ASSET MANAGEMENT – NOT JUST ABOUT LONG TERM PLANNING

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ABSTRACT

The Cambridge water supply is from two large reservoirs on the Hill by the Karapiro reservoir. These reservoirs are critical network assets that ensure continuity of water supply to the township. The prominent location of these reservoirs would result in significant property damage and cultural issues should they fail in service.

Waipa District Council during the last Long Term Plan (LTP) cycle invested significant funds into understanding the criticality of its various water assets and using these to determine the priority for their condition assessment. This philosophy for this approach was to drive effective planning and results in an optimized asset replacement strategy for the LTP.

As critical assets the reservoirs at Karapiro reservoirs had an external, visual condition inspection in October 2012. This inspection noted water ponding on the roofs of both reservoirs and suggested an internal inspection be undertaken. To minimize operational outage of the reservoirs during a period of high water demand an internal inspection was only undertaken in October 2013 using divers. The photographic evidence from the divers indicated significant issues with the internal roof support structures of reservoir 1 in particular with a need to take urgent action.

Waipa instigated immediate measures to restrict access to the reservoir roofs and implemented emergency physical works to repair the roof supports to ensure continued service of the reservoirs post the summer demand period. These repairs were undertaken in September to October of 2014 in a collaborative and innovative way between Council, Opus Consultants and Brian Perry Civil due to the uncertain nature of the extent of repair required and again with the program pressure of having the reservoir back in service before the summer period.

The paper will discuss the cradle to grave asset management philosophy as applied by Waipa with regard to the Karapiro reservoirs and how an understanding of asset criticality and condition can lead to enhanced plant understanding, performance and risk mitigation.

KEYWORDS

Asset Management, Infrastructure criticality, Condition assessment

1 INTRODUCTION

Good asset management practices are employed locally, nationally and globally to ensure infrastructure assets continue to provide sustainable and economic service. Good asset management practices are however sometimes seen by operators as having a separation from their day to day work on the ground as the asset managers are interested in depreciation costs, long term plans with regard to renewals planning, criticality based maintenance etc. This paper gives an example from Waipa District Council of how asset managers and operators came together with great outcomes for the district but also potential learnings for both going forward.

To put the paper into context, NAMS, 2015 provide a good definition what and how asset management should work.

What is Infrastructure Asset Management?

The goal of infrastructure asset management is to meet a required level of service, in the most cost effective manner, through the management of assets for present and future customers.

The key elements of infrastructure asset management are:

- Taking a lifecycle approach
- Developing cost-effective management strategies for the long-term
- Providing a defined level of service and monitoring performance
- Understanding and meeting the impact of growth through demand management and infrastructure investment
- Managing risks associated with asset failures
- Sustainable use of physical resources
- Continuous improvement in asset management practices

A formal approach to the management of infrastructure assets is essential in order to provide services in the most cost-effective manner, and to demonstrate this to customers, investors and other stakeholders

The last paragraph is key in that "other stakeholders" can include operators and others affected in any way by the assets continued use.

2 WAIPA ASSET MANAGEMENT JOURNEY

Waipa District Council is a very progressive TLA located in the Waikato to the south of Hamilton. Their major townships are Cambridge and Te Awamutu. Whilst planning their 2012 to 2022 Long Term Plan there was a recognition within the water team at Council that their asset condition knowledge with regard to reticulation and reservoirs in particular was not as good as it could be and that in order to make better informed decisions going forward they needed to address that issue. They hence committed monies in the early years of the LTP to increase the amount of reticulation condition assessment physical surveys undertaken and undertake external surveys of all their water reservoirs. Aligned with this was the update of their asset database with more detailed and extensive recording of individual assets and their criticality.

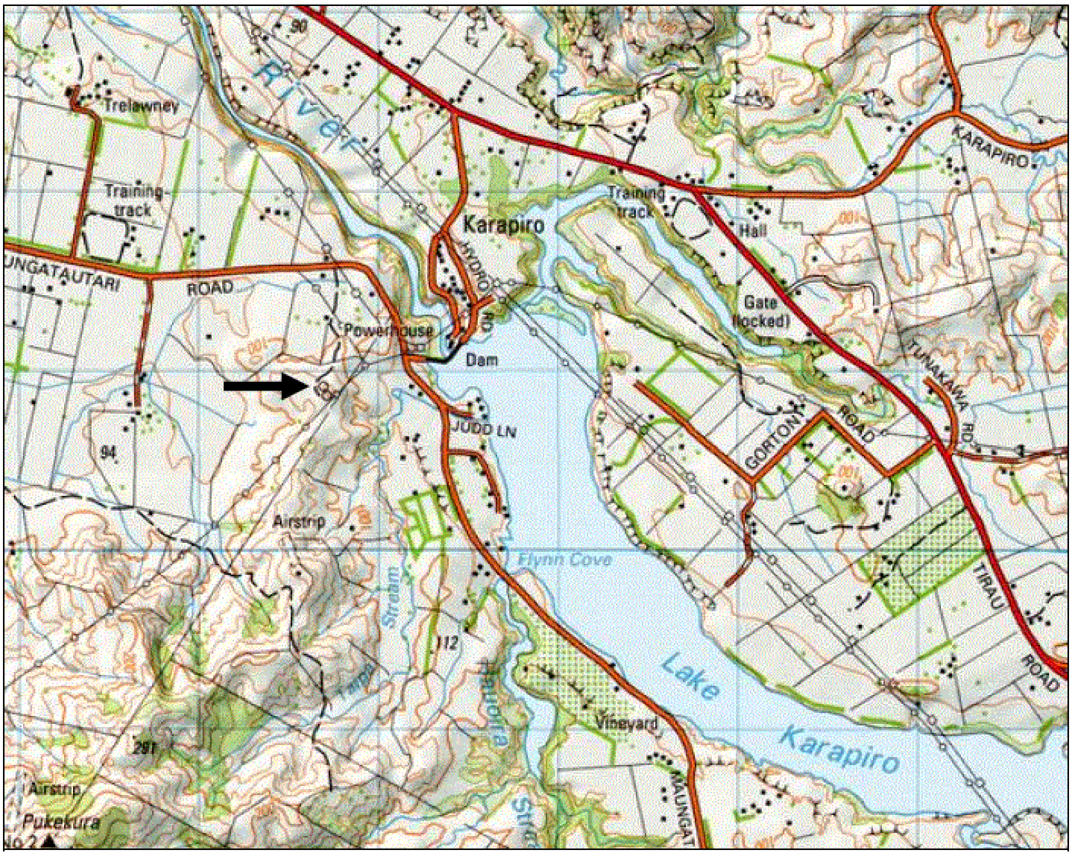
Obviously within Waipa as with many district Councils the water storage reservoirs generally came out as being of high criticality with regard to maintaining levels of service to customers and for general community wellbeing. The two reservoirs at Karapiro which are the main source of water to Cambridge definitely falling into the high criticality category.

3 KARAPIRO WATER STORAGE RESERVOIRS

3.1 LOCATION

The three Karapiro reservoirs are located on top of a high point near the Karapiro dam on the northern end of Lake Karapiro, 5km south east of Cambridge. Of the three one is redundant and out of service. The other two (Karapiro reservoirs 1 and 2) are the main water storage for Cambridge.

The site has a long history with the site being a recorded archeological site (T14/4), known as "The Crows Nest", a military redoubt and former pa site Te Tiki o te Ihingaranagi from the 1860's. The place is where Waikato Maori engaged British troops under General Cameron in 1864 (Opus, 2007).



3.2 TECHNICAL

The two operational reservoirs are:

Reservoir Name:	Karapiro (No. 1)
Storage capacity:	4900 m^3
Material type:	Precast concrete
Estimated construction date:	1974

This reservoir is constructed from vertical precast concrete panels with in-situ concrete stitches. The walls have four pilasters between which horizontal post-tensioned cables are anchored. The roof has three access hatches.

The diameter of the reservoir is 31.5 m and height 6.3 m.

Reservoir Name:	Karapiro (No. 2)
Storage capacity:	2400 m^3
Material type:	Insitu concrete
Estimated construction date:	Unknown

This reservoir is a circular insitu concrete reservoir with a flat concrete roof. The roof is supported by columns. The diameter of the reservoir is 25 m and wall height 5.3 m.

Photograph 1, general view of reservoirs

3.3 CRITICALITY

3.3.1 WATER SUPPLY

The two reservoirs are the prime water source to Cambridge and provide a minimum 24 hours water storage at average water demand. During the summer months in particular they are critical assets in that buffer water use against the available water supply from the associated Karapiro Water Treatment Plant.

They are hence highly critical assets for Waipa with a strong preference not to take them out of service for any reason and especially during the summer months when it is usually Cambridge which triggers the districts water restrictions as necessary.

3.3.2 SIGNIFICANT PLACE

Using a wider definition of asset criticality the reservoir location and surrounding land is also highly significant to local iwi due to the historic use of the land as described above. This aspect is taken into full account by Council during routine operations and maintenance plus any strategic planning for the site.

4 CONDITION ASSESSMENT

4.1 SURVEYS

As described above in the initial years of the 2012-22 LTP Waipa targeted funds to get a better understanding of in part their water storage reservoirs. Opus International Consultants were engaged to undertake external surveys at all the reservoir sites, including those at Karapiro.

The main objectives of the surveys were to provide:

- Commentary of the physical condition based on visual inspection of all easily and safely accessible surfaces.
- Commentary on services and penetrations, such as pipes, security hatches, ladders, manholes, etc.
- Commentary of any health and safety issues identified.
- Commentary on any specific operational and maintenance issues identified during the visit or by talking to the operator, e.g. security of water storage, ease of access to equipment, location and direction of scour pipe.
- A list of recommended further actions, e.g. internal inspection, remedial works.
- Estimate remaining useful life.
- Estimate reservoir capacity where data is not provided.

The initial surveys at Karapiro were undertaken on 31st October 2012. The main findings were recorded as being (Opus, 2012):

Karapiro 1 – There is a very large crack (≈10 mm) in the upstand around the centre roof access hatch, The recommended action being to undertake detailed inspection to determine cause of crack and identify most appropriate remedial repair.

Also there is evidence of minor water ponding on the roof. It appears that a thin screed has been added to the roof. The screed has spalled in one location. Saw cuts, in a square pattern, have been made and filled with sealant. Any significant ponding on the roof can add significant weight to the roof resulting in greater displacements increasing the area of ponding leading to progressive failure.

Photograph 2, crack in access upstand

Karapiro 2 - The reservoir currently has significant water ponding on the roof . The depth of the water during our inspection was 55 mm near the centre hatch. This depth would increase following rain events. It is likely the original roof did not have sufficient fall. With time settlement of the internal columns and foundations has likely occurred together with displacement of the roof slab. The water ponding adds further weight which can lead to additional settlement and progressive failure of the roof. Further, ponding can lead to contamination of the stored water.

Photograph 3 of roof ponding Karapiro 2 at time of survey

The findings and recommendations from the various reservoir surveys were analysed and works programmes put in place to initially address any high Health and Safety issues identified. With regard to Karapiro reservoirs 1 and 2 the decision was made to incorporate internal inspection of the reservoirs with a degrit operation being planned for late 2013.

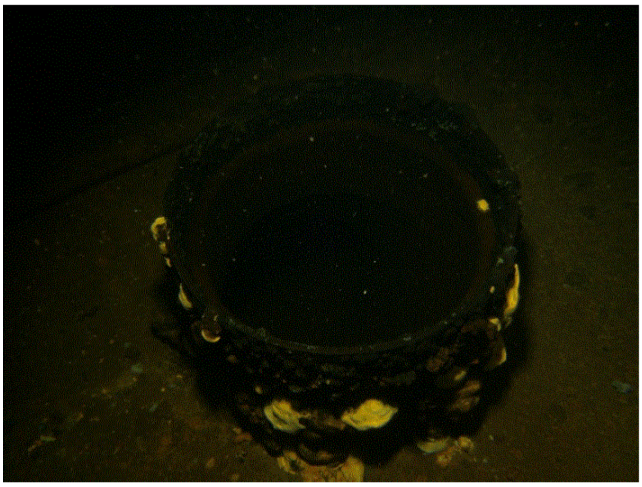
4.2 DIVER INVESTIGATIONS

Removing the grit and detritus possibly at the bottom of the reservoirs is a periodic maintenance activity. In 2013 it was decided rather than emptying the reservoirs to trial the use of divers to remove any debris. The contract being awarded to DiveCo Ltd. This company were also skilled in underwater asset inspections and hence could undertake the internal survey of the reservoirs as recommended in the initial inspections.

The internal inspections were undertaken in October 2013 and the conclusions reported in November (Opus, 2013). Pictures from the report are provided below to illustrate the type of information provided by the divers and also state of the internal condition in each reservoir.

Photographs 4, Internal views of Karapiro 1

Photographs 5, Internal views of Karapiro 2



4.3 ANALYSIS AND CONCLUSIONS

The 2013 report was very clear and definitive in that it concluded very significant and immediate structural issues with Karapiro reservoir 1 roof in particular. The internal beams being misplaced off the column supports in parts and some column tops being significantly damaged. The prognosis for Karapiro 2 being that the internal supports were of a different type to 1 and in much better condition. The observed external ponding probably being due to localized and minor beam settlement.

The Waipa response was to immediately restrict access to the Karapiro 1 roof in particular and make plans for the reservoirs repair. As it was obvious the repair would require emptying Karapiro 1 a comprehensive risk assessment was undertaken with the decision made to delay the repair until outside summer peak period.

5 RECTIFICATION

Although the internal inspection was definitive on the need to undertake repair of the reservoirs the full extent of the failures was not fully known. The lack of good as-built records didn't also assist in scoping a repair methodology. It was hence obvious a collaborative approach was required to not only scope but also undertake the reservoir repairs.

Brain Perry Civil were selected as the physical works contractor due in part to their in-house structural engineering design capability. They worked in association with Council and Opus to plan a repair strategy which achieved the ultimate goal of maintaining the reservoir structural integrity but also ensured the reservoirs were kept out of service for the minimum period of time.

The physical repairs were undertaken during September and October 2014. Once Karapiro reservoir 1 was drained entry to the reservoir by the structural engineers was made to fully scope and confirm the repair sequence agreed on paper. This internal inspection had to cut short as the observed displacement of some beams was deemed so bad that it was not safe to be inside the reservoir until temporary props were installed to support the roof!

The column tops in Karapiro 1 were repaired and enlarged such that the roof beams could not fall from them but no attempt was made to raise the beams just to support them in their present position. An interesting observation during the repairs were several small holes in the roof which were obviously a previous attempt to get rid of the roof ponding.

Once reservoir 1 was back in service Karapiro 2 was taken out of service but not emptied as the roof was in good condition. To alleviate the surface ponding and hence extra roof loading a roof drain was installed by another innovative means namely installing internal pipework from an inflatable dingy.

Both reservoirs were subsequently brought back into service in time for the summer demand.

6 CONCLUSIONS

A case study of where setting out to do the right thing resulted in some unexpected findings, the need for innovative solutions and in the end a great result for Council. Certainly a case where applied asset management resulted in risk reduction, cost effective solutions and the continued operation of critical water assets in providing levels of service to customers. In the introduction it was suggested there were some learnings from this case study. It was obvious during the repair of the reservoirs that the roof ponding issue had been spotted and attempts made to alleviate it in the past, i.e. the screen on the roof and the holes drilled in the roof to allow it to drain! None of this had been captured in the asset management system and no documented attempts made to understand underlying causes hence the beam displacements coming as a surprise during the more recent surveys.

The main learning therefore is the continued need to ensure good communications between operators, maintainers and asset managers to ensure relevant asset data is retained, stored correctly plus forward action plans generated as necessary, e.g. frequency of survey etc. and carried out to ensure optimum asset operation and replacement.

ACKNOWLEDGEMENTS

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