmful effects of water can be expected in the ZM valley.

River regulation solutions were proposed that are characterized by small investments and the need to harmonize with the construction of traffic corridor Pojate - Preljina in the the Zapadna Morava valley, for which the technical documentation at the level of the General Design was prepared in 2008.

Flood protection. It has been planned to preserve the existing flood protection system, and to reconstruct the embankments in the area of Trstenik, in order to provide protection from Q100. The construction of new embankments is not planned, because the protection of agricultural land from floods is not a priority.

Flood protection of the main and regional roads. The existing roads are mostly protected from the adverse effects of water course, in accordance with their importance. However, it has been noted that the designed route of Pojate - Preljina highway is in the zone of river impact, therefore the significant works on the regulation of river bed and the protection of the facilities from the harmful effects of water will have to be undertaken.

River route stabilization and fluvial erosion control. Biotechnical measures are recommended for the protection of erosion-prone river banks of the ZM on the sections where erosion does not endanger roads, embankments or other significant facilities in the coastal area. On the section of the ZM from r.km 96.5 to r.km 138.5 (the mouth of Čemernica River), it is necessary to regulate the river bed, which now meanders freely through the river valley and thus endangers the highway. The modification of the ZM route, including making more cut-offs and forming a new river bed, is proposed. This eliminates the several consecutive sharp river bands and several sites of erosion-prone river banks. A typical cross-section profile of the new ZM river bed with dimensions that are harmonized with the morphometric characteristics of the wider sector: width at the bottom 60 m, width at the top of the river banks 80 m, slopes 1: 2 and average depth 4 m (Figure 2) is proposed. As part of this regulation, an embankment on the right bank could be constructed.

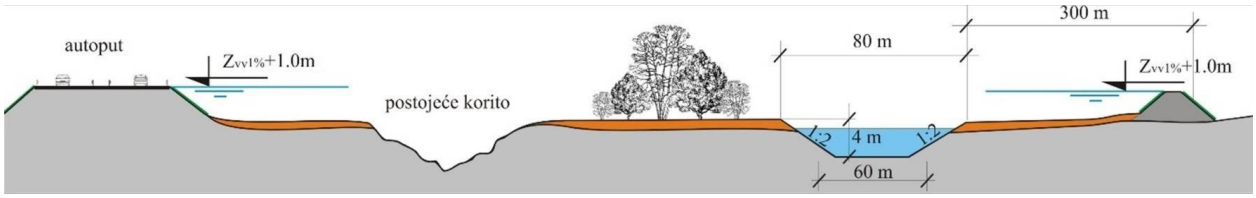


Figure 2. Characteristic cross-section elements of the regulation

3.2 General Design and Pre-feasibility Study of the E-761 highway Pojate-Kraljevo-Preljina, km 000+000.00 – km 109+612.72 (GDH2008)

GDH2008 was prepared by the Highway Institute from Belgrade, and the Investor was PE "Roads of Serbia".

Within the GDH2008, the three variant solutions of the highway route from Pojate to Preljina were analyzed. All analyzed routes pass through the ZM valley, with changes on the certain sections. When defining the variant solutions, the negative impact of large waters on the route and further construction and exploitation of the highway was not considered. The Pre-feasibility Study was prepared for the adopted variant of the highway route and it did not include the calculation of the investments on the protection of harmful water effects.

3.3 Preliminary and Main Design of the E-761 highway, Pojate – Preljina (PHD2012)

Preliminary and Main Designs of the E-761 highway were prepared in 2012-2013 by the HI (section Adrani - Preljina) and CIP (section Pojate - Adrani), and the Investor was PE "Roads of Serbia". Designs were prepared in line with the previous LPC and were not submitted to revision or technical control.

Environmental Impact Assessment Studies have not been prepared within the drafting of the PHD2012. The competent Ministry determined the scope and the content of the EIA Study only for the section from Pojate to Kruševac.

Depending on the sector and section of the highway, the several opinions of the SV and RHMS were issued in the process of issuing of the water conditions. Highway finished level was determined based on the Q100 level from the GD2007.

The highway route from the GDH2008 is significantly changed in the PHD2012 (for example, the variant from the GDH2008 has 3 bridge crossings over the ZM, and the variant from the PHD2012 has 6 bridges). The route changes have increased the impact of the highway on the ZM flow as well the impact of the river on that infrastructure facility. Also, the price of the highway was increased.

3.4 Spatial Plan for the Special Purpose Area of the E-761 highway infrastructure corridor (SPSPA2013)

Spatial layout of the highway route was done based on the technical designs at the level of the revised Pre-feasibility Study with the General Design, at a time when the Preliminary Design was in the drafting phase.

SPSPA2013 is related to the infrastructure corridor of 600 m width, stating the following:

- The protection embankments are partially built on the observed stretch of the Zapadna Morava, along its course, in order to control flood waters and protection of the settlements coast and economic activities from flood waters (the embankments are constructed partially in the zone of larger settlements and zone of low coastal terrain where the impact of floods is the largest). Considering that the route of the planned highway is, therefore, almost on the entire length in the floodplain zone of the Zapadna Morava, the highway top level must be risen above that flood water level.
- The highway route is intersecting at several places with the river bed of the Zapadna Morava River and at one place with the river bed of the Južna Morava River, and in some zones the highway route is significantly approaching to the river bed of the Zapadna Morava.

In SPSPA2013, it has been emphasized that all activities on the harmonization of traffic systems with water management infrastructure will be performed with the approval and control of the competent authorities for water management.

3.5 Hydrotechnical Study of E-761 highway corridor, section Pojate-Preljina (HTS2016)

In line with SPSPA2013, a specific study was conducted in order to harmonize the highway design with the water regime, existing water facilities and water management plans.

The HTS2016 was prepared by JCWI, according to the contract with RS, and with SoW agreed upon by SV, Ministry competent for water management and RS.

It was request in the SoW that in the HTS2016 the hydraulic model for ZM (developed in GD2007) should be used and to define the basic parameters of flow regime in the altered hydrological conditions (after the floods in May 2014).

The new **hydrological analysis** included the observation data from the period 1955-2015. The significantly higher calculated values of the maximum annual discharges of the ZM in the construction zone of E-761 highway have been defined (Table 4).

Table 4. Q_{max} (m^3/s) of characteristic return periods

River / Hydrological station	Return period			
	1000	100	50	20
Zapadna Morava/ Kraljevo/Miločaj	2555	1409	1156	870
Zapadna Morava/ Jasika	4122	2224	1823	1381

In order to determine the changes in the river bed in the period 2007-2016 and revise the hydraulic model of the ZM, the control profiles of the river bed (at the same locations as in 2007) and additional profiles (at the locations of the designed bridges on highway E-761) were surveyed. A total of 25 profiles were surveyed. The surveyed control profiles did not show the significant changes of the river bottom geometry, because the significant erosion or backfilling was not observed (bottom level changes are in the range from -1.5 m to +1.75 m).

Available ortho-photo and satellite images (www.earth.google.com) of the area were used to identify route changes from 2007 to 2016.

In the HTS2016, special attention was given to the definition of **potentially critical sections**, on which the unfavorable fluvial erosion processes can endanger the highway. They are divided into 3 categories according to the distance of the highway from the river and the status of the river bank (Table 5):

Category I: River bank is naturally stable or stabilized (there is a protective object) and the distance from the bank to the highway body is less than 50 m or the river bank is unstable and the distance from the bank to the highway body is less than 100 m,

Category II: River bank is stable and the distance from the bank to the highway body is 50-100 m,

Category III: All locations with a distance from the bank to the highway greater than 100 m.

Table 5. Potentially critical locations along the highway route

Highway sector	Total	I	II	III
Pojate - Kruševac	3	3		
Kruševac (Koševi) - Adrani	8	3	2	3
Adrani - Mrčajevci	7	6	1	

Mrčajevci - Preljina	4	2	2	

In order to determine the impact of facility on the water regime of the ZM, a 1D hydraulic calculation of the Q100 level for quasi steady-state conditions was performed in HEC RAS software, for the existing state of the river valley and for the state with the constructed highway E761.

The hydromorphological model of the **current status** of the Zapadna Morava was taken from the GD2007, with the replacement and addition of the cross-section profiles with new surveys and the minor route changes due to the occurrence of meander cut-off. The topography of river inundation zones was defined in more detail, because the data of detailed geodetic surveys along the highway route and connecting roads were also used.

The hydromorphological model of **designed status** of the Zapadna Morava was made by including all designed facilities in the model of existing state (highway body along the route with 8 bridges, access roads, loops and river bed regulation of the ZM defined in the highway designs). The existing embankments were also included, but with the assumption that their reconstruction was carried out, so that in the conditions of Q100 there would be no overflow.

The calculation results of the existing and designed states are flood zones, water levels and velocities in the main river bed in conditions of Q100 (which is relevant for the calculation of highway elements).

It was stated that:

- The designed route of E-761 highway passes, almost on its entire length, through the valleys of the Velika, Južna and Zapadna Morava and the Čemernica River. It is mostly located in the real flood zones, and the lesser extent in flood-protected areas (i.e. in potentially flood zones);
- The flood zones of the ZM in the existing and designed state of the watercourse are very similar. Namely, due to the large number of structures in the body of highway, the highway does not represent the boundary for large waters, so the flooding can be expected on both sides of the highway;
- Highway top level, that is generally in the immediate vicinity of the ZM, must be high to provide the protection from relevant Q100 (with a minimum freeboard of 1 m above the relevant water level). Highway top level in the Preliminary Designs of the highway is based on the calculation of Q100 level from the GD2007. These data are not valid for the highway project, but the impact of the highway position and supporting infrastructure (excludes the part of the discharge profile for large waters and creates the additional backwaters) and the changed hydrological conditions after floods from 2014 must be taken into account;
- There are several locations where the solutions of intersection of river and highway, i.e. the connecting roads are unfavourable (bridge angle, width of the bridge opening, position of access roads) and they need to be changed;
- The highway route is approaching to the main river bed at several localities, of which many are critical due to the high instability of the ZM river bed;
- The quantities of materials required for the construction of highway body cannot be provided by dredging from the river bed of the ZM. According to the PHD2012, about 20,000,000 m^3 of material is necessary for the construction of the highway and accompanying infrastructure along the entire length of the route (especially at sections 4, 5, 6 and 7 from Kruševac to Adrana).

3.6 New SPSPA and the harmonized Preliminary Designs of the E-761 highway and hydrotechnical regulation of the Zapadna Morava River, 2017-2020

In 2017, the procedure of amending the SPSPA2013 was initiated, due to:

- The objective reasons obtained by the detailed field investigations for the purpose of further elaboration of technical documentation;
- The harmonization of the SPSPA2013 with the HTS2016;
- The review of the road facilities locations and accompanying contents of highway and harmonization with the new legislation (the new LPC was adopted in 2014).

Issues identified in the HTS2016 from 2017 to 2020 have been elaborated and the new technical solutions were prepared at the level of preliminary designs, through the process of harmonization of highway designers and designers of hydrotechnical facilities regulation of the Zapadna Morava:

- New Preliminary Highway Designs (PHDs) were prepared by the CIP, for sectors 1 and 2, and by the HI, for sector 3, according to the contract with RS. In the new PHDs, technical solutions are defined in several phases, and the highway route has undergone the significant changes of position, position and shape of the loops, the location of the parking and rest areas, as well as the location of bases for road maintenance.
- Preliminary Design of hydro-technical regulation of the Zapadna Morava River along the E-761 highway route (PD HTR) was done by the JCWI, under a separate contract with the RS. In **PD HTR**, works and measures on the regulation of watercourse and the coastal protection in several phases were foreseen, in accordance with the highway design. SoW for the drafting of the PD HTR resulted from the HTS2016 conclusions and discussions at the meetings of the Commission of the Government of the Republic of Serbia about the highway E-761 construction. The general goal was to choose the optimal solution for the watercourse and coastal regulation, which will minimize the negative impacts of highway construction on the water regime and, at the same time, provide quantities of materials for the construction of the highway.

  For the purpose of hydraulic calculations in the PD HTR, the hydraulic model from the HTS2016 was upgraded by entering the new disposition of highway facilities, which was then changed and adapted to the solution changes described below.

The most significant coordination of project activities was related to highway sector E-761 from Kruševac to Adran (Sector 2). According to the PHD2012, in this sector, the highway was guided in a high embankment through the floodplain zone of the Zapadna Morava, with several critical localities where the negative interaction of the river and the highway was identified.

The process of coordination and review of solutions was carried out in 2 phases:

1. CIP has made the new PHD along the same route, but with change of the highway top level and the local intersections in accordance with the recommendations of the hydraulic design engineers. At the same time, in the hydrotechnical design the **construction of flood relief channels** for receiving of the part of large waters of the ZM was analysed, with inflow, outflow and stabilization facilities, in order to reduce the impact of highway, lower the Q100 level and provide material for backfilling of the highway body.

   The channel routes were designed immediately by the highway route, so that the material from the channel excavation could be used for the highway construction (Figure 3). Six flood relief channels

have been designed from Čitluk near Kruševac to the mouth with the Ibar River, with a total length of about 26 km. The channels have a trapezoidal cross-section, about 100 m wide at bottom level and with an average depth of about 4 m. The channels will be connected only when the Q100 appears, which is regulated by the inflow and outflow structures at the end of the channels.

For the purpose of the design of flood relief channel system, LIDAR survey of the river valley was performed and the existing 1D hydraulic model was updated.

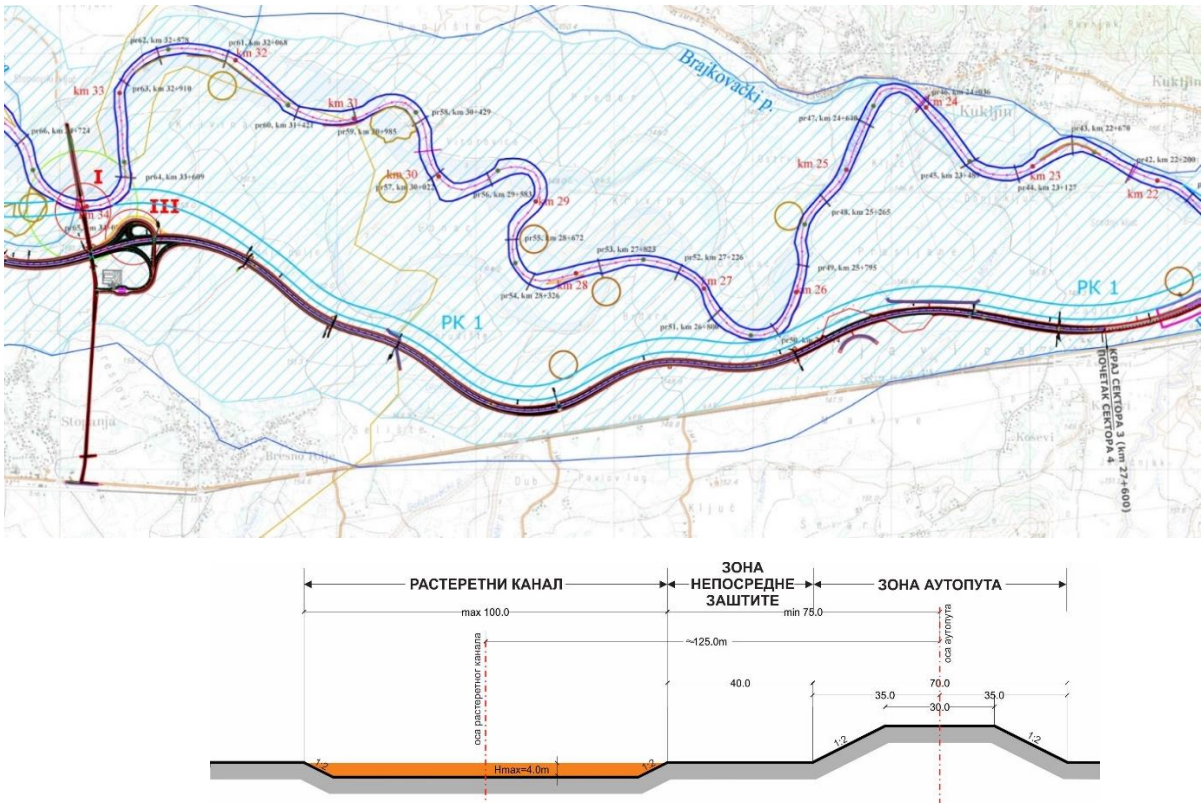


Figure 3. The route and cross-section of flood relief channels

This option with flood relief channels was rejected because it was stated that it did not solve the following problems: (a) The excavation of flood relief channels would provide about 3.5 million m^3, while the construction of highway body in the same sector would require about 10 million m^3 of material; (b) flood relief channels lower the level of Q100 by approx. 0.5 m, but the highway top level cannot be significantly lowered due to other restrictions that exist along the route (intersection with other infrastructure facilities…).

The meeting was held on 25th of May 2018 in the premises of the Government of Serbia in order to determine the status of preparation of the technical documentation. After the presentation of the highway and hydrotechnical designers, the Commission concluded that the highway solution from Kruševac to Adrani with the route in the Zapadna Morava valley is not sustainable from the aspect of risk of harmful water effects and the need for a large amount of material for filling of the highway body. The Commission requested that a new variant of the highway route should be developed, outside the floodplain, regardless of the high cost of the new exploration works and the new design.

2. The parallel work of CIP-JCWI design teams took place from September 2018 to January 2020. The JCWI analysed the several variant solutions of new highway route in order to determine the impact of highway route position on the ZM high water levels, the highway height and the new hydrotechnical solutions. In the iterative process, the several solutions of the highway route, highway structures and hydrotechnical structures were rejected.

For the final adopted technical solution of the highway route and its structures, the PHD was prepared. Each PHD contains a separate book related to the design of the hydrotechnical structures of the Zapadna Morava (PD HTR).

A comparison of the initial and final highway route at Sector 2 is presented in Figure 4.

The PD HTR on the river reaches corresponding to Sector 1: Pojate - Koševi (Kruševac) (km 0 - km 27.6) and Sector 3: Adrani - Preljina (km 79 - km 97) received a positive evaluation from the National Review Committee. The expert control of the PD HTR for Sector 2: Koševi (Kruševac) - Adrani (km 27.6 - km 81.476) is still in progress.

The new SPSPA is adopted in January 2020 (Off. Gazette of the RS, No. 10/2020 on 6th February 2020).

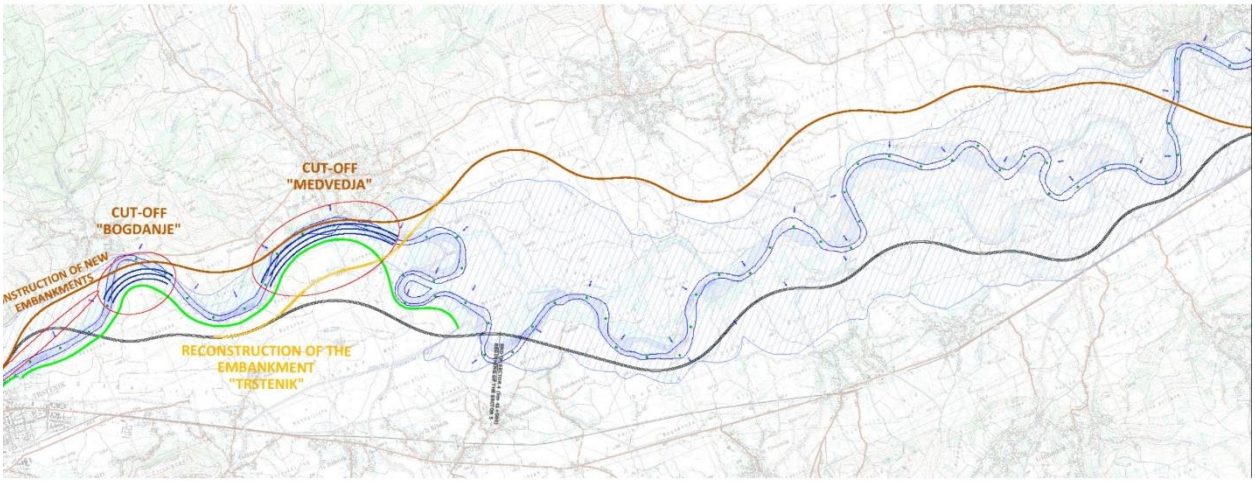


Figure 4. *Highway route (1 – initial variant, 2 – adopted variant)*

3.7 The Construction permit designs for hydrotechnical works and structures (DCP HTR2020)

The preparation of DCP HTR2020 is in progress. According to the time schedule, the design for Sector 1 will be completed during May 2020, and upon the performed technical review, which is mandatory under the Law on Planning and Construction, the Investor will receive a construction permit. The design for Sector 3 will be finalized by the end of May 2020, and the construction permit is expected at the end of June 2020. The drafting of the Sector 2 design will follow the acceptance of the Preliminary Design, for the same sector, by the National Review Commission.

As part of the preparation of DCP HTR2020, the detailed field survey was carried out or is in progress:

- Geodetic survey of the main river bed and structures, only along the route of the river structures. The distance between cross-section profiles of the ZM minor river bed (at the embankments) is 25 m, or at 100 m if a part of the river channel will be abandoned after a meander cut-off making. A detailed representation of the coastal terrains is obtained by the new LIDAR survey.
- Exploratory geological drilling and excavations along the route of the river structures, with geological mapping and laboratory testing of the soil samples.

The hydrological and hydraulical data are taken from the PD HTR.

4 CURRENT STATUS OF THE ZAPADNA MORAVA RIVER CHANNEL

Data on the current status of the Zapadna Morava originate from the documentation presented in the previous chapter, as well as the JCWI archival documentation.

The Zapadna Morava is a typical alluvial watercourse whose bed is formed in its own sediment, i.e. in alluvial deposits formed in the long-term process of geomorphological genesis of watercourses. The material structure in river bed and coast is very similar to the structure of the river sediment.

The alluvial river bed of the Zapadna Morava is very unstable and deformable, with the occurrence of bed wandering, meandering and pronounced fluvial erosion (Figure 5). According to the stability of the ZM route, the following reaches can be differed:

- **Reaches with stable route**, i.e. with the minimal variations of the river route: from the confluence with Južna Morava to the village of Bela Voda (r.km 0 - r.km 27), from the village of Počekovina to the mouth of the Vrnjačka river (r.km 37 - r.km) 62) and from the mouth of the Gruža to Kraljevo (r.km 82.3 - r.km 92.2);
- **Reaches with minor changes of the route:** from the mouth of the Vrnjačka river to the mouth of Gruža (r.km 62 - r.km 82,3), from Kraljevo to Miločaj (r.km 92,2 - r. km 107,2) and from the mouth of Ostrovka to the mouth of Kamenica (r. km 127.8 - r.km 153.2);
- **Reaches with very unstable route**: from the village of Bela Voda to the village of Počekovina (r.km 27 - r.km 37) and from Miločaj to the mouth of the Bresnica (r.km 107,2 - r.km 119).

Figure 5. Examples of localities with pronounced fluvial coastal erosion (left km 42, right km 100)

Some river regulation works (mostly stone embankments) were carried out mainly from 1965 to 1969. The existing river structures do not have their original function any more. (Figure 6).

Figure 6. The existing embankments (left km 75, right km 120)

The river bed and river banks are a significant natural resource of sand and gravel for the area of the western Serbia. The history of material exploitation is very long. Many areas in the floodplain zone have been significantly altered by dredging (in many cases ecologically devastated in comparison to the primary state) and the most of these areas are not used for agricultural production, although there are new usage forms such as fishing, etc. (Figure 7).

Figure 7. The gravel borrow pits (left km 33-34, right km 44)

The general erosion trend of river bed bottom of the Zapadna Morava was observed. In the period 1961-2007, thalweg was lowered from 0.3 to 3.8 m, while the average values were from 1 to 2 m. The most significant erosion of the river bed is from r.km 18 to r.km and from r.km 102 to r.km 112. It is assumed that erosion is the consequence of reduced sediment input from the basin due to the construction of dams and anti-erosion works in the Zapadna Morava basin, as well as the material exploitation from the river bed.

The Zapadna Morava does not have a continuous flood protection system (there are longer stretches of watercourses without dikes or with dikes only along one river bank), so that the city zones are protected, and the agricultural areas are left to floods. Most of the existing embankments would be overflowed with Q100 because they were designed with a lower protection degree. Total area of the floodplain zone with Q100 is about 122 km^2, while the estimated areas by reaches of the Zapadna Morava are given in Table 6. The floodplain zones include rural settlements (as a whole or in the parts), traffic infrastructure and arable agricultural land, as well as the localities where gravel and sand are exploited.

Tabl 6. The Zapadna Morava floodplain areas, discharge= Q100

River bank	Area	Floodplain area (ha)
Right	Confluence with the J.Morava – the mouth of Rasina	514
	The mouth of Pepeljuše-the villagy of Odžaci	2030
	Trstenik – the mouth of Ibar	1994
	The mouth of Ibar – Čačak	2708
Left	Connection with the J.Moravom – the villagy of Kukljin	594
	The village of Kukljin – Trstenik	1546
	Trstenik – the mouth of Ibar	1048
	The mouth of Ibar – the mouth of Čemernica	1825
	Total	**12259**

Factors that influence the protection status against the harmful water effects are differ by reaches of the ZM valley, considering: the geomorphological and morphological characteristics of watercourses and river valley, the artificial changes of the river route and stability of the existing route, the construction of protection embankments along watercourse, the fluvial erosion, the traffic infrastructure in the river bank and the degree of potential threat from floods and fluvial erosion, the settlements in the river bank and their potential threat from floods, the agricultural areas in the river bank and the degree of potential threat from floods and fluvial

erosion, the exploitation of materials from the river bed. The above specified factors are shown schematically in Figure 8.

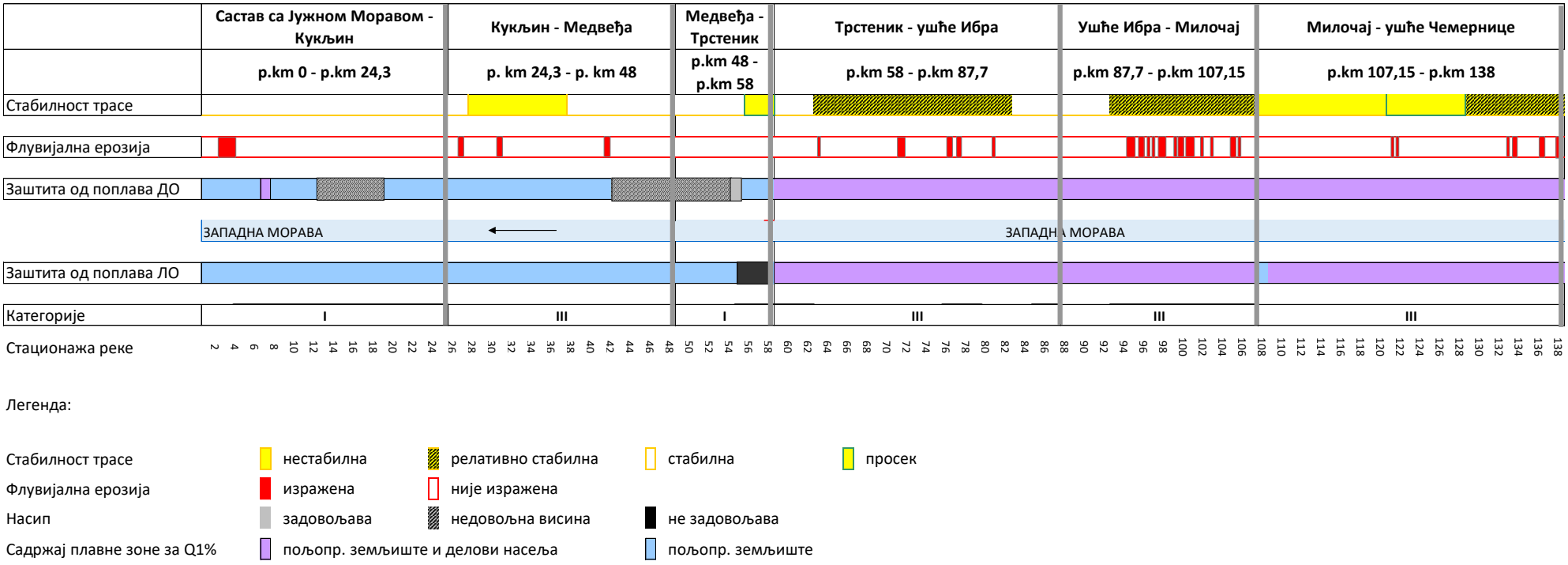


Figure 8. *The protection status against the harmful water effects in the Velika Morava floodplain*

5 THE TECHNICAL SOLUTION OF THE ZAPADNA MORAVA REGULATION ALONG THE E-761 HIGHWAY ROUTE

Based on the technical documentation (PD HTR and DCP HTR2020) it is planned to construct the following 18 structures of the hydrotechnical regulation of the Zapadna Morava:

Sector 1 Pojate - Kruševac (km 0+229,75 - km 27+600):

- **STRUCTURE 1:** The cut-off of the river curve from r.km 4.7 to r.km 7.1 near the village of Maskare (km 11 - km 11.6 of the highway). The meander cut off is projected along the right inundation of the ZM in order to move the main river channel from the highway route, and thus reduce the negative impacts of the river.
- **STRUCTURE 2:** Protection of the left bank of the ZM (embankment) in the length of ~ 600 m, from r.km 8.63 to r.km 9.25 (km 14.1 - km 15 of the highway). Embankment protects the river bank of the ZM near the highway from fluvial erosion.
- **STRUCTURE 3:** Reconstruction of the existing right-bank dike of the Zapadna Morava and the left-bank dike of Rasina near Kruševac (cassette "Čitluk") due to the protection of highway, which passes through the flood prone area (km 18.65 - km 24.6 along the highway route). Total length of dike is about 8 km.
- **STRUCTURE 4:** Protection of the right bank of the ZM (embankment) in the length of ~ 800 m from r.km 20.7 to r.km 21.26, i.e. km 25.7 - km 26.5 of the highway.

Sector 2 Kruševac (Koševi) - Adrani (km 27+600 - km 81+476,66):

- **STRUCTURE 5:** Reconstruction of the existing dike on right bank of the ZM and the left-bank dike of the Crnišavska river near Trstenik (cassette "Trstenik", (r.km 42.75 to r.km 55.32). Total length of dike is 10.2 km.
- **STRUCTURE 6:** Reconstruction of the existing dike on left bank of the ZM near Trstenik (cassette "Zvezdan", r.km 55.32 - r.km 58.1) and construction of the dike along left bank of the Mala river to the high terrain. Total length of dike is about 2760 m.
- **STRUCTURE 7**: Construction of a new dike on left bank of the Zapadna Morava from the mouth of the Ljubostinjska river (r.km 55.1) to the iron bridge in Trstenik (r.km 55.32), in length of about 235 m.
- **STRUCTURE 8:** Construction of a new dike with the regulated river channel of the Ljubostinjska river from the highway to high terrain in Trstenik, in length of about 230 m.
- **STRUCTURE 9:** Protection of the unstable left bank of the ZM from the existing concrete bridge (r.km 54.77) to the iron bridge (r.km 55.32) which is near the highway.
- **STRUCTURE 10:** Protection of the unstable right bank of the ZM from r.km 62.45 to r.km 62.97 which is near the highway.
- **STRUCTURE 11:** Protection of the unstable right bank of the ZM from r.km 66.5 to r.km 67.15 due to the highway proximity.
- **STRUCTURE 12:** Protection of the stable right bank of the ZM from r.km 87+880 to r.km 88+380 due to the highway proximity.
- **STRUCTURE 13:** The cutting off the river curve of the Zapadna Morava (from r.km 88+900 to r.km 90+970) at the location of intersection of the highway route with the existing meander of Zapadna Morava.

- **STRUCTURE 14:** The cutting off the river curve (from r.km 91.41 to r.km 95.19) at the location of intersection of the highway route with the existing meander of ZM.
- **STRUCTURE 15:** The cutting off the river curve (from r.km 96.55 to r.km 98.53) at the location of intersection of the highway route with the existing meander of ZM.
- **STRUCTURE 16:** The cutting off the river curve (from r.km 98.96 to r.km 101) at the location of intersection of the highway route with the existing meander of ZM.

Sector 3, Adrani - Mrčajevci (km 79+000 - km 97+000):

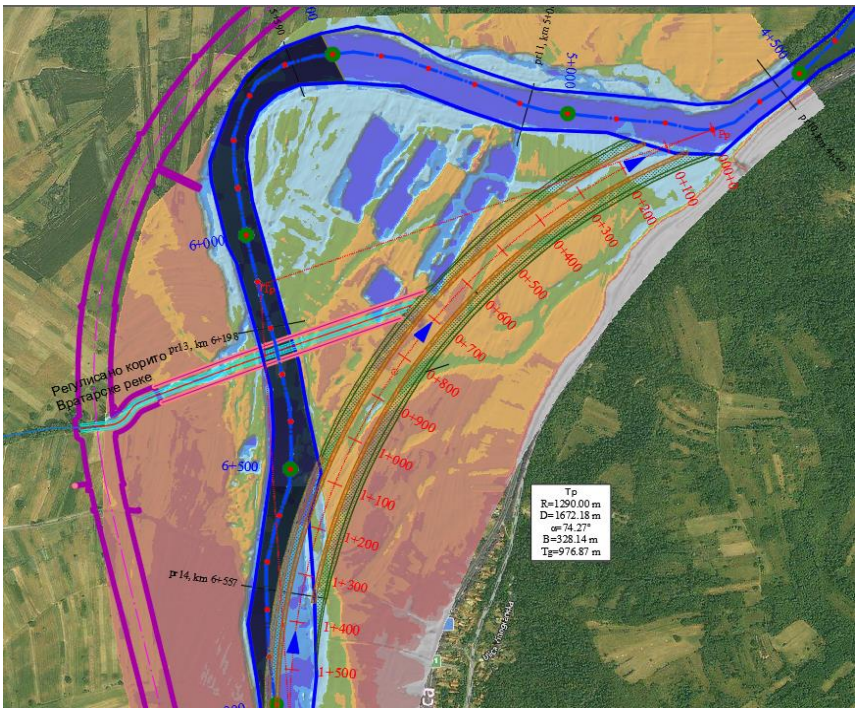
- **STRUCTURE 17:** The cutting off the river curves of the ZM on the reach Adrani - Mrčajevci (km 79 - km 97 of the highway, i.e. from r.km 100.8 to r.km 127.2).

Sector 3, Mrčajevci – Preljina (97+000 - km 109+663,80):

- **STRUCTURE 18:** The cutting off the river curves of the ZM on the reach Mrčajevci - Preljina (km 97 - km 109.664, i.e. from r.km 127.2 to r.km 138.4).

The **DCP HTR2020**, which is currently prepared for Sector 1, elaborates structures 1 to 4:

- The cut-off with double trapezoidal riverbed (structure 1 - Figure 9). Width of the cut-off at the bottom B = 50 m; Slope of minor and major river bed of the cut-off is 1: 3; Depth of minor river bed of the cut-off h = 2 m; Left and right inundations of the cut-off, width of b = 10 m, are humusized and grassed; Depth of major river bed of the cut-off is variable depending on the terrain configuration; Slopes of the minor river bed and the concave bank of the major river bed are coated with crushed stone; Biotechnical protection is conducted on the convex bank of the cut-off; At inundations, consolidation belts of the crushed stone at distance of 50 m are made, while at the river bed bottom the thresholds are without useful height. At the upstream end of the oxbow lake there is a barrier that separates the old and the new ZM river bed.



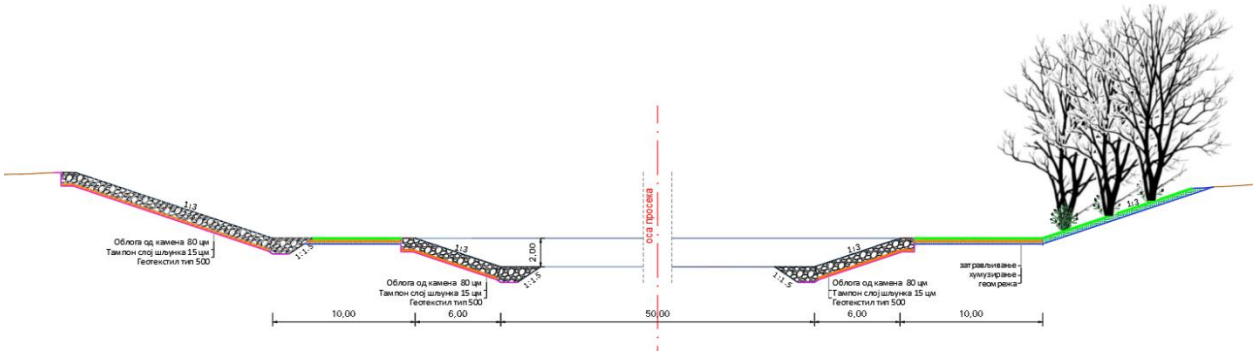


Figure 9. *The route and typical cross-section of the Structure 1, Sector 1*

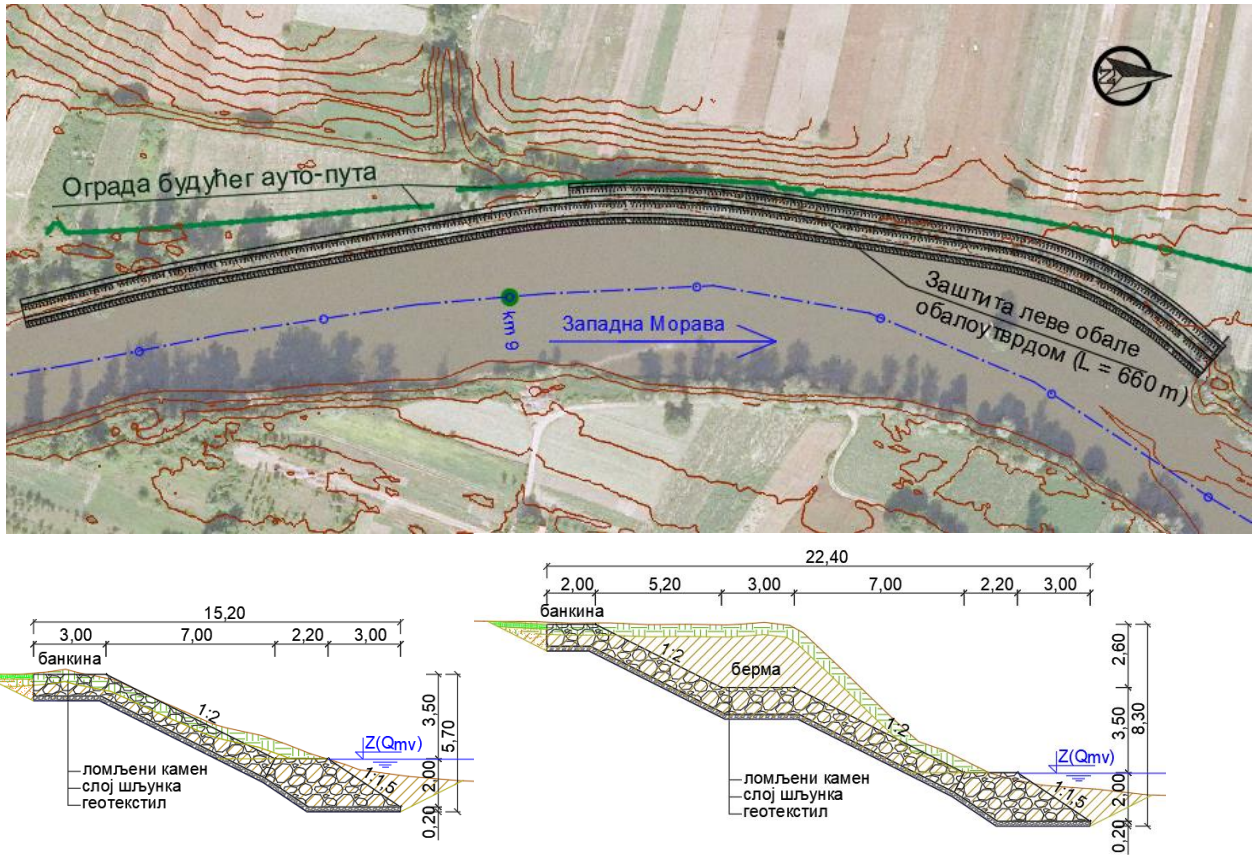


Figure 10. *The route and typical cross-section of the Structure 2, Sector 1*

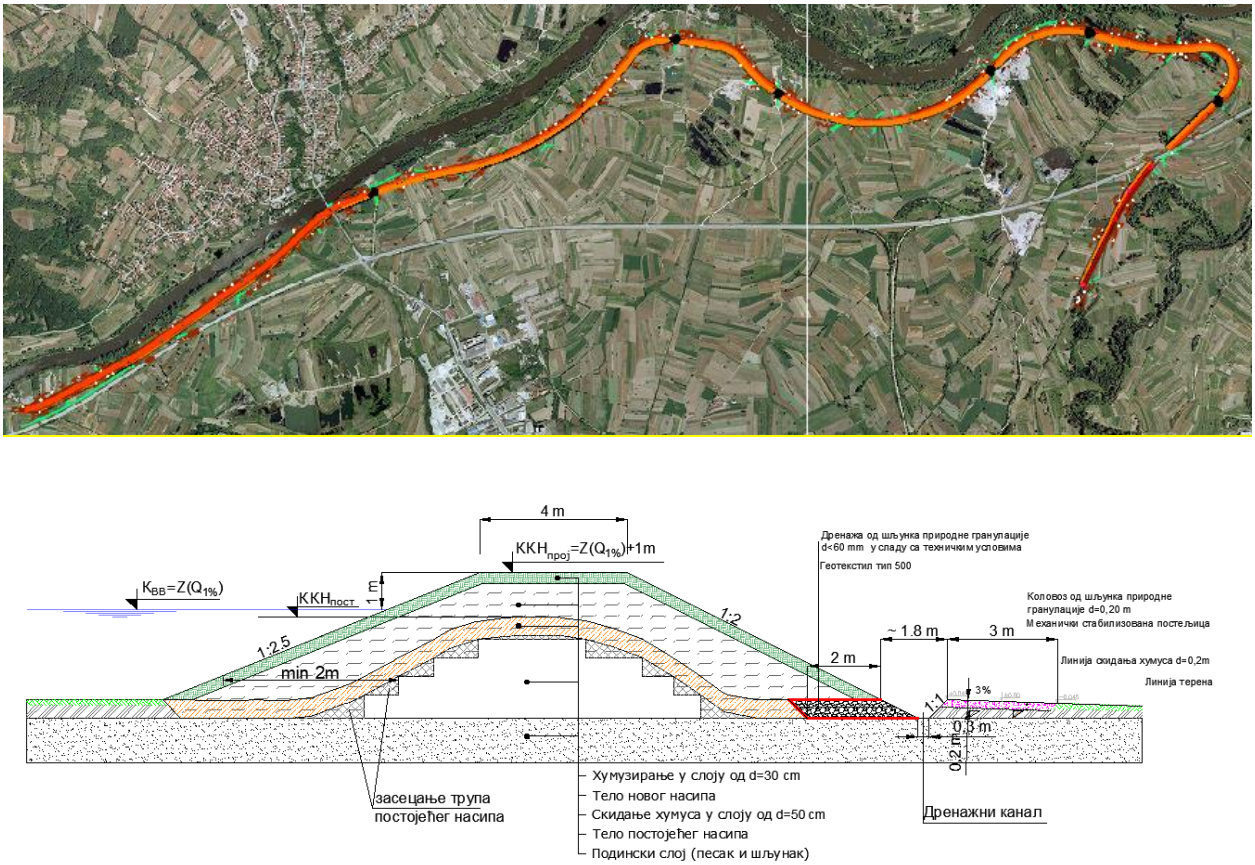
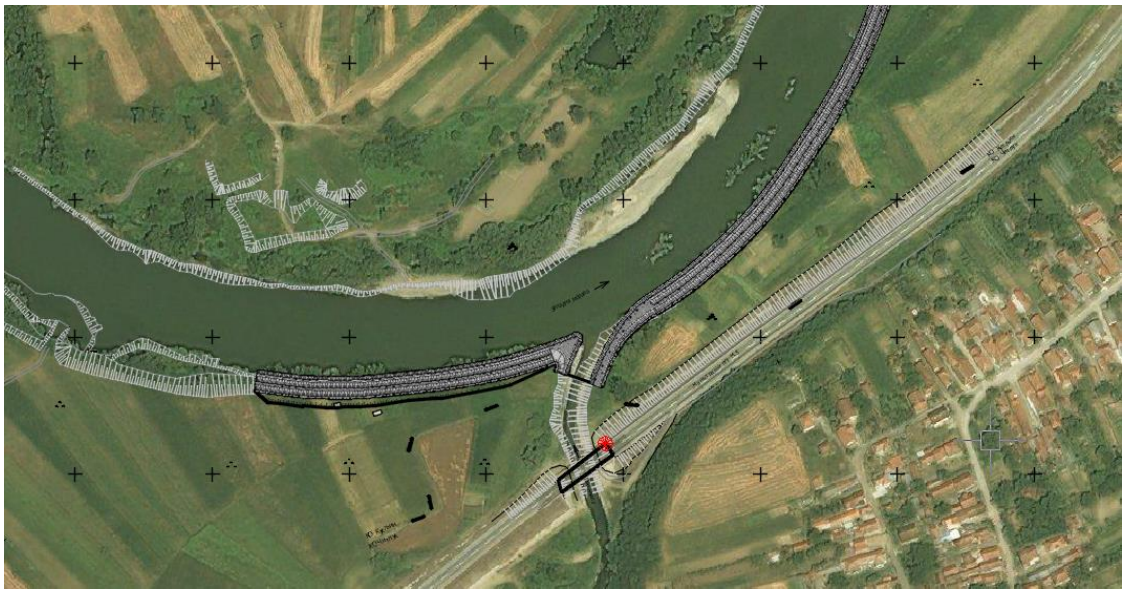
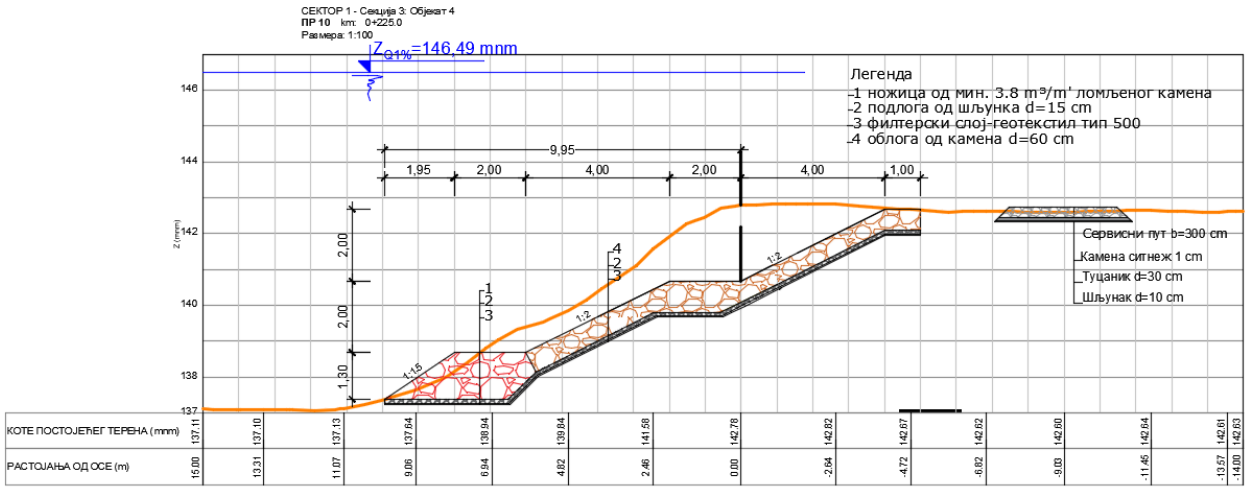


Figure 11. *The route and typical cross-section of the Structure 3, Sector 1*





Figur 12. *The route and typical cross-section of the Structure 4, Sector 1*

The project preparation for structures 17 and 18 on Sector 3 is in progress. These strucutures consist of a series of the mutual connected cut-offs, with barriers at the upstream ends of the newly constructed oxbow lakes. The chute cut off have trapezoidal profile (Figure 13), with banks in slope of 1: 3 to 2 m in height which are secured with crushed stone. The slopes above depend on the height of the river bank terrain, they are arranged in slope of 1:4, grassed and afforested.

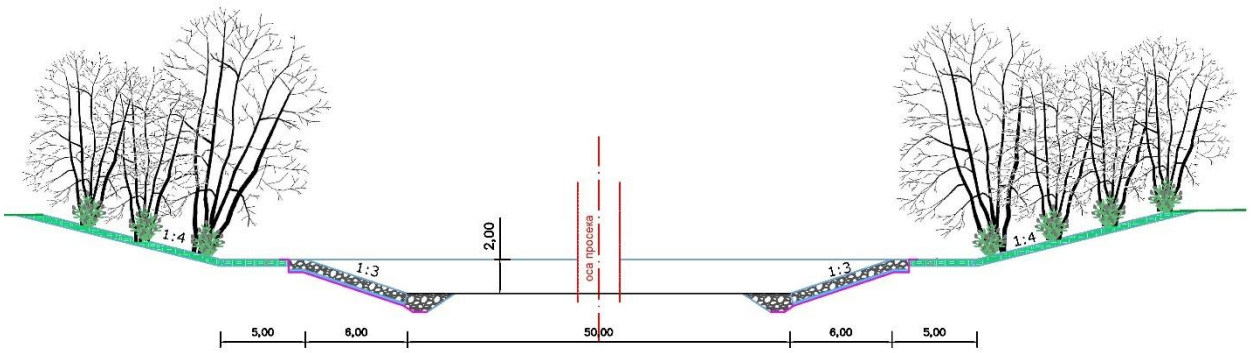


Figure 13. *River bed cross-section of the chute cut off, the Structure 17, Sector 3*

In order to redirect the river flow to the new river bed, at the upstream end of the abandoned meander, the barriers made of excavated material and stone cladding will be built (Figure 14). The barriers are made up to the banks level of the ZM, so that they overflow at high waters.

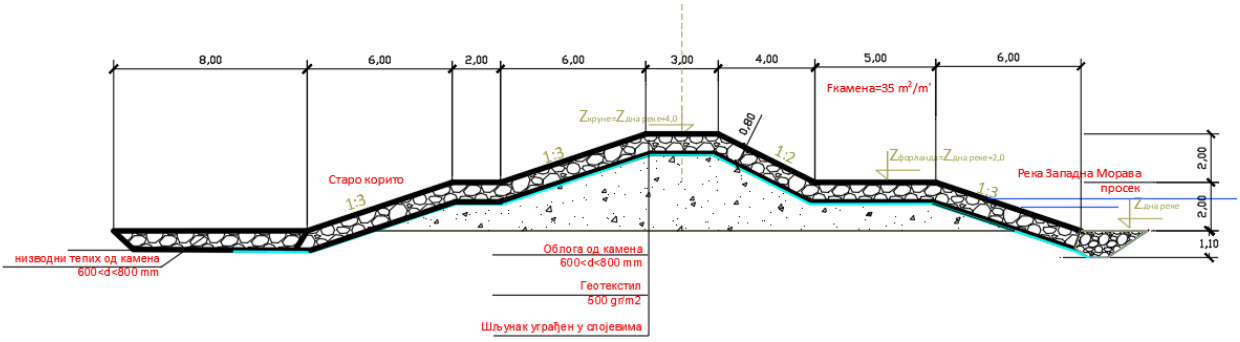


Figure 14. *The cross-section of barriers of the old river channel, the Structure 17, Sector 3*

Only natural materials (gravel from the excavation of river bed, crushed stone, humus) are used for the execution of HTR structures. Stone in cement mortar will be applied locally only in the bridge zones due to the increased flow velocities and the object protection from fluvial erosion.

6 THE COMMENT ON HTR ZM IMPACTS ON THE ENVIRONMENT

The construction of the E-761 highway and river structures, constructed in order to protect the highway from flooding, may have an effect on the chemical and ecological status of the Zapadna Morava water bodies and groundwaters. Impacts are also possible on the most downstream Južna Morava water bodies, as well as on the Zapadna Morava water bodies, downstream from the mouth of the Zapadna Morava into the Velika Morava.

6.1 The water bodies of the Zapadna Morava

The first Water Management Plan on the territory of the Republic of Serbia is in preparation, and it should be published in 2021. Preliminary delineation of the Zapadna Morava the water bodies in along the E-761 highway route is shown in Figure 15. Water bodies downstream of the Ibar river are marked with 1, and upstream are marked with 2. Analysis of pressures, risks and status of the water bodies is in the initial phase.

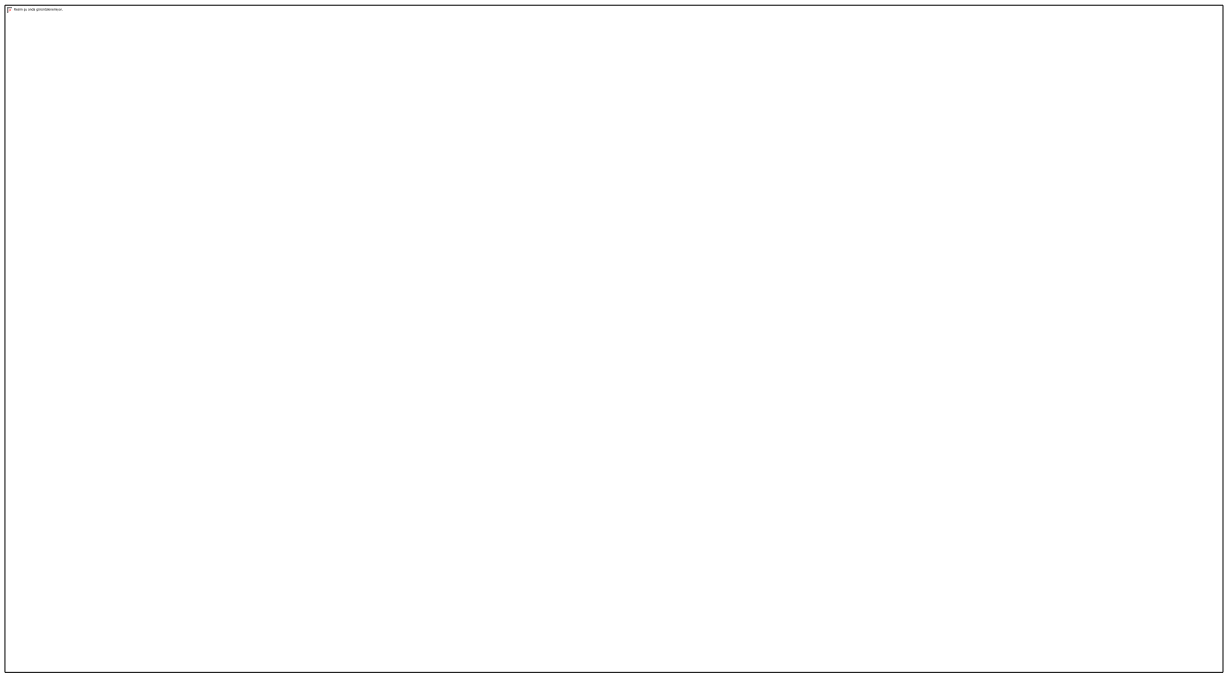


Figure 15. *The Zapadna Morava water bodies (preliminary delineation)*

Currently, the Zapadna Morava water bodies would be categorized as "natural watercourse", since there are no indications that any significant hydromorphological pressures on water bodies are present (existing structures include only local dikes and river structures). A possible change of the category of a water body, that corresponds to Sector 3, to the category "significantly changed" would presuppose the research of the current status of environment, the forecast changes and the justification analysis.

6.2 The hydromorphological changes due to the construction of HTR ZM structures

Hydromorphological changes, i.e. the changes of water and sediments regime, hydrological and hydraulic characteristics of watercourses, loss of floodplains, are special type of pressures on the water bodies.

Hydromorphological changes are the consequence of human activities, i.e. the construction of hydrotechnical structures, which provide the conditions for various types of water usage and/or protection from the harmful water effects.

According to the documents of the International Commission for the Protection of the Danube River (ICPDR), which include the ZM, the categories of hydromorphological changes are:

a) Hydrological changes (formation of reservoirs, water abstraction and change of water regime downstream of the hydropower plants - hydropeaking)

The reservoirs are formed by constructing artificial cross-section structures that cause the interruption of watercourses continuity. Due to the interruption of the river continuity, the change of discharge rates and regime of watercourses, as well as the changes in living conditions upstream and downstream of the barrier occur. Upstream of the barrier, due to the reduction of the discharge rate and the increase of the depth, rivers establish themselves as water bodies with lake characteristics, which changes the natural characteristics of watercourse. Therefore, instead of a need to achieve good ecological status, these water bodies are required to achieve good ecological potential.

Water abstraction for the water supply of settlements and industry, agriculture, hydropower and other usages, can lead to the significant reduction of the water quantity in a certain watercourse and endangerment of its status. In order to preserve the ecological status of a water body, water permits limit the abstracted water quantity guaranteeing the required river discharge downstream of the intake structure.

Changed discharge regime downstream of the hydroelectric dams is the most often the consequence of abrupt water discharges through turbines or overflows and is reflected in the artificial fluctuations of water levels. In order to preserve the ecological status of water bodies, water permits define the regime of water discharge, securing that the certain limits are not exceeded.

Within the hydrotechnical regulation of the Zapadna Morava, no interventions on the environment that could lead to the hydromorphological changes from this category are planned.

b) Interruption of longitudinal continuity and changes of the sediment regime (interruption of fish species migration and sediment transport)

The interruption of longitudinal continuity of the river flow occurs due to the construction of transverse or cross-section structures such as dams, sluices, river bottom sills and barriers for various purposes. The presence of these structures results in serious environmental problems, out of which, the most significant are the interrupted fish migrations routes and lack of free movement of other aquatic organisms. Therefore, it is necessary to build fish passes if migratory fish species are present in a watercourse.

Sediment regime changes also occur due to the construction of barriers in the river channel, which leads to changes of the natural characteristics of watercourse and endangerment of the ecological status of a water body. Numerous measures can be used to improve the status in regard by regulating the sediment regime, such as: changing the overflow structures work mode or their restructuring, introduction of sediments downstream from dams in order to compensate the loss incurred in reservoirs, etc.

Within the proposed hydrotechnical regulation of the Zapadna Morava, the construction of cross-section structures (river bottom sills) is planned in order to stabilize the river bed in the cut-offs, since due to the shortening of the route, the flow rates and traction forces will be increased and deepening of the river bed may occur. All river bottom sills are constructed at the new river bed level and they do not represent barrier for fish migration or sediment transport.

The barriers at the upstream end of the abandoned river channel do not allow fish migration, but as the compensation measure, the abandoned meanders are left open on the downstream side. Fish migration is possible through the new river channel of the Zapadna Morava.

It can be concluded that no interventions in the environment that could lead to the significant hydromorphological changes from this category are planned within the HTR ZM.

c) Morphological changes (changes in river morphology or cutting off the floodplain zones)

Changes in river morphology occur as the consequence of human activities on flood protection, improvement of the navigation conditions, watercourses regulation within the settlements, construction of infrastructure, etc. Due to morphological changes, the habitat conditions of aquatic flora and fauna deteriorate, which significantly effects the ecological status of a water body. The basic measures to improve the status are aimed at restoring the natural state of the rivers as much as possible.

Cutting off the floodplain zones mainly occurs as a result of activities to protect the nearby land from floods by the construction of lateral structures (dikes, etc.). Due to the reduction of floodplain zones, the numerous plant and animal species, that depend on the periodical flooding od these areas, are endangered. The basic mitigation measures consist of the reconnecting certain floodplain zones with watercourses, especially within the areas of the exceptional importance for flora and fauna.

There is no risk that the E-761 highway will be flooded since that the highway finished level is designed at level Q100 + 1 m and the highway body slopes towards the river are protected with lining. The foreseen hydrotechnical structures will not significantly change the ZM coastal flooding:

- Reconstruction of the several existing dikes along the existing routes reduces the risk of flooding locally and does not cause any hydromorphological changes. Several new short dikes along the ZM and its tributaries in the estuary zone will be constructed in order to protect the highway;
- The embankments do not have the flood protection function, they only secure the stability of the banks endangered by fluvial erosion. They are built along the existing coast line and from natural materials, so they will cause mainly the local hydromorphological changes in Sectors 1 and 2, while in Sector 3 the special survey activities should be done.
- The cut-offs are performed in order to move the zone of intense fluvial erosion away from the highway route. Since they have the limited discharge capacity, which depends on the topography of local terrain, the surrounding area would still be flooded every year. At discharge rate that exceeds the chute cutoff capacity, the flow takes place along the entire Zapadna Morava floodplain (through the cut-off, through the space between the oxbow lake and the cut-off, as well as through the oxbow).

The construction of chute cut-offs has little effect on the floodplain flooding regime, which remains similar to the natural state. However, due to the fact that the newly designed river channel has uniform characteristics along its route, it can be concluded that this intervention in the environment leads to the significant hydromorphological changes and the corresponding water body should be classified as "significantly changed", which would require the application of adequate protection and compensation measures.

6.3 The environmental improvement

The improvement of status of the environment in the observed area has not been the subject of detail analysis, as RAMBOLL stated in its report and remarks on the ESIA.

The construction of Pojate - Preljina highway and the related hydrotechnical regulation of the Zapadna Morava on certain reaches provide the opportunity to improve the status of the environment in the observed area. The aspects of possible improvement have not been the subject of the previous analyses.

For example, the oxbow lake construction and management (except the constructions of the barriers at their upstream end) or floodplain management was not the subject of the DCP HTR2020. As already pointed out, the floodplain in Sector 3 has been significantly altered by gravel exploitation in the previous period resulting in large number of abandoned borrow pits.

In this context, in order to define possible, realistic and justified conclusions (from the ecological, financial and social point of view) it is necessary to analyze and quantify the existing status of the environment in the zone of the E-761 highway impact (including ecosystem services, habitats, new views of space usage - abandoned borrow pits, newly created oxbow lakes, etc.) from the aspect of ecological functions, noting that according to the available data there are no endangered or protected aquatic species or natural resources in the observed area.

After detail definition of the existing status and the planned technical solutions, through the ESIA amendment and by documenting more thoroughly both the negative and positive impacts of the highway construction project, since they yet have not been taken into account, it will be possible to clearly define the ecological functions of newly created ecosystems (new oxbow lakes resulting from meander cut offs) and their new ecological values (creation of new habitats, now non-existent ecological functions and other ecological values). It is our opinion that in this way, in the final analysis of the impact of the highway, the negative impacts will be relatively reduced, and the positive impacts will be significantly increased.

Without the additional study and survey works, as minimum recommended is to use the soil material originated from the chute cut off to fill in the part of the cut off meander closest to the highway, as an additional protection measure of this structure from the fluvial erosion during the high water levels. It is recommended that the downstream end of the newly constructed oxbow lake remains open, to provides direct hydraulic connection with the Zapadna Morava main river channel. Water refreshment in the oxbow lakes will be provided, except during the flooding events, at small and medium waters of the Zapadna Morava in several ways by: filtering through and below the upstream barrier, filtration through deposits of alluvial materials between the chute cut-off and the oxbow lake, as well as from the tributaries of the Zapadna Morava that are flow into the oxbow lake.

The optimal way to improve the status of environment, depending on the needs of local government and other stakeholders (ponds, facilities for recreation, sports and recreation, etc.), and the desired environmental functions (fish hatcheries, bird habitats, biomass production, etc.) should be determined by targeted analysis within the **Study on the current environmental status and environmental improvement in the Pojate-Preljina highway impact zone**.

It is important to note that the Zapadna Morava flood plain, especially in Sector 3, is very neglected and in its current state has little social, economic and environmental value. However, if "green corridor" will be arranged between the highway route and the new ZM river bed (by giving the new functions to abandoned gravel borrow pits, afforestation of the inaccessible and disorderly agricultural land) with numerous open water surfaces, the conditions for significant tourism development would be created in this area.

7 THE GUIDELINES FOR FINALIZATION OF THE ESIA STUDY

In light of RAMBOLL's remarks and our general view that Ramboll's evaluations and recommendations on the ESIA documentation are justified and appropriate, we consider that:

1. Some of RAMBOLL's remarks may be dismissed in the light of the information presented in this document and contained in the said documentation. The available data can be partially further analyzed and systematized in a way that would enable their usage for the purposes of ESIA improvement.
2. The most significant part of RAMBOLL's related to the level and thoroughness of the river training analysis can be eliminated by drafting of the specialized study documentation, as a basis that is missing to complete the ESIA in accordance with the international standards. The missing basis, that should be prepared, primarily include:
    a. The hydrological-hydraulic analyzes of the river training using 2D models and application of the international good practice and the relevant international standards for this type of work.
    b. The specialized ecological survey works necessary for defining the current status of the watercourses and groundwaters in accordance with the good environmental practice and the international standards, as well as the requirements resulting from the relevant EU Directives, with special emphasis on improving the status of environment at the observed area in the context of the technical solutions of the Zapadna Morava.
3. The ESIA would be improved in two steps:
    a. The first step (for the purposes of loan approval) would be to act on Ramboll's remarks related to the highway route and subsequent for the part of works on river training, which would be performed on the basis of available documentation in which the ESIA did not have insight.
    b. The second step would be to draft an ESIA component for the part of project related to river training, that requires the additional necessary research, study and modeling activities.
4. It is estimated that the filed survey, study and modeling activities for securing the basis for river training, that are missing to complete the ESIA in accordance with the international standards, will require significant time (about a year). They can be realized in parallel with the preparatory works for the construction of highway, if there are no obstacles (primarily from the aspect of loan approval).
5. Having in mind the significant scope of additional study-research activities, it is necessary to provide their financing. As these activities are largely derived from the requirements of international financial institutions, and are done in order to meet the international standards and recommendations, financing could be provided through the expansion of the agreed credit line.
6. The Jaroslav Cerni Water Institute has the capacity to, together with its subcontractors, organize, lead and implement all necessary study and survey works according to the standards of international financial organizations, in order to provide the basis for completing ESIA in accordance with the international standards. In this regard, JCWI is ready to prepare ToR for the realization of the necessary studies in cooperation with RAMBOLL and 2U1K.
7. Having in mind the scope of hydrotechnical regulation of the Zapadna Morava and the fact that the construction of hydrotechnical structures will be carried out along the works on the highway construction, at large area and in complex conditions, the survey-design activities are foreseen during the entire construction phase. These activities are needed due to the optimization of hydrotechnical regulation of the Zapadna Morava, but also due to the harmonization with the works on the highway construction. The following survey-design activities are planned: geological survey works; monitoring during the execution

of works (morphological changes of the Zapadna Morava river bed, levels and discharges in the river, groundwater levels); design supervision and amendments of the construction Projects, etc.