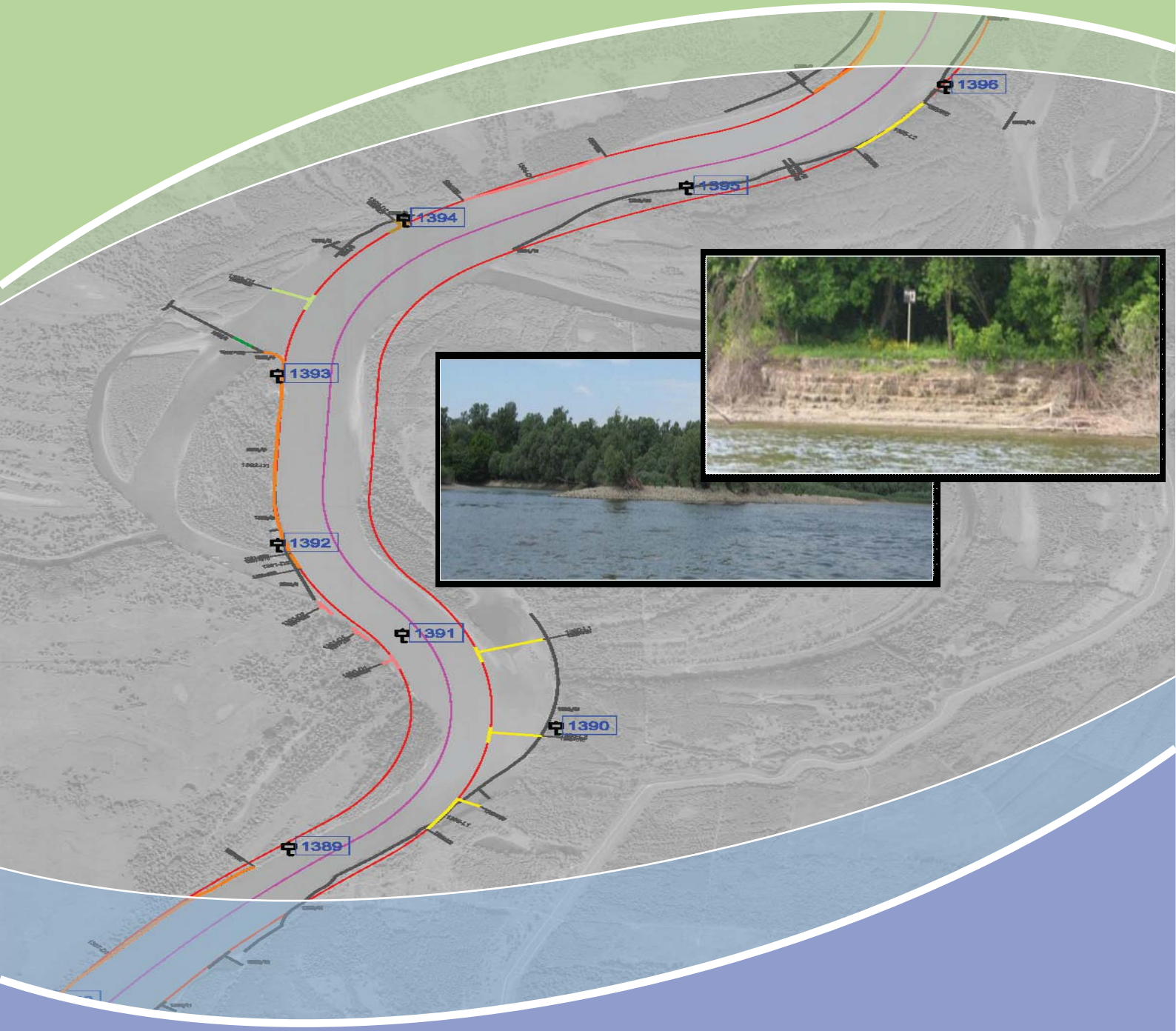
THE ENVIRONMENTAL IMPACT ASSESSMENT FOR WATERWAY ARRANGEMENT AND REGULATION WORKS ON THE DANUBE RIVER FROM 1380 TO 1433 R.KM

NOTICE TO REPUBLIC OF HUNGARY ON THE PROPOSED ACTIVITY IN ACCORDANCE WITH ESPOO CONVENTION



Client **Agency for inland waterways**

Project no. **I-1103/09**

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PROJECT TITLE:	**THE ENVIRONMENTAL IMPACT ASSESSMENT FOR WATERWAY MAINTENANCE AND REGULATION WORKS ON THE DANUBE RIVER FROM 1380 TO 1433 R.KM**
PROJECT NUMBER:	**I-1103/09**
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NOTICE TO REPUBLIC OF HUNGARY ON THE PROPOSED ACTIVITY IN ACCORDANCE WITH ESPOO CONVENTION

THE ENVIRONMENTAL IMPACT ASSESSMENT FOR WATERWAY MAINTENANCE AND REGULATION WORKS ON THE DANUBE RIVER

1. Introduction

The subject of this environmental impact assessment is the maintenance of inland waterway and regulation works on the stretch of the Danube River from 1380 to 1433 rkm. Arranging of the waterway and regulation works in further text implies the construction of navigational safety structures or simply regulation structures (objects). Therefore, regardless of the terminology, proposed interventions are in the function of fairway and waterway maintenance. It is important to note that there will be no extraction of the sediment from the Danube River within the framework of the planned interventions which are subject to this assessment.

The purpose of construction of navigational safety structures, or regulation structures is to establish the river regulation line - which defines the waterway on the Danube River, the stability of riverbanks, protection from coastal erosion and adequate transportation of ice and sediment. The waterway on the Danube River is declared as an international waterway class VIc (AGN, 1996).

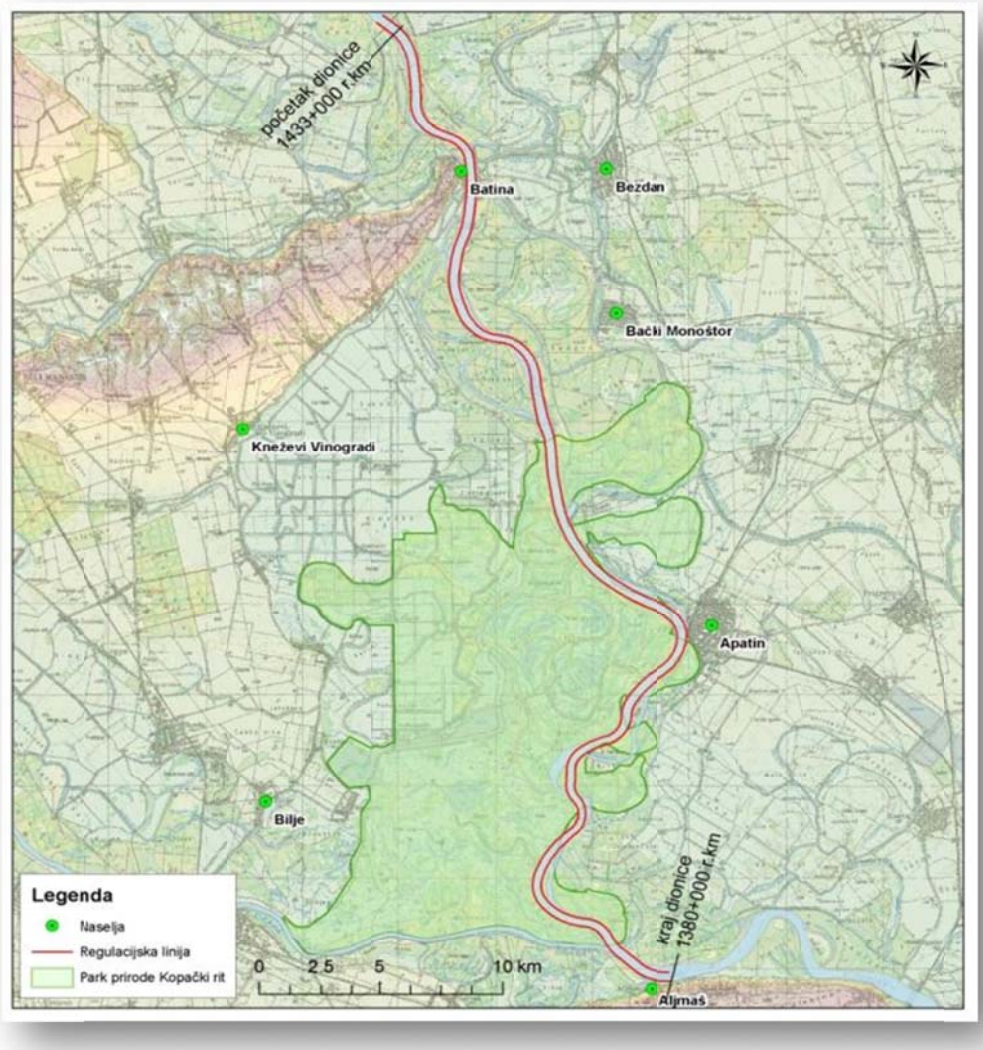

Image 1.1 Map of the Danube River stretch from 1380 to 1433 rkm

The subject section of river is located in the Osijek-Baranya County along the border with the Republic of Serbia. The beginning of the section (1433 +000 r.km) is located on the Croatian – Hungarian border, and the end of the section (1380 +000 r.km) is located approx. 2.5 km downstream from the confluence of the Drava River, near Aljmaš. Along the downstream part of the section, there is an area of Nature park Kopački rit, a valuable wetland area which is protected by numerous local and international conventions and regulations.

Due to the frequent movement of the river there was alternating erosion of right and left bank of the Danube River on this section. For that reason regulation works have been carried out during the last century, with pronounced intensity in the period between 60's and early 90's. The works were done in order to stabilize the river bank and riverbed, and to ensure the safe navigation. During the 19th century numerous cut-offs of meanders and corrections to the riverbed have been recorded. Currently on the subject section there are approximately 120 existing regulation structures on both sides of the Danube River. Most of the structures are still in function, while some of them are proposed for reconstruction.

Annex III of the European Agreement on Main Inland Waterways of International Importance, states that E-waterways must meet basic requirements of the designated class (IV-VII.), which are related to the minimum dimensions of the vessel (length and width), minimum height under bridges, required criteria of vessel draft that should reach or exceed an average of 240 days per year (or 60% of the navigation period), and meet minimum water levels. Each E-port must comply with the prescribed technical and operational criteria (excerpt from *Physical plan of Nature Park Kopački rit – Official gazette nr. 24/06*).

The current state of the Danube river waterway on the subject section does not fully meet the requirements defined by the recommendations of the Danube Commission from 1988. The main reason for this is the poor maintenance of the waterway in the past 20 years due to war activities in this area and the lack of financial resources. For the above reasons, the maintenance works of the subject section were absent, and the consequences are being reflected in the state of river bed and banks, where there is evidence of progressive erosion particularly occurring under the influence of high water levels, which are also threatening the right bank of the Danube river, on the area of Nature park Kopački rit. Direct result of the poor waterway maintenance is the emergence of bottlenecks or sections on the river where the dimensions of the waterway do not meet the required depth and width. These bottlenecks are also a problem for ice and sediment transport, which are causing the ice floods in addition to navigation problems. Furthermore according to UN / ECE classification from 1992 and the AGN from 1996, water levels are not defined, but it is stated that for each class of the waterway, safe navigation must be ensured for the relevant cargo vessels at a full draft. The Danube river stretch from 1380 to 1433 r.km including Apatin sector, and sectors Vemelj - Petreš and Aljmaš, is considered to be the most critical parts of the Danube through the Republic of Croatia, in terms of stability of the river bed, navigation conditions, and sediment and ice transport.

Considering that on the subject section there is extremely valuable wetland - Kopački rit, it is important to take into account numerous international agreements related to the protection of nature and environment, and to ensure that the construction of the planned section has no impacts on the protected area.

In case that on the subject section safe navigation conditions for class Vic are not achieved, Republic of Croatia will violate the provisions of signed international agreements on navigation along the Danube River. In this way the whole section through Republic of Croatia would represent a bottleneck for the European river traffic.

According to a Joint study of the Danube River, which was conducted on two occasions 2001 and 2007 by the International Commission for the Protection of the Danube River, the subject river section was defined as a natural water body, even though the regulation works and straightening of the river course over the past centuries were performed, which have significantly altered the hydrological state of the Danube river.

The opinion of the EIA authors is that the Danube in this area from the hydromorphological aspects is significantly regulated water body (which is at least supported by the attached maps in Map 5, chapter 3.3.6.) and that the status of the water body in this river section should be defined as such. However, a tentative definition of this river section as a natural water body indicates that in spite of numerous anthropogenic impacts state of the natural environment of the area still remained at a high level. The reason for that lies partly in the fact that on the Danube River the classic types of regulation structures are mostly used, which are built from natural materials which quickly fit into the environment. The subject of this assessment is the maintenance of the waterway and construction the regulation structures which are based on the classical principles.

This assessment deals with the proposal for construction of classical structures with construction in phases. Regulation structures on the Danube River have been proposed for the left and right river bank, in cooperation with the Republic of Serbia. This assessment deals only with the structures on the right bank while the structures on the left bank are presented graphically and are under the jurisdiction of the Republic of Serbia (but are included in the mathematical model based on which the impact assessment of the regulation works was made). The priority structures will be constructed in the first phase, while for the other proposed structures the monitoring scheme will be established, and their construction will start only if necessary. It is important to mention that the waterway is defined along the existing riverbed and that curves are defined in accordance with current natural state of the river bed.

The contents of this assessment were defined according to *the Instructions on preparation of the assessment* issued by the Ministry of Environmental Protection, Physical Planning and Construction on July 2nd 2010 in the process of issuing guidance on the content of the EIA.

Possible negative effects of the construction of regulation structures are reflected in the increase of the river flow velocity and the increased erosion of the riverbed, causing a deepening of the riverbed and decreasing of the groundwater levels. But even if the regulation structures are not carried out, decreasing of water levels on the Danube River is clearly taking place (Image 1.2). It is also important to note that the protected area Kopački rit is under evident trend of conversion from wetland area to terrestrial habitat, and that this area is depending on human interventions ensuring a constant supply of water and adequate flooding frequency.

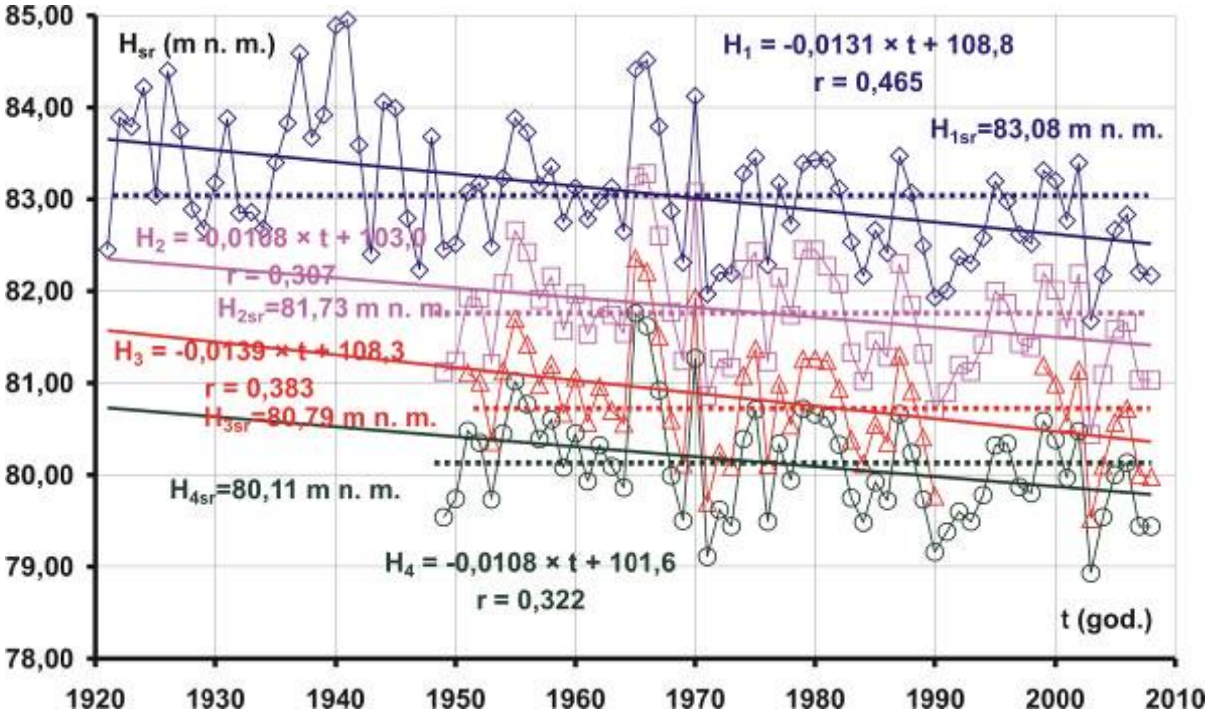

Image 1.2 Annual mean water level series at four gauge stations along the Danube expressed in m asl (above sea level)

In accordance with the results of the hydraulic model (selected alternative for construction of regulation structures with the crest height at MWL - mean water level) additional decrease of the mean water level is approximately 4 cm for the assumed period of 30 years. The model has also defined the number of structures which should be rejected in order to avoid a substantial impact on the environment.

The analysis of the subject section also determined the location of potential measures of revitalization on the subject section considering interventions that aim to improve the morphological conditions and include the removal of parts of the old regulation structures. By implementation of proposed mitigation measures for morphological conditions of the subject area it is expected that the hydromorphological status of the riverbed will improve.

Project documentation proposed the construction of the regulation structures (their description is given later in this chapter) with the crest height at MWL (mean low water) + 1 m. This EIA analysed and described alternative solutions (Chapter 2) and as the most acceptable alternative the one that differs from the project documentation was selected. The main differences are in the reduced number of planned structures and crest height of a structure, which was proposed at a level of MWL.

2. Information on the proposed activity

According to Annex I of ESPOO convention, the planned activity of regulation works on the Danube River from 1380 to 1433 km r belongs to activities under point 9 - Trading ports, including inland waterways and ports for inland waterway transport which accommodate the navigation of vessels over 1350 tons.

One of the main objectives of the waterway maintenance and construction of the regulation structures on the Danube River from 1380-1433 r.km is to ensure the minimum dimensions which are required for safe navigation. The section covered by this assessment is located on the international waterway class VIc. The relevant dimensions of the waterway were selected according to the recommendations of the Danube Commission in 1988, and the UN / ECE classification in 1992 and AGN Agreement in 1996.

3. The type of activities

This assessment deals with the proposal for construction of classical structures with construction in phases. Regulation structures on the Danube River have been proposed for the left and right river bank, in cooperation with the Republic of Serbia. This assessment deals only with the structures on the right bank while the structures on the left bank are presented graphically and are under the jurisdiction of the Republic of Serbia (but are included in the mathematical model based on which the impact assessment of the regulation works was made). The priority structures will be constructed in the first phase, while for the other proposed structures the monitoring scheme will be established, and their construction will start only if necessary. It is important to mention that the waterway is defined along the existing riverbed and that curves are defined in accordance with current natural state of the river bed.

As a positive effect of the proposed technical solution there will be an increase in water level in the domain of extreme high waters (almost +4 cm), which will result in prolonged duration and extent of flooding, but the increase will not cause any problems to the flood protection system (this primarily applies to the existing embankments).

The proposed alternative solution follows the recommendations of the “Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin” (ICPDR, 2007), the recommendations made in the document „Good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation under the Water Framework Directive“ (SedNet, 2006.), including the attached document with the pilot studies, as well as global trends in the implementation of regulation works in the domain of low water levels. It is important to note that it is expected to gradually implement the proposed works with the strict enforcement of predefined monitoring of morphological, hydrological and ecological parameters.

4. The scope of activities

The selected project alternative is the construction of river structures with a crest height at mean water level which compared to the solution proposed in the project designs has the following advantages:

- Smaller amount of material required for the construction of structures,
- Smaller area of river bed which is taken by construction of stabilization mattresses,
- Lower costs of construction,

It is also necessary to note that in the case of the construction of such structures it is proposed to perform detailed signalization on the waterway.

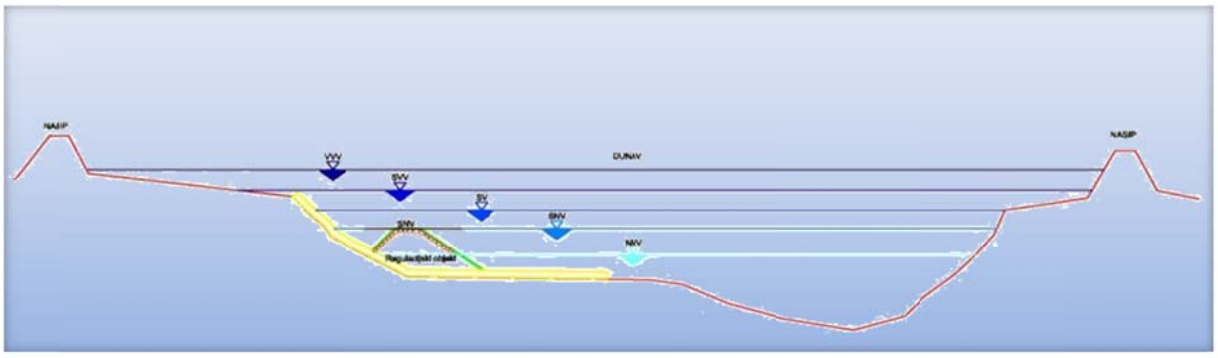

Image 4.1 Characteristic water levels of the Danube River with typical regulation structure according to the selected alternative solution

In accordance with the results of the hydraulic model further lowering of mean water levels for the proposed technical solution is approx. 4 cm for the assumed period of 30 years. Taking into account the current trend of lowering the high water levels, which (according to chapter 3.3.7. Hydrological data) amounts approximately (along the analysed section on the existing water-level stations) to 1.2 cm / year, 36 cm during the period of 30 years, further reduction is slightly more than 10%. Considering the obvious lack of measured data, which would explain the present negative trends (on the whole river, not only on the subject section), we believe that this additional lowering of the water level is not a significant impact. This interpretation does not include the additional lowering of the water levels due to different hydrological changes (variations in climate, the change of land-use in the basin, etc.).

As a positive effect of the proposed technical solution there will be an increase in water level in the domain of extreme high waters (almost +4 cm), which will result in prolonged duration and extent of flooding, but the increase will not cause any problems to the flood protection system (this primarily applies to the existing embankments).

Practice in the regulation works on the subject section in the last approx. 130 years (the period without straightening works) resulted in a relatively well-preserved *natural* character of the section as determined in chapter 3.3.6. Geomorphology where it is stated *"... meandering type of the Danube River on a large part of its course through Baranja. The exception to this is the section between Bački Monoštar–Apatin to the mouth of Vemeljac sidearm...* ".

The proposed alternative solution follows the recommendations of the "Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin" (ICPDR, 2007), the recommendations made in the document „Good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation under the Water Framework Directive" (SedNet, 2006.), including the attached document with the pilot studies, as well as global trends in the implementation of regulation works in the domain of low water levels. It is important to note that it is expected to gradually implement the proposed works with the strict enforcement of predefined monitoring of morphological, hydrological and ecological parameters.

In the next steps, ie the preparation of project documentation and process of administrative procedure, there are proposed additional analyses that will determine the optimum shape and disposition of each of the proposed structures, ie, a detailed analysis of each of the micro-location of the structures. In the case of the groyne this means: the need to define the exact type of groyne (a plain groyne, the L groyne or the T groyne), define the angle between the structure axis and the axis of the river bed (vertical or inclined in the direction / opposite direction of the flow, analyse the applicable types of the structure foundation, etc).

Additional analyses conducted by SIAM model confirmed the dominant accumulative character of the subject section. We think that such character of the subject section further reduces the potential negative impacts of the proposed technical solution.

The analysis of the proposed solutions in comparison to possible effects, as the most acceptable solution for the construction of the regulation structures, proposes the following:

• CONSTRUCTION OF NEW STRUCTURES	21
• CONSTRUCTION OF ALTERNATIVE TYPE OF STRUCTURES (OPEN GROYNE AND CHEVRON)	2
• RECONSTRUCTION OF EXISTING STRUCTURES	5
TOTAL	28

• PROPOSED STRUCTURES WHICH WILL NOT BE CONSTRUCTED	9
• CONSTRUCTION OF STRUCTURES IF NECESSARY WITH MONITORING	14
• CONSTRUCTION OF THE STRUCTURES WITHIN URGENT PROCEDURE	6
• PROPOSED MITIGATION MEASURES	5

5. The objects of proposed variants

According to the project designs for the subject section it was proposed to construct a total of 57 structures, out of which five structures are planned for reconstruction while the 6 structures are already built (or under construction) within urgent construction procedures.

The analysis of the proposed solutions in relation to the possible effects, has given the most acceptable solution for the construction of regulation structures, which is given in the following table.

Table 5.1 Overview of the structures of the selected alternative for proposed activity

Nr	STRUCTURE	(r.km)	TYPE OF CONSTRUCTION	COMMENTS
1.	1380-D/1	1380+585	GROYNE	
2.	1381-D/1	1381+115	GROYNE	
3.	1384-D/1	from 1384+523 to 1387+745	REVETMENT	reconstruction of existing structures
4.	1387-D/1	from 1387+775 to 1388+890	REVETMENT	reconstruction of existing structures
5.	1391-D/3	from 1391+865 to 1391+965	LONGITUDINAL STRUCTURE	
6.	1392-D/1	from 1391+965 to 1393+080	REVETMENT	reconstruction of existing structures
7.	1393-D/1	1393+450	CHEVRON	construction of alternative type of structures
8.	1395-D/3	from 1395+715 to 1397+270	REVETMENT	reconstruction of existing structures
9.	1397-D/1	1397+460	GROYNE	
10.	1397-D/2	from 1397+610 to 1398+385	REVETMENT	reconstruction of existing structures
11.	1399-D/1	from 1399+520 to 1399+880	REVETMENT	
12.	1400-D/1	from 1399+910 to 1400+590	REVETMENT	
13.	1404-D/1	1404+490	GROYNE	
14.	1404-D/2	1404+670	GROYNE	
15.	1404-D/3	1405+010	GROYNE	
16.	1407-D/1	from 1406+830 to 1407+330	REVETMENT	
17.	1409-D/3	1409+860	GROYNE	
18.	1410-D/1	from 1409+830 to 1410+430	REVETMENT	
19.	1411-D/1	1411+045	GROYNE	
20.	1411-D/2	1411+280	GROYNE	
21.	1412-D/1	1412+920	GROYNE	
22.	1413-D/1	1413+285	GROYNE	
23.	1416-D/1	1416+485	OPEN GROYNE	construction of alternative type of structures
24.	1418-D/1	1418+545	GROYNE	
25.	1427-D/1	1427+585	GROYNE	
26.	1427-D/2	1427+845	GROYNE	
27.	1430-D/1	1430+690	GROYNE	
28.	1431-D/1	1431+070	GROYNE	

6. Description of the activities for the performed intervention

Total of 28 of the 57 proposed new structures are acceptable for the environment and nature with implementation of prescribed protection measurements.

The planned structures will be constructed as a classic river regulation objects. However, for the construction of two structures (D-1393/2 and 1416-D/1) due to their specific location there is a proposal to construct one open groyne (D-1416/1) and one Chevron (1393-D/2) in accordance with the guidelines of Joint statement on Guiding principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin and the Manual for best practice in sustainable waterway planning - PLATINA. It is expected in both cases that the construction of such structures will have positive effects. However, as there is no experience with the objects of this type on the subject section of the Danube, the construction of one of each object type would either confirm or dispute the effectiveness of such structures, both for the environment and for the maintenance of the waterway. Proposed locations of these structures are the result of negotiations with Kopački Rit Nature Park, and will be elaborated in detail in the further project documentation.

Within this project documentation it is proposed to repair or reconstruct some of the existing structures, including total of 5 structures. This mainly relates to the revetments which will be refilled with crushed stone. Repair of structures have less impact on the environment than the construction of new structures because the works will be performed exclusively on the existing structure which will not affect additional natural habitats on the banks and within the river bed. It is also suggested that there may be more old structures which may be repaired instead of construction of new ones including six potential structures. But before any repair works begin it is necessary to determine the condition of existing structures and the exact scope of works.

A detailed analysis resulted in rejecting of construction of nine structures which were proposed by project documentation. These structures are located on extremely valuable natural areas and on the area that is important for spawning and wintering of fish. With their construction there would be significant impacts on nature. Specifically, this relates to the structures between 1407 and 1410 r.km and to the one structure on the 1394 r.km. Instead of construction of structures between 1407 and 1410 r.km it is proposed to repair existing structures subject to preliminary analysis and determining of their condition.

6 of the proposed structures are either already completed or under construction as a part of urgent construction procedure. The section of the Danube River from 1405 to 1407 r.km is the most vulnerable part of the subject section. Therefore, a project design for urgent rehabilitation works has been completed to prevent the damage of Danube River to the country's borders and damage in terms of coastal erosion towards Nature Park Kopacki Rit leading to uncontrolled spreading of river into the nature park. The project documentation proposed regulation structures which will stop this negative trend, and also suggested time schedule for construction of regulation structure in phases. On the section from 1405 to 1407 r.km it is proposed to construct four T-groynes, one revetment and one inline structure.

The first phase includes construction of:

- T-groyne 1406-D/1 – the structure is already constructed
- T-groyne 1405 D/2 - the structure is already constructed
- Inline structure 1406 D/3 - the structure is already constructed
- Revetment 1406 D/4 - the structure is already constructed

For these structures a Project documentation is has been completed and the construction of these structures has started. Title of the Project Design is: *Main / detailed design of urgent rehabilitation of river with regulation structures on the right bank of the Danube River on the stretch from 1405 km to 1407 km in order to stabilize the bank and technically maintain the riverbed and international waterway, Hidroing Ltd. Osijek, 2004.*

The second phase includes the following structures:

- T-groyne 1405-D / 1 – the structure is under construction
- T-groyne 1405-D / 3 - the structure is under construction

Project documentation for these structures is titled: *Main - detailed design of urgent repair river regulation structures on the right bank of the Danube River in the stretch from 1405 km to 1407 km in order to stabilize the bank and technically maintain the riverbed and international waterway, Hidroing Ltd. Osijek, 2007.*

Urgent repair projects are carried out on the basis of approval from the Ministry of Culture.

14 proposed regulation structures were evaluated as structures with a potential impact on the environment. At 1391 r.km there is proposed construction of 3 T-groynes in the area important for spawning and wintering of fish. At 1394 r.km there is proposed construction of revetments at exceptionally conserved area that represents one of the rare river stretches of completely natural coastline. On the stretch between 1401-1404 r.km, there is proposed series of 13 T-groynes with the aim to fix extremely critical section. This section, however, is exceptionally preserved natural landscape with developed sandbars. These constructions, therefore, cannot be defined as acceptable. However, continuous monitoring is proposed in these areas in order to evaluate the behaviour of Danube River. On the basis of the monitoring it will be possible to conclude whether the Danube is threatening with significant erosion of the banks and therefore with destruction of valuable natural habitats, and whether or not there are significant problems on this stretch related to navigation. There is also a need to monitor the construction of regulation structures on the left bank of the Danube River. In the case of recognizing the need for construction of any of these structures there is an obligation to make urgent project documentation for them and to obtain relevant permits of their acceptability from the relevant Ministry.

7. Purpose of the activities

The main goal of these river regulation structures is maintenance and arrangement of river bed and banks on the Danube River. Apart from the primary goal, proposed river regulation structures are defined in a way to meet the following objectives:

- River regulation design on the Danube River in order to ensure regulation elements for favourable hydrological and morphological characteristics of the subject section
- Develop a modern and functional international waterway of class VIc on the Danube River (after construction of regulation structure on the left river bank)
- Conservation and protection of Nature Park Kopački Rit
- Prevention of disruptions to the balance between the Danube River and the surrounding environment

Considering the existing status the river bed and banks of the Danube River and the existing boundary conditions (an international waterway, the border issue between the Republic of Croatia and Republic of Serbia, and limited funding) the proposed solution requires gradual implementation which would meet the defined purpose over a certain period of time.

8. The justification of the activities

Due to the frequent movement of the river there was alternating erosion of right and left bank of the Danube River on this section. For that reason regulation works have been carried out during the last century, with pronounced intensity in the period between 60's and early 90's. The works were done in order to stabilize the river bank and riverbed, and to ensure the safe navigation. During the 19th century numerous cut-offs of meanders and corrections to the riverbed have been recorded. Currently on the subject section there are approximately 120 existing regulation structures on both sides of the Danube River. Most of the structures are still in function, while some of them are proposed for reconstruction.

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In case that on the subject section safe navigation conditions for class Vic are not achieved, Republic of Croatia will violate the provisions of signed international agreements on navigation along the Danube River. In this way the whole section through Republic of Croatia would represent a bottleneck for the European river traffic.

9. Information about the spatial and time scope of the proposed activity

Planned activities including regulation works, maintenance of the waterway and arrangement of waterway regulation line is planned on the section of the Danube River from the 1380 to 1433 r.km on the border with the Republic of Serbia. In Republic of Croatia, it is the area of Osijek–Baranya County, including three municipalities (Draž, Bilje and Kneževi Vinogradi).

Medium-term development plan for inland waterways and ports on the inland waters of the Republic of Croatia for the period from 2009 to 2016, is the document which presents the basis for initiation of development cycle in river transportation sector, especially in the area of inland waterways and public port infrastructure. Also, this plan is the basis for making of the annual and three-year programmes related to river arrangement and technical maintenance of waterways, and for the annual plans for construction of ports and harbours on inland waters.

In the sector of inland waterways, there is a need for more intense approach to regulation works which are ensuring the navigability of existing waterway and which are ensuring the adequate signalization on the Danube River. To achieve the main goal, ensure safe navigation and the minimum draft of 2.5 m 300 days a year, it is necessary to undertake two major projects:

- Establish the IV class of the Sava River waterway (IPA project)
- Arrangement of the Danube River waterway from the 1380 to 1410 r.km (TEN-T project)

These two projects are essential for the river transport revival in the Middle Danube area. By removing of bottlenecks for navigation, river traffic would become much safer and more reliable transport resource, and therefore more competitive in relation to other types of traffic.

Realisation of the *Medium-term development plan for inland waterways and ports on the inland waters for period 2009-2016* is of particular importance for the development of river transport on Croatian territory, and is of particular importance for the connection to the transport corridors of the European Union and the Danube area. Its implementation would create the preconditions for a better redistribution of transport in favour of a river transport, which is one of the objectives of the European Action Plan for river transport (NAIADES).

10. Justification for the location of proposed undertaking

The Danube Commission was established with the signing of the Convention regarding the navigation regime on the Danube, on 18 August 1948th in Belgrade. The Convention came into force on 11 May 1949. Member States have signed the Additional Protocol to the Convention in 1998 and the Republic of Croatia is a permanent member. According to the Terms of the Danube Commission, Article 3:

The Danubian States undertake to maintain their sections of the Danube in a navigable condition for river-going and, on the appropriate sections, to sea-going vessels, to carry out the works necessary for the maintenance and improvement navigation conditions and not t obstruct or hinder navigation on the navigable channels of the Danube.
The riparian States may, within their own jurisdiction, undertake works for the maintenance of navigation, the execution of which is necessitated by urgent und unforeseen circumstances. The States shall inform the Commission of the reasons which have necessitated the works, and shall furnish a summary description thereof.

The critical sections present the bottlenecks and limitations to the transport capacity due to reduced dimensions of the waterway. The critical sections can be grouped as follows:

- **Sections with insufficient depth - shallows,**
- **Sections with insufficient width according to a waterway class,**
- **Sections on which the waterway is located near to the coast, which can hinder the stability of the bank and safety of navigation.**

The most common limitations are insufficient depth and long periods of standstill due to limited depth of the vessels draft at low water levels. Concerning all mentioned above, at Danube River section from 1380 to 1433 r.km following bottlenecks were identified:

Table 10.1 Critical sections for the navigation on the subject section of the Danube

nr	Critical section	Problem	The needed activities
1.	Šarkanj (r.km 1427-1429)	Narrow waterway, dangerous section	Upgrade of the existing structures and construction of the new structures - T-groynes
2.	Monjoroš (r.km 1412)	Low depth, erosion of the right bank	Construction of the structures for safe navigation
3.	Kopački rit Nature park (r.km 1410-1400)	Low depth, erosion of the bank, the Danube threats to breach into the Nature park Kopački rit	Rehabilitation and upgrading of the existing structures and construction of the new structures, dredging works
4.	Kopački rit Nature park (r.km 1395-1394,3)	Low depth, erosion of the bank	Revetments, dredging works
5.	Petreš (r.km 1393)	Narrow width, erosion of the river bank, the Danube threats to breach into the old river channel	Rehabilitation works are in progress
6.	Vemelj (r.km 1391,3-1390,5)	Narrow depth, wide riverbed	Rehabilitation of the river bed and river bank
7.	Aljmaš (r.km 1377,1-1374,9)	Low depth, erosion of the bank	Fixation of the right river bank and construction the revetments

* Medium-term development plan for inland waterways and ports on the inland waters of the Republic of Croatia for the period from 2009 to 2016, December 2008.

The most critical section is between the 1404.5 -1402 r.km. Due to formation of shoal, the Danube River flow is split in two along with significant erosion of the right bank, tendency of the water to breach into Nature park Kopački rit and relocation of the main flow towards the right river bank. On the left bank the erosion has damaged the existing revetments and the river bank.

In addition to the criteria for meeting the requirements of the designated class, the waterways have limited navigability due to absence of maintenance works. In the period from 1990 - 2000 there were no maintenance works performed. The state of the inland waterways in the Republic of the Croatia has therefore been aggravated due to lack of maintenance in comparison to year 1990.

The existing structures for the safe river navigation are in very bad condition. Most of them are in the state of decay. Therefore, it is necessary, in addition to regular maintenance works, to intensively perform rehabilitation and upgrading of existing structures. On the Danube River it is determined that 23 out of 87 structures are damaged.

The Apatin section is one of the most critical sections for navigation on the subject section, and on which the shoal is forming within fairway route (from approximately 1402+000 to 1404 +500 r.km according to river kilometre signs). During the preparation of the EIA, in negotiations with the Public Institution - Nature park Kopački rit, it has been concluded that no regulation structures will not be constructed on this area due of the exceptionally preserved natural landscape on the right bank and fish spawning sites, but instead to carry out continuous monitoring on this stretch. If there is no construction of the mentioned structures it is certainly necessary to remove part of the shoal to ensure minimum conditions for the navigation. Material from the shoal in this case will be deposited within the river bed along the left and right banks outside of spawning sites. In this way, problems related to navigation on this section are likely to be solved. In the case that there is no positive change, it is necessary to make appropriate project designs for this section and to implement new administrative procedures. This section is the only section within project area that requires dredging works, while no other section requires dredging.

Image 10.1 Location of Apatin shoal on the satellite image (source: Google Earth)

11. Illustrations

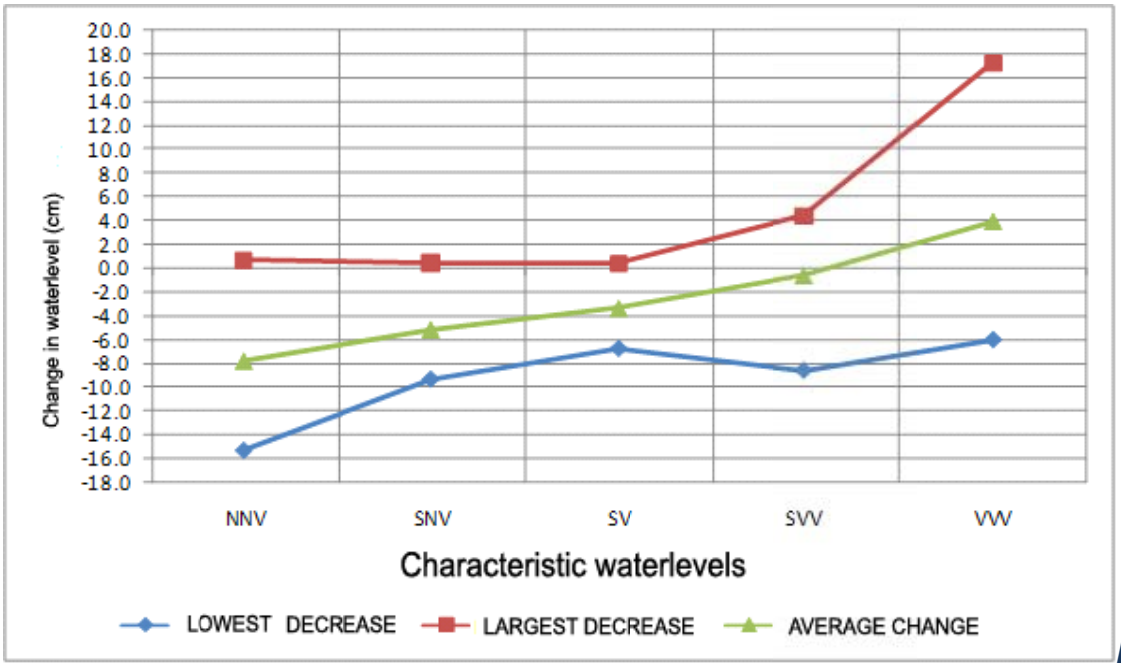


Image 11.1: Display of the characteristic values of water level changes of the Danube River for alternative regulation structures with a crest at the MLW during characteristic water levels on the section from the 1433 r.km to the mouth of the Drava River , compared to the existing state

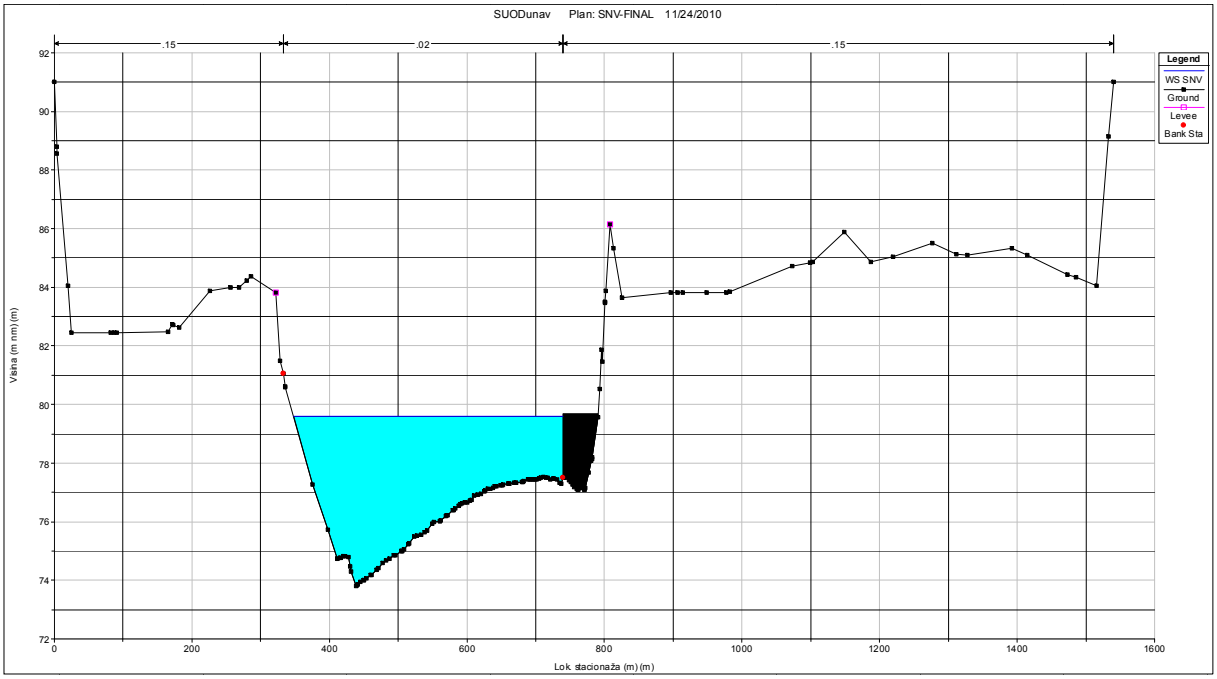


Image 11.2: Cross section of the Danube River with the river regulation structure (T-groyn, black color), with a crest at MLW level on approx. 1411+100 r.km

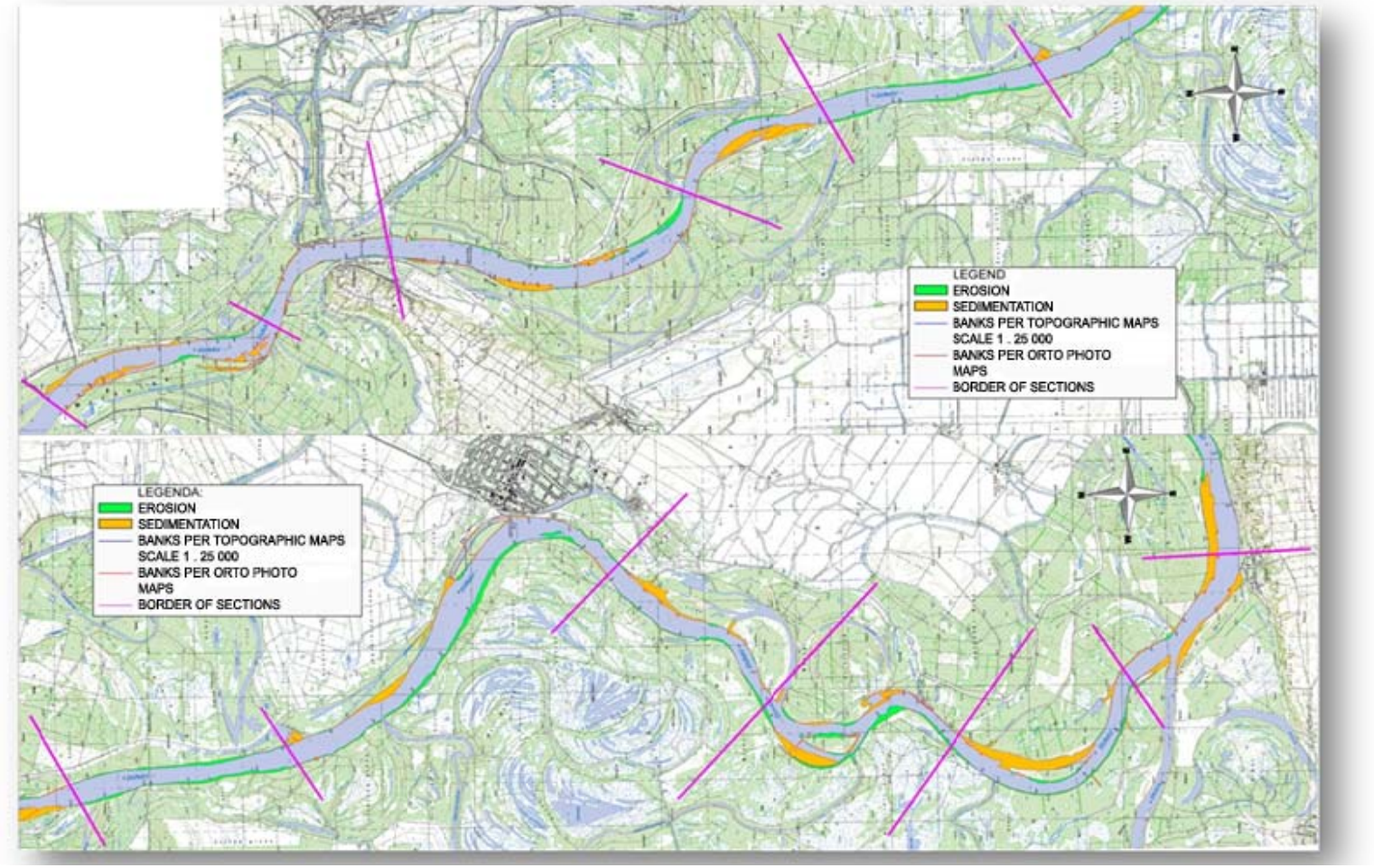


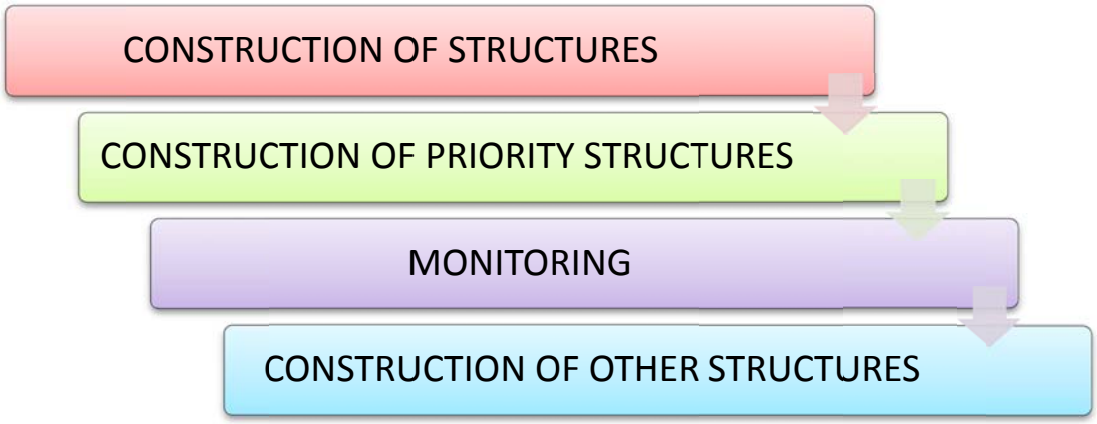
Image 11.3 Comparison of the river bed conditions of the subject section from the topographic maps and orthophoto images with marked erosion and sediment processes locations

12. Construction time –plan

Given the number of structures that need to be done, and therefore significant financial resources to be obtained, it is proposed to construct these structures in phases. If there is a possibility of an agreement for constructing parallel at both right and the left banks of the Danube, the realisation stages will be necessarily adapted through the eventual interstate cooperation. The stages of realisation depend on a considerable number of factors, and in this moment we can only speak of the general proposal for the implementation phases.

In general, time schedule is defined based on the following parameters:

1. assuming the resources available, available materials for construction, and taking into account the availability of companies that preform this kind of work in both countries, it is assumed that the annual maximum section that can be performed is 10 km,
2. works are carried out according to the priority of the section, so that on the subject section, first works are carried out on Apatin sector (1400 to 1410 r.km) which is the top priority section due to the extremely poor condition of the waterway and the river bank conditions,
3. during the construction works it is necessary to continuously monitor river and waterway conditions, and accordingly (if necessary) change the construction plan,
4. after the completion of individual sections it is necessary to monitor waterway and impacts of the designed structures and improvements on the river and waterway.



Arrangement of the right regulation line of the Danube River from 1380 to 1400 r.km can be achieved through construction of series of regulation structures. On the right bank of the subject section it is proposed to construct 4 groynes, 1 revetment and 1 longitudinal structure, and reconstruction of 5 existing revetments.

Arrangement of the right regulation line of the Danube River from 1400 to 1410 r.km can be achieved through construction of series of regulation structures. On the right bank of the monitoring section it is proposed to construct 4 groynes and 2 revetments.

Arrangement of the right regulation line of the Danube River from 1410 to 1433 r.km can be achieved through construction of series of regulation structures. On the right bank of the monitoring section it is proposed a construct 10 groynes and 1 revetment.

13. Information on the expected environmental impacts and mitigation measures

The proposed undertaking on the Danube River which includes the construction of groynes and revetments has already been implemented before on this area, and these structures have been used for over two hundred years. All proposed structures will be constructed so that the highest elevation of the crest corresponds to a height of mean low water level, with the aim of establishing the regulation line and achieving the stability of the riverbed and banks.

The assessment of acceptability of the proposed project – waterway maintenance and regulation works on the Danube River, is based on the relationship of benefits and costs that will result from a construction of the planned structures. Although the contactor will comply with health and safety conditions and environmental protection measures during the construction, there may be some negative impacts which should be separately monitored. The contractor will be obliged to comply with environmental protection measures which are determined within this assessment, and they will form an integral part of the provisions in the location permit. Apart from this, the contractor will be obliged to comply with all regulations of Republic of Croatia concerning environmental protection, protection of forests, water, soil, air and noise protection. These environmental measures have to be implemented throughout Preparatory works, Construction works, and the entire lifespan of the undertaking.

Environmental protection presents overall set of measures to maintain and improve the natural and cultural heritage, endemic and endangered plant and animal species and their living habitats. Consideration of environmental protection measures is therefore extremely important, so during the implementation stage, construction stage and the operational stage, the conditions for mitigation of environmental impacts have to be ensured.

With the analysis of the current state and detailed insight into the morphological development of the riverbed throughout the history of the subject section (from year 1783 onwards) there were identified potential locations for the implementation of mitigation measures.

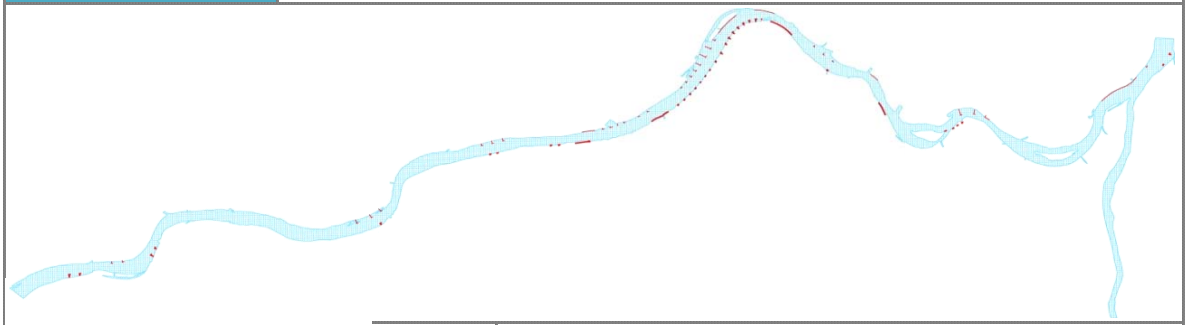
The mitigation measures involve the following types of undertakings:

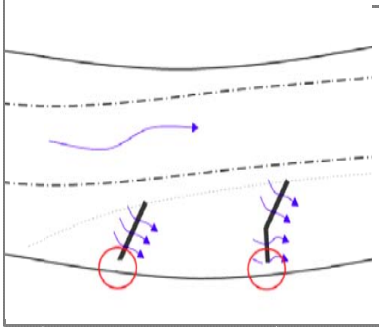
- removal or opening of stone weirs which enables reconnection of the old side arms of the Danube River with the main course of the river and establishing of water flow in cut-off meanders.
- cleaning of old side arms and ineffective flow areas from the sediment to achieve favourable hydrological conditions for introducing of significant quantities of "fresh" water, which will result in the expansion and development of aquatic and wetland habitats – the proposal to be made in a further project documentation
- along with cleaning of old side arms it might be necessary to remove parts of old regulation structures (groynes and inline structures) that fulfilled its original purpose with the aim of ensuring of water flow side arms

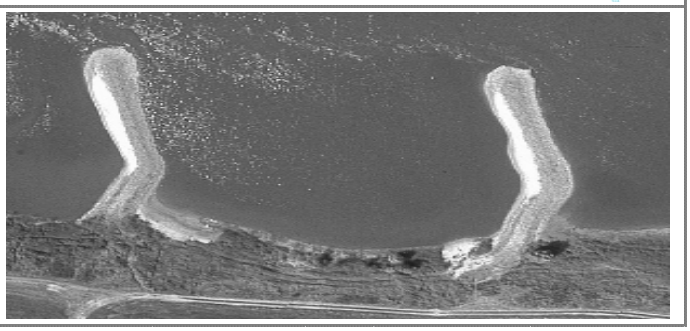
The following is an overview of the proposed characteristics of alternative regulation structure types:

- **A1 – declinant groynes** (groyne axis tilted downstream, "V" shaped groyne and a curved groyne);
- **A2 – open groynes** (without connection to the river bank) and
- **A3 – Chevron**

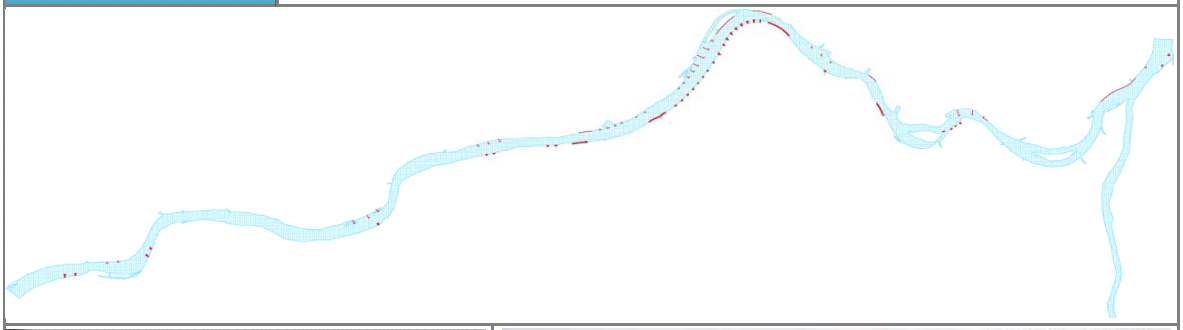
STRUCTURE		**INCLINED GROYNE**				***A1***
LOCATION		Potential location are all proposed groyne sturctures, and the final decision on use of those alternative types of structures will be defined within further more detailed project designs .				
DESCRIPTION OF STRUCTURES		Construction of modified types of regulation structures instead of classical. Alternative groynes are: downstream inclined, "V" shaped and curved groyne.				
GOALS	TECHNICAL	Improvement of navigability (increase water depth at low discharges, reduce maintenance dredging), Fixation of the navigation channel / fairway				
	ECOLOGICAL	Reduction of groyne field effects (less sedimentation etc.) Improvement of ecological conditions (improvement of aquatic habitat diversity by near bank flow) Restoration of banks (side erosion).				
REQUIREI	TECHNICAL	Groyne stability (against floods, scouring, river bed erosion) Protection of banks especially in outer curves.				
	ECOLOGICAL	Lowered silt and fine sediment accumulations in groyne fields. Minimisation of habitat fragmentation. Increase hydromorphological dynamics at banks.				
EFFECTS	low influence medium influence high influence	**N** **S** **Z**	Technical effects (fairway)		Ecological effects (side-arms, banks)	
	HIDRO-DYNAMICS	water level	**Z**	water level increase at low flows		
		flow velocity	**Z**	flow velocity increase at low flows	**Z**	increased flow velocity diversity
		shear stress	**Z**	higher shear stresses (increase of erosion processes)	**S**	more natural grain size distribution, habitat diversity
	SEDIMENT TRANSPORT	transport capacity	**S**	increase of transport capacity	**S**	improvement of meso and micro habitat diversity
	MORPHOLOGY		**N**	degradation in main channel	**S**	minimised aggradation
MONITORING		Bathimetry and flow velocity pattern upstream and downstream from structures.				

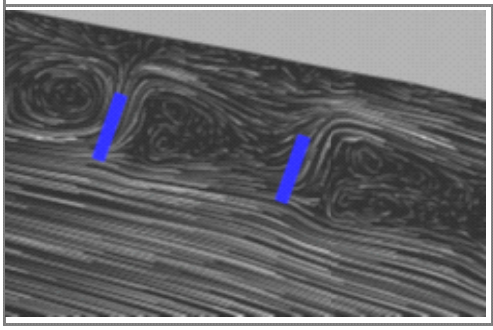




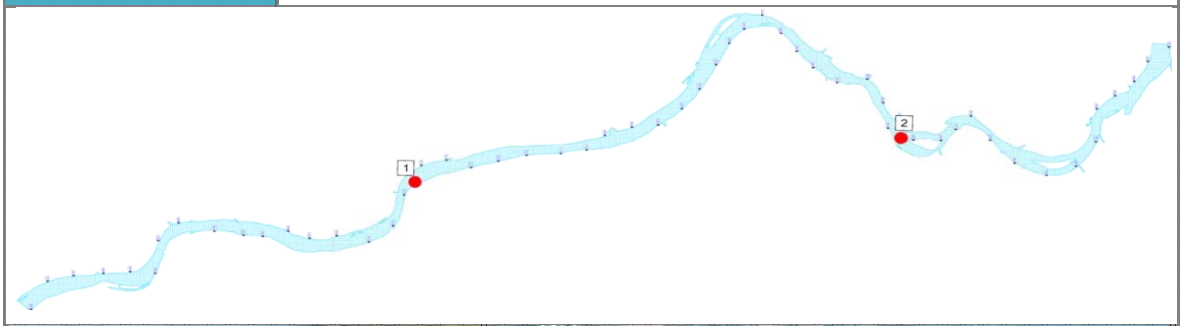


STRUCTURE		**OPEN GROYNE**					**A1**
LOCATION		Potential location are all proposed groyne sturctures, and the final decision on use of those alternative types of structures will be defined within further more detailed project designs .					
DESCRIPTION OF STRUCTURES		Opening of groyne body structure along banks in order to enable development of morpho-dynamic processes (mainly erosion).					
GOALS	TECHNICAL	Improvement of navigabilityespecially during low water levels.					
	ECOLOGICAL	Alowance of limited degree of lateral erosion and morphological dynamics along banks, providig favourable conditions for delevopment of habitats.					
REQUIREI	TECHNICAL	Groyne stability (against floods, scouring, river bed erosion)					
	ECOLOGICAL	Emergence of valuable river habitats for fish and winter birds..					
EFFECTS	low influence medium influence high influence	**N** **S** **Z**	Technical effects (fairway)		Ecological effects (side-arms, banks)		
	HIDRO-DYNAMICS	water level	**Z**	increased depth at low water levels	**Z**	increased water depths along banks during low	
		flow velocity	**Z**	Increased flow at low water depths	**S**	Increased flow along banks	
		shear stress	**Z**	increased shear forces (increase of erosion processes)	**S**	increased shear forces along banks	
	SEDIMENT TRANSPORT	transport capacity	**S**	increase of transport capacity	**S**	reduced degree of sedimentation between groynes	
	MORPHOLOGY				**Z**	increased morpho-dynamic processes along banks	
MONITORING		Bathimetry and flow velocity pattern upstream and downstream from structures.					





STRUCTURE		**CHEVRONS**				***A1***
LOCATION		1416-D1: rkm 1416+485 (1) i 1393-D1: rkm 1393+450 (2)				
DESCRIPTION OF STRUCTURES		Chevrons are curved structures which are usually constructed parallel to the river flow and they use the river energy for redistribution of flow and sediment transport.They are usually constructed along banks in order to avoid splitting of flow and deepening of river channel on both sides, development of side arms				
GOALS	TECHNICAL	Improvement of navigability (increase water depth at low discharges, reduce maintenance dredging) Modification of discharge splitting (side-arms) River regulation, fixation of the navigation channel / fairway				
	ECOLOGICAL	Minimise engineering impact				
REQUIREI	TECHNICAL	Chevron stability (against floods, scouring, river bed erosion)				
	ECOLOGICAL	Minimise reduction of side-arm discharge and morphodynamics Optimised dimension and spacing (minimise impact) Lowered silt and fine sediment accumulations behind chevrons.				
EFFECTS	low influence medium influence high influence	**N** **S** **Z**	Technical effects (fairway)		Ecological effects (side-arms, banks)	
	HIDRO-DYNAMICS	water level	**Z**	increased water depth at low discharges	**Z**	increased water depth at low
		flow velocity	**Z**	increased flow velocity at low flow	**Z**	lowered flow velocity in side-arms
		shear stress	**Z**	higher shear stresses (increased erosion)	**S**	lowered shear stress in side-arms
	SEDIMENT TRANSPORT	transport capacity	**S**	increase of transport capacity	**S**	decrease of transport capacity in side-arms
	MORPHOLOGY		**S**	reduction of side-arm morphodynamics	**S**	reduced morphodynamics in side-arms
MONITORING		Bathymetry and velocity distribution upstream and downstream from structure, transport of sediment along cross section of channel.				



13.1 Scope of the assessment

Scope of the impact assessment which would occur without technical and any other protection measures, are related to the impacts during construction, impacts during usage, impacts in accidental situations and impacts after usage of planned undertaking.

Protection measures in EIA are defined along with environmental monitoring programme for period prior to construction, during construction, during operation of the planned undertaking and for accidental events. The EIA also outlines environmental policy of the Client including objectives and principles of activities towards protection of the environmental, organizational structure of the Client including overview of overall responsibility practices, procedures and capacity of the Client for implementation of protection measures; and cooperation of the Client with the public during and after the implementation of undertaking.

13.2 Considered location features

EIA has analysed the following location features:

- Meteorological features and climate
- Geological features
- Tectonics of the area
- Geomorphological features
- Hydrogeological features
- Hydrologic and hydraulic characteristics
- Water quality of the Danube River
- Habitats
- Protected natural values
- Landscape features
- Cultural and historical heritage
- Demographic characteristics
- River transportation and ports

13.3 Estimated environmental impacts

Planned undertaking, "Maintenance of the waterway and regulation works on the Danube River from 1380 to 1433 r.km," is the project for which the *Decree on the assessment of the environmental impact (OG 64/08 and 67/09)* stipulates mandatory assessment of its impacts on the environment, so it is necessary to include the decision referred to in *Article 79 of Environmental Protection Act (Official Gazette 110/07)* within the future request for the issuance of construction permit.

When the environmental impact assessment includes the assessment of acceptability of undertaking for ecological network, or in the cases where according to the Law governing the protection of nature Main assessment is needed, then the final decision of acceptability of undertaking for environment includes separate set of measures for mitigation of negative impacts on the ecological network and/or programme of environmental monitoring in relation to the ecological network *(Article 23 of the Decree on the assessment of the environmental impact - Official gazette nr 64/08 and 67/09).*

For the intervention for which the environmental impact assessment is mandatory, as well as for the interventions for which the necessity of assessment is prescribed in the

screening procedure, The main assessment of acceptability of undertaking is conducted within the EIA procedure *(Article 13 of the Regulation on the assessment of acceptability of plans, programs and projects for ecological network (Official gazette 118/09).*

Based on the obtained data from the State Institute for Nature Protection and according to identified areas of the National Ecological Network (Regulation on the National Ecological Network – OG 109/07) it was found that the proposed project is located within the sites of National Ecological Network (NEN).

In accordance with the established categories of special areas of conservation and special protection according to Natura 2000 programme, the project is located within areas of NEN including both categories

- Important sites for wild species and habitat types (SAC NATURA 2000 sites):
  - Kopački rit (HR2000394)
  - Wider area of river Drava(HR5000013)

- Internationally important bird areas (SPA NATURA 2000 sites):
  - Danube basin and lower Drava region(HR1000016)

The Assessment also includes the areas in vicinity of project area:

- Important areas for wild species and habitat types (SAC NATURA 2000 sites):
  - Batina Dunavac (HR2001044)

The assessment includes four point areas located at different distances from the location of the project:

- Important areas for wild species and habitat types (SAC NATURA 2000 sites):
  - Dunav near Batina (HR2000733)
  - Dunavac – Šarkanj (HR2001095)
  - Šarkanj (HR2001096)
  - Zmajevac (HR2000732)

Pressures on the natural environment due to the maintenance of the waterway basically can be summarised into following points:

- changes in the natural structure of the river bed,
- changes to natural flow patterns through hydromorphological changes on the riverbed,
- changes to the flooding frequencies of surrounding areas and groundwater levels in the catchment area,
- disruptions to fish migration by construction of lateral barriers within the riverbed,
- removal/relocation of sediment with construction works and periodic maintenance of the navigation channel,
- accidental pollution by oil or other hazardous substances,
- contamination by bilge water, waste water from washing tanks and sanitary wastewater from ships,
- disturbance to aquatic environment caused by river traffic, and
- inadvertent introduction/spreading of alien species.

All planned activities are located within two areas of ecological network: Wider area of river Drava (HR5000013) and the Danube region and Drava region (HR1000016), while structures from 1383 + 300 r.km to 1412 + 150 r.km are located within Kopački Rit (HR2000394).

Analysis of potential cumulative impacts of planned undertakings on the ecological network can be divided into the following types of pressures on ecological characteristics of Danube River and natural values which are objectives of the ecological network conservation:

- changes to the natural structure of the river bed;
- changes in hydrological and hydrogeomorfological properties of river ecosystem;
- hydrological and hidrogeomorfological changes within floodplains;
- changes to the structure of aquatic and wetland habitats in floodplains which are subject to the conservation within ecological network;
- changes to the populations of endemic and endangered species which are subject to the conservation within ecological network.

Based on analysis of potential impacts of the planned undertaking with the regard to the characteristics of the project, project location and spatial distribution within sites of ecological network, we can conclude that the intervention is acceptable for the objectives of conservation and ecological integrity of the network, subject to the implementation of measures proposed within this EIA to mitigate adverse impacts of proposed undertaking. It is also expected that the planned revitalization measures will significantly reduce the negative natural (climate change) and anthropogenic trends (eutrophication, hydraulic works, irregular maintenance and dredging within waterway).

13.3.1 Potential impacts on the environment during the construction of intervention

Potential impacts on water

Construction works pose a potential time-limited threat of water pollution, especially of surface waters, due to possible leaks of fuel and lubricants from machinery. Due to improper and negligent performance of works and handling of equipment Danube River may be polluted with parts of construction machinery, oil from hydraulic equipment, etc.

Earthworks which are executed in the process of construction are carried out at the contact line between the water surface and slopes of riverbank. At this contact it is impossible to avoid occasional landslides and falling of soil into the river. Such soil will be partly carried away by a river and will partially settle to the bottom on the parts with lower flow velocities.

Potential impacts on air

Possible negative time-limited impact on the air during the construction is air pollution by dust and exhaust gases from machinery as a result of maintenance works on the waterway (transportation, loading and transportation), construction of planned structures, directly to the environment adjacent to the construction site, and also during the supply and/or delivery of construction materials.

Impacts of the undertaking on soil
Possible contamination of the soil may occur due to incidental spills or fuel leaks into the surrounding terrain. Such sites should be urgently remediated and inspected by the authorized supervisor. Such contaminations may be well controlled with good organization of construction site and with construction supervision by authorised engineer. In the practice such incidents don't occur very often.

Effect of the undertaking on nature
From the landscape oriented point of view the subject undertaking will have minimal impact on the visual quality of the space. The regulation structures will be constructed at a height of mean low water levels high and in technical terms by ensuring stability of the riverbed and banks, will not impact the view from land the towards river nor from the river to the land. Also there will be an impact on the biological and ecological values of the area.

Impacts of the undertaking on the ecological network
After examining the Annexes of the Regulation on the National Ecological Network, it has been found that the larger area of the Danube River is within the boundaries of the National Ecological Network. Pursuant to the Regulations on the evaluation of plans, programs and projects for ecological network, the Main Assessment of acceptability of undertaking for Ecological Network was prepared. Graphic excerpt from the database of National Network from the State Institute for Nature Protection, shows, that the planned project is located within several areas of the ecological network within in the Republic of Croatia.

Most of the negative impacts on biodiversity and ecological stability of ecological networks (especially of the Danube River) are already existent. Therefore the proposed reconstruction and construction of regulation structures will not have significant, both individual and cumulative impacts on the ecological network in wider area of the Danube River

Effect of the undertaking on forests
Large scale project on subject area, with a total length of 53 km, which will although be implemented only on a certain points of the waterway and only within the bed of the river Danube, for a Client and future users represent significant and extensive undertaking but without significant impacts outside out the river channel. Proposed interventions will not have any direct or indirect impacts on the forests along the river Danube. Direct effects are not likely since the construction and other related activities on the project are performed exclusively within river channel and on the riverbanks, so they are not executed on any forest areas. Indirect threats to the forests are primarily related to the change in water regime during the year, but no significant fluctuation in water level will occur, and therefore there will be no impacts on the flood waters and groundwater.

Potential impacts on river traffic
During the construction, there are possible impacts of construction vessels on the river traffic. To avoid any significant disruptions to the river transport it is necessary to prescribe measures to ensure safe navigation on the Danube River.

Accidental events during the period of construction
During the construction, there is a possibility of accidental events which are related to the process of construction. The greatest negative impact on the environment,

especially on the river Danube, can occur in event of sudden rise of water levels during the construction process and construction materials and machinery being carried away by the water. The scope and the extent of such negative impact will depend on the construction stage and actual distribution of stationary and non-stationary sources of pollution at the construction site. In the case that the construction site at the end of the working shift is not secured by removal of materials and machinery to safe heights, the negative effects will be greater.

Effect of the intervention on the occurrence of noise
Construction works which are necessary for completing the structures produce noise which is typical for the general construction works. Sources of the noise are machinery and sound signals at the site.

13.3.2 Possible impacts during operation of the undertaking

Possible impacts in the case of dysfunctionality of the structures
After the construction of the structures it is necessary to determine their functionality. On the subject section, there are existing structures that do not serve their purpose and there is a possibility of their negative influence of river regulation. Mathematical modelling in the design phase gives better chance of proper functioning of the structures. In order to confirm the accuracy of the model in reality and to monitor fitting of structures in the environment it is necessary to prescribe measures for monitoring of the condition of constructed objects to ensure that the proposed structures will meet their purposes and fit into the environment as expected.

Impacts in case of accidental events
During the normal transportation routine, due to nature of the transportation itself, it is possible that part of the goods, especially bulk cargo, by accident falls into the river Danube. Further impact may be the result of maintenance of engine parts on the vessels and possibly by inadequate washing and cleaning of vessels after unloading of cargo. Another possibility of pollution is in the case of accidents including possible collisions or overturning of vessels. In the first case, even there are small amount of pollutants in the question, and there is a possibility of a negative impacts on the aquatic ecosystems. In the second case, there is a probability of spillage of large amounts of harmful substances in a relatively short period of time, and presents large scale immediate impact on the aquatic ecosystems.

13.3.3 Transboundary effects

Managing of water sources in order to enhance, conserve and protect them, in Croatia is governed by many international obligations. These obligations are result of ratification of conventions and protocols related to use and protection of water resources and bilateral agreements on cooperation in water management. Based on the *"Convention on the Protection and Use of Transboundary Watercourses and International Lakes"*, Croatia and neighbouring countries have agreed to take all necessary measures to control, prevent and reduce transboundary impacts.

"Convention on the Protection and Sustainable Use of the Danube River" refers to the hydrologic watershed of the Danube River. This particular convention defines the purpose and scope to which extent certain activities and measures, either proposed or in progress, are causing or may cause transboundary impacts.

As an addition to the *"Convention on the Protection and Sustainable Use of the Danube River", "Environmental protection programme for Danube River Basin"* was prepared and was adopted at the Ministerial Conference of the Danube region countries.

Based on the above stated, it shall be concluded that there are legal provisions and international commitments related to the construction of the proposed project, which does not pollute air, soil or water, and have no negative global impacts on the environment.

Natura2000 which covers areas important for the conservation of endangered species and habitat types, is the basis of environmental protection in the EU, and is derived from the "Bird Directive" and "Habitats directive". The Republic of Croatia has adopted the *"Decree on proclamation of the National Ecological Network"* which defines important areas for wildlife species and habitat types, and internationally important bird areas with ecological corridors. The route of the planned waterway maintenance on river Danube passes partly through natural areas listed in the National Ecological Network.

The Republic of Croatia is also a signatory of *"Convention on European Landscape"* adopted in Strasbourg. Member parties to the Convention have agreed, citing that the quality and diversity of European landscapes constitute a common resource, it is important to cooperate for the purpose of protection, management and planning of all landscapes in Europe. Convention as such concerns landscapes that might be considered outstanding as well as common or degraded landscapes, and aims to promote landscape protection, management and planning and to organize European co-operation on landscape issues.

The Republic of Croatia is involved in the activities on the conservation of the landscape and environment, by implementation and participation in international programmes and preparation of documents important at the regional (county) level, the most importantly:

- "The Convention on Biological Diversity", which aims to conserve and improve existing biodiversity within the country and sustainable use of its components;
- "Strategy and Action Plan for the Conservation of Biological and Landscape Diversity in Republic of Croatia" and "A review of the state and the protection of biological and landscape diversity"
- "Action for the conservation of protected areas in Europe" with the aim to approve plans that protect not only the individual plant and animal species and their locations, but habitats and ecosystems that span across administrative boundaries. Actions must be conducted at cross-border or international level.

With regard to the statutory requirements of Croatian inclusion in the network of European inland waterways, it should be noted that the Republic of Croatia in Helsinki, and the Croatian State Parliament ratified Agreement on Main Inland Waterways of International Importance. In European Agreement on Main Waterways of International Importance (AGN), Danube belongs to the basic European Waterway (inland) with the code E-80. According to the agreement, the most important inland waterways are the ones in direction north to south providing access to seaports and connecting European countries on the North Sea across the Danube region with countries of the Mediterranean Sea.

In order to regulate the commitments, Republic of Croatia adopted *"Law on Inland Waters"* and *"Law on Inland Water ports"*. The Republic of Croatia and the Republic of Serbia signed the *"Agreement on navigation on inland waterways and their technical maintenance"* which allowed free navigation for vessels under both flags.

As the project section is located within the border area of Republic of Croatia, in accordance *to "Convention on Environmental Impact Assessment in a Transboundary Context"*, it is necessary to inform neighbouring countries about the planned undertakings. A procedure of assessment of transboundary impacts of the proposed project in the Republic of Hungary is initiated in accordance with the Espoo Convention through Ministry of Environmental and Nature Protection of Croatia.

During the preparatory works, as well as during the construction of regulation structures and use of inland waterway, proposed undertaking will not produce the elements of negative transboundary environmental impacts, which are contrary to the international obligations of Republic of Croatia.

14. Environmental protection measures and Measures implementation plan

14.1. Environmental protection measures during the construction

Water and river protection measures

- Supply of fuel and lubricants should be carried out directly from the tanks on a protected, waterproof and for this purpose specially designated areas, which must be equipped with means to neutralize potentially spilled fuel and lubricants.
- Define measures to regulate the water regime in the event of high water levels during the execution of works on specific stretches and perform measures to protect the parts of the system and unprotected construction areas in the events of high water levels.
- Construction work on the parts of the undertaking which may be affected by the high water levels should be performed in low water periods. For the assessment of adequate period, use statistical data on distribution of water levels throughout the year and long-term weather forecasts.
- During all excavation works, which are in direct contact with the water of river Danube, ensure that minimal quantities of soil material reach the water.
- All waste waters generated during the construction and use of the undertakings must be disposed of in accordance with valid legislation.

Air protection measures

- Regularly perform service of machinery and vehicles which are used on the site
- Raw materials should be transported using vehicles technically adopted for such use.
- In the case of high velocity winds suspend all works.

Noise protection measures

- Use machinery and devices that do not exceed the noise limit values.
- Extremely noisy works should be limited to the period between 8 to 18 o'clock, and in the case of exceeding of limit values, notify relevant inspection in accordance with the *"Regulations on the maximum permissible noise levels in the environment in which people work and live (OG 145/04)"*.

Nature protection measures

- Prevent unnecessary degradation of habitats, limiting works to small areas where the construction will take place,
- Minimise disruption to existing river bed and prevent unnecessary occupation of the meadows and the destruction of trees and shrubs.
- Reduce noise and other forms of harassment (light, etc.) of the animal species to a minimum.
- Regulation structures should be constructed using natural materials (fascine woodwork and crushed stone) and if necessary geotextile as defined in project design.
- Protect all trees which are not being removed for purposes of construction of regulation structures being constructed from the land.
- Do not perform works, except emergency works during nesting of birds namely in the period from 01 January to 1 July
- Do not light open fire in the vicinity of forests.
- Propose reconnection and revitalization of old side arms and river channels along the Danube River.

River navigation protection measures

- Properly label vessels and organize their constant surveillance.
- Traffic of vessels carrying construction equipment should be organized in a way to reduce likelihood of accidents and also to avoid unnecessary traffic.
- Properly label inland waterway in accordance with the regulation structures that define the regulation axis and place appropriate signalization on the river banks and waterway.

Measures to mitigate adverse effects of undertaking on ecological network

- Avoid removal of trees and shrubs within the riparian habitats outside the scope of revetment construction sites.
- Do not remove the fell tree trunks along the river banks that influence the creation of natural sandbars if they not directly interfere with the construction of the project structures.
- Noise, vibration and sedimentation within the water column should be reduced the extents of the structure that is being constructed.
- The construction of revetments in the area of steep soli banks should be performed outside the nesting period of kingfishers – perform works mid-May to mid-February.
- In the case of finding of animal dens (otters and beavers) and nests with eggs, cease all works and contact the Public Institution Nature Park Kopački rit.
- All waste materials should be immediately disposed to prevent their dispersion by the wind into river, and any waste including hazardous materials (packaging of chemicals, paints, solvents, oil waste, etc.) should be disposed in the special containers assigned for this purpose and disposed of through authorized legal entity.
- Refuelling of machines and vessels should be performed in a way to prevent contamination of the waterway.
- Servicing of machines and vessels should be performed on the dedicated area which are designated for servicing and maintenance of the equipment

14.2 Environmental protection measures during the use of undertaking

Water protection measures

- Undertake continuous monitoring of waterway in order to identify any possible damages due to construction works, disposal of materials into waterways, and erosion of the riverbed and banks.

Environmental protection measures

- Propose reconnection and revitalization of old side arms and river channels along the Danube River.

Measures to mitigate adverse effects of undertaking on the ecological network

- Perform monitoring programme against conservation objectives and assessment of effectiveness of conservation measures for ecological network in accordance with prepared elaborate – *Monitoring programme for ecological network which is integral part of Project Main Design.*
- If the results of the environmental monitoring programme show significant deviations from the baseline conditions, it is necessary to implement additional measures for revitalisation of objectives for conservation and ecological integrity of the network in accordance with additional measures prescribed within prepared elaborate - *Monitoring programme for environmental network, which is integral part of Project Main Design.*
- Ensure the undisturbed development of riparian vegetation on hydrotechnical structures.

Impacts in case of accidental events

- Provide continuous supervision of parts of construction site where flammable materials, fuel and lubricants are stored, in order to prevent an outbreak of fire at the site.

14.3 Environmental protection measures after termination of use

Regulation structures on the Danube River are permanent structures and environmental protection measures after termination of their use are not proposed. There is a possibility of upgrade to some of the structures if it is determined that they do not fulfil their expected purpose.

14.4 Measures based on international obligations of the Republic of Croatia

Planned construction of regulation structures on the river Danube is proposed to be performed on the territories of Republic of the Croatia and republic of Serbia. Based on the estimates presented in chapter *Possible transboundary impacts*, and all of the previous chapters of EIA, it may be concluded the planned activity will have identical effects on Serbian territory as on Croatian side.

Based on the above stated it is evident that during the construction and use of proposed activity with implementation of protection measures, there will be no significant negative impacts on wider transboundary area. Therefore, there is no need to prescribe specific measures for the protection from transboundary impacts. In addition, our neighbouring state of the Republic of Hungary is also a signatory of Espoo Convention.

15. Data and materials used for assessment

To assess the impact of the planned project, "Maintenance of waterway and construction of regulation structures on the Danube River from 1380 to 1433 km r", on the environment and proposal of environmental protection measures the following material were used:

- Atlas of the Danube River, km 1433 - km 1333, 1978-1980.
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- Charlton, Ro. 2007. Fundamentals of Fluvial Geomorphology. Routledge.
- Dingman, S. Lawrence. 2009. Fluvial Hydraulics. Oxford University Press, USA.
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- The Danube Commission, the Danube waterway – From the Hungarian-Yugoslav border to the confluence of the Sava (km 1433-1170), Scale: 1:10000, 1987.
- The Danube Commission, Recommendations for the establishment of navigable fairway dimensions, hydraulic and other structures on the Danube, Budapest, 1988.
- Einstein, H.A. 1951. The bed-load function for sediment transportation in open channel flows. WATER RESOURCES BUILDING: 43.
- Elaborate for technical solution of cleaning Vemeljac side arm at the confluence into the River Danube at 1406+800 r.km, Hidroing Ltd. Osijek, 2008. - Project Number: I - 1041/08
- Study the technical solution of the opening on lateral structure on the river Danube at r.km 1393, Hidroing Ltd. Osijek, 2008.. - Project Number: I - 1042/08
- Garde, R.J. 2006. River Morphology. New Age International Pvt Ltd Publishers.
- Geomorphological study of the impact of regulation works on the environment on the Danube River from 1433 to 1380 RKM, Andrew Bognar * (November, 2010.)
- Main-design project - urgent repair of regulation structures on the right bank of the Danube River from 1405 km to 1407 km in order to stabilize the banks,and perform technical maintenance of river and international waterway, Hidroing Ltd. Osijek, 2005. - Project Number: I - 771/05
- Main-design project - urgent repair of regulation structures on the right bank of the Danube River from 1405 km to 1407 km in order to stabilize the banks, and perform technical maintenance of river and international waterway: structures - 5-D/3 and 5-D/1, Hidroing Ltd. Osijek, 2007. - Project Number: I - 924/07
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- HEC-GeoRAS 4.2 User's Manual, US Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, September 2009
- HEC-RAS 4.1 Hydraulic Reference Manual, US Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, January 2010
- HEC-RAS 4.1 User's Manual, US Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, January 2010
- Hydrological analysis of the section of the Danube river - rkm 1380 to rkm 1433, Prof.. Dr.. Ognjen Bonacci, Split, May 2010.
- Preliminary design - rehabilitation of riverbed and the right bank of the Danube from 1380 km to 1400 km with the aim of the technical and economic maintenance of river and international waterway, Hidroing Ltd. Osijek, 2006. - Project Number: I - 814/06

- Preliminary design - rehabilitation of riverbed and the right bank of the Danube from 1410 to 1433 r.km with the aim of technical and economic maintenance of river and international waterway, Hidroing Ltd. Osijek, 2007. - Project Number: I - 961/07
- Preliminary design – rehabilitation of riverbed and the right bank of the Danube between 1400 to 1410 km, Hidroing Ltd. Osijek, 2004. - Project Number: I - 634/04
- Report on status of the state of environment in Republic of Croatia, National department for Protection of Nature and Environment, Zagreb (1998).
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- Jovanovic, M.B. (2002). "Regulation of the river - like river hydraulics and morphology," Civil Engineering Belgrade
- Julien, Pierre Y. 2002. River Mechanics. Cambridge University Press.
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- Loucks, D. P. (2006). Water Resources Systems Planning And Management (Studies and Reports in Hydrology) (p. 680). United Nations Educational.
- *Memorandum of Understanding of Corridor VII*
- Muškatirović D. (1991). "Regulation of the river," Civil Engineering University of Belgrade
- Inland waterway on Danube – from Hungarian-Yugoslav border to the confluence of the Sava (1433-1170 km), scale 1:10000, the Danube Commission, Budapest, 1987.
- PLATINA Manual on good management practices
- Handbook of inland navigation in the Republic of Croatia, Center for the Development of Inland Navigation Ltd. (Zagreb, December 2006.)
- Regulation Project for Yugoslav part of the Danube sectors of common interest (km. 1433-1333), the Institute for Water Resources "Jaroslav Cherni" – company for maintenance of inland waterways, Belgrade 1978.
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- Maintenance study of the Danube on the sector from the Yugoslav-Hungarian border to Vukovar, the Institute for Water Resources "Jaroslav Cherni" - company for maintenance of inland waterways, Belgrade 1988.
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- Water Management Plan for the watershed of the Drava and the Danube in SR Croatia, Independent water management authority for water catchment area of the Danube and Drava in Osijek in 1986.
- *White paper – European transport policy for 2010: time to decide*
- Wu, W. (2007). Computational River Dynamics (p. 508). CRC Press.

16. Means and methods of assessment

Expected impacts were estimated based on the results of the following analyses and researches performed.

- Hydrologic features based on analysis of hydrological data measured at hydrological stations on the Danube River in the Republic of Croatia - Aljmaš in Serbia - Bezdan, Apatin and Bogojevo, and on the river Drava Belišće and Osijek.
- Hydrological - Hydraulic data were obtained from field measurements and were analysed by Faculty of Engineering, University of Zagreb, Faculty of Civil Engineering in Split.
- The hydraulic model of the existing and proposed state including analysis of alternative solutions
- Hydrogeological relations along the Danube River are defined on the basis of general geological map and results of the hydrogeological studies for water supply purposes.
- Geomorphological features based on maps for period between year 1783 to present day, their analysis and other researched carried out.
- Geotechnical features based on the results of geological and geotechnical engineering investigations.
- Soil characteristics based on the Croatian soil map and Soil map of the Danube River.
- Assessment of surface water quality was made based on the data from Croatian Water Authority from monitoring of water quality in the Danube in period the 2000 - 2009. In accordance with the provisions of Regulation on the categorization of water qualities (OG 77/98).
- Climate and meteorological characteristics based on the analysis of meteorological data measured at the meteorological station in Osijek up to 2009.
- Land cover of the area was produced based on the results of mapping for the needs of the Croatian vegetation map and field visits.
- Assessment of present habitats was based on the Habitat map of Republic of Croatia.
- Assessment of animal species was based on available data, performed researches on invertebrates, fishes, amphibians, reptiles, birds and mammals, and site visits.
- Assessment of protected species and habitats was performed in accordance with Nature protection act (OG 70/05), Birds and Habitats Directive and the Red Book of Republic of Croatia completed according to international standards set by the International Union for Conservation of Nature IUCN.
- Ornithological part of the EIA was completed by Department of Biology, University of Osijek.
- Impacts of the proposed undertaking on the ecological network are defined in accordance with Regulation on proclamation of National ecological network (OG 109/07).
- River transport, ports, navigation safety and environmental protection have been analysed based on the data from the Agency for Inland Waterways, Ministry of Sea, Transport and Infrastructure and Civil Engineering University of Zagreb.
- Data on the economy, existing features and infrastructure are taken from the County Physical planning documents.

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17. Environmental monitoring program

The regulation structures will not have negative impacts on the environment and due to quick fitting into existing environment will not stand out from natural banks of the river, and they will also blend into the natural landscape and will not impact the typical landscape of the Danube River.

With the aim of improving of current state of the Danube River it is necessary to implement monitoring scheme for condition of structures which will also include monitoring of their efficiency on establishing of regulation line and fitting into the environment.

17.1 Environmental monitoring before construction

Environmental monitoring prior to the construction of project refers to the current hydrological monitoring, and monitoring of the ecological status of surface water quality in the project area. Monitoring of water quality at existing stations on Danube and its tributaries is conducted by Croatian water authority at their laboratory, and hydrological monitoring and monitoring of groundwater levels is conducted by State hydro meteorological institute.

For successful monitoring it is very important to establish baseline conditions. For this purpose it is necessary to immediately begin with monitoring of water balance in the Kopački rit, in order to correctly and objectively make relation between proposed undertaking and potential changes in hydrological conditions of the area. Along with afore mentioned it is necessary to continue with regular monitoring scheme of water levels of the Danube and Drava.

It is necessary to define detailed programme for measuring of flow velocities and sediment transport on the main water bodies and lakes. Before defining of the monitoring programme it is necessary to perform field investigation of main channels and lakes during filling in and discharge of water to define the locations for taking of measurements. It is also proposed to establish measurements for quantity and temporal distribution of water (inflow via pumping stations Zlatna Greda, Tikveš and Podunavlje) and waters which flow into Kopački rit through dam Kopačevo.

In the Baranya region and area of Nature Park there is a present problem of groundwater monitoring. Croatian Hydro Meteorological Institute gathers the data on groundwater levels through the network of monitoring stations on water catchment area of the Drava and the Danube since 1960, which is may be divided into core network, stations outside the core network and network of second order. The catchment area of Baranya has nine piezometer measuring stations, out of which one (P-5), is located in the Nature park Kopački rit. It is therefore an urgent need to expand the network of measuring stations within the Nature Park.

Monitoring of individual biological components in Kopački Rit has been implemented recently or is currently in the phase of implementation. The results of these surveys and monitoring may be used as a baseline data for further observations.

Department of Biology, University of Osijek is conducting research and monitoring of physical (water level, depth, transparency, temperature, conductivity, sediment granulometry), chemical (concentration of dissolved oxygen, chemical oxygen demand, the amount of nutrients, suspended solids) and biological properties of water (amount of chlorophyll in the water as a measure of phytoplankton biomass, composition, abundance and seasonal dynamics of bacterial populations). The also monitor the composition of meiofauna and nematode sediment composition, population size and trophic structure of macrofauna and meiofauna in macrophyte communities, and they also performed inventory of lichens flora, researches of bacterioplankton and sessile bacterial communities-biofilms. Monitoring was established at five locations along the channel from Lake Sakadaš to the Danube (Sakadas lake, canal Čonakut, lake Kopačko, inflow into lake Kopačko and Hulovo channel).

Monitoring of ichthyofauna in Kopački rit was conducted at 8 locations during 2008. Results of this initial monitoring, as well as the results of several previous studies form a baseline conditions for future monitoring. Valuable data was obtained during several years of monitoring of bird populations in the Danube and Kopački Rit and it may serve as a starting point for further systematic monitoring. Current knowledge based on research of butterflies, dragonflies and vascular plants also represent a valuable starting point for monitoring.

Considering the phases and many years required for project implementation, exceptionally, in consultation with the Public Institution of Nature park Kopački Rit, baseline conditions may be determined based on the first cycle of monitoring (the first year of monitoring).

17.2 Environmental monitoring during construction

Monitoring during construction is essentially the same as monitoring during preparation works for the proposed project. It is necessary to emphasise that during the construction works on the proposed activity there will be no changes to the current hydrologic regime of the River in duration of construction.

Considering that the undertaking will be performed in phases during several years, and that the construction of specific elements of the project will overlap with the phase of usage of other elements, the monitoring required during the use of the project specified in the following chapter, applies to this period as well.

17.3 Environmental monitoring during the use of undertaking

Environmental monitoring after construction of the proposed undertakings is related to the following:

- hydrologic monitoring
- morphological condition of riverbed
- monitoring the status of constructed structures

Monitoring of usage of natural resources by sectors

- Monitoring of water levels for surface and ground waters
- Monitoring the conditions of forest systems

Monitoring of changes in the landscape

Within the preparation of Management Plan for Kopački rit, a map of land cover was made on the basis of topographical maps from the 1970's at the scale of 1:25.000 in accordance with EUNIS classification, after which necessary corrections were made on the basis of satellite images from Spot Image satellites from 2003. Results of the analysis of satellite images were transferred into polygons and layers in GIS. Regular mapping of land cover using the same method will show possible mid-term or long-term changes. Monitoring of changes in the landscape should be made using remote sensing methods, along with the verification of the results by field surveying. For this purposes it is necessary to ensure the acquisition of satellite image of protected areas and surroundings in adequate resolution (1-10 m) every 3 years, and to detect changes in the landscape with the help of GIS applications. Results of monitoring changes should be verified by field surveys and use of GPS devices.

Monitoring of indicator species and habitats

Monitoring of indicator species listed in Table 17.1 needs to be done on a regular basis each year. Design, methodology and timetable of the research must be confirmed by experts from various fields.

Table 17.1 List of indicator species

Species	Indicator	Subject of monitoring
Birds		
White-tailed Eagle *Haliaeetus albicilla*	State of wetland ecosystems	Nesting success, distribution, feeding, wintering
Black Stork *Ciconia nigra*	State of forest and wetland ecosystems	The success of nesting, migration flows, nutrition
Colonial nesting birds: Black-necked Grebe *Podiceps nigricollis* Cormorant *Phalacrocorax carbo* Little Cormorant *Phalacrocorax pygmeus* Grey heron *Ardea cinerea* Egret *A. alba* Purple Heron *A. purpurea* White egret *Egretta garzetta* Gak kvakavac *Nycticorax nycticorax* Yellow Heron *Ardeola ralloides* Gull *Larus ridibundus* Whiskered tern *Chlidonias hybridus* Common Tern *Sterna hirundo* Bee-eater *Merops apiaster* Sand martin *Riparia riparia*	State of wetland ecosystems	The success of nesting, migration flows, nutrition
White Stork *Ciconia ciconia*	Conditions of wet meadows and pastures	Nesting success, migration flows, nutrition
Black kite *Milvus migrans*	Condition of forest ecosystems and wet meadows and pastures	Nesting success
Spoonbill *Platalea leucorodia*	State of wetland ecosystems	Course of the migration, nutrition
Mammals		
Common otter *Lutra lutra*	State of wetland ecosystems	Distribution and habitat use, nutrition
The European beaver *Castor fiber*	State of wetland ecosystems	Distribution and habitat use, nutrition

In addition to individual species, it is proposed to track the status of whole animal communities:

- Winter wetland birds count - conducted in January as part of an international project aimed at determining whether a protected area meets the criteria of the Ramsar Convention. The results of the counting contribute to the researches of climate change at the continental level.
- Regular monitoring of birds - is performed during the nesting season (April-May) as part of a pan-European project with the aim of determining the status of the population so-called common or widespread nesting birds of open, agricultural, and urban habitats.
- Monitoring of ichthyofauna to track the current wintering and spawn areas and to identify possible new ones
- Monitoring of dragonfly fauna
- Monitoring of the butterfly fauna of wetlands
- Tracking the status of rare and endangered plant species of wetlands

Nature Park Kopački rit in its Management plan emphasizes the necessity for monitoring of most of the above components, so the above specified monitoring should be organized in cooperation with the Nature park.

18 Name, address, telephone number and fax number of the designer

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19 Documentation included within Environmental Impact assessment

The environmental impact assessment for waterway maintenance and regulation works on the Danube River from 1380 to 1433 r.km Hidroing Ltd. Osijek (2010.)

Attached:

Non-technical summary of environmental impact assessment for waterway maintenance and regulation works on the Danube River from 1380 to 1433 r.km Hidroing Ltd. Osijek (2010.)