Hydrological Models and LiDAR data implementation for quantifying lot scale rainwater harvesting and future flood risks in the City Of Whittlesea

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Overview

During the Millennium Drought water restrictions across Melbourne reduced household water consumption by 40%. From a Climate Change adaptation and liability perspective, we are interested in exploring similar behaviour change scenarios that could help reduce flooding risks in low-density residential developments. The need to investigate this issue is particularly relevant given that climate modelling predicts an increase in the frequency of heavy precipitation events and more intense storm events by 2040.

One relevant and less explored scenario termed "RetroSuburbia", assumes that Climate Change and Energy Descent will incentivise more local food production on the lot scale (Holmgren, 2018). Because food production requires significant amounts of water input, household water use and collection patterns will change accordingly. One major anticipated change will be the installation of large (e.g. 20,000L) rainwater tanks. A distributed network of large rainwater tanks and more permeable surfaces for growing food should therefore translate to a reduction of stormwater flows in catchments and a reduced risk of flooding.

Geographic Information Systems (GIS) and water catchment modelling tools allow flood risks to be examined in catchments. The models make use of precipitation data, overland flows and make assumptions about water management infrastructure. Governments are increasingly using these tools to assess climate risk for communities and to prepare adaptation strategies and community education plans.

In this study, the City of Whittlesea analysed the potential of rainwater harvesting from urban rooftop catchments and land use permeability changes for flood management. From a local government perspective this will have a significant impact on the choice and timing of stormwater infrastructure investment within the municipality.

Objectives

To investigate how a distributed deployment of large rainwater tanks on residential lots can mitigate flood risks.

To explore scenarios associated with Climate Change Adaptation and Energy Descent in the context of urban stormwater management.

Method

The analysis was conducted using LIDAR (Laser Imaging Detection and Ranging) data, hydrology modelling and 2018 Arial imagery. GIS surface maps, flood extent for 100 years, waterways and drainage polygons were analysed in combination with land use data to determine potential flood risk for households.

Arc GIS 9.3 was also used to digitise all the different catchments and their respective topology was created. Finally, the area of catchments was calculated to find the total rainwater harvesting potential of the study area. The further aim is to simulate the retarding potential of rainwater tanks of different holding capacity and fill levels.

Conclusions

The prevailing practise of designing and building stormwater infrastructure to the climate patterns of the past and the failure to factor in ascertainable climate risk make communities more vulnerable to the risk of flooding. Business as usual thinking also limits the scope for innovation in tackling emergent problems such as Climate Change.

The "RetroSuburbia" scenario suggests that governments should include lot scale rainwater collection initiatives in high risk catchments to help offset extreme and catastrophic weather events. Community Integrated Water Management (CIWM) has important implications for public health and safety, risk management, policy development, water offset schemes, community education and funding opportunities within the municipality.