HOW TO SET UP A RELIABILITY CENTRED MAINTENANCE PROGRAM TO SUPPORT ASSET MAINTENANCE SYSTEMS

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ABSTRACT

In 2000 Goulburn Valley Water (GVW) undertook an internal review of its operations. From that review the 2000 GVW Operations Strategy was published, and rolled out across the corporation.

Under the Operations Strategy it had been identified that:

> "*Around the date of the merger, Goulburn Valley Water's maintenance management system was predominantly based on reactive maintenance*".

The report went on to identify that:

> *"since implementing scheduled maintenance a number indentified shortfalls are, the potential for over servicing, poor application of resources, unnecessary downtime during overhaul and a higher fault frequency related to recommissioning had occurred".*

The strategy went further to identify the need for a combination of Breakdown Maintenance (BM), Scheduled Maintenance (SM), and Reliability Centred Maintenance (RCM) programs, were required to ensure the availability of GVW assets. This paper focuses on how GVW trialled a condition monitoring program, or RCM, on the Central Water Treatment Districts assets. The purpose of the trial was to identify what would be required to roll out a comprehensive program, across the corporation's assets.

1.0 INTRODUCTION

Goulburn Valley Water generated annual revenue in 2008/2009 of around $54.9 million and managed an asset base valued at over $542 million. This infrastructure includes 39 water treatment plants, 26 wastewater management facilities, 313 pumping station, 113 tanks and reservoirs, over 1,700 kilometres of water mains and more than 1,100 kilometres of pressure and gravity sewers. These assets are divided up into 4 districts, Northern, Central, South West and South East, which in turn are then managed by District Managers (DM). It is the role of the DM to manage these assets with input from the Asset Performance group. This has meant that over the years the DM's have managed their assets from different approaches. All use a mixture of SM, and BM philosophies to ensure their equipment and plant meet the corporations needs.

The Central Water Treatment group manage 17, of the 39 water treatment plants around the Shepparton base. This includes towns like Shepparton, Kyabram, Tatura, Tongala and Rushworth along with other smaller installations.

Of all these WTP's, the Welsford Street Plant in Shepparton is the largest in the GVW group of assets. The Welsford street plant has a running capacity of up to 110 ML of water per day. The plant delivers SAFE drinking water to around 20,000 private customers and 2 major customers in SPC and, Campbell Soups. The plant on average produces 70 ML/d in summer peak production, down to 15 ML/d in winter.

With the sudden ramp up of the major customers in late spring, the Welsford Street plant must have all of its assets in a ready to run condition. In the spring of 2007 this was

found not to be the case, and this was due to the maintenance philosophy of the time. The maintenance philosophy at the time was based around pull-down, inspection or repair of major pumps, on a rotational basis. This had resulted in over servicing of some pumps, and under servicing of others, as noted in the 2000 operational review. As no major failures had occurred at the plant, this philosophy was considered appropriate.

At the start of 2007, it was decided to get a clearer understanding of the condition of the assets at the time. RCM inspections would be trialled to see if this philosophy was the right direction for our group, and ultimately GVW.

2.0 THE TRIAL

The trial consisted of a combination of vibration and thermal monitoring inspections, originally as a one off hit, to get a baseline of information. Then after the initial inspections a schedule of inspection would be confirmed.

A local contractor, Kyabram Rewinds, who in the past had carried out a majority of the Welsford Street scheduled maintenance, was approached to work with the CWT, to run the initial condition monitoring inspections. The initial inspection also included undertaking thermal inspections on the power supply switchboards. This consisted of twelve 300Kw pump sets that had power and trip protection. As Kyabram Rewinds were also very experience in motor condition, this also formed another piece of the puzzle, by inspecting all connections and the motor windings. Motor condition inspection is something that is often neglected in RCM philosophies, as the main concentration is on vibration and condition of bearing and bearing housings, and in some cases the pumps footings. It was accepted that replacing a motor after failure, is just as difficult as finding a replacement for the pump in a small turnaround timeframe.

In the first cut discussions with the contractor the type of report generated, would also form a large part of the outcome. This is because we did not what a complicated 20 page report that did more to confuse, than benchmark the pumps condition. It was decided a simple measurement based on the Australian standards for pump vibration would give us the best result.

2.1 The Initial Results

As the old saying goes “be careful what you wish for”. From the moment we started undertaking the first set of readings the worst case scenario was uncovered. While some pumps were in excellent condition most were in a poor state. Of the available 12 pumps, four were in good operational order, three where on the borderline, two were put to last start operation, and 2 where not to be run at all, or risk total failure. The thermal inspections on the switchboards reviled one of the motor contactors was close to catastrophic failure. If the contactor did fail it could feasibly take out two of the other contactors due to the design of the board, and two more needed urgent remedial repairs. What made this worse was that the pumps identified in the vibration report as being in good condition, had the failing switch gear.

2.2 The Response

From the reports then generated, the switch gear was the first to be rectified to ensure we had pump availability. It was then on to rebuilding the pumps that required a major

rebuild.
Leaving the pumps that required medium rebuilds until money was available to the next financial year. Capacity of the plant could handle these pumps being on last start reducing their run times. The report highlighted the need for RCM as an asset maintenance tool if we were going to ensure plant availability. The remaining pumps were refurbished the following year.

3.0 THE NEXT PHASE

To ensure we didn't get into a similar situation at other sites, RCM was then rolled out across the next biggest WTP's within the CWT group, at Kyabram and the Tatura sites. After the inspections were completed we found similar issues. These site both had duty standby lowlift and highlift pump sets, and similar to Welsford Street findings half of the pump sets tested were in a poor condition. Unlike the Shepparton site, the electrical thermal imaging of the switchboards showed they were in good condition. The pump sets identified to be in poor condition were removed, refurbished and returned. Upon return they were again condition monitored for a baseline to be set for future testing. During the inspection of the Kyabram plant, it was identified that one of the concrete plinths was the cause for excessive vibration. The plinth was then shored up and made stable again and retested satisfactorily. This was another good outcome as we found RCM did more than just tell a story the bearings and pump.

3.1 RCM Frequency

A meeting was held with the CWT group and contractor to set a plan of inspecting the pumps on a six monthly basis, until we were out of the woods. This way as we refurbished the out of spec pump sets over the two years, we could compare the results and measure more accurately how long a pump would last between refurbishments. If after two years we could see no immediate difference over the 6 months, we would take the monitoring out to 12 monthly inspections.

By 2009 it became obvious that the pump sets at Welsford Street would require a 6 monthly assessment, whereas the Kyabram and Tatura sites would sit fine with a yearly inspection. Other pumps by this stage had also been added to the list of yearly inspections, which now totalled 32 pump sets scheduled for assessment.

4.0 RESULTS AND THE NEXT STEPS

After three years of running the RCM trial, a clearer picture could be put together to judge the performance, and outcomes of the inspections. As fig 1 shows, spending on the pump set maintenance since 2004 had been quite erratic. Big spending one year followed by little the next, seemed to be the outcome of the philosophy at the time. After the initial repairs in 2007 more were scheduled and completed in 2009. This Resulted in 2010 programmed maintenance replacement of six of the twelve couplings to reduce vibration.

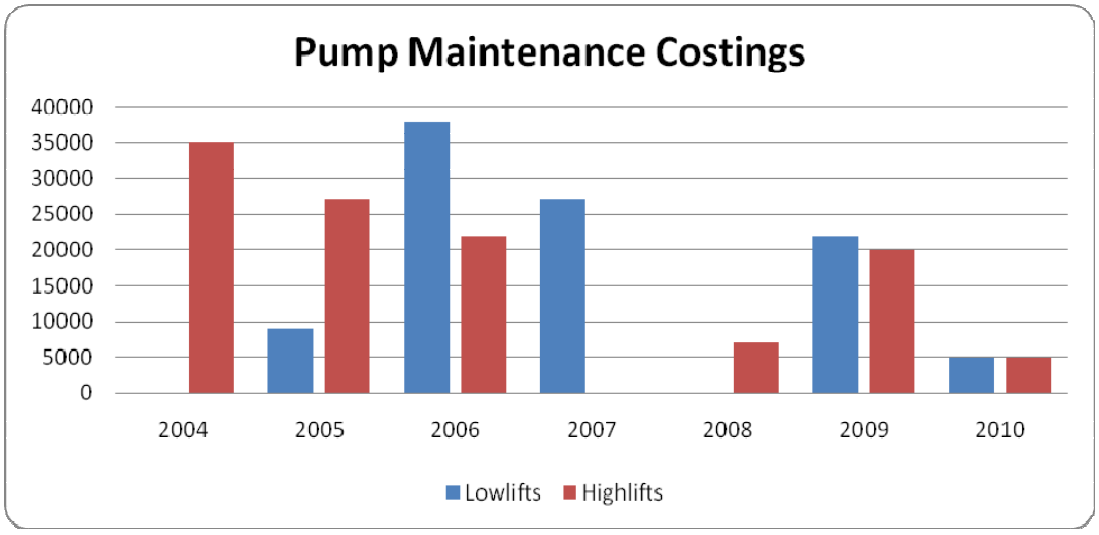


Figure 1: ***Pump Maintenance Costings***

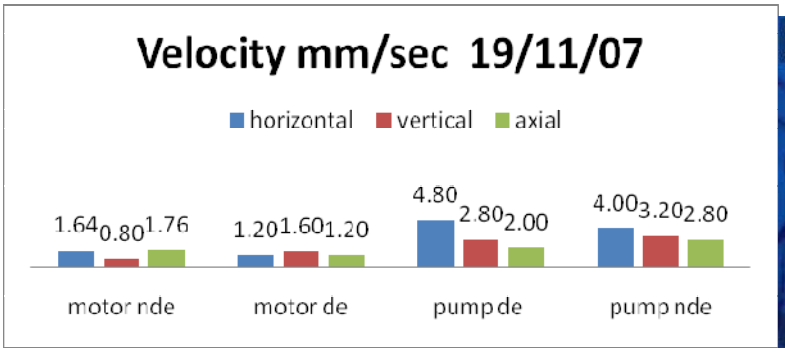
4.1 Improved Reporting

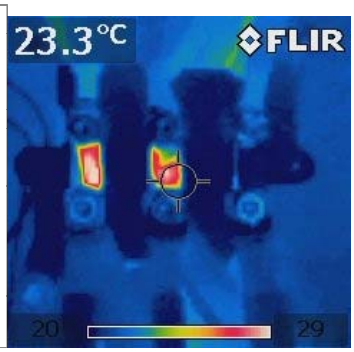
Since 2007 changes to the reporting were discussed with the contractor, which has now resulted in a format that shows clearly to operators and maintenance staff, the condition of each pumpset. The changes to the report were made to better show:

- How the pump set is performing compared to the previous inspection
- A overall corrective action plan for all pump sets, highlighting the rectification maintenance required for the next budget period
- How long after refurbishment it is until a refurbishment is required again and
- Allowing for refurbishment before total failure occurs, resulting in lower maintenance costs

The report is simple in its presentation as can be seen in Figure 2.

Further improvements were made in 2009 when the contractor introduced thermo graphing of the contactor boxes. These photos were then added to the report (see Figure 2). This now gives a total representation of the condition of the pump set. Starting from the power, into the switchboard and onto the motor, where the vibration monitoring of the assets finishes off the whole picture.





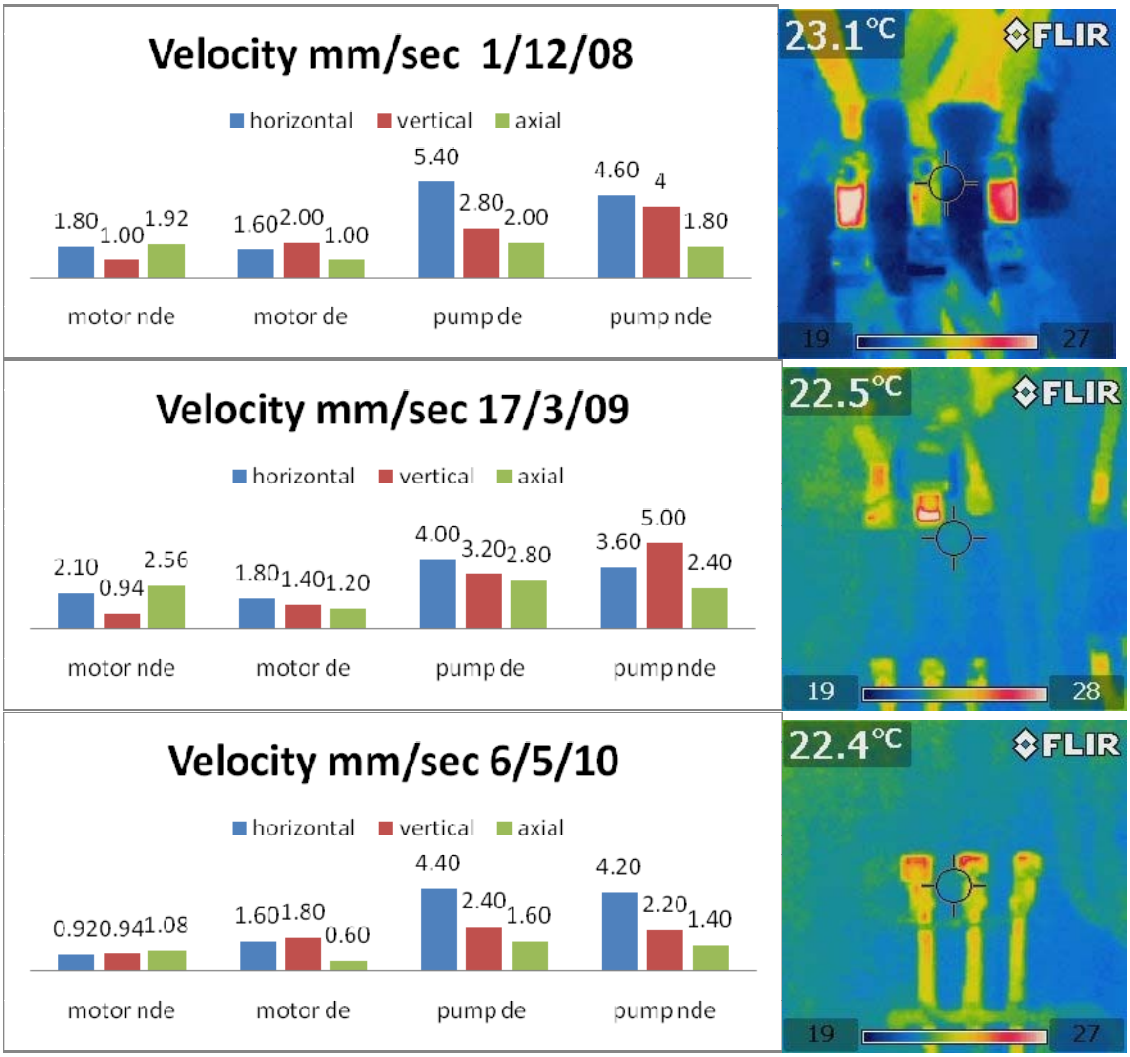


Figure 2: ***Condition reports for pumpset***

4.0 CONCLUSION

Having now run the trial for three years a clearer picture of how successful an RCM program can be, has been assured. GVW's asset performance group have now taken the data we have collected, and presented an internal review that has recommended a further rollout of inspections, across the other three districts. The review predicted savings of up to $1000 per pump set a year. While the savings were something the CWT grouped hoped might come from the RCM. The confidence of heading into the peak supply season, with the knowledge that all assets are available, and without possibility of failure is the true measure of this programs success.

While an easier call might have been to use a large contractor who specialises in condition assessment to undertake the analysis. Using a local contractor, keen to work with the CWT on this project, has been the real success story for our group. It has now resulted in having a local contractor that is more economical to use, and is armed with the knowledge of our assets in case of a pump set failure. The simplification of a report that fits our needs has really been the icing on the RCM cake.