COLLABORATING ON A JOURNEY TOWARDS REDUCING POTABLE WATER AND MAINTAINING SOCIAL LICENCE

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KEYWORDS

Collaboration, Circular Economy, Recycled Water, Social Licence, Water Security, Wastewater Reuse

EXECUTIVE SUMMARY

Newcastle Coal Infrastructure Group (NCIG) partnered with GHD and other industry partners to reduce onsite potable water usage by augmentation their water supply with recycled water at their Newcastle operation. This contributed to NCIG's social licence to operate and supporting their sustainability commitments. All parties closely collaborated, to understand the key project risks and develop the design within the working parameters of the site, including giving operators confidence of operation and maintenance of the new system. The recycled water system has successfully implemented, delivering 1.5 ML/d, and controls risks for both operations and staff.

INTRODUCTION

NCIG is a critical logistical export service operating out of the Port of Newcastle, connecting the Hunter Valley Coal Chain with global markets. As one of the largest industrial consumers of potable water in the Lower Hunter, NCIG uses potable water to supplement their on-site stores of rainwater and runoff, to facilitate dust-suppression and plant cleaning activities. Water management has always been a focus for NCIG, due to the inherent risks associated with discharging water from an industrial site and an innate responsibility as a corporate citizen to minimise impacts on the environment and community neighbouring operations. Therefore, in the drought conditions in 2018 and 2019, when NCIG was reliant on potable water to meet supply demands, water security became a renewed concern. A desire to drought-proof operation saw NCIG join the Kooragang Industrial Water Scheme (KIWS) to facilitate the supply of recycled to their site, supplementing onsite rainfall and runoff storage and reducing their reliance on potable water.

The KIWS receives sewage effluent from the Hunter Water Shortland Wastewater Treatment Works (WWTW). This wastewater is accepted by the Advanced Water Treatment Plant (AWTP) at Mayfield, where additional treatment occurs prior to being transferred to NCIG (and other users) via a common distribution pipeline. The Shortland WWTW comprises coarse screening, Intermittently Decanted Aeration Lagoon (IDAL) and chlorination as the main treatment processes. After transfer to the Mayfield AWTP the effluent undergoes chloramine dosing, microfiltration (MF), reverse osmosis (RO) and chlorination to treat the water further to a high quality. This high quality permeate is stored in a product water tank which transfers via a DN400 pipe around 8km and services both Orica and NCIG. Refer Figure 1 for system block flow diagram.

This treatment process creates a high purity permeate (refer Table 1), with a low calcium content. To ensure efficiency of the product, calculations were conducted to determine the Langelier Saturation Index (LSI) and Calcium Carbonate Precipitation Potential (CCPP) of the water. These calculations determined the product would be aggressively corrosive to NCIG's existing distribution network of ductile iron concrete lined pipes and so, a remineralisation plant was required to reduce corrosiveness prior to onsite usage. This project involved various investigations from initial feasibility through to detailed design and construction/implementation of a 1.5 ML/d recycled water system to site (refer Figure 2).

HIGHLIGHTS

- Estimated reduction in potable water use of 50% with introduction of recycled water.
- System selected is passive treatment (calcite filter) without chemical addition.
- Implementation of recycled water saves 275 ML per year of potable water usage.

METHODOLOGY

The methodology for this project involved:

- Feasibility design including benchmarking study of other similar industrial users of recycled water, log credit confirmation for virus, pathogen and protozoa, options assessment for remineralisation including investigation of five potential options and financial modelling to determine a preferred option for progression through a Multi-Criteria Analysis (MCA) workshop.
- Technical confirmation including water sampling of the AWTP, potable water supply and onsite water storages. Process modelling was conducted using EVS: Water to determine suitability of blending of streams and the use of calcite filter for remineralisation. Probabilistic site water balance modelling was conducted using GoldSim to simulate rainfall, evaporation, dust suppression and runoff for a range of scenarios. This was used to determine the ideal supply arrangement in terms of flow per day and onsite storages to maximise the benefit and operation of the recycled water, whilst not creating offsite discharge.
- Detailed design including IFC drawing set for the remineralisation system and onsite supply pipeline including all process, civil and structural aspects. Following the detailed design assessment and selection of preferred supplier including development of technical specification documentation.
- Safety in design assessments including HAZOP workshop to analyse the recycled water system for process control and operational hazards and CHAIR 2/3 workshop to assess the construction, maintenance, repair, and demolition safety issues associated with the design.
- Health risk assessment and development of a Recycled Water Management Plan (RWMP) in accordance with the Australian Drinking Water Guidelines (ADWG) including risk assessment workshop to quantify the potential health risks.

OUTCOMES

Water sampling, process modelling, and water balance modelling increased confidence in the passive treatment process using a calcite filter. This meant NCIG avoided chemical usage for pH correction (via sulphuric acid), and therefore the work health and safety risks associated with chemical storage. Through strategic discussions and engagement, including education around upstream treatment and the controls between the wastewater effluent and site, NCIG staff developed acceptance towards the usage of recycled water onsite. A ‘Health Risk Assessment’ workshop held prior to implementation of the scheme quantified key risks to workers encountering treated sewage effluent and was documented in the RWMP. This demonstrated to staff, and provided confidence, that the recycled water is safe for usage onsite and does not pose harm to the environment, staff or community, should they come into contact with it.

Through the implementation of the recycled water system and connection to the KIWS, NCIG estimate they will reduce their reliance on potable water by at least 50%. Depending on operations and rainfall, during a normal year, they will save approximately 275 million litres of potable water – the equivalent of the annual water usage of 1,700 residential homes. This has led to a positive outcome for NCIG and the community alike.

CONCLUSION

Cross industry collaboration was key for NCIG’s implementation of recycled water usage onsite. Through careful stakeholder and process management that actively engaged with key stakeholders through education, and confidence building programs, operators developed increased trust and awareness of the safety of recycled water. Significant testing, above the regulatory requirements, was conducted to ensure the sustainability of the recycled wastewater, both for the operational applications and the wellbeing of operators, surrounding community and the environment. This highly collaborative project facilitated a material decreased in NCIG’s reliance on potable water, returning 275 ML to the Hunter Water network annually and positively contributing to NCIG’s sustainability strategy and approach to supporting a circular economy.

Figure 1 is a Block Flow Diagram (BFD) of the upstream treatment processes and NCIG system.

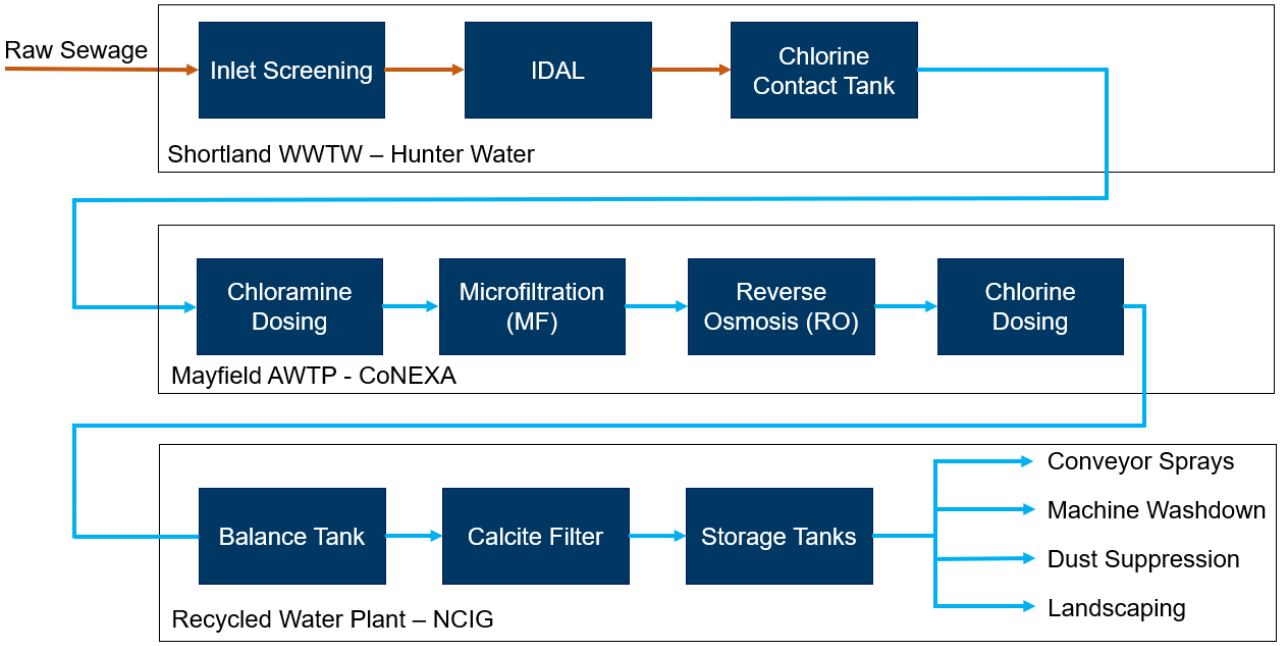

Figure 1: Upstream recycled water treatment

Figure 2 is a photo of the installed remineralisation system onsite.

Figure 2: Remineralisation Plant Installed Onsite (shown in foreground in front of larger tanks)

Table 1 presents water quality data from the system showing the quality of the recycled water for usage onsite.

Table 1: Key water quality parameters

Parameter	Average	50%ile	90%ile	Max
Total Dissolved Solids (mg/L)	24.2	25.0	40.0	48.0
Calcium (mg/L)	0.1	0.1	0.2	0.5
pH	7.1	7.1	7.4	8.2
Total Hardness (mg/L $CaCO_3$)	0.478	0.500	0.500	0.500
Alkalinity (mg/L $CaCO_3$)	11.7	11.0	18.0	22.0
E Coli (CFU/100mL)	*Non-Detectable*	*Non-Detectable*	*Non-Detectable*	*Non-Detectable*
Somatic Coliphage (PFU/100mL)	*Non-Detectable*	*Non-Detectable*	*Non-Detectable*	*Non-Detectable*
Clostridium Perfringens (Oocysts / 50L)	*Non-Detectable*	*Non-Detectable*	*Non-Detectable*	*Non-Detectable*
TSS (mg/L)	0.5	0.5	0.5	2.0
Chloramine (mg/L)	0.1	0.1	0.3	0.6
Sodium (mg/L)	10.0	9.8	12.6	15.3