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UNITYWATER'S REDCLIFFE SEWAGE TREATMENT PLANT – THE ROAD TO RECOVERY



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ABSTRACT

As part of the Queensland Government's water reform program, Unitywater began operations on 1 July 2010, which included inheriting a "Design, Build and Operate" contract for the Redcliffe Sewage Treatment Plant (STP). Shortly after taking responsibility for the plant, Unitywater proceeded to calculate the contractor's fee payments with a significant reduction (in accordance with contractual mechanisms) for regular effluent quality licence exceedances and commenced performance management activities (e.g. audits, condition assessments, requests for Action Plans) in regards to:

- Significant safety and security issues
- Licence compliances issues (odour and effluent quality)
- Maintenance and housekeeping issues (significant deterioration was apparent on structures and mechanical & electrical equipment)

Perhaps due to the mounting pressure on the contractor, Unitywater was informed by the contractor that it was going into receivership in May 2012. Within a matter of days, Unitywater took over operation of the plant and the Environmental Authority was transferred to Unitywater.

This paper presents the challenges of rapidly taking over a critically impaired plant and the journey (so far) of returning it to a reasonable and safe operational state.

1.0 INTRODUCTION

The Redcliffe STP has a design capacity of approximately 62,000EP and is located in the suburb of Clontarf on the Redcliffe Peninsula. It services residents and businesses from the suburbs of Rothwell, Kippa-Ring, Redcliffe, Clontarf, Scarborough, Margate and Woody Point.

In December 1999, the former Redcliffe City Council entered a contract with a third party to design and build an augmentation to the Redcliffe STP and operate and maintain the plant until June 2016. As part of the Queensland Government's water reform program, Unitywater began operations on 1 July 2010, providing water supply and sewerage services to Moreton Bay and Sunshine Coast residential and business customers. Unitywater inherited the Redcliffe contract upon its formation. Unlike the situation with its other plants, the Environmental Authority was issued to (and remained with) the contractor, not Unitywater.

The Environmental Authority states that the contractor must ensure "no release of contaminants from the licensed place is to cause a noxious or offensive odour beyond the boundaries of the licensed place". Hydrogen sulphide generation within the treatment plant boundary had been a major issue for several years. There was severe damage to structures and equipment at the plant due to sulphuric acid attack. Throughout the years, the contractor entered various programs and undertook investigations directed by the environmental regulator to resolve the issue. However, there was little success in mitigating odour impacts on the community.

The contract stated clearly that the contractor is fully responsible for the provision of all resources required to operate and maintain the plant in a conforming operating condition for the term of the agreement. Furthermore, at the completion of the term of the agreement, the contractor would be required to warrant that the assets still have a minimum residual life at handover. Despite having several years left in the contract and based upon inspection of the plant, it was evident that not all of the assets would be capable of achieving the contractual residual life requirements.



Figure 1: *Existing primary clarifier flow splitter with covers removed*

Crucially, Unitywater was concerned that the contractor failed to maintain a safe work environment. Many safety issues were raised during an audit undertaken by Council in November 2008, including:

- Site security
- Safe walkways and platforms
- Signage to keep people away from it
- Fixtures to ensure safety of personnel working at heights

Similarly, Unitywater engaged a third party to undertake a safety audit that was conducted in February 2011. Priority matters for immediate attention included:

- Management of hazardous substances
- Management of confined spaces and restricted access areas
- Electrical installations not in compliance with all relevant standards
- Site security

The contractor was requested to develop and implement an Action Plan to resolve the safety issues.

At this time, Unitywater commenced proactive performance management of the contractor to resolve all issues. This was due to the issues discussed above, but also due to emerging effluent quality issues. At the time, significant effluent related issues were apparent:

- The primary sedimentation tank, the grit removal system, and a secondary clarifier were all offline.
- A very high chlorine level was present in the microbiological sample of 12 Jan 2011 (approximately 14mg/L, with the licence limit being 0.7mg/L) and 19 Jan 2011.

What makes this situation appear worse is that the majority of flow is disinfected by UV disinfection (only excess wet weather flows are chlorinated) and other samples for biochemical oxygen demand, nutrients, etc. did not similarly contain the presence of chlorine. Despite repeated requests, no explanation was ever provided by the contractor.

- A lack of biosolids records and questionable monthly quantities begged the question where was the biosolids stored?
- The plant is required to achieve an effluent quality of 5mg/L total nitrogen (TN) and 1 mg/L total phosphorus (TP) as a long term median. The plant recorded some 20 instances of licence non-compliance during the period from January 2010 to June 2012. On some of these occasions, the plant failed to meet licence conditions on more than one parameter. Since a failure of the single centrifuge (which was used for both sludge thickening and dewatering) in June 2011, the effluent TN results for the plant were generally much higher than 5mg/L and resulted in the continuous exceedance of the plant's short and long term 50th percentile limits, and at times, the maximum allowable TN limit. In addition, during this time the effluent TP results were generally above 1mg/L, which resulted in the continuous exceedance of the plant's short and long term 50th percentile limits, and at times, the maximum allowable TP concentration. Also, during this period there were a number of non-compliances for faecal coliforms and suspended solids.

In accordance with the contract's method of fee calculation, Unitywater was amending the monthly fee payments to the contractor (in the order of a 20% reduction).

Perhaps not surprisingly, Unitywater received a phone message from the contractor on 23 May 2012 stating that the company was entering into receivership. Subsequent to this, Unitywater officially terminated the contract on 4 June 2012 and commenced operating and maintaining the plant at 5pm on 4 June 2012.

2.0 DISCUSSION

2.1 First Steps

The first steps of taking over a significant sewage treatment plant (with little knowledge of the idiosyncrasies of the plant) can only be described as exciting and frantic. It took concerned and dedicated employees from various Unitywater work areas (e.g. Treatment Plant Operations, Procurement, IT, HR, Legal, etc.) to address all the immediate issues. Many matters had to be urgently addressed, including (but certainly not limited to) the following:

- Transfer of the Environmental Authority to Unitywater. This was quite easy to do as the environmental regulator had exhausted its patience with the contractor.
- Urgently discussing employment with the contractor's plant staff. Unitywater identified that it was favourable to have access to the employees due to the limited in-house knowledge of the plant. However, consideration must be given to potentially automatically gaining additional liability related to the contractor's industrial instrument, leave entitlements, employment contracts, written or unwritten entitlements, etc.
- Undertake a stock take.
- Organising security including having measures in place to ensure property is not removed from the plant (interestingly, this was particularly necessary as Unitywater experienced "extremely" irate contractors/vendors that the plant contractor had failed to pay).

- Ensure services, leasing arrangements, etc. are transferred over and establish supplier agreements (e.g. telephone, power, biosolids and chemicals).
- Quickly build communication lines with the Receiver.
- Investigate access to bonds/guarantees/insurances and investigate legal action possibilities.
- Ensuring that the contractor was made inactive as a creditor and freezing any outstanding payments.
- Develop a comprehensive prioritised action list including both legal and operational matters.

In terms of operations, the team quickly developed a Redcliffe STP Operations Transition Plan that included prioritised actions with the following order of importance: 1. Safety; 2. Environment; 3. Administrative. Each task included the consideration of the type of resource required to complete the task (internal, external), estimated level of effort (days), estimated duration, and priority ranking. Notable inclusions:

- Undertake a general site safety audit and, in particular, engage qualified experts to determine if there are any non-compliant electrical installations and check site chemical storage and dosing facilities for safety and regulatory compliance
- Train staff and implement Unitywater safety systems including organising PPE for staff and Permit to Work/Isolation Procedures
- Investigate cost effective means to decrease the bioreactor mixed liquor suspended solids (MLSS) inventory (until new centrifuges can be purchased and installed) to assist with effluent quality improvement
- Ensure SCADA setup is adequate (e.g. ensure all appropriate alarms call out, software backup for SCADA and PLC's, security)
- Audit of existing information including O&M manuals, drawings, operating logs, SCADA functional specification, asset list, and maintenance records
- Establish cost tracking system to ensure Opex and Capex meets Queensland Competition Authority prudence and efficiency test



Figure 2: *Inlet works with deteriorated walkways removed (left); after making the area safe (right)*

2.2 Addressing the Issues

Unitywater knew from the onset that effluent quality would not be fixed overnight. Hence, Unitywater submitted an application to the Department of Environment and Heritage Protection (DEHP) to operate the plant under a Transitional Environmental Program (TEP) in December 2012. The TEP was approved by DEHP in January 2013. The TEP covers two specific compliance issues namely odour and effluent quality. The TEP documents Unitywater's efforts to achieve compliance through reasonable, affordable and practicable mitigation measures. The proposed program included:

Inlet Works:

- Refurbishment and reinstatement of normal operation of the step screen
- Reinstatement of grit vortex mixer and improvements to the grit removal system

Secondary Treatment:

- Inspection and cleaning of bioreactors, with replacement of parts where warranted (once the MLSS is stable within the normal operating envelope)
- Improve aeration controls
- Perform a condition assessment of secondary clarifiers and any refurbishment

Sludge Treatment and Handling:

- Undertake fermenter improvements (i.e. replace fermented sludge pumps and pipework repairs). This will improve the solids inventory within the process and improve the operation and performance of the digesters and sludge handling systems, to better stabilise the sludge and reduce the solids and nutrient loading on the bioreactors due to the return stream (i.e. centrate) flows.
- Refurbish and reinstate the existing centrifuges to enable duty/duty operation for sludge thickening and dewatering and procure and install one new piece of dewatering equipment (i.e. centrifuge or rotary drum thickener) to act as common standby to reduce MLSS concentrations within the process. This will improve the aeration efficiency and nutrient removal within the bioreactors and reduce the loading on the secondary clarifiers.

Effluent Disinfection:

- Refurbishment of the UV disinfection system

Odour Control:

- Refurbish the existing ferric storage and dosing system and reinstate ferric dosing to the inlet works
- Reinstatement odour covers and ductwork at the inlet works and repair ductwork around site
- Carry out a condition and capacity assessment of the existing Odour Control Facility (OCF) and reinstate effective operation of the current treatment facility.
- Refurbish the sodium hypochlorite storage and dosing system and reinstate sodium hypochlorite dosing to the OCF.

As of January 2014, the treatment plant has been meeting its effluent quality requirements. To reach this stage, including addressing safety matters, Unitywater's capital expenditure on the plant has totalled \$3.2M. However, there are still many matters and operational improvements to be addressed (including a new inlet works). The Unitywater Board has approved a project to rehabilitate, renew, operate and maintain the STP for a contracted period to 2022. At the time of preparation of this paper, the project is in the tender documentation development phase. Expected Contract Award is December 2014. Indicative timeframes are: construction through to April 2016 and commissioning complete by October 2016.

2.3 An Example of a Great Success

A Unitywater Operator-in-Charge, Robin Cherry, took on the challenge of improving plant performance at Redcliffe. Despite using all the considerable operational knowledge at his disposal to adjust the process and do everything he could to reduce nitrogen levels at Redcliffe, Robin was only having limited success with nitrification (Unitywater's understanding is that the contractor had tried for a considerable period of time). Knowing that results defied explanation, Robin went through the following process:

- Ammonia profiling of the reactor demonstrated that nitrification was occurring in the bioreactor, but ammonia levels would suddenly increase within a particular cell
- Lifted an a-recycle pump for an electrical check – electrician stated there were no issues and pump was rotating correctly
- Undertook a dye test within the reactor- identified short circuiting (see Figure 3)
- Lifted the pump again – electrician stated that there was nothing wrong with the pump
- Thought that the pump must not be sitting properly and therefore pumped down the bioreactor and identified that despite the a-recycle pump impeller rotating, flow was going in the opposite direction
- Lifted the pump for a third time – identified that the VSD was intermittently faulting
- Checked the other a-recycle pumps – found 3 of 4 pumps with the same issue.

Unitywater believes that Robin displayed great drive, determination, and ingenuity in tackling this problem (Robin could have easily said “there is something wrong with the design” and maintained the status quo of poor effluent quality).



Figure 3: *Bioreactor 4 dye test*

3.0 CONCLUSION

Taking over an impaired plant with minimal knowledge of its issues and idiosyncrasies is not an insignificant feat. It takes a dedicated team to initially “think on its feet” to ensure all immediate operational and administrative requirements are met. The use of audits and action plans is recommended to understand safety and operational issues and program tasks to address these matters. Good and open communication with the environmental regulator is essential. It is also highly recommended that any organisation undertaking a similar task put its best personnel on the job.