Lincoln Square flood purge analysis - the devil is in the detail

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Stormwater harvesting and flood mitigation are inherently incompatible. Stormwater harvesting schemes require the storage to be full of water to maximise effectiveness of reliability of supply whereas flood mitigation requires the airspace maximised to have storage available to hold flood water.

This is the dilemma at Lincoln Square where the initial stormwater harvesting scheme was converted to a flood mitigation scheme to mitigate some of the flooding impacts up to the 20-year average recurrence interval down Elizabeth Street in central Melbourne. Although flood mitigation was now the primary objective, the objective for Storm was to value-add to the project to maximise the reliability of stormwater harvesting without compromising the flood mitigation performance.

Flood mitigation was achieved through the opening of an actuated valve in the bottom of the storage that drained the tank back to the stormwater system downstream. The volume was defined by typical hydrologic and hydraulic assessment using ARR1987 to optimise the storage size for flood mitigation and validated through a water balance to determine the performance of stormwater harvesting. The two key issues with the actuated valve are knowing when to open the valve and when to close it.

Opening the valve required monitoring of forecasting by Bureau of Meteorology (BOM). Technology was developed to scan this forecast regularly so that when a defined predicted rainfall threshold is exceeded then the valve would open and drain the tank prior to the storm event occurring. This addressed the first issue to some degree, however the rainfall depth thresholds that would trigger the pre-release and close the valve to hold water in the tank for irrigation was still to be determined.

Storm intended on operating the system in a similar concept to managing floods in major dams where each decision to adjust a release, by valves or spillway, is informed by rainfall in the catchment (expected inflows), condition of storage (how full it is) and expected downstream flooding. A detailed purge analysis was undertaken by Storm that determined the algorithms to apply to the system to automate these decisions, due to a compressed time frame. Design hydrographs, as well as hydrographs developed from historical rainfall, were used to simulate the performance of the system for the 50 largest events. This enabled the development and testing of the variables for the 4 key algorithms that manage the flood mitigation by way of defining a target airspace throughout the various stages of the rainfall event. It also enabled sensitivity testing to be undertaken to assess the impact of the variables.

There were many learnings during this analysis, however a key learning was that the design storms did not occur. The performance varied greatly in that during some storms around a 20 year ARI storm event, the system performed poorly but in some very large storms (around 100 year ARI storm event) it performed very well.

This project is a great example of where new technology combined with clever and innovative design can assist with effective flood mitigation. Storm believes that this system will be replicated throughout Australia and beyond, to the point where it will be standard practice in stormwater management.