D1.3.2 Local strategy and action plan for urban stream restoration in Senica

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A. Introduction and Local Context

Teplica is a medium-sized urban stream in Slovakia. It is a tributary of the Myjava, which is a tributary of the Morava flowing into the Danube. It is considered a Highly Modified Water Body (HMWB) according to the Water Framework Directive (WFD) from the estuary to the Kunov reservoir for about 8 km. The 22 km above the reservoir flow in a regulated channel. The source and its first 6 km are located in the Czech Republic. The Teplica catchment stretches over approximately 130 km^2. It is dominated by cropland, only a minor part in the catchment is covered with trees and urban area. The ReBioClim pilot section of Teplica is located in the city of Senica. The site offers various social benefits, such as space for play and discovery of nature, playgrounds, trails and recreational spaces for the community, which are important elements for a healthy urban stream.

Teplica represents an important opportunity for urban stream restoration that can simultaneously enhance ecological quality and strengthen the role of blue-green infrastructure in the city. The city is currently in the planning phase of the revitalisation process, which includes the preparation of project documentation and restoration plan. This document is intended to support the city in the successful implementation of nature-based solutions for urban stream restoration. The Local Strategy and Action Plan (SAP) for the study area includes concrete and applicable actions developed by local partner based on the results of project deliverables, applying a multiperspective approach. The SAP will be adopted by local authorities and documented through letters of commitment.

Figure 1. Teplica stream in Senica

B. Summary of Specific Perspectives

This chapter shortly describes the main results of the five perspectives derived from the work package deliverables for the pilot site Teplica in Senica.

Institutional and Stakeholder Framework

Most important stakeholders

Figure 2. 44 stakeholders in total, representing 6 of 9 target groups

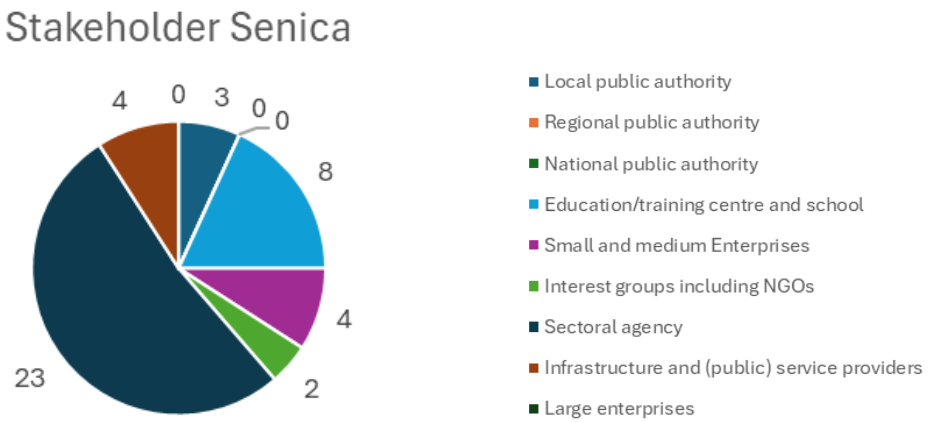


Table 1. Stakeholder role matrix

Type of stakeholder	Area of interest	Actor roles						
		Initiating	Steering and coordination	Implementing	Mediating	Financially contributing	Specialist support	Land owner
Small and medium enterprises	International	yes	yes	yes	yes	no	yes	no
Sectoral agency	Local	no	no	no	yes	no	yes	no
Education/training centre and school	National	yes	yes	yes	yes	no	yes	no
Sectoral agency	National	no	no	yes	no	no	yes	yes
Local public authority	Local	yes	yes	yes	yes	yes	yes	yes
Sectoral agency	Local	yes	yes	yes	yes	no	yes	yes
Interest groups, NGOs	Local	yes	yes	yes	yes	no	yes	no
Infrastructure and (public) service provider	Local	yes	yes	yes	yes	no	yes	yes
Education/training centre and school	Local	no	no	yes	yes	no	no	no
Sectoral agency	National	no	yes	no	no	no	yes	no

Governance and implementation setting

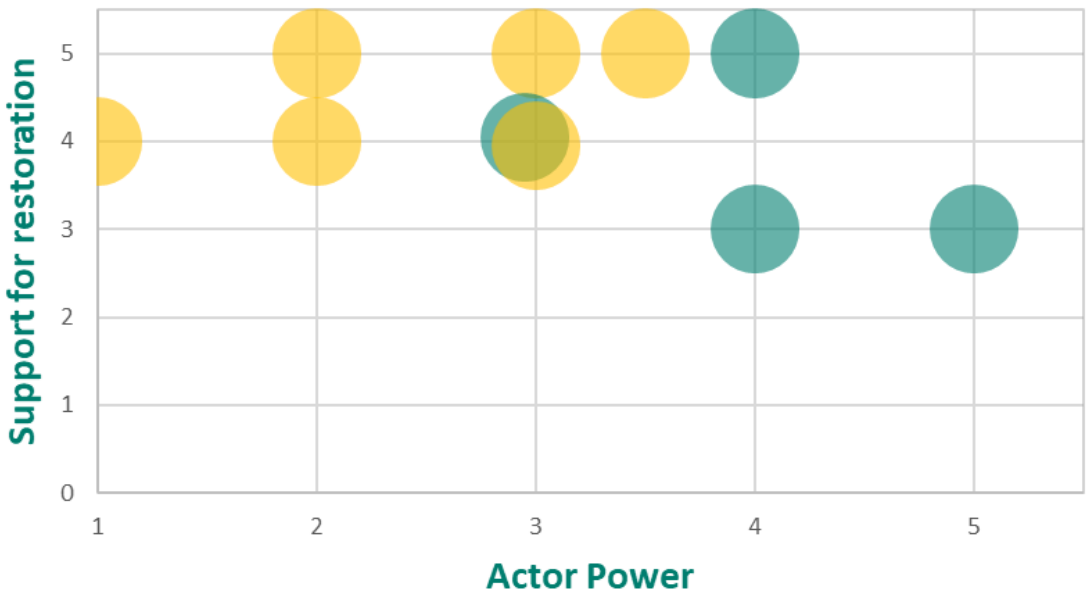
Urban stream revitalisation in Senica is implemented within a governance environment characterised by strong local institutional engagement combined with the involvement of national authorities, expert organisations and civil-society actors. Municipal actors play a central role in agenda-setting, coordination and implementation processes, reflecting a comparatively high level of local ownership over revitalisation activities and nature-based solutions.

Local authorities hold the strongest influence over planning and implementation processes and are responsible for coordinating revitalisation measures, mobilising resources and balancing environmental, technical and social objectives. National authorities and state water-management institutions provide important regulatory oversight, technical expertise and infrastructure management capacities, particularly in relation to flood protection, permitting procedures and safety requirements. Their involvement creates both enabling and constraining conditions for implementation, as ecological restoration objectives must be balanced with hydraulic and infrastructural priorities.

Research institutions, expert organisations, NGOs and educational actors contribute specialised knowledge, environmental advocacy and awareness-raising activities supporting urban stream restoration and public engagement. Although their formal decision-making influence remains limited, these actors strengthen technical quality, ecological legitimacy and communication with local communities.

Overall, the governance environment in Senica can be characterised as cooperative and supportive, with implementation challenges linked mainly to procedural fragmentation, infrastructure constraints and coordination between institutional levels rather than to stakeholder opposition. The distribution of stakeholder influence and support is illustrated in Figure 3.

Figure 3. Stakeholder power and support distribution indicating a cooperative governance environment in Senica. Local and national public authorities hold the strongest influence over decision-making processes, while expert institutions, NGOs and educational actors contribute primarily through technical, advisory and awareness-raising support.



Key institutional barriers and enabling conditions

The main institutional barriers identified in Senica and the corresponding enabling conditions are summarised in Table 2.

Table 2. Key institutional barriers and enabling conditions

INSTITUTIONAL BARRIER	ENABLING CONDITION
Fragmented administrative procedures and multi-level institutional responsibilities complicate implementation processes	Strong engagement and coordination capacity of local authorities
Technical and safety requirements related to flood protection and infrastructure management may limit ecological restoration measures	High institutional support for urban stream revitalisation and nature-based solutions
Dependence on external authorities and permitting procedures may slow implementation timelines	Cooperation between municipal actors, national institutions and expert organisations
Limited formal influence of NGOs, educational institutions and local community actors on decision-making processes	Strong advocacy, awareness-raising and educational activities supporting public engagement
Infrastructure constraints and competing technical priorities complicate implementation of restoration measures	Availability of specialised technical and environmental expertise supporting project preparation and implementation

More information can be found in deliverable Project Communication Strategy and deliverable Cross-national comparative analysis of institutions and stakeholders.

Ecological Conditions

The section in Teplica aimed to be restored is 750 meters long and located north-east of the city centre. The site was scored with urban morphology index 3 “moderately anthropogenically affected”, due to few special bed structures, concrete river bed construction, technical embankments and visible pollution (See Renner et al. 2018). The site in Teplica had parks with urban greenery, trees in the riparian zone and valuable socio-cultural characteristics that increased the overall index.

The results of the biological monitoring indicate the effect of agriculture and urbanization on the macro-invertebrate community, especially pollution and habitat degradation. Teplica had the highest amount of pollution of the ReBioClim streams. There is a gradient of urban impact from the upper to the lower stream sites, with the site closest to the source showing the best values for biodiversity, pollution and habitat quality. The monitoring site which is closest to the mouth shows the worst values.

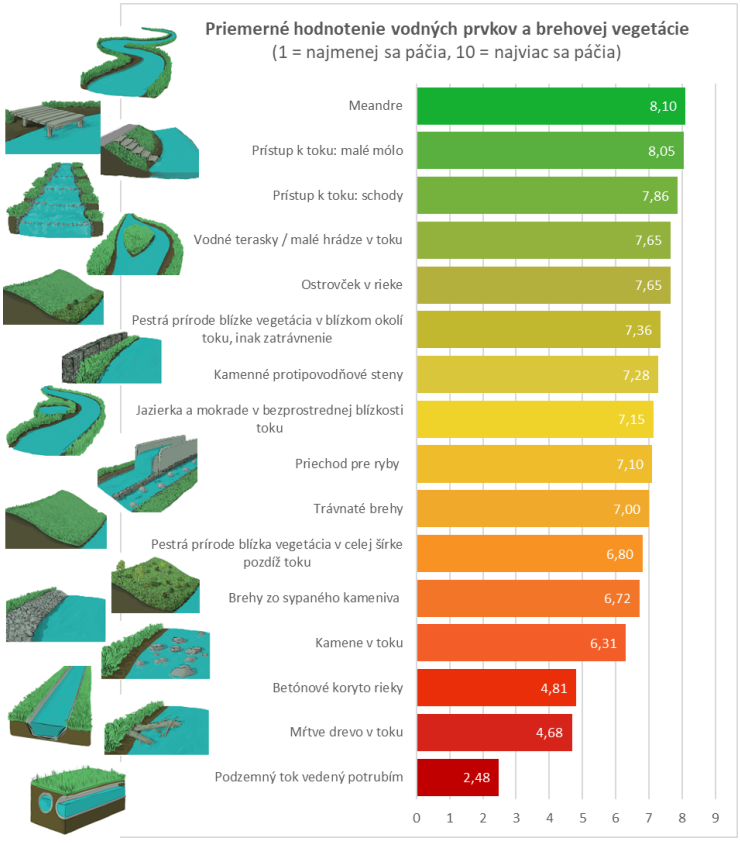
More detailed results can be found in deliverable Ecological Goals and the respective site report.

Social Perspective

The face-to-face survey conducted in Senica in 2025 focused on identifying residents' preferences for the urban stream restoration. A total of 291 valid face-to-face interviews were collected in the pilot area of the Teplica stream. Most respondents lived close to the study area, with nearly 80% residing within a 15-minute distance from the stream corridor. The sample consisted of 63% women and 37% men, with an average age of 38 years. Respondents were predominantly people with secondary education, followed by university graduates, and almost half of the sample was employed full- or part-time. Results show that the area is regularly used by local residents, with more than half of respondents visiting daily or several times per week. The most common reasons for visiting included **passing through the area, relaxation, and outdoor activities with children**. This demonstrates the importance of the stream corridor as an everyday urban and recreational space. Regarding ecosystem services, respondents considered **improved microclimate, habitats for plants and animals, air and water quality, and flood protection** as the most important benefits of stream restoration.

In terms of preferences for restoration measures, respondents clearly favoured nature-based solutions such as **meanders, access to the stream via small piers and steps, water terraces, and river islands**. Strongly engineered solutions, including streams enclosed in pipes and concrete channels, were evaluated most negatively. The choice experiment further confirmed a general preference for **meandering streams, access to water with piers, and urban park surroundings**. Respondents also strongly disliked situations where no access to water was provided. Preferences for riparian vegetation structure were more divided. More detailed analysis identified two main preference groups. The larger group (around **75%** of respondents) strongly preferred **open grassy surroundings and urban park settings**, while the second group (**25%**) placed greater importance on **natural stream morphology, wider vegetation belts, and nature-based restoration features**. This second group also showed generally stronger positive attitudes toward stream revitalisation overall.

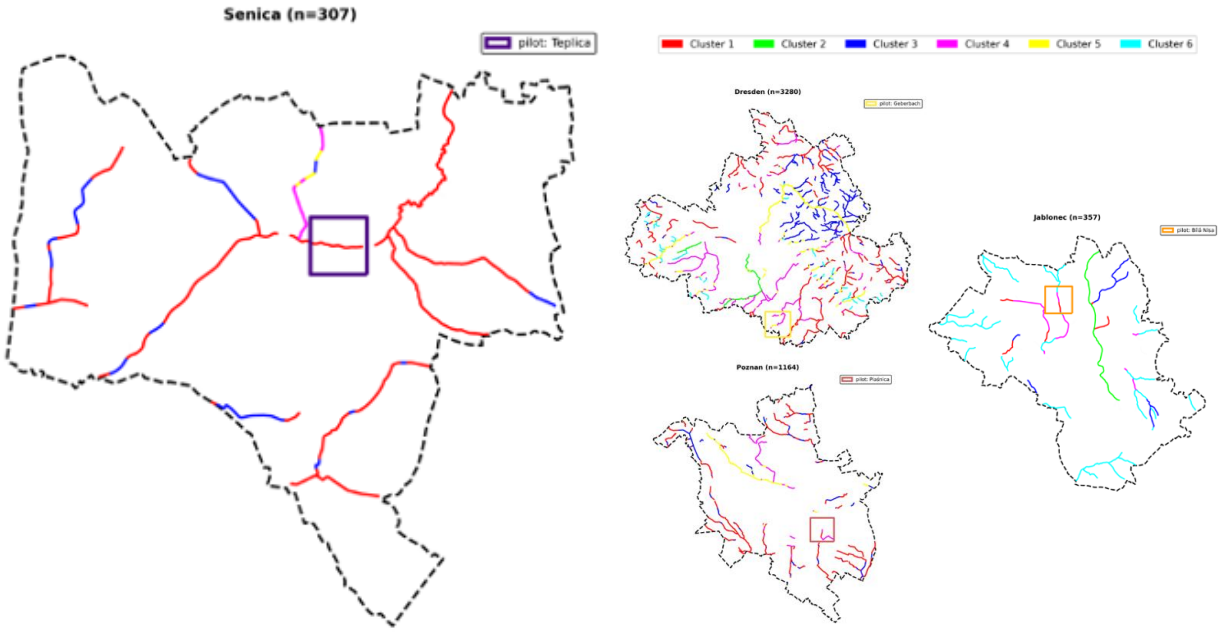
Figure 4. Average ratings of individual water features in the urban environment



Spatial Composition

All streams of the four cities were clustered into six types, based on the performance of spatial-related variables, including impervious cover, canopy cover, green land cover richness, green land cover Shannon diversity, land surface temperature, sinuosity, absolute slope, total crossings, valley depth, POI accessibility index, transport accessibility index, visibility ratio.

Figure 5. KMeans Cluster Distribution by city (k=6, 12 variables)



Regarding the characteristics of each cluster:

1 (n=2,021): High green diversity/richness, low canopy

2 (n=173): High access/crossing

3 (n=1,181): High canopy, high visibility, low diversity/richness

4 (n=716): High impervious, low visibility, high crossings, transport access, high temperature.

5 (n=302): High POI access, high sinuosity, high canopy, many crossings

6 (n=421): High valley depth, steep slope, high canopy, narrow valley

In Senica, Cluster 1 accounts for 73.9% of the city's stream segments. This cluster combines high diversity in green land cover with low canopy cover and high green richness, linked to heterogeneous green composition in the city centre and suburbs. A large proportion of stream segments fall in the lowest canopy cover class, so most of the network is only sparsely covered with trees. Mean land surface temperature is 32.1°C, the highest in the study. Mean visibility is high (0.92), likely due to the open landscape. Green land-cover Shannon diversity is high, indicating heterogeneous green composition despite sparse tree cover. Absolute slope and valley depth are gentle and shallow. More than half of stream segments have no road or railway crossings.

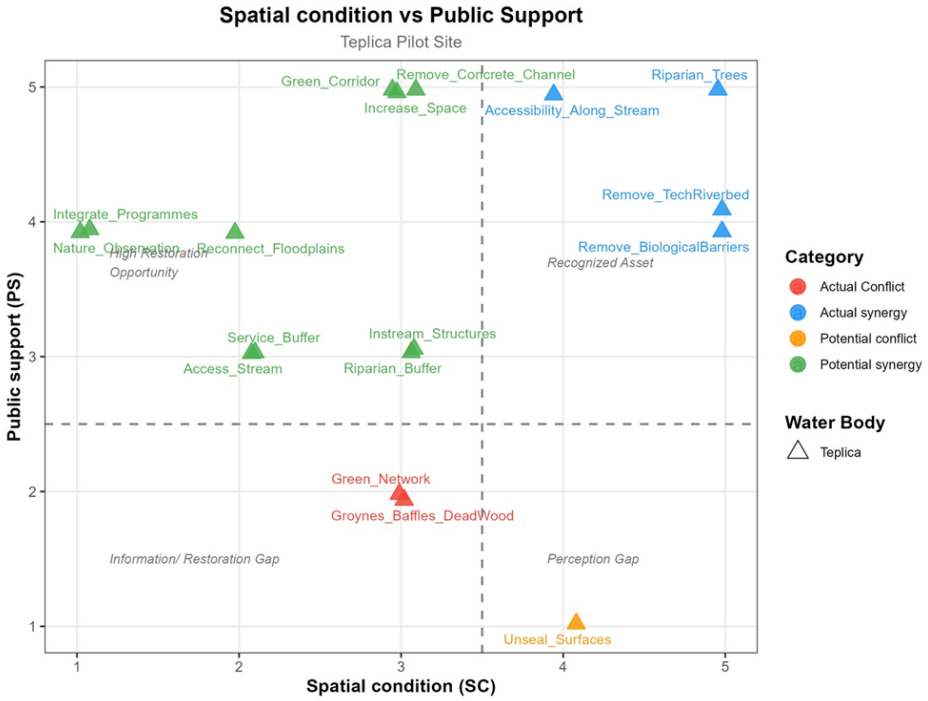
For the pilot stream in Senica, the stream segments of the pilot fall under Cluster 1, characterised by high diversity in green land cover and high green richness, combined with low canopy cover. This differs from Dresden, Jablonec nad Nisou, and Poznań, where pilot sites are dominated by Cluster 4.

Compared with the other cities, Senica stands out for a city-wide Cluster 1 share of 73.9%, the highest mean land surface temperature (32.1°C), the sparsest canopy, the lowest mean POI accessibility, and the lowest transport accessibility (0.007), with most segments at zero transport accessibility, reflecting the more rural character of the network. Mean visibility is the highest among the four cities (0.92), and a high share of stream segments falls in the lowest impervious-cover class, a pattern shared with Dresden. Slopes and valleys are gentler and shallower than in Dresden or Jablonec, while Shannon diversity of green land cover is among the highest, alongside Poznań.

Synergies and Conflicts

Based on the results from Synergies and conflicts analysis, there is a great opportunity to implement nature-based measures to restore the urban stream Teplica and surrounding. The largest group of restoration measures (10 out of 17) were classified as a potentional synergy (high restoration opportunity). That means people support the introduction of many environmentally beneficial and needed measures, e.g. **removing concrete channel**, **green corridor, integrate a leisure program, and increase space with moderate spatial condition**. This shows evidence that more related places can be created to increase the multifunctional use of the stream to enhance the synergy among all three perspectives. What also stands out is the relatively high number of actual synergies (4) which clearly showed already existing connection between ecological, spatial, and social perspective. These measures are **planting riparian trees**, **ensuring accessibility along the stream**, or **removing technical riverbed structures**. The actual conflict between ecological perspective on one side and the spatial and social perspective on the other side, occurred for the **creation of interconnected network of green spaces** or adding **dead wood, groynes or baffles** in the stream. This can be interpreted in the way, that although spatial condition for these ecologically beneficial measures are rather poor, they are not in favour with public perception – better information about the benefits is needed. There is also a potential conflict regarding the measure **unseal surfaces**, where the impervious condition is good, but not supported by the residents. From a public support-perspective, this is a signal to city officials that, in order to increase acceptance of this measure, it is necessary to raise awareness of its benefits.

Figure 6. Distribution of restoration measures based on spatial condition and public support values



C. Suggestions for NBS Implementation

This chapter describes the general recommendations for nature-based urban stream restoration measures implementation based on the specific perspectives on urban restoration and synergies and conflicts analysis, and also specific and applicable actions developed by the City of Senica for future uptake.

General recommendations

- Establish a shared long-term vision for urban stream revitalisation together with the River operator and maintain continuous coordination and regular updates of this common vision.
- In the restoration plan, prioritise measures with strong multi-perspective synergies, including removal of concrete channel, establishment of green corridors, improved access to streams, integration of leisure, educational and sports functions, and enhancement of spaces with suitable spatial condition.
- Raise awareness of the environmental and social benefits of permeable surfaces and nature-based solutions, including improved water infiltration, reduced flood risks and mitigation of urban heat-island effects.
- Strengthen cooperation between municipal authorities, national institutions and expert organisations throughout planning and implementation processes.
- Add riparian trees and small tree groups in selected locations to increase shade, habitat quality and cooling, while strengthening nature observation and leisure opportunities along the existing blue-green corridor.

Specific actions

- Elimination of illegal discharges
- Flood Protection & Master Plan

Action n. 1	**Action name**	**Elimination of Illegal Discharges**
	Implementation phase	full restoration
WHAT	**Action definition**	A systematic process involving the identification and analysis of existing pipe outlets, surveying their trajectories, and identifying the parties responsible. This includes issuing official notifications and formal requests for removal to the originators. If the situation is not rectified voluntarily, the city will initiate administrative proceedings through the District Office and supervise the process to ensure the complete removal of illegal connections.
	Scope	General ☐ Local ☑
	Typology	☑ active intervention ☐ regulation ☐ promotion ☐ monitoring and/or research program ☐ educational program ☐ other:.....
	Perspective	Spatial ☐ Public ☐ Institutional ☑ Ecological ☑
WHY	**Current status**	Within the City Park area, all existing outlets have been surveyed and sampled. These lab results have successfully distinguished between standard rainwater runoff and illegal sewage discharges. Consequently, the specific locations of illegal wastewater points into the **Teplice stream** are already identified and mapped.
	Connected restoration goal	To terminate the discharge of raw sewage into the Teplice watercourse and restore water quality.
WHO	**Competent stakeholders**	District office environmental department and Town of Senica
HOW	**Funding options**	If illegal polluters are identified, they will pay for the removal, if they are not identifiable, we will look for Environmental grants (EU or national level) if not, we will pay from our own municipal budget.
	Time and cost estimation	1 to 2 years / cost not yet determined
WHERE and WHEN	**Planned year and location (if relevant)**	2026-2027 / In city park area
	Indicators for monitoring	• Reduced number of illegal discharges • increased chemical quality of discharged water
Identified RISKS	The decision-making body is the district office of the environmental department, which is not under the Senica City office - we are therefore unable to directly influence the speed and strength of individual processes and interventions against illegal polluters.	Risk mitigation measures: The city of Senica has very good relations and good communication with the district office, and the district office's environmental department itself is interested in stopping illegal discharges into the Teplica River. At the same time, the Town of Senica will assist the Department of Environment as much as possible.

Action n. 2	**Action name**	**Flood Protection & Master Plan**	
	Implementation phase	planning	
WHAT	**Action definition**	Development of a comprehensive new Flood Protection Plan designed to identify specific risks and critical flood-prone areas, accompanied by targeted mitigation proposals. This document will serve as a foundational technical baseline for the drafting of the city's New Master Plan (Urban Spatial Plan). The goal is to shift the planning paradigm towards enhanced ecological stability and the systematic implementation of nature-based flood protection measures throughout the territory.	
	Scope	General ☑ Local ☐	
	Typology	☐ active intervention ☑ regulation ☐ promotion ☑ monitoring and/or research program ☐ educational program ☐ other:……	
	Perspective	Spatial ☐ Public ☐ Institutional ☐ Ecological ☑	
WHY	**Current status**	Not started	
	Connected restoration goal	Adoption of territorial regulations that support stream ecology and facilitate the creation of flood protection infrastructure.	
WHO	**Competent stakeholders**	Town of Senica	
HOW	**Funding options**	Municipal budget of Senica; subsidies from the Ministry of Transport (responsible for overseeing the creation of new Master Plans)	
	Time and cost estimation	Completion by 2032/ Estimated 100,000 - 200,000 €	
WHERE and WHEN	**Planned year and location (if relevant)**	Completion by 2032	
	Indicators for monitoring	• Formal approval and adoption of the new Master Plan	
Identified RISKS	Financial uncertainty due to unconfirmed subsidies, potential legal and logistical hurdles in securing landowner approvals, and a lack of guaranteed backing from key stakeholders and the river management authority.	Risk mitigation measures	The master plan will be developed through an open, participatory process featuring proactive communication and public meetings. Involving citizens, landowners, and key stakeholders—including the river management authority—from the outset will build institutional trust and community ownership. This collaborative approach directly resolves legal and logistical hurdles, secures essential stakeholder backing, and strengthens the project's positioning when applying for unconfirmed subsidies.