

WATER QUALITY AND OPERATIONAL LEARNINGS FROM QUAKERS HILL PURIFIED RECYCLED WATER DISCOVERY CENTRE

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ABSTRACT

In the Greater Sydney Water Strategy, Sydney Water has committed to identifying and planning for new rainfall-independent supply options including purified recycled water. The Purified Recycled Water (PRW) Discovery Centre at Quakers Hill is a key deliverable for Sydney Water under the strategy. The objective was to deliver an advanced treatment demonstration plant that will provide educational tours for stakeholders and the community to learn about the technology and increase water literacy. This paper presents the cross-functional process engineering and operations teams' experiences at the PRW Discovery Centre from a water quality and operational perspective. The learnings that have come from this journey will play an important role for designing and operating future full scale PRW schemes in Greater Sydney.

1.0 INTRODUCTION

The Purified Recycled Water (PRW) Discovery Centre is a 0.5ML per day demonstration plant that is a key deliverable of the Greater Sydney Water Strategy. It opened in October 2023 as part of National Water Week. The plant is located adjacent to the Quakers Hill Water Resource Recovery Facility (WRRF) which is a tertiary treatment inland plant and provides the tertiary treated effluent feed water to the PRW Discovery Centre.

This paper presents the experiences and journey of the multifaceted team which includes process engineering, plant operations, water quality, laboratory services, and projects managers within Sydney Water. The early and continuous engagement with each team has provided many learning opportunities including the management of the feed quality, the quality between each process and the final product water quality, and the operational philosophy for the plant. All of these will be documented for the future PRW schemes in Greater Sydney.



Figure 1: *Quakers Hill PRW Discovery Centre Treatment Room with the Ultrafiltration, Reverse Osmosis, and UV-Advanced Oxidation Units and their Sample Panels.*

2.0 DISCUSSION

2.1 Early Works for PRW Discovery Centre

Prior to the operations team being heavily involved in the PRW Discovery Centre, there were numerous key pieces of work that were completed. The teams involved included the Community Education, Strategic Communications, Major Projects Engagement, the Water Custodian team, and the Major Projects team.

Sydney Water's engagement with NSW Health for PRW began in 2021. This initiative started with efforts to communicate effectively with the community and establish a clear definition of PRW and its source. "Water recycled from industry and homes (including kitchens, showers and toilets) that has been purified to meet strict Australian Guidelines for Water Recycling to supplement drinking water sources." In addition to community engagement, the process involves providing monthly updates and technical discussions with the NSW Health Expert Panel. This ongoing collaboration ensures that all stakeholders are informed and aligned on the project's progress and technical aspects.

The PRW Discovery Centre is required to meet the Australian Guidelines for Water Recycling Phase 2 Augmentation of Drinking Water Supplies (AGWR Phase 2). The chemical and microbial risks were identified and assessed, which then developed into monitoring requirement for the operation of the plant. This included an audit of the Quakers Hill catchment and a 12-monthly monitoring program of the source water. This work will provide a framework for future full-scale PRW schemes.

2.4 Plant Commissioning

The commissioning of the PRW Discovery Centre began in July 2023, however early site engagement with the process engineering and operations teams on the project itself had begun a few months prior. Site construction mobilised in May 2022 and finished in parallel with the start of commissioning. Operations handover took place in December 2023. Generally, projects will always have representatives from the two teams involved early to support projects team on areas including safety in design, operability, SCADA functionality and documentation review. For the PRW, the business assigned full time resources which were based on site toward the end of construction to ensure a smooth transition into operations with a solid foundation of knowledge about the plant and minimal delays to the delivery of the plant.

Both resources assigned were considered an extension of the greater team that they belonged to, allowing for information, feedback, and learnings to be shared laterally. The experience and knowledge base of the teams that made their day-to-day role and responsibility unique included managing recycled water schemes, working in Bulk Water/Drinking water strategic operations, operating tertiary treatment plants, and operating or managing membrane technology.

During this period, the key purpose was to document the learnings throughout commissioning and foster a collaborative relationship with the commissioning team that allowed for experience and knowledge to be shared. Significant activities happening at the Discovery Centre could also be utilised as informal training days for the wider team to attend, which included the UF/RO membrane loading and unloading, and UV lamp installation.

Furthermore, operational processes and documents could be continuously shaped and built upon and troubleshooting experiences during commissioning that may have remained unknown to the

operations team until handover of the plant. There were also significant onsite challenges during this period that are unique to a small size 0.5 ML per day demonstration plant. Treatment of small flows requires small chemical dosing lines that have demonstrated to be problematic when degassing gaseous chemicals, verifying flow rates, and maintaining disinfection stability. Another unique challenge for the PRW was the minimal redundancy of duty/standby online instrumentation and treatment trains. The shared experiences working through these challenges between commissioning and operations team meant that there was a collective knowledge base build on troubleshooting, maintaining, and operating the plant.

2.5 Operational Procedures and Maintenance

The development of the operational procedure documents and maintenance strategy for the PRW has been an iterative process which began during commissioning and is currently in its final stages of revision. The purpose of starting this work early and revising it over the last 12 months has not only allowed for key learnings from commissioning to operations to be captured, it supports continuous improvement and provides Sydney Water with a mature information management system for a PRW scheme.

Operational procedure documents including the plant and equipment checks, online instrument lab testing, online instrument calibration and maintenance, plant manuals, maintenance plans, and other supporting documents being developed are essential to establishing the PRW monitoring plan and training requirements. This criteria for PRW sometimes doesn't exactly fit the moulds of current drinking water, recycled water, and wastewater schemes within Greater Sydney.

Furthermore, the maintenance strategy for PRW had to be a proactive approach that involves working closely with suppliers to build in-house capabilities within the operations team to allow first level maintenance or troubleshooting. Developing this internal capability and mindset is a slightly different way to operate and will be applied to future PRW scheme within Sydney Water. Examples of how the operations team have demonstrated this proactive approach at the PRW include optimising shutdowns by consolidating maintenance activities, maintaining close supplier day-to-day engagement outside of the project contract, sourcing site specific tools for working on PRW assets, and continuous troubleshooting of online instrumentation. The team have also established routine services of the online instruments, UV, compressors, strainers, and pumps work favourably under a proactive approach, which flag early warnings of potential failures.

Adopting this mindset for the operations and maintenance of the PRW Discovery Centre has resulted in less process instability, improved availability > 90%, and has built confidence in the reliability of the critical control points and operational control points. All of these are key objectives of the PRW Discovery Centre.

2.6 Education Engagement for PRW

The operations team also plays a vital role in supporting the Community Education team. In the past year, more than 2,200 people have visited the centre. The PRW team has assisted in fact-checking educational materials prepared for school visits and addressing visitors' questions. Their involvement in selected tours offers valuable insights into PRW operations, water knowledge, and industry experience. This ensures that the information shared is accurate and comprehensive, enhancing the educational experience for all visitors. Additionally, overseas and interstate visitors with extensive PRW experience provided an exchange of experiences and

lessons learned. Over the past year, the information and learnings gained from these interactions have been invaluable.

2.7 Water Quality Monitoring

The PRW Discovery Centre's commitment to safety is evident through its rigorous verification and operational monitoring of key processes and operations. Sydney Water's in-house NATA certified laboratory and Field Sampling team play a pivotal role in this process, ensuring comprehensive monitoring across the plant. Early collaboration with NSW Health has been crucial, allowing ample time for preparation and review, which in turn facilitates smooth coordination with operations and logistics.

One notable project was the in-situ ultrafiltration (UF) challenge test carried out at the PRW Discovery Centre. Conducted in March and July 2024, this test assessed the virus removal efficiency of the UF system. The process involved preparing a stock solution of MS2 phage in the Sydney Water lab, spiking the UF influent, and then measuring the membrane's removal efficiency under full plant capacity conditions. The challenge test required extensive preparation by both lab and operations team, where we completed triplicate analysis of 20 sample per run.



Figure 2: *Picture during the UF challenge test at Quakers Hill PRW Discovery Centre*

Since March 2024, the operational monitoring plan has been in place, providing valuable data for fine-tuning the plant's operations. Early monitoring identified the need for a high turnover of sodium hypochlorite to reduce chlorate concentration in the final water. The monitoring effort spans up to 14 sample sites across Quakers Hill WRRF and PRW Discovery Centre, with at least five concurrent monitoring plans assessing different aspects of both WRRF and PRW treatment train. This includes large volume monitoring, involving transportation of 400 L sample volumes to the lab, highlighting the extensive coordination and logistics required.

2.8 Working Together as a Team

The successful operation and monitoring of the PRW scheme at the Discovery Centre is achieved through strong collaboration between different teams in Sydney Water.

Maintaining a strong interface between the WRRF and PRW Discovery Centre is crucial for understanding the variability of wastewater treatment and its impact on the PRW treatment train. Sharing knowledge between the two teams and understanding each other's priorities improves

day-to-day operations by ensuring seamless communication and coordination, leading to more efficient and effective management of the treatment processes. This also helps to develop a coherent system for future PRW schemes.

A close relationship between the Operations team and the Water Custodian team is essential for effective communication with NSW Health and their expert panel. This collaboration was evident in the establishment of the monitoring plans, coordination of the UF challenge test, and development of the Recycled Water Quality Management framework for PRW. Providing firsthand information from PRW operations during discussions with regulators instils confidence in the management of the process and improves the Operations team's understanding of regulatory expectations. This collaboration has enhanced the Operations team's ability to manage the treatment processes effectively.

The operations team, field services and laboratory team worked closely together to enable commencement of the monitoring plans for the PRW scheme. Working together to ensure the samples are collected at the right location and at the right time, with close communication to ensure quick resolution of issues. This teamwork also facilitates knowledge sharing between the labs and operations. The lab technicians become familiar with the treatment process and the operations team gain visibility on the water testing. This was enhanced by the Laboratory team visit to the PRW Discovery Centre, and Operations team visit the Laboratory facility. This allows sharing each other's expertise, leading to the best possible outcomes.

2.9 Continuous Improvement and Lessons Learned

It has been 12 months since the opening of the PRW Discovery Centre, and it begs the question: where are we headed? There is a wealth of activities happening at the Discovery Centre that will ensure continuous improvement in operations and ensure we continue to share lessons learnt. These include:

- Uphold close relationships with product suppliers for membrane processes, online analysers, and critical equipment and establish service agreements with suppliers.
- Maintain cross-functional teams and collaborative initiatives for better informed outcomes. For example, the operations and laboratory team continue interface meetings to execute upcoming monitoring plans, future challenge or validation testing, and ongoing equipment calibration.
- Build on Sydney Water's knowledge base for membrane technologies as it is different from our conventional treatment processes.
- Finalisation of our information management system
- Continue discussions and meet milestones set with the main regulator, NSW Health
- Continue to support Discovery Centre tours, education, and consultation including on the trial of weekend tours for the community.

3.0 CONCLUSION

Securing Greater Sydney's drinking water supplies using the option of PRW requires an integrated approach involving numerous teams, suppliers and service providers working collaboratively. Adopting a proactive operations approach and mindset for PRW is crucial to capture valuable lessons learned from the PRW Discovery Centre that will shape the future of the operating philosophies and water quality management for the future scheme.

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5.0 REFERENCES

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