Sustainable Healthy Cities
A National Science Foundation-supported Sustainability Research Network (SRN)

JOURNAL BRIEF: Flooding and stormwater: How cities prepare for the future

Sustainable Healthy Cities Journal Brief - 2020, No. 24 - Urban flooding

This brief is adapted from a peer-reviewed journal article: Axelsson, C., Soriani, S., Culligan, P. and Marcotullio, P. (2020). Urban policy adaptation toward managing increasing pluvial flooding events under climate change, *Journal of Environmental Planning and Management*, DOI: 10.1080/09640568.2020.1823346

Study Intent and Research Question

Heavy rainfall can overwhelm urban stormwater infrastructure and lead to localized flooding. This study compares existing stormwater management policies developed by six geographically diverse cities—New York City, Vancouver, Copenhagen, Amsterdam, Sydney, and Auckland—to identify commonalities. While each city relies on a variety of stormwater management techniques tailored to local geography and policy goals, five common strategies emerge across cities. The research further examines how cities frame the need for stormwater management within narrative portions of their policy documents, determining whether there are shared themes. This study's findings give policymakers a broad view of current stormwater management techniques worldwide, helping them to select strategies best suited for their own municipalities.

Key Background Information

Cities are vulnerable to heavy rainfall because they are largely covered in impervious surfaces like asphalt, preventing water from soaking into the ground. Heavy rainfall causes localized flooding, which damages property, washes pollutants into waterways, and reduces quality of life for residents. Existing urban stormwater infrastructure is often insufficient for handling current rainfall. In many developed cities, water infrastructure dates back to the early twentieth or late nineteenth century, and includes outdated technology like combined sewage overflow systems, which discharge sewage directly into waterways during storms. Meanwhile, urban populations are increasing globally, putting more strain on water infrastructure systems.

Climate change models predict that the intensity of precipitation will increase in many regions worldwide over the next several decades, (Donat et al. 2016), and rising urban temperatures will exacerbate this phenomenon. Cities must therefore develop effective stormwater management policies that can address both current and future rainfall.

The researchers selected six cities, representing various sizes and regions, and evaluated their current guiding policy documents to catalog and compare which specific stormwater management strategies the cities use.

Key Findings

While stormwater management strategies necessarily vary based on geography and local patterns of precipitation, some common policy options provide a general framework for creating stormwater policy.

▶ *Five policy themes emerge in management strategies across cities.*

Among the many stormwater management policy tools considered in the cities' planning documents, five were utilized by all six cities: **public green infrastructure** financed by the municipality; **private green infrastructure** funded by the private sector and individuals; **gray infrastructure overhauls** of existing stormwater infrastructure; **government streamlining** of departments and services (such as merging oversight of water, wastewater, and stormwater systems) to provide coordinated policy guidance and centralize administration; and **maintaining**

urban environments, such as cleaning and maintaining catch basins, to ensure that the stormwater system performs efficiently.

Of these five options, publicly funded green and gray infrastructure are discussed in the highest number of policy documents published by the six cities. These two strategies may be widespread because they are supported by an existing knowledge base and tangible results, and they can be implemented within current workflows of infrastructure approval and construction.

▶ *Each city crafts a unique narrative to frame the purpose and goals of stormwater management.*

The six cities represent a diversity of geographic locations, with varying precipitation patterns and water issues. As such, while the cities share a focus on the five most common stormwater management strategies, the narrative portions of their policy documents justify these strategies based on local goals and challenges. For example, **Copenhagen** receives so much yearly rainfall that the city's primary goal is simply to remove stormwater via blue and green infrastructure, which absorb excess runoff. Copenhagen does not prioritize capturing this runoff for reuse in the municipal water system. In contrast, **Sydney**, as a city that receives little rainfall, approaches stormwater management from a standpoint of water scarcity and urban heat. Sydney's green infrastructure functions not only to capture runoff, but to mitigate urban heat, and stormwater is reused to support green spaces. Thus, while stormwater management strategies like green infrastructure and gray infrastructure overhauls appear in a variety of policy plans worldwide, cities structure and explain them differently based on local context.

Policy and Practice Implications

This study presents a useful foundation for understanding urban stormwater management policies worldwide in the face of aging infrastructure and climate change. Policy makers can draw on existing management strategies developed by these case cities and evaluate how to adjust them to their local context. This can be especially helpful for cities with smaller budgets and developing cities planning future infrastructure construction.

Water & Waste

Policy & Governance

Green Infrastructure

Further Reading and References

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About the Sustainable Healthy Cities Network

The Sustainable Healthy Cities Network is a U.S. National Science Foundation-supported sustainability research network focused on the scientific advancement of integrated urban infrastructure solutions for environmentally sustainable, healthy, and livable cities. We are a network of scientists, industry leaders, and policy partners committed to building better cities through innovations in infrastructure design, technology, and policy. SHCN connects nine research universities, major metropolitan cities in the U.S. and India, and infrastructure firms and policy groups to bridge research and education with concrete action in cities.