LANDERS SHUTE WTP RAW WATER MAIN DRAIN DOWN, REPAIR & REFILL

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ABSTRACT

Mid April 2024, Landers Shute Water Treatment Plant (WTP) had its longest ever shutdown to enable important repair works to be completed on the pre-lime dosing spear. The planned shutdown at Landers Shute presented a significant operational challenge which required careful coordination and collaboration across multiple teams within Seqwater. The complexity of isolating the raw water main and completing repairs within a limited timeframe, along with the need to ensure minimal impact on water supply, presented a significant challenge for the team.

The pre lime dose point is on the raw water main into the WTP and it can only be isolated from the dam. This meant that a full plant shutdown needed to occur, including complete drain down of the raw water main. The raw water main is almost 3km long and the majority of the main is located within a tunnel in the Blackall range. There was a lot of time and effort dedicated to rigorous risk assessments and plans to ensure the work could be conducted safely. It's not common to have a single piece of work such as this that requires such large collaboration across multiple groups.

1.0 INTRODUCTION

Landers Shute WTP is the largest in the Sunshine Coast region, with a design capacity of 140 ML/d. The WTP supplies bulk treated water to Unitywater and the South-East Queensland Water Grid, and having a relatively low operating cost, is used as a critical base load plant when Baroon Pocket Dam storage levels allow.

The raw water from Baroon Pocket Dam is typically low in alkalinity. To ensure adequate alkalinity for coagulation, lime is added to the raw water. CO2 is also added to bring the pH down to the optimal range.

In April 2024 it was discovered that there was a leak on the pre lime connection point on the raw water main. When the leak was discovered, Seqwater engaged a contractor to assess the damage and to conduct repair work. The contractor was only able to complete a temporary repair and advised that the main would need to be de-pressurised to conduct a permanent repair.

Figure 1 Leak at injection point

Figure 2 Pre lime dosing pit

2.0 DISCUSSION

Unfortunately, there are no section isolation valves upstream of the raw water lime dosing pit. Therefore, to de-pressurise the main, the entire raw water main from the intake tower at the dam to the WTP would have to be drained, this is approximately 2 ML of water. Refer to Figure 3 & Figure 4 below which show the raw water main in blue. The raw water main is a OD1086 mild steel cement lined pipe. The raw water main had never been drained before and it presented significant risks that needed to be managed.

Most of the static head in the raw water main is attributed to the intake tower which is approximately 30m high in elevation. The rest of the raw water main from the intake tower to the sedimentation basin has a net difference in elevation of 10m.

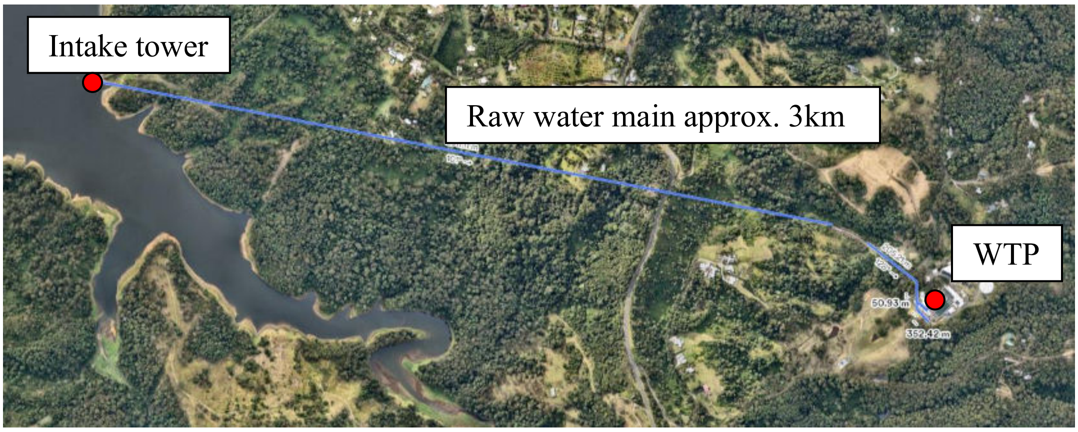

Figure 3 Aerial photo showing the length of the raw water main to the WTP

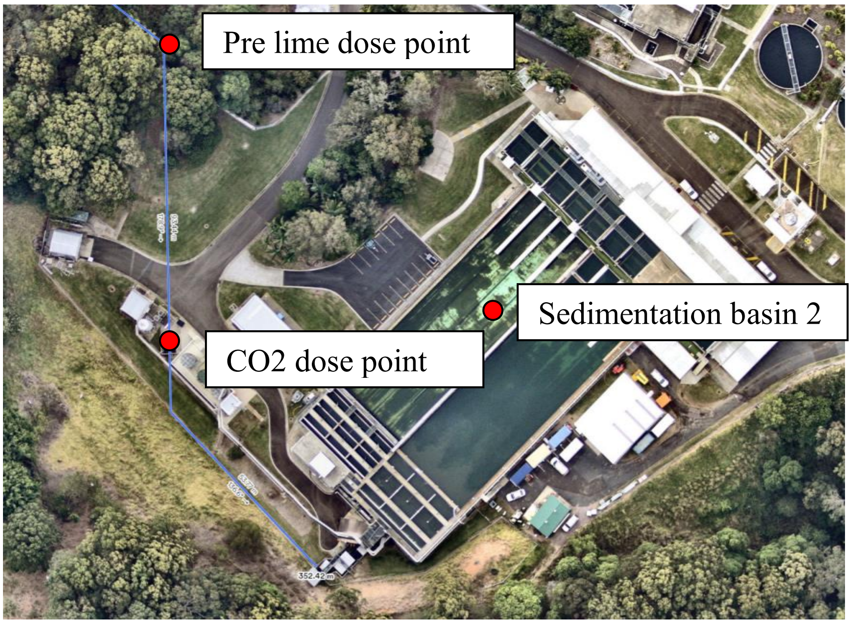

Figure 4 Aerial photo of WTP showing pre lime and CO2 dosing points

2.1 Planning the drain down and refill

The first step in the planning process was to conduct a HAZID (hazard identification) workshop to examine all reasonable possible sources of hazards during the drain down and refill procedure. The HAZID was conducted with a multidisciplinary team including Dam and WTP Operators, Maintenance, mechanical, civil and process engineers, environment and water quality. A high level procedure was developed for assessment during the HAZID. Following the HAZID, a working group was formed, and we met several times prior to the day of the works to give updates on pre work and to discuss any newly identified risks.

For the drain down of the raw water main, we identified a very high risk of a vacuum being created in the raw water main leading to pipe failure. This was due to inadequate venting. To control for this risk, we decided to remove a DN900 blanking plate at the intake tower. Scaffolding was set up at the intake tower prior to the day of the works to improve access, see Figure 5 below showing the blanking plate removal.

Figure 5 Blanking plate at intake tower

Figure 6 Raw water scour

Initially we intended to refill the raw water main using the head from the dam via the intake tower. During the HAZID we identified a very high risk of overpressure due to a surge event/ water hammer which could lead to the failure of the raw water main. We lacked any adequate controls for this as the valves at the intake tower were DN900 butterfly valves which would be very difficult to control the refill rate with. To address this risk the team came up with an alternative refill method. This method was to use a diesel Sykes pump to transfer water from the sedimentation basins at the WTP into the raw water main.

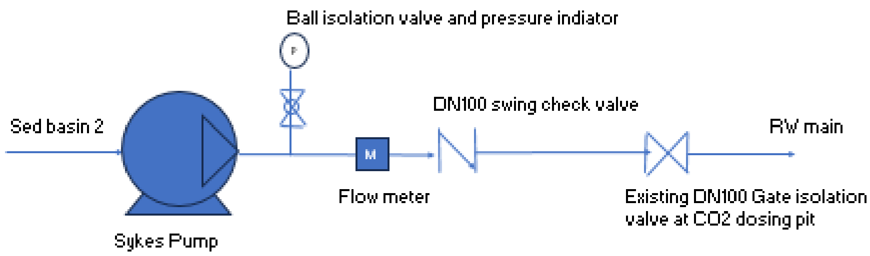

Figure 7 Sykes pump arrangement sketch

Seqwater sourced two Sykes pump (one as a backup) from other sites and had them transported to the WTP. We included an irrigation totaliser flow meter and a pressure indicator on the discharge line of the Sykes pump. The Sykes pump was connected to discharge into an existing DN100 tee in the CO2 dosing pit. Filling from the lowest point on the main allowed for the air to rise and be released though the vent at the intake tower. Figure 7 shows the Sykes pump arrangement.

Following the HAZID a detailed drain down and refill procedure was developed in Microsoft Project. Due to the slower refill rate for the pumped option, the estimated time to complete the project was 30 hours. This presented another challenge for Seqwater as the previous longest ever shut down at Landers Shute WTP was 16 hours.

In order to get an understanding of the potential supply issues with Landers Shute WTP offline for an extended period of time, a trial was conducted with the retailer. During the trial the WTP was taken offline for 48 hours. The trial was successful with reservoir levels able to be maintained. A key contributing factor to the success of the trial was good communication between Seqwater Network Operations and the retailer to manage the grid.

There were several other activities that took place in preparation prior to the main being drained. These included isolating the hydrogenator at the WTP, testing the scour valve and locking out valves at the intake tower.

The down drain procedure was reviewed the relevant subject matter experts and approved for use. The team was satisfied that the major risks had been identified and managed to an appropriate level.

2.2 During the day

Work started at 5am on the day of the repair works. The first steps were to shut down the WTP, lower the level in the intake below the blanking plate level via the scour valve, remove the blanking plate then restart the WTP to drain the main. A photo of the raw water main scour is shown in Figure 6. We were able run the WTP at a higher flow then we estimated for the drain down, so we finished these steps a few hours ahead of schedule.

After the main and been drained and the isolations were in place, the repair work began on the main. The section of the main was removed where the pipe had thinned and failed. A reinforcing pad was welded on which contained the injection point for pre lime. Refer to Figure 8 showing the repair work and Figure 9 showing the finished repair.

Refilling of the main began at 4:30pm and continued until 4am the next morning. We monitored the progress of the refilling by checking the flow meter totaliser and the pressure in the raw water main hourly. The chart below shows the data collected during the refill. The steep decline in flow at the end is due to the rapid rise in elevation at the intake tower. Upon completion of the raw water main refill, the WTP was deisolated and restarted. The project was a great success and we finished a few hours ahead of schedule.

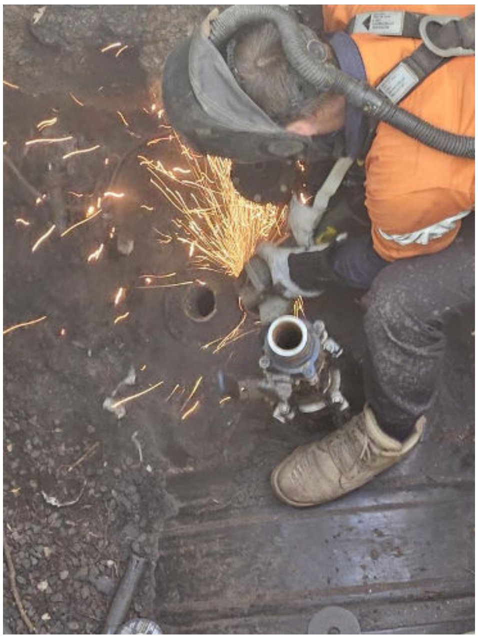

Figure 8 Works in the pre lime pit

Figure 9 Complete repair work

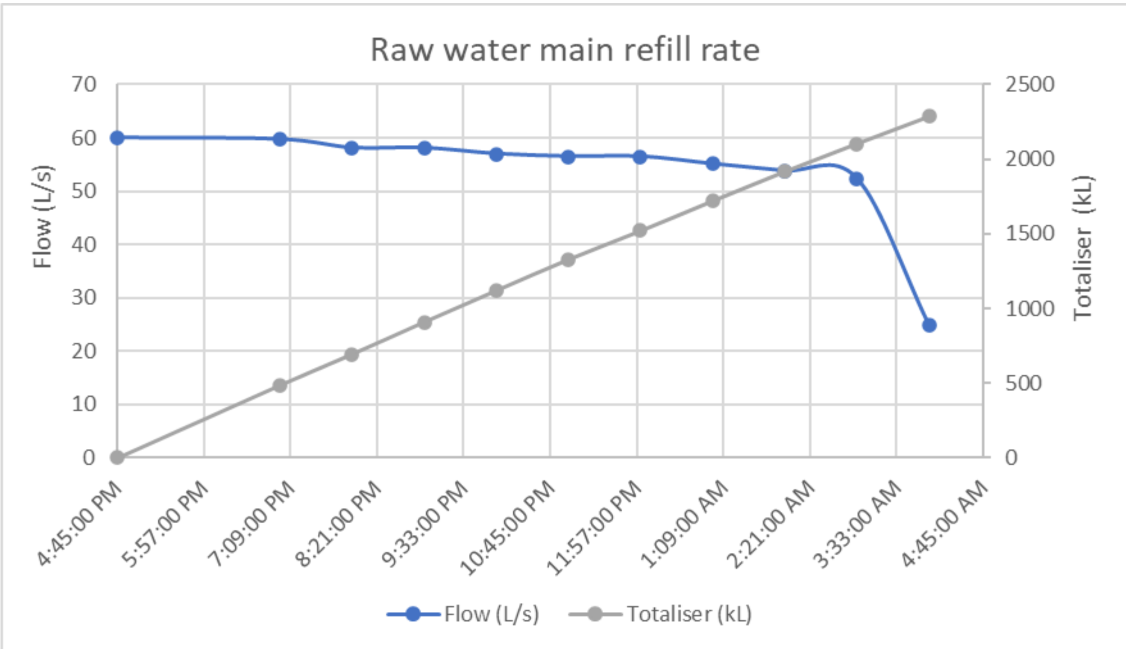

Figure 10 Chart showing raw water main refill rate

2.3 Lessons Learnt

A lessons learnt workshop was completed with key stakeholders following the project. A few of the lessons learnt are described below.

Communication throughout the project was excellent. In particular on the day of the project where the team communicated regularly through a Teams chat. Status updates and photos of works throughout the day where shared which kept everybody informed and also served as a record of the day's proceedings.

There could have been some improvements with isolations at the WTP. The penstocks and drain valves on the sedimentation finger weirs must be closed on the offline sedimentation basin. This prevents the finger weirs from filling when the sedimentation basin level is low. It is assumed that the finger weirs are not designed to support the weight of the water. There was no damage to the finger weirs during this project.

Due to the reduced drain down time, we were ready to start the repairs earlier than scheduled. A lesson for the future is to have the contractor onsite earlier than anticipated to take into account potential efficiencies in the schedule.

Regarding the refill, there were extra pressure losses in lay flat hose used for the Sykes pump that were not considered which meant the pump flow rate was lower than expected. The losses could be minimised by using sections of rigid hosing at both the Sykes pump end and the connection point at the main.

Having a mechanical flow meter on the refill line helped the team determine the flow rate and total volume of water transferred to the main. This allowed us to closely monitor the refill process. Without the flow meter monitoring of the refill process would have been more difficult as we would have to rely on the pressure indicator alone which was operating in a small window (~1 bar).

When restarting the WTP, the team was concerned about the water quality and the potential for biological growth to strip off the main and into the WTP. This was not an issue, likely due to the low refill rate.

Pre ozone should be disabled when restarting the WTP after it's been partially drained. There was a large amount of ozone gas venting to atmosphere when the plant was restarted due to the low water level in the contact tank.

3.0 CONCLUSION/ RECOMMENDATIONS

This project was a great success and everybody in the team was very proud of what we had achieved. There were some recommendations that came out the project which are discussed below.

Installing a larger air valve at the intake tower would enable drain down at higher flows without having to remove the blanking plate. The larger air valve could be installed when the dam level is below the blanking plate level to minimise impact on the WTP.

Installing isolations valves (and associated bypass and air valves) closer to the WTP at the exit of the tunnel would enable work to be conducted on the raw water main close to the WTP without having to drain the entire main.

Installing a larger tap in point on the raw water main would allow for refilling of the main at a higher flow rate and reduce the time that the plant needs to be shut down.

4.0 ACKNOWLEDGEMENTS

Big thank you to all the stakeholders and people who contributed to making this project a success!