Coonabarabran Water Treatment Plant Audit Report

for Warrumbungle Shire Council & NSW Department of Health

4 May 2015

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1 Introduction

City Water Technology (CWT) has been engaged by NSW Health to offer support to numerous utilities in the areas of water treatment process review, assistance with plant optimisation and development of operator procedures. CWT (Bruce Murray and Jacquelyn Osborne) visited Coonabarabran water treatment plant (WTP) on March 4, 2015 to evaluate the plant and take note of any issues as seen by operators and supervisory staff.

1.1 Overview of Drinking Water Supply System

Coonabarabran WTP treats and supplies water to consumers in the Coonabarabran area. Raw water is sourced from Timor Dam, Poundyard weir (in the Castlereagh River downstream of the Dam) and local back up bores (when required), treated at the WTP, and then distributed first to Rifle Range 1 and 2 reservoirs and then the Oxley Highway Reservoir. The Coonabarabran community can receive water from any of these storages. An overview of this system is shown in Figure 1-1.

Coonabarabran is a conventional WTP combining coagulation, flocculation, sedimentation, and filtration with lime dosing for pH correction. The WTP typically runs for 12 hours per day in the afternoon to minimise operating costs.

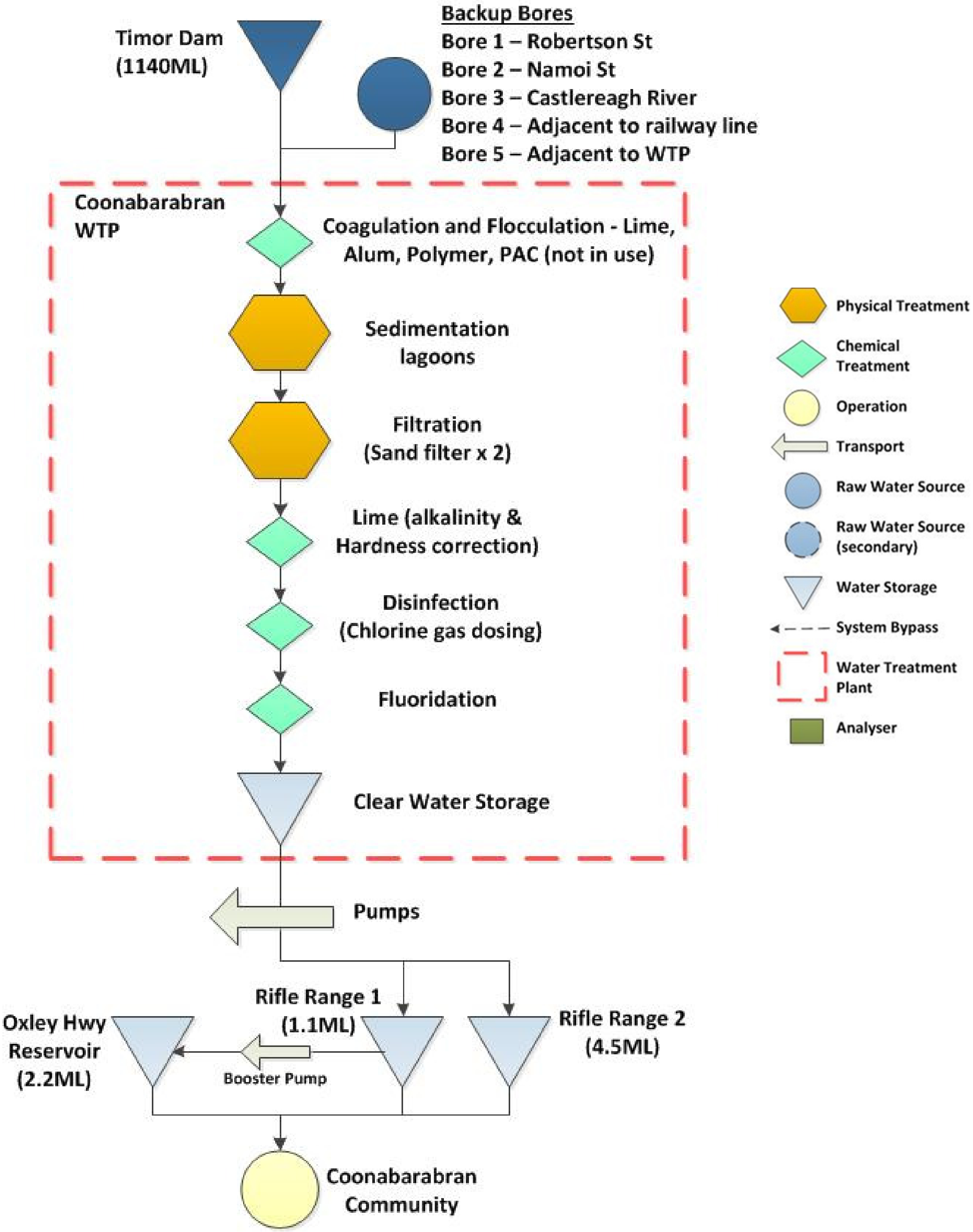

Figure 1-1: Coonabarabran Water Supply System

2 Water Quality Assessment

Table 2-1: Coonabarabran WTP NSW Drinking Water Quality Data (July 2012 to February 2015)

Parameter	Total Samples	Min	Mean	95%ile	Max	ADWG Value	Comments
Raw Water							
Turbidity (NTU)	940	0.260	11.3	30.6	293		
Colour (HU)	932	0.0	48.6	110	300		
pH	941	6.02	7.27	7.88	8.30		
Settled Water							
Turbidity (NTU)	942	0.19	0.908	1.36	11.1		
Colour (HU)	877	0.0	1.70	2.50	10.0		
pH	942	6.05	6.87	7.01	9.86		
Filtered Water							
Turbidity (NTU)	942	0.05	0.389	0.680	1.07	<0.2	Target for control of *Cryptosporidium* and *Giardia*
Colour (HU)	942	0.0	0.035	0.0	2.5		
pH	942	5.99	6.87	7.01	7.71		
Clear Water							
Turbidity (NTU)	942	0.0	0.587	0.810	2.77	<1.0	Target at point of disinfection to ensure effectiveness
Colour (HU)	942	0.0	0.066	0.0	2.5	<15	Aesthetic
pH	942	6.65	7.50	7.73	8.87	6.5 – 8.5	Aesthetic
Free Chlorine (mg/L)	941	0.88	2.40	3.40	7.50	≤5	Health

2.1 Key Points

- Raw water quality is generally good, with relatively low readings for turbidity and colour. Operators at Coonabarabran WTP reported that raw water quality has been significantly better since bushfires occurred in the Timor Dam and wider catchment area approximately two years ago.
- Turbidity is often above 0.2 NTU out of the filters, however this has improved since April 2014. The current CCP for filtration at Coonabarabran WTP requires turbidity to be <1.0 NTU. This should be tightened back to <0.5 NTU and targeting <0.2 NTU to be in line with the current best practice approach to water treatment and pathogen removal, as outlined in the ADWG.

3 Critical Control Points (CCPs)

The CCPs outlined in Table 3-1 were developed by AECOM in conjunction with WSC at a risk assessment workshop as part of the DWMS development project. CWT has analysed the available water quality data with respect to these CCP limits to determine performance and has provided comments for consideration by WSC.

Table 3-1: Coonabarabran WTP CCPs and Limits

CCP	Hazard and Location	Parameter	Units	Target Level	Adjustment Limit (AL)	Critical Limit (CL)	Performance	Comments
CBN1: Filtration	All pathogens Filter outlet	Turbidity	NTU	<0.8	>0.9	>1.0	2 results (<1%) exceeded both the AL and CL If the AL is reduced to 0.2 NTU in line with ADWG, 79% of samples do not comply	These limits for filtration are quite high when compared to the ADWG recommended targets (see note below)
CBN2: Disinfection	Chlorine sensitive pathogens Leaving WTP	Chlorine	mg/L	2.0 – 5.0	<1.8	<1.5	5% of samples exceeded AL 0.7% of samples did not comply with CL	
CBN3: Reservoirs	All pathogens and all chemicals	Reservoir Integrity	-	No breach	Detection of breach	Evidence of contamination		Not recorded on log sheet
CBN4: Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	mg/L	0.6	0.5	0.2		Not recorded on log sheet

Note: *Turbidity targets for the filtration are very generous considering the current belief that individual filters should be consistently achieving turbidities <0.2 NTU, and never going above 0.5 NTU. While the ADWG states turbidity must be <1.0 NTU for effective disinfection, above 0.2 NTU, removal of chlorine resistant pathogens such as Cryptosporidium and Giardia cannot be ensured. CCP limits for this parameter should be adjusted to be in line with best practice for a conventional WTP with filtration.*

4 System Details

4.1 Catchment

Coonabarabran WTP draws raw water directly from Timor Dam. Timor Dam is located approximately 13 km west of Coonabarabran in the Central West catchment of New South Wales. Major land uses of this catchment are agricultural, however Timor Dam is fenced and Coonabarabran WTP is high in the catchment, taking its water directly from the dam so is rarely affected by organic and other contaminants from agricultural practices that tend to infiltrate rivers and creeks in the greater catchment area.

Timor Dam occasionally experiences algae contamination events of up to 300,000 – 400,000 cells/mL. A WEARS mixer is installed and operational to destratify the dam and prevent favourable conditions for algal growth. WSC also has an EPA licence to use a copper-based algicide in the dam to kill cells if a bloom does occur.

As a destratification system is already operational at Timor Dam the following should be considered as potential additional measures to prevent conditions for favourable algal growth:

- Check the mixing profile and efficiency of the WEARS mixer to ensure appropriate destratification for the entire dam is being achieved – consider a second mixer if insufficient.
    - Check mixing profile by measuring temperature and dissolved oxygen at various depths from the dam surface to the bottom. Good mixing will be indicated by dissolved oxygen >4 mg/L at all depths, and a difference of <2 °C between the top and bottom depths.
- Consider planting vegetation in/around the dam to absorb nutrients and organics in the water.

All WTP Operators should re-familiarise themselves with the NSW Water Directorate Blue-Green Algae Management Protocols and response actions required at each stage of an algae-related contamination event (action flow chart displayed in WTP control room).

4.2 Treatment Process

Coonabarabran WTP employs a conventional treatment process, having a design capacity of 7.5 ML/day (95 L/s at 22 hr/day operation). Typical flow is generally limited to ~75 L/s (55 L/s from Timor Dam and 20 L/s from the weir) but can be increased up to ~100 L/s by manually increasing the maximum opening of the inlet valve in the raw water main to allow flows of up to 80 L/s from Timor Dam.

A Process Flow Diagram of the WTP is shown in **Error! Reference source not found.** on the following page.

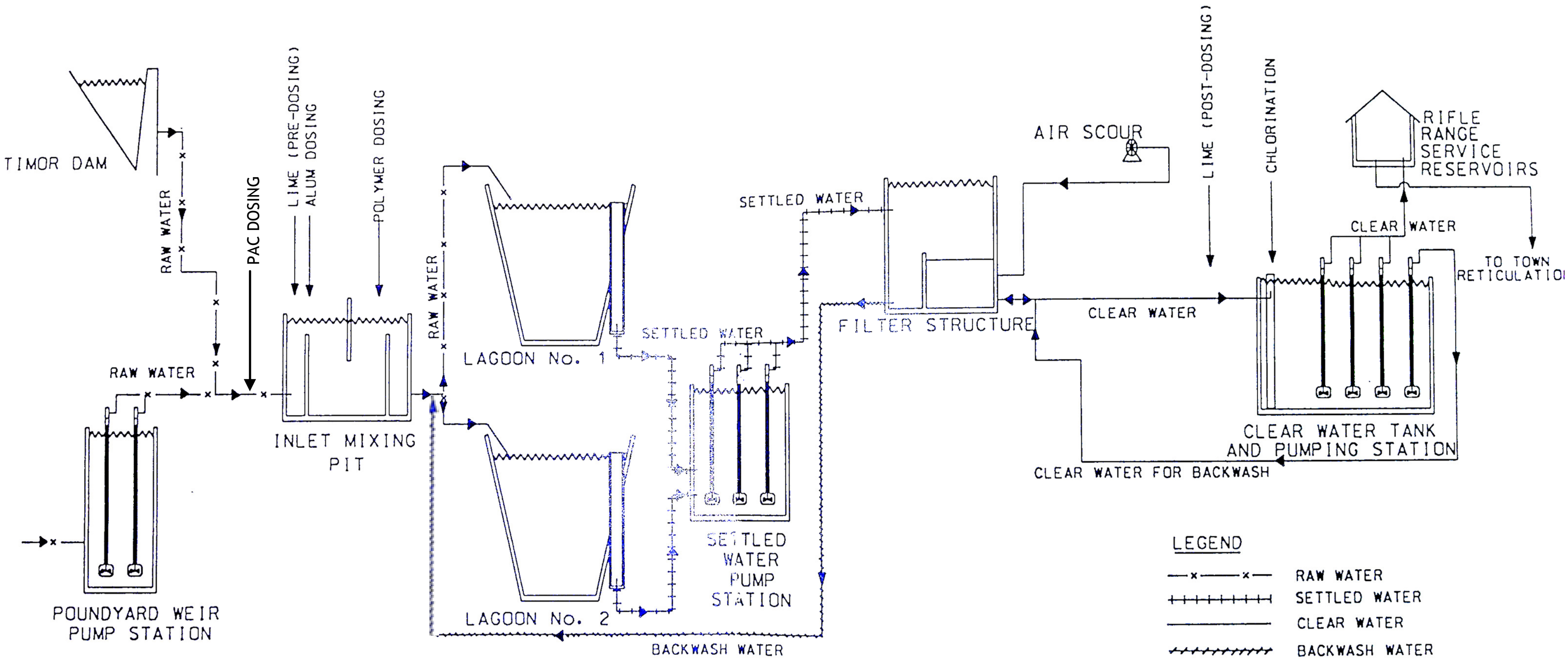

Figure 4-1: Conceptual Process Flow Diagram of Coonabarabran WTP

4.2.1 PRE-TREATMENT

At Coonabarabran WTP there are pre-treatment systems for both pH correction with lime, and organics removal with powdered activated carbon (PAC).

4.2.1.1 ORGANICS REMOVAL

When algae and organics are present in the water source, taste and odour causing compounds and algal toxins may also be present and can infiltrate the treated water if processes to remove these contaminants are not available at the WTP. A PAC dosing system is installed and operational at Coonabarabran WTP to remove organics when present, however it is a basic and operator intensive set up (see Figure 4-2 below), requiring Operators to manually load PAC and batch into a slurry. There is only one dosing pump which is a considerable risk to water quality when PAC dosing is required, in case of pumping failure.

CWT recommend that WSC consider replacing the existing PAC system with a new, automated batching and dosing system with duty/ standby pumps to alleviate the Operator intensity of the process. This will also allow for better batching and dosing reliability and may also reduce chemical use by enabling better control and optimisation of dose rates.

Figure 4-2: PAC Batching and Storage Tank at Coonabarabran WTP

PAC dosing at Coonabarabran is critical to address the significant risk of blue-green algae (BGA) blooms in Timor Dam. At present, PAC is batched into a slurry in the tank shown in Figure 4-2 and dosed into the raw water main just prior to the inlet valve. From this point the water travels a short distance to the inlet mixing pit where it is dosed with lime and alum.

PAC removal efficiency is dependent on contact time and sufficient mixing with the target water, 30 - 60 minutes being ideal. At Coonabarabran WTP, the PAC has very little contact time (2 – 3 minutes) before lime and alum dosing, leading to high doses of PAC in an attempt to overcome this.

To improve the efficiency of PAC dosing and optimise chemical usage, the PAC dosing point should be moved further upstream to allow a minimum of 30 minutes contact before other treatment processes and chemical dosing. To achieve this increased contact time there are several options for alternate dosing locations.

TIMOR DAM

Timor Dam has been identified as a possible alternate location for the entire PAC batching and dosing system. Relocating the dosing point to the dam outlet would allow potentially 6 – 8 hours contact with the affected water before reaching the WTP, ample time for the adsorption of organics to occur. Given the extended contact time, a lower grade of PAC may also be able to achieve the desired removal efficiency, potentially reducing operating costs.

Chlorine dosing at the dam outlet has previously been in place for Coonabarabran, however this system is no longer used and has since been decommissioned. There are structures and connections at Timor Dam that could be modified to accommodate a chemical batching and dosing system such as PAC. There is an existing dosing spear in the raw water main and connections to power and telemetry are available.

There are a number of non-potable water users that take their water from the pipeline between the outlet at Timor Dam and Coonabarabran WTP. If PAC dosing were to occur at Timor Dam there is the potential for these non-potable users to receive PAC laden water. Depending on the usage of this water, given the agricultural nature of the surrounding area, there may be EPA issues if used for land application, feed watering, etc.

Council will need to work with these non-potable users to determine whether this location is suitable and confirm appropriate strategies to manage non-potable water supply during PAC dosing events.

UPSTREAM OF WTP

Another option is to relocate the dosing point to after the final non-potable user. Operators and Council staff believed that this point is around 1-2 km upstream of the WTP which would also provide sufficient contact time for the PAC (approximately 2 – 3 hours at typical flows). An entirely new site will need to be established to house the PAC system and dosing point as there is no existing infrastructure at this location.

Additional costs will be required to supply power and telemetry connections to the dosing system and appropriate shelter/housing of equipment.

RAW WATER TANK

If relocating the dosing point to a location not on the WTP site is unfeasible, a raw water contact tank can be constructed onsite to allow dosing and additional contact time for the PAC. The raw water tank would be located between the raw water inlet to the WTP (current PAC dosing location) and the inlet mixing pit where lime and alum are dosed.

This tank would also allow for a buffer between the water source and WTP in the event of receiving poor quality raw water.

The type of PAC being used may also be affecting removal efficiency of taste and odour causing compounds and algal toxins. Different types of PAC (e.g. wood, coal, or coconut based) are generally better at adsorbing different organic contaminants, so it is important that Coonabarabran is using the type most suited to its requirements. Coal-based PACs are typically better at removing taste and odour compounds, and a high quality PAC with a finer particle size should be used when sufficient contact time cannot be guaranteed.

WSC should perform a jar testing study at Coonabarabran WTP to determine the most effective type and quality of PAC for the treatment process. If alterations are made to the dosing location to achieve increased contact time, a lower quality PAC may be able to achieve sufficient removal. This should be confirmed by further jar testing before any change is made.

4.2.1.2 pH CORRECTION

Lime is dosed into the inlet mixing pit at the same point as alum dosing to adjust the pH to approximately 6.8 – 6.9 for improved coagulation. Lime is particularly used for pH correction when softening of the raw water is also required.

Upon reviewing the available raw water quality data, there did not appear to be any indication that hardness of the raw water is or should be a concern. Given the operational issues associated with the lime batching and dosing system, WSC may wish to consider investigating further potential for hardness issues in the raw water, and if appropriate, alternative chemicals for pH correction.

The lime system was inspected and significant caking of precipitated calcium carbonate and lime impurities was observed both in and around the batching tanks and surrounding area. Operators also reported frequent blockages occur in the dosing lines from a build-up of calcium carbonate precipitate. These issues are most likely due to poor system design. Another common design flaw in lime systems is the location of the ball float shutoff valve. These are installed in the main body of the batching tanks and can often become encrusted with lime which prevents them from floating and can cause the tanks to overflow.

The two batching tanks for the lime slurry are square, providing ample opportunity for precipitates or undissolved lime and impurities to build up and not be dislodged during batching or cleaning. To minimise the incidence of this, WSC should consider the following modifications to the lime system:

- Reshape the slurry batching tanks to allow better draining of lime. A hopper style tank is best as they provide limited areas for precipitate to accumulate. This could be achieved by retrofitting concrete infills into the tanks to create the desired shape.
- Modify the tank outlet arrangements. Minimising the bends in the outlet pipework will further reduce the chance of blockage in the dosing lines. The outlet should also be relocated to the lowest point in the tank.
- Increase the water rate through the batching tanks to reduce the slurry concentration and produce a slurry that is easier to pump and less likely to build up inside dosing lines.
- Investigate current mixer efficiency. If insufficient to adequately mix the contents of the entire tank, consider replacing or relocating the mixer.

The lime system also needs to be cleaned frequently to ensure any precipitate residue is removed before it can accumulate and cause problems. CWT recommend the slurry tanks and dosing lines be fully flushed at each shutdown of the lime system and a weak acid clean be performed every fortnight to remove more stubborn residues and caking. To assist with cleaning, the tank lids should be modified so that they are fully removable to allow better access to all surfaces of the tank.

The batching tanks should be modified to allow the ball float valve to be housed in a separate compartment in the tank, as shown in Figure 4-3, so that it is not in direct contact with the lime slurry.

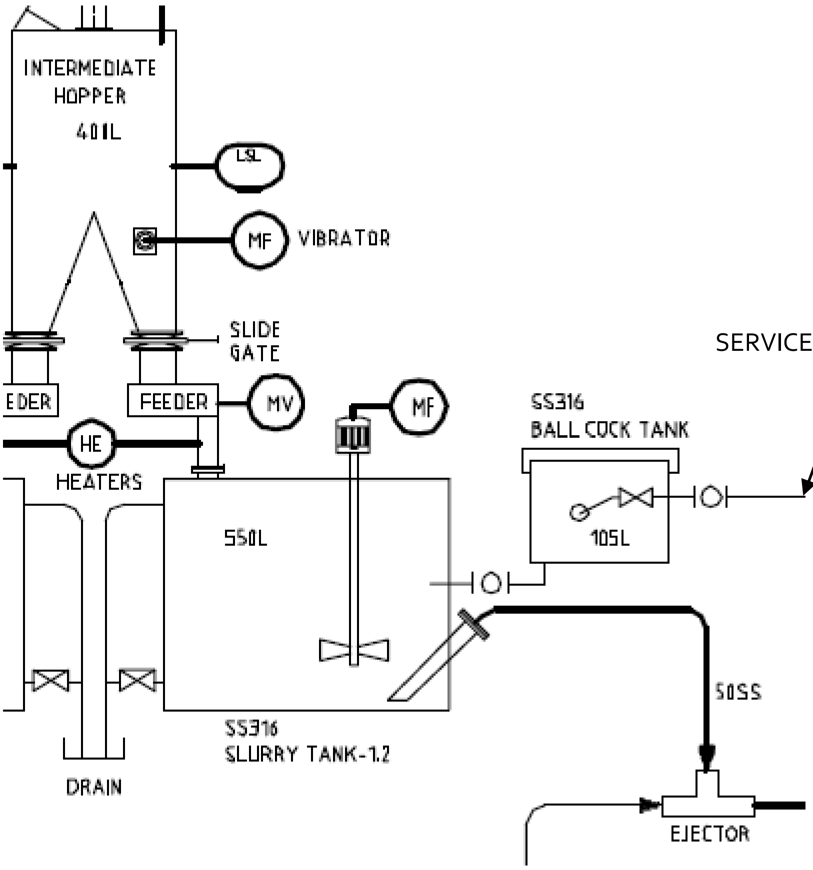

Figure 4-3: Lime Slurry Batching Tank with Separate Ball Valve Compartment

4.2.2 COAGULATION AND FLOCCULATION

Alum for coagulation is dosed into the inlet mixing pit at the same location as lime for pH correction. The inlet pit has a series of concrete baffles to provide hydraulic mixing of the water and chemicals to aid coagulation and flocculation processes.

LT20, non-ionic polyacrylamide used as a flocculation aid, is dosed into the far end of the pit to further assist with the flocculation process and achieve better settling of particulates and contaminants. PAC is also bound up in the floc at this point, assisting with settling and removal of organic compounds.

4.2.3 SEDIMENTATION

Clarification at Coonabarabran WTP is achieved using one of two sedimentation lagoons. Water from the inlet pit is directed to the online lagoon where settling of the pre-formed floc occurs. Turbidity of the settled water is typically very good, being in the range of 0.4 – 0.5 NTU in recent times (since the bushfires) with a maximum of 2.5 NTU.

Each lagoon has a capacity of 804 m^3, with a maximum operating sludge depth of 1,000 mm and is usually operational for 12 – 18 months at a time before it is taken offline so the sludge can dry, be dug out and disposed of. The lagoon in Figure 4-4 is currently offline and almost ready to be dug out and reinstated so that Lagoon 1 (Figure 4-5) can undergo the same process.

Figure 4-4: Sedimentation Lagoon 2 Offline for Drying

Figure 4-5: Sedimentation Lagoon 1 Nearing Capacity

4.2.4 FILTRATION

Coonabarabran has two dual media filters that are fed by the sedimentation lagoons. Backwashes are triggered by time or headloss set points, though turbidity breakthrough is rarely, if ever, seen. Performance of these filters is monitored online by individual differential pressure (DP) cells on each filter to monitor the headloss throughout a filter run, a single online turbidimeter on the filter 1 filtered water outlet and daily grab samples to confirm online turbidity results as well as monitor colour and pH characteristics in both filters.

The current ADWG and best practice guides for the operation of drinking water systems recommend online monitoring of all individual filter outlet turbidities to ensure sufficient particle and pathogen removal. If only one filter or the combined water is monitored then this could allow for poor performance of a filter to go unnoticed if by blending with water from the other filters it was still able to achieve the overall turbidity target.

CWT recommend that WSC purchase and install a second turbidimeter so that the individual turbidities at the outlet of both filters is being constantly monitored.

While on site, a typical backwash sequence was observed. Coonabarabran WTP uses air scour, combined air and water wash, and water only wash in its backwash sequence to clean the filter media. The backwash sequence observed onsite was as follows:

1. Drain down filter to ~100 mm above the media.
2. Air scour at 54 m^3/hr for 6 minutes.
3. Combined air and water wash for 2 minutes.
4. Water wash at 89 L/s for 11 minutes.

Once the drain down had occurred, the filter condition was observed. The media appeared to be level across the filter with no apparent mounds, holes, or mud balls, however gravel (from the bottom support layers) could be seen on the surface of the filter bed.

Gravel on the surface of the media suggests that either the air scour or water wash rates are too high and is jetting gravel to the surface of the filter bed during backwashing. The backwash sequence was reviewed whilst on site and adjusted (discussed in further detail below).

During the backwash a quick, even spread of both air and water was observed across the filter bed. However, some media carry over was seen during the combined air and water wash. Figure 4-6 shows that the combined air and water wash is continuing past the point of overflow into the launders (the edge of the launder is marked in red) and out of the filter. Loss of media over into the launders during a backwash indicates that the air component of the combined air and water wash continues too long and/or the water wash rate is too high for the current backwash length and parameters.

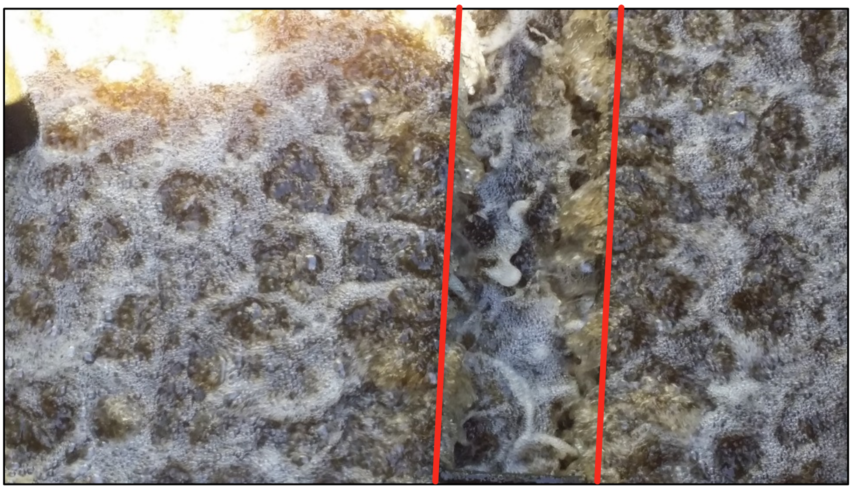

Figure 4-6: Air Scour Continuing During High Rate Water Wash Leading to a Loss of Filter Media

During a backwash, air is used to fluidise the media to dislodge trapped particles. As the air fluidises the media, it needs to be stopped before the water level reaches the top of the launder to ensure that media has time to settle to prevent losses to wastewater from carry over.

CWT recommend that operators inspect the filter media quality and depth against the design requirements, and top up where necessary.

The following adjustments were made to the backwash program whilst onsite to prevent further media losses:

- Air scour reduced from 6 minutes to 5 minutes;
- Combined air-water wash was reduced from 2 minutes to 1 minute to ensure that all of the air has been removed from the water and the media has had time to settle before the water level reaches the top of the launders;
- High rate wash reduced from 11 minutes to 8 minutes to minimise excess water usage. Monitoring backwash water turbidity may enable further optimisation of this parameter;

Operators should check the backwash details and bed expansion achieved by the new regime to ensure these adjusted values are appropriate.

Wastewater generated from backwashing is directed to the sedimentation lagoons for sludge to settle with the floc from the initial sedimentation phase.

If elevated turbidity of the settled water is seen following a backwash, WSC should consider performing routine backwashing at the end of the WTP run prior to shut down so that this water has up to 12 hours to settle before more water is drawn off from the lagoons for filtration.

4.2.4.1 POST FILTRATION pH CORRECTION

Lime is dosed into the combined filtered water well for final pH adjustment before disinfection (see Figure 4-7). A disinfection pH of 7.4 – 7.5 is targeted.

Figure 4-7: Post-Filtration Lime Dosing into Filtered Water Well for pH Correction

Chlorine is 40 times more effective as a disinfectant at pH 7 than pH 8. Operators at Coonabarabran should try to target a pH as close to 7 as possible with their current set up without risking distribution of corrosive water.

4.2.5 DISINFECTION

Disinfection at Coonabarabran WTP is achieved by dosing chlorine gas into the filtered water line at the inlet to the clear water tank. The chlorination system consists of two 70 kg chlorine gas cylinders connected in a duty/ standby arrangement, a single eductor and rotameter, and a service water connection acting as carrier water, shown in Figure 4-8 and Figure 4-9. This system has auto-changeover between the duty/standby cylinders, however the indicator that a cylinder is empty is not obvious and requires visual inspection. Additional cylinders are stored on site for both Coonabarabran and Binnaway.

Figure 4-8: Chlorine Gas Dosing System Set Up

Figure 4-9: Service Water Connection for Chlorine Gas Dosing System

Disinfection is a CCP at Coonabarabran WTP and as such should have additional and strict controls and safeguards to ensure that any failure within the dosing system does not compromise treated water quality.

An additional eductor and rotameter should be installed to allow for duty/ standby operation and auto-changeover in case of a failure of either primary instrument. Spares of each are currently available for installation on site and the current operators are confident they would be capable of effecting a quick changeover if/when necessary. However, this could not be guaranteed if current operators were not available at the time of a failure and a new or temporary operator were required to perform the changeover.

The current method of determining which cylinder is in use and if a cylinder is empty requires familiarity with the valve on the cylinder. If a new or temporary operator is responsible for the WTP, an empty cylinder could go unnoticed until a dosing fault alarm is triggered when both cylinders are empty. WSC should install scales for each gas cylinder to easily identify the operating level of each cylinder. These scales can then be linked back to the WTP SCADA and alarm when a cylinder is empty and requires changing.

4.2.6 FLUORIDATION

The fluoride system at Coonabarabran was a noted concern of the operators. Sodium fluoride powder is batched into a 4% dosing solution using a Prominent Fluid Controls softener and saturator batching and dosing system design (see Figure 4-10 to Figure 4-12 below).

Figure 4-10: Fluoride System Control Panel and Water Softener

Figure 4-11: Fluoride System Saturator Tank

Figure 4-12: Fluoride System Dosing Solution Storage Tank

Sodium fluoride powder is loaded into the saturator using a vacuum loader and forms a layer on top of the media which is used to filter any undissolved fluoride particles. Service water is softened and then also added to the saturator, gradually dissolving the fluoride powder as it flows through and is filtered by the media bed and stored for dosing. Frequent blockages at the outlet of the saturator tank and a significant amount of a crystalline substance covering the dosing spear were reported by the operators.

Issues identified with the fluoride system could be related to either poor design or equipment failure, or inadequate service water quality. Operators should first of all check the softener to ensure that it is working satisfactorily. Some concerns have been raised following the results of recent water quality tests by an external laboratory which indicate a substantial increase in both the calcium and total hardness results obtained between the raw and treated water samples. The crystalline substance forming on the surface of the dosing spear supports the possibility that the service water is too hard and is producing calcium fluoride scaling at the dosing point. This scale (and that forming in the saturator outlet) should be analysed to confirm that it is in fact calcium fluoride. Note that any calcium fluoride scale formed reduces the available fluoride for dosing into treated water, resulting in higher chemical costs and poorer control of fluoride dosing.

The outlet pipework at the base of the saturator tank often blocks with a crystalline substance. The arrangement of this pipework, shown in Figure 4-13, makes it awkward to clear the blockages.

Figure 4-13: Outlet Pipework at Base of Fluoride Saturator Tank

Augmentation to the existing pipework and tank arrangement should be considered to enable easier access to clear the pipe and reduce the risk of blockages occurring in the first instance.

Through our involvement in other similar projects, CWT is aware of a number of water treatment and supply systems experiencing issues with fluoride batching and dosing systems. We understand that NSW Department of Health is currently in discussions with Prominent Fluid Controls to resolve these issues and potentially develop and implement a new upflow system design. CWT will keep abreast of these developments and if appropriate, recommend installation at Coonabarabran.

4.3 Distribution

Water from Coonabarabran WTP supplies consumers in the Coonabarabran community with potable water. It is stored in one of three reservoirs (Oxley Highway, Rifle Range 1, and Rifle Range 2 reservoirs) totalling 7.8 ML of storage, before distribution. No concerns were raised regarding chlorine residual, organics or other complaints in the reticulation network.

5 Recommendations

The findings and recommendations from the site visit are summarised below in Table 5-1. Each recommendation is listed in priority order by process step

Table 5-1: Recommendations for Improvements to Coonabarabran WTP from the Site Audit

Recommendation	Priority
Review Filtration CCP target and limits to be in line with ADWG recommendation (<0.2 NTU).	Very High
Install a second turbidimeter on the outlet of filter 2.	Very High
Operators to refamiliarise themselves with the BGA Management Protocols and related response actions.	High
Relocate the PAC dosing point to provide increased contact time.	High
Investigate need for raw water softening and possible alternate chemicals for pH correction.	High
Modify the lime batching tanks for improved operation.	High
Inspect the filter media and compare to design details (top up where necessary).	High
Install standby rotameter and eductor for the chlorine dosing system.	High
Check the mixing profile of the WEARS mixer in Timor Dam.	Medium
Upgrade existing PAC system with a new automated batching and dosing system.	Medium
Conduct a jar testing investigation to confirm that the most appropriate form of PAC is being dosed.	Medium
Confirm adjustments to backwash regime made onsite to ensure they are effective.	Medium
Install scales for chlorine gas cylinders and connect to SCADA.	Medium
Check service water for fluoride system is within required quality limits and softener is working effectively.	Medium
Modify fluoride saturator outlet pipework.	Medium
Consider planting vegetation in/around Timor Dam to absorb organic contaminants used by algae for growth.	Low
Review lime system cleaning regime and frequency.	Low
Review pH target for disinfection.	Low
Analyse scale forming in fluoride system and on dosing spear.	Low

6 Next Steps

As Council reviews this document and proceeds with implementation of the above recommendations, CWT will be available for further assistance and any mentoring as required. CWT will continue to liaise with Council to see how the above recommendations have helped improve operations at the plant. If required, CWT can work with WSC to prepare cost estimates for the improvement works suggested above.