

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.

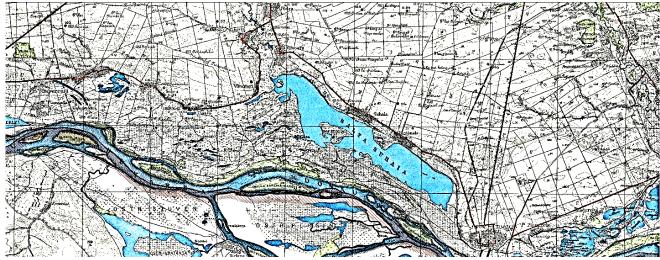


Figure 1: Historical map of the Suhaia area



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.

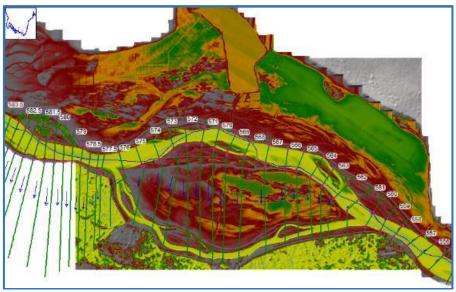


Figure 3: Distribution of cross sections along the Danube - Suhaia sector

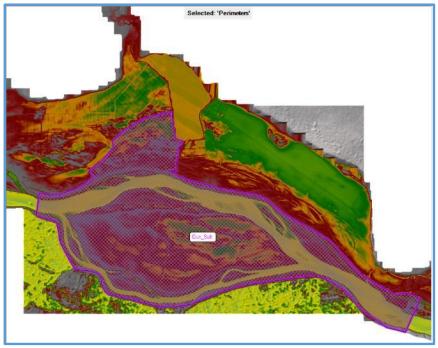


Figure 4: Field of analysis for the 2D simulation model - Suhaia area

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

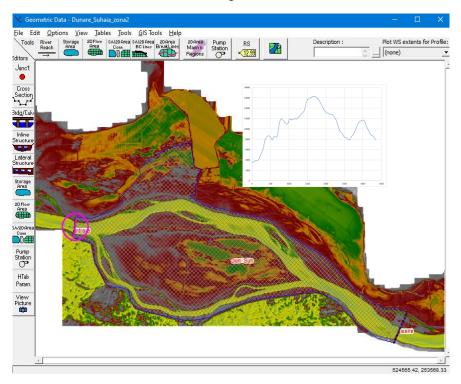


Figure 5: The upstream limit condition was the hydrograph corresponding to the flood recorded in 2006 scaled in accordance with HQ100

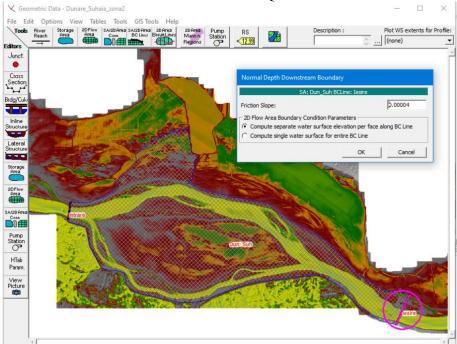


Figure 6: The downstream limit condition was the general slope of the respective riverbed 0.0004.



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

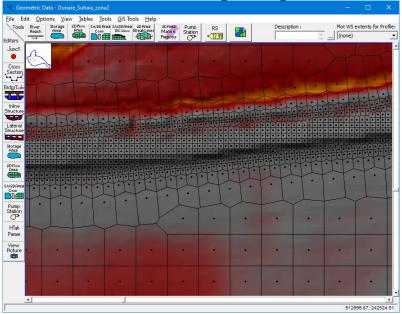


Figure 7: The discretization of the analyzed domain

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

1. Hydrology

1.1. Flood peak reduction – ΔQ

1.1.1 Description

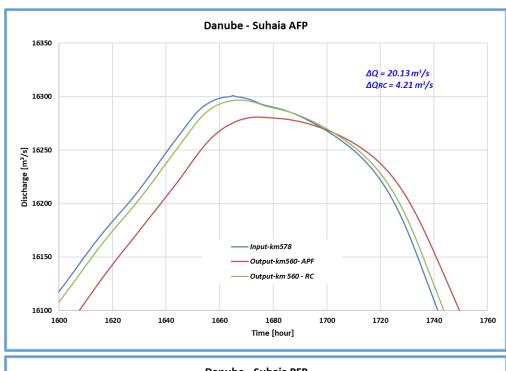
To evaluate the peak reduction for a floodplain, the peak of an input hydrograph at the beginning of the floodplain and the peak of the output hydrograph at the end of the floodplain were determined. The difference between the two peaks is the peak reduction ΔQ_{tot} [m³/s] for the investigated floodplain.

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.



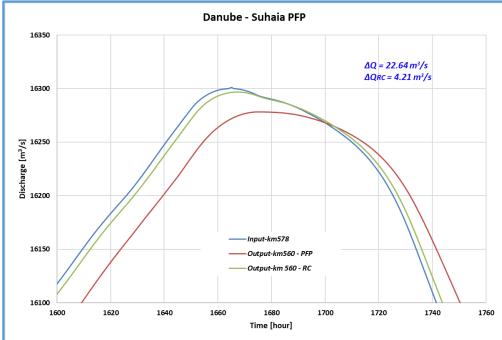


Figure 8: The results of the analysis for the *Flood peak reduction* (ΔQ) parameter for the active and potential floodplain

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 m³/s resulting in a relative peak reduction of 0.19%. The ΔQ for the potential floodplain slightly increased approximately to 18 m³/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)

	Hydrology						
Potential floodplain	Peak reduction (m ³ /s)						
rotential modupiam	ΔQ_{tot}	ΔQ_{RC}	ΔQ	ΔQ_{rel}	FEM Evaluation		
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.

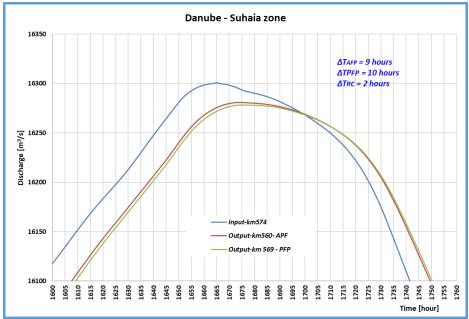


Figure 9: Flood wave translation analysis results



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)

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

2. Hydraulics

2.1. Water level change – Δh

2.1.1. 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.

2.1.2. Source

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

2.1.3. Workflow

Step 1: Calculating water level for a HQ_{100} coresponding 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})



2.1.4. 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)

		Hydraulics			
Potential floodplain	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.

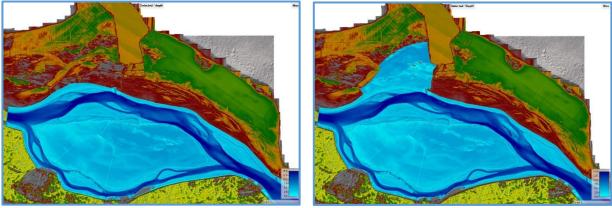


Figure 10: Water level in the Suhaia area for current situation (AFP) and restored state (PFP)

3. Ecology

3.1. 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.

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

	Ecology			
Potential floodplain	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		



3.2. 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)

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

4. Socio-economics

4.1. Potential affected buildins

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

4.2. 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 6).

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

	code_18	Label 3 category	RGB	S (ha)	FEM-e	valuation
RO_Suhaia-	512	Water bodies	128-242-230	1473.33	5	5
Zimnicea_pFP		TOTAL		1473.33		5
20 6 1 1	code_18	Label 3 category	RGB	S (ha)	FEM-e	valuation
RO_Suhaia- Zimnicea aFP	512	Water bodies	128-242-230	410.62	5	5
Zimnicea_aFP		TOTAL		410.62		5



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

5. Hydraulics

5.1. Flow velocity – Δv

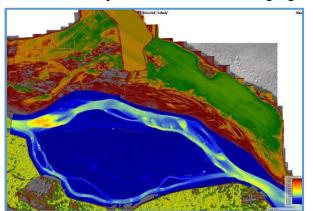
The influence on the water flow velocities was determined in a similar way to the variation of the free surface of the water.

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

	Hydraulics				
Potential floodplain	Flow velocity (m/s)				
Potential noouplain	v tot	vRC	Δν	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 7 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:



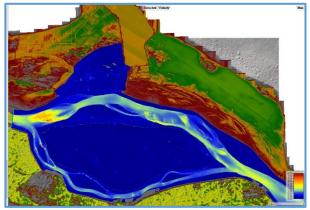


Figure 11: Flow velocity in the Suhaia area for the current state and the restored state

5.2. 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 8).



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

	Hydraulics				
Potential floodplain	Bottom shear stress (N/m²)				
	τ_{tot}	τ_{RN}	Δτ	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 8 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 strees 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:

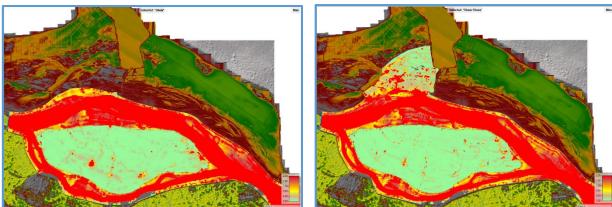


Figure 12 Shear strees in the Suhaia area for the current state and the restored state

6. Ecology

6.1. 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.

6.2. Potential for typical habitats

In the restored state, from the 14 habitats specific to floodplain areas initial 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)

,	Ecology					
Potential floodplain	Potential for tipical habitats					
	Code	e Name		Evaluation		
RO_Suhaia_pFP	3130	Oligotrophic to mesotrophic standing waters	1	1		
RO_Suhaia_aFP	-	-	1	1		

Considering also, the experince and studies for floodplain restoration in the Lower Danube floodplain and Danube Delta, other potential habitats could be develop in time. The bellow table is shoing the list of habitats estiamted 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.	Phragmites australis și Schoenoplectus lacustris	R5309	-	Scirpo-Phragmitetum Schoenoplectetum lacustris
2.	Typha angustifolia şi Typha latifolia	R5305	-	Typhetum angustifoliae Typhetum latifoliae
3.	Oenanthe aquatica și Rorippa amphibia	R5303	-	Oenantho-Rorippetum
4.	Sparganium erectum, Berula erecta și Sium latifolium	R5304	3150	Sparganietum erecti Mentho aquatice- Beruletum erecti
5.	Typha laxmanni şi Epilobium hirsutum	R5306	-	Typhetum laxmanni
6.	Glyceria maxima și Schoenoplectus lacustris	R5307	-	Glycerietum maximae
7.	Eleocharis palustris	R5302	-	Eleocharitetum palustris
8.	Bidens tripartita, Echinochloa crus-galli și Polygonum hidropiper	R5312	3270	Bidenti-Polygonetum hydropiperis Polygono lapathifolio- Bidentetum Echinochloo- Polygonetum lapathifolii
9.	Carex elata, C. rostrata, C. riparia și Carex acutiformis	R5310	-	Caricetum elatae Caricetum rostratae Caricetum acutiformis Caricetum ripariae



10.	Salvinia natans,	R2203	3150	Spirodelo-Salvinietum
	Marsilea quadrifolia,			natantis
	Azolla caroliniana și			Lemno-Azolletum carolinianae
11.	Azolla filiculoides	R2204	3150	
11.	Ricia fluitans și Ricciocarpus natans	K2204	3150	Riccietum fluitantis
12.	Hydrocharis morsus-	R2205	3150	Hydrocharitetum
12.	ranae, Stratiotes aloides	102203	3130	morsus-ranae
	și Utricularia vulgaris			Stratiotetum aloidis
	gi ciricilaria vingaris			Lemno-Utricularietum
				vulgaris
13.	Potamogetom	R2206	3150	Potamogetonetum
	perfoliatus,			lucentis
	Potamogeton			Potamogetonetum
	gramineus,			perfoliati
	Potamogeton lucens,			Potamogetonetum
	Elodea canadensis și			graminei
	Najas marina			Elodeetum Canadensis
				Potamo-
				Ceratophylletum
				submersi
14	Lemna minor, Lemna	R2202	3150	Lemnetum minoris
	trisulca, Spirodela			Lemnetum gibbae
	polyrhiza şi Wolffia			Lemnetum trisulcae
	arrhiza			Lemno-Spirodeletum
				Wolffietum arrhizae
				Spirodelo-
4.5		D2205	21.00	Aldrovandetum
15.	Nymphaea alba, Trapa	R2207	3160	Myriophyllo
	natans, Nuphar luteum			verticillati-
	și Potamogeton natans			Nupharetum luteae
				Nymphaeetum albae
				Nymphoidetum
				peltatae Trapetum natantis
				Potametum natantis
16.	Ranunculus aquatilis și	R2208	3260	Ranunculetum
10.	Hottonia palustris	K2200	3200	aquatilis
	11011011111 patasitis			Hottonietum palustris
17.	Eleocharis acicularis și	R2213	3130	Eleocharidetum
1/.	Littorella uniflora	112213	3130	acicularis
18.	(Salix alba) cu Lycopus	R4409	92A0	Salicetum albae-
10.	exaltatus		/ = 110	fragilis
<u> </u>		1		13.48.113



6.3. 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 cuantified 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 curent and for restoration state)

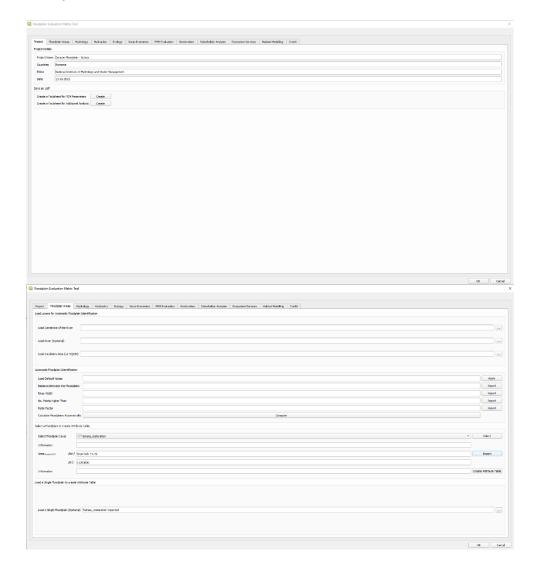
Ecosystem services								
Category	ESS	Intensity	Percentage of total Area	Intensity (Restoration)	% of area (Restoration)			
	agricultural product	High	90%	Missing	0%			
ESS	wood	Very Low	5%	Very Low	5%			
Bu	animal product	Medium	30%	Medium	30%			
Provisioning	game meat	Medium	30%	Medium	30%			
visi	honey; beehive products	Low	10%	Medium	30%			
Pro	fish or fish products	Missing	0%	High	70%			
	water (drinking, irrigation)	Very Low	5%	Medium	30%			
	local climate regulation	Very Low	10%	Medium	30%			
ESS	air purification	Very Low	10%	Medium	30%			
	low water regulation	Very Low	10%	High	60%			
Regulating	flood retention	Very Low	10%	Medium	40%			
nga	nutrient retention	Missing	0%	Medium	40%			
R 8	noise regulation	Missing	0%	Missing	0%			
	provision of habitats	Missing	0%	Very High	100%			
ESS	recreational activity	Missing	0%	High	60%			
	water related activity	Missing	0%	High	60%			
Cultural	tourism	Missing	0%	High	60%			
Cn	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).





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| Comparison | Com

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

the describes	-
Hydraulics	
Water Level Change	3
Flow Velocity Change	5
Bed Shear Stress Cha	nge 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

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

			Curre	nt St	ate	Restoration	
Perc. of Later	. during HQ 2-5	5 0			0	%	
							_
Habitat Type	Area	Flow Velocity	Area Re	s. F	Flow	Velocity Res.	
Floodplain	0	0	0	(0		1
Da alassatas	^	_	^				7

Ecosystem Services

		Ecosystem 3	CIVICCS	
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 westernpart 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.

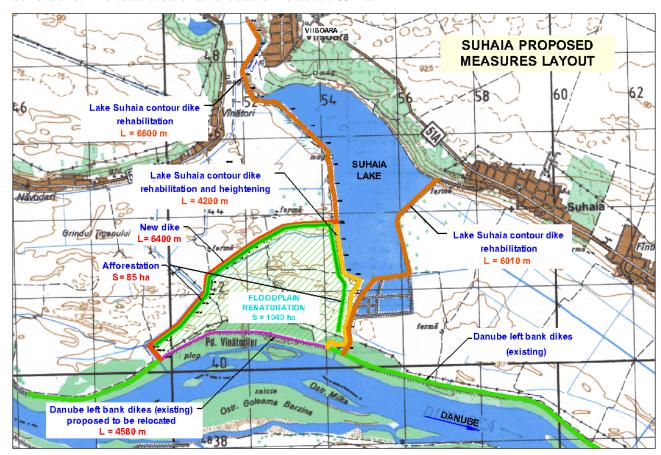


Figure 15 Suhaia proposed measures layout



Project capabilities:

Dikes rehabilitated and heighted – 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)

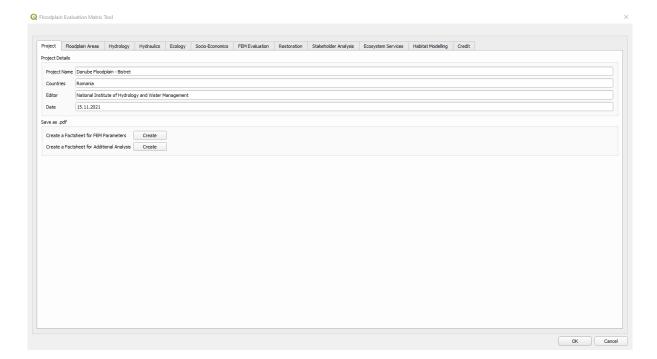
from which:

- Construction works. 16,200,000 € (including VAT)

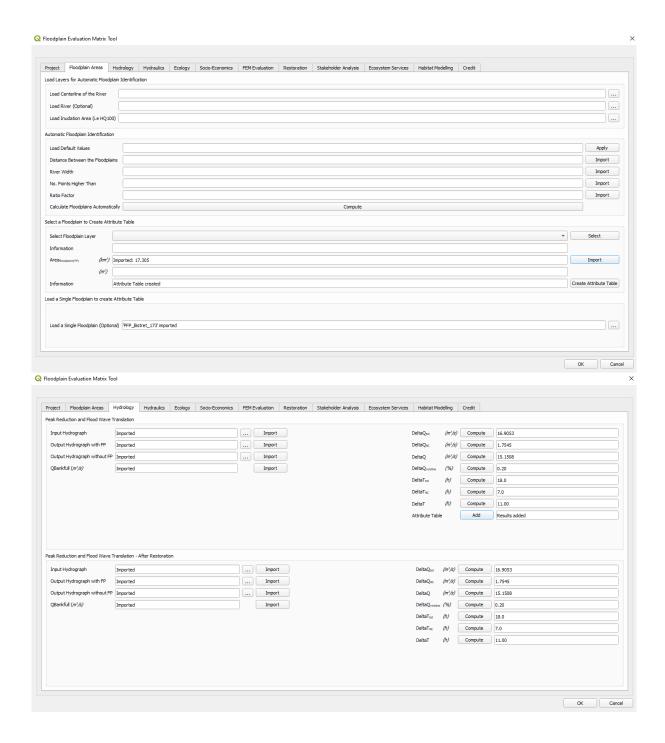
E. Results of applying the FEM-Tool using input from the previous tasks (FEM, CBA, ESS, stakeholder) – Bistret pilot area

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

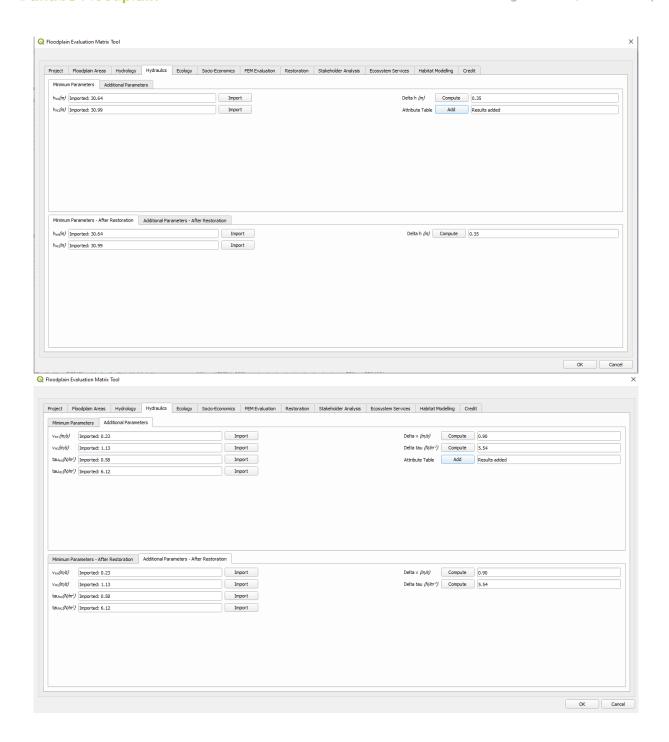
The FEM-Tool have been successfully applied for Bistret pilot area (see the screenshots presented below).



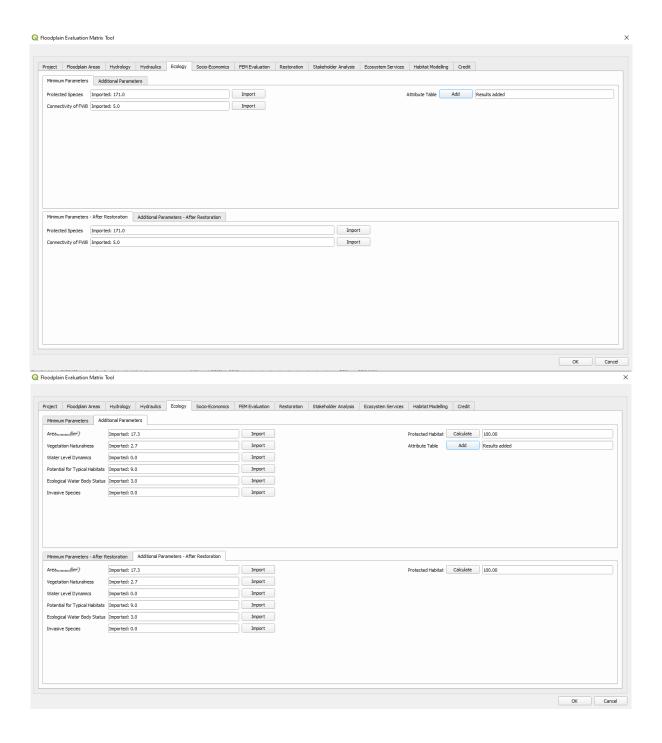




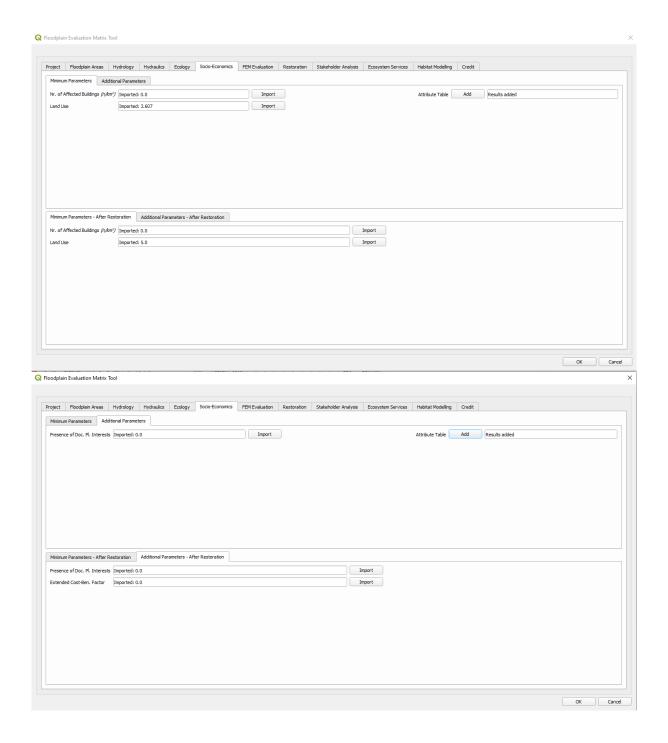




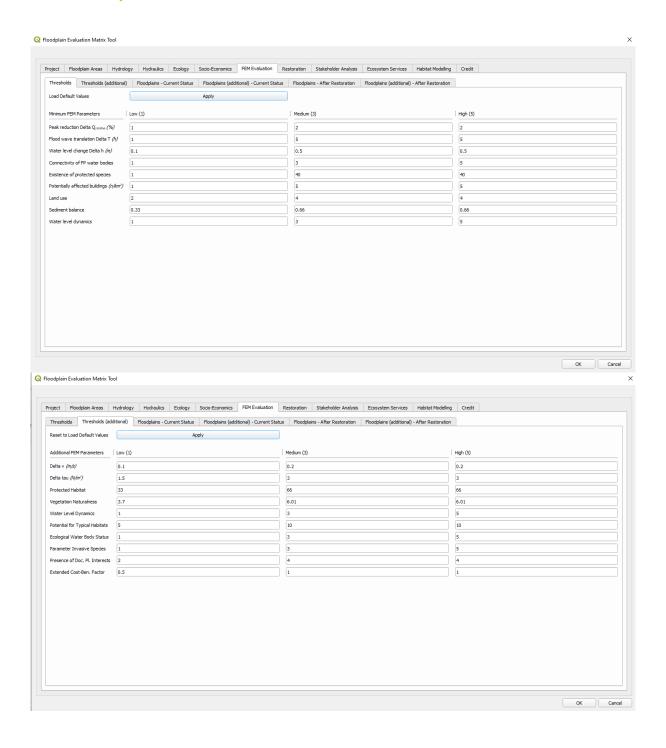




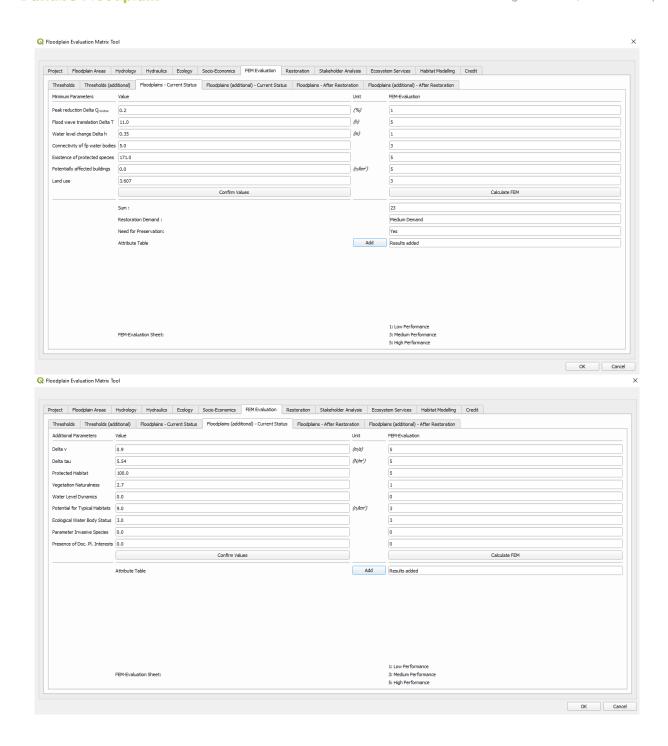




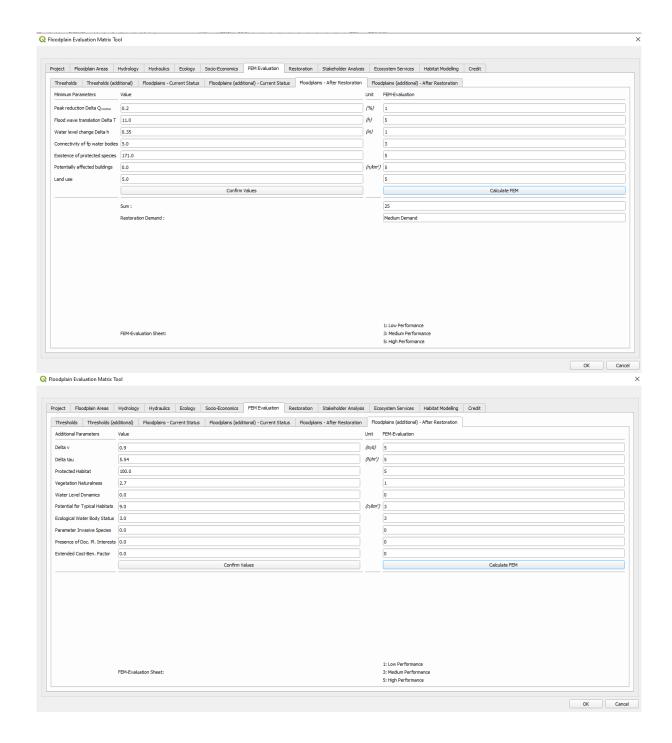




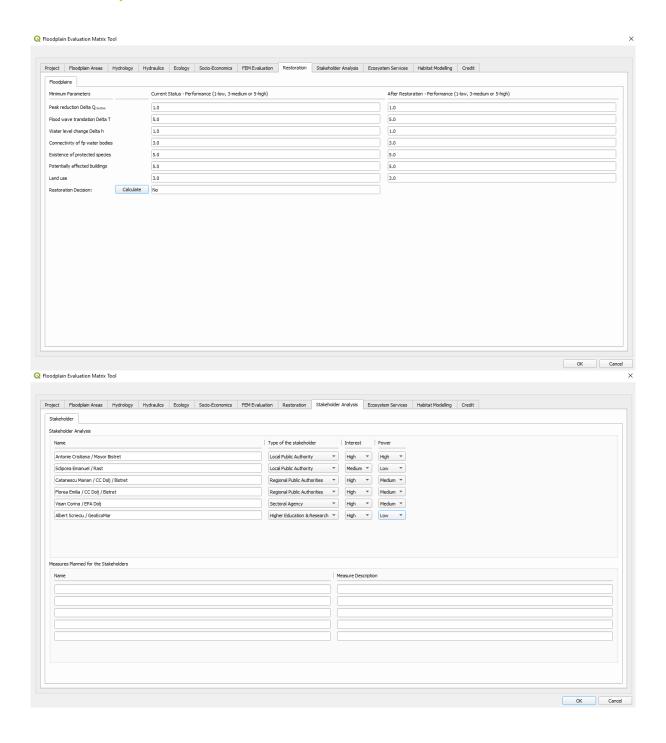




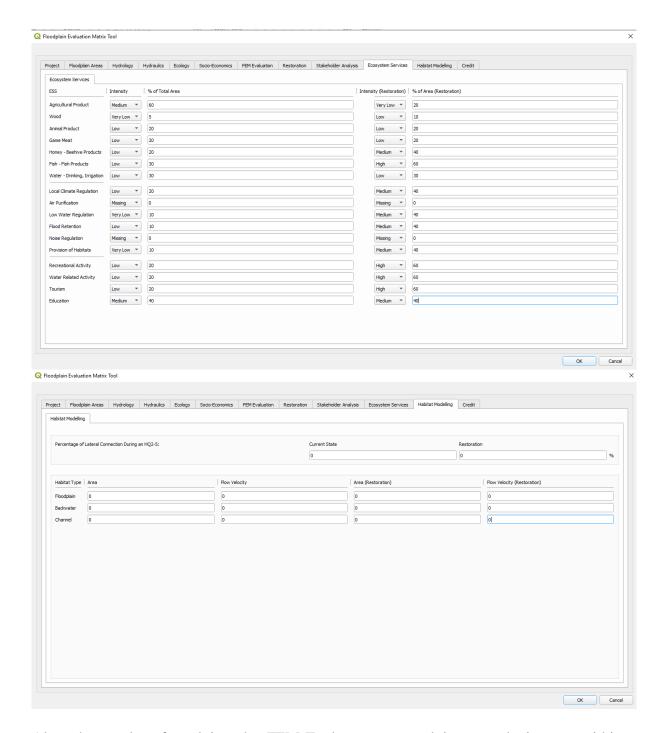












Also, the results of applying the FEM-Tool are generated in a synthetic way within two factsheets, presented below.



Danube Floodplain - Bistret Fact Sheet

Countries: Romania

Editor: National Institute of Hydrology and Water Management

Date: 15.11.2021

Need For Preservation	Restoration Demand
Yes	Medium Demand

Hydrology	
Peak Reduction	1
Flood Wave Translation	5

Hydraulics	
Water Level Change	1
Flow Velocity Change	5
Bed Shear Stress Change	5

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

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

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: 15.11.2021

Stakeholder Analysis

Hab	itat Modelling	
	Courant Chata	•

Name	Type of Stakeholder	Interest	Power				Current :	State	Restoration	
Antonie Cristiana / Mayor Bistret	Local Public Authority	High	High	iteral Con. during HQ 2-5		l Con. during HQ 2-5 0			0	%
Sclipcea Emanuel / Rast	Local Public Authority	Medium								
Catanescu Marian / CC Dolj / Bistret	Regional Public Authorities	High	Medium	١	_	Flow Velocity	Area Res.	Flow	Velocity Res.	4
Florea Emilia / CC Dolj / Bistret	Regional Public Authorities	High	Medium	⊢	0	0	0	0		4
Visan Corina / EPA Dolj	Sectoral Agency	High	Medium	L	0	0	0	0		┚
Albert Scrieciu / GeoEcoMar	Higher Education & Research	High	Low	1		Eo	nevetom S	2 on d	000	

Measures Planned for the Stakeholders

Name	Measure Description

Minimum Parameters	Current Status - Perf.	After Rest Perf.		
Delta Q relative	1.0	1.0		
Delta T	5.0	5.0		
Delta h	1.0	1.0		
Conn. of fp Water Bodies	3.0	3.0		
Existence of proct. species	5.0	5.0		
Potentially affected buildings	5.0	5.0		
Land use	3.0	3.0		
Restoration Decision	No			

		Ecosystem Services			
ESS	Intensity	Per. Total Area	Intensity Res.	Per. Total Area Res.	
Agricultural Prod.	Medium	60	Very Low	20	
Wood	Very Low	5	Low	10	
Animal Prod.	Low	20	Low	20	
Game Meat	Low	20	Low	20	
Honey	Low	20	Medium	40	
Fish	Low	30	High	60	
Water	Low	30	Low	30	
Local Cli. Reg.	Low	20	Medium	40	
Air Purification	Missing	0	Missing	0	
Low Water Reg.	Very Low	10	Medium	40	
Flood Retention	Low	10	Medium	40	
Noise Reg.	Missing	0	Missing	0	
Provision of Hab.	Very Low	10	Medium	40	
Recreational Act.	Low	20	High	60	
Water Related Act.	Low	20	High	60	
Tourism	Low	20	High	60	
Education	Medium	40	Medium	40	