Brief for GSDR – 2016 Update

URBAN STORMWATER REUSE: AN AGENDA FOR SUSTAINABLE DEVELOPMENT

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Introduction

We treat urban stormwater as a problem as it causes flooding, transports pollutants and degrades the ecosystem health of waterways (Goonetilleke et al., 2014). Municipal authorities devote a significant component of their budget to capture and remove stormwater from urban areas as rapidly as possible. Unfortunately, it is a largely unappreciated fact that urban stormwater is the last available uncommitted water resource for our cities as the demand for potable water escalates due to growing urbanisation, industrialisation and higher living standards.

A recent Australian study found that the annual stormwater runoff volume is greater than the volume of imported potable water for most cities in the Country (PMSEIC, 2007). It is unfortunate that more effort has not been made to convert this under-utilised resource into a product, thereby preserving existing traditional freshwater resources for agriculture and ecosystem services.

The significance of an alternate resource for urban water supply needs to be viewed in the context that:

- about 53% (3.8B) of the estimated world population of 7.2B are currently living in urban areas (PRB, 2014) and this is projected to increase to 66% by 2050 (UN, 2014).
- a significant number of the world's largest cities are currently under water stress and this trend is likely to worsen (McDonald et al., 2014).
- by 2050, it will be necessary to produce 60% more food globally, and 100% more in developing countries (UN, 2015).

These scenarios need to be weighed up taking into consideration the predicted impacts of climate change on freshwater resources, which is predicted to exert significant adverse impacts on natural systems such as the water environment, (IPCC, 2007; 2008). Accordingly, this paper presents a case for the widespread adoption of stormwater reuse as the key adaptation measure to counteract the impacts of climate change on water resources available for urban use. Wastewater is also a major urban water resource, but it requires sophisticated treatment for portable reuse

Climate change and the water environment

Based on weather records and climate projections, IPCC (2008) has confirmed that freshwater resources are highly vulnerable to climate change. A key finding is that increased temperatures and changes to rainfall patterns such as annual rainfall, timing of the wet seasons and frequency of droughts and rainfall extremes will adversely affect water availability and quality.

Therefore, climate change will have significant impacts on stream flow such as

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reduction in runoff events and volume, and increase peak flow and the timing of the peak. This will result in adverse impacts on water resources in terms of availability and quality and the reliability of supply for various consumptive uses. The more frequent drought conditions will lead to reduced soil moisture and annual stream flow in some catchments. Essentially, water resources will become increasingly stressed.

Fundamentals of stormwater/rainwater reuse

From water quality and microbiological perspectives, runoff harvested from roofs (roof water) and runoff from ground surfaces such as roads (stormwater) is generally considered as two different water types. Furthermore, the approach to harvesting these different types of water is different. Harvesting of rainwater from individual roofs is a decentralised approach managed by individual householders, whereas stormwater collected in large surface or underground reservoirs is a centralised approach.

Research has shown that household rainwater tanks can make a significant contribution to water supply, particularly if they supply the regular internal household water demand, rather than used solely for outdoor uses where the benefits would be less. A number of large scale studies undertaken in Australia have reported that typical water savings can often exceed one third of the daily household water requirements in most metropolitan areas in the Country (Beal et al 2015).

Untreated rainwater has the lowest health risk when used for non-potable purposes. There is credible microbiological and chemical health risks associated with its potable use or direct ingestion (Ahmed et al., 2011). However, public health monitoring and epidemiological studies have suggested otherwise (eg. Rodrigo et al., 2010). Therefore, it is essential that appropriate risk management processes are in place for rainwater reuse, either constraining end uses or applying water treatment.

Access to high value urban space can be a major constraint in centralised harvesting of stormwater, particularly in densely populated urban areas where relatively large storages are needed to ensure regular demand can be met from episodic stormwater supply. However, storage of appropriately treated stormwater in aquifers, subsurface permeable geological strata containing groundwater, is an attractive alternative. This practice, termed as 'managed aquifer recharge' (MAR), is the accelerating of the natural recharge of groundwater to aquifers using stormwater (or treated wastewater) for subsequent recovery or environmental benefit (Dillon et al., 2009). A further benefit of this approach is that an estimated 20% of the world's groundwater aquifers are over-exploited (Gleeson et al., 2012).

Essentially, MAR can contribute to protecting against aquifer salinisation, assisting groundwater demand management and enhancing environmental flows in watersheds (Dillon et al., 2009). However, MAR requires favourable hydro-geological conditions to enable the subsurface storage of large volumes of water. In the absence of favourable conditions, more costly storage options will need to be considered.

However, to assess the true viability of stormwater/rainwater harvesting, more comprehensive techniques for cost benefit analysis is needed as conventional economic analyses cannot take into consideration the social and environmental benefits (Kandulu et al., 2014). This is a major constraint in the assessment of sustainable development initiatives, and not only stormwater reuse.

A further requirement is the availability of scientifically rigorous guidelines for stormwater reuse to protect public health and to guide good practice. These are currently available in some countries, but are not common around the world. WHO guidelines are available for the safe use of wastewater (WHO, 2006), but not for stormwater harvesting and reuse.

Counting the benefits

The primary benefit of stormwater reuse is that it provides the clear opportunity to create a tangible sustainable development agenda that can spill over into other areas. In the context of climate change, stormwater/rainwater reuse has inherent robustness as an adaptation measure to counteract the anticipated adverse impacts on urban water supply as detailed above. Studies have shown that even with aggressive mitigation efforts, the negative impacts of climate change will only worsen). Consequently, scientifically robust adaptation strategies are essential to build climate resilience among communities (IPCC, 2007; 2008).

Irrespective of climate change impacts, stormwater reuse will contribute to drought proofing of urban communities from the consequences of the limitations in conventional water supply, thereby strengthening water security. Given water is a critical resource for human survival, it will also contribute to strengthening national security.

Stormwater/rainwater harvesting also provides substantial environmental benefits. These include, reducing runoff frequency, flow volumes and peak discharge to urban waterways, thereby mitigating urban flooding, improving water quality in waterways and helping maintain their ecological health (Dillon et al., 2009; Walsh et al., 2015).

The final words

Urban stormwater/rainwater reuse is an exemplar for sustainable development, helping to safeguard the natural environment and its precious water resources, contributing to the well-being of urban communities by helping meet the ever increasing demand for water supply, and strengthening climate resilience. However, it needs to be based on a sound economic foundation. Same as for any sustainable development strategy, more comprehensive techniques for cost benefit analysis is needed rather than the dependence on conventional economic analyses.

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