



LIFE IN

Runoff

URBAN RAIN IS A HIDDEN TREASURE

PROJECT ACTIVITIES
AND PROJECT RESULTS

2021– 2026



BUDAPEST



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URBAN RAIN IS WORTH ITS WEIGHT IN GOLD

“Rainwater is constantly changing its shape; if you try to catch it, it has already slipped away. Its incredible force can break through dams and sweep away houses, yet it may also patiently carve dripstones underground for millions of years, flood the burrows of groundhogs, drive earthworms from the soil and snails from the grass, or simply drizzle gently onto our faces, scattering stray drops across our windshields. We wipe them away and move on.”

(János Lackfi)



URBAN RAIN IS WORTH ITS WEIGHT IN GOLD

The climate is changing, and so is the weather. Budapest is increasingly facing meteorological extremes that were once considered rare: sudden downpours, flash floods, and increasingly long periods of drought. Although the total annual amount of precipitation has not decreased dramatically, the distribution of rainfall has fundamentally changed: large quantities now fall within short periods and at high intensity, while the number of rain-free days continues to increase.

The densely built urban environment, with its asphalt, concrete and other sealed surfaces, prevents water from infiltrating into the soil, while drainage systems become overloaded. The consequences are unpleasant: flooded streets, water entering basements, traffic disruption and significant financial damage — while only a few days later the city's green spaces may already be suffering from water shortages.

For many decades, the guiding principle of urban water management was that stormwater should disappear as quickly as possible. Under the new conditions created by climate change, however, this approach is becoming increasingly ineffective: it does not significantly reduce flood risk, while further worsening urban drought and the urban heat island effect.

LIFE in Runoff project represents a new approach: it views rainwater not as a problem but as a valuable resource. The objective is not merely drainage, but rather the local retention, slowing, infiltration and beneficial use of rainwater.

To achieve this goal, the project examined and tested in real-life environments the coordinated application of green infrastructure (such as rain gardens, green roofs and tree planting), blue infrastructure (water bodies, retention facilities and infiltration systems) and traditional grey infrastructure (drainage networks, technical systems and permeable pavements).

Through demonstration projects implemented in several districts of Budapest, RUNOFF demonstrates that integrated, nature-based solutions can simultaneously reduce flooding, improve the urban microclimate, increase the resilience of green spaces and prepare the city for the impacts of climate change.

Project Facts

Project **LIFE in Runoff**
Location **Budapest, Hungary**
Budget **EUR 3 020 487 (EU contribution: 55%)**
Duration **1 July 2021 – 30 April 2026**



OBJECTIVES

The overall objective of the project is to make Budapest more resilient to the impacts of climate change by demonstrating and practically testing an urban stormwater management approach that coordinates green, blue and grey infrastructure and treats rainfall not as a problem but as a valuable natural resource.



The project focused on the following themes:

Local utilisation of stormwater

Our demonstration sites show how rainwater can be used locally. A good example is the rainwater collected from the roof of the Klauzál Square Market Hall into an underground cistern, which is then used by District VII for irrigation purposes.

Reducing the risk of urban flooding and flash floods

To prevent flooding caused by sudden heavy rainfalls, the project tested solutions that slow down runoff, temporarily store water and gradually release it back into the environment. One example is Kolbányi Géza Street in District XVIII, where rain gardens and underground infiltration systems were installed.

Integrating green-blue-grey infrastructure

The project demonstrated that nature-based solutions such as rain gardens, green roofs and permeable pavements can work together effectively with conventional technical systems such as drainage networks, cisterns and infiltration facilities to address the challenges posed by climate change.

Improving the urban microclimate

By retaining rainwater locally, evaporation and vegetation water supply can be increased, helping to cool the environment, reduce the urban heat island effect and create more liveable public spaces. A good example is the complex rain garden system created along Pagony Street in District XII.

Public participation

In addition to technical solutions, the project raised awareness through consultations, public forums and dozens of articles, emphasising that stormwater management is not solely the responsibility of municipalities - it requires cooperation among all actors in the city, including residents, institutions and businesses.



STARTING POINT - TRADITIONAL URBAN STORMWATER MANAGEMENT METHODS ARE NO LONGER EFFECTIVE

For a long time, stormwater management in modern cities has been based on a simple principle: rainwater should be removed from streets and buildings as quickly as possible. The purpose of drainage systems has been to transport rainfall into receiving water bodies within a short period of time, thereby protecting cities from flooding.

As long as cities contained fewer sealed surfaces and more natural areas, and rainfall occurred in a relatively even distribution rather than in sudden, intense downpours, this approach worked well. However, conditions have changed.

Too many impermeable surfaces

Over recent decades, the built-up area of Budapest has continuously expanded, while the proportion of natural surfaces has decreased. As a result, less rainwater can infiltrate into the soil, and a much larger proportion enters the drainage network.

Heavy rainfall overloads drainage systems

The capacity of drainage networks is often insufficient to accommodate the enormous volumes of water arriving within a short period of time. When this occurs, the system fills up and flooding results.

Extreme weather events are becoming more frequent

In recent years, climate change has increased the frequency of sudden extreme rainfall events, flash floods, hailstorms and severe local windstorms in Hungary. Intense rainfall events cause considerable damage to urban infrastructure.

In summary, traditional systems based primarily on drainage can no longer adequately address the extreme precipitation conditions caused by climate change. This is why a new urban approach based on water retention has become necessary.





SOLUTIONS APPLIED IN THE PROJECT

Rain gardens

A rain garden is a shallow landscaped area planted with vegetation that can collect and absorb stormwater. Instead of immediately running off asphalt or concrete surfaces, water infiltrates gradually into the soil. This reduces pressure on drainage systems and lowers flood risk. Raingardens also enable local reuse of rainfall by replenishing groundwater resources and supporting vegetation.

Cisterns and Rainwater Harvesting Systems

The use of rainwater retention tanks (cisterns) and rainwater collection systems is particularly important in urban environments where extensive paved surfaces limit natural infiltration. Rainwater collected from roofs can be stored and later used for irrigation, cleaning or even toilet flushing.

Permeable Pavements

Permeable pavements, such as grass-gravel parking areas, or special porous surfaces, allow rainfall to infiltrate naturally into the ground. These solutions help recharge local water resources while reducing the burden on drainage systems. Slower runoff reduces flood risk and can also decrease water pollution.

Green Roofs

A green roof is a roof surface covered with vegetation. Beneath the vegetation is a layered system that provides suitable growing conditions while also retaining water. In addition to their aesthetic and environmental benefits, such as cooling buildings, green roofs play a key role in stormwater management. In some cities, including District XII of Budapest, green roofs are now mandatory for new flat-roof developments.

MAIN RESULTS OF THE PROJECT

Rainwater retention solutions and tools

The LIFE in Runoff partnership implemented pilot interventions in various urban conditions across three districts of Budapest. The new infrastructure retains rainfall on-site, allowing rainwater to be reused for irrigation or to infiltrate directly back into the ground. The project resulted in:

- 5 underground stormwater retention cisterns** in steep residential streets and in the high-density downtown
- 4 above-ground rainwater harvesting tanks** in community and institutional gardens
- 7 underground infiltration blocks** in low-density suburban streets and on a hillside
- 6 rain garden units** in steep residential streets and in suburban areas
- 6 permeable parking lots** in a suburban housing estate
- 2 modular green roof systems** on top of public institutional buildings
- 5 112 rainwater harvesting barrels** distributed to local residents

Modeling, assessments and strategy building

In addition to the pilot interventions, the project also included data-driven climate modeling, vulnerability assessments, and runoff modeling. These analyses provide guidance on the climate conditions we need to prepare for in the coming years, identify the areas in Budapest most at risk from extreme weather events, and assess the expected impact of new blue-green infrastructure. A monitoring network comprising 104 meteorological stations and covering the entire city of Budapest helps to continuously track changes in weather conditions within the city. Using strategy and policy documents, the partner municipalities have outlined specific goals and actions for the coming years. Thus, the partnership achieved:

- 6 vulnerability assessments** considering flash floods, heatwaves and drought
- 14 climate model-based** projections of the mid-term changes in temperature and rainfall patterns
- 2 runoff model-based** assessments to delineate sub-catchment areas and estimate stormwater runoff pathways
- 104 meteorological stations** installed across the city of Budapest
- 1 Budapest-level stormwater strategy**
- 3 district-level rainwater management action plans**

Long-term effects

The effects of the Runoff project will become directly noticeable in Budapest's everyday life over the long term. Based on the lessons learned from the pilot interventions, new and more effective stormwater retention infrastructures can be built. Guided by the new strategies and action plans, the city and district municipalities will be able to take coordinated actions on stormwater management projects and infrastructure maintenance. Thus, in the medium and long term, stormwater runoff can be gradually reduced, while rainwater retention can support and protect the urban soil and vegetation even during periods of drought.

PRESENTATION OF THE PILOT INTERVENTIONS

The goal of the project was not merely to present individual technical solutions, but to examine how these interventions function in areas of Budapest with varying characteristics. Various stormwater retention solutions were demonstrated in a densely built-up downtown environment in District VII, in a flat, suburban low-density residential area and a housing estate in District XVIII, and on a hillside with steep residential streets in District XII.

For each demonstration site, project experts assessed local technical and environmental conditions, including topography, soil characteristics, utility networks and the proportion of surrounding impermeable surfaces. Based on these analyses, they selected the most suitable combination of rain gardens, cisterns, infiltration facilities, green roofs and permeable pavements.

Each pilot intervention was carried out through several interconnected phases. First, experts surveyed the local conditions and assessed the emerging problems related to stormwater management; they then collected data using runoff models, measurements, and technical calculations. These preliminary studies served as a basis for selecting the most suitable locations and fine-tuning the technical design of the new rainwater retention infrastructures. This was followed by consultations with stakeholders, such as the local residents and the concerned institutions. Once the design plans were finalized, construction could begin, and after handover, data collection on operation and maintenance was launched. Water level sensors and soil moisture sensors were installed at each demonstration sites, allowing for continuous monitoring of the infrastructure's efficiency and its capacity to retain stormwater.





BUDAPEST DISTRICT XII

Implemented measures

- Rain garden – Pagony Street
- Cistern – Diana Street, Öröm Street
- Green roofs – Krisztinaváros Nursery and Svábhegy Nursery
- Residential rainwater harvesting support programme

UNDERGROUND RAINWATER RETENTION CISTERNS ON DIANA STREET (HILLSIDE)

Located in a hilly urban residential area, the underground cisterns on Diana Street help retain and reuse stormwater. The system has a total capacity of 30 m³ and consists of three interconnected units. Rainwater running down the steep streets is collected by a channel drain installed across the road, which then directs the water through filters into the underground tanks. The collected rainwater is used to irrigate flower beds, tree rows, and bee pastures in public areas.

The infrastructure was implemented by the Municipality of District XII of Budapest.

COSTS:

BR. HUF 20 444 205 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



UNDERGROUND RAINWATER RETENTION AND INFILTRATION ON ÖRÖM STREET (HILLSIDE)

The underground cistern and infiltration block installed on the steep hillside also help retain and reuse stormwater on Öröm Street. The pilot project consists of a 10 m³ reservoir unit and a 10 m³ infiltration block. Rainwater running off the surface is collected by two joint catch basins and then directed through filters into the interconnected underground units. The collected rainwater is used to irrigate flower beds, tree rows, and bee pastures in public areas.

The infrastructure was implemented by the Municipality of District XII of Budapest.

COSTS:

BR. HUF 14 639 066 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



BUDAPEST DISTRICT XII

Implemented measures

- Rain garden – Pagony Street
- Cistern – Diana Street, Öröm Street
- Green roofs – Krisztinaváros Nursery and Svábhegy Nursery
- Residential rainwater harvesting support programme

RAIN GARDEN SYSTEM AT THE DOG PARK OF PAGONY STREET (HILLSIDE)

Rainwater retention can be achieved using nature-based solutions, even on sloped terrain. At the dog park on Pagony Street, a system of vegetated retaining walls and drainage ditches collects rainwater running down on the adjacent slope and streets, then channels it into a rain garden located at the bottom of the dog park. The area covered by the rain garden is 1,582 m², which can retain approximately 65 m³ of rainwater. The new plantings and soil structure support the resilience of the existing vegetation even during dry periods too, while providing habitat and shelter for local wildlife.

The infrastructure was implemented by the Municipality of District XII of Budapest.

COSTS:

BR. HUF 54 818 286 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



MODULAR GREEN ROOFS ON NURSERY SCHOOLS

The extensive, modular green roofs—totaling 500 m²—installed on the roofs of the Krisztinaváros and Svábhegy Nurseries are capable of retaining a significant amount of stormwater even in extreme rainfall events, acting as temporary reservoirs and slowing down water runoff. A unique feature of the structure is that it consists of tray-like elements, allowing it to be easily installed even on older buildings. By removing the trays, future roof repairs can be carried out with ease. The green roofs significantly improve the nurseries' thermal insulation while also supporting biodiversity by providing new habitats.

The infrastructure was implemented by the Municipality of District XII of Budapest.

COSTS:

BR. HUF 14 639 066 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.





BUDAPEST DISTRICT XVIII

Implemented measures

- Rain gardens and infiltration blocks – Kolbányi Géza Street
- Permeable pavement electric vehicle parking area – Riesz Frigyes Street
- Residential rainwater harvesting support programme

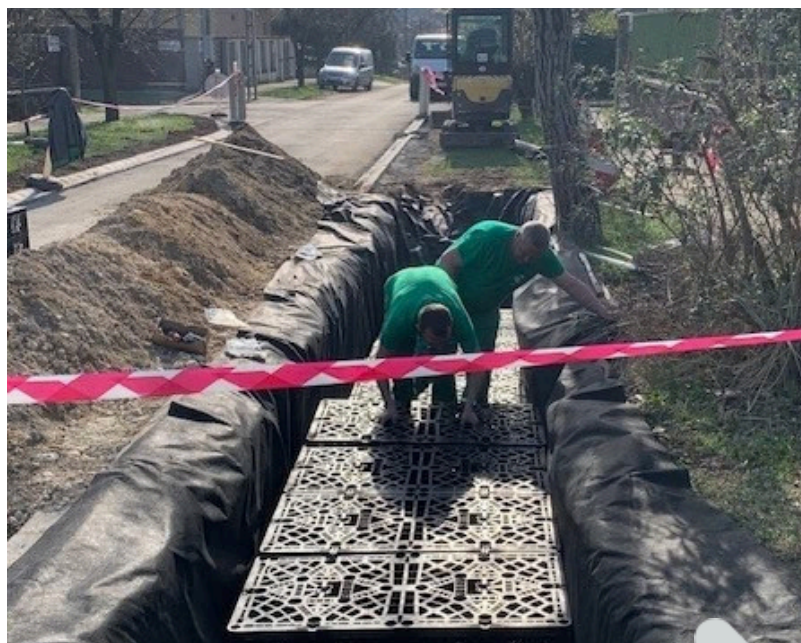
VARIOUS RAINWATER RETENTION MEASURES IN KOLBÁNYI GÉZA STREET (SUBURBAN RESIDENTIAL AREA)

Kolbányi Géza Street is located in a suburban area with single family homes which experience significant flash floods in sudden rainfall events. Six underground infiltration blocks with a total capacity of approximately 42 m³, along with four rain gardens and one tree trench were installed to slow the runoff, retain and store rainwater on-site, and infiltrate it back into the ground.

The infrastructure was implemented by the Municipality of District XVIII of Budapest.

COSTS:

BR. HUF 48 590 713 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



PERMEABLE PAVEMENTS AT RIESZ FRIGYES STREET (SUBURBAN HOUSING ESTATE)

On Riesz Frigyes Street, in a high-rise housing estate, four (and later two more) gravel-and-grass parking spaces reserved exclusively for electric cars were built, complete with electric charging stations. A uniform, contiguous green space was created in place of the previously unused asphalt pavement.

The infrastructure was implemented by the Municipality of District XVIII of Budapest.

COSTS:

BR. HUF 9 115 154 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



BUDAPEST DISTRICT VII

Implemented measures

- Underground cistern – Klauzál Square
- Rainwater harvesting tank – Kis Diófa Community Garden
- Rainwater harvesting tank – Magonc Kindergarten
- Residential rainwater harvesting support programme

UNDERGROUND CISTERN AT KALUZÁL SQUARE (DOWNTOWN)

In Budapest's high-density downtown area, rainwater from the roof of the Market Hall on Klauzál Square is collected in an underground cistern, which provides irrigation water for the maintenance of green spaces in the surrounding streets. As part of the project, a tank with a capacity of nearly 60 m³ was installed beneath the courtyard of the apartment building adjacent to the Market Hall.

The infrastructure was implemented by the Municipality of District VII of Budapest.

COSTS:

BR. HUF 34 420 747 (55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



RAINWATER HARVESTING TANKS IN A COMMUNITY GARDEN AND A KINDERGARTEN (DOWNTOWN)

Harvested rainwater is a valuable resource for managing institutional and community green spaces in the city centre with extensive paved surfaces. Rainwater from the roof of the Magonc Kindergarten is collected in two 1 m³ tanks and irrigates the kindergarten's flower beds through underground drainage pipes. In the Kis Diófa community garden, two 1 m³ tanks connected to the downspout of the neighboring apartment building harvest rainwater for watering the vegetable beds.

The infrastructure was implemented by the Municipality of District VII of Budapest.

COSTS:

Kis Diófa community garden: BR. HUF 2 394 864
Magonc Kindergarten: BR. HUF 3 702 346
(55% of which was financed by the European Union). The project was co-financed by the State of Hungary.



IMPACT

The nature-based and traditional stormwater retention solutions implemented through the project contributed to reducing stormwater runoff, improving green spaces and increasing the climate resilience of urban areas.

Stormwater retention

Based on monitoring equipment installed within the infiltration systems on Kolbányi Géza Street in District XVIII, approximately 140 m³ of rainwater was captured and infiltrated between April 2024 and December 2025. This volume of water would otherwise have flowed along streets or entered the drainage network.

In District XII the Pagony Street rain garden can retain approximately 65 m³ of water. The retention tanks at Diana Street can store approximately 30 m³, the Öröm Street cistern can store approximately 20 m³ and the extensive green roofs installed on nursery buildings can retain an additional 16 m³ of stormwater.

Reduced flooding and liveable public spaces

According to resident feedback and observations during rainfall events, the volume of water flowing along streets has decreased. In District XII, interventions not only reduce flooding locally but also decrease flood risk in lower parts of the catchment area by retaining water at higher elevations. For example, in Öröm Street, flooding of neighbouring properties has been reduced, while the water and mud that previously accumulated at the lower end of the Pagony Street dog park have disappeared, as the rain garden allows the water to infiltrate into the ground.

The reduction of stormwater runoff and the elimination of large accumulations of standing water have resulted in more liveable public spaces. In Pagony Street, for example, the newly planted vegetation improves the local microclimate, while the renovated dog park has become more orderly and functional. Water collected in the underground cisterns can also be used for irrigating vegetation, making green spaces more resilient during dry periods.

Improved green spaces and increased biodiversity

In Pagony Street in District XII, the size of the green area remained unchanged, but its quality improved significantly. Within the 1,582 m² rain garden, approximately 4,000 new plants were introduced, including native perennials and shrubs. Deadwood elements were also incorporated, providing habitat for a wide range of species. The rain garden collects stormwater not only from the green space itself but also from adjacent road surfaces, functioning as a complex nature-based stormwater management system.

As part of the project, 500 m² of new green roofs were installed on two nursery school buildings. The modular extensive green roof system consists of 6–7 different sedum species and effectively retains rainwater, improves the local microclimate, and contributes to increasing urban biodiversity.

PARTICIPATION AND COOPERATION

The successful implementation of urban stormwater management is not possible without broad cooperation. One of the key objectives of the LIFE in Runoff was therefore to connect municipalities, professional organisations and local communities, while also promoting knowledge sharing among settlements across Hungary.

The Role of Municipalities

As part of the project, a series of workshops was organised between 2023 and 2024 involving the districts of Budapest, structured around the city's stormwater catchment areas. These workshops provided an opportunity for districts to exchange experiences, learn from each other's solutions and jointly explore the future of urban water retention.

During 2024, the Runoff partnership visited six regional centres in Hungary and invited further eight neighbouring municipalities to build local rainwater management roadmaps in workshop setting. The meetings operated as platforms to share experiences about practical stormwater management solutions throughout Hungary.



Professional cooperation

Throughout the project, municipalities worked closely with numerous professional partners. Cooperation included the Budapest University of Technology and Economics, Budapest Sewage Works, HungaroMet, the Hungarian Association of Landscape Contractors and Maintenance Companies, as well as green roof designers, landscape architects and municipal technical departments.

Public Engagement

Just as municipal commitment is essential, long-term success in urban water retention cannot be achieved without the support of local communities.

In District XVIII, for example, residents have for several years been able to access rainwater harvesting barrels at reduced cost through a municipal support programme. In LIFE in Runoff, District XII and District VII launched similar programmes. Between 2021 and 2026, more than 5,000 rainwater barrels were distributed in total to the residents of the three districts. The project's key messages and results were also presented at various community events.



LIFE in Runoff also participated in several public programmes, including the green-themed lecture series organised within the UPSURGE project, where participants learned about the relationship between urban green infrastructure and stormwater management. The objective was not only to familiarise residents with rain gardens and other nature-based solutions, but also to encourage their active involvement in maintaining and caring for these interventions.

Public participation was further supported by the fact that all demonstration projects were implemented through consultation processes. Plans were presented to residents, site visits were organised and continuous dialogue was maintained throughout the construction phase.

As a creative communication initiative, the project also linked stormwater management with literature through a short-story competition, which resulted in the publication of the volume 'Urban Rain, Urban Stories', accessible on the link below:

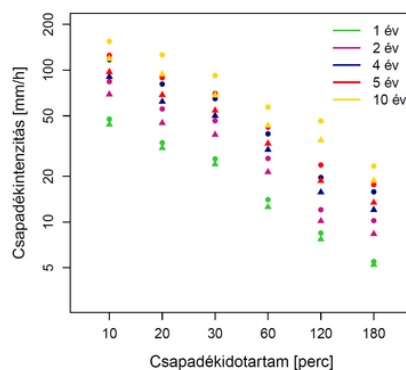
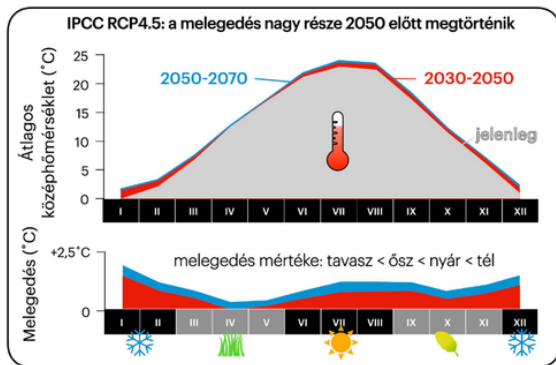
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SCIENTIFIC BACKGROUND AND DECISION-SUPPORT TOOLS

The LIFE in Runoff project not only implemented demonstration infrastructures but also developed analyses and tools that will support the climate adaptation efforts of Budapest and other municipalities in the long term.

Climate Models and Rainfall Analysis

Detailed climate models were prepared for Budapest, examining the expected development of heatwaves, extreme rainfall events, tropical nights and drought periods over the coming decades. Continuous monitoring and future modeling are supported by the installation of a network of 104 meteorological stations across the city of Budapest.



Climate Vulnerability Assessment

A GIS-based climate vulnerability assessment was prepared for the entire territory of Budapest. The assessment identified the districts, buildings, public spaces and green areas most exposed to flash floods, heatwaves and drought conditions. The results support the planning of targeted and cost-effective climate adaptation measures.

During the assessment, the following factors were considered:

- extreme weather events, such as the amount of rainfall received within a single day, temperature levels, etc.;
- the sensitivity of those affected by these events - for example, heatwaves pose a greater risk to older age groups, while older buildings are more vulnerable to damage during periods of intense rainfall;
- the adaptive capacity of those affected by extreme climate events - for example, wealthier households are generally better able to protect themselves against extreme heat because they can more easily equip their homes with insulation, cooling systems and other protective measures.

The assessment enables the Municipality of Budapest and the district municipalities to identify those parts of the city with the highest vulnerability scores. The underlying data and indicators help determine the types of interventions that are needed. For example, if a district's high vulnerability to heatwaves is primarily driven by a large proportion of impermeable paved surfaces, the municipality can examine opportunities for removing pavement and expanding green spaces. At the same time, local residents may undertake similar improvements themselves, for example by greening the courtyards of apartment buildings. Urban service providers also play an important role in adaptation, for instance by installing shaded bus stops, drinking fountains and misting stations, or by carrying out targeted irrigation of public spaces.



Vulnerability map of Budapest to heatwaves.

Dark colours indicate low vulnerability, light colours signify high vulnerability. The map clearly demonstrates that the high-density central districts are more vulnerable to heatwaves than the periphery where green spaces are more abundant and extensive.

Did you know?

During heatwaves, a south-facing urban block that is completely surrounded by paved surfaces, contains poorly insulated buildings and is inhabited predominantly by elderly residents is far more vulnerable than a suburban-style block with well-insulated buildings, large gardens and a younger population.

Opportunities for Mitigating the Urban Heat Island Effect

As part of the project, sensitivity assessments were carried out to identify the types of interventions that could reduce urban warming. Among other factors, the models examined the effects of increasing green space, using lighter-coloured paving materials and different irrigation practices. The results show that nature-based solutions play an important role not only in retaining rainwater locally, but also in improving the urban microclimate and mitigating the urban heat island effect.

TOOLKITS FOR RESIDENTS, MUNICIPALITIES AND EXPERTS

Knowledge Sharing and Replication

Building on the results of the project, toolkits were developed for both residents, municipalities and experts. These provide practical guidance on rainwater retention, rain gardens, green roofs, biodiverse green spaces and other nature-based solutions.

The purpose of the toolkits is to ensure that the experience gained through the Runoff project can benefit not only Budapest, but also other municipalities, professionals and residents by providing practical support for climate adaptation. These knowledge resources help ensure that the project's results continue to have an impact beyond the project's completion and become more widely adopted.

A toolkit for residents

The residents' toolkit demonstrates what can be done around homes, gardens and apartment buildings. It explains how rainwater can be collected and reused, highlights the benefits of rain gardens, garden ponds, infiltration systems and permeable pavements, and shows how biodiverse gardens, tree planting, green roofs and green façades can contribute to creating cooler and more liveable urban environments. The toolkit not only provides ideas but also helps users assess the advantages, limitations and maintenance requirements of different solutions.

The residents' toolkit is available at:

<https://zold.hegyvidek.hu/tudastar/lakossagnak/eszkozta-megfelelo>

A toolkit for municipalities

The toolkit developed for municipalities and professionals presents opportunities for stormwater retention at a broader, city-wide scale. Unlike the traditional approach, it treats rainwater not as a problem to be drained away but as a valuable local resource. The collection brings together both nature-based and traditional engineering solutions, including the creation of nature-friendly green spaces, reduced mowing practices, pollinator meadows, tree planting, green roofs and green façades, rainwater storage systems, rain gardens, stormwater retention tanks, infiltration systems and permeable pavements. The toolkit also presents good practices of community engagement and supporting systems to motivate the local residents in applying rainwater retention solutions in their garden.

The municipalities' toolkit is available at:

<https://zold.hegyvidek.hu/tudastar/szakembereknek/csapadekvizmegtartasi>

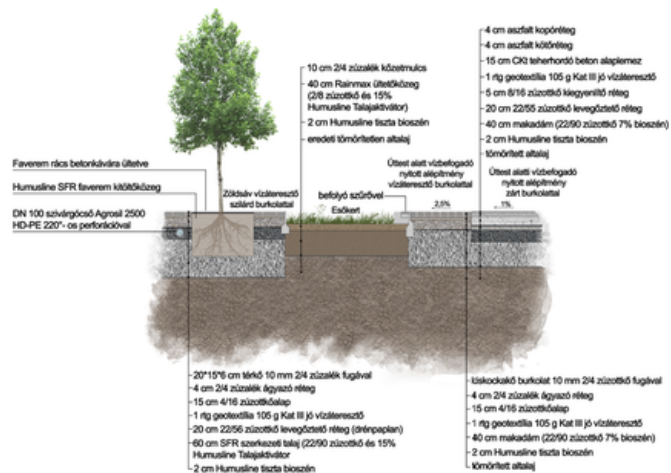
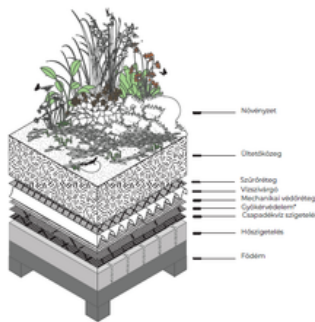


Two New Publications about Green Infrastructure

The Municipality of Budapest publication series about green infrastructures - the 'Green Infrastructure Booklets' - has been expanded with two new volumes about sponge cities and green roofs. The publications were prepared by experts in the field and are intended to support planners, designers and decision-makers while also informing residents and promoting awareness of sustainable urban water management practices. The new volumes present various solutions for green roofs and urban stormwater retention, as well as their technical and ecological requirements and potential limitations, from the perspective of several expert fields.

The Budapest 'Green Infrastructure Booklets' are available here:

<https://budapest.hu/zold-budapest/zoldfeluletek/tervezoknek>



BUDAPEST STORMWATER STRATEGY AND DISTRICT ACTION PLANS

The Municipality of Budapest aims to integrate stormwater management into the complex system of urban public services. The objective is to ensure the effective provision of water supply, drainage, public transport and other services while making greater use of rainwater for irrigation, urban cooling and improving soil water retention, thereby increasing the city's resilience to a changing climate.

The experiences gained through the LIFE in Runoff project, together with the monitoring data and modelling results, provided a solid foundation for the development of Budapest's Stormwater Strategy. The three partner district municipalities (District XII, District VII and District XVIII) developed their local rainwater management action plans, conforming to the framework provided by the city-level strategy.

The strategy proposes technical, institutional and regulatory recommendations relating both to new developments and to the existing urban water management system. One of its main objectives is the coordinated operation of stormwater infrastructure, including drainage channels and ditches, in order to ensure the efficient management of water originating both within Budapest and from surrounding areas.

Businesses, shopping centres, office buildings and private property owners also have a significant impact on stormwater management. Due to extensive paved surfaces and roof areas, a large proportion of rainfall currently enters the drainage network almost immediately. Encouraging property owners and operators to delay runoff and, even more importantly, to make use of rainwater locally is essential for reducing pressure on drainage systems and wastewater treatment plants.

By infiltrating rainwater into the ground and reusing it for irrigation, it is possible not only to support the maintenance of urban green spaces, but also to cool local environments through evapotranspiration during hot summer periods. In addition, these measures contribute to improving the water quality of small watercourses and the Danube by reducing the stormwater surcharge on urban drainage infrastructure.

The strategy proposes the preparation of district-level rainwater management action plans similar to the three district action plans developed within the Runoff project. It also advocates greater consistency in district-level regulations and promotes catchment-based stormwater management as well as stronger cooperation with municipalities in the wider urban agglomeration area.

Because rainwater primarily originates on privately owned land and local authorities have only limited opportunities to address the issue on public land alone, awareness-raising plays a particularly important role. The rainwater management solutions tested through the Runoff project provide an excellent basis for this process.

The Budapest Stormwater Strategy and the district-level rainwater management action plans are available here:

<https://varosieso.hu/dokumentumtar/>

LESSONS LEARNED

LIFE in Runoff provided numerous valuable lessons for the participating municipalities and organizations in the field of urban stormwater management.

One of the most important outcomes is that stormwater management has gradually become part of the day-to-day operation of local governments. The project contributed to closer cooperation between different municipal departments and public authorities, while also bringing the topic into public communication. Experience shows that residents are becoming increasingly aware of the challenges posed by extreme rainfall events and urban flooding, providing an important foundation for future action. The project also led to the establishment of expert partnerships and the development of concrete action plans that will support future investments and interventions. Cooperation at the Budapest city-level has also strengthened, and the project's results are already being utilised in other initiatives.

At the same time, implementation presented a number of challenges. In densely built urban environments, opportunities for large-scale interventions are limited, while existing infrastructure—such as ageing combined sewer systems—often complicates the application of new solutions. Investments are frequently slowed by complex ownership arrangements, permitting procedures and the need to involve multiple authorities. The project also demonstrated that some measures, such as the initially planned green roof grant scheme targeting apartment buildings, attracted less interest than expected, partly because of costs and the technical restraints.

The assessments also highlighted that flooding cannot be effectively addressed at individual locations alone - instead, the entire catchment area must be taken into consideration. In many cases, stormwater retention measures should begin in the elevated parts of the catchment area. Experience suggests that in densely built urban environments, several smaller, complementary interventions may be more effective than a single large investment.

The project also demonstrated that stormwater management is a long-term process. Planning, data collection and implementation often require several years. Nevertheless, the knowledge, partnerships and methodologies developed through the project provide a solid foundation for future progress.

The project partners will continue this work through related initiatives, including the Interreg HU-SK #mountgreenfra, the LIFE INSSURE and COOLZONE, as well as the Horizon coCreek, CLIMAAX, Pathways2Resilience and UPSURGE projects.



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