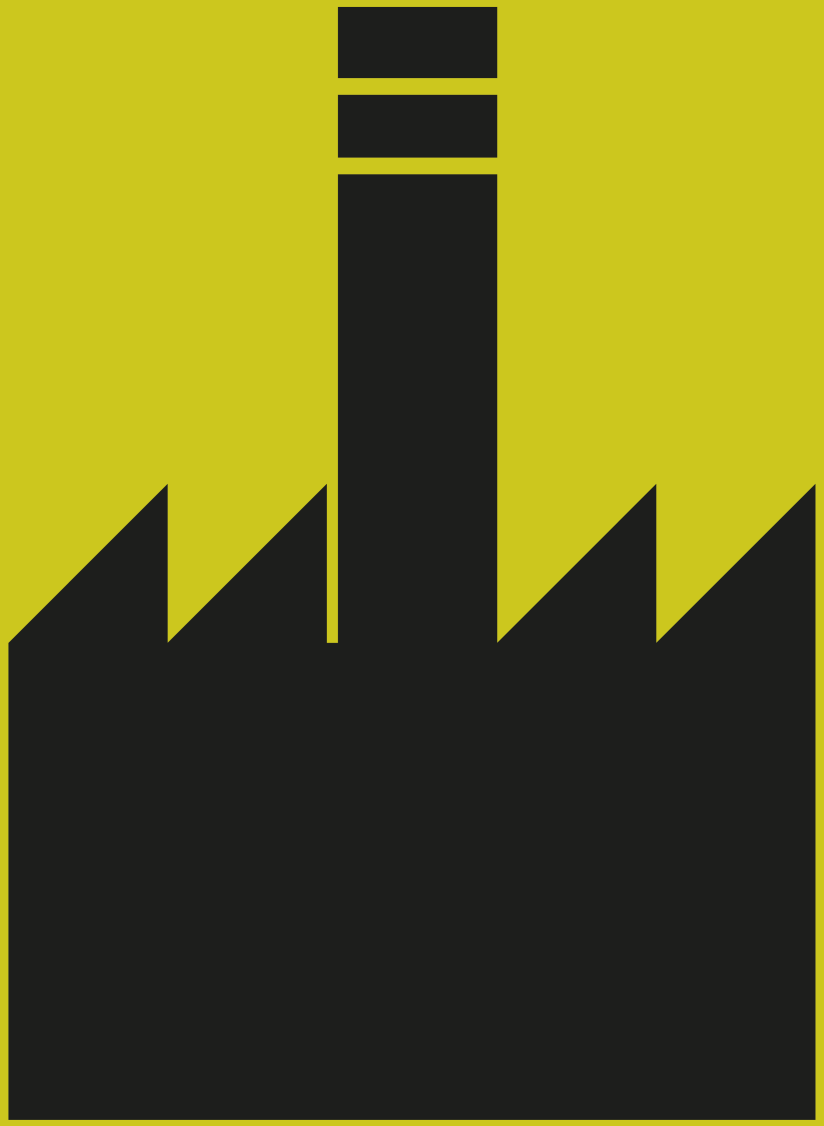
Author: Dominik Kamiński



NEWSLETTER
JUNE/6/2026

Sustainable Development Office
ZIELONY WSIiZ

SUSEE Sustainability

Co-funded by the European Union

11 SUSTAINABLE CITIES AND COMMUNITIES

ISSUE TOPIC:

URBAN WATER RETENTION

Sustainable Development Goal 11: Sustainable Cities and Communities

The increasing frequency of flash floods is one of the consequences of climate change. Prolonged periods of drought are increasingly interspersed with episodes of intense rainfall, while parched soil is unable to absorb the large volumes of water that fall within a short period of time.

Sudden rises in the water levels of rivers and other, often inconspicuous, watercourses, combined with overloaded drainage and sewer systems, lead to the rapid flooding of streets, basements, and urban infrastructure. Flash floods therefore result not only in environmental damage but also in costly destruction to the built environment, which can be difficult and time-consuming to repair.

STRAIGHT TO THE POINT

PIOTR NIEZNAŃSKI

Code for Green Foundation, lecturer of the course "Civilization Challenges" at UITM

In urban areas, rainwater is too often viewed as a problem that must be removed as quickly as possible through drainage systems. In reality, however, it is a valuable resource that can be managed wisely by capturing, storing, and using it where it falls.

Therefore, **decentralized water retention** measures are particularly important, including:

- rain gardens,
- bioretention basins,
- tree pits designed for water infiltration,
- permeable surfaces,
- the removal of impervious paving from squares and sidewalks,
- and rainwater harvesting tanks installed near buildings.

Such solutions operate close to where rainfall occurs, slowing surface runoff, reducing pressure on drainage systems, and enabling water to be used locally—for irrigating green spaces, carrying out maintenance work, or supporting the upkeep of urban areas. Unlike large artificial reservoirs, decentralized water retention does not concentrate water in a single location, where higher summer temperatures can increase losses through evaporation, overheating, and declining water quality, including the risk of algal blooms. Instead, numerous small-scale water storage systems—in soil, vegetation, and urban green spaces—more effectively support the local microclimate, biodiversity, and a city's resilience to both drought and heavy rainfall.

This is a solution that benefits everyone: residents enjoy a cooler, greener, and safer city, while the environment benefits from more water being retained within the local water cycle.

FLASH FLOODS

The so-called " flash "Flood " is a phenomenon that is best characterized by two key features: **they occur rapidly and with great intensity**.

They appear suddenly – just a few dozen minutes of heavy rainfall is enough.

WHERE DO THEY OCCUR?

Flash floods are a global phenomenon, and their frequency is steadily increasing, including in Poland.

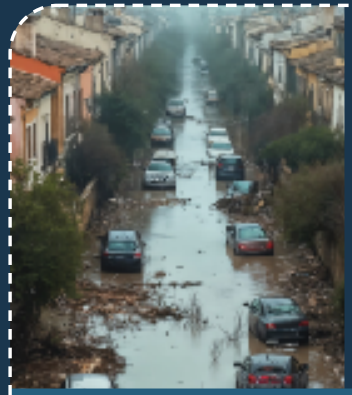
WHY ARE THEY SIGNIFICANT?

During a flash flood, the amount of rainfall recorded within just a few hours can exceed one-fifth of the average annual total.

HOW DO THEY FORM?

They are most often caused by nearly stationary thunder-storm cells that linger over a given area for 1-2 hours (or longer in extreme cases), bringing heavy rainfall.

They can also result from so-called "**training storms,**" in which successive storm cells move over the same area one after another.



WHY ARE CITIES PARTICULARLY VULNERABLE?

- Sealed surfaces (concrete, asphalt, roofs);
- Insufficient blue-green infrastructure;
- Rapid water runoff over-loads the sewer system.

Dried soil cannot absorb heavy rainfall.

DID YOU KNOW THAT...

According to the World Meteorological Organization (WMO), flash floods account for

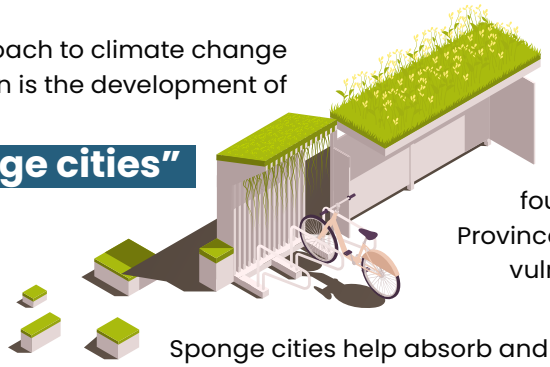
85%

of all flood events worldwide

and have the highest mortality rate among hydrological hazards[1]

One approach to climate change adaptation is the development of so-called

"sponge cities"



Examples can be found in China's Qinghai Province, which is particularly vulnerable to flash floods

Sponge cities help absorb and retain rainfall through features such as permeable pavements, green roofs, rainwater harvesting systems, and drainage swales[2]

The concentration of rainfall over urban areas is influenced by the **urban heat island** effect*, which contributes to the formation of vertically developed storm clouds capable of producing torrential rainfall.

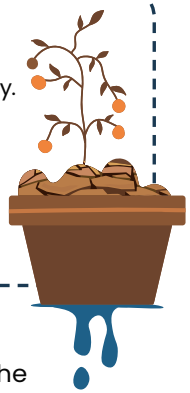
*Urban heat island - a built-up urban area that experiences higher temperatures than the surrounding rural or less densely developed areas. Temperature differences can reach several degrees Celsius and result from heat being absorbed and retained by concrete and asphalt surfaces, limited vegetation, reduced wind speeds, and heat emissions from transportation and air-conditioning systems.

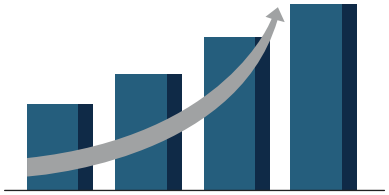
Intense rainfall over a short period does not necessarily improve local water availability

- the affected area may still experience drought**

**This can be illustrated by an example cited in an article by Sebastian Szklarek: if severely dried-out soil in a small flowerpot is suddenly given a bucket of water, it will be unable to absorb it quickly. The excess water will overflow onto the windowsill and spill onto the floor.

The same mechanism occurs during a flash flood. Most of the excess water flows away from the affected area, while only a small proportion is retained where the rainfall occurred.[2]





Global projections indicate that the **frequency of flash floods is likely to continue increasing**[2,3]

1% → 3,3%

In an already highly impervious catchment***, a further 1% increase in impervious surface cover may raise **flood risk** by as much as 3.3%[4]

***catchment – a land area from which both surface water and groundwater drain into a particular river (or part of a river), lake, wetland, or other hydrological feature.

[1] https://obserwator.imgw.pl/2026/03/25/hydrologu-nadchodzi-powodz-ktorej-nie-zmierzyles/_za: https://wmo.int/media/news/devastating-floods-highlight-need-and-challenges-warnings

[2] https://www.nature.com/articles/d41586-023-00626-9

[3] https://onlinelibrary.wiley.com/doi/full/10.1111/jfr3.12999

[4] https://naukaoklimacie.pl/aktualnosci/powodzie-blyskawiczne-w-miastach-zdarzaja-sie-coraz-czesciej-potrzeba-wiecej-zieleni-i-wywiad

WHAT IS THE SITUATION IN POLAND?

Over the past decade, flash floods have been classified as a

new category of insurance risk

and are considered among the most dangerous and unpredictable natural hazards facing Poland[5]

Flash floods prompted more than

1,500
fire brigade interventions in 2021

By 2024, that number had risen to over

2,500
interventions[6,7]

Although flash floods are among the best-documented hydrological phenomena, they remain one of the most difficult to forecast due to their rapid onset and highly localized nature[8]

[5] https://piu.org.pl/wp-content/uploads/2023/07/PIU-raport-klimatyczny-2023_27-lipca_premiera.pdf

[6] https://www.imgw.pl/sites/default/files/2022-04/imgw-pib_raport-klimat-polski_2021_0.pdf

[7] https://imgw.pl/wp-content/uploads/2025/07/RAPORT-IMGW-PIB-Klimat-Polski-2024.pdf

[8] https://obserwator.imgw.pl/2026/03/25/hydrologu-nadchodzi-powodz-ktorej-nie-zmierzyles/

[9] Departament Gospodarki Wodnej i Żeglugi Śródlądowej: https://www.gov.pl/web/retencja/czym-jest-retencja

[10] https://www.gov.pl/web/wody-polskie/retencja-przydomowa

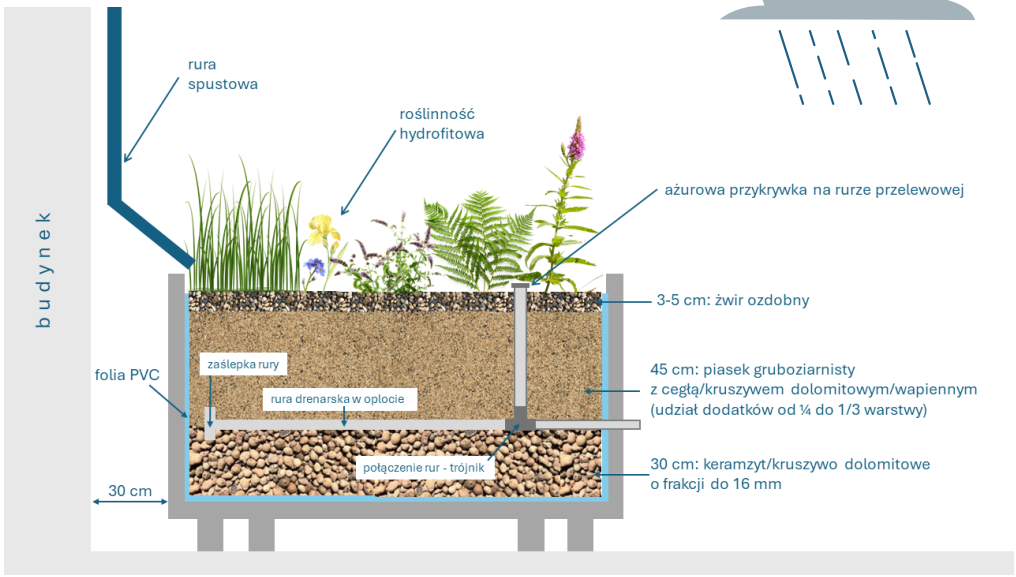
Proper water resource management is more important than ever. Climate change, droughts, and floods all have a negative impact on Poland, its economy, and the well-being of its residents.

Poland ranks among the European countries with the lowest water resources per capita. As a result, managing these limited resources effectively is no longer simply a matter of good practice—it is a necessity. Ensuring adequate water retention can help protect us from many potential disasters. However, action must be taken now, before it is too late.[9]

What can we do at home?

As individuals, we can also contribute to improving local water management. **Small-scale and household water retention** measures that can be implemented on private properties include:

- rainwater harvesting tanks (e.g. barrels or cisterns),
- surface water retention features (e.g. garden ponds with vegetation),
- permeable surfaces (e.g. permeable paving blocks),
- green roofs (which retain water and help regulate the microclimate),



Example of a rain garden design. Source: Natalia Górka, M.Sc. Eng.

URBAN WATER RETENTION

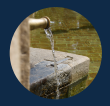
How can cities reduce the risk before problems arise?

The nature of flash floods differs from that of river or coastal flooding, limiting the range of measures available once the threat has emerged. However, effective prevention can be achieved through appropriate urban planning and spatial management, including:

dry and/or wet **retention basins** (including underground reservoirs located beneath roads and parking areas),

expanding **green spaces**, including increasing tree cover,

reducing the extent of impervious surfaces (such as concrete and asphalt-covered squares, marketplaces, and pedestrian zones)



constructing local **infiltration wells** and additional drainage systems

In some cases, economic analyses may indicate that local relocation is necessary. However, the selection of measures should always be **tailored to the specific characteristics and needs of a given area**[11].

Fot.: magnific.com

Which measures are most effective?

Not all initiatives have a significant impact on urban water retention. The primary challenge in cities is the rapid drainage of rainwater into sewer systems; therefore, the most effective measures are those that slow down this process:

- **repaving and increasing permeability**: replacing asphalt and concrete with permeable surfaces, using permeable parking areas, and reducing unnecessary paved surfaces,
- **rain gardens and bioretention basins**: when properly designed, they effectively capture runoff from roofs and streets, store water, and reduce the rate at which it leaves the area,
- **green roofs** with deep growing media and integrated water-storage systems beneath the vegetation,
- **catchment-scale retention measures**: maintaining ponds and urban wetlands, restoring river floodplains, and preserving areas that can temporarily store excess water during flood events[12],
- **planting and preserving as many large trees** as possible, as they intercept rainfall in their canopies, increase infiltration, reduce surface overheating, improve soil structure, and enhance the soil's capacity to retain water[13].

The least effective are single and highly dispersed actions.
These include:

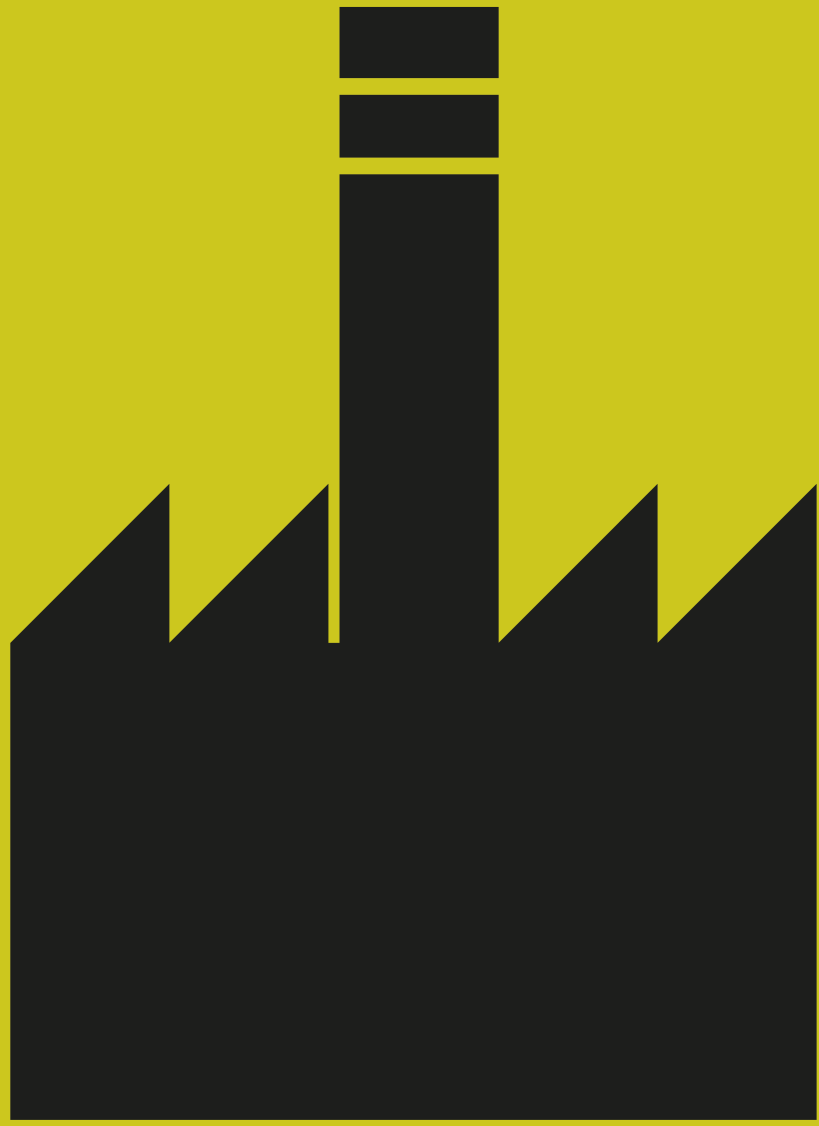
- individual rainwater tanks installed at public buildings and presented as a solution for the entire city,
- planting trees without adequate rooting space—for example, in small concrete tree pits without suitable soil or access to water (such trees rarely grow large enough to make a meaningful contribution to water retention),
- fountains, which may improve the appearance of public spaces but do not contribute to water storage,
- planting vegetation without modifying the surrounding drainage system, where impervious concrete surfaces remain in place and rainwater is still directed immediately into the sewer network[14].

[10] https://obserwator.imgw.pl/2021/12/09/uchronic-miasto-przed-powodzia/
[11] https://www.gov.pl/web/wody-polskie/zielona-retencja--wodna-recepta-dla-miast
[12] https://www.epa.gov/green-infrastructure
[13] Facebook: Perły Greenwashingu - post z dn. 16 marca 2023

11 SUSTAINABLE CITIES AND COMMUNITIES

WATER IS A RESOURCE FOR A SECURE FUTURE

Author: Dominik Kamiński



Any suggestions regarding the Newsletter, including proposals for interesting topics and initiatives, to: bzr@wsiz.edu.pl

Sustainable Development Office | ZIELONY WSIiZ

Team of Sustainable Development
Sustainable Development Office – RA 143
+48 17 866 12 82 / +48 17 866 11 84