



Nature's integration in cities'
hydrologies, ecologies and societies

Policy brief

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WHAT MAKES NBS WORK? GOVERNANCE APPROACHES TO TACKLE COMBINED SEWER OVERFLOWS IN URBAN WATER SYSTEMS

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INTRODUCTION

The increasing frequency of extreme weather events highlights the limitations of traditional gray infrastructure in urban stormwater management. Combined Sewer Overflows (CSOs) pose environmental and public health risks, particularly as extreme weather intensifies. Nature-Based Solutions (NBS) can offer a sustainable alternative or support by leveraging natural processes to manage stormwater, enhance resilience, and provide co-benefits like biodiversity and improved urban life¹. However, their successful implementation requires supportive governance and policy frameworks². Particularly, collaborative governance models involving multiple stakeholders are recognised as an essential factor for a successful adoption of NBS in urban environment^{3,4}. Policy frameworks promoting integrated

water management can further facilitate the transition toward resilient urban water systems.

As part of the NICHES project, the role of urban governance in integrating NBS into local policies was assessed in five cities across Europe and North America: Rotterdam (Netherlands), Barcelona (Spain), Berlin (Germany), Sheffield (UK), and Boston (USA). Each of these cities faces multiple challenges related to CSOs and has introduced measures to address them. This policy brief therefore presents main policy barriers and enablers across these urban areas, highlighting best practices and lessons learnt to maximise NBS effectiveness in mitigating CSOs while advancing urban sustainability goals.

POLICY GAPS AND OPPORTUNITIES FOR NBS IMPLEMENTATION

Comparing governance and policy frameworks in the NICHES case study cities reveals common **barriers and opportunities** for an urban NBS implementation. The assessment, based on the Diagnostic Water Governance Tool⁵, evaluated governance across three dimensions: **Processes** (policy implementation and coordination mechanisms), **Governance Structure** (institutional frameworks and regulatory clarity, and **Context** (socioeconomic and environmental conditions shaping water governance). The results show that across five cities common enabling features include **citizen engagement through collective action, cross-sectoral**

collaboration and institutional support, guidance and vision through master planning, and a **mix of traditional and innovative approaches**. At the same time, existing policy and governance barriers also became apparent, often directly opposing some of the enablers. These include **lack of collaborative governance, knowledge and data challenges, insufficient policy development and enforcement, fragmented or incomplete policy frameworks, low private sector engagement, challenging citizen engagement, and competition over urban space and resources**.

1 Grimm, N. B., Pickett, S. T. A., Hale, R. L., & Cadenasso, M. L. (2017). Does the ecological concept of disturbance have utility in urban social-ecological-technological systems? *Ecosystem Health and Sustainability*, 3(1), e01255. <https://doi.org/10.1002/ehs2.1255>

2 Martin, J. G. C., Scolobig, A., Linnerooth-Bayer, J., Liu, W., & Balsiger, J. (2021). Catalyzing innovation: Governance enablers of nature-based solutions. *Sustainability*, 13(4), 1971.

3 Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental Science & Policy*, 93, 101–111. <https://doi.org/10.1016/j.envsci.2018.12.033>

4 Mahmoud, I., & Morello, E. (2021). Co-creation Pathway for Urban Nature-Based Solutions: Testing a Shared-Governance Approach in Three Cities and Nine Action Labs. In A. Bisello, D. Vettorato, D. Ludlow, & C. Baranzelli (Eds.), *Smart and Sustainable Planning for Cities and D4.2 Governance and Institutional Frameworks 41 Regions* (S. 259–276). Springer International Publishing. https://doi.org/10.1007/978-3-030-57764-3_17

5 The Diagnostic Water Governance Tool | The Diagnostic Water Governance Tool

Main enablers



Citizen Engagement through Collective Action and Consultation

Citizen engagement is a critical enabler for successful NBS implementation.

Example: Barcelona ensures public stakeholder consultations in policy drafting, i.e. in the **Tecnical Plan for the Use of Alternative Water Resources** (PLARHAB) preparation. In Boston, the **2025 petition and advocacy campaign "Cut the Crap"** (<https://www.crwa.org/cutthecrap>) raises awareness and pressures decision-makers to increase efforts against CSO into Charles River. Neighbourhood Initiatives like **"Berliner Wassertanke"** distribute and install free Rain Barrels.



Cross-Sector Collaboration and Institutional Support

Effective NBS implementation requires collaboration across sectors and institutions.

Example: The **Barcelona Department for Ecology, Urban Planning, and Mobility** enables cross-departmental collaboration, while **Berlin's Water Competence Centre (KWB)** and **Rainwater Agency** provide legal advice, planning tools, and funding instruments, while fostering stakeholder networks.



Guidance and Vision Through Master Planning

Comprehensive master planning provides the vision and strategic direction necessary for NBS and CSO mitigation

Example: **Berlin's Water Resource Act (WHG)** and the **National Water Strategy** provide localized regulatory frameworks aligned with national goals. These master plans highlight the importance of aligning national and local strategies to provide clear priorities for urban water management. **Strategic visions**, such as the Sponge City approach in Berlin, give guiding directions for the formulation of future policy goals.



Mix of Traditional and Innovative Approaches

A combination of traditional funding mechanisms and innovative tools accelerates NBS adoption. Especially the use of digital tools seems to foster knowledge sharing and stakeholder engagement.

Example: The Netherlands' **Digital Environmental Desk** combines traditional regulatory frameworks with user-friendly digital tools, allowing stakeholders to easily navigate planning requirements. The tool integrates all physical environment regulations into a single digital platform, streamlining local urban planning processes.

Main barriers


Lack of Collaborative Governance	Institutional fragmentation and hierarchical municipal structures hinder NBS co-development, causing duplication and missed opportunities due to the lack of central coordination.
Knowledge and Data Challenges	Insufficient data and knowledge-sharing mechanisms impede the implementation of NBS. Hence the quantification of context-specific NBS performance remains challenging.
Insufficient Policy Development and Enforcement	Delayed or inadequate policy implementation hampers progress in cities. Slow enforcement and administrative burdens deter private sector engagement despite often existing stormwater mitigation requirements
Fragmented or Incomplete Policy Frameworks	The absence of holistic master planning is a significant barrier for cities, where fragmented regulations fail to address long-term CSO management.
Low Private Sector Engagement	High costs, administrative burdens, and limited incentives discourage private sector involvement. Stormwater mitigation requirements often lack streamlined processes and financial incentives, reducing participation.
Challenging Citizen Engagement	Citizen engagement requires time, communication, and alignment of stakeholder interests. Conflicting initiatives about the usage of urban space underscore the need for inclusive, participatory planning.
Competition over Urban Space and Resources	Repurposing urban spaces for NBS competes with other vital services, e.g., housing and transportation. Underground infrastructure, like water storage systems, also faces spatial and financial constraints, complicating retrofitting

POLICY IMPLICATIONS AND RECOMMENDATIONS


Best practices and lessons learned from NBS implementation for CSO mitigation across five NICHES cities have laid a solid foundation for drawing recommendations for policymakers and practitioners facing the same issue. These recommendations aim to improve the current governance framework and maximise the benefits of NBS implementation.

 **Promote integrated governance models** by establishing vertical coordination mechanisms to align municipal, regional, and national policies. Use examples like Rotterdam's Waterkracht Alliantie to harmonise objectives and improve water management efficiency.

 **Enhance public participation** by involving local communities, businesses, and NGOs in the design, implementation, and monitoring of NBS. Use participatory governance models like Barcelona's PLARHAB consultations in policy drafting to create resilient, multifunctional infrastructures addressing local and systemic challenges.

 **Expand innovative not bureaucratic funding mechanisms for NBS** by creating dedicated streams that ensure consistent financial support. Leverage public-private partnerships to pool resources, share risks, and ensure the long-

term sustainability of NBS beyond traditional infrastructure projects.

 **Foster private sector engagement** and incentives for NBS by implementing incentive programs for NBS on private land, inspired, e.g., by Boston's approach to stormwater management through compliance-based permits and subsidies. Offer support mechanisms like grants, tax benefits, and technical assistance to encourage widespread NBS integration in urban areas.

 **Address institutional silos** by creating interdepartmental task forces for horizontal coordination and cross-sector collaboration. Draw on Berlin and Barcelona's examples of successful collaborative platforms and cross-departmental working groups to reduce fragmentation in urban planning and water governance.

 **Leverage digital tools for NBS knowledge management and facilitation** by using platforms to enhance awareness, facilitate planning, and provide accessible regulatory information. Develop user-friendly tools for private entities to assess feasibility and integrate NBS, inspired by Rotterdam's Environmental Desk. Promote innovation in digital mapping and visualization to support participatory decision-making and stakeholder communication.

PROJECT OBJECTIVES AND METHODOLOGY

The NICHES project explored the potential of NBS to address the growing challenges posed by heavy rainfall events that overload combined sewage systems leading to contamination and aquatic biodiversity decline. The project developed sustainable, resilient solutions to manage stormwater and mitigate the negative impacts of CSO on aquatic ecosystems. The project employed a Social-Ecological-Technical Systems (SETS) approach⁶ to co-create knowledge on restorative NBS and assess their ecological, social, and economic impacts.

Key objectives of NICHES:

- Co-creating knowledge on restorative NBS to prevent stormwater run-off;
- Analysing the ecological, social, and economic impacts of CSO events and evaluating the mitigation potential of NBS;

Developing an integrated framework to assess trade-offs and synergies between urban needs and NBS implementation;

Co-creating pathways for integrating NBS into existing policy frameworks.

These objectives are achieved using various methods and tools, such as targeted stakeholder interviews and workshops, literature review, policy content analysis, the Diagnostic Water Governance Tool, scenario analysis and mapping, among others. This holistic approach employing both qualitative and quantitative methods from various disciplines allows comprehensively address a complex issue of effective NBS implementation for stormwater management in a transforming urban setting.

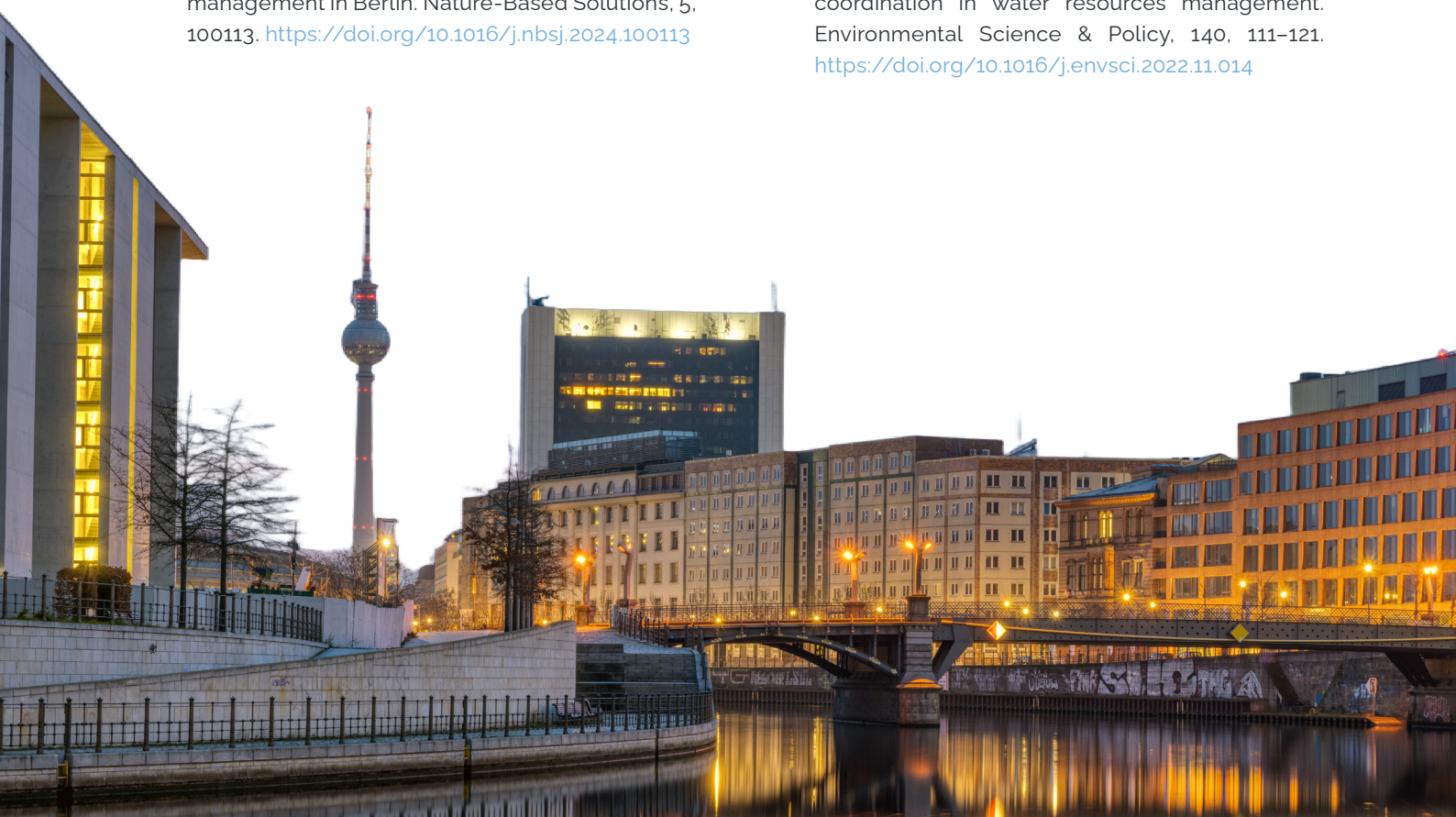
These efforts are expected to support urban resilience to climate change, aligning with EU biodiversity targets for 2030 and the EU Nature Restoration Regulation to halt biodiversity decline.

⁶ McPhearson, T., Cook, E. M., Barbés-Blázquez, M., Cheng, C., Grimm, N. B., Andersson, E., Barbosa, O., Chandler, D. G., Chang, H., Chester, M. V., Childers, D. L., Elser, S. R., Frantzeskaki, N., Grabowski, Z., Groffman, P., Hale, R. L., Iwaniec, D. M., Kabisch, N., Kennedy, C., ... Troxler, T. G. (2022). A social-ecological-technological systems framework for urban ecosystem services. *One Earth*, 5(5), 505–518. <https://doi.org/10.1016/j.oneear.2022.04.007>.

FURTHER READING

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PROJECT IDENTITY

PROJECT NAME

Nature's Integration in Cities' Hydrologies, Ecologies and Societies

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CONSORTIUM



FUNDING SCHEME

Biodiversa and WaterJPI joint COFUND call on "Conservation and restoration of degraded ecosystems and their biodiversity, including a focus on aquatic systems"

FOR MORE INFORMATION

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DURATION



April 2022 – March 2025 (36 months)

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FUNDING ACKNOWLEDGEMENT



Funded by
the European Union



This project was funded through the 2020–2021 Biodiversa and Water JPI joint call for research proposals, under the BiodivRestore ERA-Net COFUND programme, and with the funding organisations: German Federal Ministry of Education and Research, Agencia Estatal de Investigación española, Ministry of Agriculture, Nature and Food Quality of the Netherlands. NICHES is coordinated by the Ecologic Institute.

This policy brief reflects only the author's view and the European Commission/REA is not responsible for any use that may be made of the information it contains.