URSOiLL

D2.3 Site Implementation Design I

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R = Document, report
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DMP = Data Management Plan
SEN = Sensitive, limited under the conditions of the Grant Agreement
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1. Project Summary

The URSOILL project (Innovative Solutions for Sustainable Urban Soil Restoration through Living Labs) aims to improve urban soil health and support the development of resilient, sustainable, and climate-adapted cities across Europe. Through a network of five Urban Living Labs located in Sweden, Spain, Italy, Greece, and Luxembourg, the project brings together researchers, municipalities, businesses, civil society organizations, and citizens to co-create, test, and validate innovative solutions for urban soil restoration.

Urban soils provide essential ecosystem services, including water regulation, carbon storage, biodiversity support, urban cooling, and improved human well-being. However, these functions are increasingly threatened by soil sealing, contamination, compaction, and unsustainable land use practices. URSOILL addresses these challenges through an integrated Living Lab approach that combines nature-based solutions, technological innovations, and socio-economic measures to restore soil functions and enhance ecosystem services. By strengthening the connection between scientific research, policy development, and practical implementation, URSOILL contributes to the objectives of the EU Mission "A Soil Deal for Europe" and supports the transition towards healthier, greener, and more resilient urban environments.

2. Executive Summary

Deliverable D2.3, *Site Implementation Design I*, presents the first iteration of implementation planning under Work Package 2 (WP2) of the URSOILL project. Building on the co-creation processes and site selection activities conducted during the initial project phase, the deliverable documents how the five Urban Soil Living Labs have translated identified challenges and stakeholder priorities into site-specific implementation designs for urban soil restoration. The report establishes the operational framework that will guide the implementation, monitoring, and evaluation of restoration activities across the Living Labs.

The deliverable presents the initial portfolio of experimental sites selected across the Living Labs and describes the interventions planned at each location. These sites represent a broad range of urban environments, including public parks, school grounds, community gardens, urban green corridors, depaved spaces, and former industrial areas. Together, they address key urban soil challenges such as soil sealing, compaction, contamination, biodiversity loss, poor water infiltration, and declining soil functionality.

For each Living Lab, the report outlines site characteristics, implementation objectives, planned restoration measures, baseline conditions, monitoring requirements, stakeholder participation mechanisms, and risk management considerations. The proposed interventions include nature-based solutions, sustainable and circular soil management practices, Soil functional restoration, soil de-sealing and decompaction measures, urban greening and reforestation approaches, remediation techniques, and innovative soil amendments intended to improve soil health and enhance ecosystem service delivery.

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The report also demonstrates the diversity of governance and management arrangements supporting implementation. Experimental activities are being delivered through collaborations involving municipalities, universities, schools, community organisations, land managers, and other local stakeholders. These arrangements provide opportunities to evaluate how urban soil restoration solutions can be implemented and maintained under different institutional and socio-environmental conditions across Europe.

D2.3 establishes the operational foundation for the implementation phase of URSOILL It represents the first consolidated overview of the project's experimental site portfolio. The documented site designs provide the basis for implementation, monitoring, and assessment activities under WP3 and support future evaluation, replication, and scaling of successful restoration approaches. As implementation progresses, the site portfolio and intervention designs will be further refined through D2.4 and D2.5, incorporating implementation experience, stakeholder feedback, and additional restoration opportunities arising through the cascade funding mechanism.

3. Introduction

This deliverable presents the first iteration of the Site Implementation Designs developed within the URSOILL Urban Living Labs. Building on the site selection, characterization, stakeholder engagement, and co-creation activities conducted during the initial phase of the project, the report documents how identified urban soil challenges and restoration priorities have been translated into site-specific implementation plans.

Task 2.3 of WP2 is responsible for transforming the outcomes of the co-creation process into practical implementation activities. The purpose of this deliverable is therefore to establish a common framework for site implementation and experimental design across the Living Lab network, ensuring that interventions are scientifically sound while remaining responsive to local environmental and societal needs.

Although the Living Labs operate in different geographical, climatic, and governance contexts, a harmonised methodology has been applied to support consistency and comparability across the project. Sites were selected within or closely linked to the participating NetZero Cities[1], ensuring alignment with broader urban sustainability and climate neutrality objectives. In addition, site selection was guided by a common set of criteria, including the relevance of local soil challenges, feasibility of implementation, stakeholder commitment, suitability for long-term monitoring, and potential for replication. The process was underpinned by the Healthy Soil Living Lab (HSLL) mapping framework (D1.1[2]), which provided the conceptual basis for site profiling and stakeholder mapping across the Living Labs.

[1] https://netzerocities.eu/

[2]https://ursoill.eu/wp-content/uploads/2026/07/D1.1.-Stakeholder-mapping-and-baseline-analysis-of-local-ecosystemswatermark.pdf

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This harmonised approach ensures that URSOILL generates evidence that is locally grounded and responsive to specific urban soil challenges, while also enabling cross-site comparison, knowledge exchange, and learning at the European scale. Each implementation plan incorporates a structured experimental design that defines restoration objectives, intervention measures, baseline assessments, monitoring requirements, comparison conditions where relevant, and risk mitigation actions. This framework provides the basis for evaluating the effectiveness of implemented solutions and facilitates the generation of robust evidence on their environmental and social impacts.

The monitoring and assessment of implemented interventions will be conducted under WP3 through a harmonised soil health evaluation framework. Common indicators will enable cross-Living Lab comparisons, while additional site-specific parameters may be included to address local priorities and conditions.

This report is organised into two main components. The first presents the common methodology used for site selection, implementation planning, and experimental design. The second provides detailed Living Lab-specific implementation plans describing selected sites, proposed interventions, operational arrangements, and anticipated challenges. Together, these elements establish a shared foundation for the deployment, monitoring, and evaluation of urban soil restoration solutions throughout the URSOILL project.

Given the iterative Living Lab approach adopted by URSOILL, the site portfolio and implementation designs are expected to evolve throughout the project as experience is gained, additional stakeholders are engaged, and new restoration opportunities are identified.

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4. Site Selection and Experimental Design Methodology

This section presents the approach used by the URSOILL Living Labs (LLs) to identify, assess, and select experimental sites and to develop site-specific implementation designs for the first phase of interventions. The methodology combines stakeholder-driven co-creation processes established under WP1 (D1.1 and D1.2[3]) with the technical requirements of WP2 and the specific soil health challenges identified in each Living Lab. Site selection and experimental planning were informed by stakeholder input, local ecosystem analyses, and scientific assessments, ensuring that proposed interventions address real-world urban soil restoration needs while remaining feasible, scalable, and relevant to local socio-environmental conditions. Through an iterative process involving Living Lab partners, local stakeholders, and technical experts, each site was characterised, priorities were defined, and preliminary experimental designs were developed to support the implementation and testing of innovative solutions for improving urban soil health, ecosystem services, and sustainable land management practices.

[3] https://ursoill.eu/wp-content/uploads/2026/07/D1.2-Living-Lab-Methodologywatermark.pdf

4.1. Co-creation Process and Stakeholder Involvement

The implementation design of each URSOILL LL is rooted in a structured and inclusive co-creation approach that places stakeholders at the centre of decision-making and innovation processes. In line with the URSOILL LL methodology, the design of interventions is based on a detailed understanding of local ecosystems, stakeholder needs, and urban soil health challenges, ensuring that proposed solutions are both scientifically robust and locally relevant (D1.1).

The co-creation process started with comprehensive stakeholder mapping and ecosystem analysis conducted under WP1. Stakeholders representing public authorities, municipalities, landowners, urban planners, researchers, businesses, civil society organisations, community groups, and citizens were identified and engaged through targeted recruitment and outreach activities. This process aimed not only to identify relevant actors but also to understand their interests, motivations, challenges, and potential contributions to urban soil restoration efforts.

During the first project phase (M1-M9), each Living Lab organised a series of stakeholder engagement and co-creation activities, including kick-off meetings, workshops, and thematic discussions. The first co-creation activities (CCS#1) provided the foundation for the site implementation designs by establishing stakeholder ecosystems, identifying key urban soil challenges and opportunities through PESTLE analyses, and developing a shared understanding of local restoration priorities across the five Living Labs. These activities informed the subsequent selection of implementation sites and restoration pathways documented in D1.1.

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These interactions enabled participants to:

- Co-Identify and validate key urban soil health challenges and opportunities;
- Define local priorities, objectives, and site-specific constraints;
- Exchange knowledge and experiences related to sustainable urban soil management;
- Co-design and refine potential restoration and management solutions;
- Contribute to the selection of experimental sites and interventions to be implemented within the Living Labs.

The co-creation activities followed a multi-actor and interdisciplinary approach, fostering dialogue among scientific experts, local authorities, practitioners, and citizens. Through these exchanges, each Living Lab established a shared understanding of priority challenges and collaboratively defined the most suitable experimental actions for addressing them. Consequently, the experimental designs presented in this deliverable reflect not only technical assessments but also the collective knowledge, experiences, and preferences of local stakeholders. The detailed outcome of first co-creation activity is documented and reported in D1.2.

An important outcome of this process was the identification of site-specific challenge-solution pathways, linking urban soil issues such as contamination, soil sealing, compaction, reduced biodiversity, or limited ecosystem service provision with innovative nature-based, technological, or management solutions to be tested within the LLs.

By embedding stakeholder participation throughout the planning and implementation stages, URSOILL strengthens local ownership, enhances the relevance and acceptance of proposed interventions, and supports the development of scalable and transferable solutions. This collaborative approach will continue throughout the project, providing iterative feedback to refine experiments, support monitoring and evaluation activities, and contribute to the long-term sustainability and replication of successful urban soil restoration practices across Europe.

4.2. Typology of Solutions and Interventions

The co-creation process implemented within each URSOILL Living Lab contributed to the identification and prioritisation of urban soil health challenges and informed the selection and refinement of interventions to address them. Through stakeholder engagement, local ecosystem assessments, and collaborative planning activities, each LL explored potential solutions and implementation pathways tailored to local environmental, social and technical conditions. The resulting intervention portfolios build on these co-creation processes together with scientific assessments, technical expertise and site-specific requirements.

Within URSOILL, solutions are understood as innovative practices, technologies, nature-based approaches, governance mechanisms, or educational activities designed to improve urban soil health, restore ecosystem services, and promote sustainable land management. These solutions are tested and refined through Living Lab experimentation and iterative learning processes under real-world conditions.

Recognising that urban soil restoration requires multiple and complementary approaches, URSOILL implements three broad categories of solutions and interventions:

Soil Restoration and Management Solutions

These interventions directly target soil health improvement and ecosystem service recovery through practical actions implemented at experimental and demonstration sites. They encompass nature-based solutions, restoration measures, soil amendments, and innovative management practices designed to address soil contamination, sealing, compaction, biodiversity loss, reduced water infiltration, and declining soil functionality. Such approaches contribute to enhancing soil biodiversity, regulating water and nutrient cycles, improving carbon storage, and increasing resilience to climate change (Lehmann & Joseph, 2015; European Commission, 2021).

Examples include:

1. **Phytoremediation and microbial remediation techniques**, which use plants and beneficial microorganisms to remove, immobilize, or degrade contaminants while improving soil biological activity and ecosystem functioning (Su et al., 2022; Kumpiene et al., 2019).
2. **Biochar and compost applications**, which enhance soil organic matter, nutrient retention, water-holding capacity, microbial diversity, and carbon sequestration while

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reducing contaminant bioavailability (Lehmann & Joseph, 2015; Mazzurco-Miritana et al., 2025).

3. **Soil de-sealing and permeable surface solutions**, aimed at restoring soil functions by removing impervious surfaces and promoting water infiltration, groundwater recharge, soil biodiversity, and urban climate regulation (European Commission, 2021; Scalenghe & Marsan, 2009).
4. **Nature-based stormwater management systems**, such as rain gardens, bioswales, infiltration basins, and constructed wetlands, which reduce runoff, enhance water retention, filter pollutants, and support urban ecosystem services (European Environment Agency, 2021; Raymond et al., 2017).
5. **Biodiversity enhancement measures**, including pollinator habitats, native vegetation establishment, green corridors, and habitat diversification, which strengthen ecosystem resilience and support essential soil biological communities (FAO, 2020; IPBES, 2019).
6. **Urban agriculture and agroecological practices**, including community gardens, regenerative cultivation methods, compost recycling, and reduced chemical inputs, which support soil fertility, food production, circular resource use, and social benefits in urban areas (Wezel et al., 2020; FAO, 2018).
7. **Soil engineering and soil construction approaches**, involving the creation, reconstruction, or amendment of soils using designed soil mixtures, recycled materials, and engineered substrates to restore soil functions in degraded urban environments (Morel et al., 2015; CREA, 2017).

Together, these solutions contribute to restoring soil multifunctionality, improving ecosystem services, and supporting sustainable and climate-resilient urban development (European Commission, 2021).

Monitoring and Decision-Support Solutions

These solutions support the assessment, monitoring, and management of urban soils through scientific, technological, and digital tools. Their primary purpose is to generate reliable information for decision-making, evaluate intervention performance, and improve understanding of soil health dynamics across LL sites.

Examples include:

- Soil health indicator monitoring systems;
- In-situ sensors and field measurement technologies;
- Remote sensing and Copernicus-based analyses;
- Story maps and spatial visualisation tools;
- Web applications and data management platforms;
- Predictive models and AI-assisted assessment tools;
- Decision-support systems for urban soil management.

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These interventions aim to strengthen awareness, knowledge, and behavioural change related to urban soil health. By improving soil literacy and encouraging active participation, they contribute indirectly to long-term soil restoration and sustainable land stewardship.

Examples include:

- Stakeholder workshops and co-creation sessions;
- Citizen science activities;
- Educational programmes and training courses;
- Public outreach and awareness campaigns;
- Community gardening and urban farming initiatives;
- Participatory monitoring activities;
- Demonstration sites and living exhibitions.

Although presented as separate categories, many URSOILL interventions combine multiple functions. For example, urban farming initiatives may simultaneously improve soil quality, enhance biodiversity, promote stakeholder engagement, and increase soil literacy. Likewise, monitoring activities may support both scientific evaluation and citizen participation. This integrated approach reflects the LL philosophy, where technical innovation, social learning, and collaborative governance are closely interconnected.

The categorisation of solutions provides a useful framework for understanding the diversity of interventions implemented across the five LLs and facilitates the identification of synergies, complementarities, and opportunities for replication. Depending on local priorities, stakeholder interests, and site-specific conditions, each LL may implement one or several solutions within each category.

This typology also supports the methodological framework applied throughout WP2, informing the processes of site selection, implementation design, monitoring, evaluation, and the future scaling and replication of successful urban soil restoration solutions.

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4.3. Experimental Site Selection and Characterisation

The implementation of URSOILL interventions is founded on a careful selection of experimental sites within each LL. These sites provide real-world environments where innovative solutions for urban soil restoration, monitoring, and stakeholder engagement can be tested, evaluated, and refined. The site selection and characterisation process was designed to ensure that interventions address locally relevant soil health challenges while reflecting the environmental, social, and operational contexts of each LL.

The selection of experimental sites built upon stakeholder engagement, local ecosystem analyses, site profiling activities, and scientific and technical expertise developed through WP1. Through the co-creation activities conducted within the Living Labs, local stakeholders contributed to identifying priority soil health challenges, opportunities and intervention needs.

These insights were combined with site-specific assessments undertaken by LL partners to support the identification of suitable locations for implementing and monitoring the proposed interventions.

4.3.1. Identification of Potential Experimental Sites

The identification of potential sites was carried out through an iterative process that combined stakeholder engagement, local ecosystem analysis, and technical assessments.

Key activities included:

- Stakeholder consultations and co-creation workshops conducted under WP1, where local actors identified priority urban soil challenges and suggested potential intervention areas.
- Assessment of local environmental conditions, land-use characteristics, past and future land-use plans, ownership structures, and accessibility considerations.
- Site visits and preliminary field assessments conducted by LL teams to evaluate technical feasibility and implementation requirements.
- Alignment of potential sites with the objectives and priorities jointly established by stakeholders and LL partners.

This process resulted in a portfolio of candidate sites within each LL. The final selection reflected both local stakeholder priorities and the practical requirements for implementing, monitoring, and validating URSOILL interventions over the course of the project.

4.3.2. Criteria for Experimental Site Selection

To ensure consistency across the LLs while allowing flexibility for local conditions, a common set of selection criteria was applied.

Selected sites were evaluated according to:

- **Relevance to identified urban soil challenges**, including issues such as contamination, sealing, compaction, poor fertility, biodiversity decline, or limited ecosystem service delivery.
- **Environmental suitability**, including site characteristics, soil conditions, land-use history, hydrological context, and surrounding ecological features.
- **Technical feasibility**, considering the practicality of implementing, maintaining, and monitoring proposed interventions throughout the project period.
- **Stakeholder commitment and accessibility**, ensuring adequate engagement from landowners, municipalities, site managers, and local communities where relevant.
- **Demonstration and replication potential**, enabling successful interventions to serve as examples for future implementation in similar urban contexts.
- **Monitoring compatibility**, ensuring that sites could support soil health assessments, environmental measurements, and data collection activities required under WP3.

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The application of these criteria ensured that selected sites represent meaningful opportunities for testing innovative urban soil restoration solutions under realistic conditions.

4.3.3. Site Assessment, Documentation and Validation

Following site selection, each LL conducted a detailed assessment and documentation process to establish the foundation for future implementation and monitoring activities.

This process included:

- Field verification visits to confirm site suitability and implementation requirements.
- Collection of baseline information on environmental and site characteristics.
- Documentation of existing land use, management practices, and identified soil health challenges.
- Recording of geographic information and site boundaries where applicable.
- Initial assessment of opportunities, constraints, and potential risks associated with intervention implementation.

The resulting site profiles provide a comprehensive overview of the selected experimental locations and support the development of tailored implementation designs. Together, these assessments ensure that interventions are adapted to local conditions while maintaining consistency with the broader objectives of the URSOILL LL network.

The experimental sites presented in this deliverable represent the first implementation phase of the project and provide the basis for subsequent refinement of interventions, monitoring activities, and validation processes in future WP2 deliverables.

4.4. Implementation and Experimental Design Framework

The testing, evaluation, and refinement of innovative solutions for urban soil restoration within the LLs will be followed by baseline soil assessment results. Building upon the co-creation activities conducted under WP1 and the site selection process described in Section 2.3, each Living Lab developed tailored implementation designs for its selected experimental sites. The implementation approach combines three complementary components:

- **Soil restoration and management interventions**, aimed at directly improving soil health and ecosystem services;
- **Monitoring and assessment activities**, designed to evaluate site conditions and measure intervention performance over time;
- **Stakeholder engagement and soil literacy actions**, supporting awareness, participation, and long-term adoption of sustainable soil management practices.

Although these components are presented separately, they are closely interconnected within the LL framework and contribute collectively to urban soil restoration and knowledge generation.

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4.4.1. Design of Site-Specific Interventions

The intervention design process was carried out through collaboration between Living Lab partners, technical experts, and stakeholders. Building on the priorities identified during the co-creation process, each LL developed interventions that respond to local soil challenges while considering technical feasibility, resource availability, and expected environmental benefits.

The implementation designs generally follow a set of common principles:

- Alignment with the soil health challenges identified through stakeholder engagement activities;
- Adaptation to local environmental, social, and operational conditions;
- Consideration of scalability and long-term applicability beyond the project duration;
- Integration of scientific monitoring and evaluation requirements;
- Flexibility to accommodate site-specific opportunities and constraints.

Depending on local priorities, interventions may include measures such as soil remediation techniques, amendments to improve soil quality, de-sealing activities, biodiversity enhancement measures, urban greening actions, innovative soil substrates, permeable materials, urban agriculture practices, or other nature-based solutions.

Where appropriate, intervention performance will be evaluated through comparisons between baseline and post-implementation conditions, supported by continuous monitoring and stakeholder feedback.

4.4.2. Harmonised Experimental Design Approach

The experimental design aims to assess the effects of soil management interventions by comparing control and treatment areas over a three-year period while ensuring that soil samples are collected from different locations at each sampling campaign to maintain spatial independence Figure 1. The experimental design includes a control area and a treatment area. The control area will remain under existing conditions without any restoration measures, whereas the treatment area will be subjected to the selected intervention(s). Monitoring of both areas will allow the evaluation of the effectiveness of the implemented solution(s). The experimentation ladder (reported in detail in D1.2) consists of four stages: Co-identify, where local needs and challenges are assessed; Co-design, where solutions are collaboratively developed; Co-implement, where solutions are tested and refined in real-world settings; and Co-evaluate, where outcomes are assessed to support learning, replication, and long-term adoption. Baseline sampling is conducted in Year 1, followed by mid-term and final sampling campaigns in Years 2 and 3. Throughout the study, sampling depth, timing, and analytical methods remain unchanged to ensure comparability across years.

A key feature of the design is its adaptive structure. While Treatment 1 is established at the start of the experiment, sufficient area should be reserved for a potential Treatment 2, which may represent either a modified treatment level or a completely new intervention introduced after

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evaluating initial results, and an illustrative example is given in Figure 1. This approach allows Living Labs to refine their experiments based on emerging evidence while retaining a consistent control for comparison.

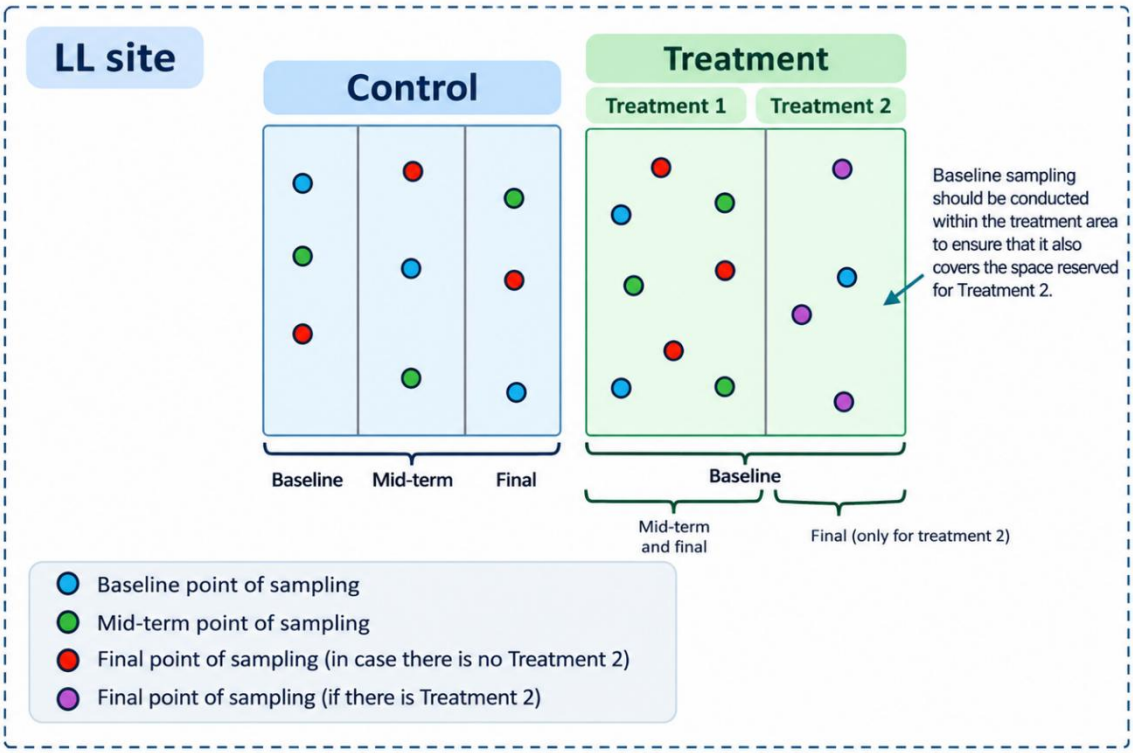

Figure 1: Schematic illustration of an adaptive experimental design in Living Labs.

Figure 1 shows an initial treatment is complemented by a potential second treatment introduced later in response to early findings, while retaining a common control treatment for comparison.

To avoid resampling the same points, a grid-based or GPS-based sampling system is recommended. Baseline, mid-term, and final samples should be taken from separate sampling points within the designated control and treatment areas. Baseline sampling in the treatment area should include the space reserved for any future Treatment 2.

The design also accounts for site heterogeneity. Control and treatment areas should be located in relatively homogeneous sections of the site whenever possible (Figure 2). If experimental areas must cover substantial variation in soil properties, texture, or colour, additional sampling points should be included to adequately capture this variability. Sampling numbers should be increased in case of field heterogeneity. Details of the sampling protocol for the LL sites have been documented in D3.1[4].

[4] https://ursoill.eu/wp-content/uploads/2026/07/D3.1-Catalogue-of-soil-health-indicatorswatermark.pdf

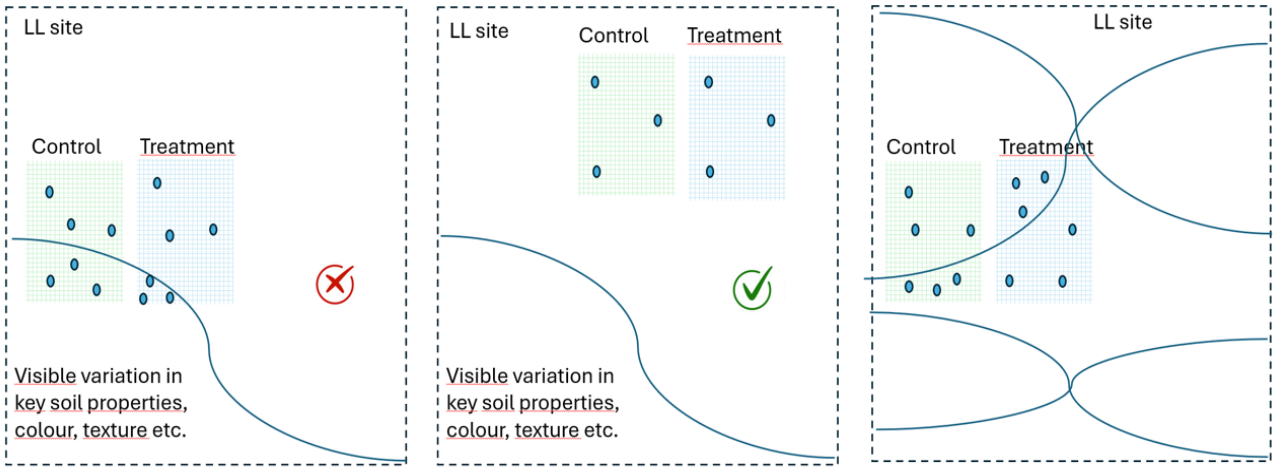

Figure 2: Examples of recommended and non-recommended placement of control and treatment plots within a Living Lab site.

Control and treatment areas should be located in relatively homogeneous sections of the field to minimize variation in key soil properties (e.g., texture and colour). If plots span heterogeneous areas, additional soil samples should be collected according to the original sampling protocol to adequately represent field variability. In highly heterogeneous fields, plot placement should prioritize areas with the least variation while maintaining sufficient sampling intensity.

For de-sealing sites, where a traditional control area may not be available after intervention, baseline measurements from the de-sealed site serve as the pre-treatment reference. Where feasible, a nearby sealed site can be used as an additional reference for comparison during later sampling campaigns. The basic strategy of the sampling locations for control and treatment is illustrated in Figure 3.

Key Principles

- Three-year monitoring framework (baseline, mid-term, final).
- Comparison between control and treatment conditions.
- No overlap of sampling points between years.
- Consistent sampling protocol throughout the study.
- Flexibility to introduce or modify treatments based on earlier results.
- Consideration of field heterogeneity when locating plots and determining sample numbers.
- Special adaptation for de-sealing sites lacking a permanent control area.

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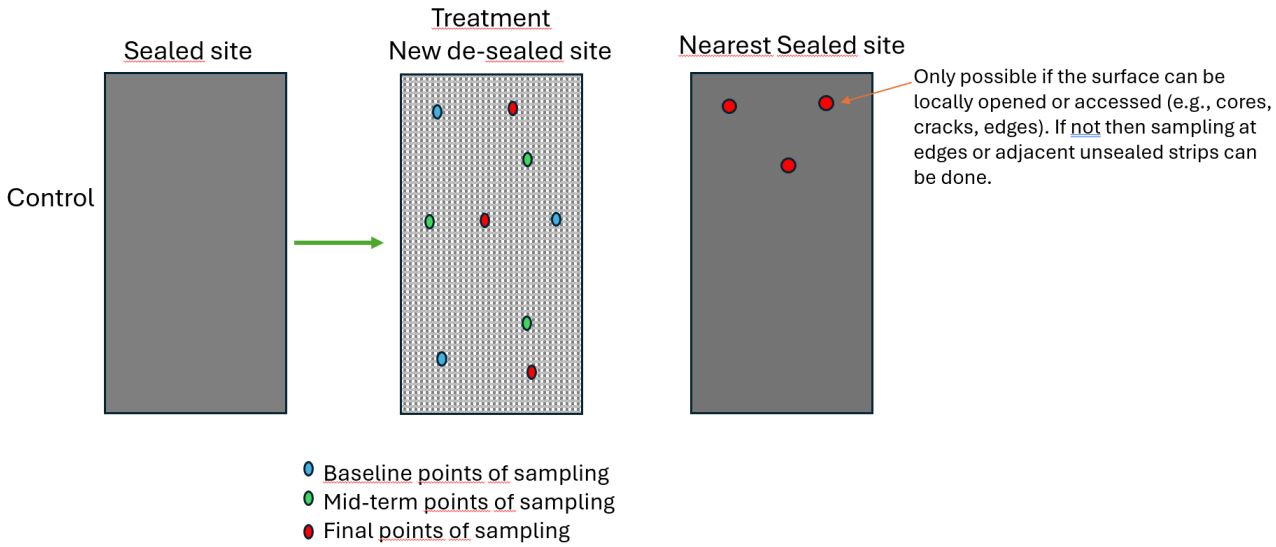

Figure 3: Alternative sampling design for de-sealed sites where a dedicated control area cannot be retained.

In such cases, baseline sampling points within the newly de-sealed site serve as both the control and treatment reference. Changes over time in the treatment area (new permeable surface) are assessed relative to baseline conditions and may be compared with a nearby reference site that has not yet undergone de-sealing during the final sampling campaign. The inclusion of a reference site is optional but recommended to support interpretation of treatment effects.

4.4.3. Monitoring and Data Collection Strategy

Monitoring activities are integrated into all experimental sites to ensure consistent assessment of soil health conditions and intervention outcomes throughout the project.

The monitoring framework follows the methodologies established under WP3 and includes:

- Collection of baseline site information and soil health data;
- Monitoring of selected environmental, physical, chemical, and biological indicators;
- Use of field measurements, laboratory analyses, sensors, and digital monitoring tools where relevant;
- Documentation of implementation activities and site management practices;
- Collection of stakeholder observations and feedback related to intervention performance.

In addition to the common monitoring framework, LLs may include site-specific indicators and measurements that reflect the unique objectives of individual interventions.

All data generated through implementation and monitoring activities will be managed according to project data management procedures and harmonised protocols to ensure consistency, quality, interoperability, and future reuse.

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4.5. Risk Assessment and Mitigation Measures

The implementation of innovative solutions and experimental activities across diverse urban LL environments involves a range of technical, environmental, operational, and stakeholder-related risks. As part of the site implementation design process, each LL conducted an assessment of potential risks that could affect the successful deployment, monitoring, and long-term performance of the proposed interventions.

The objective of this process is to anticipate potential challenges at an early stage and establish appropriate mitigation measures that support resilient, effective, and adaptive implementation throughout the project lifecycle.

Potential risks identified across the LLs generally fall into the following categories:

- **Environmental and climatic risks**, including extreme weather events, flooding, drought, heat stress, or other environmental conditions that may affect site performance or intervention effectiveness.
- **Site-specific constraints**, such as limited accessibility, land-use restrictions, utility conflicts, unexpected soil conditions, or physical barriers to implementation.
- **Stakeholder and governance risks**, including changes in ownership, reduced stakeholder participation, shifting priorities among local actors, or institutional barriers.
- **Operational and logistical risks**, including delays in procurement, installation challenges, resource limitations, or technical equipment failures.
- **Monitoring and data-related risks**, including inconsistencies in data collection, equipment malfunction, sensor failures, or incomplete documentation.
- **Communication and engagement risks**, such as low participation in Living Lab activities, reduced stakeholder commitment, or limited public awareness and involvement.
- **Regulatory and administrative risks**, including permitting delays, compliance requirements, or unforeseen legal and administrative constraints.

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To address these potential challenges, each LL identified preventive and corrective measures tailored to local conditions. Examples of mitigation measures include:

- Identification of alternative implementation locations or backup sites where feasible.
- Development of contingency plans for unexpected environmental events.
- Establishment of clear agreements and regular communication with site owners and stakeholders.
- Application of harmonised monitoring protocols and quality assurance procedures.
- Use of complementary monitoring methods to minimise data gaps and support data validation.
- Early coordination with local authorities and relevant organisations to address administrative or regulatory requirements.
- Continuous stakeholder engagement to maintain participation, ownership, and local support throughout implementation.

Risk management will remain an ongoing process within URSOILL. As interventions progress, identified risks and mitigation measures will be regularly reviewed and updated through LL activities, monitoring exercises, and stakeholder feedback. This adaptive approach strengthens the resilience of implementation activities while supporting transparent decision-making, continuous learning, and effective collaboration among project partners and stakeholders. The development and implementation of mitigation measures will follow the stakeholder mapping and ecosystem analysis framework described in D1.1, which includes the identification of key governance actors, site managers, engagement strategies, potential conflicts, and long-term stewardship mechanisms to support sustainable soil restoration.

4.6. Adaptive Implementation and Continuous Improvement

The implementation designs presented in this deliverable represent the initial phase of intervention planning within the URSOILL LLs. As LL activities advance, interventions and implementation strategies will be continuously refined through an iterative process that combines stakeholder feedback, monitoring results, technical assessments, and practical implementation experience.

The LL approach adopted by URSOILL is inherently adaptive. Rather than following a fixed implementation pathway, solutions are expected to evolve as new knowledge emerges and local conditions change. This enables interventions to remain relevant, scientifically robust, and responsive to stakeholder needs throughout the project.

The continuous improvement process will be informed by:

- Results from environmental and soil health monitoring activities;
- Feedback from stakeholders participating in LL activities and co-creation sessions;
- Technical evaluations of intervention performance;
- Lessons learned from implementation and operational experiences;
- Emerging opportunities for optimisation, replication, or scaling.

Where necessary, LLs may refine implementation methods, monitoring approaches, site management practices, stakeholder engagement strategies, or technical specifications to improve effectiveness and feasibility. Any modifications will be carefully documented to ensure transparency and maintain comparability across the LL network.

This iterative learning process is a fundamental component of the URSOILL methodology. It supports the co-development of solutions that are not only effective in addressing local urban soil challenges but are also transferable, scalable, and applicable to a wider range of urban contexts across Europe. Future iterations of the Site Implementation Design deliverables will document these refinements and provide updated information on implementation progress, lessons learned, and the evolving performance of the LL interventions.

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5. Details of LL Experimental Sites context, and Intervention Design, and stakeholder alignment

The selected experimental sites are all located within urban and peri-urban environments, while representing a diverse range of land-use types and historical management contexts, including parks, schoolyards, community gardens, transport infrastructure, industrial brownfields, urban forests and recreational areas. Despite their differing land-use histories and site-specific characteristics, all sites address soil-health challenges commonly encountered in urban landscapes, including soil contamination, soil sealing, soil compaction, loss of soil fertility, biodiversity decline, erosion, impaired water regulation and limited soil literacy.

The information presented in the following sections was collected through a structured questionnaire distributed to all participating Living Labs within URSOILL. The questionnaire captured information on site characteristics, land-use history, identified soil-health challenges, stakeholder priorities, proposed interventions, implementation considerations and expected outcomes. Responses were provided and validated by the respective Living Lab teams, ensuring that the experimental designs reflect local conditions, priorities and objectives. The following sections present the experimental design and stakeholder alignment for each Living Lab site.

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5.1. Urban Living Lab Sweden (Swe ULL)

The Swedish Urban Living Lab (Swe ULL) is located within the **Mälardalen region** and includes experimental sites in Solna, Stockholm, Järfälla and Uppsala. Situated across a range of urban and peri-urban settings, the sites include urban parks, schoolyards, former brownfields, urban agriculture sites, roadside green infrastructure and historically contaminated pre-industrial environments. The Swe ULL addresses major urban soil challenges including PFAS contamination, heavy metals, PAHs, pesticides, soil compaction, soil sealing and declining performance of constructed urban soils.

The Living Lab evaluates a portfolio of restoration and management interventions including phytoremediation, fungal-assisted remediation, biochar amendments, soil de-sealing, urban forestry techniques and engineered soil systems. These interventions will be implemented and assessed through collaboration among municipalities, universities, citizens and private-sector actors to improve soil functions, enhance ecosystem services and generate transferable knowledge for restoring urban soil functions and improving ecosystem services.

The Swedish ULL contributes primarily to:

- Soil restoration and remediation.
- Reduction of PFAS and legacy contamination risks.
- Prevention and reversal of soil sealing and compaction.
- Enhancement of biodiversity and urban ecosystem services.

- Climate adaptation through improved infiltration and stormwater management.
- Sustainable urban food production.
- Soil literacy and citizen engagement.

5.1.1. Site Portfolio Summary

The Swedish ULL includes 11 experimental sites grouped into four thematic categories.

Soil Contamination and Remediation

- Polska Udden
- Tivoliudden/Pipers Park
- Byleden
- Fyrislund Fire Station
- Ekebydalen
- Ultuna Täppförening

Soil Sealing and Compaction

- Tullgårdsskolan
- Eriksdalsskolan
- Flogstavallen

Urban Forestry and Green Infrastructure

- Ulls Väg

Constructed and Engineered Soils

- Kunskapsparken

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5.1.2. Historical context

The Swedish ULL sites have experienced diverse historical land uses including industrial production, firefighting operations, horticultural activities, urban agriculture, education facilities and public green spaces.

Major historical drivers of soil degradation include:

- Industrial contamination by PAHs, hydrocarbons and heavy metals.
- PFAS contamination from firefighting training activities.
- Long-term pesticide use in nurseries and horticultural areas.
- Construction activities resulting in soil compaction.
- Urban expansion causing soil sealing.
- Excavation and replacement of contaminated soils.
- Declining quality of engineered urban soils.

Several sites have undergone previous restoration or remediation activities, though comprehensive long-term monitoring data remain limited.

5.1.3. Future Perspectives

The Swedish ULL sites are intended to demonstrate long-term solutions for sustainable urban soil management.

Future ambitions include:

- Restoration of contaminated urban soils.
- Improved management of PFAS-contaminated land.
- Climate-resilient schoolyards and parks.
- Enhanced urban biodiversity and ecosystem services.
- Safe urban agriculture and food production.
- Improved urban tree establishment and green infrastructure.
- Development of sustainable engineered soil systems.
- Prevention of future soil sealing and degradation.

Several sites, such as Byleden, are planned for future residential development following remediation, while others will continue serving as demonstration sites for urban soil restoration and climate adaptation.

5.1.4. Site-specific intervention, Stakeholder Engagement and Strategic Alignment

In Swe ULL, site owners and managers provide access to and stewardship of the experimental sites, while research organisations and SMEs contribute scientific expertise, monitoring methods, and innovative remediation solutions. Municipalities, schools, urban gardeners, and local communities are actively engaged through Living Lab activities, ensuring that the proposed interventions address local needs and support long-term adoption of sustainable urban soil management practices.

The following tables summarise the site-specific challenges, planned intervention, governance structure and key stakeholder groups involved in the Swe ULL.

Table 1 – Swe ULL: Site-specific challenges, main planned intervention and expected outcome

Site	Main Challenge	Main Intervention planned	Expected Outcome
Polska Udden	PFAS, PAHs, hydrocarbons	Phytoremediation and fungal remediation	Reduced contaminant mobility
Tivoliudden/Pipers Park	DDT, pesticides, heavy metals	Nature-based remediation	Improved soil quality

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Byleden	Heavy metals, pesticides, dioxins	Biochar and phytomanagement	Safe future residential development
Tullgårdsskolan	Soil compaction and sealing	De-sealing and biochar	Improved infiltration
Eriksdalsskolan	Soil sealing	Alternative permeable surfaces	Better stormwater management
Fyrislund Fire Station	PFOS contamination	Biochar and carbon-rich amendments	Reduced PFAS mobility
Ekebydalen	PFAS, heavy metals, microplastics	Soil restoration and phytoremediation	Enhanced biodiversity
Ultuna Täppförening	Food-safety risks from contaminants	Crop monitoring and remediation	Safe urban food production
Ulls Väg	Compacted soils affecting trees	Reforestation and substrate testing	Improved tree establishment
Flogstavallen	Soil compaction	Decompaction and biochar	Enhanced ecosystem functions
Kunskapsparken	Declining engineered soils	Manufactured soil systems	Long-term soil sustainability

Table 2 – Key Stakeholders within Swe ULL

Stakeholder Group	Main Organisations
Research and Academia	RISE, SLU, Linnaeus University
Municipalities	Solna, Stockholm, Uppsala, Järfälla
Government Authorities	Swedish EPA (SEPA)
Property Owners	SISAB, Akademiska Hus
SMEs and Industry Partners	ETPC, MYMI, ALSCAN, MycoMine
Emergency Services	Uppsala Brandförsvar
Civil Society	Ultuna Täppförening, citizens, school communities
Living Lab Coordination	RISE

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5.2. Urban Living Lab Spain (ES ULL)

The Spanish Urban Living Lab (ULL) is located in the **Basque Country**, encompassing experimental sites in the municipalities of **Vitoria-Gasteiz**, **Gernika-Lumo**, and **Forua**, including locations within the **Urdaibai Biosphere Reserve**. The Living Lab addresses urban soil challenges related to contamination of brownfields and former landfills, soil sealing, compaction, loss of biodiversity, degraded nutrient cycling, lack of soil fertility, limited soil literacy, and underutilized urban land.

The Spanish ULL combines brownfield regeneration, phytoremediation, ecological restoration, de-sealing, agroecological production, urban greening, soil monitoring, and soil literacy actions. Experimental sites range from former landfills and contaminated industrial areas to naturalized schoolyards, urban green corridors, community spaces, and cultural facilities. Through these interventions, the Living Lab aims to demonstrate innovative approaches for improving soil health, ecosystem services, biodiversity, and community engagement in urban environments.

The Spanish ULL contributes primarily to:

- Urban soil restoration and regeneration.
- Remediation of contaminated soils and brownfields.
- Reduction of soil sealing and enhancement of soil permeability.
- Improvement of soil biodiversity and ecological functions.
- Climate adaptation and water regulation.
- Promotion of agroecological land use and urban agriculture.
- Soil literacy, citizen science, and stakeholder engagement.
- Reuse and transformation of degraded and underutilized urban land.

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5.2.1. Site Portfolio Summary

The Spanish ULL includes 10 experimental sites grouped into four thematic categories.

Brownfield Restoration and Soil Remediation

- ARKATXA
- LERMANDA
- Abadetxea

Schoolyards, Soil Literacy and Community Engagement

- Judizmendi Schoolyard
- Arriagako Haritza Schoolyard
- San Fidel I Urban Soil Literacy Garden
- San Fidel II Educational Greenhouse & Terraces

Urban Green Infrastructure and De-sealing

- Margarita
- Renteria I Green Corridor & Railway Interface
- Renteria II Riverbank Restoration & Community Park

Cultural Heritage and Participatory Urban Regeneration

- Kulturetxea Forua

5.2.2. Historical context

The Spanish ULL sites represent a diverse range of urban land-use histories, including former waste disposal sites, landfills, brownfields, industrial land, educational facilities, transport corridors, community spaces, and urban green areas. Several sites have undergone substantial transformations from degraded or sealed land into multifunctional urban green infrastructure.

Major historical drivers of soil degradation include:

- Industrial contamination and waste disposal.
- Landfilling activities.
- Soil sealing and artificialisation.
- Excavation and construction activities.
- Traffic-related disturbances and compaction.
- Loss of soil structure and topsoil.
- Reduced biodiversity and ecological functionality.
- Limited public awareness regarding urban soil health.

Particularly notable are the former landfill sites at **ARKATXA** and **LERMANDA**, where restoration efforts focus on recovering ecological functions and biodiversity. Several schoolyard sites, including **Judizmendi**, **Arriagako Haritza**, and **San Fidel**, were previously paved educational spaces that have been transformed through de-sealing and greening initiatives.

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5.2.3. Future perspectives

The Spanish ULL seeks to transform degraded, sealed, and underutilized urban areas into healthy, multifunctional, climate-resilient landscapes that support biodiversity, ecosystem services, and community well-being.

Future ambitions include:

- Restoration of contaminated and degraded urban soils.
- Increased biodiversity and habitat connectivity.
- Improved soil structure and nutrient cycling.
- Enhanced water infiltration and flood resilience.
- Reduction of soil sealing and compaction.
- Development of urban agriculture and agroecological systems.
- Expansion of citizen science and soil literacy programs.

- Integration of soil health into urban planning and green infrastructure strategies.
- Creation of demonstration sites supporting replication across the Basque Country.
- Strengthening community stewardship and participatory governance.

Several sites are expected to become long-term demonstration areas supporting sustainable urban development beyond the duration of the URSOILL project.

5.2.4. Site-specific intervention, Stakeholder Engagement and Strategic Alignment

The following tables summarise the site-specific challenges, planned intervention, governance structure and key stakeholder groups involved in the ES ULL.

Table 3 - ES ULL: Site-specific challenges, main planned intervention and expected outcome.

Site	Main Challenge	Main Intervention planned	Expected Outcome
ARKATXA	Heavy metal and organic contamination	Soil amendments and bioremediation	Improved soil health and biodiversity
LERMANDA	Degraded nutrient cycling and brownfield conditions	Agroforestry orchard establishment	Restored ecological functions and biodiversity
Judizmendi	Soil compaction and previous sealing	Decompaction and participatory monitoring	Improved soil structure and soil literacy
Arriagako Haritza	Soil compaction and low fertility	Decompaction and citizen science monitoring	Enhanced soil function and awareness
Margarita	Artificialised shallow soils and low fertility	Nature-based soil restoration and vegetation establishment	Improved soil functions and climate regulation
San Fidel I	Soil sealing and lack of soil literacy	De-sealing, raised beds, technosoils and sensors	Enhanced soil permeability and education
San Fidel II	Soil literacy and limited soil functionality	Composting, technosoil testing and training	Improved education and soil awareness
Renteria I	Soil sealing, drainage issues and contamination risks	Green corridor establishment and de-sealing	Improved connectivity and climate resilience
Abadetxea	Heavy metal contamination	Phytoremediation	Soil decontamination and restoration

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Renteria II	Drainage limitations and low vegetation cover	Technosoils and compost applications	Improved infiltration and biodiversity
Kulturetxea Forua	Soil literacy and community engagement	Participatory redevelopment and awareness actions	Increased citizen involvement and stewardship

Table 4 – Key Stakeholders within ES ULL

Stakeholder Group	Main Organisations
Research Organisations	University of the Basque Country (UPV/EHU), University of Deusto, Mondragon Unibertsitatea, Neiker-Tecnalia, BC3, Tecnalia, CIC EnergiGUNE, Ikerbasque
Regional and Municipal Authorities	Basque Government Environment Department, Diputación Foral de Bizkaia, Ayuntamiento de Vitoria-Gasteiz, Ayuntamiento de Gernika-Lumo, Ayuntamiento de Forua, Bilbao Municipality
Environmental Agencies	IHOBE, URA (Basque Water Agency), Consorcio de Aguas Bilbao Bizkaia, European Environment Agency
Protected Area and Land Management Bodies	Urdaibai Biosphere Reserve Management Council (Patronato), Forest Service, Green Belt Service, Rural Land Services
NGOs and Civil Society Organisations	Ekologistak Martxan, Greenpeace Spain, Hazien Sarea, WWF España, Fundación Cristina Enea
Education and Schools	San Fidel School, IES Barrutialde, CEIP Judimendi, Escuela Infantil Zaramaga, Escuela Infantil Gurutzmendi, CEIP Odon de Apraiz
SMEs and Environmental Technology Actors	Ekotek, SoilCares, Libelium, Biolan Microbiosensores, DINAM, Gaiker
Industry and Infrastructure Actors	Ingeteam, Técnicas Reunidas, Sener, Ormazabal, Urbaser, Acciona Agua, Saitec, MAIER, EDINOR
Social Innovation and Community Engagement Actors	ESKILARA, Euskampus Foundation, Gernika TEK Energy Cooperative, Gernika Gogoratuz, Basque District of Culture and Creativity
Cultural and Community Organisations	Gernika Culture House, Kulturetxea Forua, Basque Coast Geopark
Citizen and Community Groups	School communities, village councils (Concejo Mendiola and Concejo Lermanda), local volunteers, community gardeners, citizen science participants, energy communities

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5.3. Urban Living Lab Greece (GR ULL)

The Greek Urban Living Lab (ULL) is located in **Western Macedonia**, primarily within the municipalities of **Kozani, Ptolemaida and Ano Komi**. The region is undergoing a major socio-economic and environmental transition due to the phase-out of lignite-based energy production. The Greek ULL addresses urban soil challenges associated with soil degradation, soil sealing, contamination, compaction, erosion, declining fertility, loss of biodiversity, and limited soil literacy.

The Living Lab combines soil restoration measures, ecological restoration, organic matter management, erosion control, decompaction, urban greening, phytostabilisation and soil literacy actions. Experimental sites are distributed across parks, public spaces, school grounds, infrastructure corridors and former industrial landscapes to demonstrate practical solutions for improving urban soil health and ecosystem services.

The Greek ULL contributes primarily to:

- Urban soil restoration and regeneration.
- Improvement of soil fertility and biodiversity.
- Reduction of soil sealing and compaction.
- Climate adaptation and water regulation.
- Urban greening and ecosystem restoration.
- Soil literacy and citizen engagement.
- Sustainable management of post-industrial urban landscapes.

5.3.1. Site Portfolio Summary

The Greek ULL includes 14 experimental sites grouped into four thematic categories.

Soil Restoration and Fertility Improvement

- Mikis Theodorakis Park
- Green Space near Residential Complex
- Veterinary Office of Kozani
- Park Close to Cemetery of Ptolemaida
- Cultural Centre Green Area

Soil Compaction, Sealing and Urban Regeneration

- Kozani Public Garden
- Green Space Used for Parking
- Prefectorial Administration of Kozani
- Green Park in the Flea Market Area

Erosion Control and Ecosystem Restoration

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- Old Railway Station
- Motocross Racing Track
- Green Hiking Corridor

Soil Literacy and Community Engagement

- Emergencies Park

Unified Special Vocational School of Ano Komi

5.3.2. Historical context

The Greek ULL sites represent a variety of urban land-use histories including parks, public spaces, transport infrastructure, recreational facilities and educational sites. Many locations have experienced disturbances associated with urban development, utility works, excavation, construction activities and infrastructure development.

Major historical drivers of soil degradation include:

- Soil sealing and surface impermeabilisation.
- Construction-related compaction.
- Loss of topsoil during redevelopment.
- Hydrocarbon contamination from transport and industrial activities.
- Heavy metal accumulation.
- Flooding and erosion.
- Limited organic matter inputs.
- Declining biodiversity in urban landscapes.

Across the region, the transition from lignite-based industries is creating opportunities for ecological restoration and more sustainable urban land management.

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5.3.3. Future perspectives

The Greek ULL supports the transformation of urban and peri-urban areas into healthier, climate-resilient and multifunctional landscapes.

Future ambitions include:

- Increased biodiversity and ecological connectivity.
- Improved soil fertility and nutrient cycling.
- Restoration of degraded urban soils.
- Enhanced climate resilience and flood mitigation.
- Reduced soil compaction and sealing.
- Increased urban greening.
- Strengthened community stewardship.
- Integration of soil health into urban planning.
- Development of educational hubs for soil literacy.

Several sites are intended to become long-term demonstration areas supporting sustainable urban development and citizen engagement beyond the duration of the URSOILL project.

5.3.4. Site-specific intervention, Stakeholder Engagement and Strategic Alignment

The following tables summarise the site-specific challenges, planned intervention, governance structure and key stakeholder groups involved in the GR ULL.

Table 5 - GR ULL: Site-specific challenges, main planned intervention and expected outcome

Site	Main Challenge	Main Intervention planned	Expected Outcome
Kozani Public Garden	Heavy metal accumulation, sealing	Baseline soil assessment	Improved understanding of contamination risks
Mikis Theodorakis Park	Low organic carbon	Compost and aeration	Increased biodiversity and soil fertility
Green Space Used for Parking	Soil degradation and loss of topsoil	Native wildflower and grass establishment	Soil restoration
Green Space near Residential Complex	Poor fertility and soil imbalance	Compost and pH correction	Improved soil quality
Prefectorial Administration	Soil compaction	Deep decompaction	Improved rooting and infiltration
Veterinary Office	Poor soil fertility	Native flowering vegetation	Increased biodiversity
Old Railway Station	Potential contamination	Soil monitoring	Restoration planning
Flea Market Green Park	Salinisation and contamination	Soil improvement measures	Enhanced water regulation
Motocross Racing Track	Soil erosion and compaction	Native grasses and stabilization	Reduced erosion
Hiking Corridor	Erosion and hydrocarbon risks	Phytostabilisation	Improved soil stability
Cemetery Park	Poor topsoil quality	Compost, manure and biochar	Improved soil function
Cultural Centre Green Area	Flood risk and compaction	Natural vegetative barriers	Climate adaptation
Emergencies Park	Limited soil literacy	Community garden and education	Citizen engagement
Ano Komi School	Waste management and soil literacy	Educational greenhouse and root bench	Improved soil awareness

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Table 6 – Key Stakeholders within GR ULL

Stakeholder Group	Main Organisations
Research Organisations	University of Western Macedonia (UOWM), Hellenic Mediterranean University (HMU), CERTH and collaborating research institutes
Municipal Authorities	Municipality of Kozani, Municipality of Eordaia (Ptolemaida), Regional Unit of Kozani
Regional and Public Authorities	Region of Western Macedonia, Prefectorial Administration of Kozani, local public services
Environmental Agencies	Regional environmental authorities and environmental monitoring services
Educational Institutions	Unified Special Vocational School of Ano Komi, local schools, educational centres in Kozani and Ptolemaida
Civil Society Organisations	Local community groups, environmental associations, citizen volunteers
SMEs and Innovation Actors	Local environmental consultancies, soil restoration companies, compost and green infrastructure providers
Citizen Associations	Neighbourhood associations, park users, community gardening groups, local volunteers
Land Managers and Site Operators	Municipal park departments, infrastructure and public-space management authorities
End Users	Residents of Kozani and Ptolemaida, students, visitors, recreational users and local businesses

5.4. Urban Living Lab Italy (IT ULL)

The Urban Living Lab Italy (IT ULL) operates across the metropolitan areas of **Turin (Piedmont)** and **Milan (Lombardy)**, two highly urbanized regions facing significant challenges related to soil sealing, contamination, biodiversity loss, and degradation of urban green spaces. The ULL addresses these challenges through a portfolio of experimental sites located in urban parks, community gardens, brownfields, parking areas, urban forests and redevelopment sites.

The IT ULL focuses on restoring soil health through soil remediation, urban greening, de-paving, reforestation, soil literacy, and sustainable urban agriculture. The LL combines scientific research, stakeholder engagement and practical demonstration activities to support the transition towards healthier, more climate-resilient urban environments.

The IT ULL contributes primarily to:

- Restoration of contaminated urban soils.
- Reduction of soil sealing and artificialisation.
- Regeneration of urban brownfields.
- Sustainable urban food production.

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- Enhancement of biodiversity and green infrastructure.
- Climate adaptation and carbon sequestration.
- Soil literacy and citizen engagement.

The IT ULL is located in two former industrial regions with long histories of urbanisation and industrial development.

Lombardy, particularly the Milan metropolitan area, is among the most urbanised regions in Europe and experiences extensive soil sealing, loss of agricultural land and increasing flood risk due to reduced infiltration capacity.

Piedmont, particularly Turin, has a long tradition of urban agriculture but faces challenges related to soil contamination, especially in urban gardens and former industrial areas.

The Italian ULL seeks to address these challenges through innovative soil health interventions, combining urban planning, ecosystem restoration, urban agriculture and stakeholder participation.

The Living Lab brings together municipalities, universities, environmental agencies, NGOs, SMEs and citizen groups to co-design and implement site-specific soil restoration solutions.

5.4.1. Site Portfolio Summary

The IT ULL comprises 13 experimental sites grouped into three main thematic clusters.

Soil Contamination and Urban Agriculture

- Arrivore Urban Park
- Parco del Meisino Garden
- Ferraro-Sassari Garden
- Via Chambery Garden
- Cascina Maletta
- Sansovino
- Mirafiori

Soil De-Sealing and Urban Regeneration

- Parco Nord Milano De-paving Parking Lot
- Parking Lot Via Aldo Moro
- Former Stonemasonry Area Bruzzano
- Casiraghi High School Parking Lot

Reforestation and Climate Adaptation

- Parco Nord Reforestation Area
- Cambiago Urban Forest Area

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5.4.2. Historical context

Many IT ULL sites have undergone substantial land-use change during the last century.

In Turin, several sites transitioned from:

- Agricultural land.
- Industrial activities.
- Fertilizer manufacturing.
- Gravel extraction.
- Abandoned urban land.

to parks, allotment gardens and recreational areas.

In Milan, the sites are strongly influenced by:

- Industrialisation.
- Urban expansion.
- Conversion of agricultural land.
- Extensive road and parking infrastructure.
- Soil sealing and artificialisation.

Historical challenges identified across sites include:

- Heavy metal contamination.
- Hydrocarbon contamination.
- Soil compaction.
- Soil sealing.
- Loss of topsoil.
- Declining biodiversity.
- Reduced ecosystem connectivity.

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5.4.3. Future perspectives

The IT ULL sites are expected to become demonstration areas for sustainable urban soil management.

Future ambitions include:

- Restoration of ecological connectivity.
- Safe urban food production.
- Conversion of sealed surfaces into multifunctional green spaces.
- Development of urban climate refuges.
- Increased carbon sequestration.
- Improved water infiltration.
- Enhanced biodiversity.

- Long-term soil remediation.
- Increased public awareness of soil health.

Several Milan sites will demonstrate large-scale de-paving and reforestation solutions, while Turin sites will focus on remediation of contaminated urban garden soils and ecological restoration.

5.4.4. Site-specific intervention, Stakeholder Engagement and Strategic Alignment

The following tables summarise the site-specific challenges, planned intervention, governance structure and key stakeholder groups involved in the IT ULL.

Table 7– IT ULL: Site-specific challenges, main planned intervention and expected outcome

Site	Main Challenge	Main Intervention planned	Expected Outcome
Arrivore Urban Park	Soil contamination	Nature-based remediation	Ecological restoration and climate refuge
Parco del Meisino Garden	Heavy metals	Soil remediation	Safe urban agriculture
Ferraro-Sassari Garden	Diffuse contamination	Phytoremediation	Biodiversity enhancement
Via Chambery Garden	Heavy metals, hydrocarbons, asbestos	Biochar and phytoremediation	Public access and soil recovery
Cascina Maletta	Metal contamination	Soil restoration	Sustainable urban gardening
Sansovino	Metal contamination	Soil remediation	Improved food production
Mirafiori	Soil contamination and low awareness	Soil testing and literacy	Informed soil management
Parco Nord Milano Parking Lot	Soil sealing	De-paving	Improved infiltration and biodiversity
Parco Nord Reforestation Area	Low-quality technosols	Reforestation	Carbon sequestration
Via Aldo Moro Parking Lot	Soil sealing	De-paving	Restoration of soil functions
Bruzzano Area	Soil sealing	Green space creation	Ecological connectivity
Casiraghi School Parking Lot	Impermeable surfaces	Green infrastructure	Educational demonstration site
Cambiago Urban Forest	Soil sealing and low fertility	Reforestation and biochar	Climate resilience

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Table 8 – Key Stakeholders within IT ULL

Stakeholder Group	Main Organisations
Research Organisations	INNOVHUB, University of Milan (UMIL), Politecnico di Milano (POLIMI), University of Turin (UNITO)
Municipal Authorities	Turin Municipality, Milan Municipality, Cinisello Balsamo Municipality
Environmental Agencies	ARPA, ARPIE
Urban Park Authorities	Parco Nord Milano
Civil Society Organisations	PN, COL, SISEF, Orme Torinesi
SMEs and Innovation Actors	POLIE, MM, MIRES, SF, UTF
Citizen Associations	Community gardeners, urban agriculture networks
Schools and Educational Institutions	Casiraghi High School and local schools

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5.5. Urban Living Lab Luxembourg (Lux ULL)

The Luxembourg Urban Living Lab (Lux ULL) is situated within the **Minett Region in southern Luxembourg**, including the municipalities of Differdange, Bettembourg, Sanem, Schifflange, Esch-sur-Alzette and Bascharage. The region has a strong industrial heritage associated with iron mining and steel production and is part of the UNESCO Minett Biosphere Reserve. Many areas are currently undergoing major urban regeneration and transformation, creating opportunities to integrate soil health into urban planning and development.

The Lux ULL addresses a broad range of urban soil challenges, including contamination of former industrial lands, degradation of soil quality, soil sealing, poor infiltration capacity, declining biodiversity, and limitations for urban food production. The Living Lab combines soil construction, phytomanagement, ecological farming, de-sealing, reforestation, and circular soil management approaches to demonstrate innovative solutions for urban soil restoration and climate resilience.

The Living Lab contributes primarily to:

- Soil restoration and regeneration of industrial brownfields
- Reduction of soil sealing and improvement of infiltration
- Climate adaptation and flood mitigation
- Urban biodiversity enhancement
- Sustainable urban agriculture
- Circular soil management

- Citizen engagement and soil literacy

5.5.1. Site Portfolio Summary

The Luxembourg ULL includes 10 experimental sites distributed across four thematic intervention categories:

Brownfield Restoration and Soil Construction

- Bus Parking Bascharage
- Belval Sud
- Metzeschmelz

Soil De-Sealing and Water Regulation

- Parking Cimetière Niederkorn
- Parking Huncherange Cimetière
- SISA Industrial Site

Urban Agriculture and Community Gardening

- Wandel Bar
- Jardin Communautaire Jacquinot
- Community Garden Sanem

Biodiversity and Climate Adaptation

Tiny Urban Forest

5.5.2. Historical context

The Minett Region has undergone profound land-use change during the past century. Historical iron mining and steel production have shaped much of the landscape, leaving numerous industrial brownfields and altered soil systems. Several sites exhibit residual contamination from historical industrial activities, while others have experienced degradation through sealing, infrastructure development, or urban expansion.

Key historical drivers of soil degradation include:

- Steel production and heavy industry.
- Mining activities.
- Soil excavation during redevelopment.
- Urbanisation and infrastructure development.
- Conversion of agricultural land.
- Long-term soil sealing.
- Loss of natural soil horizons during construction.

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Many sites currently form part of large-scale urban regeneration projects where soil restoration is integrated into future development planning.

5.5.3. Future perspectives

The Lux ULL sites are intended to serve as long-term demonstrations of sustainable urban soil management.

Future ambitions include:

- Conversion of industrial brownfields into functional urban districts.
- Creation of climate-resilient green infrastructure.
- Restoration of soil biodiversity and ecological functionality.
- Improved stormwater management through increased infiltration.
- Development of fertile urban soils for food production.
- Demonstration of circular soil construction techniques.
- Prevention of future soil sealing.
- Increased citizen participation in soil stewardship.

Several sites, including Belval Sud and Metzeschmelz, are planned to become residential neighbourhoods supported by restored and engineered soils. Sites focused on de-sealing will demonstrate how urban infrastructure can maintain functionality while significantly improving soil ecosystem services.

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5.5.4. Site-specific intervention, Stakeholder Engagement and Strategic Alignment

The following tables summarise the site-specific challenges, planned intervention, governance structure and key stakeholder groups involved in the Lux ULL.

Table 9 – Lux ULL: Site-specific challenges, main planned intervention and expected outcome

Site	Main Challenge	Main Intervention planned	Expected Outcome
Bus Parking Bascharage	Possibly contaminared industrial soils	phytomanagement	Restored soil from contamination
Parking Cimetière Niederkorn	Soil sealing	Permeable paving	Improved infiltration Depollution
Wandel Bar	Arsenic and zinc contamination	Ecological farming and remediation	Safe food production Depollution
Tiny Urban Forest	Poor soil structure	Soil engineering and afforestation	Improved biodiversity Compaction

Jardin Communautaire Jacquinot	Low fertility soils	Constructed fertile soils	Increased food production Depollution Community engagement
Parking Huncherange	Impermeable surfaces	De-sealing	Improved infiltration Depollution
Community Garden Sanem	Soil literacy and monitoring	Participatory soil management	Depollution Community engagement
Belval Sud	Brownfield redevelopment	Soil engineering and phytomanagement	Urban ecosystem restoration Compaction
Metzeschmelz	Industrial contamination	Soil construction and remediation	Safe urban redevelopment Depollution
SISA Industrial Site	Future sealing risk	Circular soil management	Sustainable green infrastructure

Table 10 – Key Stakeholders within Lux ULL

Stakeholder Group	Main Organisations
Research and Innovation	LIST, UniLU
Environmental Authorities	Environmental Administration (AEV); Ministry of Housing and Spacial Planning
Municipalities	Differdange, Bettembourg, Sanem
Urban Development Organisations	AGORA
Private Sector	SISA, SL Immo, Luxcontrol
SMEs and Regeneration Actors	Green City, INTERALIA, Green World, ProSud
Civil Society Organisations	CELL, EBL
Education and Capacity Building	CNFPC
Local Communities	Community gardens, urban gardeners, residents

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6. Conclusion

This deliverable presents the first iteration of the Site Implementation Designs developed within the five URSOILL Urban Living Labs and establishes the operational framework for implementing urban soil restoration activities across Sweden, Spain, Greece, Italy, and Luxembourg. Building on the stakeholder engagement, ecosystem analyses, and co-creation processes conducted during the initial project phase, the Living Labs have translated locally identified soil challenges into concrete site-specific intervention plans and experimental designs.

The selected portfolio comprises a diverse range of urban and peri-urban sites, including parks, schoolyards, community gardens, brownfields, former industrial areas, de-sealed surfaces, urban forests, transport corridors, and public green spaces. Despite their diversity, all sites address common urban soil challenges such as soil contamination, sealing, compaction, biodiversity loss, reduced ecosystem service provision, poor water infiltration, and limited soil literacy.

A key achievement of D2.3 is the establishment of a harmonised experimental design and implementation framework applicable across the Living Lab network. The framework combines restoration interventions, monitoring activities, and stakeholder engagement actions while allowing sufficient flexibility to accommodate local environmental conditions, governance structures, and stakeholder priorities. The adaptive design approach enables interventions to evolve based on monitoring results and Living Lab learning processes while maintaining scientific robustness and comparability across sites.

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The deliverable demonstrates the value of the Living Lab methodology in urban soil restoration. Through the active involvement of municipalities, research organisations, land managers, schools, businesses, civil society organisations, and citizens, the project has created a foundation for co-created, locally relevant, and potentially scalable solutions. This collaborative approach strengthens ownership of interventions and increases the likelihood of long-term sustainability beyond the duration of the project.

The implementation designs documented in this report serve as the basis for future restoration activities, monitoring campaigns, and performance assessments under the Monitoring and Evaluation tasks (WP3) of the project. The resulting evidence will support the evaluation of environmental, social, and governance impacts of urban soil restoration measures and contribute to identifying solutions with strong replication and scaling potential across Europe.

As URSOILL enters the implementation phase, the Living Labs will continue to refine interventions through iterative learning, stakeholder feedback, and monitoring results. Future deliverables under WP2 will document implementation progress, lessons learned, newly established experimental sites through cascade funding, and further improvements to the intervention portfolio. Together, these efforts will contribute to the objectives of the EU Mission "A Soil Deal for Europe" by generating practical knowledge, transferable methodologies, and innovative solutions for healthier, more resilient, and multifunctional urban soils.

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