Crown Street Mall Redevelopment

Water Sensitive Urban Design and Stormwater Harvesting

Concept design – August 2010

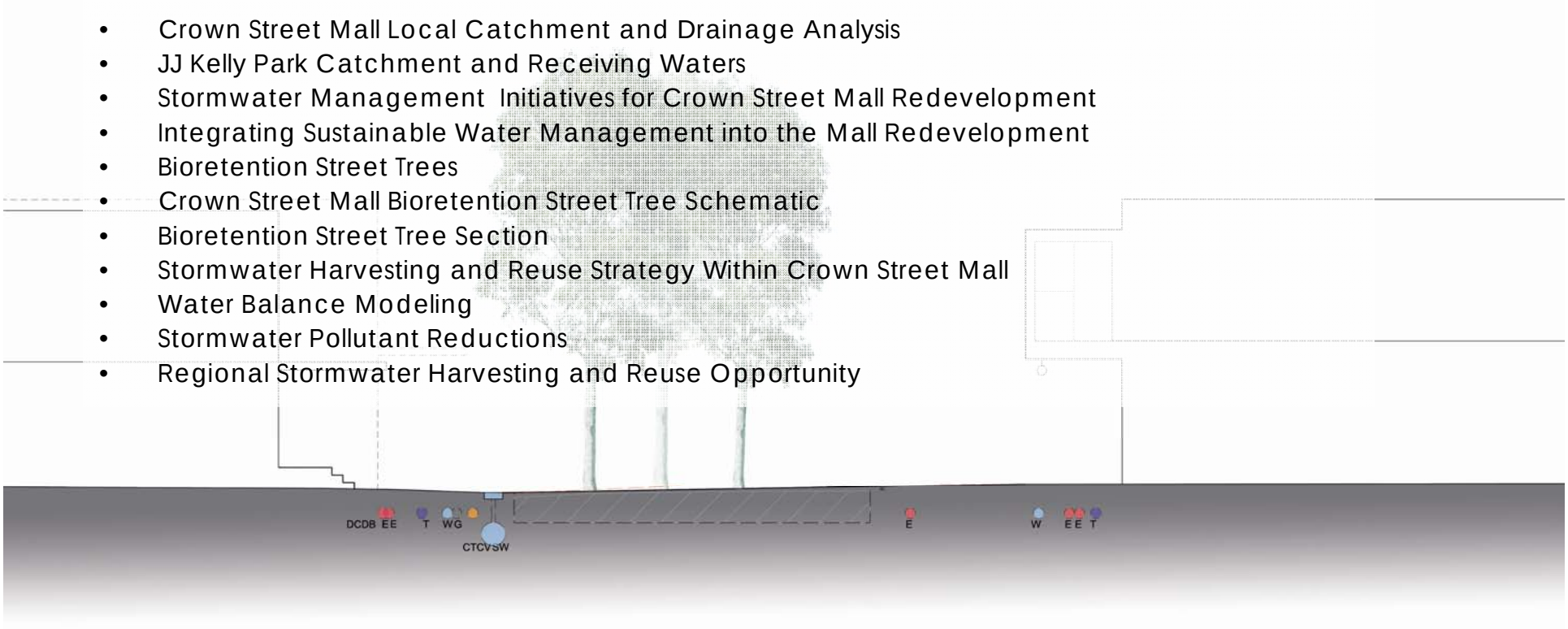
Overview

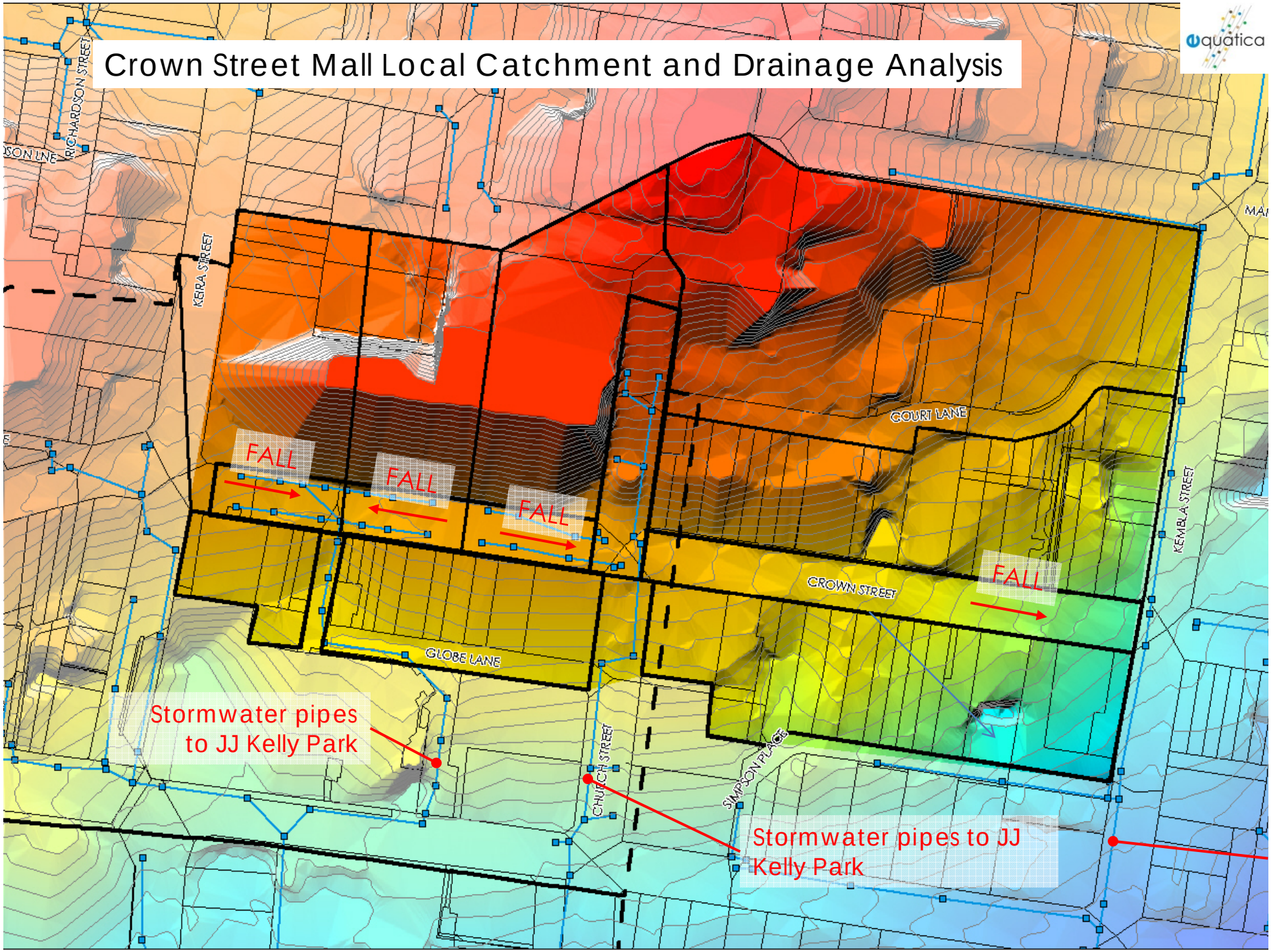
Equatica was engaged by the Government Architect's Office to develop sustainable water management initiatives that can be incorporated into the Crown Street Mall redevelopment.

The project included an assessment of sustainable water management opportunity and constraints, and based on this assessment and consideration of the proposed Masterplan, a stormwater treatment, harvesting and reuse strategy was developed. Elements of the stormwater harvesting strategy were quantified using water balance computer software. Through collaboration with the Government Architect's Office the stormwater harvesting and reuse strategy was integrated into the proposed Mall redevelopment thereby incorporating the principles of Ecological Sustainable Development as they apply to the urban water cycle into the Mall upgrade.

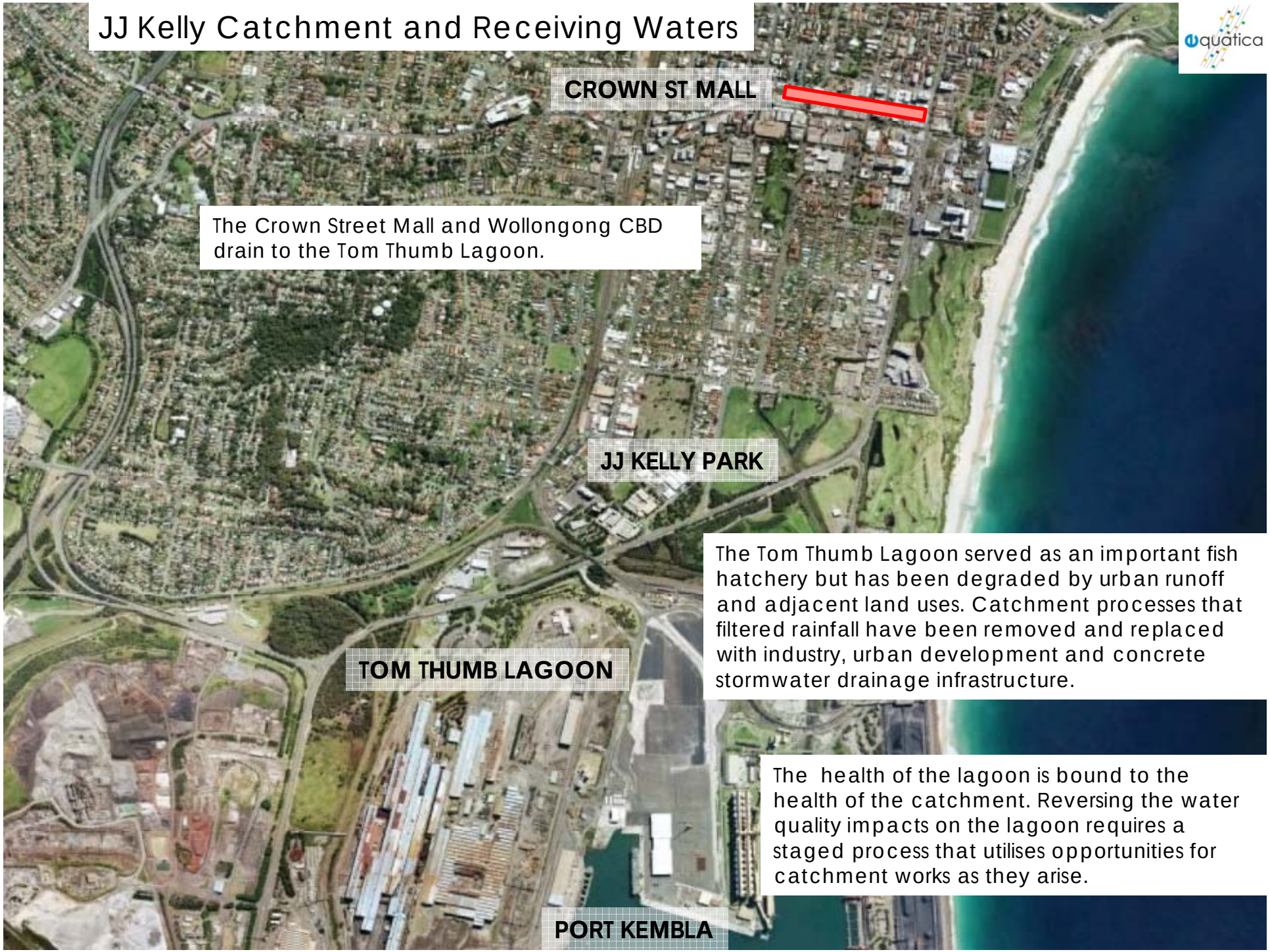
The proposed stormwater treatment and harvesting strategy are presented in the following pages and includes :

- Crown Street Mall Local Catchment and Drainage Analysis
- JJ Kelly Park Catchment and Receiving Waters
- Stormwater Management Initiatives for Crown Street Mall Redevelopment
- Integrating Sustainable Water Management into the Mall Redevelopment
- Bioretention Street Trees
- Crown Street Mall Bioretention Street Tree Schematic
- Bioretention Street Tree Section
- Stormwater Harvesting and Reuse Strategy Within Crown Street Mall
- Water Balance Modeling
- Stormwater Pollutant Reductions
- Regional Stormwater Harvesting and Reuse Opportunity




Crown Street Mall Local Catchment and Drainage Analysis
aquatica
RICHARDSON STREET
KEIRA STREET
COURT LANE
FALL
FALL
FALL
FALL
CROWN STREET
KEMBLA STREET
GLOBE LANE
Stormwater pipes to JJ Kelly Park
CHURCH STREET
SIMPSON PLACE
Stormwater pipes to JJ Kelly Park

JJ Kelly Catchment and Receiving Waters



The Crown Street Mall and Wollongong CBD drain to the Tom Thumb Lagoon.

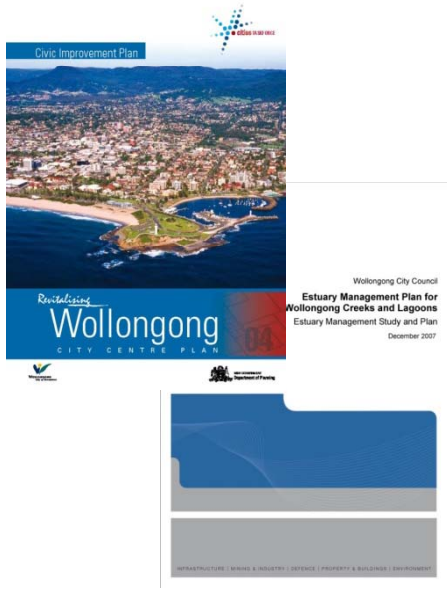
The Tom Thumb Lagoon served as an important fish hatchery but has been degraded by urban runoff and adjacent land uses. Catchment processes that filtered rainfall have been removed and replaced with industry, urban development and concrete stormwater drainage infrastructure.

The health of the lagoon is bound to the health of the catchment. Reversing the water quality impacts on the lagoon requires a staged process that utilises opportunities for catchment works as they arise.

Stormwater management initiatives for Crown Street Mall

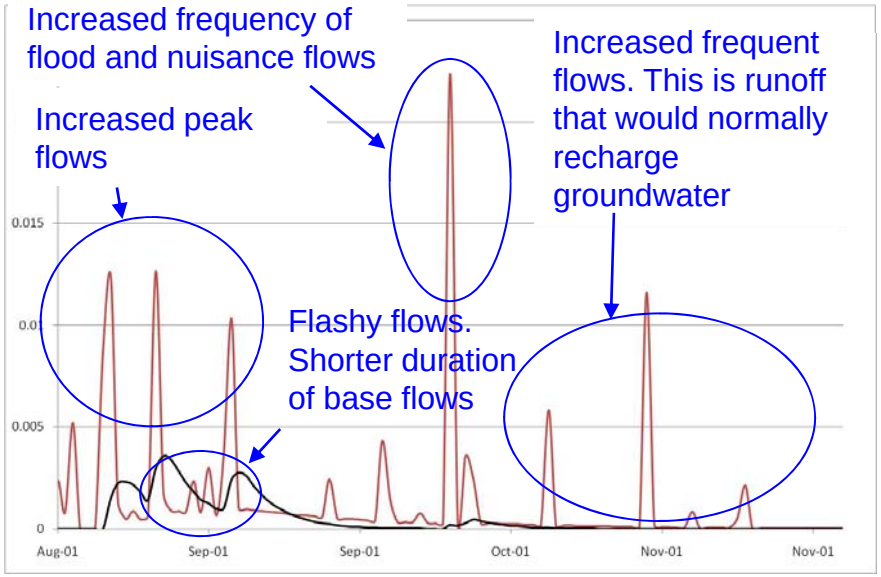
The *Wollongong City Centre DCP* promotes landscape design to 'improve stormwater quality and control runoff'. This is consistent with the principles of Water Sensitive Urban Design (WSUD) which seeks to mimic natural catchment processes within the urban fabric of cities.

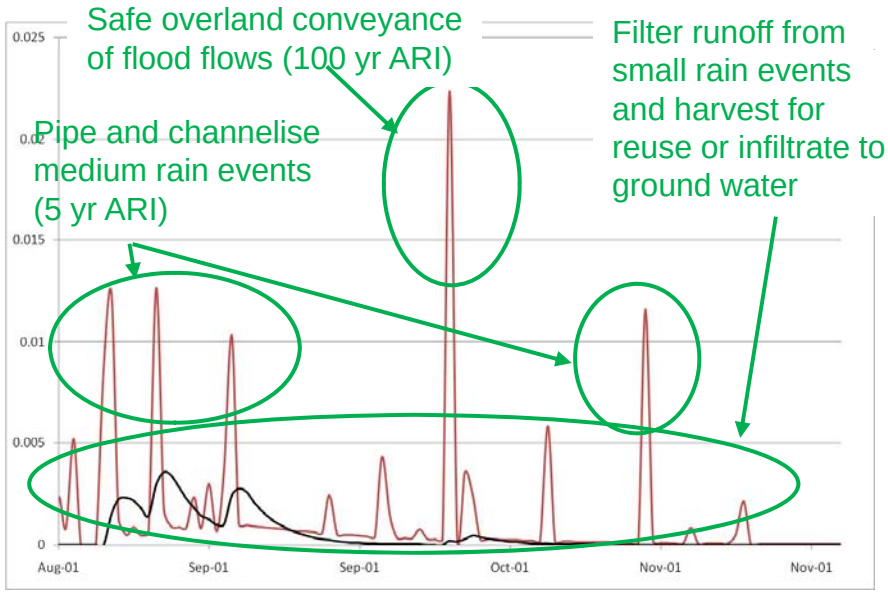
The *Estuary Management Study and Plan for Several Wollongong Creeks and Lagoons* (including the Tom Thumb Lagoon) recommends incorporating Water Sensitive Urban Design (WSUD) within the catchment to improve the long term water quality and habitat value of the estuary.



Incorporating WSUD principles into the Church Street Mall redevelopment establishes an important precedent for other developers across the LGA.

The WSUD philosophy adopted for Crown Street is summarised in the figure below. Hypothetical hydrographs for a natural catchment (black) and urban catchment (red) are shown with the strategies adopted (in green) to address the respective changes to the runoff cycle (in blue).





Integrating Sustainable Water Management into the Mall Redevelopment

It is proposed to replace the existing Crown Street Mall shade screen with a stand of native trees.

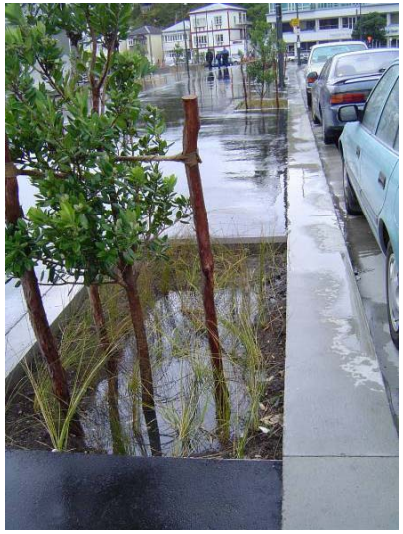
The trees will be planted within a continuous strip of soil media along the entire mall. Pavement will be reinstated over the tree roots to provide for pedestrian amenity.

The success of street trees in highly urban areas is dependent on the tree roots getting access to water and oxygen which are limited when impermeable pavements cover over the trees root zone.

Where a small window of soil (ega tree grate) is open to the atmosphere, rainfall alone may be insufficient to support tree establishment and flourishing.

In order to address these potential shortcomings and allow for healthy trees, the reinstated pavement will be made porous by incorporating a network of subsurface grates and pipes that will deliver the equivalent amount of rainfall and oxygen that a forest tree would receive.

In this manner, the trees become bioretention street trees which provide a stormwater quality outcome as well as enhancing the microclimate of the Mall.



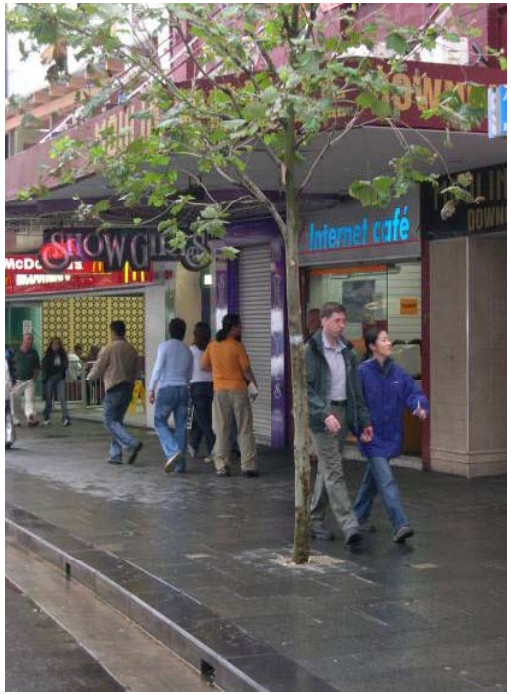
Wellington, NZ

Little Bourke Street, Melbourne

Pirrama Rd, Pyrmont

Docklands, Melbourne

Sydney University



Darlinghurst Rd, Darlinghurst

Bioretention Street Trees

Runoff from the Crown Street Mall will be collected within a network of grated trenches and delivered to the planting media surface during each local rain event.

Stormwater runoff percolates through the planting media and fine sediment and dissolved pollutants are captured within the upper layers of the street tree planting media. Over time this layer may need to be tilled to remove accumulated fines and restore the permeability of the planting media.

Excess water is captured within slotted pipes within the lower zone of the street tree media. This ensures that the planting media around the tree roots is free draining. Each volume of water that drains through the root zone also draws an equivalent volume of air to the roots.

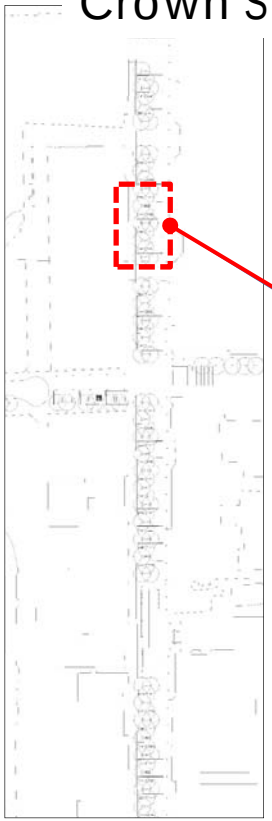
Slotted pipes carry the water to the stormwater drainage network for discharge or harvesting.

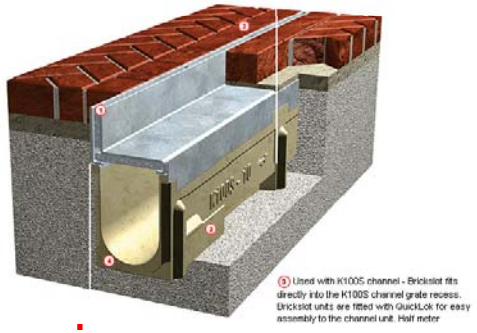
During heavy rain stormwater bypasses the street trees via grated trench drains and discharges directly to the stormwater drains as it currently does.

Bioretention street trees deliver the following outcomes:

- Encourage infiltration and reduce runoff volumes in accordance with the objectives of the City Centre DCP.
- Filter stormwater and improve downstream runoff quality in accordance with the recommendations within the Estuary Management Study and Plan for Several Wollongong Creeks and Lagoons .
- Delivers a dual stormwater management and landscape function.
- Treated stormwater collected from the street trees can be tanked and reused locally to irrigate trees in drought periods.

Crown Street Mall Bioretention Street Tree Schematic





100mm grated trench drain to deliver runoff and harvested stormwater

Approximate extent of planting media

Slotted pipes connections through planting media

Recycled water delivered directly to trench drain

Slotted pipes connections through planting media

New stormwater pit lids

New stormwater pits and pipe are required East of Church Street

Tree canopy

Recycled water main to supply harvested stormwater for irrigation

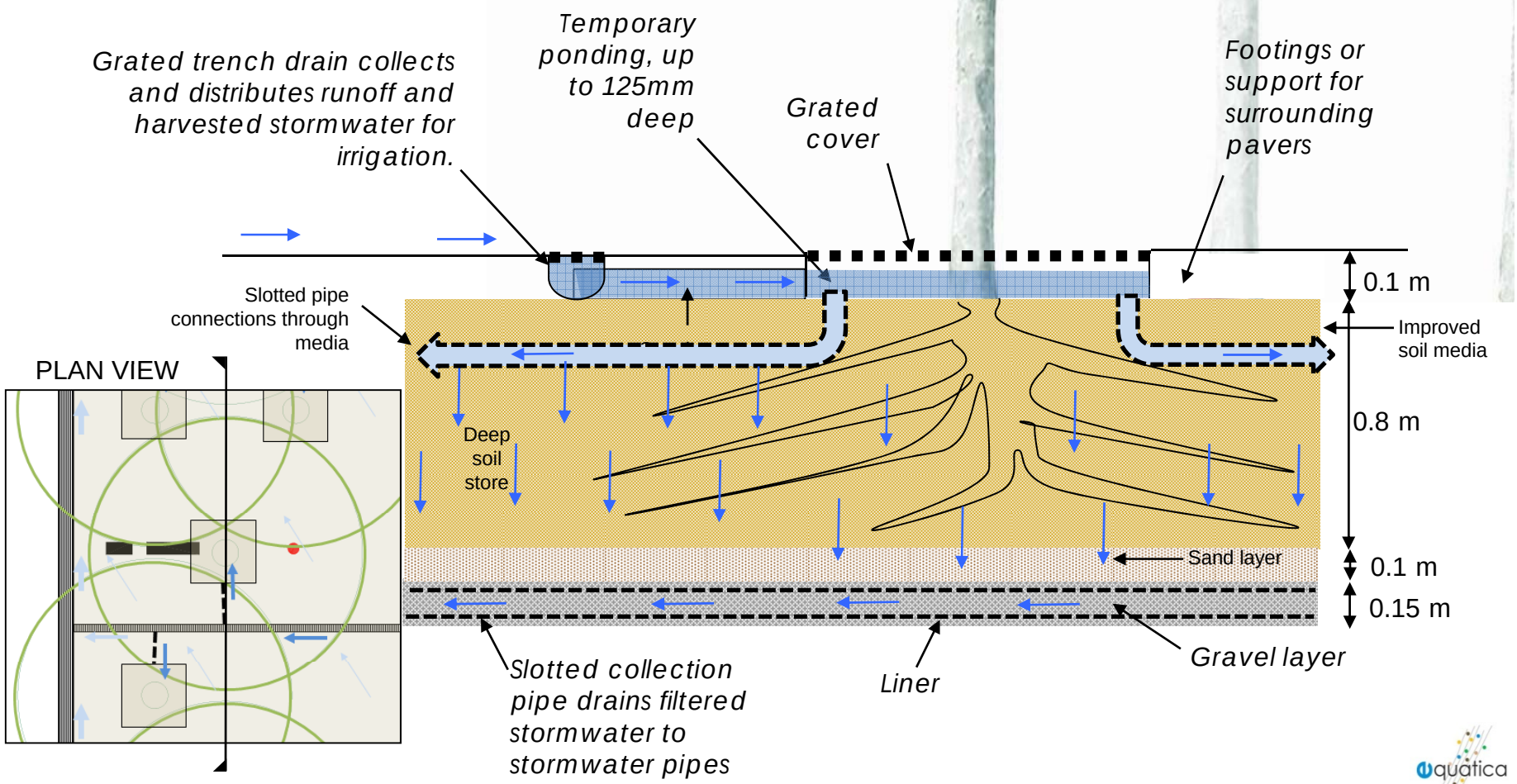
Grated trench grate to convey heavy runoff to stormwater

Grated cover

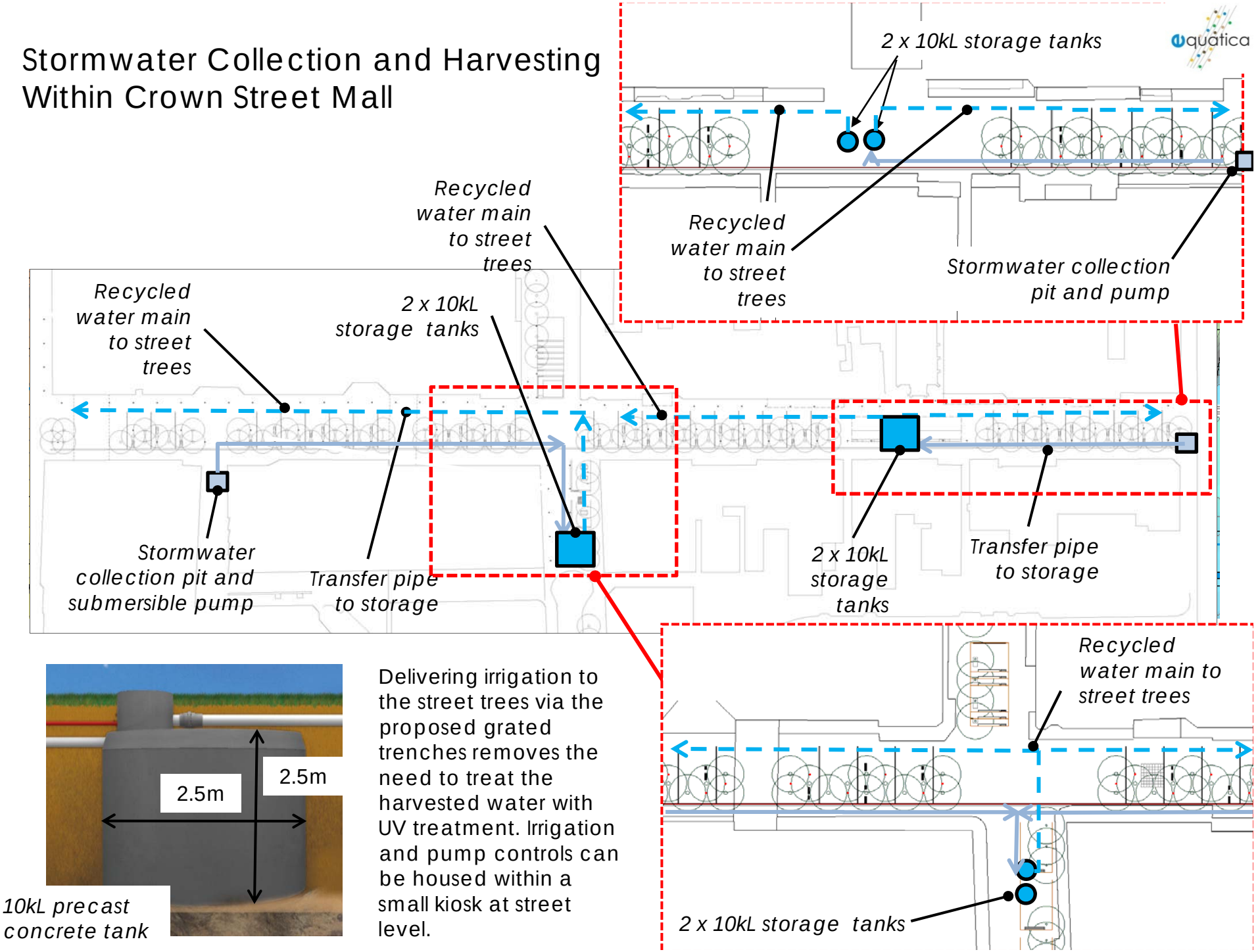
Bioretention Street Tree Section

Additional considerations include:

- Must accommodate services
- Require a suitably deep stormwater pipe to drain to
- Need specifically designed pavement
- Existing stormwater conveyance capacity within Western Mall is to be retained.
- New pits and pipes will be required within the Eastern Mall



Stormwater Collection and Harvesting Within Crown Street Mall



10kL precast concrete tank

Delivering irrigation to the street trees via the proposed grated trenches removes the need to treat the harvested water with UV treatment. Irrigation and pump controls can be housed within a small kiosk at street level.

Water Balance Modeling

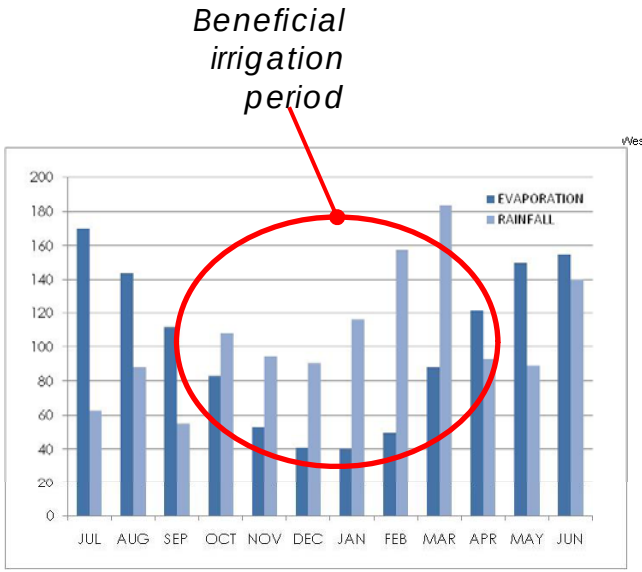
Stored stormwater can be used to irrigate the trees throughout the year or as an emergency storage for drought periods

The optimal tank size for Crown Street Mall was determined using a water balance model. Stormwater harvesting and reuse was simulated using MUSIC software with local rainfall and evapotranspiration data. The effectiveness of several tank sizes was tested for an annual irrigation rate of 500mm/year. This is considered to be generous (heavy irrigation) for native trees.

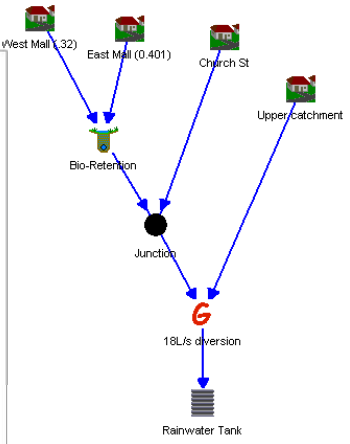
The optimal tank size coincides with the 'point of diminishing returns' shown on the plot below .

This volume is shown to be 40kL of storage

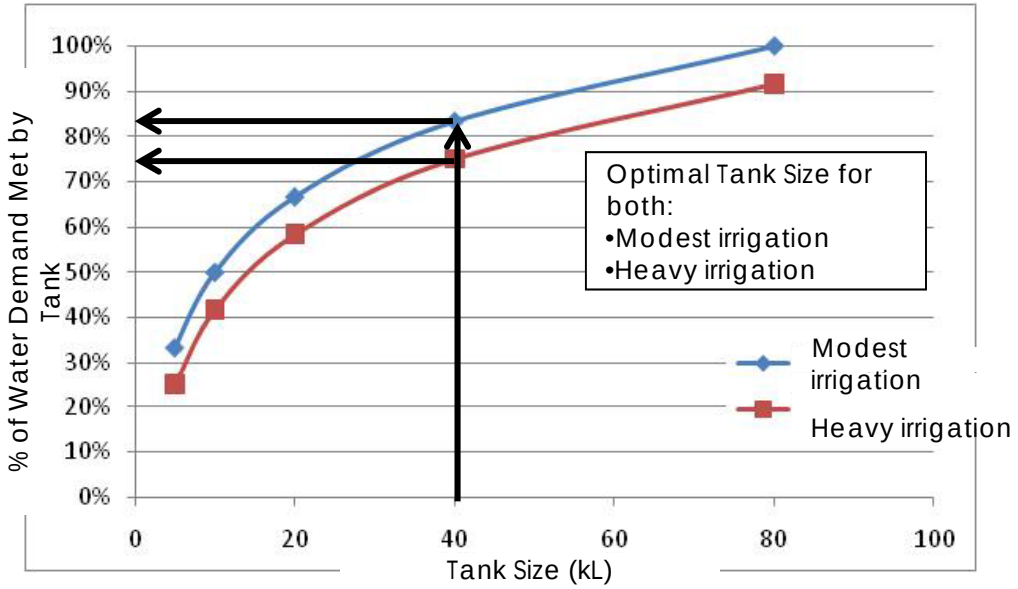
During times of drought stress, gum trees will benefit from the equivalent of 25mm of rain applied over their drip zone. This is approximately 1kL /week for a mature tree. A 40kL storage will only provide approximately half of this amount to each tree in the Mall. The storage and irrigation system must be topped up with other water sources during prolonged drought periods.



Wollongong climate averages



MUSIC Model Structure



Stormwater Pollutant Reductions

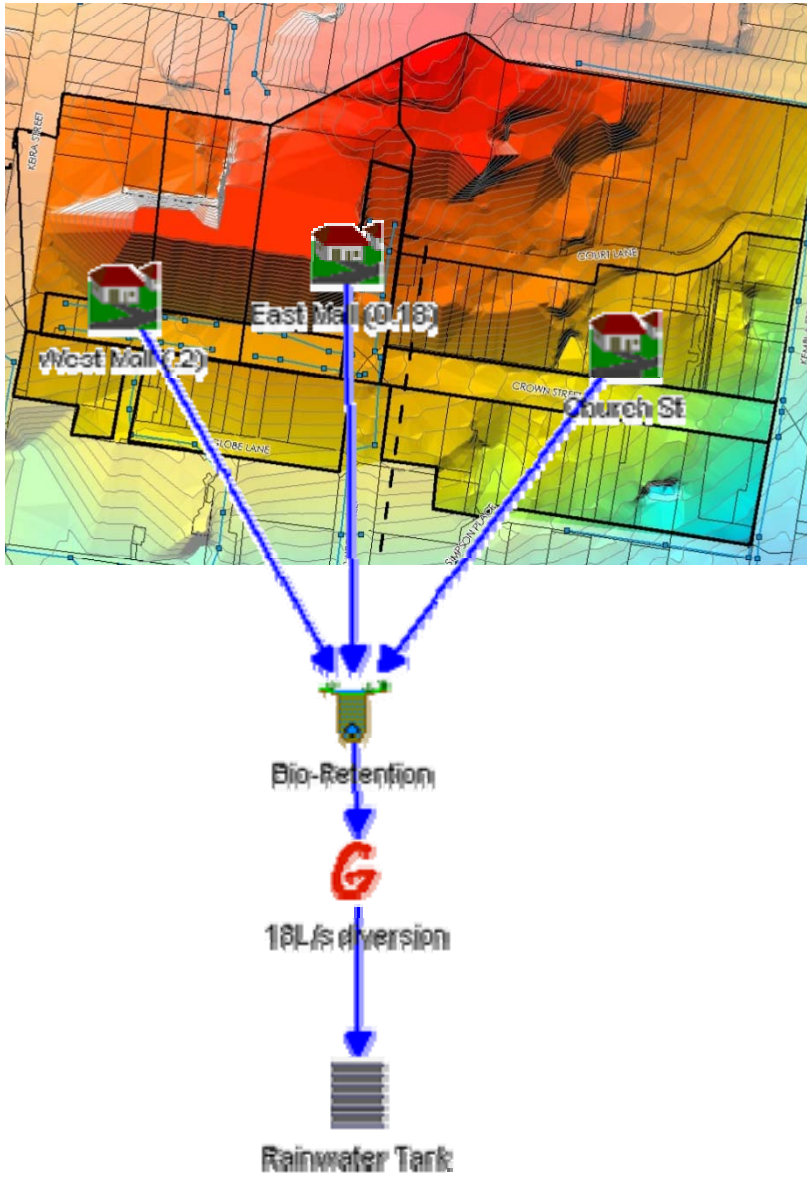
Stormwater harvesting and reuse intercepts stormwater pollutants and reduces the annual net export to receiving waters.

Best practice targets for stormwater pollutant reduction in NSW are:
Total Suspended Solids 85%
Total Phosphorous : 65%
Total Nitrogen : 45%

MUSIC modeling results for the stormwater harvesting strategy are presented are summarised in the table below

Annual reductions in stormwater pollutants	Proportion removed from Mall runoff	Proportion removed from Mall and Church Street runoff
Flow (ML/yr)	17%	28%
Total Suspended Solids (kg/yr)	95%	70%
Total Phosphorus (kg/yr)	82%	65%
Total Nitrogen (kg/yr)	65%	59%
Gross Pollutants (kg/yr)	100%	100%

MUSIC modeling shows that the harvesting strategy within the Mall will provide stormwater pollution reductions beyond current best practice for the Mall redevelopment. With the exception of Suspended Solids, the strategy will also deliver best practice pollutant reduction targets for the catchments draining through the Mall.



Regional Stormwater Collection and Harvesting Opportunity

The opportunity exists to invest in a larger stormwater harvesting strategy downstream of the Mall within McCabe Park.

Larger stormwater harvesting strategies can achieve better returns in terms of stormwater pollutant reductions and potable water savings.

Water balance modeling for shows that an 800kL storage within McCabe Park could deliver 6.6ML of irrigation water annually and deliver large pollutant reductions from the upper catchment.