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RE-PUBLIC SPACES

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D1.2.1. STRATEGY FOR ADAPTING FIVE HISTORIC COURTYARDS TO CLIMATE CHANGE IN THE CITY OF ŁÓDŹ

Version 1

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1.1. Historical background of Łódź

Łódź has a unique and authentic complex of historic tenement houses in eclectic and Art Nouveau styles dating from the turn of the 19th and 20th centuries, complemented by numerous palaces, villas, and factory complexes. These buildings stand as symbols of the city's multinational and multi-cultural heritage, making Łódź an exceptional example of urban and architectural diversity in Europe.

The origins of Łódź can be traced back to a farming settlement, which received city rights on July 29, 1423. For centuries, it remained a small agricultural town until 1820, when the government of the Kingdom of Poland designated it as an industrial settlement with a special role as a weaving and cloth production center. Between 1824 and 1827, the settlement of Łódka was established south of New Town District, along the axis of today's Piotrkowska Street.

The development of large-scale industry in Łódź began soon after, with the creation of major factories by entrepreneurs such as Ludwik Geyer, Karol Scheibler, Traugott Grohmann, and Izrael Poznański. This period saw rapid industrial growth, turning Łódź into a "Promised Land" that attracted Poles, Jews, Germans, and Russians. Their presence is still visible in the city's post-industrial complexes, architectural monuments, temples, and cemeteries.

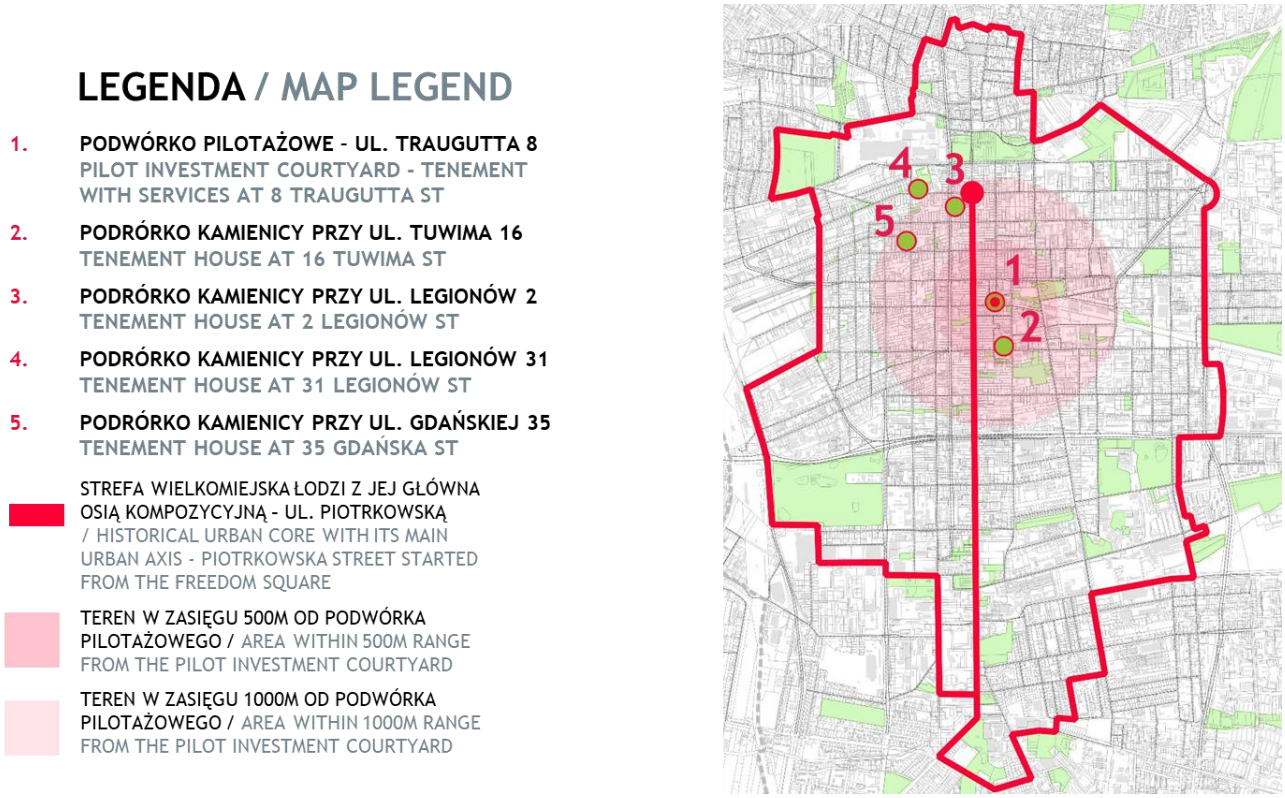

Figure 1. Location of the Analyzed Courtyards in the Context of Łódź's Historic Urban Core, Source: Łódź - Charter of Cortyards

1.2. The Historic Urban Core

As a post-industrial city, Łódź is characterized by its production and industrial buildings, but also by a distinctive housing typology. More than 10,000 buildings erected in the second half of the 19th century and the early 20th century now form what is referred to as the Historic Urban Core. This area covers about 1400 ha of the central area of the city and consists of traditional urban blocks made up of tenement houses (frontages with outbuildings) and internal courtyards. The Historic Urban Core is characterized by a high density of 'urban functions', both local and metropolitan (trade, services, government administration, culture, recreation, housing, education, etc.) — within a comprehensible structure ordered by squares and streets.[1] The most common layouts of these tenements are O-, U-, or L-shaped, creating long and narrow courtyards with limited sunlight penetration deep inside the plots.

[1] City Council of Łódź. (2024, November 6). Resolution No. IX/236/24 on the adoption of the Spatial Development Strategy of Łódź 2030+. Retrieved from: https://bip.uml.lodz.pl/files/bip/public/BRM_2024/09_236.pdf

These courtyards, while originally designed for utilitarian purposes, now serve as important components of the urban landscape. They reflect both the challenges and opportunities of Łódź's dense urban fabric: restricted green space, insufficient comfort for everyday use, but also a high potential for ecological adaptation and social revitalisation.

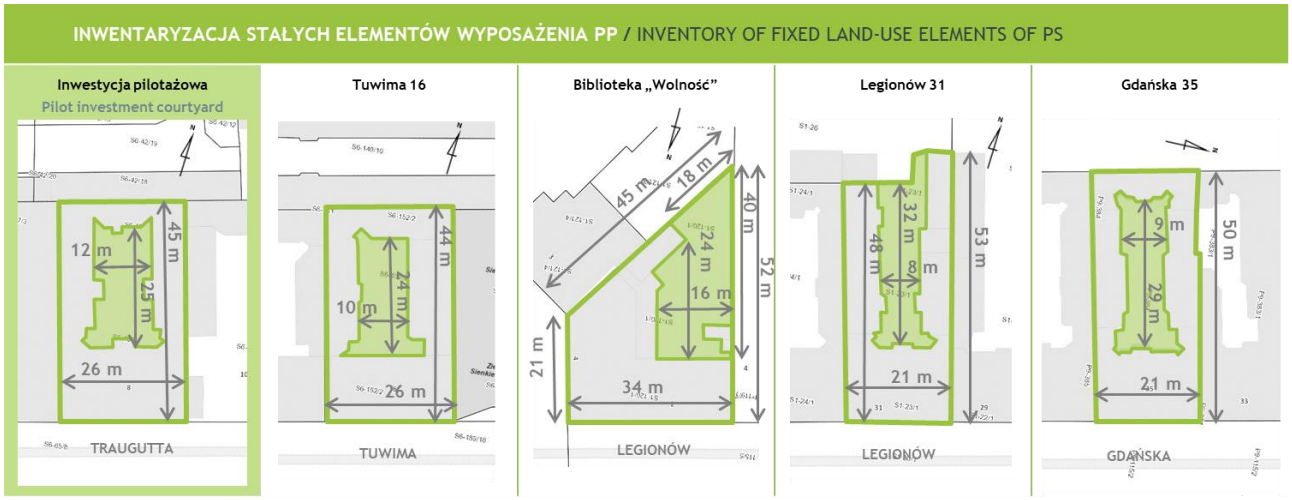

Figure 2. Inventory of the Analyzed Courtyards by Size and Shape
Source: Łódź - Charter of Cortyards

As a priority area from both historical and urban perspectives, the Historic Urban Core of Łódź is protected through several Local Spatial Development Plans as well as heritage protection based on local conservation policies and stratagies.

1.3. Characteristics of the Courtyards

For the purpose of the Re-Public Spaces project, we selected five courtyards located within the Historic Urban Core of Łódź. These sites were chosen as examples of the city's dense tenement fabric and its characteristic courtyard system. The selected courtyards met common criteria such as historical character, typical size of around 250–450 m², and ownership conditions — all properties are owned and maintained by the City of Łódź. In addition, their land-use provides sufficient space to allow for adaptation work; while a few courtyards contain scattered greenery, most lack adequate vegetation and ecological functions, leaving them poorly prepared to address climate challenges in their present form. The following courtyards were therefore selected for detailed analysis and assessment within the project: 8 Traugutta Street (also serving as a site for

exemplary pilot implementation), 16 Tuwima Street, 2 Legionów Street / 4 Freedom Square, 31 Legionów Street, and 35 Gdańska Street.

The courtyards generally maintain a uniform ground level with the adjacent street, with slight variations to aid rainwater drainage. Historically, the ground floors of tenement houses stood above ground level; however, modern adaptations in some cases managed to improve accessibility through lowered thresholds, and embedded ramps.

Ground surfaces are paved with a mix of historic and modern materials such as granite setts, concrete screed, or paving plates in gray and earthy tones, often laid in straight, brick, or arched patterns. In some yards, original stone paving has been preserved and exposed, highlighting the historical character of the space.

Figure 3. Inventory of the Analyzed Courtyards - Photographic Views of Each Courtyard
Source: Łódź - Charter of Cortyards

Several characteristic architectural and design elements contribute to the identity of selected courtyards. Facades are painted in historically grounded colors, supported by studies and conservation rules, while windows and doors range from preserved wooden joinery to newer PVC frames in traditional shades of brown, green, red, and grey. Cast iron decorative features, balustrades, guard stones, and stone or ceramic gateway pavements reinforce the unique genius loci of the courtyards. Gates, often decorated

in wood or iron, remain defining features, sometimes reused as exhibition spaces after revitalization.

Some courtyards remain closed and "well-shaped," while others offer opportunities to connect with adjacent plots, potentially creating larger shared public spaces. Fencing and boundary treatments depend on the presence of outbuildings; where absent, blind walls or brick fences serve as barriers, increasingly softened with climbing greenery. Most courtyards lack facilities tailored to diverse resident groups, with only isolated examples of children's play equipment or temporary furnishings introduced by tenants themselves. Safety is addressed through lighting, non-slip paving, and, in some cases, monitoring systems.

Taken together, these elements demonstrate both the shared heritage and evolving functions of Łódź's courtyards. Their distinctive layouts, historic architectural features, and potential for adaptive reuse underscore how these spaces serve both as protected cultural assets and as opportunities for ecological, social, and spatial renewal.

1.4. Accessibility

When considering accessibility in historic courtyards, it is essential to account for the specific characteristics of heritage buildings. These structures are legally protected due to their historical and architectural value, and any interventions must respect conservation principles. Accessibility should therefore be analyzed from both construction and preservation perspectives.[2]

The historic tenement courtyards of Łódź underwent massive revitalization beginning around early 2010s, aimed primarily at improving general conditions rather than enhancing accessibility for elderly or disabled residents. Accessibility in Łódź is now guided by the Łódź Accessibility Standard (Ordinance No. 7120/VII/17 of the Mayor of the City of Łódź dated 20 October 2017 on the Implementation of the "Łódź Accessibility Standard"), which provides comprehensive recommendations for barrier-free design in public and semi-public spaces. It sets a clear framework for addressing accessibility comprehensively, including the needs of visually impaired residents, people with hearing

[2] Szmygin, B. (2022). Architectural Accessibility of Historic Buildings for People with Special Needs. Warsaw: National Heritage Institute; Lublin University of Technology Press. ISBN 978-83-67381-08-6, 978-83-7947-530-8. First edition. Retrieved from: https://ksiegarnia.nid.pl/wp-content/uploads/2022/12/Dostepnosc-architektoniczna-obiektow-zabytkowych_www.pdf

difficulties, and those with cognitive or sensory challenges. This includes tactile guidance surfaces, clear signage, high-contrast materials, safe lighting, and unobstructed pathways.

Considering the heritage value of the selected courtyards, accessibility interventions require careful, context-sensitive planning to ensure that Łódź's courtyards can be used by all residents without compromising their architectural and cultural integrity.

2. Urban and Climate Context

2.1. Climate Characteristics and Adaptation Potential

Łódź is a post-industrial city characterized by dense tenement quarters with numerous inner courtyards. Its urban structure and topography make the city particularly sensitive to climate change. High shares of sealed surfaces limit water retention, increasing vulnerability to urban flooding during torrential rains. Climate projections for Łódź indicate rising average annual temperatures, more hot days, fewer frosty days, and increased precipitation by 2050. Areas with high-density residential development — particularly the Historic Urban Core — are most at risk from urban heat island effects, extreme rainfall events, flooding, and air pollution.

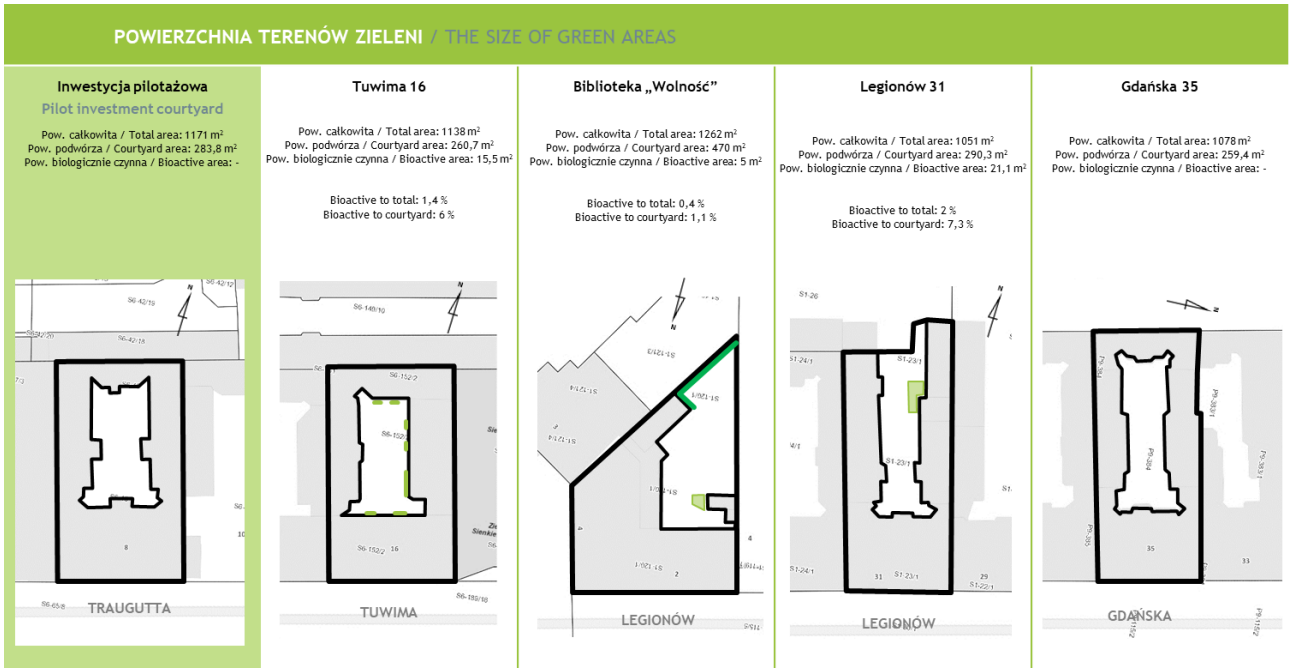

Figure 4. Inventory of the Analyzed Courtyards - The Size of Green Areas
Source: Łódź - Charter of Cortyards

The selected courtyards share common physical, functional, and ecological characteristics:

- **Layout and Structure:** O-, U-, or L-shaped tenement arrangements, with front houses providing access to inner courtyards and outbuildings along the plots.
- **Surfaces and Materials:** Predominantly non-permeable surfaces (93–100%) such as concrete setts or plates; façades are light-colored and reflective, reducing some heat absorption. Outbuilding façades in certain locations (e.g., 8 Traugutta Street) are insulated with EPS to improve thermal performance.
- **Sunlight and Ventilation:** Most courtyards receive less than four hours of direct sunlight. Ventilation ranges from low to medium depending on orientation and shape, contributing to heat accumulation during summer months.
- **Greenery and Biodiversity:** Vegetation is limited to small lawns, flower beds, potted plants, or climbing plants along walls. Some courtyards, like 31 Legionów Street, feature perennial flower beds and medium-sized trees maintained by residents. Vertical greening on walls and fences is largely unused.
- **Rainwater Management:** Courtyards primarily rely on sloped surfaces directing water to drains or streets, with minimal local retention. Flooding can occur during heavy rainfall events due to insufficient storage and infiltration.

These characteristics directly relate to the four key climate adaptation strategies.

Figure 5. Simple Climate Strategies as a Response to Existing Challenges
Source: Łódź. Work Progress. 25.02.2025

2.1.1. Urban Heat Island (UHI) and Heat Waves

Currently, the courtyards are dominated by sealed surfaces (93–100%) made of concrete setts or plates, which absorb and retain heat. Most courtyards receive limited direct sunlight, but poor ventilation allows heat to accumulate during the summer months. Light-colored façades (beige, white, stone) help reflect some solar radiation, yet the lack of greenery and nature-based solutions (NBS) results in minimal natural cooling. At present, residents rely primarily on small potted plants for relief, which have little effect on the microclimate. Expanding vegetation, incorporating NBS, and designing climate-sensitive surfaces would be crucial to reduce localized heat buildup and improve thermal comfort.

2.1.2. Torrential Rains – Water Management

Rainwater management in the courtyards is largely based on sloped surfaces that channel water directly into drains or toward the street. This system prioritizes quick discharge into the sewage network, with no provisions for retention or infiltration. As a result, heavy rainfall often causes temporary flooding, especially where drainage systems are insufficient. None of the courtyards currently make use of rainwater for local

ecological or social benefits. Strategic interventions are needed, such as partial de-concreting, introduction of permeable surfaces, rain gardens, or small water retention tanks. These measures would not only reduce flood risk but also support cooling and biodiversity functions in the courtyards.

2.1.3. Nature-Based Solutions (NBS)

Currently, greenery in the courtyards is sparse, fragmented, and often in poor condition. Small lawns, flower beds, and potted plants maintained by residents exist in some sites, but they provide minimal cooling, air quality improvement, or recreational opportunities. Most surfaces remain sealed, and greenery does not significantly influence the microclimate. To transform these spaces, the introduction of vertical greening, rain gardens, and pocket lawns could enhance air cooling, increase comfort, and create welcoming, social spaces for residents.

2.1.4. Building Green Infrastructure (GI) and Biodiversity

Presently, the courtyards contribute little to biodiversity. With a few exceptions, such as resident-maintained flower beds or occasional trees, the ecological value of the spaces is low. The lack of diverse plantings and permeable surfaces limits habitats for pollinators, birds, and other species. However, even these modest plantings show potential: climbing plants, shrubs, and flower beds can serve as a starting point for ecological enrichment. Introducing additional GI elements—such as planters, lawns, bio-retention areas, and vertical gardens—would not only support biodiversity but also improve the well-being of residents and promote healthier living conditions.

Overall, while the five courtyards currently face challenges in heat accumulation, water management, and ecological functions, their historic layouts, resident engagement, and available space provide strong potential for implementing climate adaptation strategies in line with the four focus areas.

2.2. Rainwater Management in Historic Cities: Challenges, Opportunities, and Solutions

Historic cities face unique challenges in adapting to the impacts of climate change, particularly with respect to water management. Their dense urban fabric, extensive sealed surfaces, and fragile heritage structures limit the possibilities for conventional

drainage systems. At the same time, these environments provide opportunities for small-scale, integrated solutions that combine sustainability with heritage conservation. Courtyards, characteristic elements of many historic cores, such as those in Łódź, offer a valuable testing ground for innovative rainwater management strategies.

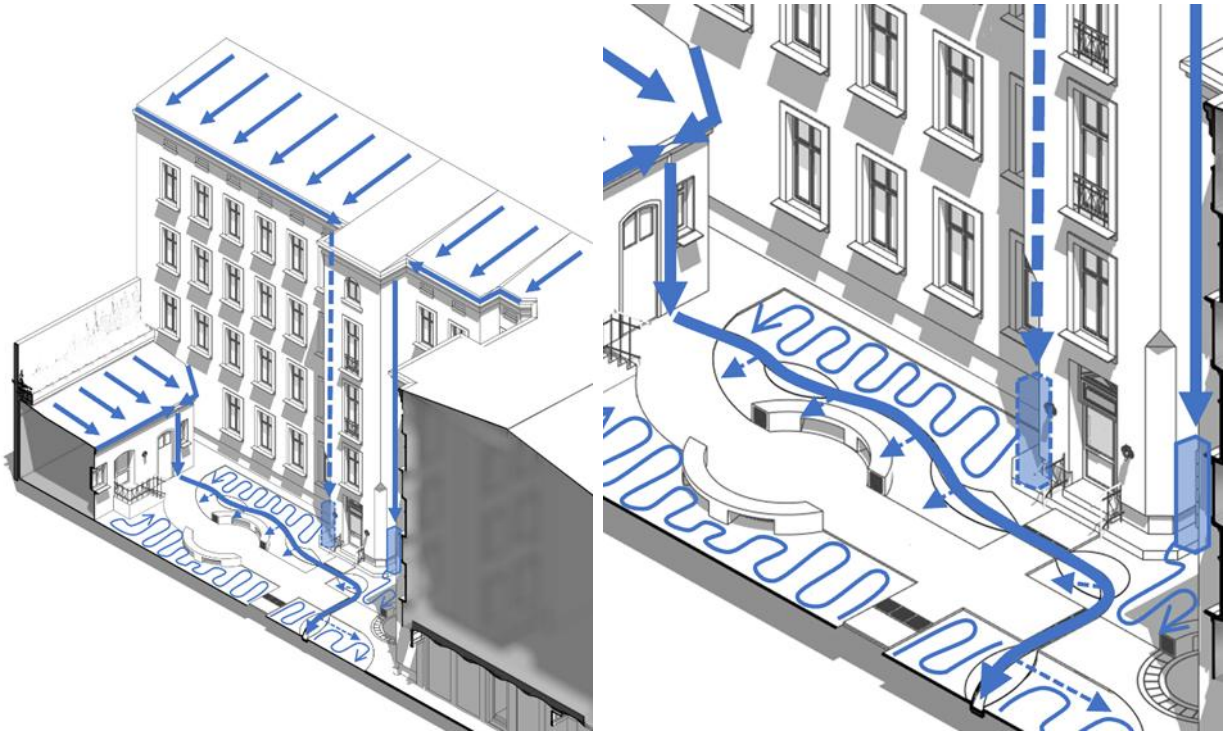

Figure 6. Rainwater harvesting and management scheme for the pilot implementation at 8 Traugutta Street, Łódź, Poland
Source: Łódź. Work Progress. 25.02.2025

2.2.1. Challenges of Rainwater in Historic Urban Fabrics

The morphology of historic city centers typically includes narrow plots, high-density buildings, and limited open space. Courtyards and streets are often paved with impermeable materials such as stone setts, concrete plates, or asphalt, leaving little room for natural infiltration. This creates several pressing challenges:

- **Flood risk during torrential rains.** Heavy precipitation events can overwhelm existing drainage networks, causing localized flooding in courtyards, basements, and adjacent streets.
- **Poor water retention capacity.** Historic centers usually prioritize rapid discharge into sewage systems, meaning that rainwater is lost rather than used locally for ecological or social benefits.

- **Soil degradation and compaction.** Where soil exists, it is often compressed or contaminated, limiting infiltration and healthy plant growth.
- **Constraints of heritage preservation.** Interventions must respect historic layouts, architectural integrity, and conservation regulations, restricting options for large-scale infrastructural modifications.
- **Vulnerability of buildings**. Moisture penetration into foundations or walls poses a direct risk to the longevity of historic structures. Infiltration-based solutions therefore require careful siting and protective measures.

These challenges are compounded by climate change. Projections for Central Europe, including Łódź (Poland), predict more frequent and intense rainfall events, alongside higher temperatures. Historic cores are therefore at particular risk from both urban flooding and heat accumulation, underscoring the urgency of climate-sensitive water strategies.

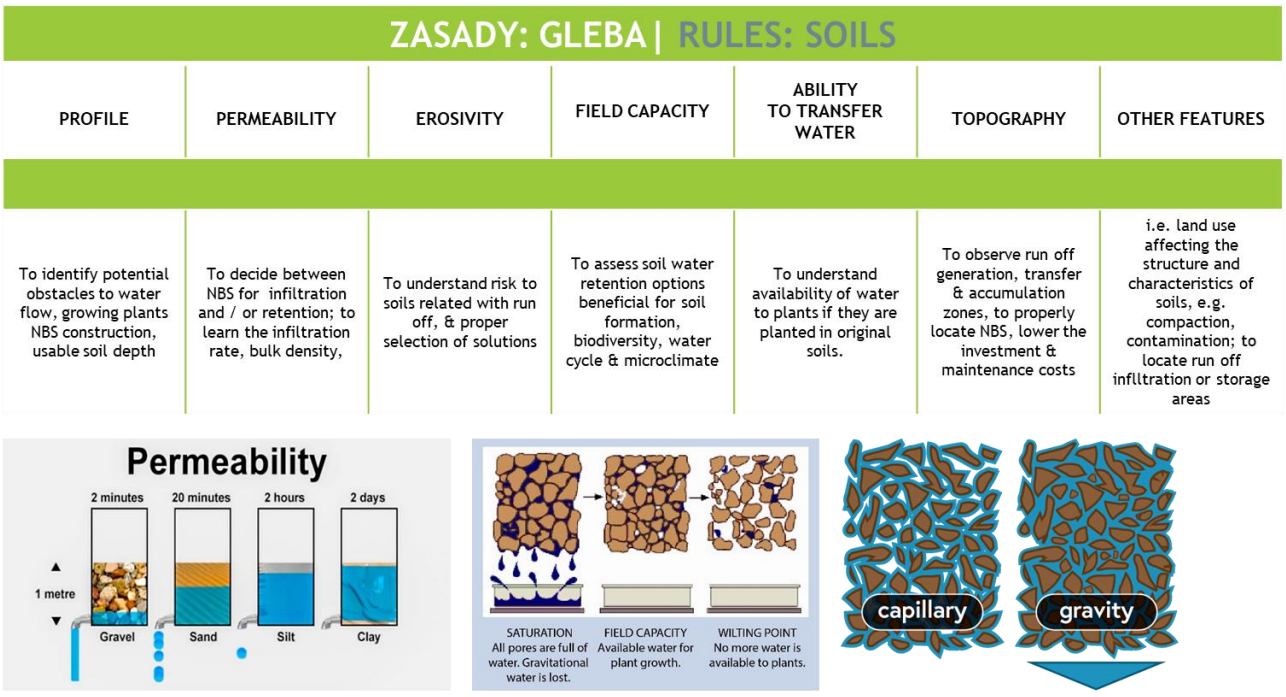

Figure 7. Soil Properties and Their Role in Sustainable Rainwater Management
Source: Kinga Krauze, Łódź - Sustainable Urban Drainage (Multispecies City)

Despite surtain limitations, historic cities also hold great potential for innovative rainwater management. Courtyards, as semi-public spaces, can function as platforms for integrating blue-green infrastructure (BGI) and nature-based solutions (NBS). Their

moderate scale makes them ideal for pilot projects, which can then be replicated across wider neighborhoods. Key opportunities include:

- **Micro-scale interventions**, such as permeable paving, rain gardens, or pocket lawns, can significantly improve local infiltration and cooling.
- **Integration with heritage features.** Integration with heritage features: Historic paving stones and decorative elements can be preserved and incorporated into new structures, such as drainage channels, retention basins, or vertical greenery.
- **Community engagement.** Courtyards are lived-in spaces where residents directly experience environmental issues. Public consultations and co-design processes can help ensure solutions meet both ecological goals and everyday needs.

By aligning ecological, social, and heritage considerations, courtyards can become multifunctional "green chambers" that both mitigate climate risks and enhance quality of life.

2.2.2. Key Steps in Revitalizing Courtyards for Water Management

Developing effective rainwater strategies in historic courtyards requires a systematic approach that balances technical precision with community and heritage sensitivity. The process involves several stages:

1) **Site assessment.** A thorough inspection of the courtyard and its microclimatic conditions, including inventory of historic and contemporary materials, is the foundation of any intervention.
2) **Archival and technical research.** Collecting documentation and existing infrastructure plans helps identify constraints and opportunities for water management.
3) **Hydrological analysis.** Modeling rainfall patterns, runoff volumes, and extreme event scenarios reveals vulnerabilities to flooding and guides design decisions.
4) **Geological and soil studies.** Understanding soil permeability, field capacity, and erosion risks determines the suitability of infiltration versus retention strategies.

5) **Community involvement.** Public consultations ensure that tenant expectations, needs, and habits are integrated into the design.
6) **Boundary conditions.** Evaluating building foundations, waterproofing, and existing drainage networks sets the technical limits for safe interventions.
7) **Concept development.** Designers select appropriate NBS and infrastructural solutions that balance ecological, aesthetic, and social considerations.

This structured process ensures that proposed measures are both technically feasible and socially acceptable, while respecting heritage values.

2.2.3. Possible Solutions: From Retention to Infiltration

Rainwater management typically combines two complementary approaches:

- **Retention.** Local storage of water through tanks, cisterns, or decorative ponds provides immediate resources for irrigation and cooling. Retention is highly visible, socially attractive, and adaptable to small spaces.
- **Infiltration.** Directing water into soil systems supports groundwater recharge, biodiversity, and long-term ecological benefits. Infiltration requires careful siting away from foundations, often supported by bio-retention areas, swales, or permeable paving.

Figure 8. The difference between infiltration and retention
Source: Kinga Krauze, Łódź - Sustainable Urban Drainage (Multispecies City)

Specific solutions include:

- **Permeable surfaces** replacing concrete with stone setts on sand bedding or porous paving plates.
- **Rain gardens and biofilters** that capture and clean runoff while providing green benefits.
- **Vertical greening and green facades** that retain moisture and reduce heat stress.
- **Rainwater harvesting systems** (e.g., water catchers, tanks) integrated with irrigation.
- **Sedimentation tanks or separators** to remove pollutants where runoff is contaminated.
- **Native planting schemes** to maximize ecological resilience and minimize maintenance.

By carefully combining these solutions, courtyards can evolve into multifunctional, climate-resilient spaces that provide cooling, biodiversity, social value, and heritage-compatible design.

Rainwater management in historic cities cannot rely on a one-size-fits-all approach. Each courtyard, street, or square represents a distinct context shaped by heritage, infrastructure, and community use. However, the principles of site-specific assessment, multifunctional design, and integration of nature-based solutions provide a transferable framework.

Ultimately, the challenge of rainwater in historic cores is also an opportunity: to reimagine courtyards and similar urban micro-spaces as resilient, green-blue chambers that connect ecological function with cultural heritage and everyday urban life.

2.3. Public participation and tenant education.

Public participation plays a crucial role in the process of revitalization and in shaping effective ecological adaptation. In the city of Łódź, as part of the Re-Public Spaces project, the first public consultations held on 4th July 2024 for the future pilot investment at the Traugutta 8 courtyard highlighted how even simple educational processes can positively influence tenants' approaches to ecological adaptation. This engagement provides hope that the upcoming investment will not only inspire replication across the city and beyond — demonstrating how communities can respond to environmental challenges while enhancing urban life — but also foster ongoing community involvement in maintaining the revitalized courtyard.

Figure 9. Public consultations in Łódź, 8 Traugutta Street, 04.07.2024
Source: Personal archive

By giving residents a meaningful role in the design process, the project strengthened social ties and nurtured a shared sense of engagement. The courtyard has a chance to become more than a functional space for rainwater management; it can serve as a hub for community interaction, education, and ecological awareness. Residents are empowered to care for the environment they helped shape, turning the courtyard into a living demonstration of sustainable urban design.

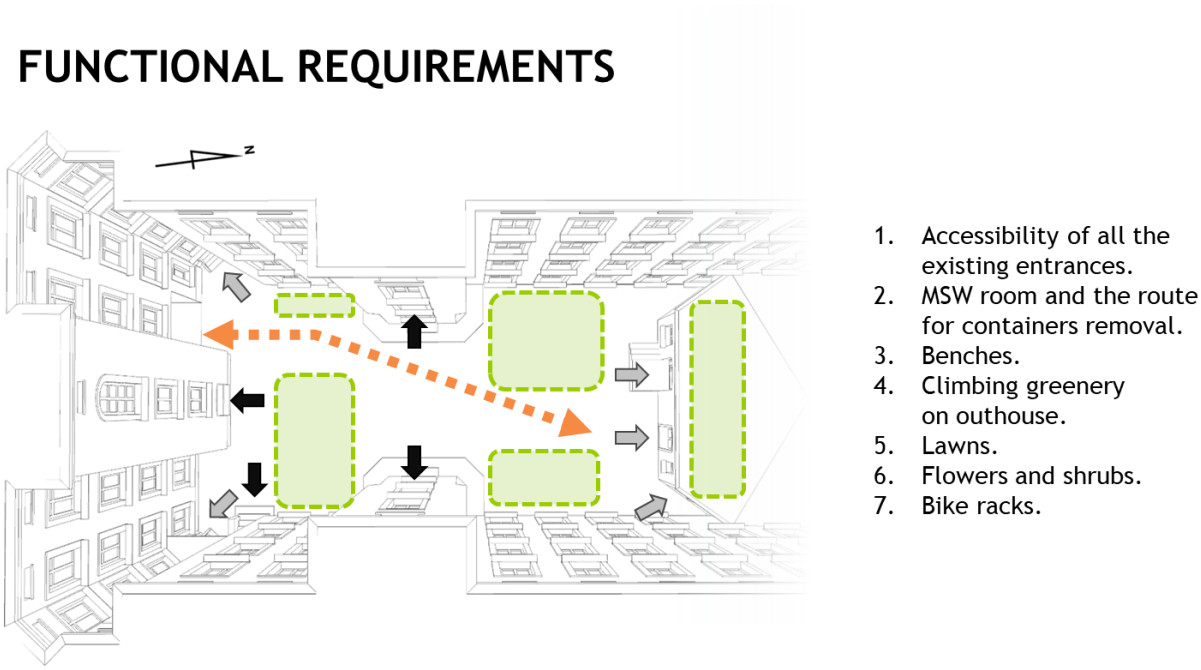

Figure 10. Functional Requirements for the Revitalization of the Courtyard at 8 Traugutta Street (Based on sketches from the participatory meeting)
Source: Participatory Meeting. 8 Traugutta St, Łódź, 14.11.2024

The revitalization of the Traugutta 8 courtyard can become not merely an architectural or ecological intervention — it is a collective act of placemaking, driven by the voices, needs, and aspirations of the residents themselves. Tenants were engaged from the earliest stage of the project, and through consultations, conversations, and surveys, their input informed crucial design decisions, including the placement of benches and bike stands, the routing of walkways, and the organization of green areas. This inclusive approach ensured that the courtyard met not only aesthetic and ecological goals but also the practical rhythms of daily life in the community.

In essence, public participation transforms ecological projects from top-down interventions into co-created spaces where social cohesion, environmental education, and climate adaptation converge.

3. Strategic Framework

3.1. The Łódź City Development Strategy 2030+ — "A City Shaped Together"

The city of Łódź has established a forward-looking framework for its development through the Łódź City Development Strategy 2030+ — "A City Shaped Together", adopted by the City Council in November 2021. The strategy emphasizes sustainable urban development, highlighting the importance of ecological adaptation and climate resilience in shaping the city's future. Environmental considerations, including green and blue infrastructure, water management, and the promotion of biodiversity, are central to the strategy, reflecting Łódź's commitment to creating a city that is not only functional and attractive but also resilient to climate change and responsive to the needs of its residents.

Figure 11. View of Piotrkowska Street toward Liberty Square
Source: Arecki Photo Video

The following section is taken from the **Łódź City Development Strategy 2030+ — "A City Shaped Together"** and illustrates the city's commitment to sustainable urban development and ecological resilience. It outlines the thematic areas and strategic projects designed to strengthen the city's capacity to adapt to climate change, enhance green and blue infrastructure, and foster environmental engagement among residents. This section demonstrates how Łódź integrates long-term planning, participatory approaches, and nature-based solutions to ensure a resilient, livable, and ecologically responsible urban environment for current and future generations.

3.1.1. Strong and Resilient Łódź

Climate-Resilient City. The city shapes its structure and manages urban space to adapt to ongoing climate changes and to minimize, and in the long term eliminate, its own impact on global climate change. In managing space, social capital, and natural resources in the face of the climate crisis, the city applies a long-term perspective that accounts for future needs. It aims to preserve and create resources necessary for the functioning of future generations under changing living conditions. Through its actions, the city contributes to the implementation of the European Green Deal.

Operational Goals:

- Improving the quality of urban investments, including through the implementation of standards for green space protection and development, retention solutions, and ecological energy sources for investments.
- Development and maintenance of blue-green infrastructure to provide ecosystem services that enhance the city's resilience to climate change.
- Increasing water retention, with particular emphasis on soil and environmental retention, constructing systems to capture and store rainwater, and protecting flood-prone areas in accordance with water management planning documents.
- Promoting water-saving practices in households and businesses.
- Biodiversity zones: creating conditions that support the coexistence of people, animals, and plants of various species in urban spaces, including preventing the degradation of existing natural resources.

3.1.2. Planned Strategic Projects for Łódź in Connection with Building a Climate-Resilient City

Strategic Project No. 4 – Construction of a Water Management System in the City of Łódź with Emphasis on Retention and Water Reuse

Planned Activities: Construction of a city-wide water management system with particular emphasis on retention (including decentralized and small-scale retention) and water reuse. The project scope includes, among others, the construction of retention reservoirs, adaptation of rainwater collectors to climate change and city needs, reconstruction/regulation of riverbeds, canal construction, restoration/reconstruction of watercourses, construction of stormwater drainage with retention facilities (reservoirs), and development of water and sewage systems, including abstraction, treatment, supply, and storage. All activities aim to retain stormwater runoff, support water retention (including small-scale retention), and renaturalize transformed watercourses and dependent areas.

Expected Effects:

- Retention of stormwater runoff
- Increased retention capacity
- Development of small-scale retention
- Positive impact on the natural environment and its preservation for future generations
- Enhanced regional economic resilience through continuity of orders for construction companies operating primarily in local markets by generating new investments
- Direct benefits for individuals and entities using the new/modernized infrastructure

Figure 12. EC1 - City of Culture, Top View
Source: Arecki Photo Video

Strategic Project No. 12 - Green Transformation of the City

Planned Activities: Investments in forest, park, and green area infrastructure. Development of public spaces, including creation or modernization of recreational, leisure, and activity areas. Nature-based solutions, including accompanying vegetation (street greenery, green parking lots, bus stops, walls, roofs, rain gardens, pocket parks, woonerfs, flower meadows, river valleys, urban forests, and meadows) and infrastructure for pedestrian and bicycle movement. Investments in sustainable rainwater management using blue-green infrastructure. Renaturalization of river valleys through technical and engineering measures as part of green area reclamation. Investments in circular economy solutions, including a comprehensive waste management system providing residents with infrastructure for selective waste collection to increase recycling rates. Raising residents' awareness of the need to recover secondary raw materials through

waste segregation. Creating multifunctional, open public spaces that mitigate urban heat islands. Educational activities for residents and entrepreneurs on the city's green transformation and climate adaptation.

Expected Effects:

- Increased quantity and quality of recreational, leisure, and activity spaces in the city
- Improved quality of public spaces
- Quantitative and qualitative improvement of urban greenery
- Reduction of greenhouse gas emissions (mainly CO_2) and improvement of the urban climate
- Increased rate of selective waste collection
- Educational activities for residents and entrepreneurs on the necessity of a green city transformation toward climate neutrality and climate adaptation
- Raising awareness of the need for secondary raw material recovery through waste segregation
- Positive impact on the natural environment and its preservation for future generations[3]

3.2. Spatial Development Strategy of Łódź 2030+

The following text is taken from **The Spatial Development Strategy of Łódź 2030+**, and it corresponds to the **Łódź City Development Strategy 2030+ - "A City Shaped Together"**. It illustrates the city's commitment to sustainable and resilient urban development, emphasizing compact, ecologically conscious growth, the enhancement of green and blue infrastructure, and long-term adaptation to climate, health, energy, and geopolitical challenges. Following section provides a guiding framework for planning, investment, and public engagement in shaping a city that balances urban development with environmental engagement and quality of life.

[3] City Council of Łódź. (2021, November 17). Attachment to Resolution No. L/1535/21: Łódź City Development Strategy 2030+ — "A City Shaped Together." Retrieved from: https://uml.lodz.pl/files/bip/public/BSM_2021/strategia_UCHWALONA.pdf

Figure 13 View of Piotrkowska Street toward East-West Route
Source: Arecki Photo Video

3.2.1. Sustainable Compact City

The main objective of Łódź's spatial development strategy is to create a sustainable, compact city, resilient to health, climate, energy, and geopolitical challenges. This "inward" development continues the direction established in the Łódź Spatial Development Strategy 2020+ and reinforces urban regeneration efforts. Sustainable development in Łódź involves maximizing the use of already urbanized areas while preventing expansion into new territories. Given the city's demographic challenges, simply halting urban sprawl is insufficient. In response to depopulation and negative spatial processes, the strategy advocates for a reduction in the urbanized area: new urban expansion should be balanced by returning larger areas elsewhere to nature.

Urbanized space demand must be offset by ecological and environmental investments that improve quality of life, leverage the potential of "Green Łódź" — including Poland's

largest urban forest — and utilize the city's rivers, which historically attracted the textile industry. Dense urban fabric provides an excellent spatial base for energy optimization. Innovation and investments in energy- and climate-related projects, while respecting the city's material heritage, constitute key development directions. The reference framework for urban area classification and typology is the city's spatial structure and the existing circular railway line, forming an irregular oval centered on Piotrkowska Street, the historical axis of city development.

3.2.2. Strategic Goals — Green City with History

- Build a city resilient to health, climate, energy, and geopolitical challenges.
- Support innovations that improve the efficiency of energy, water, and other resource use.
- Increase the availability and diversity of public spaces and recreational areas.
- Improve accessibility to public services (15-minute city concept, support for eco-friendly transport, expansion of pedestrian areas).

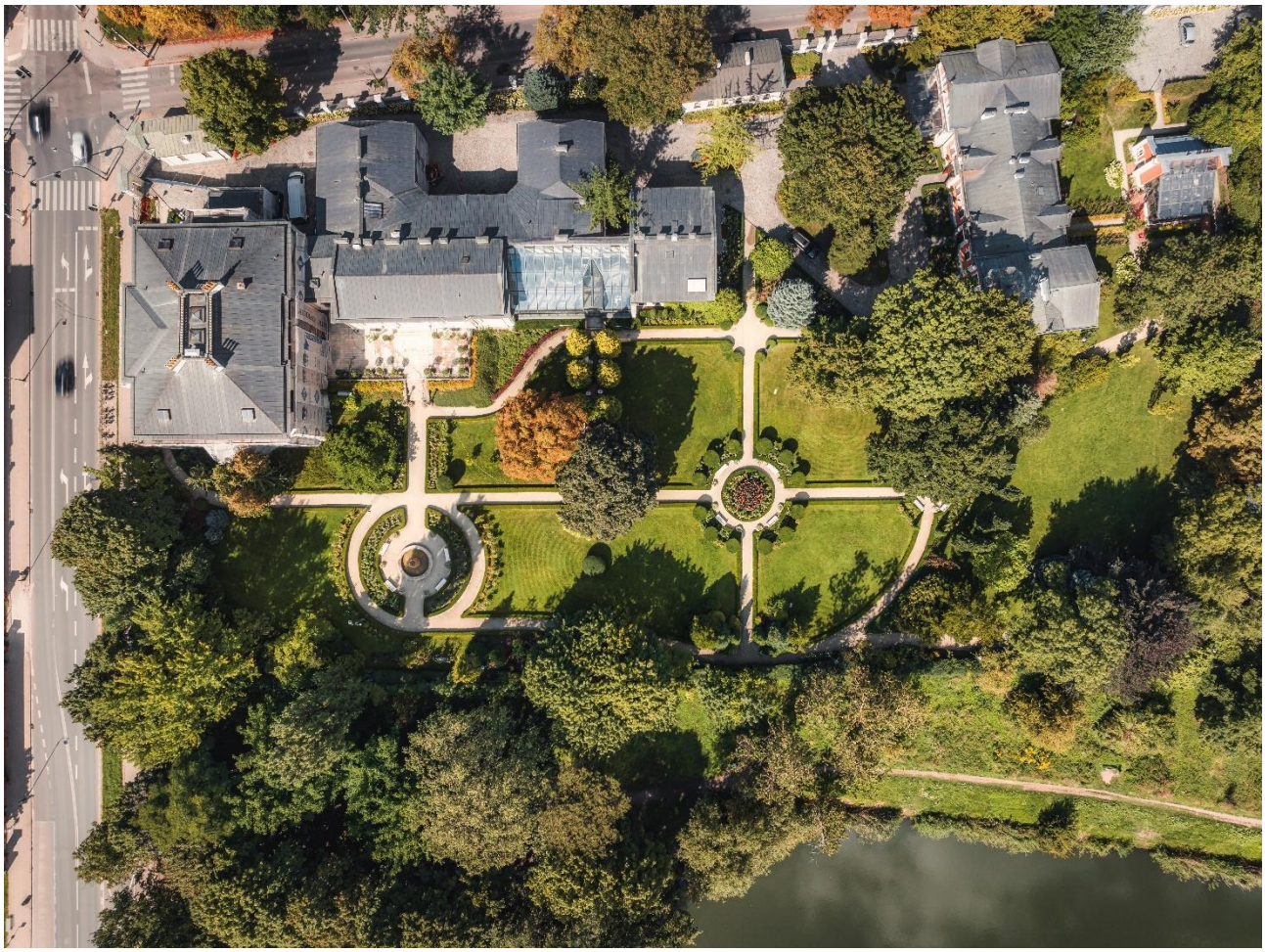

Figure 14. Herbst Palace Museum with inner garden, top view
Source: Arecki Photo Video

The city and its residents face growing challenges due to climate change and geopolitical risks. Urban heat islands, water surplus or shortage (flooding, long droughts), air pollution, rising noise levels, destruction of natural green areas, and insecurity caused by political, economic, or post-pandemic conditions require a focus on spatial adaptation and long-term climate mitigation actions. Improving environmental conditions — air quality, noise reduction, waste and water management, animal welfare — directly enhances urban quality of life.

Building infrastructure to support resilient natural systems and implementing nature-based solutions (NBS) — such as green roofs and facades, retention basins, bio-retention ditches, and rain gardens — is essential. Energy efficiency must be prioritized through the protection of natural energy resources, reducing environmental impacts of energy production, and using renewable sources. Climate adaptation should be integrated with

economic, social, and spatial considerations, with broad local community engagement and intergenerational equity in access to natural, cultural, and economic resources. The overarching goal is to sustainably meet human needs.

Guidelines and Principles for Strategic Actions

Increase the Quantity and Functionality of Green Areas in Łódź

- Urban planning must integrate green spaces alongside construction zones.
- Revalorization of parks and green spaces; creation of new forests, pocket parks, and landscaped squares.
- Development of green corridors along roads, bike paths, and public transport infrastructure.
- Implementation of special green forms: vertical gardens, urban meadows, and ruderal plantings.
- Protection and renaturalization of rivers and valleys; implementation of blue-green infrastructure for stormwater retention and infiltration.
- Resident engagement and education initiatives.

Examples of Actions:

- Removal of unnecessary concrete installations; permeable surfaces instead of asphalt/concrete.
- Pocket parks, vertical gardens, green roofs and walls.
- Household rainwater collection and targeted water management.
- Nature-based solutions for environmental, social, and economic benefits.
- Community gardens, wild zones, flower meadows, permeable park paths.
- Street, square, and courtyard tree planting; green tram tracks.
- Preservation of existing trees and diverse plant species.

The above measures are not exhaustive; all climate adaptation solutions must be appropriate to achieve the intended objectives.[4]

3.3. Strategic Development for the Courtyards in Łódź

The adaptation of the courtyards must be understood not as isolated interventions, but as integrated elements of a city-wide ecological and social strategy. By aligning the pilot project at 8 Traugutta Street and the evaluation of the other four courtyards from different perspectives with the Łódź City Development Strategy 2030+ — "A City Shaped Together" and the Łódź Spatial Development Strategy 2030+, the courtyards serve both as practical implementations of climate adaptation principles and as symbolic anchors for broader urban transformation.

Figure 15. Courtyard of Kościuszki 19 and Wólczańska 36, headquarters of the City Architect Bureau
Source: Arecki Photo Video

[4] City Council of Łódź. (2024, November 6). Resolution No. IX/236/24 on the adoption of the Spatial Development Strategy of Łódź 2030+. Retrieved from: https://bip.uml.lodz.pl/files/bip/public/BRM_2024/09_236.pdf

Courtyards demonstrate the potential of nature-based solutions (NBS) in compact, historic urban settings. Ecological objectives include:

- Climate adaptation: reducing the effects of urban heat islands (UHIs), mitigating flood risk, and creating cooling microclimates.
- Water management: promoting retention and infiltration, reducing pressure on the sewage system, and ensuring sustainable rainwater use.
- Biodiversity enhancement: introducing plant diversity, creating micro-habitats, and supporting pollinators and small fauna.
- Resident well-being: increasing access to green, shaded, and multifunctional spaces that improve daily life.

At the scale of individual courtyards, these objectives correspond directly with city-wide ecological goals, including expanding blue-green infrastructure, improving environmental quality, and building resilience against climate change.

3.3.1. Main Actions – Strategic Steps

To integrate courtyard revitalizations with the city's strategic vision, the following actions are proposed:

1. **Green Infrastructure Development**
    - Replacement of sealed surfaces with permeable paving.
    - Introduction of rain gardens, vertical greenery, and planted roofs.
    - Systematic planting of trees and shrubs to increase shading and evapotranspiration.
2. **Water Retention and Reuse**
    - Installation of localized retention tanks and cisterns for irrigation.
    - Use of permeable surfaces and infiltration beds to reduce runoff.
    - Linking courtyard systems with neighborhood-scale retention basins where possible.

3. **Cultural-Heritage Sensitive Adaptation**
    - Emphasizing the need to protect historical building's facades and other historic architectural elements while introducing new ecological solutions, including the preservation of the heritage asset's visual perception and exposure.
    - Preservation of historic paving stones and facades while integrating new ecological functions.
    - Use of reversible and non-invasive design techniques to respect heritage regulations.

4. **Social and Educational Programs**
    - Embedding participatory design workshops and tenant consultations at each stage.
    - Transforming courtyards into "learning sites" for sustainable design, demonstrating NBS in practice.
    - Strengthening neighborhood engagement and eco-education, especially among children and youth.

5. **Integration with Wider Urban Systems**
    - Linking courtyard projects with planned strategic projects (e.g., Strategic Project No. 4: Water Management System, Strategic Project No. 12: Green Transformation).
    - Establishing courtyards as nodes in a larger ecological network — micro-habitats and "cool islands" interconnected with streets, parks, and river valleys.

3.3.2. Scope of Work and Estimated Costs

The following table presents selected and analyzed courtyards in Łódź, Poland, with regard to the proposed scope of work and the estimated costs of potential revitalization investments. Each concept is designed to enhance environmental sustainability, strengthen social functions, and improve the overall quality of urban space. Planned measures include rainwater management, de-sealing of impermeable surfaces,

introduction of diverse vegetation, installation of irrigation and retention systems, as well as the addition of urban furniture to foster community use. For each courtyard, the estimated revitalization cost has been calculated on the basis of its total area and a standardized cost per square meter.

No.	Address of the courtyard	Scope of work	Estimated revitalisation cost based on area and cost per 1m2
1.	**8 Traugutta ST, Łódź, Poland**	**Rainwater Management** • Installation of above-ground retention tanks ("water catchers") at downspouts • Construction of a gravity-fed irrigation system using retained rainwater • Introduction of an open, stone-lined watercourse to guide runoff and promote infiltration **Green Infrastructure & Plantings** • De-sealing of the courtyard by removing unnecessary solid surfaces (e.g., excess concrete, paving stones) • Planting of low and medium vegetation adapted to urban conditions and microclimate • Use of mulches and specialized soil to retain moisture and support plant health **Circulation & Surfaces** • Creation of a main (2 m wide) and secondary (1.5 m wide) pedestrian route • Preservation of existing concrete belt along façades **Infrastructure & Utilities** • Relocation of municipal waste containers into the utility building • Reinforced paving along the service route for waste container movement • Execution of necessary demolitions for improved spatial clarity and function **Urban Furniture & Features** • Addition of benches, bins, pergolas, planters, bike racks, and railings • Commemorative paving to mark the former courtyard well • Elements designed to foster everyday comfort and support social interaction	Yard Area: **283.8 m²** Cost per 1 m²: **1,700 zł (~365 EUR)** Total Revitalization Cost: In PLN: **482,460 zł** In EUR: **103,587 EUR**

2.	**16 Tuwima ST, Łódź, Poland**	• De-sealing the courtyard by removing unnecessary solid layers, including concrete or paving stones; • Construction of irrigation systems combined with the construction of water retention tanks ("water catchers"); • Greenery – planting of low and high vegetation, green walls in the form of evergreen clematis; • Small architectural elements creating a resident-friendly space that fosters interpersonal relationships; • Necessary demolitions.	Yard Area: **260,7 m²** Cost per 1 m²: **1,700 zł (~365 EUR)** Total Revitalization Cost: In PLN: **443 190 zł** In EUR: **95 155,5 EUR**
3.	2 Legionów ST/4 Freedom square, **Łódź, Poland**	• De-sealing the courtyard by removing unnecessary solid layers, including concrete or paving stones; • Construction of irrigation systems combined with the construction of water retention tanks ("water catchers"); • Greenery – planting of low and high vegetation, green walls in the form of evergreen clematis; • Small architectural elements creating a resident-friendly space that fosters interpersonal relationships; • Necessary demolitions.	Yard Area: **470 m²** Cost per 1 m²: **1,700 zł (~365 EUR)** Total Revitalization Cost: In PLN: **799 000 zł** In EUR: **171 550 EUR**
4.	**1 Legionów ST, Łódź, Poland**	• De-sealing the courtyard by removing unnecessary solid layers, including concrete or paving stones; • Construction of irrigation systems combined with the construction of water retention tanks ("water catchers"); • Greenery – planting of low and high vegetation, green walls in the form of evergreen clematis; • Small architectural elements creating a resident-friendly space that fosters interpersonal relationships; • Necessary demolitions.	Yard Area: **290,3 m²** Cost per 1 m²: **1,700 zł (~365 EUR)** Total Revitalization Cost: In PLN: **493 510 zł** In EUR: **105 959,5 EUR**
5.	**35 Gdańska ST, Łódź, Poland**	• De-sealing the courtyard by removing unnecessary solid layers, including concrete or paving stones; • Construction of irrigation systems combined with the construction of water retention tanks ("water catchers");	Yard Area: **259,4 m²** Cost per 1 m²: **1,700 zł (~365 EUR)** Total Revitalization Cost:

		• Greenery – planting of low and high vegetation, green walls in the form of evergreen clematis; • Small architectural elements creating a resident-friendly space that fosters interpersonal relationships; • Necessary demolitions.	In PLN: **440 980 zł** In EUR: **94 681 EUR**

3.3.3. Implementation Timeline

The revitalization of the five courtyards should follow a phased approach, aligned with the scope and estimated cost of investments defined by the Re-Public Spaces project and Łódź's 2030+ strategies:

Short-term (until the end of 2026)

- Pilot implementation at 8 Traugutta Street, with full monitoring of ecological and social outcomes.
- Launch of public education campaigns on water-saving and eco-friendly practices.
- Preparation of the Guidelines for Climate Change Adaptation of Courtyard Spaces in Historic Cities and the Charter for Green and Sustainable Courtyards in Historic Cities, summarizing the Re-Public Spaces project.

Medium-term (2027-2031)

- Analysis of the results of the revitalization at 8 Traugutta Street, as well as of the Guidelines and the Charter for Courtyard Spaces in Historic Cities.
- Initial consultations and preparation of concept designs for the remaining four courtyards.
- Efforts to secure funding for the implementation of subsequent projects.
- Continuation of public education campaigns on water-saving and eco-friendly practices

Long-term (2030+)

- Expansion of the courtyard model to additional sites within the Historic Urban Core.

- Continuation of public education campaigns on water-saving and eco-friendly practices.
- Ongoing monitoring and data collection to inform Łódź's Climate Action Plan and future updates of the City Development Strategy.

3.3.4. Expected Impacts

By aligning local courtyard revitalizations with city-wide strategies, the following impacts can be achieved:

- Environmental: Increased stormwater retention, reduced local flooding, improved microclimates, and enhanced biodiversity.
- Social: Stronger community cohesion, increased sense of ownership, and improved quality of life.
- Educational: Courtyards serving as living platforms for climate adaptation, inspiring replication across neighborhoods.
- Economic: Reduction of infrastructure maintenance costs, creation of new green jobs, and improved attractiveness of Łódź as a climate-resilient city.

The revitalization of courtyards in Łódź is conceived as an integrated element of the city's ecological and social strategy, rather than as isolated interventions. By connecting the pilot project at 8 Traugutta Street with evaluations of four additional courtyards and aligning them with the Łódź City Development Strategy 2030+ ("A City Shaped Together") and the Łódź Spatial Development Strategy 2030+, these spaces function both as practical examples of climate adaptation and as symbolic anchors for broader urban transformation.

The implementation at 8 Traugutta Street sets the precedent for the remaining four locations, where future investments will proceed as financial resources allow. Serving as both a testing ground and a model for replication, this pilot ensures that lessons learned at one site can be effectively adapted across other courtyards in the city.

4. Summary

An analysis of large-city courtyards, combined with expert input in the fields of environmental protection, heritage conservation, and accessibility for people with individual needs, provides the foundation for developing universal guidelines. These will complement the city's strategic objectives as set out in the Łódź City Development Strategy 2030+ and the Łódź Spatial Development Strategy 2030+, offering a systematic framework for sustainable revitalization.

The preparation of Guidelines for Climate Change Adaptation of Courtyard Spaces in Historic Cities as well as the Charter for Green and Sustainable Courtyards in Historic Cities will ensure the proper implementation of subsequent courtyard revitalizations in Łódź, across Poland, and throughout Central Europe. The universality of this documentation guarantees that the developed solutions will extend beyond courtyard revitalization alone, forming a baseline for broader urban interventions.

5. List of Figures: