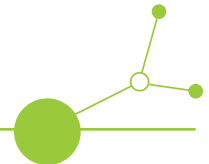


# D.2.4.4 Report on pilot action - Technical and tendering solutions



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## A. Introduction

Urban areas in Central Europe face increasing environmental challenges due to urban sprawl, which replaces green spaces with grey infrastructure. This shift exacerbates the negative impacts of extreme weather events and climate change, intensifies the effects and incidence of urban heat islands and urban flooding, and leads to air pollution, health problems, loss of biodiversity and increased energy demand. The GreenScape CE project aims to address these challenges by integrating Nature-based Solutions (NbS) and Green Infrastructure (GI) into urban infrastructure.

GreenScape CE brings together 12 partners across six countries (Austria, Croatia, Hungary, Italy, Poland, Slovenia) to strengthen multi-level governance and facilitate peer-to-peer learning, capacity building, and participatory decision-making. Through the implementation of five NbS/GI Action Plans and three Pilot Actions in Milan Metropolitan Area, Ptuj, Szeged, Warsaw, and Zagreb, the project seeks to provide replicable solutions for integrating NbS into urban planning.

Key project goals include:

- Enhancing citizen engagement and co-creation processes with key stakeholders.
- Developing technical and tendering solutions to facilitate the implementation of NbS/GI.
- Exploring financing models, including public, private, and citizen-led approaches.
- Strengthening policy frameworks to encourage the integration of NbS into urban planning.

One of the main objectives of GreenScape CE is to develop and implement three local NbS Pilot Actions, leading to citizen co-creation, technical, and funding solutions that capture multiple benefits of NbS in urban areas.

The piloting process builds heavily on preparatory activities such as the definition of a Joint Strategy on Strengthening NbS Implementation in CE available [here](#), the creation of the GreenScape CE visual mapping tool available [here](#), 5 NbS/GI Action Plans in pilot areas available here:

[Local Action Plan Zagreb](#)

[Local Action Plan Ptuj](#)

[Local Action Plan Warsaw](#)

[Local Action Plan Milan](#)

[Local Action Plan Szeged](#)

For the development of the five NbS/GI Action Plans in CE pilot areas, project partners have jointly collaborated, and these action plans are products of the transnational co-design process, capacity building



workshops for local government representatives in pilot areas and citizen involvement. Action Plans define priority areas and measures for NbS development in the above mentioned five urban areas in CE and serve as a foundation for identifying Pilot Actions in those areas.

Thus, this report aims to narrate results, experiences and lessons learned concerning **technical and tendering solutions from the piloting actions in Zagreb, Warsaw, Milan, Ptuj and Szeged**, to provide a frame for potential replicability. Pilot Partners share this guided and comprehensive reflection based on their experience, which serves as a baseline for potential replicating urban areas.



## B. Report on technical and tendering solutions implemented in Ptuj, Slovenia

### 1. Short description of technical and tendering solutions within the pilot

The proposed Nature-Based Solutions (NBS) provide a comprehensive strategy for achieving the specific objectives of the Municipality of Ptuj in the areas of sustainable development, urban planning and environmental conservation. Their implementation ensures that the city's green infrastructure is not only maintained but also strategically enhanced and adapted to the challenges of climate change, while responding to the needs of the local community.

Conservation of nature is supported through the establishment of community gardens and the planting of urban orchards, which safeguard traditional plant species and practices. At the same time, ecological corridors, such as hedgerows and green walls, create new habitats and improve the connectivity of existing green areas. In this way, the natural framework of the city is strengthened and ecosystem fragmentation reduced.

The selected NbS will be implemented in the historic city centre and residential neighbourhoods of city Ptuj. The designed NbS are Street Trees, Permeable Pavements, Rain Gardens, Vegetated Pergola & Pergola Pathways, Green Wall, Community Gardens and Implementation of urban tree plantations.

#### Technical Solutions

**Street Trees** - Includes the preservation of existing trees, improvement of growth conditions, and new tree plantings with enhanced planting conditions suitable for the urban environment.

**Permeable Pavements** - NbS implementation focuses on replacing impermeable surfaces with permeable pavements, improving tree-growing conditions and increasing shared root zones.

**Rain gardens** - Implementation of rain gardens in residential areas where water stagnation is an issue, ensuring effective drainage and rainwater collection.

**Vegetated Pergola** - Installation of green pergolas or wire structures along streets or in residential green spaces, such as near community gardens adjacent to parking areas.

**Green wall** - In the historic city centre, where space for large plants is limited, climbing plants will be introduced on designed structures to create green walls.

**Community Gardens** - Development of community gardens as shared spaces where residents can cultivate plants in raised beds. A diverse selection of plant species is encouraged, with an emphasis on pollinator-friendly plants.

Implementation of urban tree plantations include conifer plantations for improved air quality, fruit tree plantations, which also serve as pollinator-friendly zones, and tree-lined avenues and ecological hedgerows to enhance biodiversity and habitat development.

#### Implementation Status

As part of the GreenScape CE project, project documentation for Ptuj has been prepared at the **conceptual design stage**. An inventory, analysis, and interpretation of the existing conditions were carried out to identify issues and potential solutions. NbS were defined, selected, and designed in



relation to specific locations. In parallel, a public participation process was conducted to ensure community engagement and alignment with local needs.

Although the pilot action already foresees the implementation of NbS at selected sites, the solutions have not yet been physically realised. As this remains a planning phase, the project follows the **official implementation procedures** defined in Slovenia, including the acquisition of permits and approvals, harmonisation of technical documentation, and securing of sufficient financial resources for realisation.

#### Pilot Action Areas in Ptuj

- **Historic city centre:** *Ulica heroja Lacka* and *Zelenikova ulica*
- **Residential neighbourhoods near the old town:** *Rimska ploščad*, *Panonska ulica*, *Ciril Metodov drevored*, and *Kvedrova ulica*

All listed areas are part of the GreenScape CE project. Some sections within these areas are also included in other projects that will apply for different funding mechanisms:

#### Specific Locations

- **Part of Ulica heroja Lacka** - This project focuses on the redesign of a traffic-calmed street with restricted motor vehicle access, allowing only delivery, emergency, and temporary access for nearby users (employees and residents). Planned works include reconstruction of public utility infrastructure, use of permeable paving surfaces, and improvement of tree-growing conditions—all applying NbS principles. Project documentation is in its final phase, and funding will be sought through the **CTN mechanism**.
- **Kvedrova neighbourhood** - Part of the neighbourhood's open spaces will be redesigned using NbS solutions defined within the GreenScape CE project. The redevelopment project is financed under the **Interreg Euro-MED** programme within the **RealUrbanGreen** project, implemented by *Javne službe Ptuj d.o.o.* in cooperation with the **Municipality of Ptuj** as an associated partner.
- **Ciril Metodov drevored (CMD) neighbourhood** - Within the pilot area, a multi-residential building will be constructed, with adjacent green areas developed according to the NbS approach proposed in the GreenScape CE project (street trees, permeable pavements, urban tree plantations). The design also integrates NbS elements such as a small urban forest with a children's playground and local rainwater retention features. The housing project is in the pre-implementation phase, with a building permit already issued. The project applicant will apply for funding through the **Housing Fund of the Republic of Slovenia**.

#### Available fundings:

For the implementation of NbS in Ptuj (Slovenia), several funding programmes and tenders are available, including the **LIFE Programme**, **Horizon Europe**, **Interreg**, and selected **national-level calls**:

- **Public Call for Co-Financing Sustainable Mobility Measures (2023-2029)**, published by the Republic of Slovenia.
- **LOKALNO Municipalities**, published by the Slovenian Regional Development Fund, aimed at co-financing projects that improve public and local infrastructure across Slovenia.
- **Green Infrastructure and European Cohesion Funds**, aligned with the *Programme of European Cohesion Policy 2021-2027 in Slovenia (Version 4.2.2., December 2022)* and the *Regulation on the Implementation of EU and Euratom Regulations in the Field of European Cohesion Policy 2021-2027*. Within this framework, municipalities may apply for **Integrated Territorial Investments (CTN)**.



## 1. Obstacles at pilot level

Although NbS pilot project in Ptuj is currently in the pre-implementation phase, we have already encountered several technical and tendering-related challenges during the planning and design stages. One of the main obstacles is the integration of diverse NbS elements (rain gardens, pergolas, community garden, etc.) into a densely built urban area with fragmented land ownership and outdated infrastructure. The coordination between stormwater management and existing sewage capacity proved complex, particularly due to missing or inconsistent underground utility data.

One of the main obstacles encountered during implementation was the fact that the entire historical core of Ptuj is protected as cultural heritage. As a result, every intervention in public space requires approval from the Institute for the Protection of Cultural Heritage, which often significantly prolongs the permitting process. This constraint affected the timeline and required close coordination between designers, municipal services, and heritage authorities from the early planning stages onward.

From a procurement perspective, uncertainties regarding the long-term maintenance responsibilities of NbS elements have made it difficult to define precise tendering terms, especially for NbS that require living materials and seasonal performance (e.g. plant-based systems, green wall). The absence of standard technical specifications for NbS within national procurement frameworks is also a barrier to drafting tenders that ensure quality and sustainability.

Furthermore, technical feasibility was affected by budget limitations: green infrastructure often appears cost-effective in the long term, but initial construction costs (e.g. permeable materials, soil mixtures, custom elements) are higher compared to conventional solutions. This has required trade-offs and phased implementation planning.

Finally, the lack of experienced local contractors for NbS works is a potential risk for implementation and was considered during the design stage, prioritizing modular, replicable, and low-maintenance components to ensure feasibility.

## 2. Lessons learned and expected impacts

Although our NbS pilot in Ptuj is still in the planning stage, several anticipated technical impacts and strategic alignments can already be identified. One key technical benefit is the multifunctionality of proposed solutions, particularly rain gardens and community gardens, which contribute simultaneously to stormwater retention, urban cooling, biodiversity and social interaction of the residents.

The integration of NbS into the existing urban fabric also led to improved collaboration between technical and procurement teams. For example, aligning design elements with locally available materials and simple construction techniques helped reduce future procurement risks. Early coordination with public utility services was crucial to ensure feasibility and avoid conflicts with underground infrastructure.

A key takeaway is that modular and low-maintenance NbS (e.g., compact rain gardens or climbing green pergolas) are technically suitable for historic and densely built areas such as Ptuj. Their implementation is less disruptive and allows phased procurement strategies. We suggest prioritizing such adaptable and scalable solutions in similar urban contexts, as they offer flexibility, cost control, and ease of integration.

## 3. Recommendations and next steps



Based on our experience in preparing the NbS pilot in Ptuj, we recommend the following key steps for potential replication teams:

1. Start with detailed baseline mapping - ensure high-quality geodetic and utility data early on to avoid delays during technical design.
2. Engage utility providers and municipal departments early - coordination with infrastructure services is critical to align NbS with existing systems.
3. Define maintenance responsibilities from the outset - this ensures that technical design aligns with long-term feasibility and procurement clarity.
4. Develop modular, low-maintenance designs - particularly important in historic or space-constrained urban areas.
5. Anticipate procurement challenges - prepare tender documentation that allows for flexibility in materials and methods due to limited local expertise in NbS.
6. Include citizen engagement in all stages of the process - it helps provide insights into needs of the local community, helps identify priority areas for NbS interventions, encourages broader community involvement and increases project acceptance, provides regulatory support and ensures compliance with regulations, ensures long-term sustainability and maintenance of interventions etc.
7. Plan for interdisciplinary collaboration - early involvement of landscape architects, engineers, and procurement experts ensures smoother implementation.
8. If restarting the process, we would place even more emphasis on stakeholder coordination, site-specific feasibility checks, and clearer early-stage cost estimates to avoid future redesigns.

In conclusion, the proposed NBS simultaneously addresses ecological, social and cultural priorities. Their implementation represents a significant enhancement of Ptuj's urban green system, contributes to improved quality of life for residents, safeguards biodiversity and strengthens the city's adaptive capacity and resilience in the face of climate change.

## C. Report on technical and tendering solutions implemented in Szeged, Hungary

### 1. Short description of technical and tendering solutions within the pilot

The pilot project focuses on the reconstruction of the Szivárvány tram stop and its adjacent urban environment in Szeged, with the dual aim of improving accessibility and safety while creating a more climate-resilient and green public space. Technically, the project involves the full renewal of the tram stop platforms, including elevation adjustments for step-free boarding, installation of durable and slip-resistant surfacing, and tactile paving to assist visually impaired passengers. A new covered passenger waiting area will be provided, complemented by modernized public lighting to enhance both safety and energy efficiency. Drainage systems will be upgraded to secure the long-term resilience of the infrastructure.

A central element of the project is the greening of the surrounding public space. Pedestrian pathways will be reconstructed and integrated with newly revitalized green surfaces, which not only improve aesthetics but also contribute to urban cooling and stormwater retention. Additional trees and shrubs are planned to



provide shading and biodiversity benefits, while permeable surfaces will further support sustainable water management. Street furniture and bicycle stands will be installed to foster community use and multimodal connectivity. Special attention is given to barrier-free design and long-term environmental sustainability, ensuring that the project functions as both an infrastructure upgrade and a green urban intervention.

From a tendering perspective, the project is implemented under the Hungarian and EU public procurement framework. The tender documentation clearly specifies functional and technical requirements, environmental performance standards, and inclusive design principles. Procurement was informed by a preliminary technical study and stakeholder consultations, ensuring that the solutions meet regulatory standards as well as local community needs. The approach is intended to serve as a replicable model for small-scale urban mobility projects that integrate greening measures into transport infrastructure.

However, the preparation of the detailed execution plans has experienced delays, which may affect the timeline for implementation.

Within the framework of the GreenScape CE project, the planning tasks will be implemented and accounted for, and the costs of implementation will be covered either from domestic and European Union funds or from own resources.

## 2. Obstacles at pilot level

Several technical and tendering-related obstacles were encountered during the planning and preparation stages of the Szivárvány tram stop reconstruction. One major technical challenge was the existing underground utility network (water, electricity, telecommunications), which required precise mapping and coordination to avoid conflicts during construction. Inaccurate or outdated utility data caused delays in finalizing the design and led to necessary on-site adjustments.

The limited available space within the existing urban layout posed further challenges, especially for ensuring barrier-free access while maintaining safe pedestrian flow and compliance with tramway clearance requirements. Designing an elevated platform (300 mm above rail level) that is both accessible and compatible with existing rolling stock required technical refinement.

On the tendering side, strict procurement regulations under national and EU law created limitations in terms of flexibility and contractor selection. The inclusion of green infrastructure elements (e.g. permeable surfaces and planting areas) led to higher initial costs, which exceeded preliminary budget estimates and required scope adjustments. This was partly due to the inflation of construction material prices in the 2023-2024 period, affecting the cost-effectiveness of proposed solutions.

Unforeseen constraints included discrepancies between the surveyed topography and the actual terrain levels, affecting drainage system design and requiring additional civil works. Furthermore, the integration of tactile paving and new lighting systems with existing infrastructure encountered compatibility issues, which delayed installation and required alternative product specifications.

Overall, technical feasibility, limited urban space, and budgetary restrictions were the most decisive limiting factors influencing design and procurement choices. These experiences highlight the importance of detailed preliminary surveys, flexible design approaches, and contingency planning for successful replication in other municipalities.

One of the biggest obstacles was the delay of the technical documentation. The technical content of the project was developed through data collection and evaluation processes.

Due to the complexity of the intervention area, data provision by these organizations is difficult and time-consuming. After receiving numerous suggestions and expectations, we were able to define a planning task that was acceptable to everyone.



After this document was completed, companies with the appropriate planning qualifications were sought out, and preliminary planning costs were obtained from them so that we could determine the cost of the planning work.

After receiving the quotations, it was determined that the design task we had defined would involve costs that exceeded our budget, so a new series of consultations was held with the organizations involved. This resulted in the current, reduced technical content, which will also be the final result of the feasibility study.

### 3. Lessons learned and expected impacts

The pilot provided valuable insights into the integration of inclusive, accessible, and sustainable design in a constrained urban environment. Technically, the key success factor was the accurate alignment between tram platform height and rolling stock, improving accessibility without compromising safety. One notable result is the improved platform design (300 mm height, 2.5 m width) which can serve as a model for other tram stops in Szeged and similar cities.

KPIs used during and after implementation include platform accessibility compliance (measured by slope and surface standards), passenger safety (e.g. lighting levels  $\geq 20$  lux), drainage efficiency (rainwater runoff rate), and material durability. These metrics were chosen for their relevance to long-term operational performance and user satisfaction.

In terms of procurement, clear technical specifications combined with transparent evaluation criteria contributed to contractor accountability and quality assurance. However, tight budget constraints and rising material prices underlined the importance of early cost-risk assessments and buffer planning.

A key takeaway for replication is the need for early coordination with utility providers and local transport operators to avoid later-stage technical conflicts. The use of modular pavement elements and prefabricated tactile surfaces proved cost-effective and time-saving, particularly suitable for dense, inner-city environments.

Overall, the alignment of technical and procurement strategies resulted in a feasible, scalable solution for inclusive tram infrastructure upgrades. This approach is especially relevant in urban areas with aging infrastructure and limited physical space.

### 4. Recommendations and next steps

Based on the challenges and lessons learned during the Szivárvány tram stop pilot in Szeged, several recommendations can support replication in similar urban contexts. First and foremost, comprehensive and up-to-date mapping of underground utilities should be prioritized before finalizing technical plans, as misalignments caused delays and extra costs. Early-stage coordination with service providers and transport operators is essential for avoiding conflicts during execution.

A detailed topographic survey is also recommended to ensure accurate planning of drainage systems and platform geometry. In terms of procurement, allocating additional time for preparatory studies and integrating flexible cost estimates can mitigate the effects of market volatility.

If the process were restarted, greater emphasis would be placed on stakeholder engagement during the concept phase, including accessibility advocacy groups and local transit authorities. This would improve functional design outcomes and reduce costly late-stage design changes.

Modular and prefabricated elements (e.g. tactile paving, curb edges) should be preferred to reduce on-site construction time and improve quality control. A staged implementation plan, possibly with pilot testing of



certain components (e.g. surface materials), would allow for real-time adjustments and performance verification.

Next steps should include post-implementation monitoring using defined KPIs (e.g. surface durability, accessibility compliance, user satisfaction) and integration of findings into future tenders. This iterative learning cycle will support the broader replication of sustainable, accessible mobility solutions in Szeged and beyond.

## D. Report on technical and tendering solutions implemented in Zagreb, Croatia

The pilot action in Zagreb addresses the growing environmental pressures associated with dense urbanization by planning the integration of Nature-based Solutions (NbS) and Green Infrastructure (GI) into a neighbourhood sports field in Trnsko. With a strong focus on multifunctional active spaces, the approach combines technical innovation and participatory design, notably through a co-creation hackathon involving community stakeholders and municipal departments. Preparatory phases have included initial assessment of the site's microclimate and infrastructure constraints, as well as engagement of expert and local knowledge to ensure future technical feasibility and replicability.

### 1. Short description of technical and tendering solutions within the pilot

The conceptual design focuses on the pilot site located at parcel no. 1532/1, K.O. Klara, Trnsko, Zagreb. The project aims to transform the existing degraded asphalt surface into a climate-resilient, multifunctional recreational space. Measures include the replacement of impervious surfaces with permeable synthetic turf to improve water infiltration and reduce surface temperatures, bioswales and vegetated infiltration strips, photovoltaic-powered lighting, planting of new drought-tolerant native trees to increase shading and support biodiversity, and vegetated pergolas and green pathways. Tree planting strategies prioritize drought-tolerant native species to increase shading and support biodiversity. Bioswales and vegetated infiltration strips will be placed at key access points to manage stormwater and mitigate flooding. The inclusion of rainwater harvesting systems for irrigation and the use of photovoltaic-powered lighting fixtures are also proposed. Additional landscape measures involve vegetated pergolas, green pathways, and layering of understory planting to enhance biodiversity and user comfort. These elements are designed based on comprehensive assessments of microclimate, soil conditions, and hydrological flows. A co-design process, including a hackathon and targeted workshops with community and city stakeholders, shaped the proposed interventions to meet local needs. The tendering approach foresees a multi-lot structure, promoting transparent division of work packages and maximizing competition among bidders.

Tender was made in line with the Croatian and EU public procurement framework with clear technical requirements that the solution needed to meet related to the vegetation and permeable surfaces. Technical documentation for this pilot project was developed using the budget from GreenScape CE project, and part of the project was also identification of possible funding schemes for implementation, that include EU funding calls, co-financing options via Croatian fund for Environmental protection, Green loans and Corporate sponsorships and community-based schemes.



## 2. Obstacles at pilot level

The preparatory phase of the pilot provided valuable insights, particularly in navigating the complex process of identifying and securing a suitable pilot site. Initial attempts to locate the project at sites such as Remiza, municipal parking areas, and a rooftop garden at the City Assembly building were unsuccessful due to issues related to unresolved property ownership, environmental risks, structural constraints, and restrictive legal acts such as the Water Act and the Fire Protection Act. A GIS-based suitability analysis, which covered more than 250 potential locations across the city, played a key role in narrowing down feasible options. Ultimately, the selection of a neighbourhood sports field in Novi Zagreb was made possible due to the district's advantage of a separate stormwater and wastewater system, which supports future NbS applications.

This process highlighted the critical importance of early stakeholder engagement and close coordination with legal, cadastral, and administrative bodies. Challenges included the lack of accurate land registration, fragmented property records, the requirement to conduct a public tender procedure for redevelopment despite clear land use designation, which would have complicated the project timeline, and strict regulatory frameworks such as water management rules that restrict runoff water discharge without treatment. Hence, the preparatory work emphasised the need to balance regulatory compliance with local community needs and project objectives.

Despite these complexities, the structured, participatory approach and use of spatial analysis tools established a strong planning foundation. Lessons learned from the site selection and stakeholder consultation process are expected to serve as a transferable methodology for future NbS projects at additional locations across the city.

Based on the results of this pilot selection process and the demonstrated value of the methodology, the City of Zagreb has additionally decided to initiate the preparation of ten further pilot projects outside the scope of GreenScape CE. These projects will apply the same principles and planning framework to accelerate the adaptation of neighbourhood sports fields across the city. A dedicated GIS-based suitability analysis was developed specifically for Zagreb to support systematic site selection for the pilot. The tool was designed to be compatible with the GreenScape CE Visual Mapping Tool methodology.

Early-stage co-design through hackathons and workshops resulted in design proposals that balance recreational use with ecological resilience, addressing challenges such as urban heat islands and stormwater management. The use of the GreenScape CE visual mapping tool and detailed spatial analysis has supported identification of optimal intervention areas and informed NbS typology selection (e.g., bioswales, permeable surfaces, vegetated shading, rain gardens).

Anticipated outcomes include measurable improvements in stormwater retention and infiltration, increased biodiversity through native planting, and microclimate moderation with temperature reductions compared to conventional surfaces. It is expected that the participatory approach will strengthen the feeling of local ownership and interest in further application of NbS in public space revitalisation. Proactive market consultations prior to tendering are foreseen to address the current lack of local contractor experience with NbS delivery. The Zagreb pilot serves as a transferable reference model for replication across other neighbourhood playgrounds and recreational areas in the city and provides a strong transferable framework for scaling NbS into other public space improvement projects.

## 3. Lessons learned and expected impacts

The main challenge encountered during the preparatory phase was the identification and selection of a suitable pilot site. Multiple candidate locations were considered, including Remiza and municipal parking



areas, but were excluded due to unresolved property ownership issues, contamination risks, or structural limitations. A proposal for a rooftop garden at the City Assembly building was also explored but proved unfeasible due to load-bearing constraints.

The selection process was further complicated by legal, cadastral, and administrative constraints, such as gaps in land registration and designation of public use spaces, as well as the fragmented responsibilities among municipal departments. Existing regulatory frameworks, including water management legislation prohibiting uncontrolled discharge of runoff water, posed additional challenges. The need to align the proposed NbS measures with these strict legal and operational requirements remains a potential challenge during later implementation phases. Limited local experience with NbS solutions among contractors has been identified as another risk for the tender phase. Early stakeholder coordination and regulatory consultation have been critical to advance the project despite these obstacles.

## 4. Recommendations and next steps

The City of Zagreb has initiated the preparation of an additional ten pilot projects outside the GreenScape CE framework, applying the same principles to other neighbourhood sports fields.

Future activities should focus on early coordination with legal, cadastral, and regulatory bodies to prevent delays linked to administrative requirements or unclear ownership. The creation of internal municipal standards and templates for NbS technical specifications and maintenance guidelines is recommended to streamline future procurement processes and minimize ambiguity. While underground utility conflicts have not been a major factor for this site, detailed site assessments remain essential for future projects.

Organizing early market engagement activities, such as informational workshops for potential bidders, can help mitigate risks linked to limited local contractor experience with NbS delivery. Finally, ongoing dialogue with stakeholders and continued refinement of the participatory model will ensure project outcomes align with community needs and facilitate wider replication throughout the city's green infrastructure development strategy.

## E. Report on technical and tendering solutions implemented in Metropolitan City of Milan, Italy

### 1. Short description of technical and tendering solutions within the pilot

The Metropolitan City of Milan's pilot focuses on developing a digital technical platform combined with an adaptable procurement approach to map and manage Nature-based Solutions (NbS) and Sustainable Urban Drainage Systems (SuDS). Central to this is the GreenScape Visual Mapping Platform (GVMP) - the GIS-based system that visualizes all existing and planned NbS across the 133 municipalities. Our GVMP provides the tools of:

- Accessibility analysis which evaluates the distribution of green spaces in relation to residents
- Connectivity mapping which identifies potential ecological corridors to support biodiversity and create a coherent green network.



These tools enable real-time, data-driven decision support, ensuring NbS projects are optimally placed for maximum environmental and social benefit. To build a comprehensive NbS inventory, the pilot combined strategic mapping with bottom-up mapping (crowdsourced inputs from local stakeholders).

- **Top-down mapping of green areas** (public vs. non-accessible):
  - Base dataset: DUSAF 7.0 (regional land-use database)
  - Integration with PGT - municipal land-use plans to verify whether spaces are public or private.
  - Final validation through Google Earth / street-level imagery.
- **Bottom-up identification of NbS projects** (existing, ongoing, planned):
  - Integration of datasets from LIFE Metro Adapt, CLEVER Cities and “Città Metropolitana Spugna / PNRR” projects.
  - Crowdsourced inputs from municipalities, architects, students and citizens.
  - Field verification and desk research (Google Earth, suppliers’ websites, questionnaires).
- **Unified geodatabase and attribute table:**
  - Every NbS instance was linked to detailed attributes (scale, typology, year, cost, accessibility, vegetation, designer, etc.), enabling comparability across 133 municipalities.

**Outcome:** first metropolitan map that *distinguishes accessible vs. non-accessible green areas* and locates NbS with spatial + technical attributes.

### Tendering / procurement solutions tested

From a tendering perspective, the pilot emphasized aligning the technical solution with public procurement processes.

The pilot tested a modular and procurement-ready approach, aligned with public tendering processes:

- Early definition of **clear technical specifications** for mapping, data harmonization and platform development → enabling separate tenders for components instead of one large procurement.
- **Reuse of existing datasets and platforms** (LIFE Metro Adapt, CLEVER Cities, PNRR programs) to reduce the need for new tenders and limit cost.
- **Regulatory integration:** the technical solution is aligned with existing planning and regulatory tools – *Metropolitan Territorial Plan (PTM)* and *Strategic Plan* – providing a **ready legal and procedural framework for issuing tenders**, and allowing NbS mapping outcomes to be formally embedded into planning and decision-making processes.
- Platform and dataset designed to integrate directly into the official **Metropolitan GIS platform**, ensuring continuity after the project.
- Financing model based on **expertise and low-cost development**, supported by Interreg funds and in-kind contributions (local institutions + university hackathon for mapping of NbS).

This entire activity has been carried out within the framework of the GreenScape CE project. To support the bottom-up mapping process and the enrichment of the NbS database, a curricular internship was activated in collaboration with University Politecnico di Milano. The internship was unpaid, fully in line with



university regulations for curricular placements; the student was covered exclusively by the health and safety insurance provided by the university during the internship period. The student contributed to the collection, validation and georeferencing of NbS data, working under the supervision of Ambiente Italia and in coordination with the Metropolitan City of Milan. In the final project phase, the ongoing work – including platform refinement, NbS integration and quality control – will be completed by Ambiente Italia’s internal staff, continuing to work in close collaboration with the Metropolitan City of Milan to ensure continuity and institutional adoption of the outputs.

This methodology – combining top-down integration of official datasets with bottom-up participatory data collection and a standardized GIS structure – is fully replicable. It can be applied by other municipalities, provinces and metropolitan cities in Italy and abroad that wish to map NbS through a participatory approach. The procedure is scalable, uses open data and widely available GIS tools, and relies on a modular procurement structure, allowing territories with different levels of resources and technical capacity to reproduce the same process.

## 2. Obstacles at pilot level

During implementation, the pilot encounters several technical and procurement-related challenges:

- **Fragmented geospatial data:** Relevant NbS information was scattered across various municipalities and projects, with “*no single, up-to-date inventory of all NbS projects*” initially available. This data fragmentation hindered the assessment of overall green coverage and identification of gaps, necessitating significant effort in data collection and cleaning.
- **Interoperability issues:** Differences in data formats and GIS systems is leading to integration difficulties. Each project had its own way of storing spatial data (if at all), so harmonizing layers into the central GVMP required establishing common standards. Without a shared digital tool, merging datasets revealed inconsistencies (e.g. varying coordinate systems, attribute schemas) that have to be resolved for the platform to function uniformly.
- **Lack of standardized digital tools across municipalities:** With 133 municipalities in the metropolitan area, technical capabilities vary widely. Some cities have advanced green infrastructure maps and policies, while others have none. This uneven digital readiness meant the pilot could not rely on pre-existing local tools. It highlighted a procurement challenge as well - smaller municipalities might not have resources or expertise to acquire sophisticated GIS tools, making a shared platform like the GVMP even more critical. However, getting all parties on board requires demonstrating that the platform could accommodate their needs without extensive local IT investment.
- **Alignment with procurement and legal frameworks:** Implementing a new digital system in the public sector had to comply with existing regulations and tender procedures. Ensuring the platform and data collection efforts meet privacy laws, data-sharing agreements, and public tender rules is an obstacle that needed careful navigation. The pilot is integrating its approach with the **regulatory documents** (such as the Metropolitan Territorial Plan and Strategic Plan as well the Metropolitan Agenda for Urban Sustainable Development) so that results would be formally recognized and usable in official procurement of NbS projects. This sometimes-slowed progress, as adapting the innovative mapping approach to fit bureaucratic processes required additional coordination and legal clarifications.



### 3. Lessons learned and expected impacts

**Technical takeaways:** The pilot demonstrates the critical importance of an integrated platform and standardized data in metropolitan NbS planning. Creating a unified mapping platform proved feasible and highly beneficial - merging fragmented datasets into the GVMP broke down information silos. This harmonized approach showed that cross-municipal geospatial data can be consolidated to support regional decision-making. Another key lesson was the value of combining top-down and bottom-up data collection: official plans provided strategic oversight, while local contributions ensured fine-grained detail and community relevance. Technically, the team is learning to establish clear data standards (common formats, coordinate reference, and metadata) at project outset, as this greatly eased later integration. The use of **standard NbS typologies and metadata** for each project is making analysis and comparisons much easier, reinforcing the need for data standardization as a best practice.

**Use of KPIs and data integration:** The pilot adopted clear performance indicators to measure outcomes, which is both a lesson learned and a benefit for future planning. For example, **spatial coverage** of NbS was tracked to quantify what percentage of the metropolitan area is served by green solutions. A **connectivity index** was introduced via the GVMP's connectivity analysis tool to evaluate how well individual NbS sites link to form a continuous green network. This index helps identify where new interventions could improve ecological connectivity. Additionally, the integration of Land Surface Temperature (LST) data allowed the team to map urban heat islands and correlate them with NbS distribution. By overlaying LST and other risk factors, the platform can highlight priority areas (e.g. densely populated heat-vulnerable neighborhoods lacking green cover) for future NbS investment. This evidence-based approach is expected to strengthen funding bids and justify NbS in urban development projects (a technical alignment with procurement, as future tenders for green infrastructure can reference these metrics to target high-impact projects). Another takeaway is that the **Benefit Evaluation Framework** developed in parallel reinforced the technical work by systematically assessing NbS outcomes, which was crucial for building the case to scale up NbS initiatives.

**Expected impacts:** In the long term, the pilot's technical and tendering solutions are set to deliver substantial benefits. The immediate outcome is a **comprehensive NbS database and live mapping platform** that remains in place as a decision-support tool for the Metropolitan City of Milan. This will greatly enhance cross-department and cross-municipality coordination - planners and officials can now access up-to-date maps of all green initiatives, enabling more coherent metropolitan policies. We expect improved **spatial planning**: by visualizing NbS coverage and gaps, the Metropolitan City of Milan can strategically direct resources to where new projects will maximize connectivity or address climate vulnerabilities. The connectivity index, for instance, can guide the creation of green corridors linking parks and natural areas, leading to a more interconnected urban green network (with benefits for biodiversity and recreation). Integrating LST and other environmental data into planning means **climate adaptation efforts are more targeted and effective**, cooling hot spots and mitigating flood-prone zones with appropriate NbS. The pilot also has an institutional impact: it aligns technical innovation with the Metropolitan City of Milan's policy framework, meaning the platform and data are readily usable in official planning and procurement. This ensures longevity - the tools can be embedded in regular municipal operations (for example, informing the criteria in public tenders for new developments to include NbS or referencing the NbS map in urban plan updates). Ultimately, the pilot's success in Milan is expected to yield a **strong demonstration effect**. As data continue to be collected and the benefits (like improved air quality, reduced heat, better stormwater management) are measured, it will strengthen the argument (backed by KPIs) for investing in NbS across the region. In summary, the pilot leaves behind a technically robust platform and a set of proven practices that will accelerate Milan's progress toward a greener, more resilient metropolitan area.



## 4. Recommendations and next steps

- **Adopt a modular tendering approach:** Break down the procurement of technical components into modules or phases. For example, separately tender the data collection, platform development, and maintenance/upgrades. This modular tendering provides flexibility - municipalities can issue smaller, focused contracts that align with their budget cycles and capabilities.
- **Implement metadata standards:** Establish clear metadata and data standards for all NbS information from the outset. Define a common schema (e.g. each project entry should include location, NbS typology, size, installation date, cost, etc.) and use standardized classifications for NbS types (as Metropolitan City of Milan did with 15 typologies). This ensures that data coming from different municipalities, departments or even stakeholders is interoperable and easily merged.
- **Leverage existing frameworks and open-source tools:** Where possible, use existing software tools or open-source platforms to jump-start the development. Many components (mapping libraries, database systems) do not need to be built from scratch. Additionally, ensure the solution adheres to any national or regional data infrastructure frameworks (for example, using compatible formats with national geoportals) to simplify approvals and integration.
- **Provide training and capacity building:** Alongside technical deployment, invest in training sessions for municipal staff on using the platform and managing data. Early training helps embed the platform into daily workflows and ensures data entry and maintenance responsibilities are clear.
- **Plan for phased scaling and refinement:** After initial implementation in the pilot area, identify additional districts or neighbouring cities to onboard in a second phase. This phased expansion, combined with continuous monitoring and feedback loops, will improve the methodology over time. It is also wise to define KPIs for the replication process itself (e.g. number of municipalities adopting the platform, data update frequency, etc.) and track them to ensure the approach remains effective as it grows.

## F. Report on technical and tendering solutions implemented in Warsaw, Poland

### 1. Short description of technical and tendering solutions within the pilot

The Warsaw pilot implementation within the framework of the GreenScape CE project focuses on testing innovative technical and tendering solutions that promote sustainable urban transformation, climate resilience, and the integration of nature-based solutions into city street design. The technical solutions selected for testing include the use of permeable surfaces, rain gardens, small retention basins, native vegetation plantings, and the implementation of a sponge city approach to improve stormwater management, reduce runoff, and enhance biodiversity. In parallel, tendering procedures have been applied, including competitive selection processes requiring multiple bids and sustainability criteria in contractor evaluation. These approaches aim to ensure transparency, cost efficiency, and high environmental standards in project delivery.



The pilot implemented by the Public Roads Authority in Warsaw focuses on the preparation of a comprehensive redevelopment concept for Wileńska street, serving as a model for future green and climate-resilient urban projects.

The first phase, which covers preparatory actions and conceptual design development, is implemented within the GreenScape CE project. It includes extensive data collection and innovative pre-design analyses. The second phase, encompassing the construction works, final inspection, and usage permit, will be implemented after the completion of GreenScape CE, with funding to be sought through municipal and participatory budgeting mechanisms.

Warsaw's pilot implementation within the framework of the GreenScape CE project represents a comprehensive effort to redesign city streets with a strong emphasis on sustainable development and climate resilience. The project is structured into two distinct phases: preparatory actions and construction work, each playing a crucial role in ensuring the project's success. This initial phase involved extensive pre-design studies focused on gathering essential data to inform the project design. Key activities included traffic measurements to understand vehicle flow and usage patterns, and detailed stormwater runoff analysis to evaluate how rainwater is currently managed within the urban environment. Importantly, conducting comprehensive hydrological and stormwater studies before commissioning the design works represented an innovative approach for the Public Roads Authority, tested for the first time within this pilot. These studies provided critical insights into challenges related to urban drainage, flooding risks, and potential areas for intervention. The pre-design studies were financially supported by the European Union through the INTERREG GreenScape CE programme, illustrating the EU's commitment to fostering sustainable urban transformation in Central Europe.

Crucially, this phase laid a solid foundation for the subsequent design stages by identifying optimal locations for nature-based solutions (NbS) such as rain gardens and retention basins. These features are integral components of a sponge city approach, aimed at increasing urban water retention, reducing runoff, enhancing biodiversity, and improving microclimate conditions.

Following the data collection, the project progressed to the **concept design and execution design** stages, funded by the Public Roads Authority in Warsaw. This stage involved translating the collected data and strategic goals into concrete engineering and architectural plans, carefully tailored to the local urban context. Given the significant financial commitment required for these design services, a competitive procurement process was conducted, requiring at least three contractor bids to ensure transparency, fair pricing, and high-quality outcomes.

This phased and data-driven approach underpins Warsaw's strategic vision to integrate green infrastructure within the existing urban fabric, promoting the city's resilience against climate change effects such as urban heat islands and extreme precipitation events. The project stands as a model example of multi-level governance cooperation, co-financing mechanisms, and the practical application of cutting-edge sustainable urban planning principles.

The Company working with Phase I prepares complete final concept for the development of the study area, with particular emphasis on natural elements and detailing the land development elements that consider NbS. The contractor shall provide information on trees to be planted, permeable surface area, small retention solutions to be implemented, shrubs and perennial beds to be planted, and other design solutions incorporating NbS. The study will also result in a complete traffic design for the street, including the transformation of urban space, traffic calming, the introduction of bicycle lanes and, above all, an increase in retention areas and an attempt to capture all rainwater in green areas.

Phase II, comprising the construction phase, final inspection, and usage permit approval, is not yet funded. ZDM plans to apply for municipal funding through Warsaw's Municipal Revitalisation Programme, which covers the area of the pilot actions, and plans to complement it with funds from a citizen-submitted project



under the participatory budget scheme. This participatory model allows citizens to allocate a portion (0.5%) of the city's annual budget to community projects through public voting.

To date, three contractor selection processes have been carried out for the project through requests for proposals.

## 2. Obstacles at pilot level

As the implementation of the pilot task, which is the reconstruction of the entire street, it is crucial to rely on preliminary analyses: water runoff analysis and traffic analysis. And here, when designing, it is extremely important to combine at least three main needs: understanding that Wileńska Street is one of the vessels in a system of connected vessels and that any changes made to it will affect the entire system. The same is true for rainwater runoff. The street does not function in isolation from the surrounding area. When designing, it was important to select a comprehensive area for research. Thus, the desire to transform one large street requires examining the entire system.

The first major challenge was to identify options for working on the street's traffic system, and thus the area itself. The question was how far to go in terms of traffic restrictions and giving space to pedestrians, cyclists and greenery. Although the desire for major changes was obvious, it was necessary to face the fact that only part of the area could and should function as a street with restricted vehicle traffic. A complete exclusion or restriction of traffic would have very negative effects on the functioning of the area and services on the street in question.

The second challenge was to confront the results of the runoff analysis, which showed that Wileńska Street is not a street with a high accumulation of rainwater. The key problems in this regard are located two blocks away on a street that has already undergone modernisation, but not yet in the spirit of NbS. Here, we had to ask ourselves how to proceed and whether to really focus so much on NbS solutions, even if the runoff problems are not widespread. However, the decision was made to use a system of connected vessels again, with the idea that the small retention system on one street could be expanded in the future. And the modernisation of Wileńska Street must take place anyway due to the appalling technical condition of the street. So all the barriers encountered so far have appeared at the strategic stage.

## 3. Lessons learned and expected impacts

The pilot project in Warsaw concludes with the preparation of documentation. Therefore, it is not possible to provide actual implementation indicators at this stage. However, it will be feasible to determine the expected indicators after the project has been implemented. The basic KPI will be the amount of concrete-covered area and the introduction of new users of the area. Another KPI are devoted to traffic measurements. Traffic intensity measurements at intersections were carried out during the morning rush hour between 7:00 and 9:00 a.m. and during the afternoon rush hour between 3:00 and 5:00 p.m., in accordance with the results of the analysis presented above. The data obtained from the measurements were aggregated into 15-minute intervals. Results for the measured points, for conventional vehicles for the rush hour determined in the first stage of measurements. The conversion factors from actual vehicles to contractual vehicles are presented in the analysis results. The basic factor of traffic studies after analysing the implementation of the project will be traffic flow and traffic intensity. A reduction in traffic intensity and maintained traffic flow in the area will be considered positive.

However, the key and expected effect will be the social indicators specified in the Revitalisation Programme, based on which Wileńska Street was included as a degraded street covered by the revitalisation programme. Technical and purchasing aspects do not pose a major problem. This is because all aspects



relating to road reconstruction, materials used, dimensions and strength parameters are specified by law or municipal standards. When it comes to the tender process for documentation orders, unfortunately, the price offer is still the key indicator in the evaluation of submitted bids.

Here are some common indicators used to measure the effectiveness of sponge city projects:

- **Runoff Reduction:** Percentage decrease in stormwater runoff volume compared to pre-project conditions.
- **Infiltration Rate:** Amount of rainwater absorbed into the ground from sponge city facilities like rain gardens or permeable pavements.
- **Peak Flow Mitigation:** Reduction in the peak discharge rate during heavy rainfall events to prevent flooding.
- **Water Quality Improvement:** Reduction in pollutants (such as sediments, nutrients, and heavy metals) in stormwater before it reaches water bodies.
- **Groundwater Recharge:** Increase in groundwater levels due to enhanced infiltration and storage.
- **Biodiversity Enhancement:** Increase in local flora and fauna diversity thanks to green and blue infrastructure components.
- **Urban Heat Island Mitigation:** Reduction in surface and air temperatures in areas with sponge city interventions.
- **Social Acceptance and Awareness:** Level of community awareness, participation, and satisfaction with sponge city installations.
- **Maintenance and Operational Efficiency:** Measured by the ease and cost of maintaining sponge city elements to ensure long-term functionality.
- **Cost-effectiveness:** Evaluation of life-cycle costs relative to the benefits gained from improved stormwater management and urban resilience.

These indicators cover environmental, social, and economic dimensions essential for assessing sponge city projects comprehensively.

## 4. Recommendations and next steps

The first recommendation is that, Wileńska Street is one of the largest streets in the Praga district, initiating a pilot project there represents a substantial investment accompanied by a risk of delays. It would be more prudent to commence with smaller-scale actions. Additionally, the proposed measures for Wileńska Street are largely applicable to public spaces in any city. Therefore, it can be stated that replicating the pilot project's assumptions would be straightforward and could serve as a standard approach for urban investments across cities.

Large-scale investments tend to create delays due to several interrelated factors. These projects require extensive planning and coordination, and the complexity involved often leads to unforeseen obstacles. For instance, inaccurate or incomplete initial planning and scheduling can cause bottlenecks and extend timelines. Changes in project design or scope during implementation—sometimes due to evolving requirements—can interrupt workflows and necessitate rework, further delaying progress.

Moreover, large investments rely heavily on multiple approvals and permits, which often involve several regulatory agencies. Delays in securing these necessary permissions can significantly slow down the project. Supply chain disruptions, such as shortages or late deliveries of critical materials and equipment, are more



impactful in larger projects due to the scale of resources required. Labor shortages or productivity issues, particularly with specialized skills, also contribute to slower advancement.

Financial complexities add to the challenges, including potential funding delays, budget overruns, and disputes over payments. All these factors combined increase the risk that large projects will not proceed as smoothly or quickly as smaller, simpler ones. This is why it is often advisable to start with smaller-scale pilot actions for a more manageable and timely implementation.

Smaller investments in nature-based solutions (NbS) offer several distinct advantages in urban renewal projects. Due to their scale, these interventions require less capital and shorter implementation times, allowing for quicker, more manageable actions with reduced risk of delays and cost overruns. They provide flexibility to tailor solutions specifically to local needs, making it easier to respond to the unique characteristics of each street or neighborhood.

Such projects often focus on improving social and cultural dimensions of urban living by enhancing green spaces and fostering community engagement. They create attractive, usable public areas that encourage social interaction and physical activity, contributing to healthier and more vibrant communities. Importantly, many of these small-scale NbS investments address universal urban challenges, such as stormwater management, air quality, and noise reduction, in ways that can be adapted to various contexts.

Because of their modular and adaptable nature, these solutions can be replicated across different streets and districts with relative ease, creating a standardized yet locally sensitive approach to urban development. Encouraging community participation from the outset further ensures that the interventions meet real needs and promote a sense of ownership and empowerment among residents. This replicability and community focus make smaller NbS investments an effective and sustainable option for widespread urban renewal.

#### Steps for Replicating Nature-Based Solutions (NBS) Like Rain Gardens and Sponge City Concepts

##### 1. Assessment and Identification

- Assess local urban challenges related to water management, heat mitigation, biodiversity, and air quality.
- Identify potential sites and conditions suitable for installing NBS such as rain gardens or sponge city elements.

##### 2. Stakeholder Engagement and Co-Creation

- Involve local communities, public authorities, urban planners, and experts in participatory workshops to co-design solutions.
- Collect input on site-specific needs, preferences, and potential constraints to ensure solutions are locally adapted.

##### 3. Planning and Prioritization

- Develop a detailed implementation plan prioritizing interventions based on feasibility, impact, and resource availability.
- Define clear objectives, performance indicators, and monitoring strategies.

##### 4. Design and Customization

- Tailor technical designs to local urban context, respecting the ecological, social, and infrastructural specifics of each street or neighborhood.
- Ensure flexibility so that designs can be adapted easily to different urban layouts.

##### 5. Implementation Phasing



- Roll out the interventions in manageable phases to allow learning and adjustment at each stage.
- Secure necessary permits, funding, and resources ahead of time.

#### **6. Monitoring and Evaluation**

- Establish monitoring protocols to evaluate technical performance (e.g., water retention, biodiversity support) and social acceptance.
- Use the data to inform ongoing maintenance and future improvements.

#### **7. Knowledge Sharing and Upscaling**

- Document lessons learned and best practices clearly.
- Share successful models with other districts or cities to encourage replication, adapting to new contexts as needed.

When we take under consideration modelling the NbS solutions the length of it should be selected so that, given the specified rainfall will capture enough water to eliminate flooding along the street. We find good that NbS solutions such as rain gardens for water retention have been dimensioned with only a little reserve, leaving part of the ‘freed’ area along Wileńska Street for other green activities, such as tree planting.

During the reconstruction, care should be taken to ensure that rainwater is directed first towards green infrastructure facilities. Excess rainwater in retention facilities should be directed to drains via overflows to ensure that the outflow is delayed and the water is retained in the catchment area before being discharged into the sewerage system. This requires appropriate profiling of the road, including the pavement and cycle path, and the creation of slopes towards green solutions, as well as the use of gutters where water needs to be drained along the street towards green solutions.