A new method for protecting urbanising waterways: Urban Streamflow Impact Assessment

Dr Stephanie Kermode[1], Dr Geoff Vietz[2], Mr Carl Tippler[3], Ms Kathy Russell[4], Prof Tim Fletcher[4], Dr Marlene van der Sterren[1], Mr Phillip Birtles[1], Mr Micheal Dean[5]

[1]Sydney Water, Parramatta, Australia, [2]Streamology Pty Ltd, Bright, Australia, [3]CT Environmental, Wagga Wagga, Australia, [4]The University of Melbourne, Melbourne, Australia, [5]i2i Digital, Blacktown, Australia

Overview

The urban stream syndrome describes the degradation of waterways, physically and ecologically, following catchment urbanisation. The primary driver of this degradation is altered hydrology – most frequently through excess stormwater runoff from urban catchments, although where present, wastewater treatment plants can significantly increase discharge to waterways. To address this an approach is needed to help understand what flows a given stream can accommodate. However, there is currently no formal method to assist planners, stormwater designers and engineers to do this.

The Urban Streamflow Impact Assessment (USIA) was developed to fill this significant management and planning knowledge gap. The framework begins with identification of waterway values (social, ecological and geomorphic) and then explicitly links them to streamflow characteristics using hydraulic metrics. USIA has been applied to two case studies in western Sydney and has demonstrated the loss of values associated with 'business-as-usual' approaches to stormwater and wastewater management and highlighted opportunities. It highlighted that conventional WSUD approaches do not remove enough flow from the system, and that USIA can be applied across urbanising and urban catchments to provide explicit input to controls on urban streamflows (what flows to keep out of the waterway), informing urban planning at a broad strategic level through to detailed design stages.

Objectives

It is increasingly understood that the primary causes of degradation to urban waterways relate to excess stormwater and altered hydrology. While the impacts of pollutants are regulated and managed, a gap remains for how impacts on flow regime can be assessed and managed. The objective of this study was to develop a method to determine, at catchment level, what flows a creek can accommodate. The framework linked social and ecological values with geomorphic and subsequently flow requirements. This then enables an understanding of under what scenarios or management criteria can the ideal waterway outcomes be met.

Method

USIA features three stages;

Stage 1: identification of catchment values, delineation of (sub)catchments, selection of the assessment reach, and data review

Stage 2: development of hydrologic scenarios, hydraulic models, and geomorphic and ecological assessments

Stage 3: a workshop leading to sub catchment specific social, ecological and geomorphic values and flow metrics, resulting in a risk assessment assessing protection of creek values against streamflows resulting from development scenarios

An output of these stages is a risk assessment 'traffic light' matrix. The matrix explicitly considers both likelihood (of changes to ecologically-relevant parts of the flow regime) and consequence (what values are lost).

Results

To reduce the risk to creek ecosystems associated with future increased flows to a low level, requires reduction of the unmitigated 2050 annual flow volume by approximately 50% for both Lowes and Science Creeks. The simulated WSUD scenario falls short of this, with only around a 20% decrease in annual flow volume. When the effect of WWTP effluent is considered for Lowes Creek, the volume reduction required is much greater, at around 90%. Such reductions are likely to require significant stormwater harvesting and reuse, and near-total wastewater harvesting and reuse, or transfer out of catchment.

Conclusions

This study provides an initial proof of concept for the development and application of the Urban Streamflow Impact Assessment (USIA). This initial development phase has provided an effective tool to predict future impacts to creek values caused by urban flows. The following recommendations are made to enable further iterations and refinements to ensure USIA becomes a robust tool which can be applied across the Sydney Water area of operations and beyond:

- predicting channel change
- investigate parameters for hydrologic modelling specific to South Creek
- hydrologic scenario goals
- monitoring
- improving understanding of the ecological condition of urban creeks receiving WWTP discharge.