PIGGING OF THE O'SHANNASSY OUTLET MAINS

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ABSTRACT

The water transfer capacity of the O'Shannassy Reservoir outlet mains had gradually reduced from 335ML/day to 215ML/day since 1965.

The loss in pipeline capacity has been attributed to a build-up of iron-manganese slime on the pipe walls, measuring between 5-10mm in thickness.

When O'Shannassy Reservoir is full, the lost capacity spills into the O'Shannassy River and can only be recovered by pumping out of the Yarra River at Yering Gorge, 40kms to the west, and into Sugarloaf Reservoir. This water is then filtered and disinfected at Winneke Treatment Plant at some considerable cost.

Therefore, pigging the main was identified as an economical way to improving capacity, whilst reducing intake from Yarra River and deferring pipeline duplication.

1.0 INTRODUCTION

The O'Shannassy Reservoir is among the smallest of 11 reservoirs managed by Melbourne Water with a total storage capacity in the order of 3,100ML. But it is on a very productive catchment, with stream flow averaging 80,000ML/annum.

The reservoir has a protected mountain catchment nestled within the Yarra Ranges National Park, located approx. 80kms east of Melbourne near the township of Warburton.

2.0 DISCUSSION

2.1 Infrastructure

Harvest from O'Shannassy Reservoir is transferred via two pipelines: M230 (O'Shannassy-Yarra Conduit) and M301 (O'Shannassy-Upper Yarra Conduit) collectively referred to as the O'Shannassy Outlet Mains.

The M301 main was constructed in 1940 to connect the Upper Yarra and O'Shannassy Aqueducts to enable water to be diverted from Upper Yarra Dam to Silvan Reservoir. It is welded mild steel and enamel lined, measuring 1150mm in diameter.

The M301 originally measured 3kms in length, extending between O'Shannassy Aqueduct and '00' Basin, where it meets Upper Yarra Aqueduct. Abandonment of O'Shannassy Aqueduct in 1996 resulted in the abandonment of a 600m length of the M301 between the aqueduct and the junction with M230.

Today, only 2.4kms of the M301 main remains in service, and together with the M230 form the only outlet from O'Shannassy Reservoir.

The M230 main was constructed in 1965. It measures 1150mm in diameter and 4kms in length. It is welded mild steel and enamel lined. At the time, it provided a second outlet from O'Shannassy Reservoir to augment the capacity of the O'Shannassy Aqueduct. It also connected the O'Shannassy Reservoir to the M301 main, enabling O'Shannassy water to be supplied to Melbourne via the Yarra-Silvan conduits, which by that time had been duplicated as part of the Upper Yarra Dam project. *Refer to Figure 4 Network layout*.

The M230/M301 mains once converged at a 'T' junction located some 4kms downstream of O'Shannassy Reservoir. The project proved a timely opportunity to reconfigure the pipeline network, particularly in light of the 'T' junction no longer serving an operational purpose since abandonment of the O'Shannassy Aqueduct in 1996. *Refer to 2.5 Enabling Works*.

2.2 Loss of Capacity

Between 1965 and 2004, transfer capacity had been reduced by 36% from 335ML/D to 215ML. Inspection revealed the presence of iron-manganese slime measuring between 5mm-10mm in thickness.

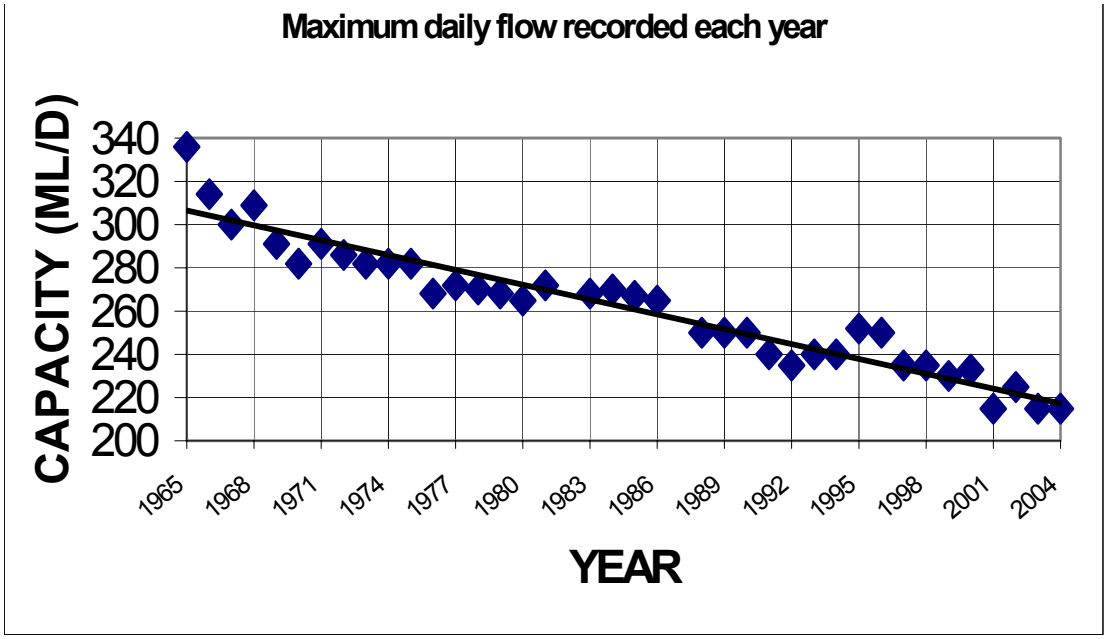

Figure 1: ***O'Shannassy 1150 Outlet Capacity***

2.3 System Performance

O'Shannassy Reservoir is small, and functions like a diversion weir. Once streamflows rise, the reduced transfer capacity of the outlet mains results in increased spills into the O'Shannassy River, which then flow into the Yarra River. This capacity can only be recovered by pumping out of the Yarra River at Yering Gorge some 40kms further downstream into Sugarloaf Reservoir, where it requires treatment at Winneke.

Harvesting water this way is very energy intensive, especially compared to the gravity transfer to Silvan Reservoir from O'Shannassy Reservoir.

The extra cost of pumping from Yering Gorge to compensate for transfer loss at O'Shannassy Reservoir, and subsequent treatment at Winneke Water Treatment Plant is in the order of $70/ML, with about 75% of this being energy cost. In comparison, water from O'Shannassy Reservoir is from closed mountain catchments, and can be transferred directly into Silvan Reservoir and the distribution network via gravity and without filtration.

2.4 Possible solutions

A long-term solution to increasing yield from O'Shannassy Reservoir is the duplication of the outlet mains. This was first proposed in 1986, and now forms an integral part of Melbourne's Storage Recovery Plan developed in 2003 by Melbourne Water in consultation with the three retail water companies.

Therefore, pigging was seen as the only viable solution to recovering lost transfer capacity, as flushing was not possible due to low pressures.

Cleaning delivered approximately 70% of the capacity improvement possible through duplication for less than 3% of the estimated cost of duplication.

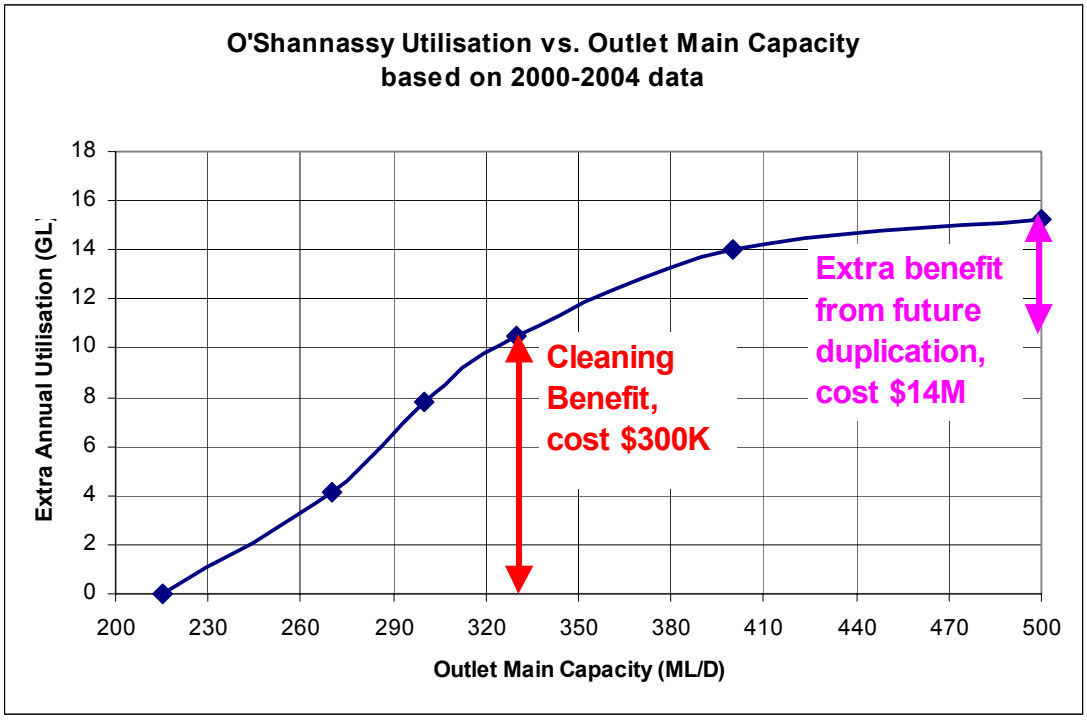

Figure 2: *O'Shannassy Utilisation V's Outlet Main Capacity*

2.5 Project Phasing

The project comprised four stages:

Planning

Considerable effort upfront would assure Melbourne Water a positive outcome. With this in mind, a project team was assembled comprising key Melbourne Water personnel and Thiess Services (Principal Maintenance Contractor). Some of the major considerations taken into account in the planning for the pigging operation, included:

- Stakeholder engagement
- Enabling works
- Lead time for materials: Pig, Tee Kay Couplings, etc.
- Work sequences – Staging of pigging operation
- Sludge Management

Stakeholder Engagement

Early engagement of stakeholders, both internal and external, was identified as crucial. A consultative approach toward managing stakeholders was seen as a contingency. Accordingly, stakeholders were consulted in the early stages of planning to ensure their requirements were factored into the scope of works. If not addressed, these requirements could potentially impact project delivery.

Enabling Works

Entry and retrieval points for pigging were achieved by cutting out spool pieces, which were reinstated using Tee Kay couplings.

As outlined in 1.1 Infrastructure, this project provided the timely opportunity to reconfigure part of the pipeline network no longer serving any operational purpose. Accordingly, this resulted in the replacement of the 'T' junction where the M230/301 mains once intersected with two 45 degree bends, thereby creating a continuous pipeline. This facilitated the pigging operation, whilst increasing capacity by reducing pressure losses.

Pigging

The pigging operation was sub-contracted by Thiess Services (Principal Maintenance Contractor) to T.D. Willamson Pty Ltd who also supplied the pig. The pig cost $14,000 to manufacture and was imported from the U.S.

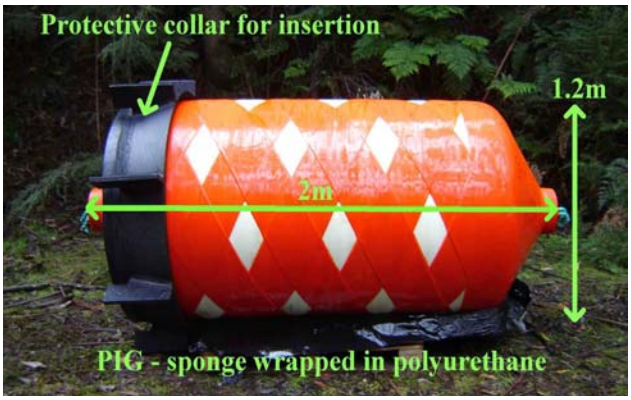

Figure 3: ***The Pig Used in the Cleaning Process***

2.6 Work Sequences

The butterfly valve located in Valve House 1 resulted in the need to split the project into two stages, as outlined in figure 7.

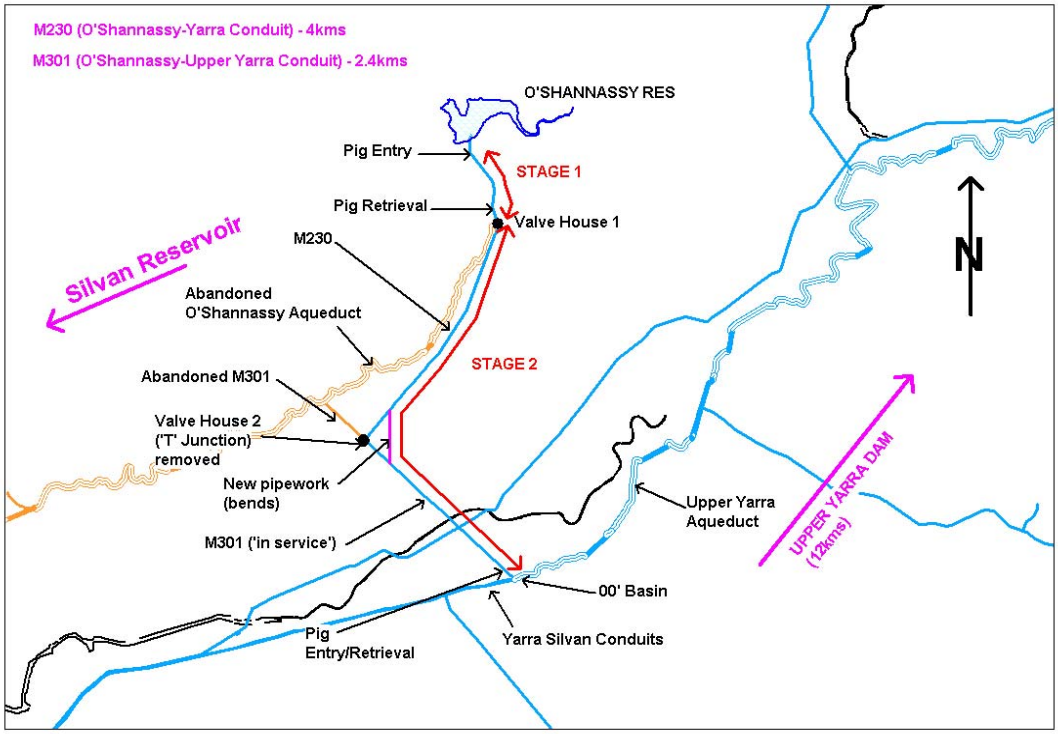

Figure 4: ***The Network Layout***

Stage 1 - O'Shannassy Reservoir to Valve House 1(upstream) – Length 1km:

Stage 1 involved cleaning the section between the reservoir and Valve House 1 in two passes. The entry point for the pig was immediately downstream of the dam spillway and the exit/retrieval point immediately upstream of Valve House 1.

Discharge was directed into the abandoned O'Shannassy Aqueduct via the stilling basin. The pig was then removed and re-installed at the original insertion point and the exercise repeated.

Stage 2 - Valve House 1(downstream) to Junction Basin– Length 5.4km:

This stage involved the cleaning of the M301 from '00' Basin to Valve House 2, and from Valve House 2 to Valve House 1 (along the remaning length of the M230 not cleaned in Stage 1). This stage involved two passes. A single entry/retrieval point for the pig was cut into the M301 at '00' Basin.

Using pumps set into the Upper Yarra aqueduct, the required hydraulic head to drive the pig was achieved. A specially built manifold was installed at the end of the M301 to accommodate the pump inlets.

In the first pass, the pig was driven upstream to Valve House 1. Discharge was directed into the abandoned aqueduct via the stilling basin, as per Stage 1.

The pig was not removed after the first pass, and in the second pass the pig was driven back to the insertion point at '00' Basin using head from O'Shannassy Reservoir.

Sludge handling for the second pass in Stage 2 ('return trip') at this location was critical as the discharge point was close to the operating aqueduct.

2.7 Sludge Management

The abandoned O'Shannassy Aqueduct was used as a temporary storage basin to receive discharge. It was used for both passes in Stage 1 and the first pass of Stage 2 works from '00' Basin to Valve House 1.

A series of permeable weirs were installed at 100m intervals along the aqueduct, allowing the liquid component of the discharge to filter, thereby trapping the solids for removal once dried. An impermeable weir was installed some 400 metres from the stilling basin.

Figure 5: ***Permeable weirs allowing liquid component to filter through***

3.0 CONCLUSION

As outlined in *2.4 Possible Solutions*, cleaning delivered approximately 70% of the capacity improvement possible through duplication for less than 3% of the estimated cost of duplicating the outlet from O'Shannassy Reservoir.

There has been an increase in transfer capacity by more than 58% (215ML/day to 335ML/day). This equates to savings in operating costs in the order of $600K-$700K/annum, which also represents a significant financial return on total project cost of $500K ($300K – Opex for pigging and $190K - Capex for new pipework). Additionally, these results represent environmental benefits through conservation in electrical energy and reduced greenhouse emissions.

These results have encouraged Melbourne Water to look elsewhere in the system where this maintenance strategy can be utilised.

4.0 ACKNOWLEDGEMENTS

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and delivery the project.