

WP6

Activity 6.1

Application: Floodplain tools optimization, application and dissemination

Deliverable D 6.1.2 (Part II)

Floodplain Evaluation Matrix Tool tested and applied in pilot site to assess the restoration projects

Results of applying FEM-Tool on Suhaia-Zimnicea and Bistret pilot areas

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Introduction

The proposed floodplain area Suhaia-Zimnicea has 1063 ha and is located in southern Romania along the Danube, in Teleorman county.

From administrative point of view it belongs to Lisa commune.

From the recent events we mention the period from beginning of March 2018 when the sudden melting of the snow, high temperatures and rain led to high water levels. In March 11-18, 2018 when the level in Lake Suhaia increased permanently by 10-15 cm per day. On March 19, the pumping station Garla Iancului started operating with 4 m³/s, taking into account the forecast on the nearby rivers Calmatui and Urlui in the area.

On March 27, 2018, when the water level in the lake was about 1.5 m above the normal level, the water spilled over the canopy of the western dam on a length of 10 m with a water blade of 3-4 cm.

The Danube water level raised beginning with 16 March 2018, and in 28 March the inundation level at Zimnicea gauging station exceeded inundation level.

The intervention was done by protecting the western dam of Lake Suhaia and raising the eastern dike to prevent the spill.

At the same time, the high water discharger of the western dike was put into controlled operation by lowering it by 30 cm for a controlled discharge in the drainage channels inside the enclosure.

On the western dike, the pitching was 80% destroyed, and on the eastern dike, the outer slope was 85% destroyed.

Assessing the creation of a naturally flooded area upstream lake Suhaia

The enclosure of Seaca-Vanatori-Suhaia-Zimnicea has an area of 14,161 ha. The area was in natural regime until 1965 - 1966. On the bank of the Danube there were willow forests, and inside the reed ponds: Luciei, Rosie, Listeava, Bran, Vasluietului, Suhaia, Lake Nasada and the rest of the reed swamp.



Figure 1: Historical map of the Suhaia area

Suhaia lake is recognized as a major component of what remains of the former Danube floodplain and is an integral part of the plan to rebuild the lower Danube green corridor, an agreement signed in year 2000 by Romania, Bulgaria, Moldova and Ukraine. Also, the presence of the Persina Natural Park (Bulgaria) in the vicinity of the Suhaia Lake, creates the premises for cross-border cooperation for the conservation of biodiversity and the functions of these ecosystem complexes on both banks of the Danube.

Balta Suhaia natural reservation is located in Teleorman county, belonging, from an administrative point of view to Suhaia commune. It is an avifauna reservation, being included in the fourth category of the International Union for Conservation of Nature.



Figure 2: Suhaia natural protected areas

The Suhaia area has a double protection status: Natura 2000 site (ROSPA0102 Suhaia) and wetland of international importance (RORMS0012 Suhaia).

The Natura 2000 site was declared a Special Protection Area by the Government Decision no. 1284 of October 24, 2007 (regarding the declaration of special avifauna protection areas as an integral part of the European ecological network Natura 2000 in Romania) and covers an area of over 4,515 hectares.

The Suhaia wetland of international importance (since June 2012) is protected by the Ramsar Convention. The site of over 19594 ha offers habitat to numerous threatened species of birds which feed, rest and breed here, including 21 bird species of European importance as well as the globally vulnerable Dalmatian Pelican (*Pelecanus crispus*). Moreover, several threatened species of invertebrates, fish, amphibians, reptiles and mammals can be found, including the globally vulnerable European Mudminnow (*Umbra krameri*).

Engaging stakeholders at the Suhaia – Zimnicea pilot site

The Suhaia City Hall has been involved (consulted by telephone) for the ESS assessment in the potential floodplain Suhaia-Zimnicea.

Setting up 1D and 2D models

The 1D hydrodynamic model developed for the entire length of the Danube River on the Romanian sector was used to calculate the parameters defined in the FEM. A 2D hydrodynamic model was developed to detail the flow in the area proposed for renaturation.

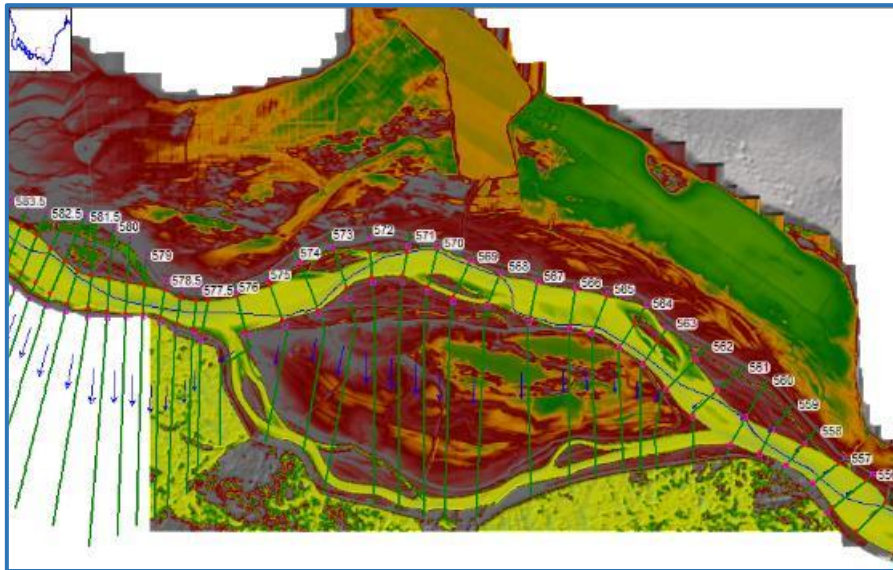


Figure 3: Distribution of cross sections along the Danube - Suhaia sector

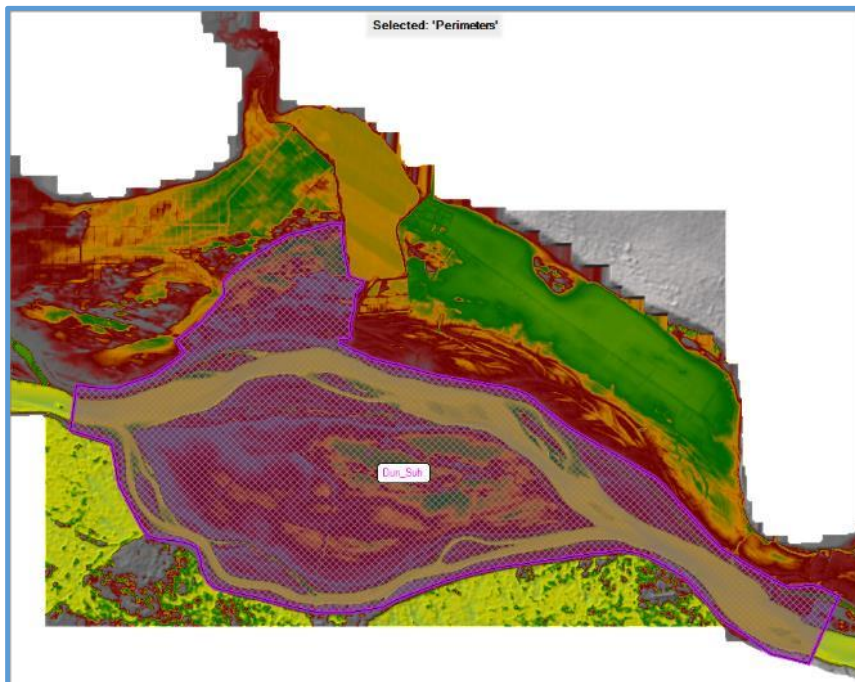


Figure 4: Field of analysis for the 2D simulation model - Suhaia area

The upstream limit condition consisted of the flow hydrograph corresponding to the flood recorded in 2006 scaled in accordance with HQ100.

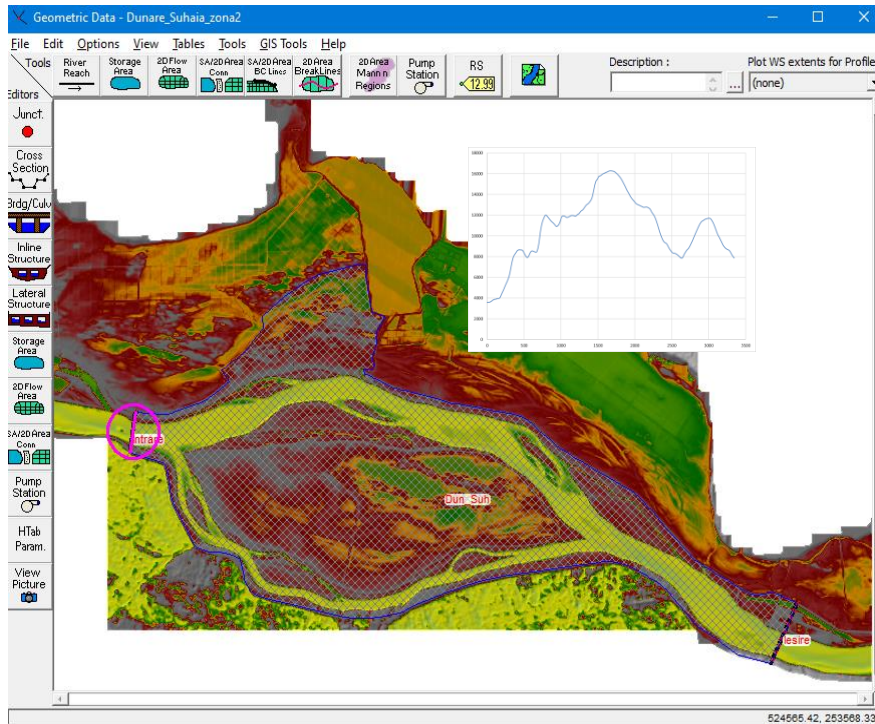


Figure 5: The upstream limit condition was the hydrograph corresponding to the flood recorded in 2006 scaled in accordance with HQ100

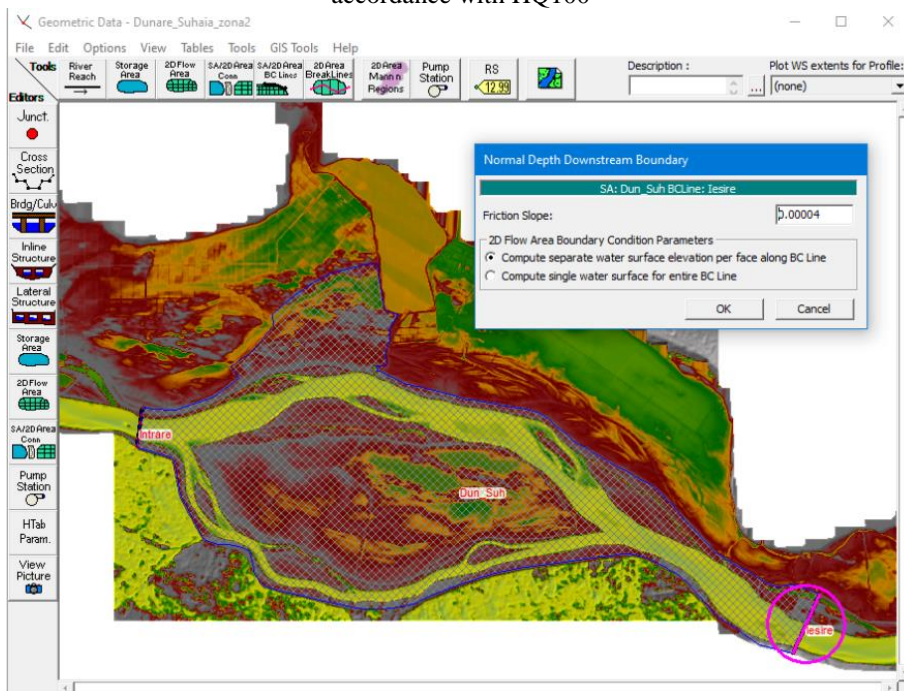


Figure 6: The downstream limit condition was the general slope of the respective riverbed 0.0004.

The discretization of the analyzed domain was performed by rectangular calculation cells with the size of 50 m x 50 m. Where there are infrastructures that can significantly influence the flow of water, the network has been detailed through rectangular cells measuring 5 m x 5 m.

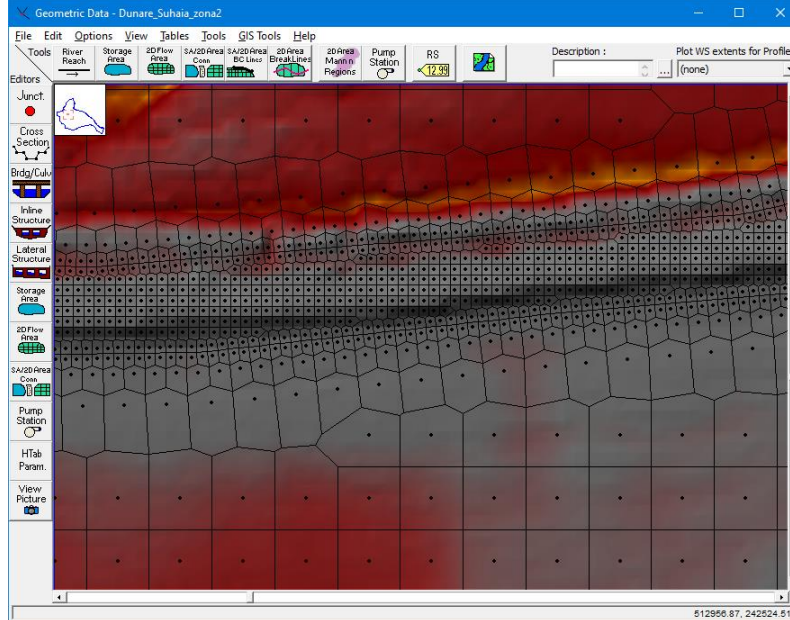


Figure 7: The discretization of the analyzed domain

The calculation step used to perform the simulations was 1 minute.

A. Calculating minimum Floodplain Evaluation Matrix (FEM) parameters for current and after restoration state – Suhaia Zimnicea pilot area

Hydrology

1.1. Flood peak reduction – ΔQ

1.1.1 Description

To evaluate the peak reduction for a floodplain, the peak of an input hydrograph at the beginning of the floodplain and the peak of the output hydrograph at the end of the floodplain were determined. The difference between the two peaks is the peak reduction ΔQ_{tot} [m³/s] for the investigated floodplain.

1.1.2 Source

For the determination of the peak reduction, results of unsteady hydrodynamic-numerical simulations were used.

1.1.3 Workflow

The following graphs show details from the peak area of the corresponding HQ100 flow hydrographs in the upstream and downstream sections of the area analyzed for renaturation. These were the basis for the determination of ΔQ in accordance with the requirements of the FEM.

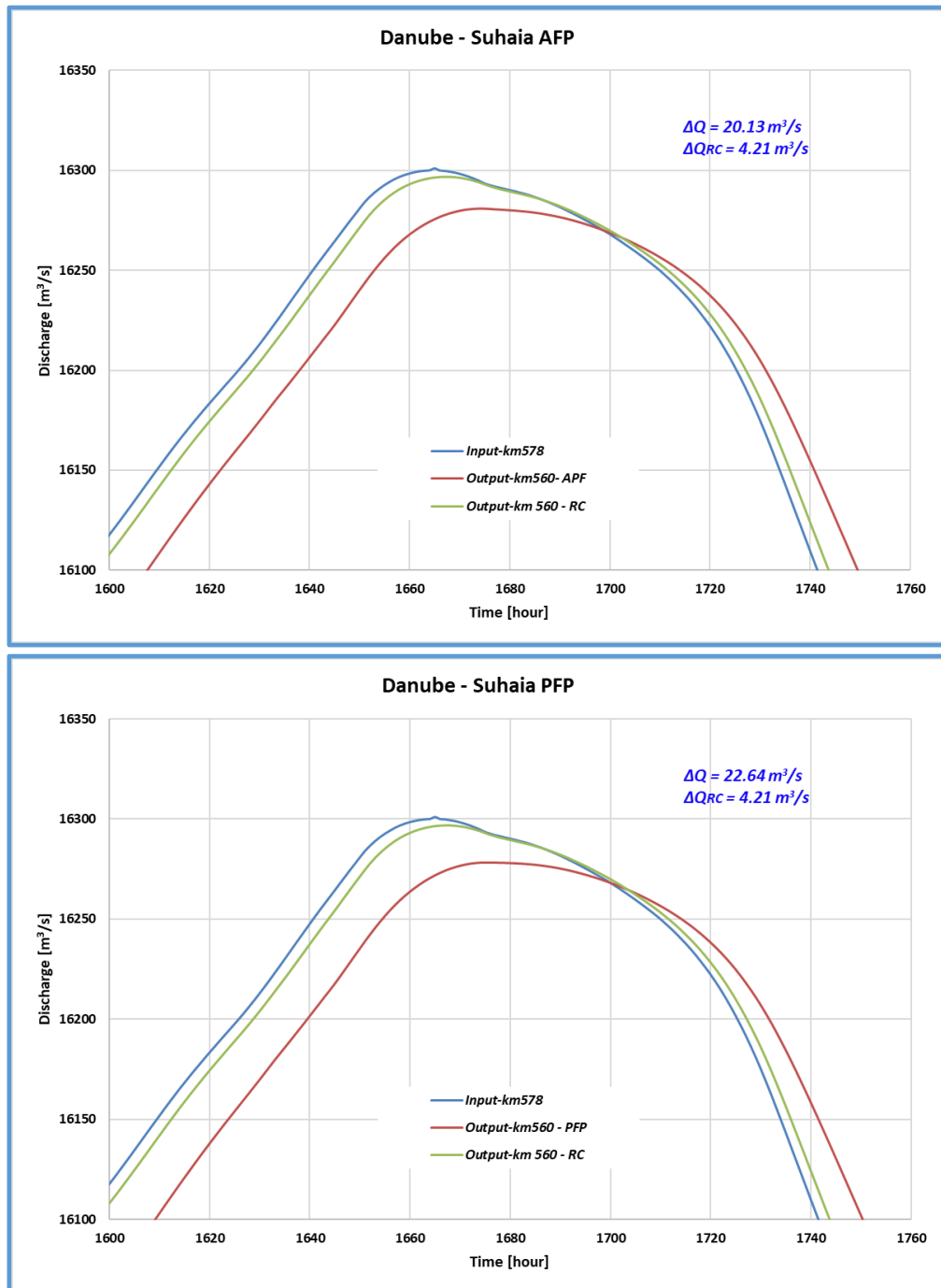


Figure 8: The results of the analysis for the *Flood peak reduction* (ΔQ) parameter for the active and potential floodplain

1.1.4 Results

In table 1, the results of the peak reduction for the active and potential floodplain are presented. The ΔQ for the active floodplain is around 16 m^3/s resulting in a relative peak reduction of 0.19%. The ΔQ for the potential floodplain slightly increased approximately to 18 m^3/s and a

relative reduction of 0.22%. For both floodplain scenarios, the performance for the flood peak reduction parameter is low.

Table 1: Flood peak reduction parameter on Suhaia-Zimnicea pilot area - FEM evaluation (for current and potential situation)

Potential floodplain	Hydrology				
	Peak reduction (m ³ /s)				FEM Evaluation
	ΔQ_{tot}	ΔQ_{RC}	ΔQ	ΔQ_{rel}	
RO_Suhaia-Zimnicea_pFP	22.64	4.21	18.43	0.22%	1
RO_Suhaia-Zimnicea_aFP	20.13	4.21	15.92	0.19%	1

1.2. Flood wave translation – Δt

1.2.1 Description

This parameter is determined in a similar way as the peak reduction, namely by calculating the time difference Δt [h] between the occurrence of the output/input hydrograph peak.

1.2.2 Source

For the determination of the flood wave translation results of unsteady hydrodynamic-numerical simulations were used.

1.2.3 Workflow

The following graphs show details from the peak area of the corresponding HQ100 flow hydrographs in the upstream and downstream sections of the area analyzed for renaturation. These were the basis for the determination of ΔT in accordance with the requirements of the FEM.

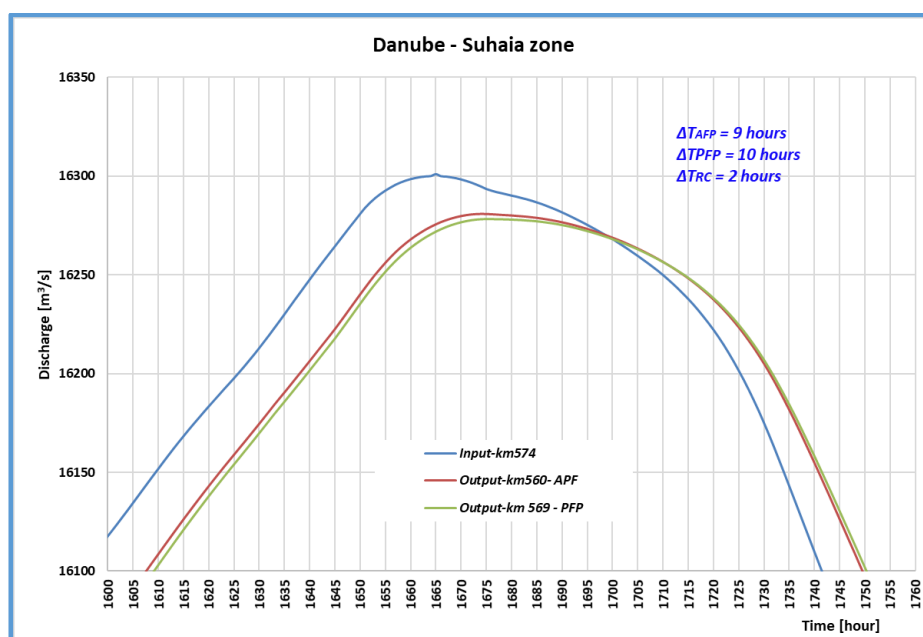


Figure 9: Flood wave translation analysis results

1.2.4 Results

In table 2, the results of the flood wave translation for the active and potential floodplain are shown. The Δt for the active floodplain is 7 h and for the potential floodplain 8 h resulting in a high performance in the FEM-evaluation.

Table 2: Flood wave translation parameter on Suhaia-Zimnicea pilot area - FEM evaluation (for current situation and potential situation)

Potential floodplain	Hydrology			
	Flood wave translation (h)			
	Δt_{tot}	Δt_{RC}	Δt	FEM Evaluation
RO_Suhaia-Zimnicea_pFP	10	2	8	5
RO_Suhaia-Zimnicea_aFP_01	9	2	7	5

1. Hydraulics

1.1 Water level change – Δh

1.1.1 Description

Calculating this parameter demonstrate the effects of a total loss of a floodplain on the water level.

The values are calculated in a cross section chosen in the middle of the floodplain.

1.1.2 Source

Comparison of water surface level in the current scenario and in the analyzed renaturation scenario using the results of the unsteady hydrodynamic model.

1.1.3 Workflow

Step 1: Calculating water level for a HQ₁₀₀ corresponding current situation (h_{tot} – active floodplain) and the renaturation status (h_{tot} – potential floodplain)

Using the same hydrodynamic-numerical calculation which was used to determine the hydrological parameters (ΔQ_{tot} and Δt_{tot}). At a defined cross-section in the middle of the floodplain, the water level h_{tot} was determined.

Step 2: Calculating water level for a HQ₁₀₀ without floodplain(h_{RC})

Using the same hydrodynamic-numerical calculation, which was used to determine the hydrological parameters (ΔQ_{RC} and Δt_{RC}) and determined the calculated water level (h_{RC}) on the same place as in step 1.

Step 3: Calculating the Δh

The Δh was calculated for both scenarios (active and potential floodplain) by subtracting the calculated water levels (h_{tot}) from the water levels of the river channel model (h_{RC})

1.1.4 Results

Table 3 shows the results of the water level change for the active and potential situation. The water level would slightly decrease after the restoration measure by 3 cm in the river channel at the investigated cross-section.

Table 3: Water level change parameter on Suhaia-Zimnicea pilot area - FEM evaluation (for current situation and restoration situation)

Potential floodplain	Hydraulics			
	Water level (m)			
	h_{tot}	h_{RC}	Δh	Evaluation
RO_Suhaia-Zimnicea_pFP	25.62	26.71	1.06	5
RO_Suhaia-Zimnicea_aFP_01	25.65	26.71	1.09	5

The distributions of the maximum depths resulting from the corresponding HQ100 simulations in the Suhaia area in the existing situation and proposed for renaturation are presented in the figure 9.

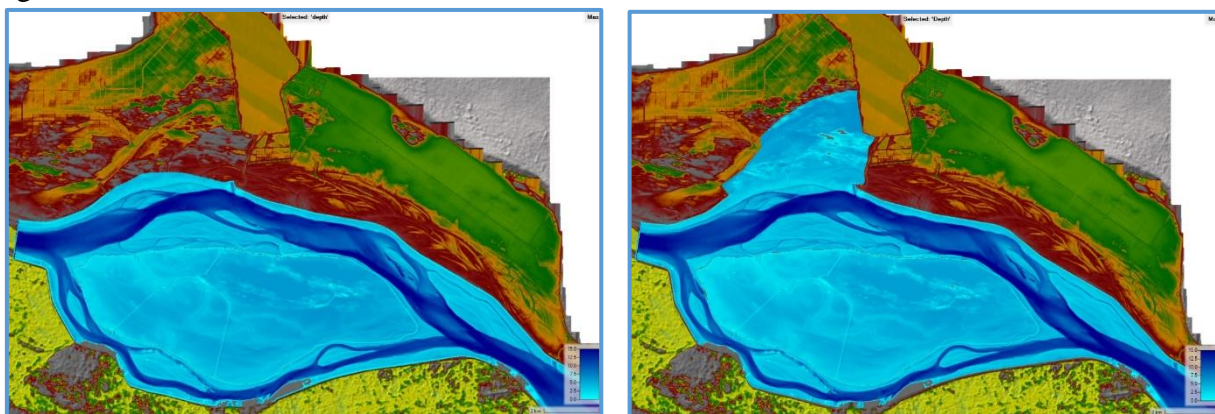


Figure 10: Water level in the Suhaia area for current situation (AFP) and restored state (PFP)

2. Ecology

2.1 Connectivity of floodplain water bodies

For restoration state the selected scenario was Scenario 2 (Water bodies are connected at mean water level up to bankfull discharge) for the Suhaia area. According to the considered scenario, for the Suhaia floodplain, the results are shown in the table below.

Table 4: Connectivity of floodplain water bodies – FEM evaluation (for current and restoration state)

Potential floodplain	Ecology	
	Conectivity of floodplain water bodies	
	*) Q for bankfull	FEM evaluation
RO_Suhaia-Zimnicea_pFP	8000 mc/s	3
RO_Suhaia-Zimnicea_aFP	8000 mc/s	3

2.2 Existence of protected species

By applying the steps from FEM-handbook the results for this parameter shows that no change will occur within Suhaia-Zimnicea pilot area for the restored situation (see table below).

Table 5: Protected species on Suhaia-Zimnicea pilot area - FEM evaluation (for current and restored situation)

Potential floodplain	Ecology	
	Existence of protected species	
	No. of species and habitats	Evaluation
RO_Suhaia-Zimnicea_pFP	1 natural habitat and 125 species: 1 mammal, 17 fish, 107 species of birds	5
RO_Suhaia-Zimnicea_aFP	1 natural habitat and 125 species: 1 mammal, 17 fish, 107 species of birds	5

3. Socio-economics

3.1 Potential affected buildings

For the Suhaia-Zimnicea the number of buildings affected are the same with the current state (see table 7).

3.2 Land use

The land use parameter proves from a medium performance (3) at the current status to a high performance (5) after the restoration (see table 13).

Table 6: Result of evaluation for land use parameter on Suhaia-Zimnicea pilot area - FEM evaluation (for current and restoration state)

RO_Suhaia-Zimnicea_pFP	code_18	Label 3 category	RGB	S (ha)	FEM-evaluation	
	512	Water bodies	128-242-230	1473.33	5	5
TOTAL				1473.33		5
RO_Suhaia-Zimnicea_aFP	code_18	Label 3 category	RGB	S (ha)	FEM-evaluation	
	512	Water bodies	128-242-230	410.62	5	5
TOTAL				410.62		5

B. Calculating additional Floodplain Evaluation Matrix (FEM) parameters for current and after restoration state – Suhaia Zimnicea pilot area

Hydraulics

1.1 Flow velocity – Δv

The influence on the water flow velocities was determined in a similar way to the variation of the free surface of the water.

Table 7: Flow velocity parameter on potential floodplain Suhaia-Zimnicea pilot area - FEM evaluation (restoration state)

Potential floodplain	Hydraulics			
	Flow velocity (m/s)			
	v tot	vRC	Δv	FEM evaluation
RO_Suhaia-Zimnicea_pFP	0.36	1.16	0.75	5
RO_Suhaia-Zimnicea_aFP	0.41	1.16	0.80	5

Table 10 shows the results of the flow velocity change for the active and potential situation. The velocity would slightly decrease after the restoration measure by 0.05 m/s in the river channel at the investigated cross-section.

The distributions of the maximum speeds resulting from the corresponding HQ100 simulations in the Suhaia area in the existing situation AFP and proposed for renaturation PFP (2D model) are presented in the following figures:

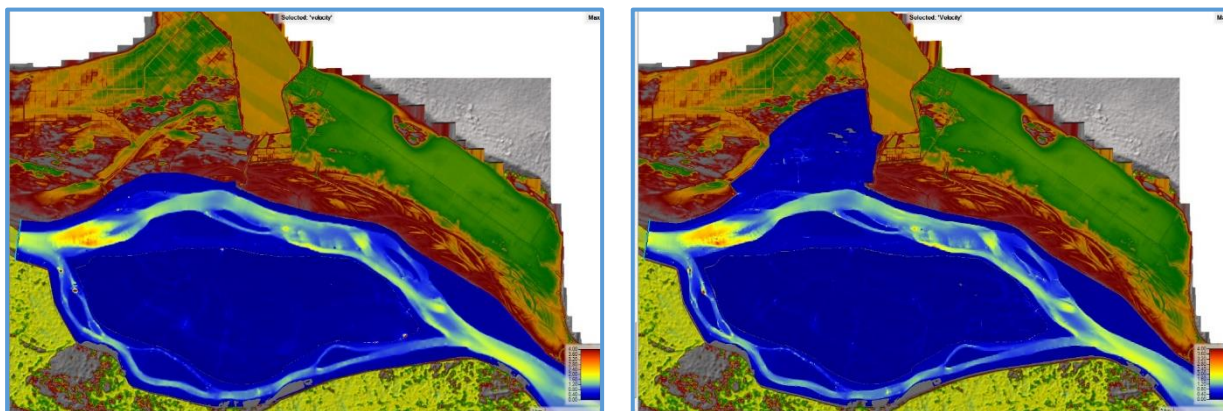


Figure 11: Flow velocity in the Suhaia area for the current state and the restored state

1.2 Bottom shear stress – $\Delta \tau$

The assessment of this parameter was done similarly to the assessment of flow velocity parameter by comparing of the bottom shear stress of different scenarios using the results of unsteady hydrodynamic 1D model (table 20).

Table 8: Bottom shear stress parameter on potential floodplain Suhaia-Zimnicea pilot area - FEM evaluation (restoration state)

Potential floodplain	Hydraulics			
	Bottom shear stress (N/m ²)			
	τ_{tot}	τ_{RN}	$\Delta\tau$	FEM evaluation
RO_Suhaia-Zimnicea_pFP	1.62	9.8	8.18	5
RO_Suhaia-Zimnicea_aFP	1.25	9.8	8.55	5

Table 11 shows the results of the bottom shear stress change for the active and potential situation. The shear stress would slightly increase after the restoration measure by 0.37 N/m² in the river channel at the investigated cross-section.

The maximum distributions of the shear stress parameter, resulting from the corresponding HQ100 simulations in the Suhaia area (2D model) in the existing situation AFP and proposed for renaturation PFP are presented in the following figures:

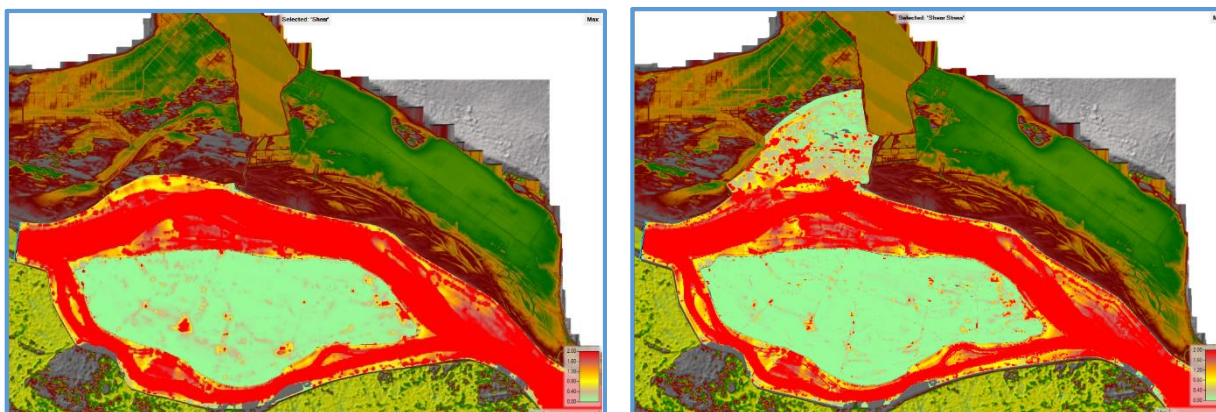


Figure 12 Shear stress in the Suhaia area for the current state and the restored state

2. Ecology

2.1 Protected habitats

In the restored state, the area designated as protected area according to the Natura 2000 or other documents about protected species or habitats will be the same as in the current state.

2.2 Potential for typical habitats

In the restored state, from the 14 habitats specific to floodplain areas initially identified, one may be present in the Suhaia area. The only habitat, from preliminary estimation, that could be present in the Suhaia area is 3130 *Oligotrophic to mesotrophic standing waters*. The results are presented in the following table.

Table 9: Potential for typical habitats on Suhaia-Zimnicea pilot area - FEM evaluation (for current and restored state)

Potential floodplain	Ecology			
	Potential for typical habitats			
	Code	Name	No.	Evaluation
RO_Suhaia_pFP	3130	<i>Oligotrophic to mesotrophic standing waters</i>	1	1
RO_Suhaia_aFP	-	-	1	1

Considering also, the experience and studies for floodplain restoration in the Lower Danube floodplain and Danube Delta, other potential habitats could be developed in time. The following table is showing the list of habitats estimated after an extensive study on the restored area in Mahmudia / Danube delta on around 1000 ha from agriculture area to open water land cover.

Nr.	Types of habitats	Habitats cod for Romania	Natura 2000 cod	Flora species associated
1.	<i>Phragmites australis</i> și <i>Schoenoplectus lacustris</i>	R5309	-	<i>Scirpo-Phragmitetum Schoenoplectetum lacustris</i>
2.	<i>Typha angustifolia</i> și <i>Typha latifolia</i>	R5305	-	<i>Typhetum angustifoliae</i> <i>Typhetum latifoliae</i>
3.	<i>Oenanthe aquatica</i> și <i>Rorippa amphibia</i>	R5303	-	<i>Oenantho-Rorippetum</i>
4.	<i>Sparganium erectum</i> , <i>Berula erecta</i> și <i>Sium latifolium</i>	R5304	3150	<i>Sparganietum erecti</i> <i>Mentho aquatice-Beruletum erecti</i>
5.	<i>Typha laxmanni</i> și <i>Epilobium hirsutum</i>	R5306	-	<i>Typhetum laxmanni</i>
6.	<i>Glyceria maxima</i> și <i>Schoenoplectus lacustris</i>	R5307	-	<i>Glycerietum maximae</i>
7.	<i>Eleocharis palustris</i>	R5302	-	<i>Eleocharitetum palustris</i>
8.	<i>Bidens tripartita</i> , <i>Echinochloa crus-galli</i> și <i>Polygonum hidropiper</i>	R5312	3270	<i>Bidenti-Polygonetum hydropiperis</i> <i>Polygono lapathifolio-Bidentetum</i> <i>Echinochloo-Polygonetum lapathifolii</i>

9.	<i>Carex elata</i> , <i>C. rostrata</i> , <i>C. riparia</i> și <i>Carex</i> <i>acutiformis</i>	R5310	-	<i>Caricetum elatae</i> <i>Caricetum rostratae</i> <i>Caricetum acutiformis</i> <i>Caricetum ripariae</i>
10.	<i>Salvinia natans</i> , <i>Marsilea quadrifolia</i> , <i>Azolla caroliniana</i> și <i>Azolla filiculoides</i>	R2203	3150	<i>Spirodelo-Salvinietum</i> <i>natantis</i> <i>Lemno-Azolletum</i> <i>caroliniana</i>
11.	<i>Riccia fluitans</i> și <i>Ricciocarpus natans</i>	R2204	3150	<i>Riccietum fluitantis</i>
12.	<i>Hydrocharis morsus-</i> <i>ranae</i> , <i>Stratiotes aloides</i> și <i>Utricularia vulgaris</i>	R2205	3150	<i>Hydrocharitetum</i> <i>morsus-ranae</i> <i>Stratiotetum aloidis</i> <i>Lemno-Utricularietum</i> <i>vulgaris</i>
13.	<i>Potamogeton</i> <i>perfoliatus</i> , <i>Potamogeton</i> <i>gramineus</i> , <i>Potamogeton lucens</i> , <i>Elodea canadensis</i> și <i>Najas marina</i>	R2206	3150	<i>Potamogetonetum</i> <i>lucentis</i> <i>Potamogetonetum</i> <i>perfoliati</i> <i>Potamogetonetum</i> <i>graminei</i> <i>Elodeetum Canadensis</i> <i>Potamo-</i> <i>Ceratophylletum</i> <i>submersi</i>
14	<i>Lemna minor</i> , <i>Lemna</i> <i>trisolca</i> , <i>Spirodela</i> <i>polyrhiza</i> și <i>Wolffia</i> <i>arrhiza</i>	R2202	3150	<i>Lemnetum minoris</i> <i>Lemnetum gibbae</i> <i>Lemnetum trisolcae</i> <i>Lemno-Spirodeletum</i> <i>Wolffietum arrhizae</i> <i>Spirodelo-</i> <i>Aldrovandetum</i>
15.	<i>Nymphaea alba</i> , <i>Trapa</i> <i>natans</i> , <i>Nuphar luteum</i> și <i>Potamogeton natans</i>	R2207	3160	<i>Myriophyllo</i> <i>verticillati-</i> <i>Nupharetum luteae</i> <i>Nymphaeetum albae</i> <i>Nymphoidetum</i> <i>peltatae</i> <i>Trapetum natantis</i> <i>Potametum natantis</i>
16.	<i>Ranunculus aquatilis</i> și <i>Hottonia palustris</i>	R2208	3260	<i>Ranunculetum</i> <i>aquatilis</i> <i>Hottonietum palustris</i>
17.	<i>Eleocharis acicularis</i> și <i>Littorella uniflora</i>	R2213	3130	<i>Eleocharidetum</i> <i>acicularis</i>
18.	(<i>Salix alba</i>) cu <i>Lycopus</i> <i>exaltatus</i>	R4409	92A0	<i>Salicetum albae-</i> <i>fragilis</i>

2.3 Ecological, chemical and ground water status

In the Suhaia area, the status of the three waterbodies (1 surface water body and 2 groundwater bodies) will be the same in the restored state as in the current state.

Analysing Ecosystem Services

The ecosystem services provided by the Suhaia area were quantified with the help of the local stakeholders (Suhaia City Hall). The result for the current state and for the restored state are presented in the following table.

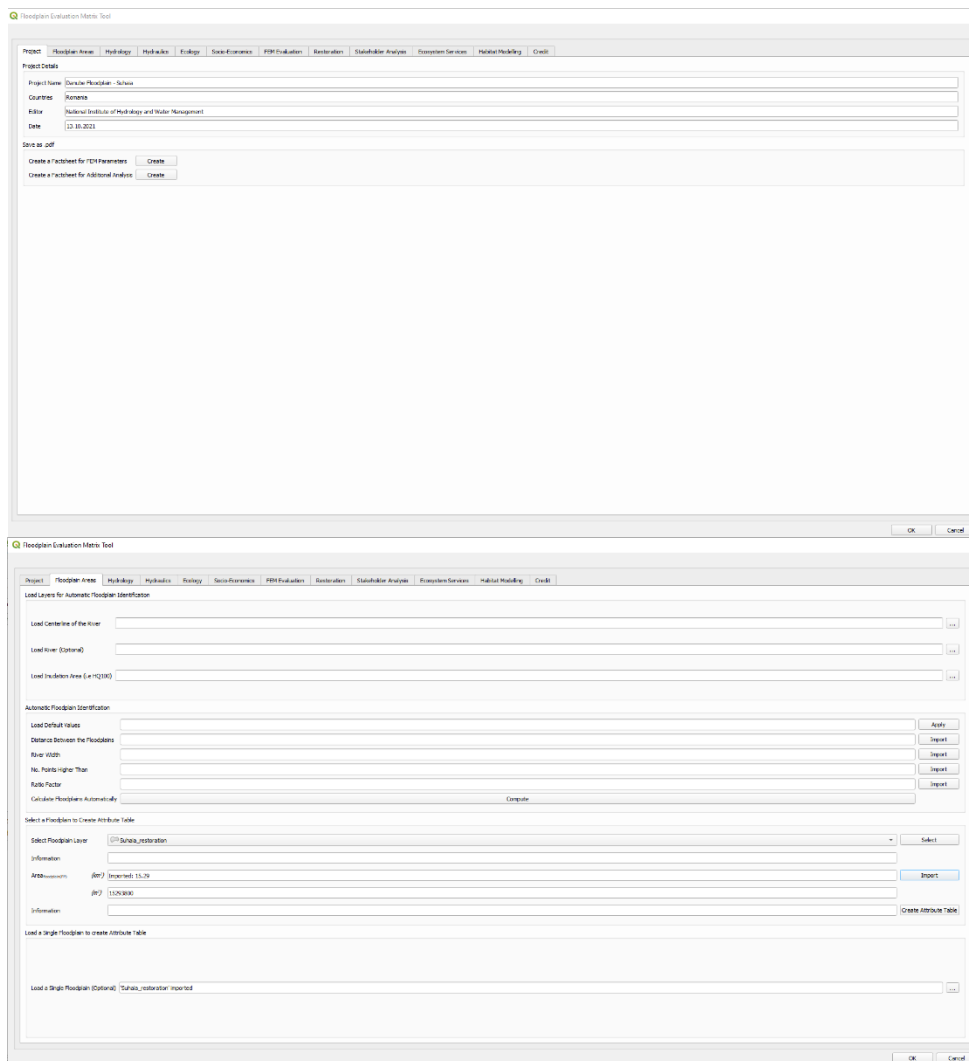
Table 10: Results of the ecosystem services assessment for Suhaia pilot area (for current and for restoration state)

Ecosystem services					
Category	ESS	Intensity	Percentage of total Area	Intensity (Restoration)	% of area (Restoration)
Provisioning ESS	agricultural product	High	90%	Missing	0%
	wood	Very Low	5%	Very Low	5%
	animal product	Medium	30%	Medium	30%
	game meat	Medium	30%	Medium	30%
	honey; beehive products	Low	10%	Medium	30%
	fish or fish products	Missing	0%	High	70%
	water (drinking, irrigation)	Very Low	5%	Medium	30%
Regulating ESS	local climate regulation	Very Low	10%	Medium	30%
	air purification	Very Low	10%	Medium	30%
	low water regulation	Very Low	10%	High	60%
	flood retention	Very Low	10%	Medium	40%
	nutrient retention	Missing	0%	Medium	40%
	noise regulation	Missing	0%	Missing	0%
	provision of habitats	Missing	0%	Very High	100%
Cultural ESS	recreational activity	Missing	0%	High	60%
	water related activity	Missing	0%	High	60%
	tourism	Missing	0%	High	60%
	education	Very Low	10%	Medium	50%

C. Results of applying the FEM-Tool using input from the previous tasks (FEM, CBA, ESS, stakeholder) – Suhaia Zimnicea pilot area

In order to apply FEM-Tool the input data set has been prepared. All the data were used to calculate the FEM parameters (FEM minimum and additional parameters) for both current and restored state according to FEM-parameters handbooks.

In order to install and use the FEM-Tool the open-source QGIS software has been used. The FEM-Tool have been successfully applied for Suhaia-Zimnicea pilot area (see the screenshots presented below).



The image displays two screenshots of the 'Floodplain Evaluation Matrix Tool' interface. The top screenshot shows the 'Project Details' section, which includes fields for Project Name (Danube Floodplain - Suhaia), Country (Romania), Editor (National Institute of Hydrology and Water Management), and Date (13.10.2021). Below these fields are buttons for 'Create a FactSheet for FEM Parameters' and 'Create a FactSheet for Additional Analyses'. The bottom screenshot shows the 'Automatic Floodplain Identification' section, which includes fields for 'Load Centerline of the River', 'Load River (Optional)', and 'Load In-Stream Area (e.g. HQ100)'. It also features an 'Automatic Floodplain Identification' section with fields for 'Load Default Values', 'Distance Between the Floodplains', 'River Width', 'No. Points Higher Than', and 'Ratio Factor'. Below this is a 'Select a Floodplain to Create Attribute Table' section with a dropdown menu set to 'Suhaia_restoration' and a 'Select' button. There are also fields for 'Attribute Table Name' and 'Attribute Table Path' with 'Import' and 'Create Attribute Table' buttons. At the bottom, there is a field for 'Load a Single Floodplain (Optional)' set to 'Suhaia_restoration'.

Reception Evaluation Matrix Tool

Project: [] Region: [] Hydrology: [] Hydrology: [] Ecology: [] Socio-Economics: [] FPM Evaluation: [] Restoration: [] Stakeholder Analysis: [] Ecosystem Services: [] Habitat Modelling: [] Credit: []

Peak Reduction and Flood Wave Transition

Input Hydrograph	Imported	Import	DeltaQ ₁ (m³/s)	Compute	13.2500
Output Hydrograph with FP	Imported	Import	DeltaQ ₂ (m³/s)	Compute	7.3600
Output Hydrograph without FP	Imported	Import	DeltaQ ₃ (m³/s)	Compute	2.8400
Q ₀ (m³/s)	Imported	Import	DeltaQ ₄ (m³/s)	Compute	0.83
			DeltaT ₁ (h)	Compute	0.0
			DeltaT ₂ (h)	Compute	6.0
			DeltaT ₃ (h)	Compute	1.00
			Attribute Table	ADD	Results added

Peak Reduction and Flood Wave Transition - After Restoration

Input Hydrograph	Imported	Import	DeltaQ ₁ (m³/s)	Compute	13.2500
Output Hydrograph with FP	Imported	Import	DeltaQ ₂ (m³/s)	Compute	7.3600
Output Hydrograph without FP	Imported	Import	DeltaQ ₃ (m³/s)	Compute	2.8400
Q ₀ (m³/s)	Imported	Import	DeltaQ ₄ (m³/s)	Compute	0.83
			DeltaT ₁ (h)	Compute	0.0
			DeltaT ₂ (h)	Compute	-1.0
			DeltaT ₃ (h)	Compute	1.00

OK Cancel

Reception Evaluation Matrix Tool

Project: [] Region: [] Hydrology: [] Hydrology: [] Ecology: [] Socio-Economics: [] FPM Evaluation: [] Restoration: [] Stakeholder Analysis: [] Ecosystem Services: [] Habitat Modelling: [] Credit: []

Hydro Parameters

h ₀ (m)	Imported: 25.65	Import	Delta h (m)	Compute	1.00
h ₁ (m)	Imported: 26.71	Import	Attribute Table	ADD	Results added

Hydro Parameters - After Restoration

h ₀ (m)	Imported: 25.65	Import	Delta h (m)	Compute	1.00
h ₁ (m)	Imported: 26.71	Import			

OK Cancel

Reception Evaluation Matrix Tool

Project: [] Region: [] Hydrology: [] Hydrology: [] Ecology: [] Socio-Economics: [] FPM Evaluation: [] Restoration: [] Stakeholder Analysis: [] Ecosystem Services: [] Habitat Modelling: [] Credit: []

Hydro Parameters

h ₀ (m)	Imported: 0.43	Import	Delta h (m)	Compute	0.15
h ₁ (m)	Imported: 1.16	Import	Delta h ₁ (m)	Compute	0.55
h ₂ (m)	Imported: 1.25	Import	Attribute Table	ADD	Results added
h ₃ (m)	Imported: 0.8	Import			

Hydro Parameters - After Restoration

h ₀ (m)	Imported: 0.36	Import	Delta h (m)	Compute	0.30
h ₁ (m)	Imported: 1.16	Import	Delta h ₁ (m)	Compute	0.43
h ₂ (m)	Imported: 1.02	Import			
h ₃ (m)	Imported: 0.8	Import			

OK Cancel

Floodplain Evaluation Matrix Tool

Project | Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

Protected Species | Dependent: 120.0 | Import | Attribute Table | Add | Results added

Connectivity of FHR | Dependent: 1.0 | Import

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

Protected Species | Dependent: 120.0 | Import

Connectivity of FHR | Dependent: 1.0 | Import

OK | Cancel

Floodplain Evaluation Matrix Tool

Project | Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

Area... (m²) | Dependent: 1.1 | Import | Protected habitat | Calculate | 26.81

Vegetation heterogeneity | Dependent: 2.90 | Import | Attribute Table | Add | Results added

Water Level Dynamics | Dependent: 0.0 | Import

Potential for Typical Habitats | Dependent: 0.0 | Import

Ecological Water Body Status | Dependent: 3.0 | Import

Invasive Species | Dependent: 0.0 | Import

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

Area... (m²) | Dependent: 14.79 | Import | Protected habitat | Calculate | 60.73

Vegetation heterogeneity | Dependent: 2.83 | Import

Water Level Dynamics | Dependent: 0.0 | Import

Potential for Typical Habitats | Dependent: 0.0 | Import

Ecological Water Body Status | Dependent: 3.0 | Import

Invasive Species | Dependent: 0.0 | Import

OK | Cancel

Floodplain Evaluation Matrix Tool

Project | Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

No. of Affected Buildings (No.) | Dependent: 1.0 | Import | Attribute Table | Add | Results added

Land Use | Dependent: 4.04 | Import

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

No. of Affected Buildings (No.) | Dependent: 0.07 | Import

Land Use | Dependent: 3.12 | Import

OK | Cancel

Floodplain Evaluation Matrix Tool

Project: Floodplain Area | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

Presence of Dec. Pl. Species | Reported: 0.0 | Import

Attribute Table | Add | Results editor

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

Presence of Dec. Pl. Species | Reported: 0.0 | Import

Extended Cost-Ben. Factor | Reported: 0.0 | Import

OK | Cancel

Floodplain Evaluation Matrix Tool

Project: Floodplain Area | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Thresholds | Thresholds (additional) | Floodplains - Current Status | Floodplains (additional) - Current Status | Floodplains - After Restoration | Floodplains (additional) - After Restoration

Load Default Values | Apply

Minimum FPM Parameters	Low (L)	Medium (M)	High (H)
Peak reduction Delta Q _{peak} (M³)	1	2	2
Flood wave translation Delta T (h)	1	5	5
Water level change Delta h (m)	0.5	0.5	0.5
Conductivity of FF water (m/s)	1	5	5
Distance of protected species	1	40	40
Potentially affected buildings (year)	1	5	5
Land use	2	4	4
Sediment balance	0.33	0.66	0.66
Water level dynamics	1	3	5

OK | Cancel

Floodplain Evaluation Matrix Tool

Project: Floodplain Area | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Thresholds | Thresholds (additional) | Floodplains - Current Status | Floodplains (additional) - Current Status | Floodplains - After Restoration | Floodplains (additional) - After Restoration

Reset to Load Default Values | Apply

Additional FPM Parameters	Low (L)	Medium (M)	High (H)
Delta v (m/s)	0.1	0.2	0.2
Delta h _{max} (m/s²)	1.5	3	3
Protected habitat	30	60	60
Equivalent Resistance	0.7	0.01	0.01
Water Level Dynamics	2	3	5
Potential for Tropical Inland	5	30	30
Ecological Water Body Status	1	3	5
Parameter Invasive Species	1	3	3
Presence of Dec. Pl. Species	2	4	14
Extended Cost-Ben. Factor	0.5	3	3

OK | Cancel

Floodplain Evaluation Matrix Tool

Project: Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Thresholds	Thresholds (additional)	Floodplains - Current Status	Floodplains (additional) - Current Status	Floodplains - After Restoration	Floodplains (additional) - After Restoration	UNIT	FPM-Evaluation
Minimum Parameters		Value					
Peak reduction Delta Q _{max}	0.02					(%)	1
Flood wave translation Delta T	1.0					(h)	3
Water level change Delta h	1.06					(m)	3
Connectivity of flood water bodies	1.0						3
Existence of protected species	125.0						5
Potentially affected buildings	1.0					(b/km ²)	3
Land use	4.54						5
		Confirm values				Calculate FPM	
Sum:							22
Restoration Demand:							Medium Demand
Need for Preservation:							Yes
Attribute Table:							Add Results added

FPM-Evaluation Sheet:

1: Low Performance
2: Medium Performance
3: High Performance

OK Cancel

Floodplain Evaluation Matrix Tool

Project: Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Thresholds	Thresholds (additional)	Floodplains - Current Status	Floodplains (additional) - Current Status	Floodplains - After Restoration	Floodplains (additional) - After Restoration	UNIT	FPM-Evaluation
Additional Parameters		Value					
Delta v	0.75					(m/s)	1
Delta tau	0.30					(h/m ²)	3
Proctored Habitat	26.81						1
Vegetation Richness	1.90						3
State Level Dynamics	0.3						6
Potential for Topical Habitats	0.3					(b/km ²)	6
Ecological Visitor Body Status	1.3						3
Parameter Diverse Species	0.3						6
Presence of DCL, N, Wetland	0.3						6
		Confirm values				Calculate FPM	
Attribute Table:							Add Results added

FPM-Evaluation Sheet:

1: Low Performance
2: Medium Performance
3: High Performance

OK Cancel

Floodplain Evaluation Matrix Tool

Project: Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Thresholds	Thresholds (additional)	Floodplains - Current Status	Floodplains (additional) - Current Status	Floodplains - After Restoration	Floodplains (additional) - After Restoration	UNIT	FPM-Evaluation
Minimum Parameters		Value					
Peak reduction Delta Q _{max}	0.02					(%)	1
Flood wave translation Delta T	1.0					(h)	3
Water level change Delta h	1.00					(m)	3
Connectivity of flood water bodies	1.0						3
Existence of protected species	125.0						5
Potentially affected buildings	0.07					(b/km ²)	3
Land use	15.13						5
		Confirm values				Calculate FPM	
Sum:							22
Restoration Demand:							Medium Demand

FPM-Evaluation Sheet:

1: Low Performance
2: Medium Performance
3: High Performance

OK Cancel

Floodplain Evaluation Matrix Tool

Project | Floodplain Area | Hydrology | Hydraulic | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Methodic | Thresholds (Additional) | Floodplains - Current Status | Floodplains (Additional) - Current Status | Floodplains - After Restoration | Floodplains (Additional) - After Restoration

Additional Parameters	Value	Unit	FPM Evaluation
Delta x	0.8	h/h	5
Delta tau	0.28	h/h ²	5
Protected Habitat	06.73		5
Vegetation Richness	2.80		1
Water Level Dynamics	0.3		0
Potential for Typical Habitats	1.9	h/h ²	5
Ecological Water Body Status	3.3		3
Parameter Inverse Slopes	0.3		0
Number of DW, N, Character	0.3		0
Differential Coefficient Factor	0.3		0

Confirm Values Calculate FPM

FPM Evaluation Sheet

1: Low Performance
3: Medium Performance
5: High Performance

Floodplain Evaluation Matrix Tool

Project | Floodplain Area | Hydrology | Hydraulic | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Floodplains

Minimum Parameters	Current Status - Performance (1-4in, 3-medium or 3-4g)	After Restoration - Performance (1-4in, 3-medium or 3-4g)
Peak Inflow Delta Q _{max}	1.0	1.0
Flood wave transition Delta T	3.0	3.0
Water level change Delta h	3.0	3.0
Connectivity of B water bodies	3.0	3.0
Existence of protected species	3.0	3.0
Potentially affected buildings	3.0	3.0
Land use	3.0	3.0

Restoration Decision: Yes

Floodplain Evaluation Matrix Tool

Project | Floodplain Area | Hydrology | Hydraulic | Ecology | Socio-Economics | FPM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Stakeholder

Stakeholder Analysis

Name	Type of the stakeholder	Interest	Power
Software City Hall	Local Public Authority	High	Medium
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing

Measures Planned for the Stakeholders

Name	Measure Description

Restoration Evaluation Matrix Tool

Project: [] Floodplain Area: [] Hydrology: [] Hydraulics: [] Ecology: [] Socio-Economics: [] FDF Evaluation: [] Restoration: [] Stakeholder Analysis: [] Ecosystem Services: [] Habitat Modeling: [] Credit: []

Ecosystem Services

Category	Intensity	% of Total Area	Intensity (Restoration)	% of Area (Restoration)
Agri-Food Product	High	50	Missing	0
Wood	Very Low	5	Very Low	5
Animal Product	Medium	30	Medium	30
Game Meat	Medium	30	Medium	30
Honey - Beehive Products	Low	10	Medium	30
Wild-Fish Products	Missing	0	High	70
Water - Drinking, Irrigation	Very Low	5	Medium	30
Local Climate Regulation	Very Low	10	Medium	30
Air Purification	Very Low	10	Medium	30
Low Water Regulation	Very Low	10	High	60
Flow Obstruction	Very Low	10	Medium	40
Soil Regulation	Missing	0	Missing	0
Retention of Sediments	Missing	0	Very High	100
Recreational Activity	Missing	0	High	60
Water Related Activity	Missing	0	High	60
Tourism	Missing	0	High	60
Education	Very Low	10	Medium	30

Habitat Modeling

Percentage of Lateral Connection During an HCD: [] Current Date: [] Restoration: [] %

Habitat Type	Area	Flow Velocity	Area (Restoration)	Flow Velocity (Restoration)
Woodland	[]	[]	[]	[]
Scrubland	[]	[]	[]	[]
Channel	[]	[]	[]	[]

Also, the results of applying the FEM-Tool are generated in a synthetic way within two factsheets, presented below.

Danube Floodplain - Suhaia Fact Sheet

Countries: Romania

Editor: National Institute of Hydrology and Water Management

Date: 13.10.2021

Need For Preservation	Restoration Demand
Yes	Medium Demand

Hydrology	
Peak Reduction	1
Flood Wave Translation	3

Hydraulics	
Water Level Change	3
Flow Velocity Change	5
Bed Shear Stress Change	5

Ecology	
Connectivity of FWB	3
Protected Species	5
Protected Habitat	1
Vegetation Naturalness	1
Water Level Dynamics	0
Potential for Typ. Habitats	0
Ecological Water Body Status	3
Invasive Species	0

Socio-Economics	
Affected Buildings	3
Land Use	5
Presence of Doc. Pl. Int.	0

FEM Rating Performance	Ranking
High	5
Medium	3
Low	1

Danube Floodplain - Suhaia Fact Sheet

Countries: Romania

Editor: National Institute of Hydrology and Water Management

Date: 13.10.2021

Stakeholder Analysis

Name	Type of Stakeholder	Interest	Power
Suhaia City Hall	Local Public Authority	High	Medium
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing

Measures Planned for the Stakeholders

Name	Measure Description

Restoration

Minimum Parameters	Current Status - Perf.	After Rest. - Perf.
Delta Q relative	1.0	1.0
Delta T	3.0	3.0
Delta h	3.0	3.0
Conn. of fp Water Bodies	3.0	3.0
Existence of proct. species	5.0	5.0
Potentially affected buildings	3.0	5.0
Land use	5.0	3.0
Restoration Decision	Yes	

Habitat Modelling

	Current State	Restoration	
Perc. of Lateral Con. during HQ 2-5	0	0	%

Habitat Type	Area	Flow Velocity	Area Res.	Flow Velocity Res.
Floodplain	0	0	0	0
Backwater	0	0	0	0

Ecosystem Services

ESS	Intensity	Per. Total Area	Intensity Res.	Per. Total Area Res.
Agricultural Prod.	High	90	Missing	0
Wood	Very Low	5	Very Low	5
Animal Prod.	Medium	30	Medium	30
Game Meat	Medium	30	Medium	30
Honey	Low	10	Medium	30
Fish	Missing	0	High	70
Water	Very Low	5	Medium	30
Local Cli. Reg.	Very Low	10	Medium	30
Air Purification	Very Low	10	Medium	30
Low Water Reg.	Very Low	10	High	60
Flood Retention	Very Low	10	Medium	40
Noise Reg.	Missing	0	Missing	0
Provision of Hab.	Missing	0	Very High	100
Recreational Act.	Missing	0	High	60
Water Related Act.	Missing	0	High	60
Tourism	Missing	0	High	60
Education	Very Low	10	Medium	50

Figure 13 Factsheets from the FEM Tool for the Suhaia-Zimnicea pilot area

D. Evaluation of Cost – Suhaia Zimnicea pilot area

Lake Suhaia is delimited by the western dike (L=11.5 km) and the eastern dike (L=7 km). The western protective dike is destroyed on about 70% of the length, towards the lake, up to the crest. Although it was protected by a wall of concrete slabs, it fell, thus favouring the erosion of the dike body.



Figure 14 Suhaia Lake

At Garla Iancului pump station, which is located at the intersection of the western dike of Lake Suhaia with the longitudinal dike on the Danube, the contour dike of the suction basin is exposed to waves and is damaged. 130 m is the length on which consolidation is required. The area analyzed from the point of view of renaturation is on the left bank of the Danube, in the western part of Lake Suhaia. The main works that will contribute to the renaturation of these areas are:

- a. Achieving lateral connectivity with the Danube river by relocating the left bank dikes
- b. Construction of a new dike
- c. Rehabilitation and heightening of a sector from western Suhaia contour lake dike
- d. Rehabilitating the rest of both western and eastern dike;
- e. Creating a forest curtain along the dikes;
- f. Rehabilitation of existing structures – pumping station and weir

The renaturation of the area on the left bank of the Danube upstream of Lake Suhaia will be done by relocating the existing dike on a length of about 4,580 m and building a new dike along the existing drainage channel that continues on the ridge area up to the middle of the contour dike on the western side of Lake Suhaia. By renaturation of the area in western part of Lake Suhaia, the existing drainage system will not be significantly affected.

The new dike will have a length of 6400 m, average height of 4.00 m, a crown width of 5.00 m and slopes of 1: 2.5. The slopes will be protected by grass and a bicycle track will be arranged on the dike crest. The dike crest elevation was set according to the 1% level on the Danube to which a safety guard of 0.5 m was added. The floodplain restoration will have a surface of 1063 ha.

The condition of the contour dams requires rehabilitation in order to operate them safely. The works consist of earth filling at the dike body, rehabilitation of the slopes protection. The project proposed rehabilitating and heightening of the contour dikes of Lake Suhaia, at levels corresponding to 1% levels on the Danube. On the contour of Lake Suhaia were provided to be made wooden pontoons.

According to the conclusions and recommendations of the technical expertise the project includes the rehabilitation of the degraded concrete structures and the replacement of the hydro-mechanical equipment.

Along the dikes that follow area proposed for renaturation, it is envisaged to build a forest curtain with of 100 m width, made of species adapted to the local climate and soil conditions. The total area of afforestation is about 85 ha.

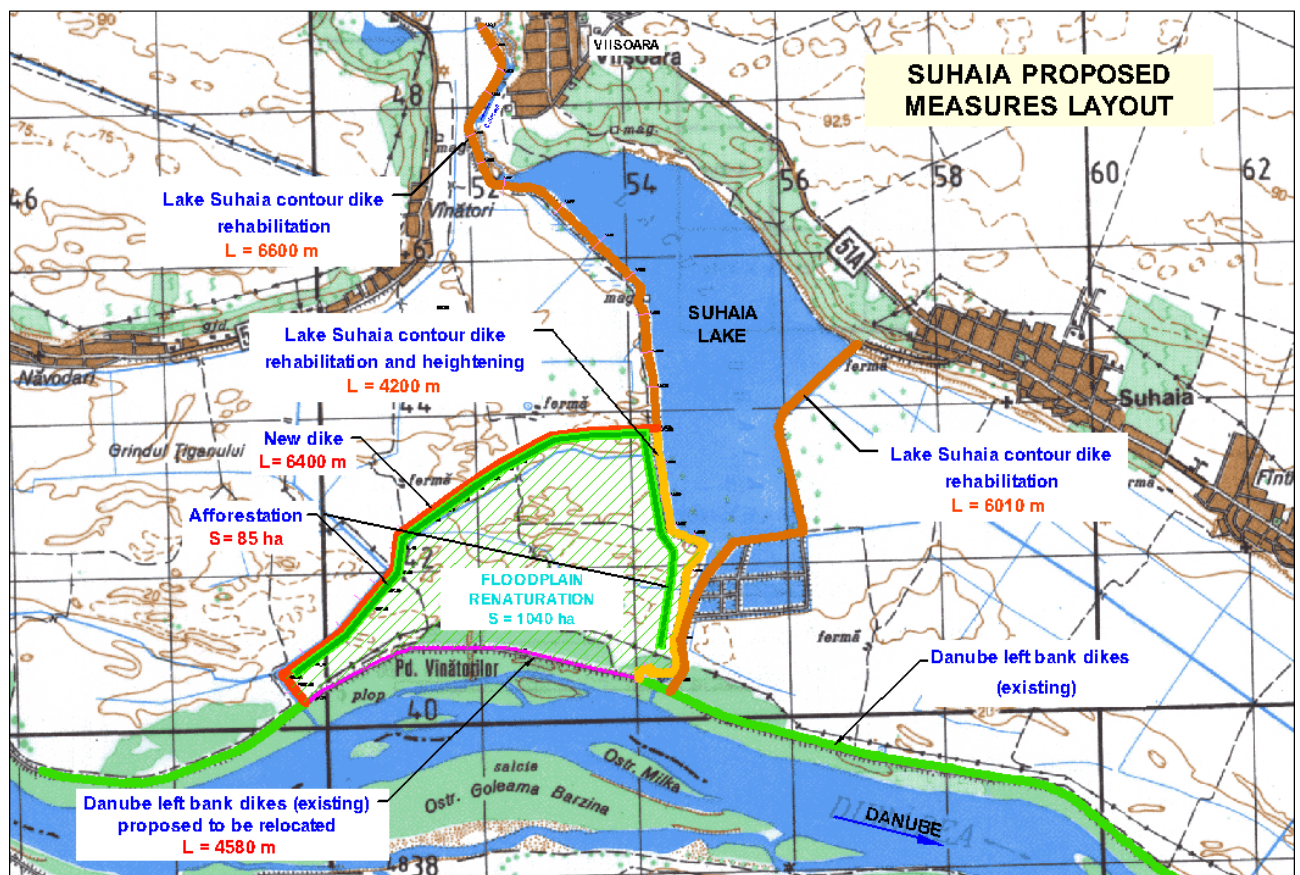


Figure 15 Suhaia proposed measures layout

Project capabilities:

- Dikes rehabilitated and heightened – L=4.20 km
- Dikes rehabilitated – L = 12.610 km
- New dikes – L= 6.40 km
- Afforestation – S = 85 ha
- Floodplain renaturation – S = 1040 ha

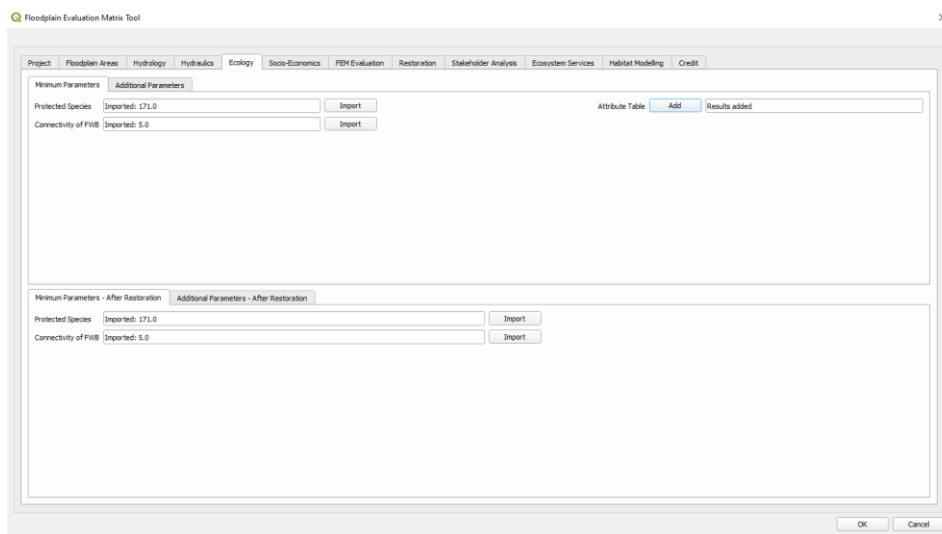
Project costs:

- Total investment: 21,100,000 € (including VAT)
- from which:
- Construction works. 16,200,000 € (including VAT)

E. Results of applying the FEM-Tool using input from the previous tasks (FEM, CBA, ESS, stakeholder) – Bistret pilot area

In order to apply FEM-Tool the input data set has been prepared.

The FEM-Tool have been successfully applied for Bistret pilot area (see the screenshots presented below).



Floodplain Evaluation Matrix Tool

Project | Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FEM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

Area_{min} (km²) Imported: 17.3 Protected Habitat

Vegetation Naturalness Imported: 2.7 Attribute Table

Water Level Dynamics Imported: 0.0

Potential for Typical Habitats Imported: 8.0

Ecological Water Body Status Imported: 3.0

Invasive Species Imported: 0.0

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

Area_{min} (km²) Imported: 17.3 Protected Habitat

Vegetation Naturalness Imported: 2.7 Attribute Table

Water Level Dynamics Imported: 0.0

Potential for Typical Habitats Imported: 8.0

Ecological Water Body Status Imported: 3.0

Invasive Species Imported: 0.0

Floodplain Evaluation Matrix Tool

Project | Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FEM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

Nr. of Affected Buildings (y/km²) Imported: 0.0 Attribute Table

Land Use Imported: 3.607

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

Nr. of Affected Buildings (y/km²) Imported: 0.0

Land Use Imported: 3.607

Floodplain Evaluation Matrix Tool

Project | Floodplain Areas | Hydrology | Hydraulics | Ecology | Socio-Economics | FEM Evaluation | Restoration | Stakeholder Analysis | Ecosystem Services | Habitat Modelling | Credit

Minimum Parameters | Additional Parameters

$h_{min}(t)$ Imported: 30.64 Delta h (m) 0.35

$h_{max}(t)$ Imported: 30.99 Attribute Table Results added

Minimum Parameters - After Restoration | Additional Parameters - After Restoration

$h_{min}(t)$ Imported: 30.64 Delta h (m) 0.35

$h_{max}(t)$ Imported: 30.99

Also, the results of applying the FEM-Tool are generated in a synthetic way within two factsheets, presented below.

Danube Floodplain - Bistret Fact Sheet

Countries: Romania

Editor: National Institute of Hydrology and Water Management

Date: 14.12.2021

Need For Preservation	Restoration Demand

Hydrology	
Peak Reduction	
Flood Wave Translation	

Hydraulics	
Water Level Change	
Flow Velocity Change	
Bed Shear Stress Change	

Ecology	
Connectivity of FWB	
Protected Species	
Protected Habitat	
Vegetation Naturalness	
Water Level Dynamics	
Potential for Typ. Habitats	
Ecological Water Body Status	
Invasive Species	

Socio-Economics	
Affected Buildings	
Land Use	
Presence of Doc. Pl. Int.	

FEM Rating Performance	Ranking
High	5
Medium	3
Low	1

Danube Floodplain - Bistret Fact Sheet

Countries: Romania

Editor: National Institute of Hydrology and Water Management

Date: 14.12.2021

Stakeholder Analysis

Name	Type of Stakeholder	Interest	Power
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing
	Missing	Missing	Missing

Measures Planned for the Stakeholders

Name	Measure Description

Restoration

Minimum Parameters	Current Status - Perf.	After Rest. - Perf.
Delta Q relative		
Delta T		
Delta h		
Conn. of fp Water Bodies		
Existence of proct. species		
Potentially affected buildings		
Land use		
Restoration Decision		

Habitat Modelling

	Current State	Restoration	
Perc. of Lateral Con. during HQ 2-5			%
Habitat Type	Area	Flow Velocity	Area Res. / Flow Velocity Res.
Floodplain			
Backwater			

Ecosystem Services

ESS	Intensity	Per. Total Area	Intensity Res.	Per. Total Area Res.
Agricultural Prod.	Missing		Missing	
Wood	Missing		Missing	
Animal Prod.	Missing		Missing	
Game Meat	Missing		Missing	
Honey	Missing		Missing	
Fish	Missing		Missing	
Water	Missing		Missing	
Local Cli. Reg.	Missing		Missing	
Air Purification	Missing		Missing	
Low Water Reg.	Missing		Missing	
Flood Retention	Missing		Missing	
Noise Reg.	Missing		Missing	
Provision of Hab.	Missing		Missing	
Recreational Act.	Missing		Missing	
Water Related Act.	Missing		Missing	
Tourism	Missing		Missing	
Education	Missing		Missing	