Interreg
CENTRAL EUROPE

Co-funded by the European Union

ReBioClim

D1.3.2 Strategy and action plan documentation

Version 1

05 2026

Lenka Dubová, Claudiu Forgaci, Nora Franzke, Ulrike Haase, Henriette John, Jiří Louda, Karol Mrozik, Martin Neruda, Lenka Slavíková, Ralf-Uwe Syrbe, Štěpánka Truhlářová, Yehan Wu et al.
(authors listed in alphabetical order by last name)

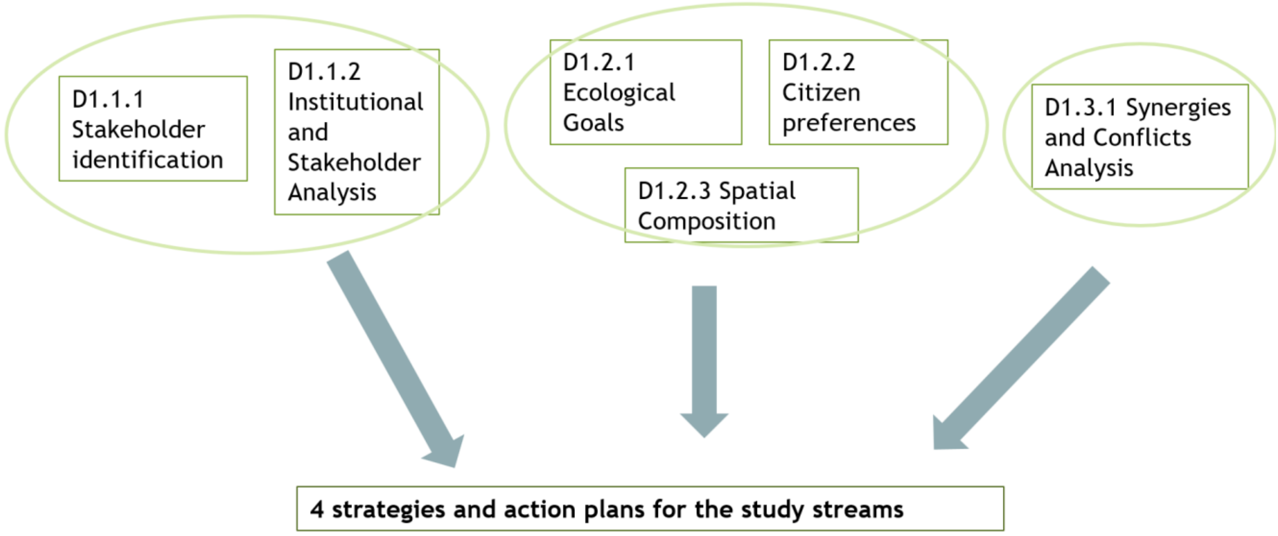
CONTENT

ReBioClim

A. Introduction

This deliverable (Strategy and action plan documentation) is a report of four local Strategies and Action Plans (SAPs) developed for the pilot stream study areas in Dresden (Geberbach stream), Jablonec nad Nisou (Bílá Nisa), Poznań (Piasnica) and Senica (Teplica). The SAPs aim to support the successful implementation of nature-based solutions for urban stream restoration and provide a basis for future restoration activities in the pilot cities. The strategies and action plans were developed by scientific and local partners using the results of seven WP1 deliverables (Figure 1).

Figure 1. Work package 1 deliverables used for Strategy and action plan documentation



These results were synthesised into five perspectives: Institutional and Stakeholder, Ecological, Social, Spatial, and Eco-social-spatial Synergies and Conflicts, providing a comprehensive understanding of the challenges and opportunities associated with urban stream restoration. The report first summarises the methods and also key findings of the WP1 deliverables within each perspective for each pilot city. Based on these results, it outlines set of general recommendations that may support urban stream restoration planning and implementation in other Central European cities. Finally, the report provides the actions identified by local partners for future implementation. Each SAP will be taken up by local authorities from pilot cities and will be documented via letters of commitment.

B. Common Theoretical and Methodological Framework

This chapter shortly describes the methodology used to achieve respective WP1 results used as a basis for the development of the local strategies and action plans and briefly explains how each deliverable was developed. References to the respective deliverables are also provided.

1. Institutional and Stakeholder Framework

The institutional and stakeholder analysis was based on a combined governance-oriented approach integrating stakeholder analysis and institutional analysis in the context of urban stream revitalisation and nature-based solutions. The analysis focused on identifying key actors involved in restoration processes, assessing their influence and support for revitalisation measures, and examining institutional barriers and enabling conditions affecting implementation. The analytical framework emphasised governance structures, coordination mechanisms, implementation capacities and multi-level institutional relationships influencing urban stream restoration in the pilot cities.

Stakeholder analysis combined desk research, local expert knowledge and semi-structured interviews with representatives of public authorities, sectoral agencies, NGOs, research institutions and other relevant actors. The analysis assessed stakeholders according to their roles in implementation processes, perceived influence on decision-making and level of support for urban stream revitalisation. The results were synthesised into stakeholder mappings and interpretative assessments of governance dynamics and actor relationships.

The institutional analysis focused on identifying the main barriers and enabling conditions related to implementation of revitalisation measures. Data were collected primarily through semi-structured interviews conducted by local project partners with selected stakeholders in all pilot cities between July and November 2025. The interviews were subsequently transcribed, translated into English where necessary, and analysed using qualitative coding and thematic interpretation focused on administrative procedures, regulatory frameworks, financing conditions, institutional coordination and implementation challenges. The resulting analysis provided the basis for identifying governance-related risks, implementation opportunities and strategic recommendations supporting urban stream revitalisation processes.

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

2. Ecological Perspective

The basis for the analysis was a set of 36 restoration goals identified in deliverable Ecological goals for restoration of the study streams that followed setting up driver, pressure, state, impact, response relationship (DPSIR framework) for the pilot streams. The DPSIR framework is recommended as a best practice for stream and river restoration in both scientific literature (Song et al., 2012; Lu et al., 2019; Pinto et al. 2013) and international restoration projects (WISER Project, REFORM Consortium, Global Water Partnership). For the case study sites, the most common pressure types related to urbanization, hydro-morphological alteration and climate change were selected based on WFD Reporting Guidance 2016 (Annex 1A), which presents a list of pressures relevant in European freshwaters (EC, 2015). The related responses (restoration goals) were based on findings of REFORM project, that analysed the effect of restoration measures across Europe.

For each restoration goal, we identified a set of possible restoration measures with a description of the effect on climate adaptation, biodiversity, and quality of life. We used this dataset as a basis for the toolbox developed within ReBioClim to support the co-design workshop methodology. As urban stream health is the starting point for our restoration efforts, the ecological restoration measures served as a reference for assessing spatial conditions and public perception.

Additionally, physico-chemical and biological data was obtained by LP and projects partners to assess the ecological status quo of the four project streams. To interpret and compare the ecological quality of the project streams different core metrics calculated from the taxa lists of benthic invertebrates (makrozoobenthos) within the PERLODES evaluation scheme were combined. The indicators were chosen for their relevance in (urban) stream environments and grouped into 3 categories (See **Table 1**).

Table 1. Categories for ecological assessment of the pilot streams with respective indexes and metrics

Category	Metrics
Biodiversity	Shannon Index, Evenness, Fauna Index, Rheo Index, Percentage of EPT-Taxa
Pollution	Inverted Saprobic Index, SPEAR Index
Habitat quality	Inverted percentage of pelal preference, Percentage of shredders

More information can be found in the deliverable Ecological goals for restoration of the study streams.

3. Social Perspective

A structured face-to-face survey was designed to capture residents' attitudes, preferences, and perceptions of urban stream restoration in the four pilot areas. The questionnaire consisted of seven thematic sections covering general environmental attitudes, relationship to the site, evaluation of stream and riparian features, perceived benefits of restoration, socio-demographic characteristics, and interviewer-recorded contextual information. A central part of the survey was a discrete choice experiment, where respondents repeatedly selected between two illustrated restoration scenarios defined by key attributes such as corridor type, water accessibility, riparian vegetation, and surrounding green space management. In addition, respondents rated visual examples of stream features and assessed the importance of ecosystem and social benefits using structured rating scales.

Data were collected in 2024–2025 near the pilot streams, and 1,054 valid interviews were completed. The resulting data were analysed using descriptive statistics and econometric methods applied to the choice experiment, allowing estimation of preferences for different restoration attributes and their relative importance. In addition, Spearman's rank correlation test was used to examine relationships between stated preferences from survey questions and respondents' socio-demographic characteristics, enabling the identification of statistically significant associations between preference patterns and population groups. These results provide a quantitative evidence base of public preferences, which was used to inform the integration of the social perspective into the overall assessment of restoration measures.

More information can be found in the deliverable Citizens' preferences towards specific restoration measures considered for implementation.

4. Spatial Perspective

To understand the current physical conditions of urban streams and support informed restoration decisions, their spatial characteristics were examined. Specifically, a multi-scalar analysis was conducted at three levels: (1) the pilot sites for each city, (2) all stream segments within the four cities, and (3) the sub-catchments that cover all the streams. For each scale, the most relevant variables were selected to calculate and map spatial variations. The resulting maps provide stakeholders with a clear spatial reference to guide the decision-making process.

For pilot sections, ecosystem services including provisioning, regulating and cultural services were analysed and mapped. Every pilot stream was rated to indicate which stretches already offer good conditions and which ones could benefit from simple restoration measures. For all stream segments within the four cities, spatial features in and around the stream corridors were mapped and analysed for each city.

Using these features, the streams were grouped into six types. Each type reflects a different situation, helping identify what kind of local restoration might be suitable in different parts of each city. At the sub-catchment level, larger sub-catchment areas were grouped into five categories. This shows how the wider landscape affects the health of the streams and where broader actions may be needed.

Together, these three levels of analysis provide a clear and easy-to-understand overview of urban stream conditions. They are meant to support cities in choosing where to act and what kinds of measures are likely to work effectively for stream restorations.

More information can be found in the deliverable [Spatial composition, configuration analyses and assessments of ecosystem services].

5. Eco-Socio-Spatial Synergies and Conflicts

The synergies and conflicts analysis combines ecological, spatial, and social perspectives on urban stream restoration using a mixed-methods approach and results from WP1 and WP2 deliverables. A set of 36 ecological restoration goals and measures was first defined based on DPSIR analysis and then refined using co-design workshop results to ensure relevance for local stakeholders. The analysis uses a common spatial unit (50 m stream sections and whole pilot sites) to allow comparison across case studies. Spatial condition indicators were derived from structural and spatial analyses, while public support indicators came from citizen surveys, including choice experiments and preference ratings. All variables were standardised to a five-level scale (1–5) to ensure comparability.

Synergies and conflicts were then identified by comparing spatial condition (SC) and public support (PS) for the measures using a quadrant approach for each pilot area. The five-level scores for the measures were grouped into low (≤ 3 – for SC; < 3 for PS) and high (> 3 – for SC; ≥ 3 for PS) categories and the measures were classified into four quadrants: actual synergy (recognized asset), potential synergy (high restoration opportunity), potential conflict (perception gap), and actual conflict (information and restoration gap), depending on whether SC and PS were high or low. This approach highlights where ecological needs and public preferences align, and where they differ, providing a clear evidence base for prioritising restoration measures.

More information can be found in the deliverable [Report on social-ecological synergies and conflicts].

C. Summary of the Perspectives for Each City

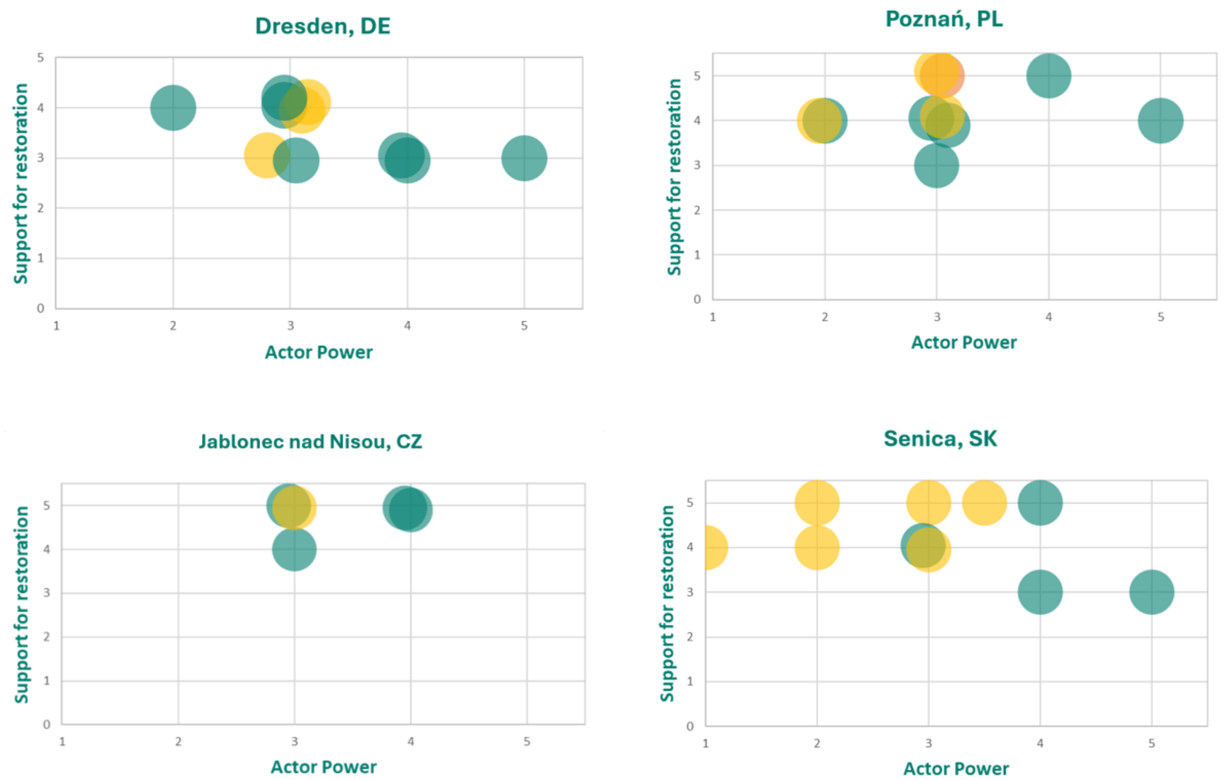
This chapter shortly describes the local context and main results of the five above mentioned perspectives derived from the Work Pacakge 1 deliverables specifically for each city.

1. Institutional and Stakeholder Framework

The institutional and stakeholder analysis highlighted that urban stream revitalisation in all pilot cities depends strongly on the capacity to coordinate multiple actors, balance ecological and technical objectives, and integrate nature-based solutions into broader urban-development and climate-adaptation agendas. In all cities, municipal authorities and sectoral public institutions play a central role in the planning, coordination and implementation processes. Meanwhile, expert organisations, NGOs and local communities contribute ecological expertise, public legitimacy and participatory support. The analysis also showed that stakeholder opposition is generally limited; the main implementation challenges arise primarily from administrative complexity, fragmented institutional responsibilities, technical constraints, financing conditions and competing land-use priorities.

At the same time, all pilot cities demonstrated substantial institutional and stakeholder support for urban stream revitalisation and increasing recognition of the multifunctional benefits of nature-based solutions, including biodiversity enhancement, flood-risk reduction, climate adaptation, recreation and improvement of public-space quality. The analysis identified cross-sectoral cooperation, long-term strategic planning, stakeholder engagement and integration of revitalisation objectives into spatial and climate-adaptation policies as key enabling conditions supporting successful implementation processes.

Figure 2. Stakeholder power and support distribution in the pilot cities



Dresden

The governance environment in Dresden is characterised by strong institutional capacity combined with high administrative and procedural complexity. Municipal and sectoral public actors hold the strongest influence over implementation processes, while technical experts and civil-society actors contribute mainly through advisory and participatory support. The main barriers relate to lengthy permitting procedures, land-use competition, fragmented ownership structures and unstable long-term financing conditions. At the same time, the city benefits from strong institutional expertise, growing recognition of multifunctional restoration benefits and active cooperation between environmental, technical and planning actors.

Jablonec nad Nisou

Jablonec nad Nisou demonstrates a comparatively supportive and cooperative governance environment with strong political commitment to urban stream revitalisation and nature-based solutions. Municipal authorities play a central coordinating role and actively integrate revitalisation objectives into broader urban-development and climate-adaptation strategies. The main implementation challenges stem from fragmented ownership structures, infrastructure-related constraints and dependence on external permitting and regulatory authorities. Stakeholder support is generally high and conflicts between actors remain limited.

Poznań

Urban stream revitalisation in Poznań is shaped by a multi-level governance environment with a particularly strong role of regional water-management and sectoral institutions. Regional authorities and municipal service providers hold substantial influence over planning and implementation processes, while NGOs and community actors contribute mainly through participatory activities and environmental advocacy. Key barriers include complex institutional coordination, technical infrastructure constraints and dependence on regional permitting procedures. At the same time, strong stakeholder support and growing recognition of the climate-adaptation and flood-retention benefits of nature-based solutions create favourable conditions for implementation.

Senica

The governance environment in Senica is characterised by strong local institutional engagement supported by national authorities, expert organisations and educational actors. Municipal authorities play a central role in coordinating revitalisation processes and balancing environmental, technical and social objectives. The analysis identified procedural fragmentation, infrastructure-related constraints and dependence on external authorities as the main implementation challenges. However, stakeholder relations are generally cooperative and supportive, with strong involvement of NGOs, schools and expert actors contributing to awareness-raising, public engagement and ecological legitimacy of revitalisation measures.

2. Ecological Conditions

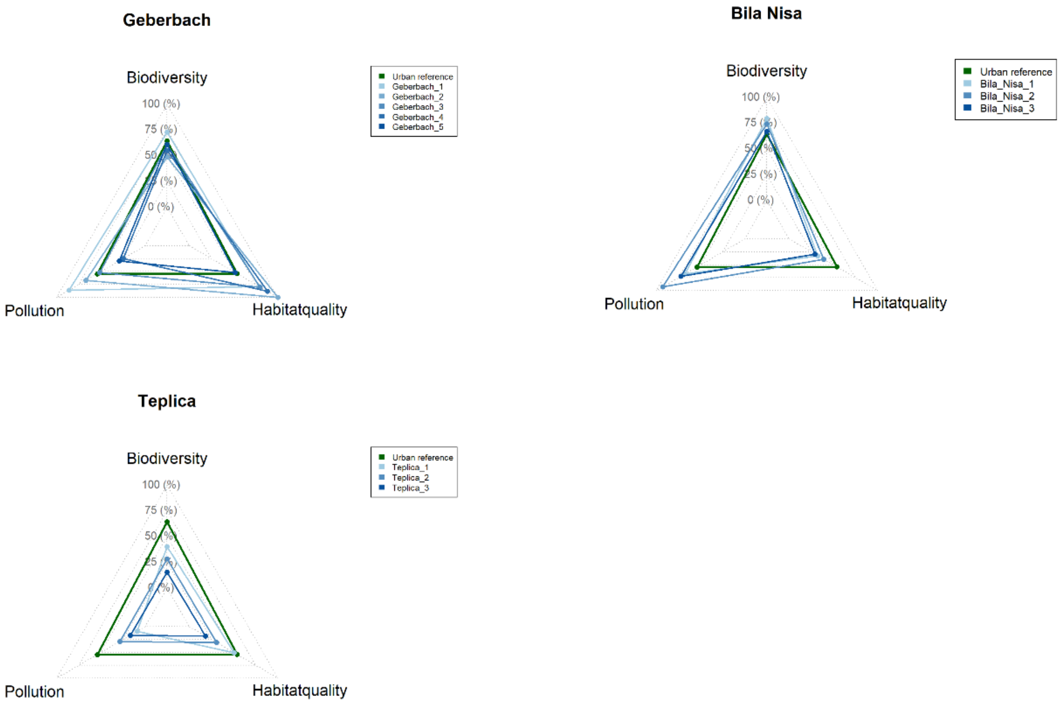
Even though the cities and streams differed in catchment size and discharge, they all share the influence of urbanization on their biology, physico-chemistry and geohydraulics. All pressure types related to urbanization from WFD Reporting Guidance 2016, Annex 1 are relevant for the ReBioClim pilot streams. The streams have been confined to a regulated channel (or even piped) and are disconnected from their floodplain and former meanders. All streams were degraded by chemical pollution due to agriculture, industry and urban run-off. Migration barriers impair ecological connectivity.

Table 2. List of Pressure Types (WFD Reporting Guidance 2016, Annex 1) related to urbanization and their respective effects on stream ecology

Driver	Effect
Urban wastewater	Pollution ↑, Biodiversity ↓
Storm overflows	Pollution ↑, Biodiversity ↓
Waste disposal sites, Contaminated sites or abandoned industrial sites	Pollution ↑, Biodiversity ↓
Urban run-off	Pollution ↑, Biodiversity ↓
Discharges not connected to sewerage network	Pollution ↑, Biodiversity ↓
Abstraction or flow diversion – Public water supply	Habitat quality ↓, Biodiversity ↓
Physical alteration of channel/bed/riparian area/shore - Flood protection	Habitat quality ↓, Biodiversity ↓
Hydrological alteration	Habitat quality ↓, Biodiversity ↓
Littering	Pollution ↑, Biodiversity ↓
Hydromorphological alteration - Physical ↓ of whole or part of the water body	Habitat quality ↓, Biodiversity ↓

The results of the biological monitoring displayed the best ecological condition for Bílá Nisa, followed by Geberbach, Teplica and Piasnica in regard of biodiversity, habitat-quality and pollution. Bílá Nisa had the lowest and Teplica the highest overall levels of chemical pollution. The results show a gradient from better to worse ecological condition in relation to distance to source, from urban reference sites to downstream (more urban sites) for all streams, which can be explained by increasing levels of pollution and increasing degradation of habitats. The full results of physico-chemical and biological assessment can be found in deliverable [Ecological goals for restoration of the study streams]() and the site reports.

Figure 3. Spider plots with scaled ecological indexes for Biodiversity, Habitat quality and Pollution for Bila Nisa, Geberbach and Teplica in three different sites and the urban reference site (as weighted mean)



Dresden

Along the gradient of urbanization, the habitat quality decreases and pollution increases (see Figure 3). The biodiversity of benthic invertebrates remains rather high, showing good potential for ecological stream restoration.

Jablonec nad Nisou

Bila Nisa showed the best ecological condition in comparison to the other pilot streams. Pollution levels were below and biodiversity index were above urban reference values (see Figure 3). Habitat-quality was low, especially in the project sites. These factors indicate a high potential for stream restoration with NBS that aim to increase habitat quality.

Poznań

The pilot section is fully piped and therefore in bad ecological condition. An analysis as it was performed on the other streams was not possible due to missing data.

Senica

The species composition of Teplica shows a severely disturbed mountainous stream. All indicators were below urban reference conditions (see Figure 3). Teplica had the highest amount of pollution of the three streams. The high levels of pollution are most probably the cause for depletion of sensitive species, leading to underscoring in terms of biodiversity and habitat quality.

3. Social Perspective

The survey results from all four cities demonstrate a shared preference for nature-based measures and accessible, green, and natural urban watercourses, integrated into the daily lives of residents. In all pilot areas, respondents rejected concrete channels and the absence of water access. Meandering stream with diverse vegetation and access via small piers or stairs was consistently rated most positively. Urban parks were the preferred type of surrounding greenery, while semi-natural parks were least favoured. Figure 4 shows the combination of measures most frequently preferred in the choice experiment. While local contexts and experiences shape specific expectations, natural, multifunctional and socially inclusive stream restoration designs are broadly supported by urban residents across Central Europe cities.

Figure 4. Combination of the most frequently preferred attributes in the choice experiment

Dresden

A total of 268 valid face-to-face interviews were collected in 2025 in the pilot area of the Geberbach stream. Most respondents lived close to the study area, although only a small proportion had lived in the district since birth. The sample consisted of 63% women and 37% men, with an average age of 55 years. Respondents were predominantly people with vocational education, followed by university graduates, and a large proportion of the sample consisted of retirees. Results show that the area is frequently used by residents, with three quarters of respondents visiting daily or several times per week, mostly on foot. The most common reasons for visiting included **observing and experiencing nature, relaxation, passing through the area**, and **social interaction**. This confirms the importance of the Geberbach corridor as both a recreational and everyday urban space. Regarding ecosystem services, respondents considered the **creation of habitats for plants and animals, improved air quality, and a better microclimate** as the most important benefits of stream restoration. In terms of preferences for restoration measures, respondents clearly favoured nature-based solutions such as **meanders, river islands, wetlands, fish passages, and diverse riparian vegetation**. Strongly engineered solutions, including concrete riverbeds and streams enclosed in pipes, were evaluated most negatively. The choice experiment further confirmed a general preference for natural and multifunctional stream corridors, with respondents particularly favouring **meandering streams with additional natural elements** and **accessible riverbanks**. Areas without access to water or without vegetation were generally disliked. More detailed analysis identified two main preference groups. The larger group (**63%**) strongly preferred **natural stream morphology and wide riparian vegetation**, while rejecting concrete channels. The second group (**37%**) placed stronger emphasis on **access to water and urban park surroundings** but showed weaker preferences regarding stream morphology and vegetation structure.

Jablonec nad Nisou

A total of 246 valid face-to-face interviews were collected in autumn 2024 in the pilot area, with the majority of respondents living in the immediate surroundings. The sample was relatively balanced in terms of gender and had an average age of 49 years, with a broad distribution across education and income groups. Results show that the area is frequently used by residents, with most respondents visiting at least several times per week and spending more than 15 minutes per visit. The most common reasons for visiting include **walking through the area, relaxation, nature observation, and social interaction**. This indicates that the stream corridor plays an important role in everyday recreation and local liveability. Regarding valued ecosystem services, the most important benefit that revitalisation can provide is the creation of **habitats for plants and animals**, together with **improvements in air quality, water quality, and the local microclimate**. In terms of preferences for restoration measures, respondents clearly favour nature-based solutions such as **river meanders, in-stream islands, diverse riparian vegetation, and improved access to the water** (e.g., steps or small piers). In contrast, heavily engineered solutions such as **channelisation, concrete beds, and flood protectio**n walls are strongly rejected. The choice experiment further confirms a general preference for a natural, accessible, and green river corridor, particularly one with **meanders, wider vegetation zones, and urban park surroundings**. More detailed analysis of the choice experiment reveals three distinct preference groups. Two dominant groups (together **88%** of respondents) consistently reject a concrete channel and prefer **access to water and wider riparian vegetation**, although they differ in the intensity of their positive versus negative preferences. A smaller group (**12%**) shows weaker overall preferences and is more accepting of a **highly engineered, urban park-like stream environment**, with a higher representation of older respondents.

Poznań

A total of 249 valid face-to-face interviews were collected in the pilot area of the Piaśnica stream in 2025. Most respondents lived close to the study area, with the majority residing within a 15-minute distance from the stream corridor. The sample consisted of 57% women and 43% men, with an average age of 39 years and a high proportion of respondents with university education. Results show that the area is regularly used by local residents, with half of respondents visiting daily or several times per week, most commonly on foot or by public transport. The main reasons for visiting included **relaxation and enjoying peace**, **passing through the area**, **experiencing nature**, and **physical activity**. This highlights the importance of the stream corridor as both a recreational and functional urban space. Regarding ecosystem services, respondents considered **improved air quality, habitats for plants and animals, better water quality, and improved microclimate** as the most important benefits of stream restoration. In terms of preferences for restoration measures, respondents clearly favoured natural river features such as **river islands**, **small piers**, **wetlands**, **meanders**, and **water terraces.** Strongly engineered solutions, including **streams enclosed in pipes, concrete channels, and stone flood walls**, were evaluated most negatively. The choice experiment further confirmed a general preference for nature-based and multifunctional stream corridors, with respondents particularly preferring **meandering streams and access to water via piers**. Concrete channels were consistently rejected. Most respondents also preferred **wider riparian vegetation**, although part of the population (**25%**) favoured more open or managed riverbanks. In terms of surrounding land use, respondents showed the strongest preference for an **urban park environment**, while semi-natural park arrangements were less supported.

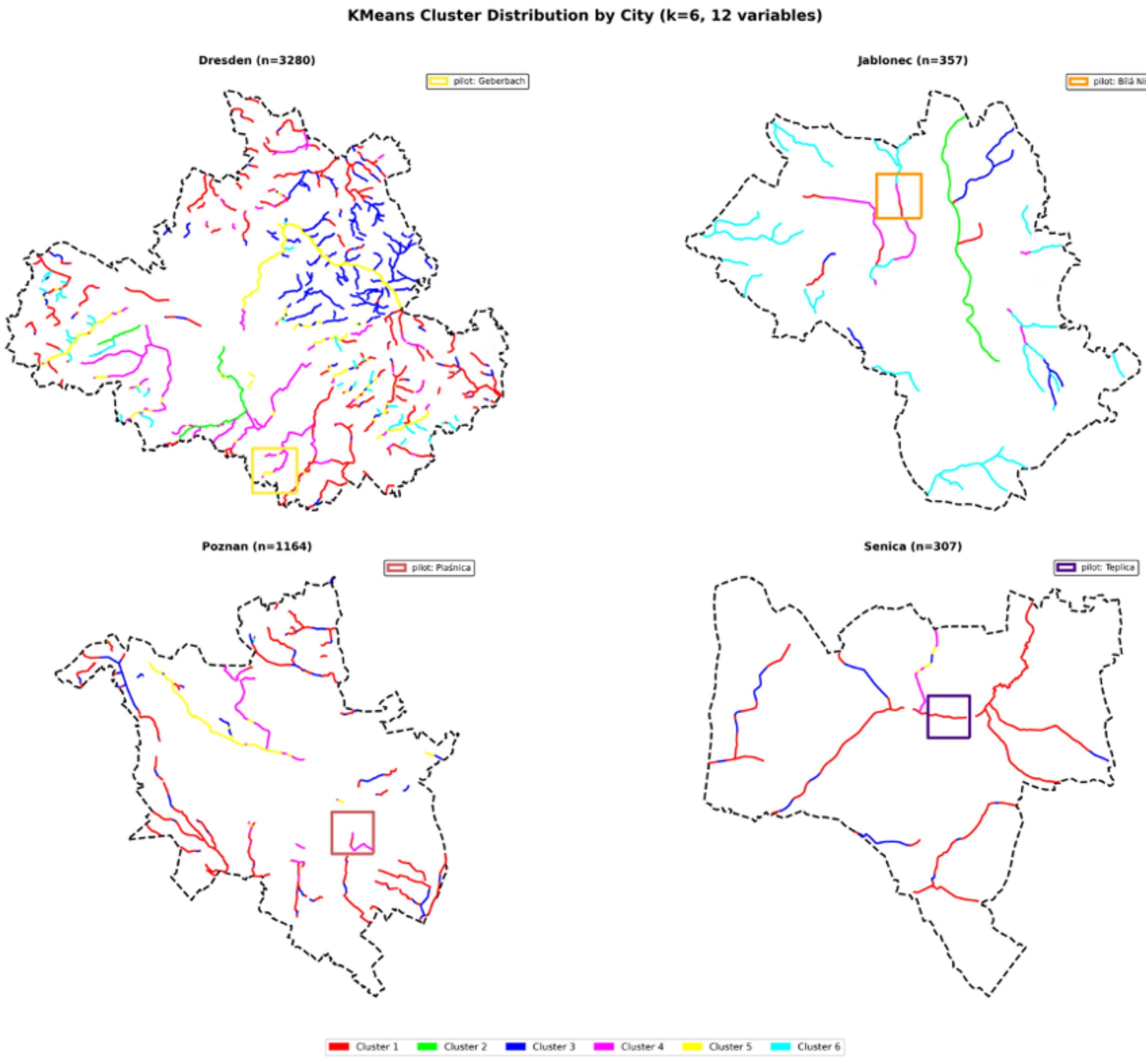
Senica

A total of 291 valid face-to-face interviews were collected in the pilot area of the Teplica stream in 2025. 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.

4. 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. Cluster distribution in the pilot cities



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

Dresden

In Dresden, Cluster 1 contains more segments than any of the other clusters (33.4%). The reason is related to the heterogeneous composition of green cover in suburban Dresden. Cluster 3 takes up the second highest composition (26.2%) in Dresden. These patterns reflect stream corridors with dense and uniform tree cover type and open viewsheds that provide good visibility; in Dresden, Cluster 3 segments are primarily located in the northeastern part of the city, associated with smaller tributary streams. Cluster 4 is associated with high impervious cover, low visibility, high total crossings, high transport access, and high land surface temperature. Cluster 5 is found in corridors such as the Prießnitz stream in Dresden, which provides good access to points of interest and is intersected by multiple transportation corridors. At the variable level, many stream segments fall in the lowest impervious-cover class, including large northeastern stretches with no impervious area at all. Dresden has the largest share of highly tree-covered segments, consistent with relatively low impervious cover in the same catchments. Green land-cover Shannon diversity is comparatively low, suggesting more uniform riparian green. Mean land surface temperature is 30.7°C; forested northeastern areas are around 6°C cooler than other parts of the city. Sinuosity averages 1.11, with some northwestern green reaches up to 4.0.

For the pilot Geberbach, the pilot sites are dominated by Cluster 4 segments with high impervious cover, and low visibility, combined with high total crossings, high transport access, and high land surface temperature.

Compared with the other cities, Dresden stands out for hosting 72.9% of all Cluster 4 segments and 77.2% of all Cluster 5 segments, the highest mean POI accessibility, and high crossing density together with mean land surface temperature of 30.7°C. Dresden also shows relatively high absolute slope and moderate valley depths, with mean transport accessibility of 0.15 and a greater proportion of segments with moderate to high transport accessibility than in Poznań or Senica.

Jablonec nad Nisou

In Jablonec nad Nisou, Cluster 6 accounts for 54.9% of the city's stream segments, the largest share of any typology in the city. This cluster is characterised by high valley depth and steep slope, along with high canopy cover and narrow valley width, mostly on the urban fringe. Cluster 2 accounts for 14.6% of the city's streams, the second-largest typology, with high POI accessibility, high transport accessibility, a high number of crossings, and high impervious cover; these values are linked to the dense concentration of points of interest around Mšenský potok and a well-developed transport network. Cluster 3 segments in the city reflect dense and uniform tree cover, open viewsheds, and good visibility. Jablonec exhibits the steepest stream segments and the deepest valleys (mean 48.8 m), with most segments in higher depth classes. Sinuosity is the lowest and most uniform (mean 1.05, maximum 1.38), reflecting confined valley morphology. Mean land surface temperature is 25.4°C, the lowest of the four cities. Green land-cover Shannon diversity is lower than in Poznań or Senica. Crossing density is high, as in Dresden.

For the pilot stream in Jablonec nad Nisou, the pilot site is dominated by Cluster 4 segments with high impervious cover, low visibility, high total crossings, high transport access, and high land surface temperature.

Compared with the other cities, Jablonec stands out for the highest mean transport accessibility (0.24), the steepest slopes, the deepest valleys (48.8 m mean), the lowest mean land surface temperature (25.4°C), and city-wide dominance of Cluster 6. Mean visibility (0.75) is the lowest among the four cities, though still generally high.

Poznań

In Poznań, Cluster 1 is present in both the city centre and suburban areas, associated with heterogeneous green land cover. Poznań accounts for 19.7% of all Cluster 4 segments in the study and 21.9% of all Cluster 5 segments. Cluster 4 is characterised by high impervious cover, low visibility, high total crossings, high transport access, and high land surface temperature. Cluster 5 combines high POI accessibility, high sinuosity, high canopy cover, and many crossings. Green land-cover richness is generally the highest across the stream network, while most segments still contain three types of green cover. Mean Shannon diversity of green land cover is among the highest, indicating heterogeneous riparian composition. Absolute slope and valley depth are gentler and shallower than in Dresden or Jablonec. Crossing density is moderate. Mean land surface temperature and POI accessibility are relatively low across all cities.

For the pilot stream in Poznań, the pilot site is dominated by Cluster 4 segments with high impervious cover, low visibility, high total crossings, high transport access, and high land surface temperature, as in Dresden and Jablonec nad Nisou. The high impervious cover can be attributed to the surrounding parking lot and the road infrastructures.

Compared with the other cities, Poznań stands out for high green land-cover richness and Shannon diversity together with gentler slopes, shallower valleys, moderate crossing density, and relatively low transport accessibility (0.06). Its role in Cluster 4 and Cluster 5 is secondary to Dresden but substantial (19.7% and 21.9% of those typologies study-wide).

Senica

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.

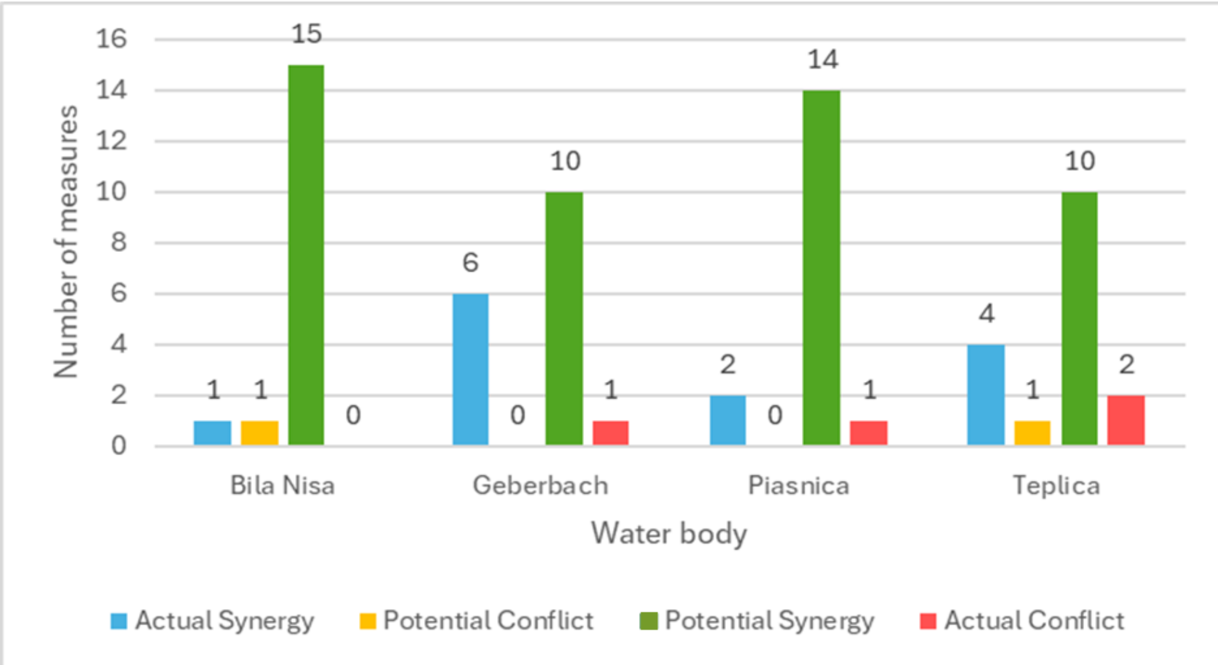
For the pilot stream in Senica, the stream segments of the pilot fall under Cluster 1, characterised by high diversity in green land cover and high green richness, combined with low canopy cover. This differs from Dresden, Jablonec nad Nisou, and Poznań, where pilot sites are dominated by Cluster 4.

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.

5. Eco-Socio-Spatial Synergies and Conflicts

Based on the analysis, the most common category of measures across all four cities was “potential synergy”. This indicates situations where the current spatial condition is weak, while public support is high, suggesting strong potential for implementing restoration measures that are well aligned with public perception and acceptance. This provides evidence of the potential to create more stream-related spaces that increase the multifunctional use of the stream and enhance synergies among all three perspectives.

Figure 6. Number of classified restoration measures for each pilot site



Dresden

There is strong potential to implement additional nature-based measures to restore Geberbach and its surrounding area. The pilot stream has already a high number (6) of measures with good performances on the related spatial conditions. It is for example a **type of riverbed, riparian trees, removing biological barriers, and in-stream structures** or **deadwood**. Those measures are at the same time synergistic, as they are strongly supported by residents. Most restoration measures (10) are categorised as a potential synergy – they are highly supported by residents, but the related current spatial conditions are to be improved. For example, the **nature observation opportunities** are highly supported, but the current spatial condition, with the indicator of bench numbers around the streams, is very low. Two other examples are the **green corridors** and **green networks**, which have a high to very high perception. For these measures the conditions for implementing them are even better, as some green spaces already exist (medium status), thereby reducing the effort required for restoration. The actual conflict occurs for the measure **unseal surfaces**, where the spatial condition and public support are both low. From the spatial perspective, the stream corridors, especially two streams of the pilot sites in the southern Geberbach have more impervious surfaces and if the city wanted to meet environmental goals, they should be unsealed. From public support perspective, residents tend to prefer urban arrangement of greenery in the wider area of the stream, which suggests that removing impervious surfaces along the river is not a priority for them.

Jablonec nad Nisou

There is a great opportunity to implement nature-based measures to restore the urban stream Bílá Nisa and surrounding. 15 out of 17 classified restoration measures fell into the category of potential synergy (high restoration opportunity). This means that people support the introduction of these environmentally beneficial restoration measures, which are needed from a spatial perspective, as the current conditions are low to moderate. This is the case, for example, with riverbed (measures **remove technical riverbed**, **remove concrete channel**), but also **facilities for nature observation and leisure time**. Also, **accessibility along the stream** can be improved in priority considering the bad spatial condition and the high public support. More **walking and cycling path** should be created along the stream corridors to enhance continuous public access along the stream. The measure **increase space for river and floodplain** represents an actual synergy, which means that there is high public support for this measure and already a good current spatial condition. Only measure categorised as an potential conflict is **unseal impervious surfaces.** It is necessary to inform residents about the benefits of it to increase acceptance of this measure (as people do not view it as necessary, even though it brings significant benefits to both nature and society).

Poznań

There is a relatively challenging but a great opportunity to implement nature-based measures to restore the urban stream Piasnica and its surrounding. The spatial status of most measures (82% of all classified measures) is assessed as poor, mostly because of the underground section of the pilot stream. However, 14 out of 17 restoration measures were classified as a potential synergy, which represents high restoration opportunity as those measures are needed and likely to be accepted by the public. In this category belong for example **removal of biological barriers, introduction of a leisure program, riparian trees, removal of technical structures in the riverbed and channel, and stream access**. The actual conflict between ecological perspective and the other two perspectives (spatial and social) occurs for **unseal surfaces**, where both spatial condition and public support are rated the lowest. From a spatial perspective, the high level of impervious surface coverage is primarily attributed to the surrounding main and internal road networks, as well as the presence of a large parking area. From the public perspective, removing impervious surfaces is not as high a priority as other measures. Already existing synergies exist for the **accessibility along the stream** and an **increased space for the stream and floodplain**. Given that the stream runs underground in a culvert, the latter one represents the spatial potential following the stream's reopening.

Senica

There is a great opportunity to avoid discovered conflicts and implement suppported 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**. 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.

D. Suggestions for NBS Implementation for Each City

This chapter presents general recommendations for the implementation of nature-based solutions in urban stream restoration based on the synthesis of WP1 results, including the individual perspectives on urban stream restoration and the analysis of synergies and conflicts. It also outlines specific and applicable actions co-developed by the international project team and representatives of the pilot cities that will be implemented by local authorities in the future. More detailed descriptions of these actions are provided in the respective local Strategies and action plans.

Specific actions from pilot cities

Dresden

- Integrated Water Management Plan (iGEP) Prohliser Landgraben/Geberbach
- Implementation of the measures considered in the preliminary planning for GH_I-86-03947, GH_I-86-03954.01 and GH_I-86-03954.02
- Implement the recommendations set out in the study on the water balance and discharge analysis for the Geberbach, Prohliser Landgraben and Niedersedlitzer Flutgraben
- Implementing measures from the Prohlis 2030+ Master Plan

Jablonec nad Nisou

- Settlement of property rights for the affected land parcels
- Ensuring river accessibility and the natural organization of movement and quiet zones
- Implementation of ecological site management

Poznan

- Development of a programmatic and spatial concept for the canalized section of the Piaśnica stream in the Lecha housing estate
- Integrated Water Management Plan Piaśnica

Senica

- Elimination of illegal discharges
- Flood Protection & Master Plan

General recommendations for CE cities

Institutional and stakeholder perspective

- Establish early and continuous coordination between municipal departments, permitting authorities, infrastructure managers and other key stakeholders.
- Strengthen cooperation between local authorities, regional institutions, national agencies and expert organisations.
- Develop a shared long-term vision for urban stream restoration and regularly update implementation priorities.
- Prepare long-term operational and implementation plans to ensure continuity beyond individual projects.
- Improve access to long-term funding through integration of restoration measures into climate-adaptation and urban-development programmes.
- Increase political awareness and support for urban stream restoration to facilitate resource allocation and implementation.
- Address land ownership constraints through cooperation, negotiated agreements and strategic land acquisition where necessary.
- Maintain transparent communication among stakeholders throughout planning, permitting and implementation processes.

Ecological perspective

- Restore more natural stream morphology and ecological processes by removing unnecessary technical channel modifications.
- Strengthen riparian buffers through strategic planting of native trees and vegetation.
- Increase shading and habitat diversity while maintaining appropriate visual accessibility along urban streams.
- Improve water quality by addressing pollution sources throughout the catchment, including agricultural, industrial and urban runoff.
- Implement catchment-scale water retention measures to improve hydrological conditions and climate resilience.
- Enhance ecological connectivity through the development of continuous green and blue corridors.
- Prioritise restoration measures that generate synergies between ecological, social and spatial objectives.

Spatial perspective

- Integrate urban stream revitalisation objectives into broader urban-development and climate-adaptation strategies.
- Prioritise measures that create multifunctional blue-green corridors combining ecological, recreational, educational and social functions.
- Improve access to and along urban streams through soft-surfaced paths and carefully designed access points while minimising habitat fragmentation.
- Support the creation of multifunctional public spaces for nature observation, recreation and social interaction.
- Replace unnecessary paved and compacted surfaces near streams with permeable materials and nature-based solutions.
- Reduce impervious surfaces and strengthen urban water retention through rain gardens, vegetated buffer strips and other blue-green infrastructure.
- Address land-use conflicts and parking demands through integrated planning and alternative spatial solutions.
- Develop long-term restoration master plans to guide future revitalisation phases and spatial development around urban streams.

Social perspective

- Increase public awareness of the environmental, social and climate-adaptation benefits of urban stream restoration and nature-based solutions.
- Organise educational and outreach activities targeting schools, local communities and the wider public.
- Promote nature observation and environmental education through interpretative elements and educational infrastructure.
- Strengthen community engagement throughout planning and implementation processes.
- Ensure that restoration projects provide visible benefits for residents, including recreation, leisure and improved environmental quality.
- Communicate the benefits of permeable surfaces and nature-based solutions, including flood mitigation, urban cooling and improved quality of life.
- Support public participation in defining long-term visions for urban stream revitalisation.

E. Discussion and Conclusion

The four Strategies and action plans developed for the stream study areas in Dresden, Jablonec nad Nisou, Poznań and Senica highlight that successful urban stream restoration requires an integrated approach combining ecological improvements with social, spatial and institutional considerations. The results of the analysis carried out in WP1 demonstrated that urban stream restoration in Central European cities is not primarily limited by a lack of public support, but rather by institutional, technical and financial constraints. Across all pilot cities, stakeholders and residents recognised the ecological, social and climate-adaptation benefits of nature-based solutions, and expressed strong preferences for natural, accessible and multifunctional stream environments.

Despite considerable differences in geographical setting, stream morphology and governance structures, several common patterns emerged among pilot cities. Ecological analyses confirmed that all pilot streams have been substantially affected by urbanisation, including channel modification, loss of floodplain connectivity, water-quality degradation and reduced habitat quality. At the same time, the social surveys revealed remarkably similar preferences among residents. Respondents in all cities clearly favoured nature-based restoration measures such as meanders, riparian vegetation, wetlands and improved access to water, while strongly rejecting highly engineered solutions such as concrete channels and culverted streams. These findings indicate that urban stream restoration can simultaneously address ecological objectives and public expectations when appropriately designed.

The institutional and stakeholder analyses further highlighted the importance of cross-sectoral cooperation, long-term planning and stable financing mechanisms. Although the specific governance contexts differed among the pilot cities, common challenges included fragmented responsibilities, complex permitting procedures, infrastructure constraints and competing land-use priorities. Consequently, successful implementation of restoration measures will depend not only on ecological feasibility but also on the ability of municipalities to coordinate actors, secure funding and integrate restoration objectives into broader urban-development and climate-adaptation policies. These findings are reflected in many of the proposed actions, including the development of long-term implementation plans, integrated water management strategies and mechanisms for improved coordination between municipalities, water authorities and infrastructure managers.

The eco-socio-spatial analysis provided particularly valuable insights by identifying synergies and conflicts between ecological needs, spatial conditions and public preferences. In all pilot cities, the majority of restoration measures were classified as potential synergies, indicating that many desired restoration interventions are both socially supported and spatially needed. This suggests significant opportunities to enhance the multifunctionality of urban streams and strengthen the contribution of blue-green infrastructure to biodiversity, climate resilience, recreation and quality of life. Conflicts were relatively limited and were most frequently associated with measures such as the removal of impervious surfaces or the introduction of less familiar ecological features, highlighting the importance of communication and awareness-raising activities.

Overall, the SAPs demonstrate that nature-based solutions offer a viable and broadly supported pathway for urban stream restoration in Central European cities. The proposed actions provide locally tailored implementation guidance for the pilot cities while the broader recommendations offer transferable lessons for other municipalities facing similar environmental and urban-development challenges. The results underline that the greatest benefits can be achieved when restoration measures are planned as multifunctional interventions delivering value for both people and nature. However, effective restoration planning requires a comprehensive understanding of ecological, social, spatial and institutional conditions before defining restoration goals, priorities and actions.