Appendix F – Rainwater Tank Memorandum

Memorandum

01 April 2019

To	Melbourne Water		
Copy to			
From	GHD	Tel	
Subject	Rainwater Tanks	Job no.	3136555

1 Introduction

This memorandum was prepared for South East Water in October 2018 as part of the Fishermans Bend Water Sensitive Drainage and Flood Strategy. This version addresses feedback provided by Melbourne Water and South East Water.

1.1 Purpose of this memorandum

The purpose of this memorandum is to provide a summary of works to date to assist in understanding the benefits of the proposed rainwater tanks for the Fishermans Bend renewal area. Some questions that this memorandum aims to answer include:

- What are the quantitative and qualitative benefits of the rainwater tanks?
- Do the rainwater tanks have the same benefit in all areas of the renewal area?

2 Background Context

2.1 Nature of Flooding and Drainage

Fisherman's Bend is low lying and flat, and therefore water does not drain away. In some areas the lowest point at the end of drains is lower than sea level and pumping is required to move water out.

All water that hits the ground therefore adds to the total flow that the drains and pumps must carry.

Therefore, storage above ground or at the property reduces the need for drainage or pumping, or alternatively, frees up capacity in these systems to reduce overall flood levels.

In principle, therefore, rainwater tanks in this area will provide a flood management or asset cost reduction benefit.

The question thus becomes the extent of this benefit, not whether such benefit exists.

2.2 Broad Drivers for Rainwater Tanks

The broad drivers for rainwater tanks at Fishermans Bend are as follows:

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- Provide flood storage, capturing up to 50% of the overall catchment (roof and podium), reducing the cost of drainage works downstream (i.e. storage and/or other at ground level/underground assets where excavation of Coode Island contaminated soils is required as well as the magnitude of pipes and pumps downstream);
- Provide a primary source of alternative water supply (backed up by recycled water from FB sewer mining plant) to the proposed in-building third pipe network; and
- Assist in removal of water from the general stormwater system to meet BEPM related targets. (Note that in areas outside Fisherman's Bend in the CBD, new high rise and other buildings typically install rainwater tanks to meet the planning requirements of the City of Melbourne in any case, so the requirement to provide tanks at Fisherman's Bend is not counter to what occurs in other areas.)

An earlier opportunity that was identified by SEW as part of the IWM Strategy in 2015 was to have the ability to be upgraded to a smart multi-function tank in the future so that the tank can be further optimised in future to further increase its value and be used for other storage purposes (e.g. recycled water from FB sewer mining plant). It is understood from SEW however that because of operational and risk management considerations this is no longer a driver/opportunity being pursued.

highlights the various scenarios that a smart multi-function tank would need to accommodate as part of the Fishermans Bend IWM strategy. Note this is now superseded.

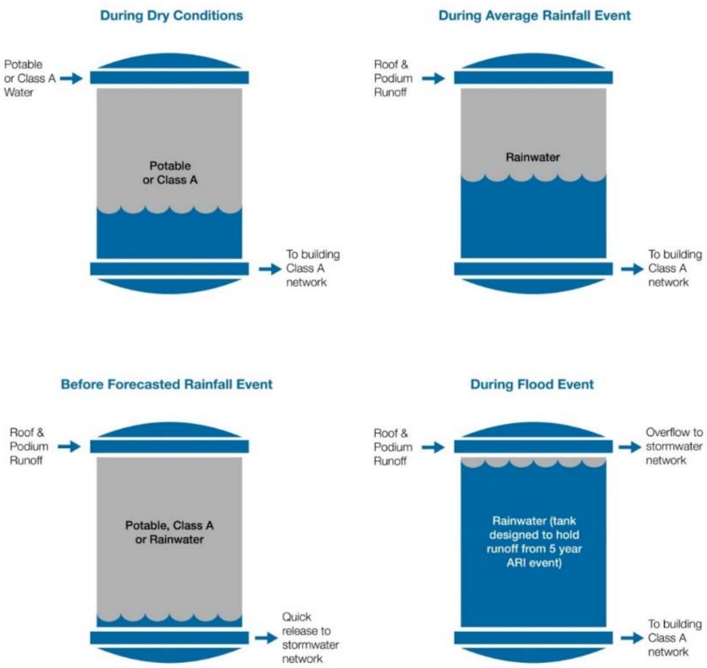

Figure 1 Smart Multi-Functional Tank Concept (Fishermans Bend IWM Strategy, GHD 2015)

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Figure 2 highlights the current operational philosophy for the rainwater tanks as advised by SEW.

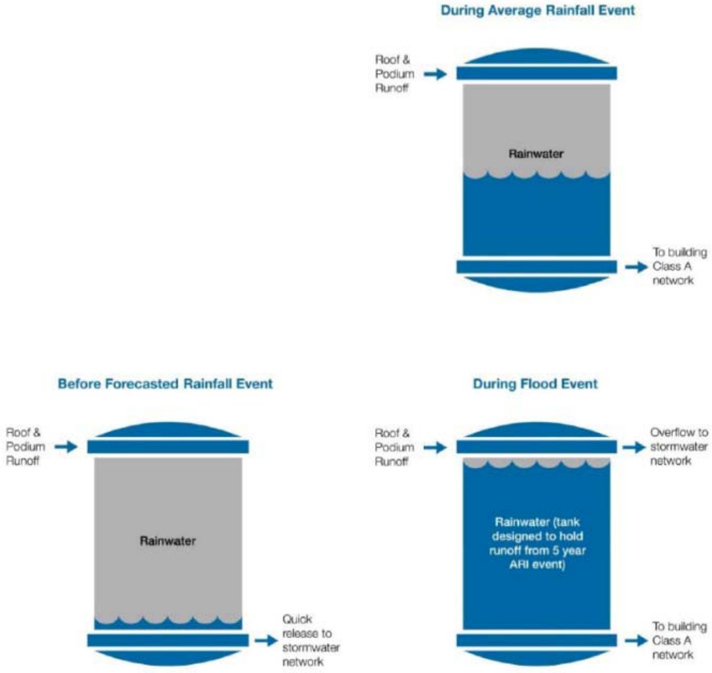

Figure 2 Smart Multi-Functional Tank Concept (Water Sensitive Drainage and Flood Strategy, GHD 2019)

Note the exact operating philosophy and sizing basis for tanks has evolved over time, as discussed below, and so the reference to 'holding the runoff from 5 yr ARI event' should be considered indicative.

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2.3 Modelling of Rainwater Tanks

The Fishermans Bend Strategic Framework Plan (SFP) requires rainwater tanks to be installed on each new building within urban growth area. There are two main requirements within the SFP, which could influence the size of the rainwater tanks:

- 7.1 To make efficient use of stormwater not overload existing drainage and create green urban environments which protect the environmental health of urban waterways and Port Phillip Bay.
- 7.2 To reduce the need to augment potable water supplies.

Based on guidance received from Victorian Planning Authority (VPA) in relation to the intent of the Strategic Framework Plan (SFP) requirements, it was understood during the previous IWM work that the rainwater tanks would need to capture the first 101 mm (equivalent to the total rainfall from a 5 year 72-hour storm event) from the building roof and any podium hardstand, and retain a minimum of 50% of this volume. It was assumed that given the tanks would be typically drawn down reasonably fast (i.e. within 24-48 hours) there was no requirement to separate the retention and detention elements of the rainwater tank.

For illustrative purposes and based on the work completed as part of the previous IWM project, the average size that a building scale rainwater tank would need to be was 278 kL, with 50% for reuse (139 kL) and 50% for slow release (139 kL). The average size of 278 kL was based on:

- * An average building roof area of 1903 sqm.
- * An average contributing podium area of 853 sqm (representing 70% of the podium, based on the land use assumptions derived by GHD in collaboration with VPA).

In practice, the size of the rainwater tanks will vary from site to site. However, for the purposes of the modelling it was necessary to select a nominal building size.

These tanks would be designed to primarily detain flood peaks with an orifice (leaky tank) half way up the tank. These tanks would perform two functions as follows:

- Provide rainwater to the building scale third pipe network (primary supply) – bottom 50% of tank (139 kL on average).
- Have the ability to slowly release water to the Yarra River and Port Phillip Bay (after the flood peak has receded) – top 50% of the tank (139 kL on average).

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Since completing the IWM work, it has been agreed between Melbourne Water and the Fishermans Bend Task Force that the rainwater tanks as part of the baseline drainage plan would not need to capture the first 101 mm (equivalent to the total rainfall from a 5 year 72-hour storm event) from the building roof and any podium hardstand. **Instead, the rainwater tanks should only be sized to have a capacity of 0.5 m^3 per 10 m^2 from the building roof and any podium hardstand**. This change will effectively half the size of the rainwater tanks compared with that calculated as part of the previous IWM work (i.e 139 kL rather than 278 kL). ***We have thus modelled a 139 kL rainwater tank on average for the baseline drainage assessment.***

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2.4 Work to Date

Table 1 summarises the work undertaken by GHD to date exploring base case drainage solutions. It is critical to understand that this is part of a work-in-progress, and the ongoing development of innovative and community centred streetscapes by the Councils suggests more storage is needed rather than less.

Table 1 Work to Date

Study	Scenario Investigated	Key Findings
IWM Strategy, October 2015	Development of a base case flood solution with rainwater tanks in all buildings for the 5 yr & 100 yr ARI events	Lot scale rainwater tanks can provide flood storage (potentially at a lower cost to precinct base storages. The uncertainty in the cost of implementing precinct scale storages is a clear driver for exploring the implementation or larger or smart rainwater tanks at the lot scale. This uncertainty relates to poor ground conditions (high water table and Coode Island silt), contaminated soils, cost of land as well as the uncertain time frame of development. Lot scale rainwater tanks can provide a rainwater harvesting function. Lot scale rainwater tanks can provide a short term storage alternative for potable water (after third pipe is installed and before recycled water plant is required due to a low population in the early years of development). Lot scale rainwater tanks can provide a long term storage alternative for potable water and/or recycled water.
Drainage Assessment of Base Case, March 2017	Development of base case flood solution with rainwater tanks in all buildings for the 5yr, 20 yr & 100 yr ARI events	Identified the tank, pipe, pump station and flood levee requirements to achieve a range of different levels of service. Note that this assessment assumed the required rainwater tank size as set out in Section 2.3 above.
Drainage Assessment of Base Case 2018	Development of revised base case flood solution with rainwater tanks in all buildings for the 20 yr & 100 yr ARI events	Optimisation of the 2017 base case scenario (i.e. increased the size of pipes and reduction in pumps). This assessment has explored the CAPEX costs and not the total lifecycle costs at this stage. CAPEX costs are higher relative to 2017 base case (i.e. pipe CAPEX does not offset smaller pump station CAPEX). Note that this assessment assumed the required rainwater tank size as set out in Section 2.3 above.

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3 Rainwater Tanks Investigations - 2018

Between July and September 2018, as the Baseline Drainage Plan for the Fishermans Bend renewal area was being prepared by GHD, an investigation was also carried out to understand the impacts of the proposed rainwater tanks on pipe upgrade requirements of the Baseline Drainage Plan.

The following modelled peak flood extents for the 20 year ARI & 100 year ARI events are provided to demonstrate the impacts:

- Figure C3/C2 – Baseline drainage plan, which includes 13 km of pipe upgrades costing $85 million, and $34 million in rainwater tanks (90 ML of rainwater tanks). The level of service is generally achieved for both the 20 year and 100 year ARI events. Note that this assessment assumed the required rainwater tank size as set out in Section 2.3 above.
- Figure D2/D1 – Baseline drainage plan, without rainwater tanks. Removal of the rainwater tanks shows increased areas of flooding and increased depths up to 0.1 – 0.4 m inside and outside the renewal area. The changes in flood depths with and without tanks is further shown in Figures D7/D6. The level of service is reduced for the 20 year ARI. The level of service is still generally achieved for the 100 year ARI. *This work demonstrated that the tanks do in fact provide a flood benefit.*
- Figure D5/D4 - Baseline drainage plan, without rainwater tanks, with additional 2 km pipe upgrades costing and additional $14 million. With the additional pipe upgrades, there is a reduction (improvements) in flood extents for some areas, but the level of service is still worse off compared to the baseline conditions (Figures C3/C2), particularly in the Wirraway precinct and the low-lying areas of the Montague precinct. *This work showed that (as expected in these flat areas) it is very difficult to substitute for storage. Rainwater tanks are one approach to storage.*

  Within the low lying areas of the Montague precinct, the limited fall to the discharge points into the Yarra River meant that it was not practical to further upgrade the pipe drainage. Rainwater tanks or other forms of storage upstream may be the only practical solution in this area.

  The major constraint on the drainage system servicing the Wirraway precinct is the limited capacity of the pipe drainage network downstream through the City of Port Phillip. Without rainwater tanks, or other storage solutions, upgrade works would need to be made to the downstream drainage system outside of the renewable area to enable the level of service to be achieved within Fishermans Bend. This will increase infrastructure costs, but an estimate has not been assessed at this stage.

There are also other rainwater tank benefits, such as improved stormwater quality entering Port Phillip Bay, by reusing rainwater and removing pollutants which would otherwise be delivered to the Lower Yarra or to the bay. Note however, that in the City of Melbourne it is typical for new buildings to include a rainwater tank to meet BPEM requirements for water quality.

Additionally, the rainwater tanks reduce the peak flows in the drainage network reducing the size of the pump stations.

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4 Rainwater Tank Sensitivity Analysis - 2019

The rainwater tanks are critical to flood protection across Fishermans Bend, and reduce the amount of pipe upgrades or surface storages required. It is important to note that the extent of other mitigation infrastructure required at Fishermans Bend assumes that the rainwater tanks are fully effective as flood storages. Therefore as part of the current *Fishermans Bend Water Sensitive Drainage and Flood Strategy*, a sensitivity analysis of the risk of not achieving the required rainwater tank flood storage volumes was undertaken, which showed that if only 50% of the rainwater tank flood storage volumes were implemented (or effective during an event), for any given reason, then this would approximately double the required surface storage volumes from around 24 ML to 47 ML within the sub-catchments for which distributed storage is proposed.

Method

For 2100 conditions for the 5% AEP rainfall event, two model scenarios were run, each with the levee, pumps and rainwater tanks included in the model, but without any within-catchment pipe upgrades or distributed storages. For these scenarios the 'spill' volumes that result are a measure of the required volume of distributed storage that would be needed to alleviate the flooding. The baseline scenario assumes 100% of rainwater tank flood storage volume is available (i.e. that they are implemented and are effective). The sensitivity case assumes only 50% of the storage is available, uniformly across the whole area.

Results

The results are shown in Table 2 below, with the catchment for which distributed storages are proposed in the final Water Sensitive Drainage and Flood Strategy noted in bold.

Table 2 Required distributed storage volumes for baseline and sensitivity case

Row Labels	**100% tank volume (baseline scenario)** 20 yr Spill Volume (m3)	**50% tank volume (sensitivity)** 20 yr Spill Volume (m3)
Butchers Ln Drain	**413**	**870**
Cargo Ln PS	14316	20923
Cargo Ln PS East	39249	43057
Hall St PS	**4198**	**6060**
Poolman St Drain	**1575**	**2064**
River Esplanade PS	**2987**	**8072**
Sabre Drive PS	0	58
Salmon St Drain	**12515**	**25307**
Salmon St PS	**2936**	**4679**
Todd Rd Drain	19870	23464
Todd Rd PS	620	1642
Westgate Lakes	5497	5786

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5 Conclusions

This investigation showed that there are some benefits of rainwater tanks for the Fishermans Bend renewal area which have been assessed and quantified, whilst some other benefits which are qualitative have not yet been assessed. These benefits are summarised below:

1. Capital costs

The rainwater tanks have an estimated capital cost of $34 million. Without rainwater tanks, additional pipe upgrades within the Fishermans Bend renewal area have been estimated to cost an additional $14 million on top of the baseline drainage plan.

Note: this additional $14 million does not lead to an equivalent flooding outcome compared to the outcome delivered by the $34 million of rainwater tanks, as there are areas where pipes and pumps cannot achieve the same outcomes as storage. This includes further pipe upgrades further downstream in the City of Port Phillip (outside of Fishermans Bend), which have yet to be assessed or costed.

2. Different levels of flood protection for different areas

Rainwater tanks in the Fishermans Bend renewal area can provide:

- A level of flood protection (reduced flood extent and flood depths) in place of additional pipe upgrades in some areas of the renewal area.
- Flood protection in areas where pipe upgrades may not necessarily be a viable option within the renewal area (e.g. within the low lying Montague precinct or where pipe upgrades outside the renewal area are required).
- A contribution to improving flood conditions outside the precinct (specifically the southern portion of Fishermans Bend that drains to the south, where there would be some contribution to downstream flood mitigation outside the precinct).

3. Stormwater quality improvement

The rainwater tanks will provide some level of stormwater quality improvement (which has not been quantified yet) by retaining pollutants which would otherwise be delivered to the local stream or waterway, if rainwater is reused.

Note however, that in the City of Melbourne it is typical for new buildings to include a rainwater tank to meet BEPM requirements for water quality.

4. Ability to provide a primary source of alternative water supply (backed up by recycled water from FB sewer mining plant) to the proposed in-building third pipe network

The rainwater tanks will provide a primary source of alternative water supply for in-building the pipe network.

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5. Ability to be upgraded to a smart multi-function tank in the future so that the tanks can be further optimised and can be used for other storage purposes (i.e. recycled water from FB sewer mining plant).

The rainwater tanks will provide the ability to store recycled water from FB sewer mining plant if the tanks are converted to smart multi-function tanks in the future.

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Attachments (8 No.) Flood Maps

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