

## Designing with Nature: Stormwater and Aquatic Biodiversity Considerations

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### Abstract

Urban land use fundamentally changes the quantity and quality of water flowing off the landscape. In addition to pavement, roofs and other impervious surfaces, urban drainage systems further compound alterations to the water cycle because they are conventionally engineered to whisk water away as fast as possible. While these designs mitigate flood risks and reduce puddling on streets, the consequences for aquatic biodiversity of altered flows due to urban drainage infrastructure are not fully appreciated or even studied. Changes to the natural flow regime are initiated with very small changes to land surfaces. Urbanization has catastrophic consequences for aquatic biodiversity when it reaches only about ten percent of a watershed's land cover. Known as *urban stream syndrome*, multiple concurrent changes to the aquatic ecosystem with urbanization mean that it is very difficult to scientifically identify individual causal factors. Water temperature, water chemistry and water quantity all shift simultaneously, including specific characteristics of flow, which in turn affect the viability of aquatic species in the receiving waters. For example, an increase in the rate of change in flow, or flow acceleration, in urbanizing areas is associated with decreased fish richness in the Great Lakes region of Canada. With limited geographic extent, and potentially unique endemic species, island states have additional considerations for how drainage infrastructure is designed and operated. Biodiversity is in crisis, with freshwater biodiversity being the most imperiled group of species. With immediate linkages from land to sea, island nations have an opportunity to demonstrate the importance of designing urban drainage with nature. The factors in making choices for urban drainage extend beyond the technical and scientific to cultural norms, risk tolerance, precaution in the face of uncertainty, and perceptions and values of nature and humanity's place in it.

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