MELBOURNE WATERWAY RESEARCH-PRACTICE PARTNERSHIP
Research for the improved management of Melbourne's waterways

Research Note

Benefits of stormwater control measures for mitigating downstream flooding

The traditional approach to flood risk management in urban areas has involved the use of hydraulically efficient drainage infrastructure and flood armoring. An alternative or potentially complementary approach is the retrofit of drainage systems with green infrastructure or Stormwater Control Measures (SCMs) such as rainwater tanks, rain-gardens and green roofs.

As part of Project 2.5, researchers used a modeling framework to assess if the small-scale flood risk mitigation benefits afforded by use of SCMs can propagate to benefits downstream in the catchment.

Methods

This research used the Little Stringybark Creek (LSC) as a case study. A semi-distributed MUSIC hydrologic model (eWater) was calibrated to current catchment conditions. Outputs from the MUSIC model were used to force flow in 2D hydraulic BreZo model (UC Irvine). Scenarios included:

- 84 design rainfall events with range of durations (10 min to 24 hours) and annual exceedance probability (63-1%).
- No SCMs, Current SCM conditions, a full implementation of SCMs.

Findings

- For short duration events where runoff volumes don't exceed SCM storage capacity, flood extents can be diminished.
- SCMs have the ability to reduce flow intensities inside the stream (Fig 1), mitigating flow hazard substantially and benefitting citizen safety.
- Flow intensity of overland flow can also be reduced, allowing for safer evacuation on flooded streets.
- With the application of SCMs, shorter duration storms are likely contained (Fig 2), meaning that longer storm durations would need to occur for flows to reach peak conditions.
- For storms ≤ 3 hours, a complete application of SCMs exhibits on average:
  - 84% peakflow mitigation,
  - downstream flooded area alleviation by 91%,
  - maximum flow intensities reduction by 83%, and
  - maximum flood duration decrease by 79%.

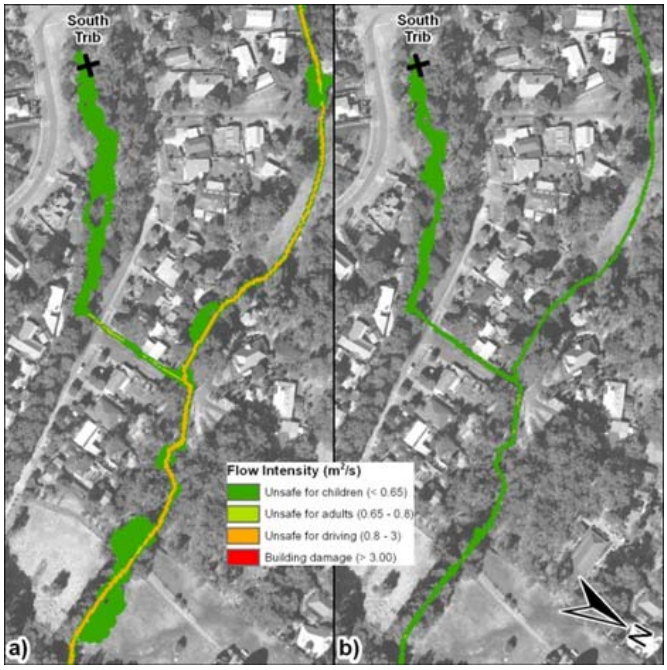

Figure 1. a) Flow intensity for 30 min 1% AEP event under current SCM conditions, b) Flow intensity for 30 min 1% AEP event under full SCM implementation.

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Summary and broader applications

- SCMs are technologies effective in regions with short-duration events, where rainfall depths ≤ retention capacity of SCMs.
- SCMs substantially reduce maximum flow intensities inside streams. They could have significant impact on channel morphology, reducing stream bank maintenance costs, and result in less frequent wildlife habitat loss.
- Peakflows predicted by the hydrologic model are a good indicator for the effective range of mitigated storm events. Therefore, hydrologic models could be used to study the stochastic behavior of SCMs through a Monte Carlo simulation approach, while computationally expensive hydraulic models could be used to study the flood hazard of critical events.
- The methods developed in this research can be used to further study how SCMs not operating at their full efficiency impact flood hazard. Limitations to the system may have significant effects to downstream flood.
- SCMs have the ability to reinstate a more natural flow regime in urban streams, with potentially increased baseflows. This may reduce the flood hazard, especially from rare long duration events.

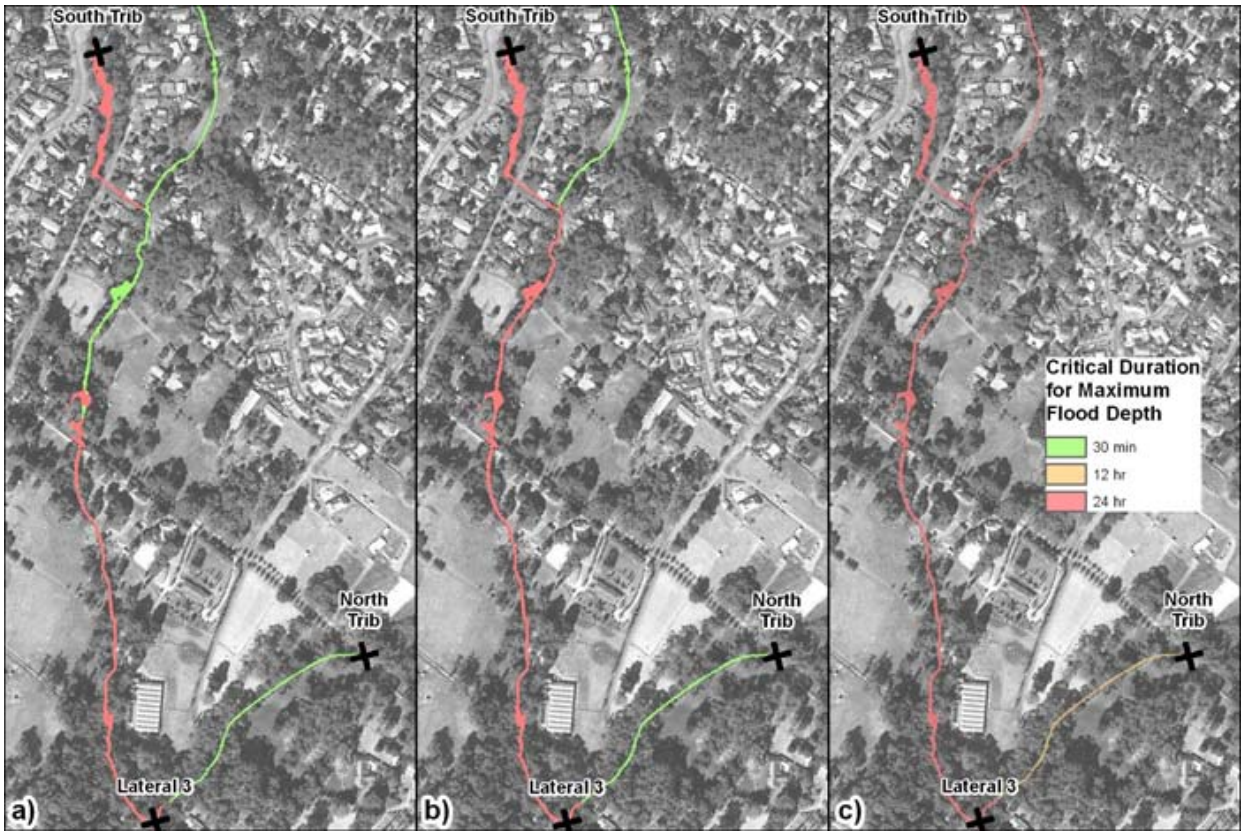

Figure 2. Critical storm durations leading to maximum flow depth conditions locally for the 63% AEP rainfall events a) without SCMs, b) current SCM conditions, and c) full implementation of SCMs.

This Research Note is based on findings of the project ***Setting hydraulic objectives*** *from site-scale to catchment-scale* (Project 2.5 of the MWRPP)