WORLD GREEN INFRASTRUCTURE NETWORK
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Urban Green Infrastructure: Green roofs

AN EFFECTIVE SOLUTION TO TACKLE URBAN FLOODING AND THE POLLUTION OF WATERWAYS

The rapid spread of urbanisation, combined with climate change that is causing more frequent and intense rainfall, is putting huge pressure on municipal waste-water treatment systems.

Overflows due to stormwater, and the resulting pollution of waterways is becoming a growing problem. Where authorities are doing their best to manage the situation, they often have to use large amounts of energy to do so, which is both costly and environmentally unfriendly.

Ways of tackling this issue need to be a high priority in the European Commission's ongoing evaluation of the Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC.

One method to consider is encouraging the use of urban green infrastructure, and in particular green roofs. They offer a unique, highly efficient and environment-friendly way to reduce stormwater overflows.

Background

The Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC has been in place for 27 years. It has not been updated, but the European Commission is now evaluating it.

Under the terms of the current Directive, Member States have to ensure that all urban wastewater, except stormwater, is treated before being discharged.

However, the majority of large European cities have relatively old water infrastructure systems, and many do not have a two-tier system necessary for dealing separately with stormwater and wastewater.

Consequently, when it rains heavily, massive amounts of stormwater enter common wastewater systems, requiring the stormwater to be treated in the same way as wastewater. It necessitates substantial investment to provide excess treatment capacity for occasional use and involves significant energy consumption.

When the ageing systems cannot cope or fail, flooding and the pollution of waterways occurs.

The green infrastructure solution

Green roofs (sometimes also referred to as vegetated or living roofs) prevent stormwater surges by eliminating or slowing down the water flow into the wastewater system. They

typically consist of layers of vegetation, growing media and drainage. Depending on the depth of the growing media layer they are referred to as extensive or intensive roofs. Extensive roofs generally have a growing media depth of less than 150 mm and are the most common.

Green roofs retain stormwater in the growing media and vegetation, considerably reducing the peak flow and volume compared to conventional roofs. Well-designed green roofs can typically retain up to 70-90% of stormwater in summer.

The vegetation also allows water to evaporate (evapotranspiration) which further helps reduce the runoff. Water from a fully saturated green roof can naturally evaporate at a rate of between three and five litres per square metre during a hot summer day.

Green roofs can be retrofitted as well as incorporated in the design of new buildings.

Advances in research and technology

Green roofs are not a new technique[1] and their use for stormwater management has had notable success in various cities around the world. But what is more recent are the advances in knowledge and technology that have considerably increased their effectiveness.

Not only have they benefitted from years of research and trials, but stormwater measurement tools have now been developed which allow green roofs to be designed specifically for different cities and micro-climates.

An example of such research is an ongoing five-year study performed by the Laboratory of Sustainable Studies in Buildings at the University of Ljubljana in Slovenia. It has resulted in the development of software capable of evaluating customised green designs for almost anywhere in the world. Modelling is based on using 20-year historical meteorological data.

The green roof industry has also invested in sophisticated, computerised stormwater laboratories to simulate local storm conditions to test and optimise different roof green roof designs.

Various studies explaining the benefits and effectiveness of green roof technology in more technical detail are summarised and cited in the paper *Green Roof for Stormwater Management in a Highly Urbanized Area: The Case of Seoul, Korea*[2].

THE BENEFITS OF GREEN INFRASTRUCTURE

> ***"Green Infrastructure provides multiple benefits in the form of supporting a green economy, improving quality of life, protecting biodiversity and enhancing the ability of ecosystems to deliver services such as disaster risk reduction, water purification, air quality, space for recreation and climate change mitigation and adaption."*** [3]
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> *"Green Infrastructure and Climate Adaptation" European Commission*[4]

In addition to appreciably reducing pressure on urban drainage systems and helping prevent flooding, green roofs offer a range of other benefits.

[1] Köhler, M. Green Roof Technology—From a Fire-Protection System to a Central Instrument in Sustainable Urban Design. In Proceedings of the 2nd Green Roof Conference, Portland, OR, USA, 2–4 June 2004.
[2] Green Roof for Stormwater Management in a Highly Urbanized Area: The Case of Seoul, Korea. Muhammad Shafique, Reeho Kim, and Kwon Kyung-Ho. Sustainability 2018, 10, 584; doi:10.3390/su10030584
[3] http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_climate_adaptation.pdf
[4] http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_climate_adaptation.pdf

They are a highly efficient, environmental-friendly way to reduce energy consumption in buildings, and they have a direct, positive impact on cooling down the surrounding environment, similar to trees and other vegetation.

Green Infrastructure solutions can also reinstate significant vegetation to paved areas, thus contributing very positively to climate change mitigation and climate adaptation.

IMPORTANT FACTS ABOUT GREEN ROOFS

Green roofs appreciably reduce pressure on urban drainage systems and help prevent flooding

- Green roofs are able to retain large amounts of rainwater (Up to 70-90%, in summer) and consequently reduce the volume and flow-rate of water entering the drainage system.
  - A fully saturated square metre of green roof can naturally evaporate at a rate of between three and five litres per square metre during a hot summer day.
  - Through water retention, green roofs play an important role in helping to lower energy and infrastructure costs of urban waste water treatment.
  - Evidence has shown that municipal and domestic energy use can be significantly reduced by implementing Green Infrastructure practices, such as green roofs.
  - Green roofs can help conserve valuable water resources as the rainfall collected can be saved for later use.

Green roofs help water purification

- Through natural bio-filtration, green roofs prevent contaminants and toxins from reaching streams and waterways.
  - According to Kohler & Schmidt research (1990) 95% of the lead, copper and cadmium sulphide and 19% of the zinc coming from the rainwater remains in the growing media, which helps to improve local water quality.

THE NEED TO PROMOTE URBAN GREEN INFRASTRUCTURE

The main objective of the Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC was to protect the environment from the adverse effects of waste water discharges from urban areas and certain industrial sectors. Overall, it been very successful in significantly improving the scale and quality of waste water treatment in Europe and there has been a very significant improvement to the quality of surface water.

However, since the UWWTD was adopted various developments have taken place that provide both threats and opportunities in relation to waste water.

- ever more frequent and intense droughts and floods,
- the rise of new pollutants
- increasing water scarcity
- the need to reduce energy consumption and carbon emissions.

Available studies and performance tools clearly demonstrate the potential of Green Urban Infrastructure and its benefits in different climate zones.

Several cities, including Hamburg, Paris and Copenhagen, have set up programmes with incentives to promote the implementation of Green Infrastructure focusing especially on green roofs on buildings.

However, stronger leadership is still needed at EU, national and local levels to take full advantage of the tremendous potential offered by green infrastructure to tackle urban flooding and the pollution of waterways.

POLICY RECOMMENDATIONS FOR DEVELOPING URBAN GREEN INFRASTRUCTURE WITH THE AIM OF REDUCING overflows, pressure on urban wastewater treatment facilities and to reduce waste water energy use

Reducing the amount of storm water being directly released from public and private surfaces into wastewater treatment infrastructures should become priority.

Green infrastructure not only helps lower the amount of storm water being released, but plays a vital role in peek-flow reduction which consequently limits the need to put extra wastewater treatment capacities in place during extreme rain events.

Implementation of Green Urban Infrastructure, especially green roofs, should be promoted as an effective tool to reduce pressure on urban wastewater treatment facilities and to reduce energy costs for the treatment of storm and waste water. As such, we ask policymakers to:

<u>At EU level</u>

- **Support Green Urban Infrastructure development within the process of evaluation of the Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC.** Green Infrastructure can make a significant contribution to reducing pressure on wastewater treatment systems.

<u>At national level</u>

- **Consider green infrastructure as a priority measure to reduce the burden of stormwater on sewage and stormwater systems.** It will result in benefits greater than wastewater management alone.