Stormwater Innovation at Riverwalk: An Integrated Water Cycle Management Journey

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This paper documents the development of a sustainable water strategy, including a stormwater harvesting and reuse proposal, to service the Riverwalk development and surrounding region.

**Background; Introduction to Riverwalk**

The Riverwalk development comprises approximately 197 hectares of surplus Melbourne Water land in Werribee, approximately 35kms south-west of the Melbourne CBD. The land, formerly part of the Western Treatment Plant, is now being developed by Places Victoria in partnership with Melbourne Water.

The Riverwalk site borders the lower Werribee River, and is at the northern tip of the Western Treatment Plant (WTP). The WTP site includes approximately 11,000 hectares of land with an 18km shoreline on Port Phillip Bay. The plant receives approximately 52% of wastewater generated across metropolitan Melbourne (over 400ML/day), with treated wastewater recycled for end uses including POS irrigation, irrigation of market gardens at the Werribee Irrigation District, onsite pasture and crop irrigation\(^1\) and environmental flows to the Ramsar-listed WTP wetlands. The remainder of the treated effluent is discharged to the adjacent Port Phillip Bay.

\(^1\) Western Treatment Plant is also the largest agricultural enterprise in Victoria.
Following several years of master-planning and design, development of the Riverwalk site commenced in 2010 with the first stage residential release selling out in one day. When Riverwalk is fully developed in approximately 2022, it will include approximately 2300 dwellings housing 7000 residents, a mixed use town centre, two schools and extensive public open space.

The partnering deed between Places Victoria and Melbourne Water, which governs the development process, identifies water use initiatives as a specifically agreed project sustainability objective. This has been reinforced by the establishment of a vision for the Riverwalk development that includes reference to Riverwalk’s future “green parks, leafy ... streets”, “high quality streetscape environment” and “best practice storm water management”. The Riverwalk vision also aspires to ‘set new benchmarks for water efficiency in Melbourne’s west’, in a reflection of the strategic vision of the two development partners.

**Background – Riverwalk in Werribee**

Riverwalk is part of the Wyndham growth corridor - the fastest-growing municipality in Victoria, with approximately 5,500 new dwellings approved in 2010.
The Werribee district, located on Melbourne’s western plains, has the lowest average annual rainfall of metropolitan Melbourne (approximately 400mm/year) and a resultant rainfall deficit (after accounting for evaporation) of approximately 800 mm/yr.

This combination of rapid population growth and low rainfall creates a circumstance of vulnerability to water scarcity. This was evidenced at the height of Melbourne’s recent drought (approximately 2007 – 2009) when the local Council reported a severe inability to provide adequate sporting facilities to meet community demands under circumstances of Stage 3A water restriction. These factors of high population growth and low rainfall also strengthen the need for a truly integrated approach to developing a Water Cycle Management (IWCM) strategy in order to deliver on the development vision.

Whilst the Riverwalk development was undergoing planning and design, City West Water (the water retailer which will service Riverwalk) was working to deliver the West Werribee Dual Supply Project. Currently in construction, this scheme will supply low-salt Class A recycled water to new housing estates in the West Werribee region (including Riverwalk) and public open spaces managed by Wyndham City Council by 2014.

A dedicated salt reduction plant and recycled water distribution network will be constructed as part of this project.

**Background – Riverwalk Sustainable Water Strategy**

In early 2010, the Riverwalk Sustainable Water Strategy was developed, which identified the opportunity to reduce residential potable water consumption by approximately 70% to 55 L/capita/day. The strategy included demand management measures supported by two sources of non-potable water supply; reticulated Class A recycled water for garden use and flushing, supplemented by household rainwater tanks for laundry use.

In addition, the potential to harvest up to 225ML/yr of stormwater flows for reuse was identified within the strategy.

This paper outlines the objectives which guided the development of the stormwater reuse strategy, its integration into the Sustainable Water Strategy and existing regional servicing strategies, and the collaborative approach which lead to a truly integrated stormwater harvesting and reuse proposal being developed for Riverwalk and the Wyndham corridor.

**Project Objectives**

While the Riverwalk Sustainable Water Strategy was undergoing development and approval (2007-2010), Victoria faced a water supply crisis and Melburnians experienced an extended period of significant water restrictions. This led to an early focus on water security through diversity of supply and potable water substitution. A key aim of this focus was to deliver a strategy which would enable the maintenance of green public and private spaces, consistent with the project vision, which was severely constrained by the current water restrictions.

In 2008 the Victorian state government launched a high-profile behaviour change campaign, Target 155, which aimed to encourage domestic water-saving behaviour through the use of a personal water consumption target (155L/cap/day).
In this context, the expected water savings arising from the Riverwalk sustainable water strategy were messaged to stakeholders in comparable terms: the combination of proposed demand management measures and potable water substitution was forecast to deliver average potable water consumption of 55L/cap/day, a 65% improvement on the personal consumption target identified by government.

The strategy also identified expected stormwater runoff of 225ML/yr from the completed development, with total flows through the Riverwalk site (including runoff from upstream catchments) even higher.

**Options development**

A number of options for stormwater harvesting and reuse were developed, including for augmentation of Class A recycled water supply, for direct open space irrigation, and for non-potable use by nearby institutional uses (such as the Werribee Racecourse).

The presence of multiple reuse opportunities for Riverwalk stormwater prompted the need for a detailed options analysis. In early 2011 a collaborative cross-organisational working group was formed for this purpose by Places Victoria, Melbourne Water and City West Water.

When the Riverwalk stormwater harvesting and reuse strategy was scoped by the working group in early 2011, the context of the IWCM strategy had changed significantly relative to the initial work done in developing the Sustainable Water Strategy for the development. Water restrictions had been substantially eased, Melbourne’s water storages had recovered from their 2009 low of approximately 27% to be steady at approximately 55%, and the Victorian Desalination project was nearing its proposed commissioning date.

In this context, the imperative to deliver water security from stormwater harvesting and reuse was significantly reduced and the opportunity to deliver multiple alternative benefits was explored. These objectives included:

- Augmentation of the proposed West Werribee Dual Supply recycled water scheme
- Reduced reliance on Melbourne’s centralised water infrastructure
- Reduced harm to sensitive receiving waterways, including the Werribee River
- Providing affordable water services to customers
- Demonstrate to the region the benefits and the feasibility of going beyond regulatory requirements for integrated water management

Consistent with the project proponents involvement in the Centre for Water Sensitive Cities, the working group aspired to reflect the values of a Water Sensitive City through this strategy, including the adoption of multi-functional infrastructure, delivery of improved amenity and liveability, and climate change resilience (including through microclimate benefits), and habitat protection through the restoration of natural hydrological regimes. The strategy also aimed to
provide value for money and maximise the efficient use of existing assets for multiple purposes, in order to further reduce project costs.

Throughout 2011 as the investigations continued, project objectives evolved further to include alleviating rising cost-of-living pressures. This was expected to arise from stormwater augmentation of non-potable supply into the West Werribee Dual Supply Scheme, which would enable City West Water to potentially defer major investment in a planned augmentation of the Salt Reduction Plant (proposed in approximately 2020) to service the Wyndham growth corridor.

**Stormwater harvesting and reuse – options evaluation**

A working group was established to collaboratively develop a stormwater harvesting strategy. This strategy was required to

- Identify alternative stormwater harvesting and reuse options
- Assess option performance with regard to the objectives
- Confirm the feasibility, with respect to technical, commercial and stakeholder considerations, of the various stormwater reuse proposals
- Understand the relationship between these proposals and existing regional servicing strategies and regional water needs
- Confirm the desirability of each proposal in context of the regional servicing strategy and identified alternatives
- Subject to confirmation of feasibility and desirability, identify the preferred opportunity for stormwater harvesting and reuse.

A number of options were developed to a concept level of detail for evaluation, with the scale of each option ranging from domestic to regional initiatives. A similarly broad range of final water quality was considered, ranging from untreated stormwater for passive use in public open space maintenance to Class-A equivalent for domestic dual supply. Options developed included:

- Localised and distributed use of stormwater for public open space irrigation
- Stormwater attenuation at the lot scale with localised infiltration to local aquifers (such as through domestic-scale infiltration trenches) to enhance baseflow to the Werribee River
- Intensive harvesting and use of rainwater (to supply laundry toilet flushing and hot water demands)
- Capture and transfer of stormwater to a dedicated storage located at WTP (above-ground or aquifer storage), with treatment to a suitable standard for domestic dual-supply use (toilet flushing and outdoor use). Treated stormwater would be blended with CWW’s recycled water supply and delivered through CWW’s non-potable supply network.
These options were assessed relative to a base case ('business as usual') which involves the supply of Class A recycled water to residential and non-residential customers for non-potable use (toilet flushing and outdoor uses), and the mandatory installation of rainwater tanks for laundry use in all single-dwelling residential buildings.

A number of other options were initially considered but quickly discarded due to the limited benefits they presented relative to the costs and risks involved. This included regional scale aquifer recharge to limit salt-water intrusion arising from groundwater extraction by irrigators, use of stormwater for market garden irrigation in the Werribee Irrigation District, and treatment of stormwater to potable standard to augment existing potable water supplies.

A Triple Bottom Line multi-criteria assessment approach was used to identify the preferred options, which were then subject to a risk management and feasibility assessment to confirm the preferred approach.

The process included assessment of each options performance against seven criteria categories, undertaken by the working group members. The assessment criteria were adopted from a tool specially developed by City West Water for use in assessing competing alternative for stormwater harvesting and re-use, with some revisions made to the definitions in use to reflect the broader objectives of the working group members.

This tool included the following criteria and associated weightings:

<table>
<thead>
<tr>
<th>Criteria Category</th>
<th>Description</th>
<th>Weighting (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td>To deliver the project in a timely manner</td>
<td>5</td>
</tr>
<tr>
<td>Volume</td>
<td>Alternative water source can meet volumetric demand</td>
<td>5</td>
</tr>
<tr>
<td>Quality &amp; Reliability</td>
<td>Water is of a sufficient quality and reliability to meet service need</td>
<td>15</td>
</tr>
<tr>
<td>Indicative Cost</td>
<td>To deliver cost efficient non-potable water</td>
<td>10</td>
</tr>
<tr>
<td>Implementation Risks</td>
<td>To minimise implementation risks</td>
<td>15</td>
</tr>
<tr>
<td>Social &amp; Stakeholder</td>
<td>To meet customer and stakeholder expectations</td>
<td>15</td>
</tr>
<tr>
<td>Environment</td>
<td>To minimise negative impacts on the environment (atmosphere, land and water)</td>
<td>35</td>
</tr>
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As the purpose of the tool was to identify preferred options for detailed risk and feasibility analysis, the six lowest weighted criteria were assessed using slightly coarse data generated from concept-level design.

Environmental impacts accounted for over one third of the total decision weighting. Consequently, these were quantified in more detail by a consultant using an integrated water cycle modelling toolkit which considered a range of environmental performance measures. These metrics were then used to evaluate the environmental performance of each option under consideration using a separate MCA model developed by Melbourne Water (in conjunction with Yarra Valley Water) for Integrated Water Cycle Management Planning.
This model takes into account a range of environmental impacts including potable water use, nutrient and sediment discharges (to both waterways and the Bay), and flow frequency metrics. Impacts on both the Lollipop creek and Werribee River catchments were considered in applying this model.

**Options Study Results**

The working group used this decision framework to form preliminary conclusions regarding the preferred concept for stormwater harvesting and reuse at Riverwalk which made efficient use of existing or proposed at Riverwalk to harvest stormwater and treat to a standard suitable for injection into City West Water’s non-potable distribution pipeline.

The proposed central floodway, required to provide flood control and drainage services to the development, provided an excellent opportunity for a centralised harvesting scheme. Therefore, the preferred option was expected to harvest stormwater from this asset, with sub-surface collection and storage proposed to segregate treated stormwater from the bioretention cells for re-use.

The presence of a non-potable reticulation network provided an excellent opportunity to reuse stormwater at scale for domestic purposes, which maximises the benefits this project may deliver to the natural environment (by maximizing diversion of wet-weather runoff). Therefore the preferred approach involved the treatment of stormwater to Class A equivalent, to be blended with City West Water’s supply of Class A recycled water and delivered to customers for toilet flushing and outdoor use.

Preliminary investigations were made into the use of local aquifers to maximise the benefits of this approach in meeting peak (summer) demands for non-potable water. As part of this process, there was recognition that City West Water’s existing investigations into aquifer storage and recovery (ASR) for Class A recycled water appeared very positive and that aquifer storage of permeate from the salt reduction plant was likely to proceed. As a result of this, the expected capital cost savings from stormwater reuse during peak demand periods (achieved through deferred augmentation of CWW’s Salt Reduction Plant) were unlikely to be realised.

This prompted the working group to review the evaluation of options to identify a new preferred option. This re-evaluation identified centralised harvesting of stormwater to augment Melbourne Water’s wholesale Class A recycled water supply as the preferred option. This source or non-potable water services irrigators in the Werribee Irrigation District (via Southern Rural Water’s retail service) as well as City West Water’s West Werribee dual supply area (via wholesale supply to CWW).

Supply of treated stormwater to the Werribee Irrigation District had been previously disregarded, as a result of the perceived ‘low value use’ of valuable stormwater resources for irrigation purposes, which was considered to be a lower priority use than the potential to use stormwater for domestic dual supply. However, as the project had proceeded the context in which the decision criteria had been set had changed considerably.

The changed decision to supply the Irrigation District as well as the West Werribee Dual Supply Area has resulted in significantly reduced project costs by removing the proposed aquifer storage and a proposed stormwater treatment plant from the design. It is now proposed that
smaller stormwater storages will be constructed at WTP, and WTP’s Class A plant (UV + Chlorine disinfection) will treat the stormwater.

As well as delivering a forecast 65% reduction in reliance in potable water, the IWCM strategy for Riverwalk has been modelled to achieve a reduction of stormwater flows to waterway of over 50%. In addition, the number of days where stormwater pollutes the Werribee River is reduced from eleven to six.

This concept will now be the subject of a thorough business case to ensure the necessary financial, stakeholder and regulatory objectives will be met.

Conclusions and Lessons Learnt

The integrated water cycle management journey at Riverwalk has clearly illustrated that a change in the project context gives rise to changing objectives, which therefore results in a different preferred strategy. This project initially focussed on providing water security through diversity of supply, and then on reducing the cost of non-potable water supply. The final iteration focussed on maximising harvesting volumes at minimum cost to reduce harm to waterway health. The evolution of the preferred option could not have occurred if the project team had remained committed to the objectives which were initially agreed. Instead the team were prepared to review these project objectives to reflect the changed environment, and as a result have reduced the capital cost of the project by more than 50%.

The strategy also clearly demonstrates that integration of various systems at various scales is essential; project proponents need to consider all sources, all end uses and all scales.

Melbourne Water and Places Victoria’s collaboration is based on an existing strong relationship. City West Water was also invited onto the working group due to the strong connection of their strategy to ours and the potential synergies between the various infrastructure proposals being considered.

Much alignment (and indeed, overlap) exists between the visions of the three organisations involved. This has made for “smooth sailing” within the working group. However, consideration of the limited residential demand for alternative water is essential, so that provision of stormwater does not harm the business case for West Werribee supply scheme recycled water reticulation. The initial preferred option ran the risk of duplicating a large investment in aquifer storage and recovery infrastructure which would provide little marginal benefit if both ASR schemes were to proceed.

Outcomes from this study also demonstrates that some project delay has been an advantage; a better outcome has arisen from new objectives adopted in 2011 compared to those initial project direction identified using project objectives which were current in 2009. As well as reducing the real cost of infrastructure delivery by deferring it’s delivery, the scale of investment required has been reduced from $11.35 million capital cost and $265,000 per year operating cost to $4.84 million capital cost and $89,000 per year operating cost, with almost no reduction in the volume of stormwater harvested.
The integrated water management journey for Riverwalk is still in the early concept stage. Much more work is needed to check the feasibility and refine the stormwater harvesting concept. Commercial arrangements and sources of funding also need to be secured.