IMPLEMENTATION AND EXECUTION OF A WATER RECYCLING SCHEME AT KOORAGANG ISLAND

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ABSTRACT

Orica were the largest single consumer of drinking water in the lower Hunter, using over 4% per year of Hunter Water Corporation's (Hunter Water's) total water supply. Orica's plant, which opened in 1969, uses the water as part of their ammonium nitrate production process.

Hunter Water have constructed an Advanced Water Treatment Plant (AWTP) as part of an Alliance contract, to significantly reduce the drinking water supply demands of Orica. The Kooragang Industrial Water Scheme was created with the Mayfield West AWTP at the centre. To deliver the required quantity and quality of effluent to the scheme, the Shortland WWTW underwent several upgrades.

Hunter Water engaged Veolia as the treatment operations contractor delivering Operation and Maintenance services for water and waste water treatment infrastructure in the region. The commissioning of the Mayfield West AWTP took place at the same time. This meant a change in people, leadership and potential loss of knowledge about the treatment process.

Despite taking over the plant operation at a critical time, the new operator was able to smoothly manage this transition. They recognised the need for wastewater expertise as part of the Mayfield West AWTP operation team, provided support to the operators and leveraged of the existing operations such as Fairfield AWTP to provide support and technical expertise.

Four months after Hunter Water awarded the contract to Veolia, the Mayfield West AWTP is proving to be successful by consistently producing suitable water quality and smooth operations.

1.0 INTRODUCTION

The aboriginal meaning of Kooragang Island is 'A Place of Many Birds' and was formed from seven different islands which were used by families for farming. After the major floods in 1955, it was resumed by the State of Industrial Land and has housed the Newcastle coal terminals since 1984.

In 1969, Orica opened its facility to produce Ammonium Nitrate initially for agriculture. Twenty years later, they opened a second plant to exclusively supply ammonium nitrate for the mining industry. They employ 210 staff and 40 contractors from the local Hunter area and produce approximately 360,000 tonnes per annum of ammonium nitrate.

Given Orica's significant position on Kooragang Island and its significant water consumption of 2,300 ML per annum, Hunter Water recognised the need to decrease Orica's water footprint. Through this understanding, the decision was made to construct a Wastewater Recycling Plant at Mayfield West, which would service Kooragang Island through an 8km pipeline. The effluent was supplied by the neighbouring Shortland Waste Water Treatment Plant which is one of nineteen Wastewater Plants that the Hunter Water Corporation owns in the Hunter Valley, NSW. Figure 1 shows the close proximity of Shortland WWTP, Mayfield West AWTP and Kooragang Island.

Figure 1: ***Location of Mayfield West AWTP, Shortland WWTP, Kooragang Island (highlighted in red) and Orica***

The commissioning of the Mayfield West AWTP was being finalised at the same time as the operations contract was awarded. This posed a significant challenge to Veolia the new operator. It was important the correct operations team was selected with appropriate skills and experience.

2.0 DISCUSSION

2.1 Preparation in the Lead up to Commissioning of Mayfield West

Shortland Waste Water Treatment Works (WWTW) is an activated sludge plant with chlorine disinfection which releases its effluent into the Hunter River. Figure 2 shows the treatment process steps at Shortland.

Figure 2: ***Shortland WWTW Process Flow Schematic***

Construction commenced at Mayfield West AWTP under an Alliance contract with the existing water treatment team becoming involved and providing support. To provide suitable raw water for Mayfield West AWTP, Shortland WWTW required a number of upgrades including the addition of an Aluminium Sulphate dosing system, a blower upgrade and the diversion of influent from Newcastle 10 Pumping Station to provide more water to be able to achieve a minimum inflow of 12 ML per day. Waste tankers discharging into the inlet was also discontinued. The timeline for construction and upgrades is shown in Figure 3.

During the commissioning of Mayfield West, work on site began for the installation of a new dewatering facility at Shortland as part of the long term solution for managing the sludge blanket in the IDAL's and reducing the chance of fouling at Mayfield West.

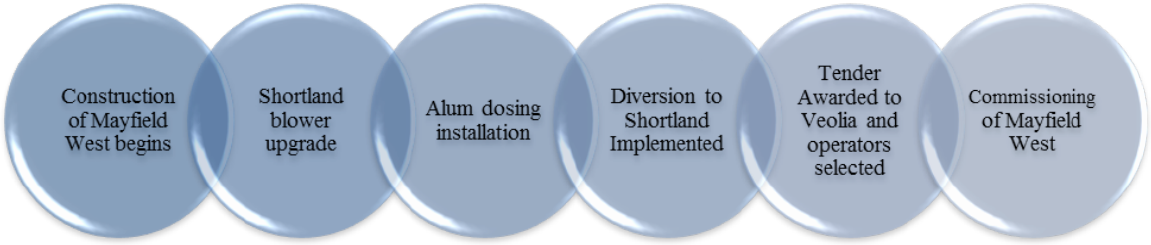


Figure 3: ***Timeline of Significant Events Over 12 Months***

2.2 An Operator's View Prior to Commissioning

From an operators point of view at Shortland WWTW, it was a time of a lack of clarity about the future given the commencement of the new Treatment Operation contract. The existing Shortland operators retired, taking with them decades of knowledge of the plant operation. None of the other operators had a chance to settle at Shortland for a lengthy period to be able to be equipped with an intimate knowledge of the plant. Thankfully, Hunter Water made the decision to retain one of the retiring plant operator for another month at Shortland WWTW to ensure continuity of services.

A similar situation occurred at Mayfield West AWTP as the Alliance had been conducting the commissioning, operation and troubleshooting of the Recycling Plant with the Water Treatment Team assisting to a degree.

The Shortland Wastewater team did not completely understand how their daily actions could influence the Mayfield West AWTP and product water. At the same time, the Water Operators did not fully understand what was taking place at the Wastewater Plant that was feeding the Recycling Plant.

2.3 Evolving and Supporting the Team Through Transition

Veolia won the treatment operation contract and this corresponded with the culmination of commissioning. Proactive decisions had to be made to give the Recycling Water Scheme the best possible start. Veolia had approximately six weeks from the finalisation of commissioning until they would be held completely accountable for the plant operations.

It was acknowledged that the experience of a water operator with the skills that come from strict water quality standards needed to be matched with a waste water operator from Shortland WWTW to ensure smooth operations at the new plant. The two operators needed to be able to establish a critical operational practice to what is virtually a new plant to the network. They also had to maintain the customer focus with each decision and implementation of routine maintenance and procedures.

The table hereafter shows the benefits provided by the Kooragang Industrial Water Scheme and the operational challenges that the new Treatment Operations provider had to face to deliver a reliable recycled water supply.

Table 1: ***The Scheme's Objectives and Challenges***

Situation before Mayfield West AWTP establishment	Scheme's Objectives	Challenges at Mayfield West AWTP / Shortland WWTW to achieve targets
Orica consuming 4% per annum of potable water. Going from largest consumer to 19th	Significantly replace potable water to recycled water	Forecasted consumption from Orica is obtained weekly. Diversion from local Wastewater network to Shortland WWTW is scheduled by the WWTW operators to obtain enough effluent to meet demand. Strong coordination between Orica, Mayfield West AWTP and Shortland WWTW required.
Orica's removal of minerals from potable water (using a demin plant)	Provide a permeate with a consistent quality	Establish monitoring and control necessary to produce recycled water of an appropriate quality for the end users. Ensure appropriate response to CCPs.. High end monitoring and rigorous bench testing to maintain integrity. Understand challenges at the WWTWs and how this can affect product water quality.
No Advanced Water Treatment Plant operated by Hunter Water	Reliable operation of the plant	Good communication between Shortland WWTW and Mayfield West AWTP Cultural change from water / wastewater treatment to advanced water treatment Access to technical expertise & training Establishment of daily rounds, bench testing, stock orders, SOP development

2.4 My Contribution to the New Team

Given my experience as waste water operator at Shortland WWTW and my understanding of the importance to deliver a quality product to a customer, I was given ownership as one of two main operators of the Mayfield West AWTP. The other operator selected had an extensive knowledge of water treatment, especially from the Grahamstown catchment. This catchment is the largest supply to the area - so water testing, bench testing and analysers were more familiar to him than myself.

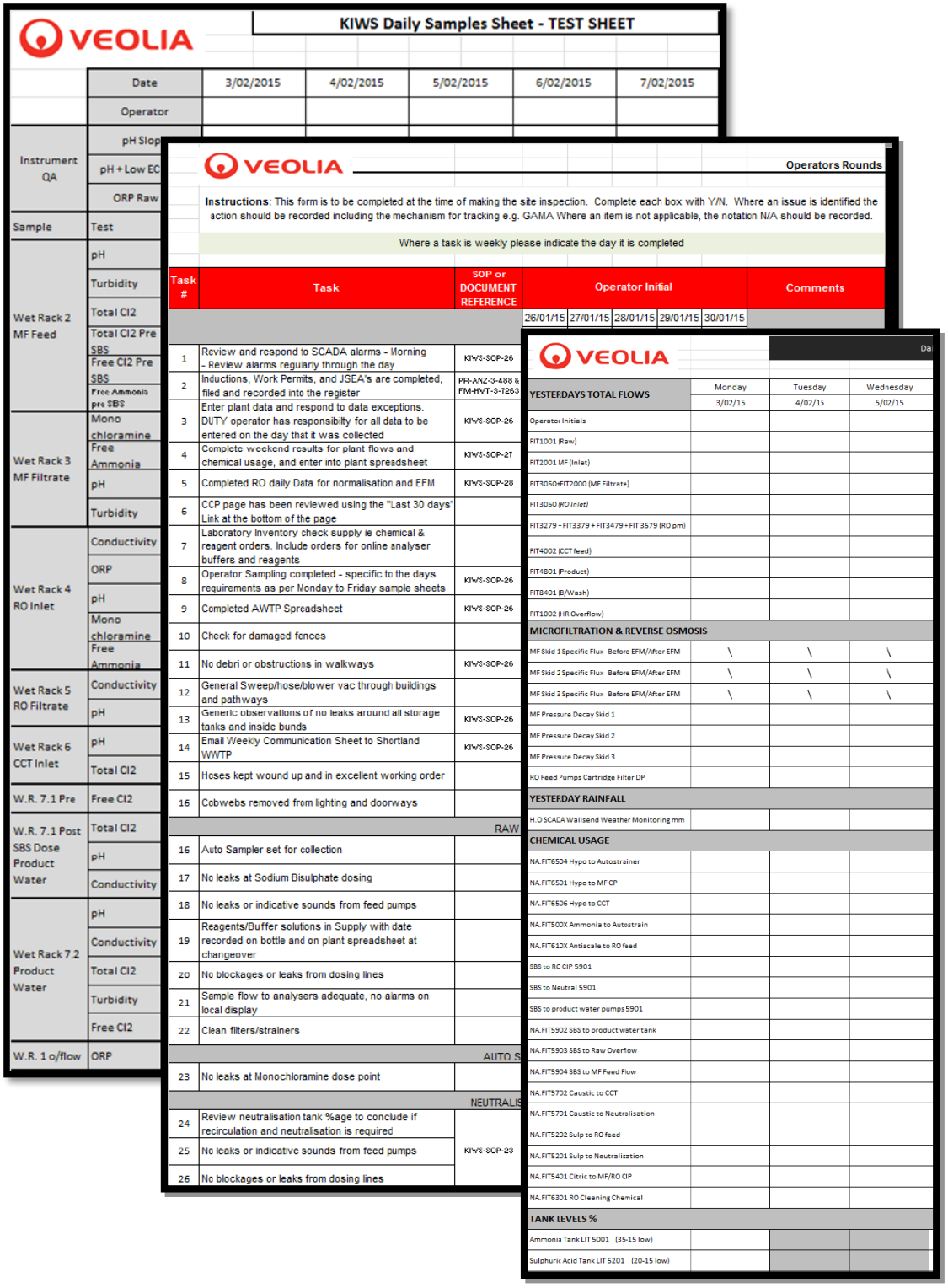
I brought to our team the operational knowledge of Shortland WWTW. I understood the process, the type of equipment installed at the plant, what the maintenance schedule involved, as well as the pressure the weather placed on the process. The Shortland WWTW SCADA was accessible from Mayfield West AWTP and it certainly made trouble shooting at Mayfield West AWTP easier. All of this combined with my daily morning check on the plant meant we could anticipate any fires starting and putting in measure to prevent them, rather than trying to put them out once they arise. To make the communication more robust, I developed a communication protocol between the Waste Water Plant and the Recycle Plant.

In collaboration with my co-workers, any procedural gaps were closed by developing routine task lists, water quality testing, analyser comparative bench tests. These documents were linked to the KIWS recycled water quality plan as well as the Safe Operating Procedures that were handed over by the Alliance commissioning team and Hunter Water.

I considered while developing these tools what an on-call operator may find helpful, and

ensured that they could be used by any operator unfamiliar with the site to be able to complete the duties of a Mayfield West Operator.

The following tools are a few examples of the systems I have established for the day to day operations of the plant. This helps us every day to achieve an excellent product and a well operated Recycling Plant.



VEOLIA

KIWS Daily Samples Sheet - TEST SHEET

		Date	3/02/2015	4/02/2015	5/02/2015	6/02/2015	7/02/2015
		Operator					
Instrument QA		pH Slop					
		pH + Low EC					
		ORP Raw					
Sample		Test					
Wet Rack 2 MF Feed		pH					
		Turbidity					
		Total Cl2					
		Total Cl2 Pre SBS					
		Free Cl2 Pre SBS					
		Free Ammonia pre SBS					
Wet Rack 3 MF Filtrate		Mono chloramine					
		Free Ammonia					
		pH					
		Turbidity					
Wet Rack 4 RO Inlet		Conductivity					
		ORP					
		pH					
		Mono chloramine					
		Free Ammonia					
Wet Rack 5 RO Filtrate		Conductivity					
		pH					
Wet Rack 6 CCT Inlet		pH					
		Total Cl2					
W.R. 7.1 Pre		Free Cl2					
W.R. 7.1 Post SBS Dose Product Water		Total Cl2					
		pH					
		Conductivity					
Wet Rack 7.2 Product Water		pH					
		Conductivity					
		Total Cl2					
		Turbidity					
		Free Cl2					
W.R. 1 o/flow		ORP					

VEOLIA — Operators Rounds

Instructions: This form is to be completed at the time of making the site inspection. Complete each box with Y/N. Where an issue is identified the action should be recorded including the mechanism for tracking e.g. GAMA Where an item is not applicable, the notation N/A should be recorded.

Where a task is weekly please indicate the day it is completed

Task #	Task	SOP or DOCUMENT REFERENCE	Operator Initial 26/01/15	27/01/15	28/01/15	29/01/15	30/01/15	Comments
1	Review and respond to SCADA alarms - Morning - Review alarms regularly through the day	KIWS-SOP-26						
2	Inductions, Work Permits, and JSEA's are completed, filed and recorded into the register	PR-ANZ-3-488 & FM-HVT-3-T263						
3	Enter plant data and respond to data exceptions. DUTY operator has responsibilty for all data to be entered on the day that it was collected	KIWS-SOP-26						
4	Complete weekend results for plant flows and chemical usage, and enter into plant spreadsheet	KIWS-SOP-27						
5	Completed RO daily Data for normalisation and EFM	KIWS-SOP-28						
6	CCP page has been reviewed using the "Last 30 days' Link at the bottom of the page							
7	Laboratory Inventory check supply ie chemical & reagent orders. Include orders for online analyser buffers and reagents							
8	Operator Sampling completed - specific to the days requirements as per Monday to Friday sample sheets	KIWS-SOP-26						
9	Completed AWTP Spreadsheet	KIWS-SOP-26						
10	Check for damaged fences							
11	No debri or obstructions in walkways	KIWS-SOP-26						
12	General Sweep/hose/blower vac through buildings and pathways							
13	Generic observations of no leaks around all storage tanks and inside bunds	KIWS-SOP-26						
14	Email Weekly Communication Sheet to Shortland WWTP	KIWS-SOP-26						
15	Hoses kept wound up and in excellent working order							
16	Cobwebs removed from lighting and doorways							
	RAW							
16	Auto Sampler set for collection							
17	No leaks at Sodium Bisulphate dosing							
18	No leaks or indicative sounds from feed pumps							
19	Reagents/Buffer solutions in Supply with date recorded on bottle and on plant spreadsheet at changeover							
20	No blockages or leaks from dosing lines							
21	Sample flow to analysers adequate, no alarms on local display							
22	Clean filters/strainers							
	AUTO S							
23	No leaks at Monochloramine dose point							
	NEUTRALIS							
24	Review neutralisation tank %age to conclude if recirculation and neutralisation is required	KIWS-SOP-23						
25	No leaks or indicative sounds from feed pumps							
26	No blockages or leaks from dosing lines							

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YESTERDAYS TOTAL FLOWS	Monday 3/02/15	Tuesday 4/02/15	Wednesday 5/02/15
Operator Initials			
FIT1001 (Raw)			
FIT2001 MF (Inlet)			
FIT3050+FIT2000 (MF Filtrate)			
FIT3050 *(RO Inlet)*			
FIT3279 + FIT3379 + FIT3479 + FIT 3579 (RO pm)			
FIT4002 (CCT feed)			
FIT4801 (Product)			
FIT8401 (B/Wash)			
FIT1002 (HR Overflow)			
MICROFILTRATION & REVERSE OSMOSIS			
MF Skid 1 Specific Flux Before EFM/After EFM	\	\	\
MF Skid 2 Specific Flux Before EFM/After EFM	\	\	\
MF Skid 3 Specific Flux Before EFM/After EFM	\	\	\
MF Pressure Decay Skid 1			
MF Pressure Decay Skid 2			
MF Pressure Decay Skid 3			
RO Feed Pumps Cartridge Filter DP			
YESTERDAY RAINFALL			
H.O SCADA Wallsend Weather Monitoring mm			
CHEMICAL USAGE			
NA.FIT6504 Hypo to Autostrainer			
NA.FIT6501 Hypo to MF CP			
NA.FIT6506 Hypo to CCT			
NA.FIT500X Ammonia to Autostrain			
NA.FIT610X Antiscale to RO feed			
SBS to RO CIP 5901			
SBS to Neutral 5901			
SBS to product water pumps 5901			
NA.FIT5902 SBS to product water tank			
NA.FIT5903 SBS to Raw Overflow			
NA.FIT5904 SBS to MF Feed Flow			
NA.FIT5702 Caustic to CCT			
NA.FIT5701 Caustic to Neutralisation			
NA.FIT5202 Sulp to RO feed			
NA.FIT5201 Sulp to Neutralisation			
NA.FIT5401 Citric to MF/RO CIP			
NA.FIT6301 RO Cleaning Chemical			
TANK LEVELS %			
Ammonia Tank LIT 5001 (35-15 low)			
Sulphuric Acid Tank LIT 5201 (20-15 low)			

Figure 4: ***Example of Daily Data, Daily/Weekly Tasks Sheet, and Routine Bench Testing***

2.5 Technical and Operation Support from the Wider Veolia Network

Throughout this scheme, Veolia played a critical role in supporting the team of operators. They provided a support to the operators by utilising their contacts within the wider Veolia network. From the beginning of the Treatment Operations contract, operators from Fairfield AWTP were sent to Mayfield West AWTP as Veolia observers. The Veolia observers were able to witness the commissioning and familiarise with the plant prior to handover. This provided also the existing operators with a support network outside the local team. The process engineer from Fairfield AWTP also took part in a review of the monitoring and operation of the microfiltration and reverse osmosis process units.

Being part of a larger network of expertise enables stronger training and knowledge transfer. As an operator of several Reverse Osmosis plants, Veolia is able to provide regular and local process support on reverse osmosis. The Process Chemist from Bayswater treatment plant allocated some of her time investigating product water quality exemptions, transferring knowledge to the operators in sessions and identify best cleaning regimes for the RO membranes.

3.0 CONCLUSION

Operating an Advanced Water Treatment Plant extended the focus of the operational team beyond their plant and provided them with an understanding of the waste water treatment operation supplying raw water to the AWTP. The new operator provided their teams the ownership to setting up of systems at Mayfield West and gave them their trust and support for the benefits to the entire team and the customer.

The change in perception from an operators level become evident. The mindset transcended from a sole focus on the daily tasks to how the daily tasks influenced the whole scheme. Focus was put on a drive to do the best possible job at both Shortland WWTW and Mayfield West AWTP. Any troubleshooting is made in consideration of the other part of the scheme, to help support the greater network of water treatment and provide appropriate product water quality to the customer.

Without doubt, I can conclude, with the exposure to this Advanced Water Treatment Scheme and the opportunity to support my team mates, I am more passionate about what I do than I ever have been before.

4.0 ACKNOWLEDGEMENTS

Thank you to James Morrison, my Mayfield West colleague who has taught me so much about water and helped me appreciate what the Water Operators do. Marie Jourden, Deanne Pope, Brock McPhee and Dan Slocombe, without their decisiveness, experience and knowledge I would never had had the opportunity to operate Mayfield West let alone submit this paper on it. Thank you to Marie for believing in me and being patient with me and listening to some of my trouble shooting theories. Thank you Caitlin for showing me some SmartArt tricks. Thank you to Robert O'Rourke my partner for seeing me through my nervousness of this submission.

5.0 REFERENCES

Operations – Orica Kooragang Island http://www.orica.com
Islands of the Lower Hunter River NSW http://www.geni.com