

Data Collection, hydraulic and morphological modelling of the
Danube River and the Sava River in the Republic of Serbia
Lot 1: Hydraulic and morphological modelling of the SRB-CRO
common stretch of the Danube River
2D Modelling Progress

Stakeholders' Forum Meeting No. 14

25/03/2025

Table of Contents

- Work plan
- 2D Modelling
 - Model development
 - Scenarios definition
 - River training structures
 - Scenarios overview
 - Simulations

Work plan

No.	Activity/Task/Output/Report	2024												2025					
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun					
		Month of the Contract																	
		M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13					
Activity 4	2D hydrodynamic and morphological modelling																		
Task 04-01	Data Collection																		
Task 04-02	Model Setup																		
Task 04-03	Model Calibration																		
Task 04-04	Model Verification																		
Task 04-05	Definition of Variants for each Bottleneck																		
Task 04-06	Preparation of Model for Considered Variants																		
Task 04-07	Analysis of Results																		
Task 04-08	Application of MCA																		
Task 04-09	Elaboration of Technical Report on 2D Modeling and Application of MCA																		
Meeting	Stakeholders' Forum meeting																		
Meeting	Stakeholders' Forum meeting																		
Meeting	Stakeholders' Forum meeting																		
Output 04-01	2D Model Calibrated and Running																		
Output 04-02	Bottlenecks Variants Defined																		
Output 04-03	Technical Report on 2D Modeling and Application of MCA																		
Activity 5	Elaboration of an Integrated study on alternative solutions																		
Task 05-01	Elaboration of an Integrated study on alternative solutions																		
Meeting	Stakeholders' Forum meeting																		
Output 05-01	Integrated study on alternative solutions elaborated																		

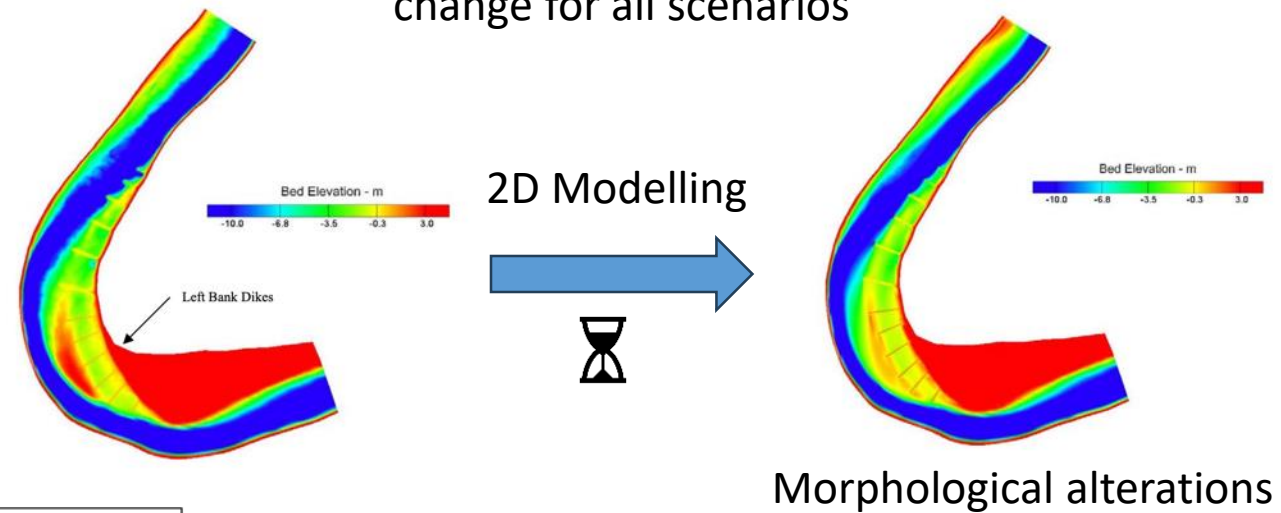
A4: 2D Hydrodynamic and Morphological Modelling

Purpose of the Modelling activity

- Evaluation of solutions whose impact is considered over time (scenarios)
- „Do nothing” is baseline scenario
- 2D Sediment transport model for morphological changes prediction (effects of solutions compared)

Do nothing – scenario without measures (even operational or maintenance measures not included)

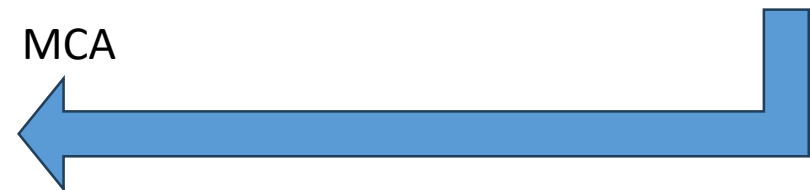
Numerical simulations of morphological change for all scenarios



This table is just an example.

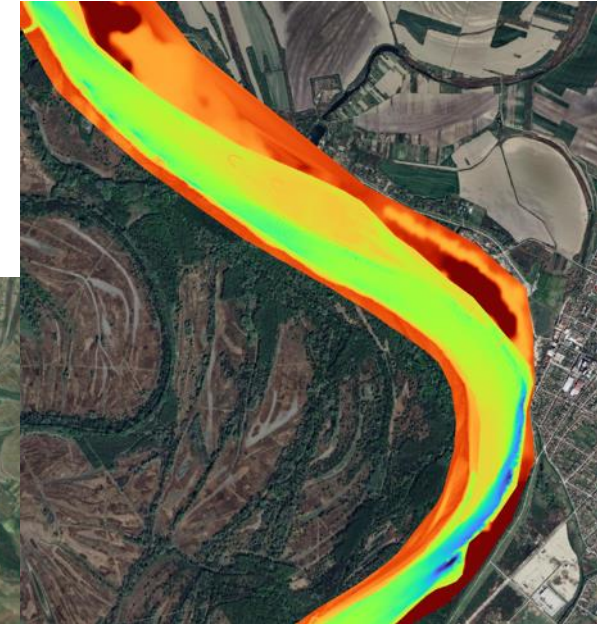
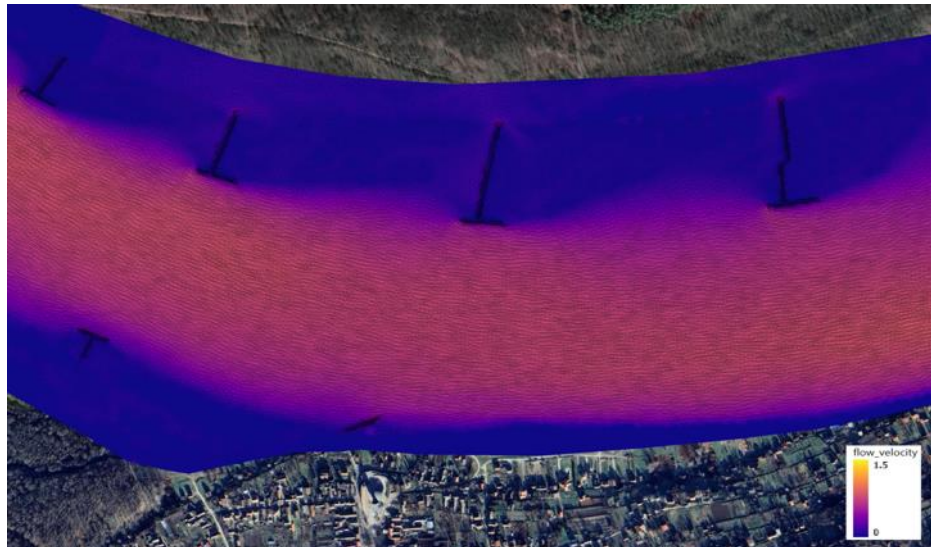
	Group score for navigation	Group score for environment	Group score for feasibility	Total Score
"Do nothing"	1.00	1.00	1.00	1.00
Groyne system	1.07	0.81	1.04	0.90
Fairway realignment	1.05	1.00	1.06	1.12

MCA



Model setup

- Model calibrated and validated (baseline scenario)
- Models created for all scenarios
- GPU parallelization enabled
- Hybrid riverbed model adjusted



4 Scenarios - Definition

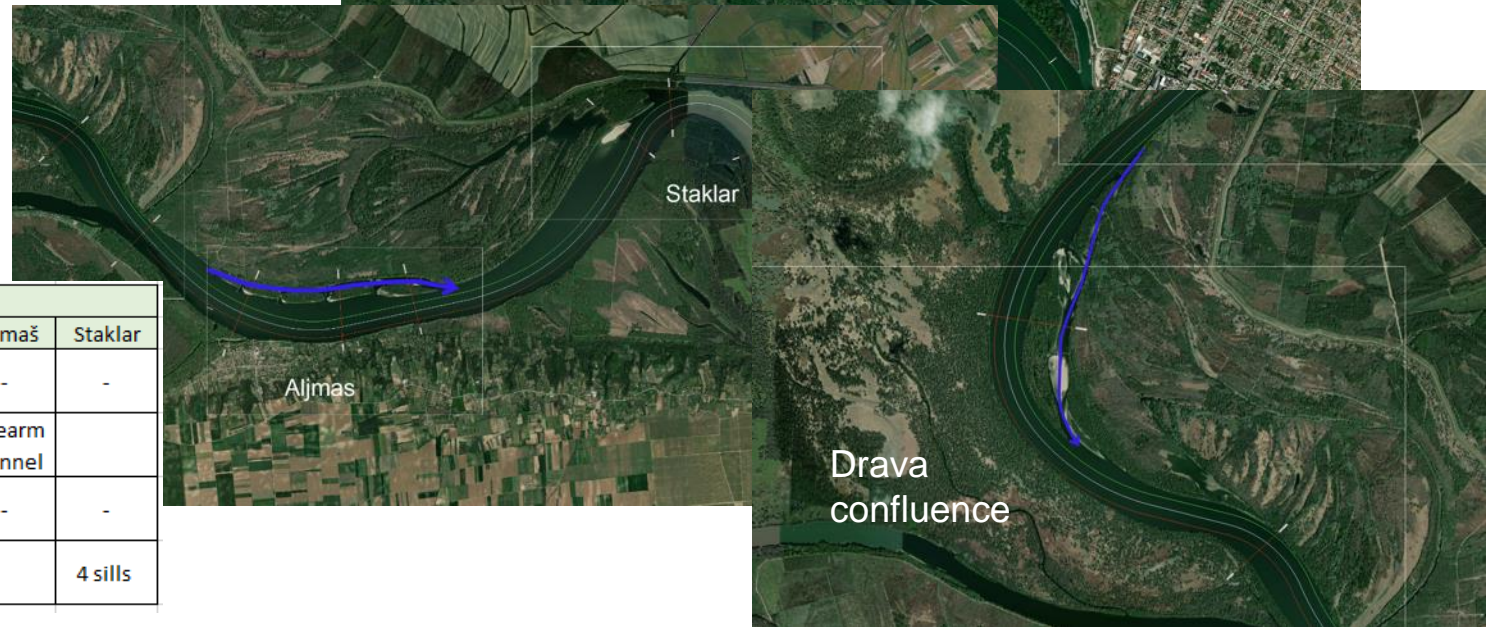
S1 - Do nothing

S2 - Structural and revitalization measures
 (2 chevrons, 3 sills and opening of 2 side arms)

S3 - Fairway realignment

S4 - Structural measures

(2 chevrons, 10 sills and 1 groyne)



Scenario	Sector				
	Apatin	Čivutski rukavac	Drava Confluence	Aljmaš	Staklar
Scenario 1 (S1) - Do nothing-	-	-	-	-	-
Scenario 2 (S2) - Structural and revitalization measures -	2 Chevrons, 3 sills		Sidearm channel	Sidearm channel	
Scenario 3 (S3) - Fairway realignment-	-	-	-	-	-
Scenario 4 (S4) - Only structural measures-	2 Chevrons, 3 sills	1 Groyne	3 sills		4 sills

River training structures

Chevrons:

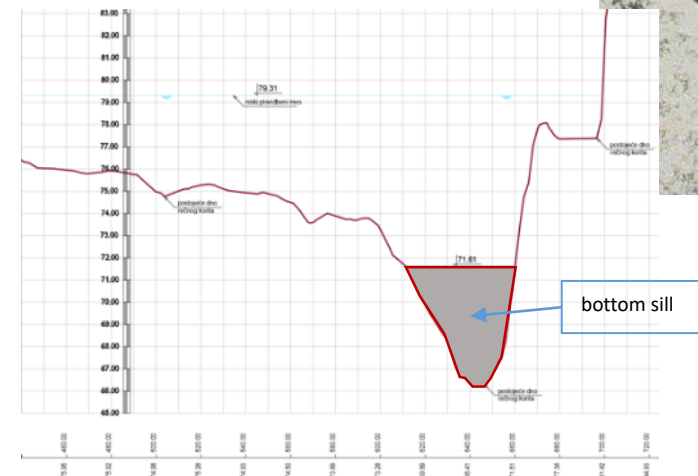
- Influence flow patterns
- Guide temporary sediment deposition behind the structure
- Habitat formation

Groynes (Traditional vs Detached):

- Influence flow patterns
- Sediment deposition between the structures
- Reduced environmental impacts (detached vs traditional groynes)

Bottom sill:

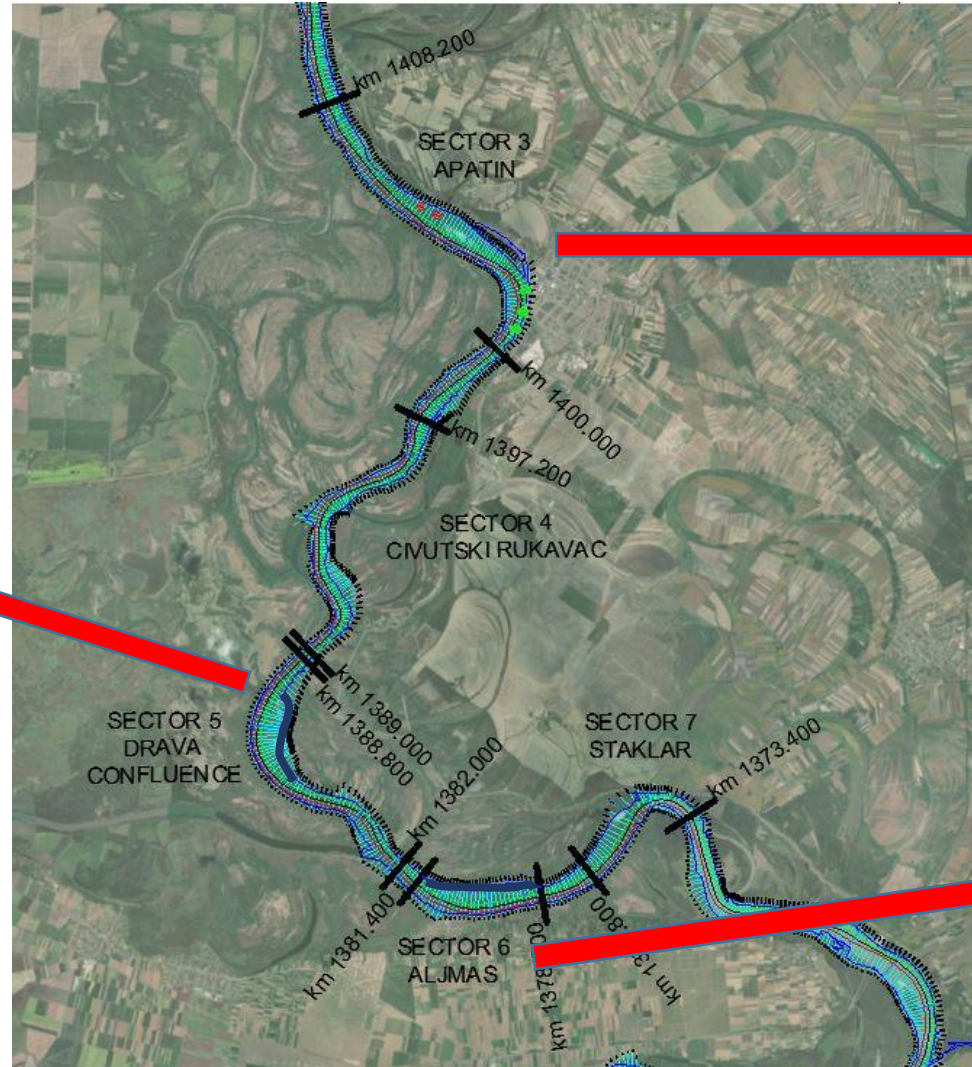
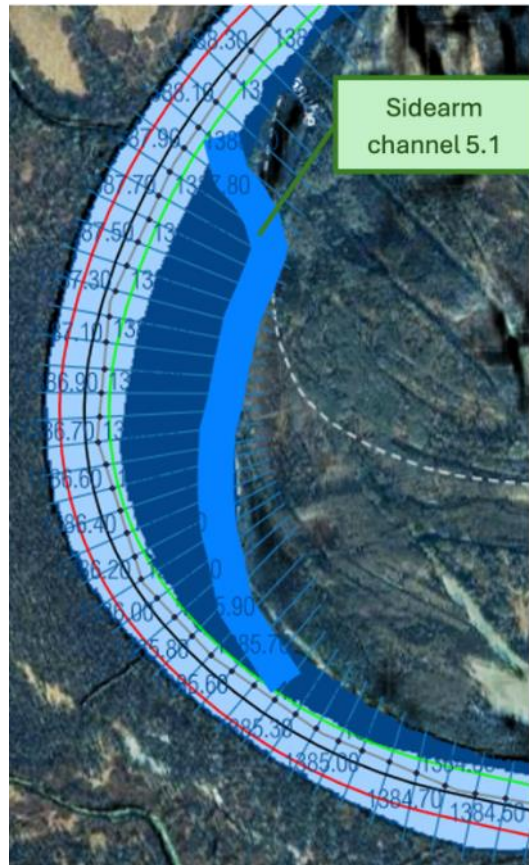
- Reduce riverbed erosion and redistribute water volumes across a selected area of the river



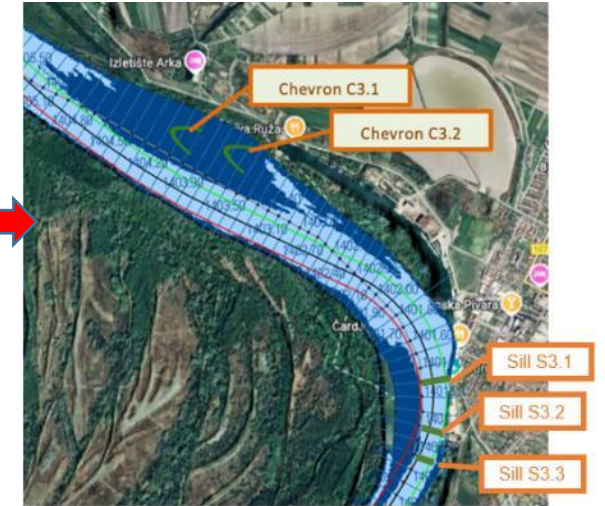
Overview of scenario

S2 – Structural and revitalization measures

Sector Drava Confluence



Sector Apatin



Sector Aljmaš



Legend
 ■ Water depth <2.5m bellow ENR
 ■ Water depth >2.5m bellow ENR



Republic of Serbia
 Ministry of Construction, Transport
 and Infrastructure

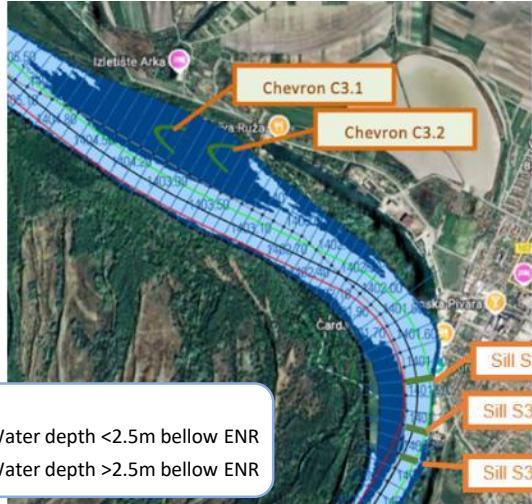
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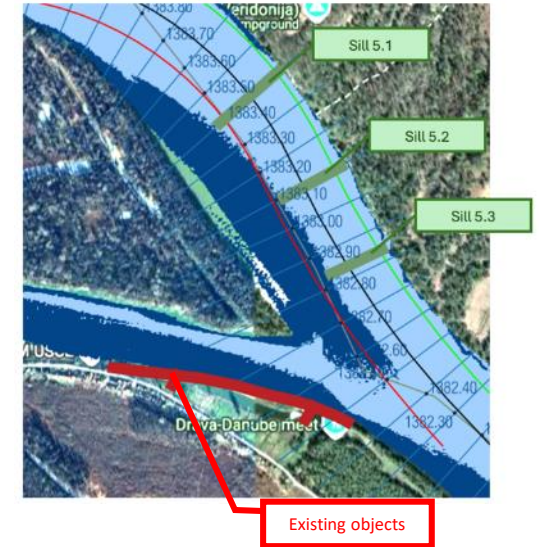
Overview of scenario

S4 – Structural measures

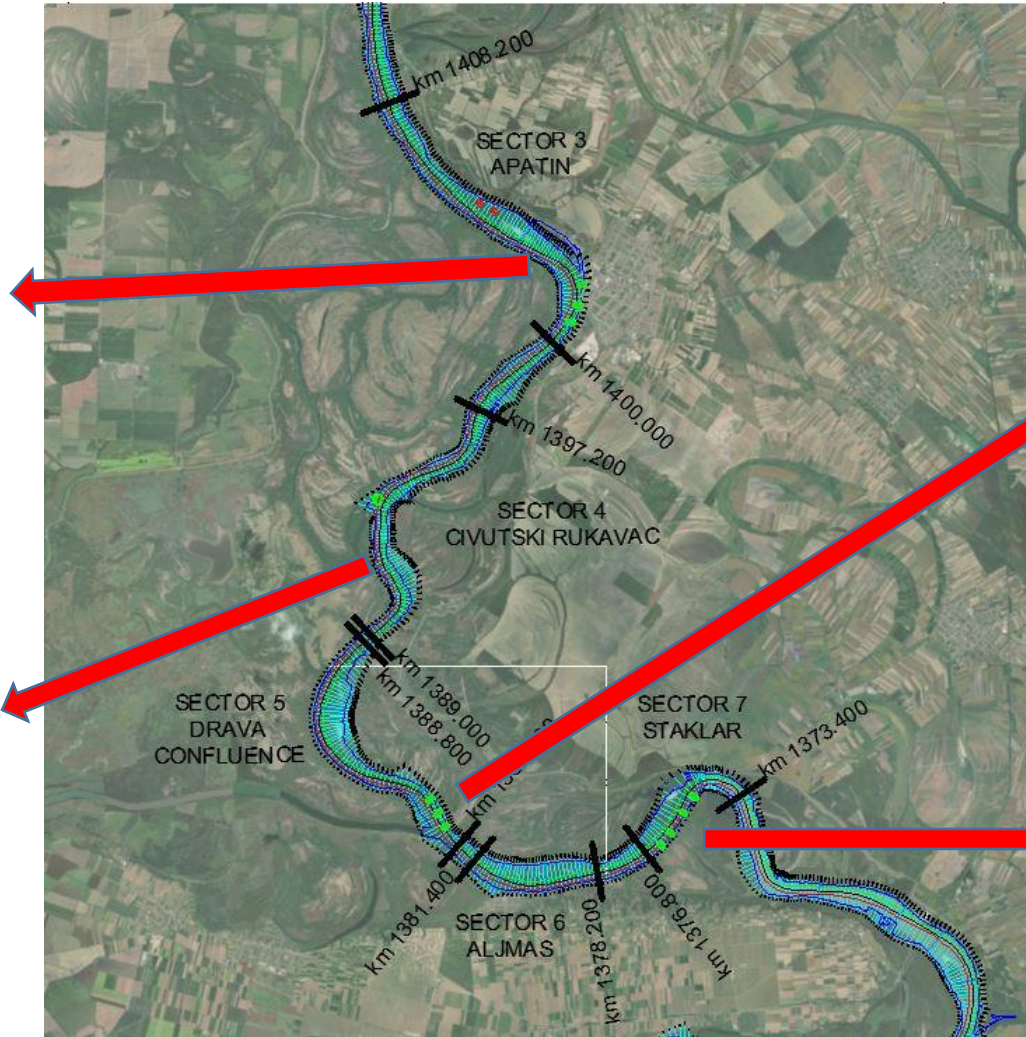
Sector Apatin



Sector Drava Confluence



Sector Čivutski rukavac

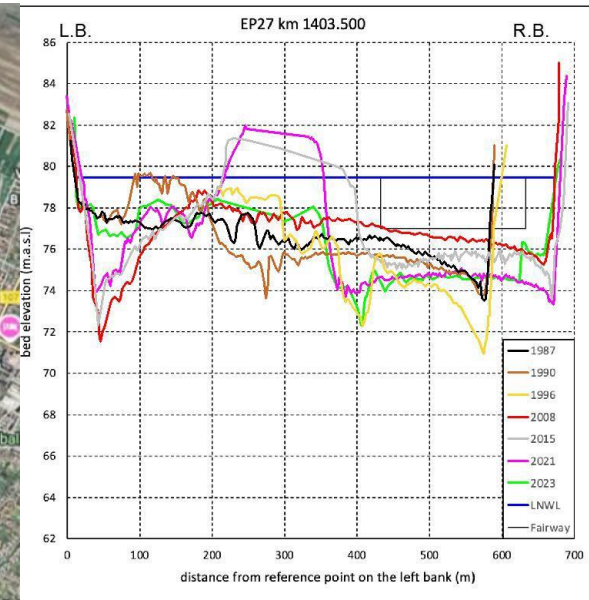
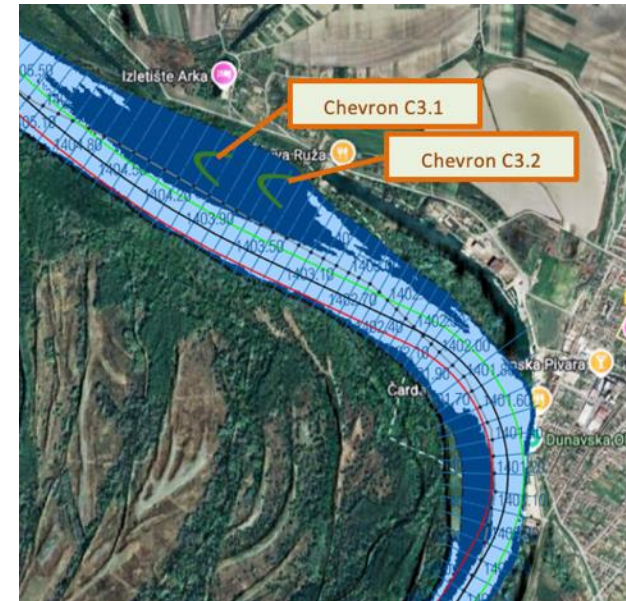
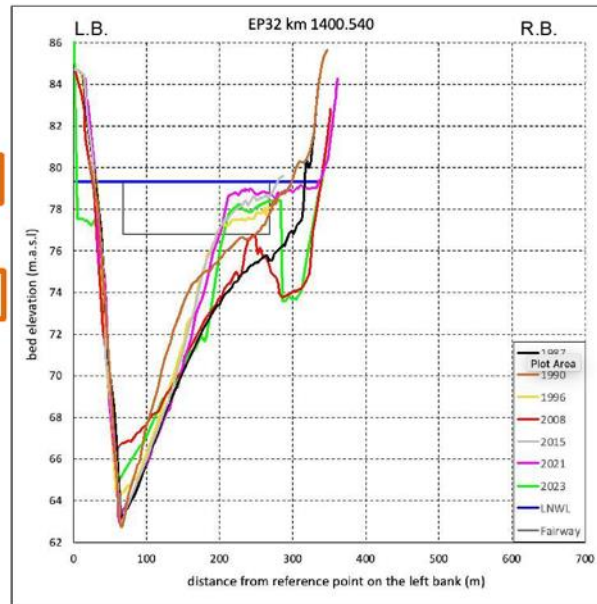
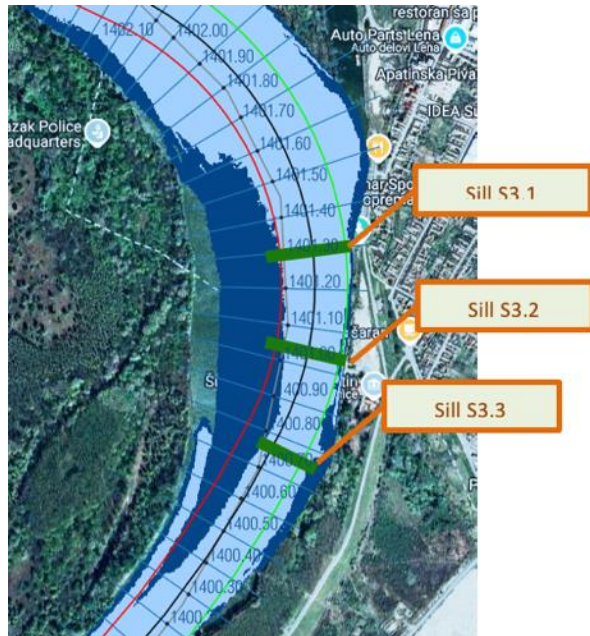
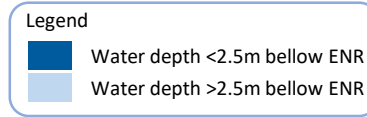
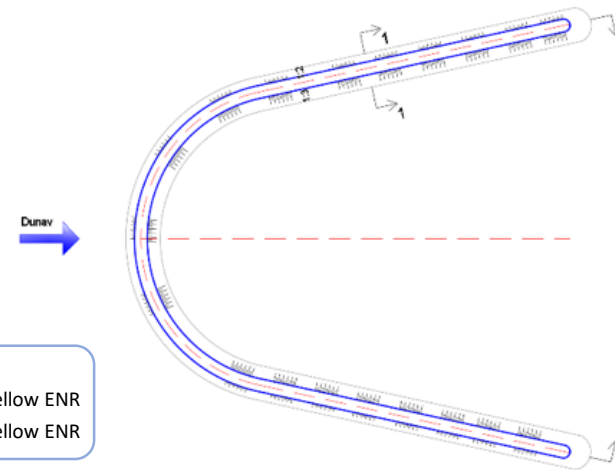


Sector Staklar



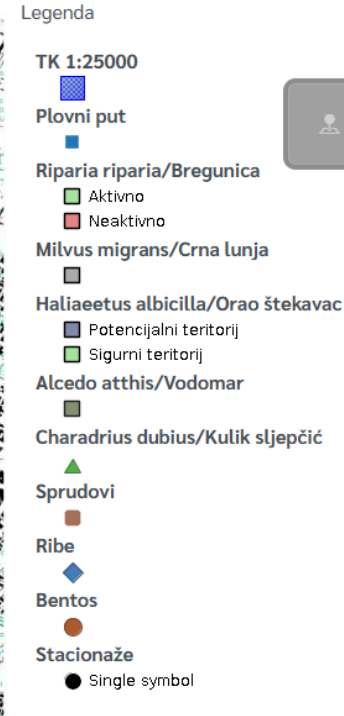
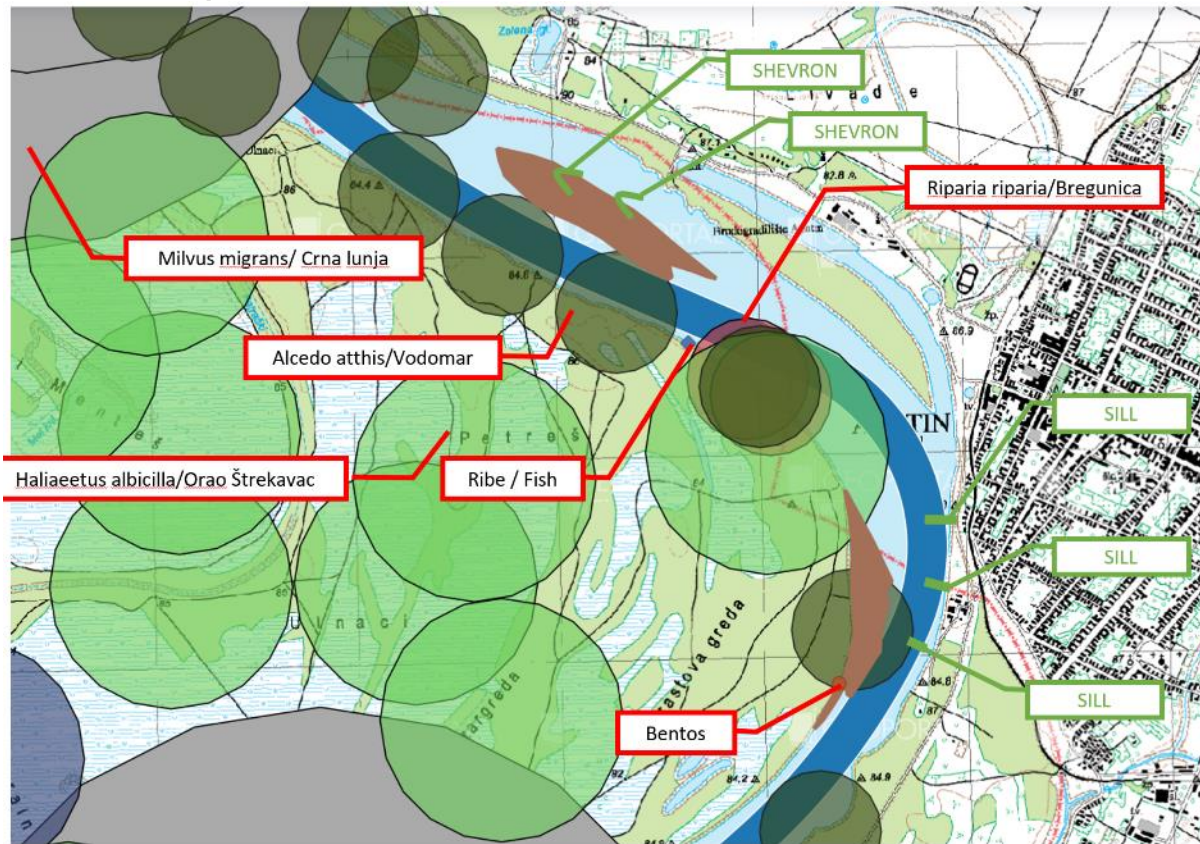
Apatin – Scenarios 2 and 4

- Unstable upstream sandbar
- Insufficient depths along the right bank (downstream sandbar along right bank)
- 2 chevrons + 3 sills (S2&S4)

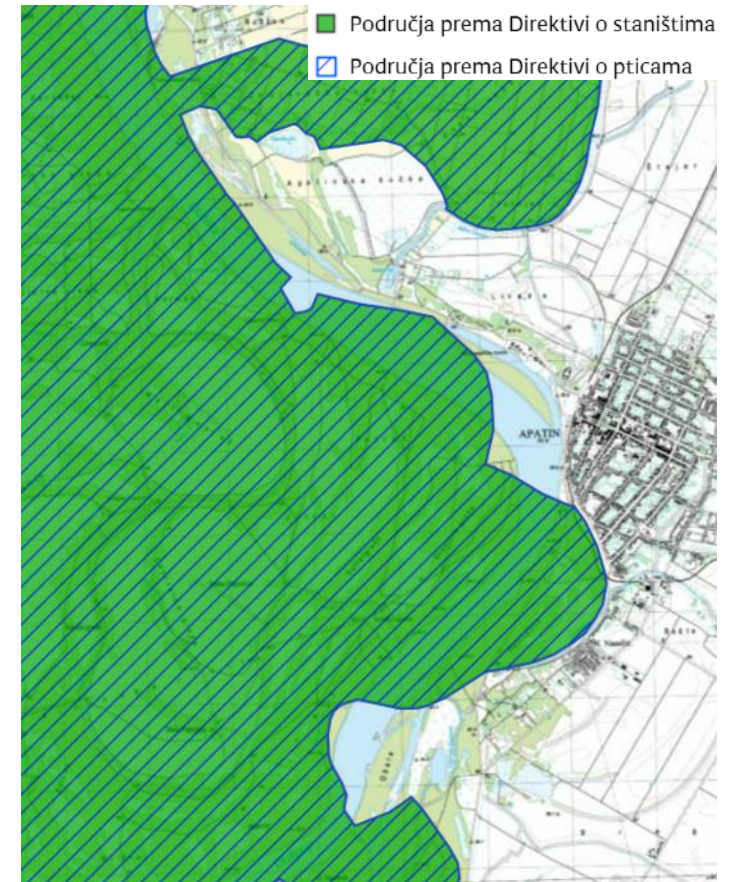


Apatin – Scenarios 2 and 4

Biodiversity overview



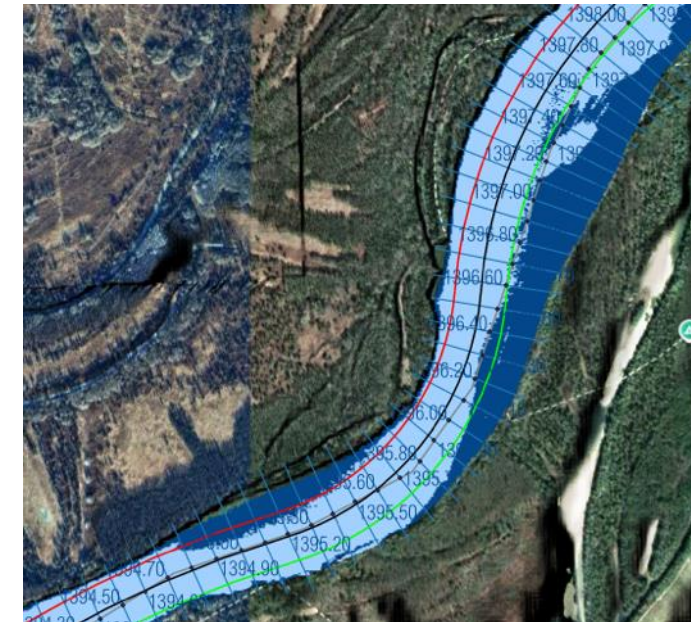
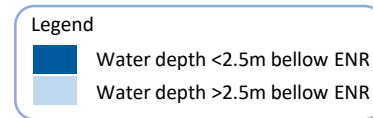
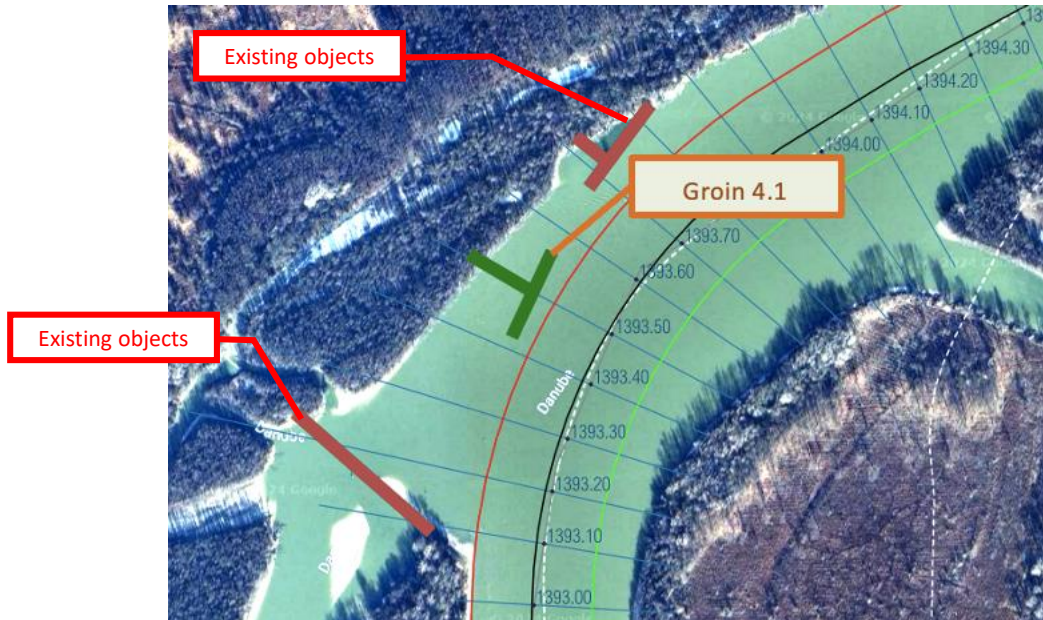
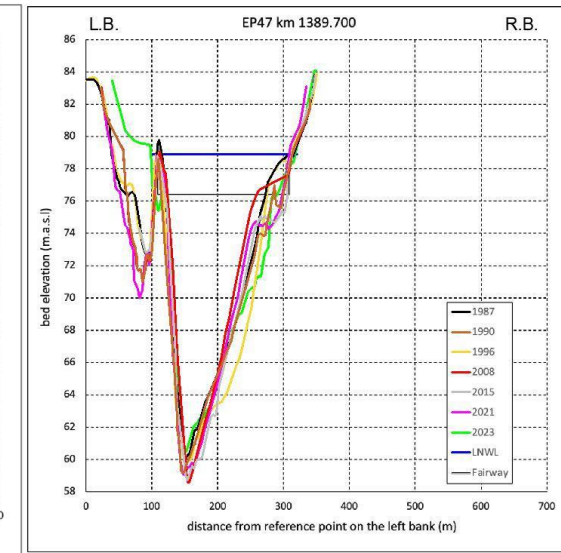
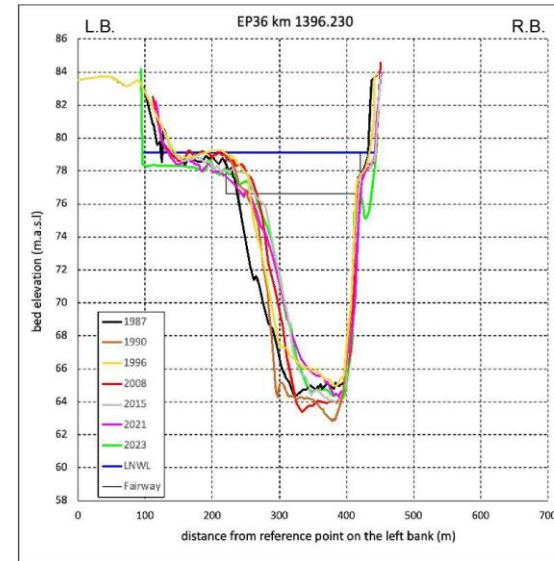
Natura 2000



Source: gis database created by the Croatian team

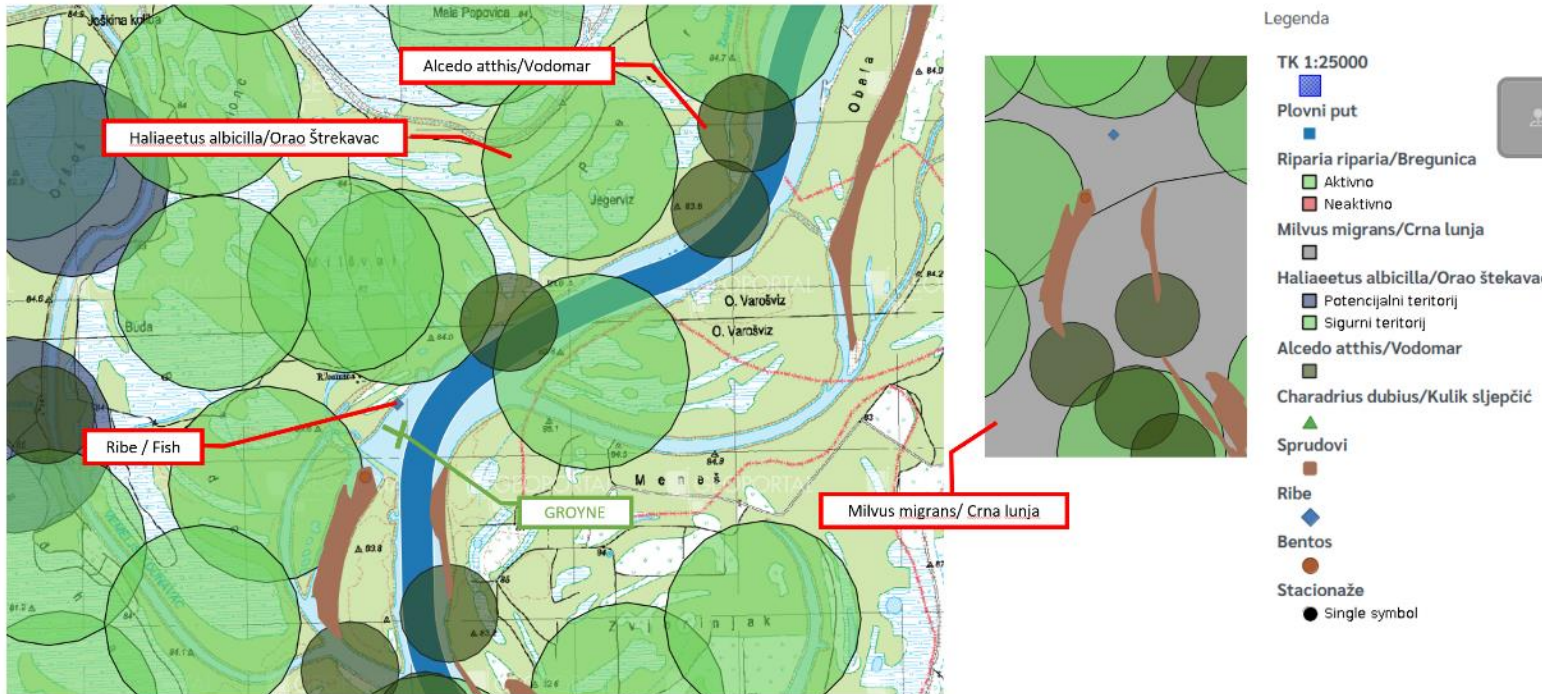
Čivutski rukavac – Scenario 4

- Narrow and deep section
- Insufficient depths only in a narrow zone along the edges of the fairway
- There is not much room for additional measures
- One groyne (S4) has been identified that could divert a significant portion of the flow toward the fairway



Čivutski rukavac – Scenario 4

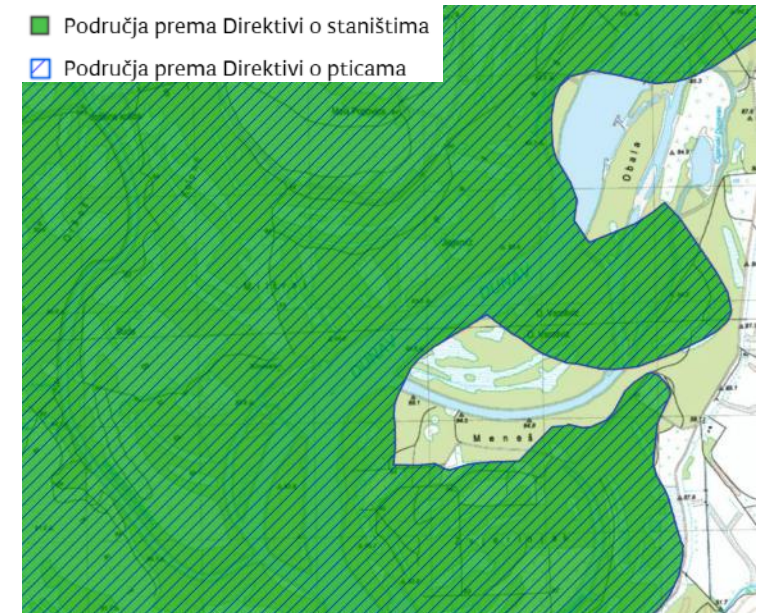
Biodiversity overview



THE ENTIRE SECTOR IS
 HABITAT OF CRNA LUNJA

Source: gis database created by the Croatian team

Natura 2000

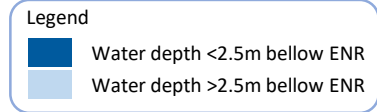
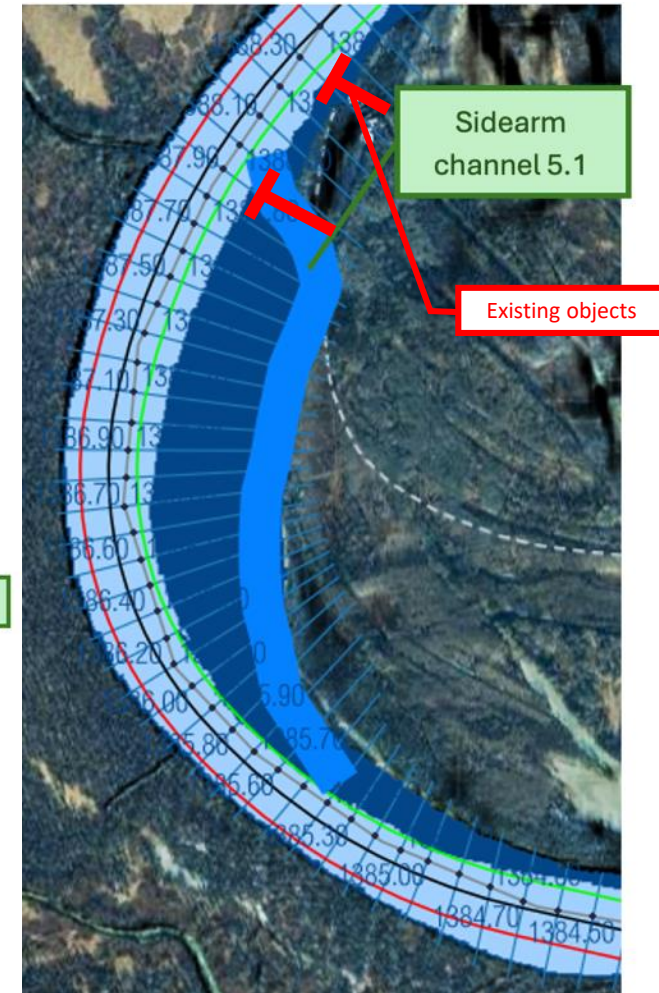
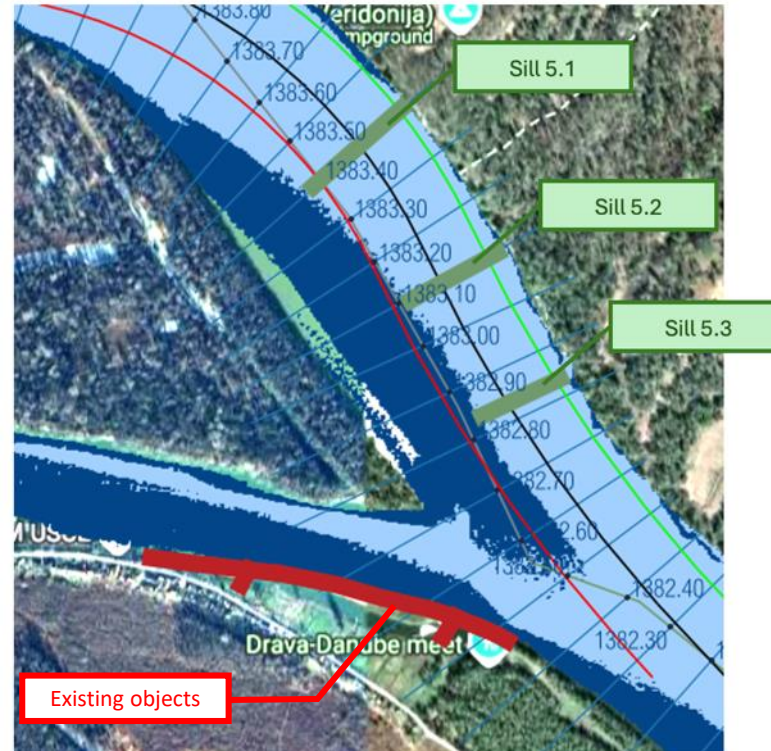
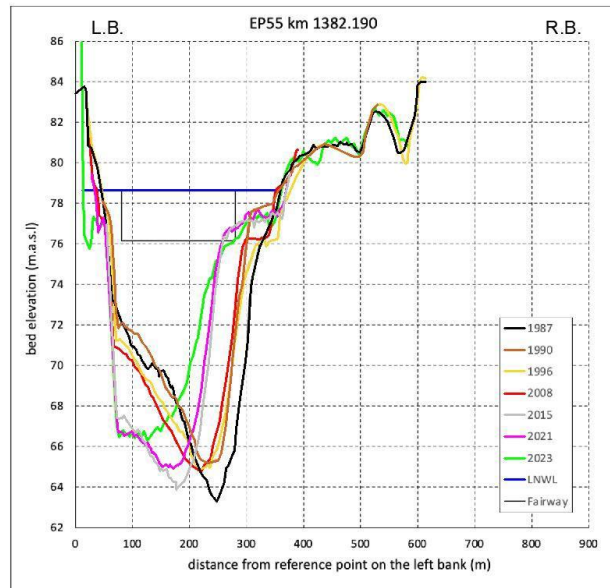


Source: gis database created by the Croatian team

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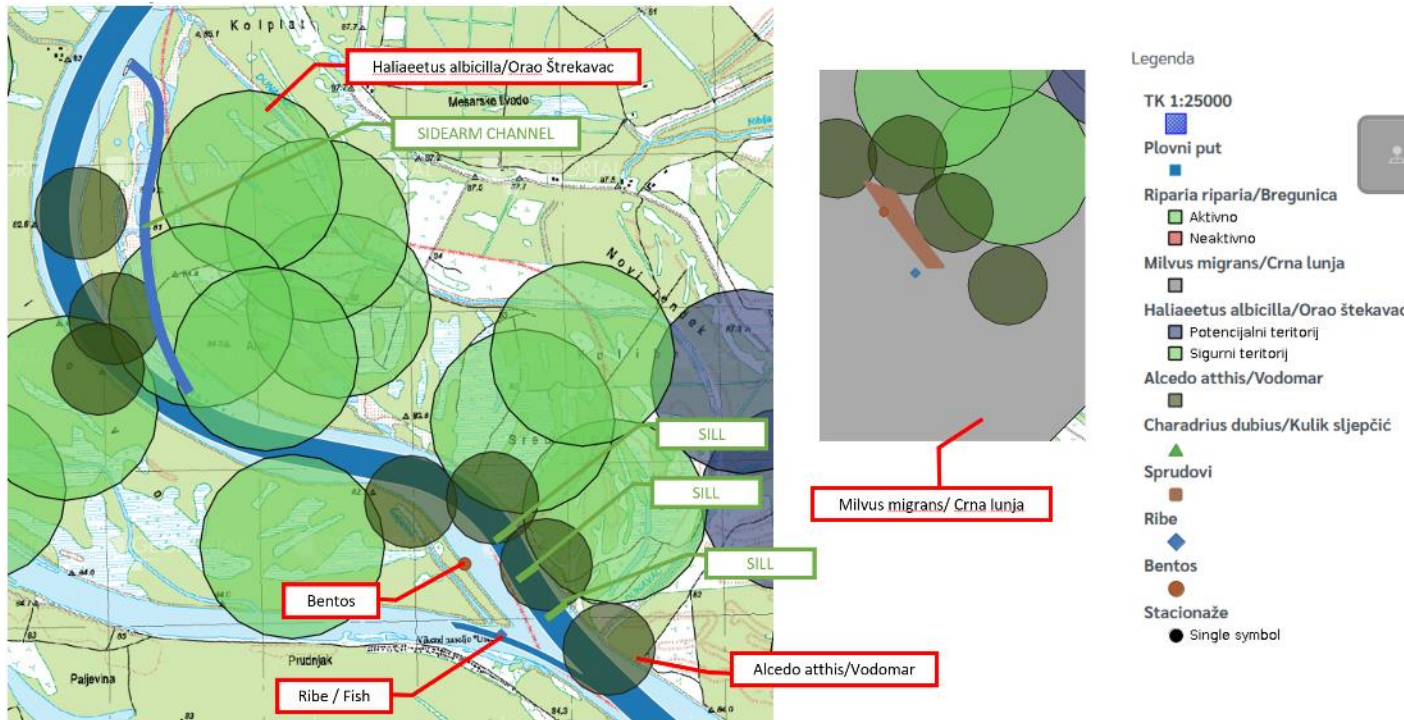
Drava Confluence – Scenario 2 and 4

- Obstacle for navigation is related to sediment deposition in confluence zone
- Reduction of sediment inflow by sidearm opening (S2)
- Increase in sediment transport capacity by constructing sills (S4)



Drava Confluence – Scenario 4

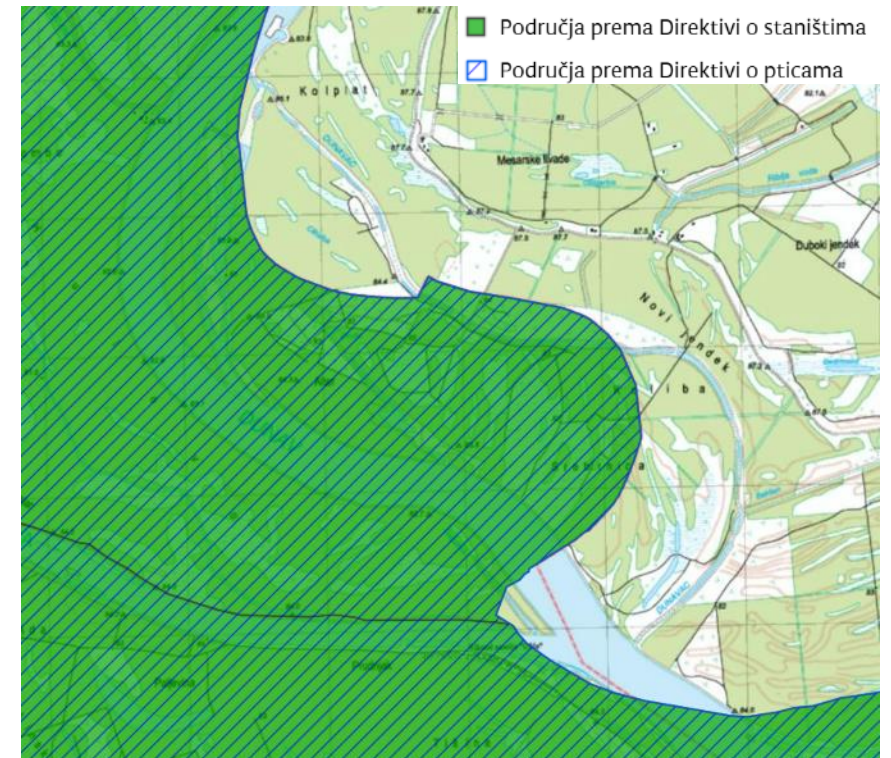
Biodiversity overview



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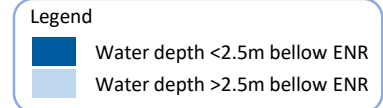
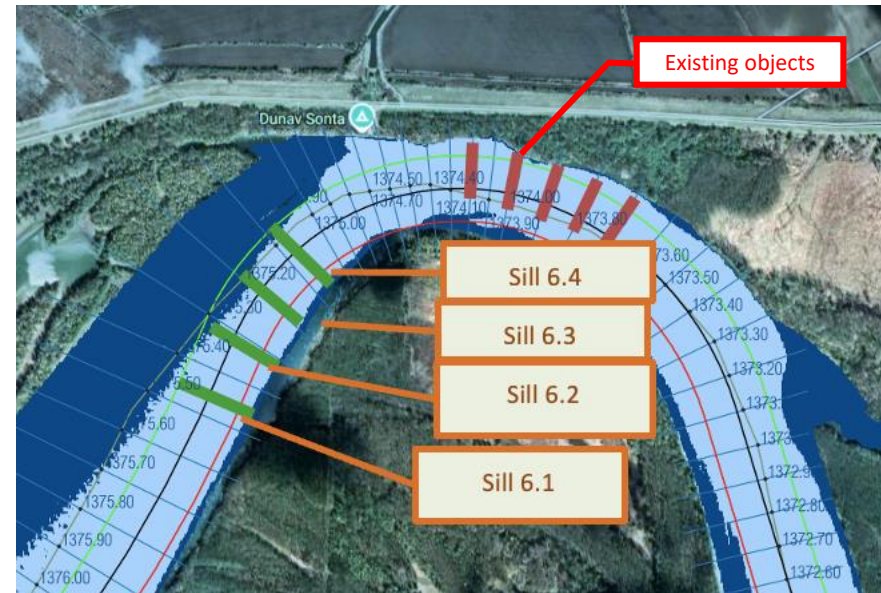
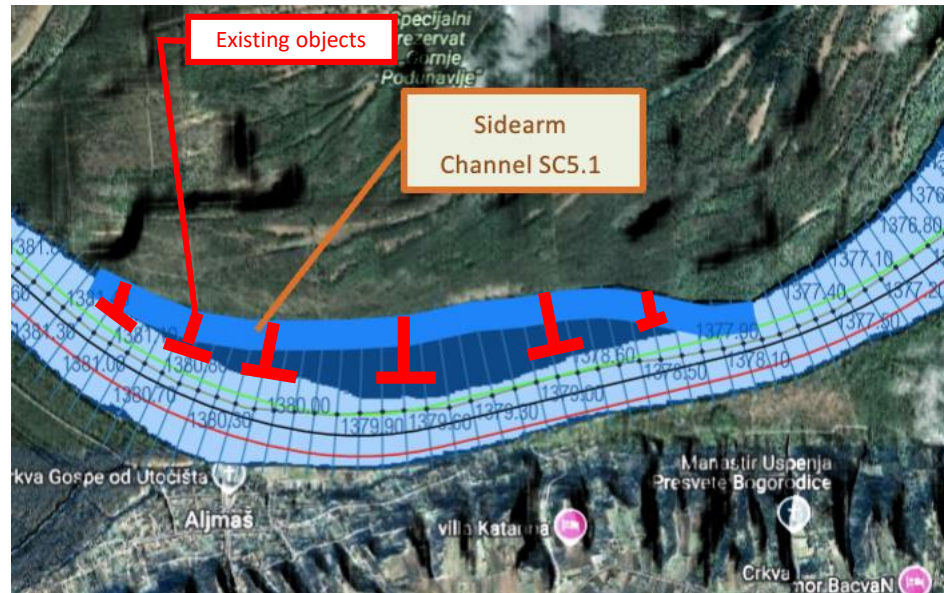
Source: gis database created by the Croatian team

Natura 2000



Staklar (and Aljmaš) – Scenarios 2 and 4

- Obstacle for navigation is related to sediment deposition in the curve zone
- Reduction of sediment inflow into the fairway by sidearm opening at Aljmaš (S2)
- Increase in sediment transport capacity by constructing sills (S4)



Staklar – Scenarios 2 and 4

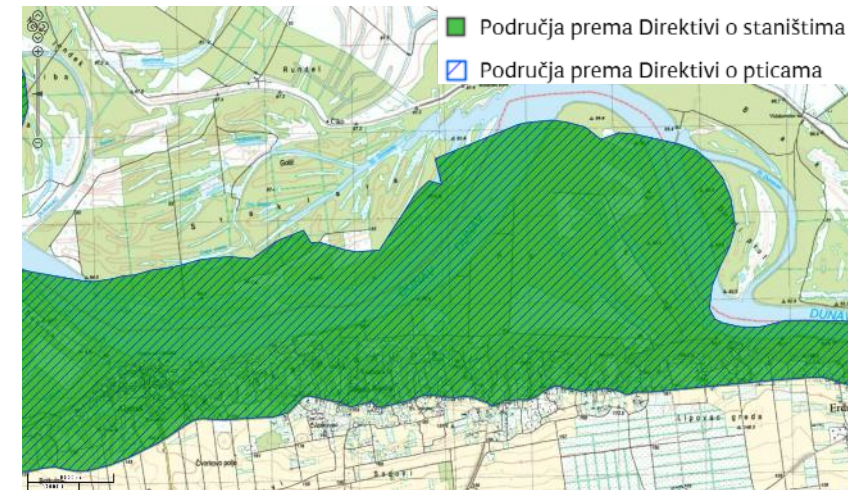
Biodiversity overview



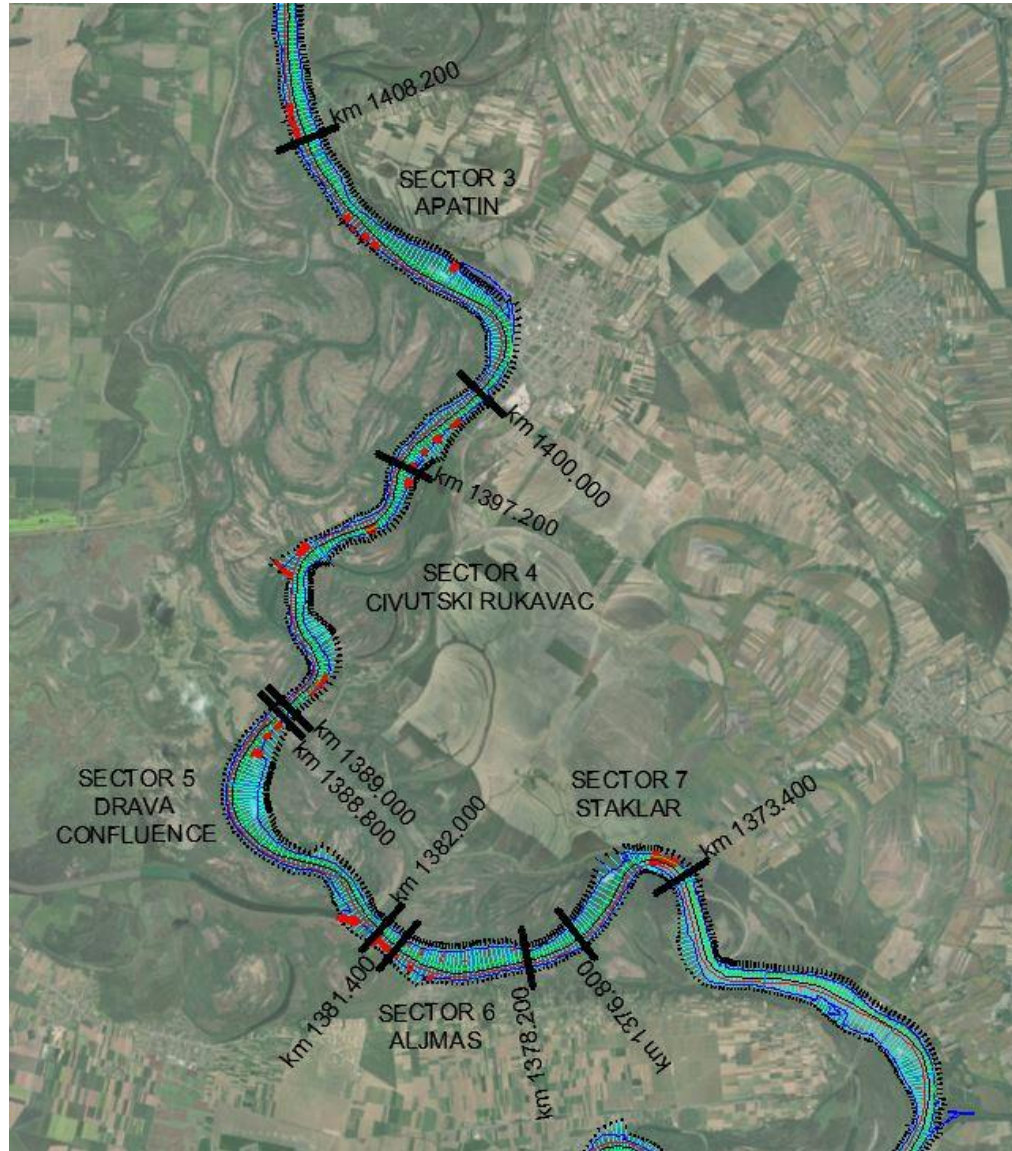
THE ENTIRE SECTOR IS
 HABITAT OF CRNA LUNJA

Source: gis database created by the Croatian team

Natura 2000



Existing river training structures on the Danube



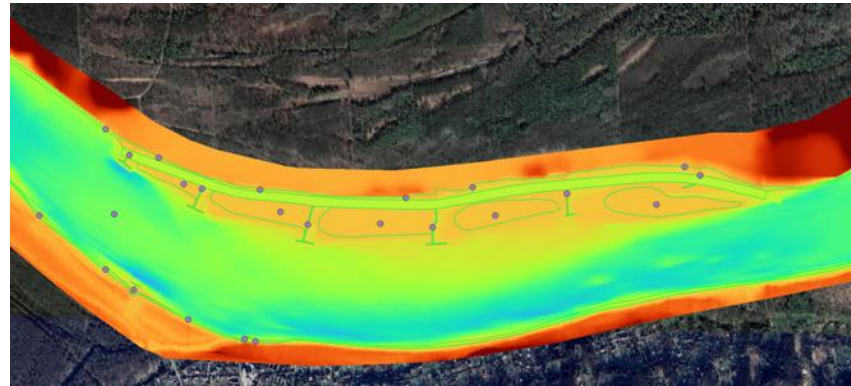
FACILITIES ON THE DANUBE													
Current situation													
Sector	Left side of the Danube						Right side of the Danube						
	Serbia						Croatia						
	r.b.	Station	Object type	Length	Label	condition	Station	Object type	Length	Height	Label	condition	
Sector 3 Apatin (km 1.408,2 - 1.400,0)	5					no data, but they all perform their functions so it can be say that they are in good condition	1406+281	Groyne	91.25	80.39	1406-D2	excellent	
	6						1406+001	Groyne	32.98	81.09	1406-D1	excellent	
	7						1405+691	Groyne	93.24	79.77	1405-D2	excellent	
	8						1405+383	Groyne	93.25	81.38	1405-D1	excellent	
Sector 4 - Civutski Rukavac (km 1.397,2 - 1.389,0)	13	1396+720	Groyne	115.44	\								
	14	1395+420	sills	153.70	\								
	15	1395+300	sills	81.64	\								
	16												
	17												
	18	1389+880	sills	153.70	\								
	19	1389+810	Groyne	81.64	\								
Sector 5 - Ušće reke Drave (km 1.388,8 - 1.386,8)	20	1389+525	Groyne	150.33	\								
	21	1388+640	Groyne	123.10	\								
	22	1388+325	Groyne	63.37	\								
	23	1387+910	Groyne	98.46	\								
	24												
Sector 6 - Aljmaš (km 1.381,4 - 1.378,2)	25						1382+557	sills	37.06	80.03	1382-D2	Satisfactory	
	26	1381+190	Groyne	66.76	\		1381+381	Groyne	85.31	79.62	1381-D1	excellent	
	27												
	28	1380+795	Groyne	73.38	\								
	29												
	30	1380+230	Groyne	81.44	\								
	31	1379+630	Groyne	89.56	\								
Sector 7 - Staklar (km 1.376,8 - 1.373,4)	32	1379+045	Groyne	53.75	\								
	33	1378+490	Groyne	123.76	\								
	34	1374+200	sills	85.00	\								
	35	1373+980	sills	85.00	\								
	36	1373+890	sills	85.00	\								
	37	1373+790	sills	85.00	\								
	38	1373+700	sills	85.00	\								

Based on the review of existing facilities, there is no basis for their removal, most are in good condition

Source: Data on existing objects for objects on the right side of the river were taken from the inventory of objects, and for objects on the left side of the river it was done on the basis of navigational bulletin, and the existing condition at low water levels

Preliminary simulation results

- Simulated morphological alterations for Scenario 1 serve as the basis for evaluating the effects of the measures
- Solution modifications (spatial characteristics)
- The report with the final results will be delivered by April 25th



Code	Criteria	Indicators	Acceptable Score	Weighting coefficient
N ₁	Maximal DC recommendations	<u>Quantitative</u> - Water depth ratio (width of 200 m used as reference value), Width ratio (water depth of 2.5 m used as reference value), Curve radius ratio	1.5 - 2	0.30
N ₂	Maneuverability	<u>Quantitative</u> - Velocity ratio <u>Qualitative</u> - Hindrance	0.25 - 2	0.05
N ₃	Safety	<u>Qualitative</u> - Visibility of the structures	0.25 - 1	0.05

Data Collection, hydraulic and morphological modelling of the Danube River and the Sava River in the Republic of Serbia
Lot 1: [Hydraulic and morphological modelling of the SRB-CRO common stretch of the Danube River](#)

Thank you for your kind attention

Stakeholders' Forum Meeting No. 14

25/03/2025