BLIGH TANNER

Drinking Water Management System Implementation

Warrumbungle Shire Council

DATE: February 2016

CLIENT: Warrumbungle Shire Council

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+ DOCUMENT CONTROL SHEET

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Drinking Water Management System Implementation

+ JOB NUMBER

2015.117.401

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1 PROJECT SCOPE

NSW Health has engaged Bligh Tanner to assist Warrumbungle Shire Council with the implementation of their drinking water management system, with the aim of making improvements to public health outcomes.

Bligh Tanner inspected the Warrumbungle Shire Council Schemes during January 2016, and discussed operational details and operational improvements with the water treatment plant operators and Water Managers.

There were 2 key focus areas of the inspections:

1) Determine if the target, action, and critical limits for each CCP were appropriate for the scheme.
2) Inspect the integrity of bores and reservoirs, to identify if there are potential points of ingress for vermin and contaminants that may present an unsatisfactory health risk.

In addition, the current drinking water management system does not have an emergency response plan that would enable council to react quickly in the event of an incident or emergency. As such, the current procedures were reviewed, and a draft emergency response plan prepared.

1.1 Context

Drinking water management systems are put in place in all states of Australia to ensure that drinking water is safe for consumers. These systems are based on the Australian Drinking Water Guidelines (ADWG). The ADWG is a “catchment to tap” risk based framework for identifying and managing risks to drinking water.

Why is it important?

1.1.1 Milwaukee

In 1993, approximately 403 000 people in Milwaukee (a city of 1.6 million) became ill due to *Cryptosporidium* infection that was transmitted through the public water supply. At least 69 people (some estimates are over 200) died as a result of the outbreak.

In this case, the source water was contaminated by *Cryptosporidium,* and *the filters at the water treatment plant did not effectively remove the protozoa.*

1.1.2 Alamosa

In 2008, approximately 2 300 people in a community of 8 900 became sick, and one person died from *Salmonella* in the town water supply.

Whilst the exact cause of the outbreak is unknown, *a reservoir was found to be compromised*. The Colorado Department of Public Health and Environment concluded that the reservoir was “an attractive location for wildlife to gather” and concluded that *Salmonella* entered the reservoir either by an animal, or due to faecal matter washing into the reservoir.

1.1.3 Walkerton

In 2000, approximately 2300 people in a community of 5 000 became sick, and 7 people died as a result of pathogenic *E. coli,* and *Campylobacter* infections transmitted through the town water supply.

The incident occurred after surface water, containing the pathogenic bacteria *infiltrated into the groundwater bores*.

1.1.4 Northamptonshire

In 2008, a rabbit drowned in the late stages of the water treatment process for Anglian Water, resulting in ~442 cases of cryptosporidiosis, and a boil water alert for over 100 000 people. This was the first instance where it was demonstrated that rabbits harbour a human infective strain of *Cryptosporidium*.

The incident occurred due to *ineffective vermin proofing of the final stages of the treatment processes*.

1.1.5 Roma

In 2011, Queensland Department of Health identified 26 laboratory confirmed cases of *Salmonella* in Roma. Three people were hospitalised.

Frogs had colonised a ground level reservoir that was inadequately sealed, introducing *Salmonella* into the water supply.

1.1.6 Why are these incidents mentioned in this report?

There are specific operational and infrastructure failures that resulted in each of the above incidents. Many of the underlying causes of the incidents above are present in Warrumbungle Shire, and immediate action should be taken to improve each scheme.

Bore protection: The groundwater schemes of Bugaldie, Coolah, Dunedoo and Kenebri use groundwater with disinfection only. However, all of these schemes have the potential for contamination of the groundwater source.

For example, in both Dunedoo and Coolah, there are “wells” that are either not covered, or incompletely covered, and in Coolah there is an abandoned, uncapped bore that is assumed to tap the drinking water aquifer. In all schemes, the actual boreheads are not completely sealed, allowing for frogs, snakes and other vermin to access the bore, and potentially contaminate the water supply.

All potential areas for ingress into groundwater need to be sealed. This also applies to the Mendooran backup supply and Baradine, although for these schemes, there is additional treatment.

Filtration: It is now known that to be an effective barrier against protozoan pathogens, conventional filtration should be continuously monitored (online monitoring of individual filters), and operating with turbidity targets of <0.3 NTU (See the WSAA Manual for the Application of Health Based Treatment Targets, September 2015).

At present, the filtration plants in Warrumbungle Shire are monitored infrequently (daily or a few times per day), and the turbidity targets provide little to no protection from protozoan pathogens. The treatment plants at Barradine, Binnaway, and Coonabarabran should have individual online turbidity meters installed to monitor turbidity post filtration. For all filtration schemes, the target, action and critical limits should be improved (lowered) towards best practice. The Mendooran WTP does have a higher level of control. It is not clear that the operator gets alerts or call outs if the turbidity exceeds CCP critical limits. If this is possible, it should be implemented as soon as practicable.

Reservoir integrity: During the site visit, the clear water tanks and a number of reservoirs were inspected, and suspected points of ingress were noted. Bligh Tanner was also provided the Aqualift reports and inspection photographs that confirm the predominantly ground based observations. It can be concluded that the majority, if not all reservoirs are not properly secured from either water ingress, or contamination by vermin. A comprehensive program to effectively seal all reservoirs from access by vermin is of the highest priority.

It is noted that there is a focus on disinfection in each scheme, and that generally good chlorine residuals are maintained. Where chlorine residuals are maintained, there will be a good level of

protection from bacterial and viral pathogens. However, *Cryptosporidium* and *Giardia* are either poorly or not deactivated by chlorination, and were bores or reservoirs contaminated with these pathogens, an outbreak of disease is a likely outcome.

It is also important to note that the Australian Drinking Water Guideline advocates a multi-barrier approach to managing risks. In many of the Warrumbungle Shire Council schemes, as there is not enough emphasis on source protection or on the integrity of the distribution network; as a result, residual disinfection is the only barrier that is preventing a disease outbreak. The over-reliance on chlorination as the only effective barrier is not sufficient in the longer term.

2 SCHEME BASED OBSERVATIONS AND RECOMMENDATIONS

2.1 Baradine

The Baradine Water Treatment Plant consists of the following

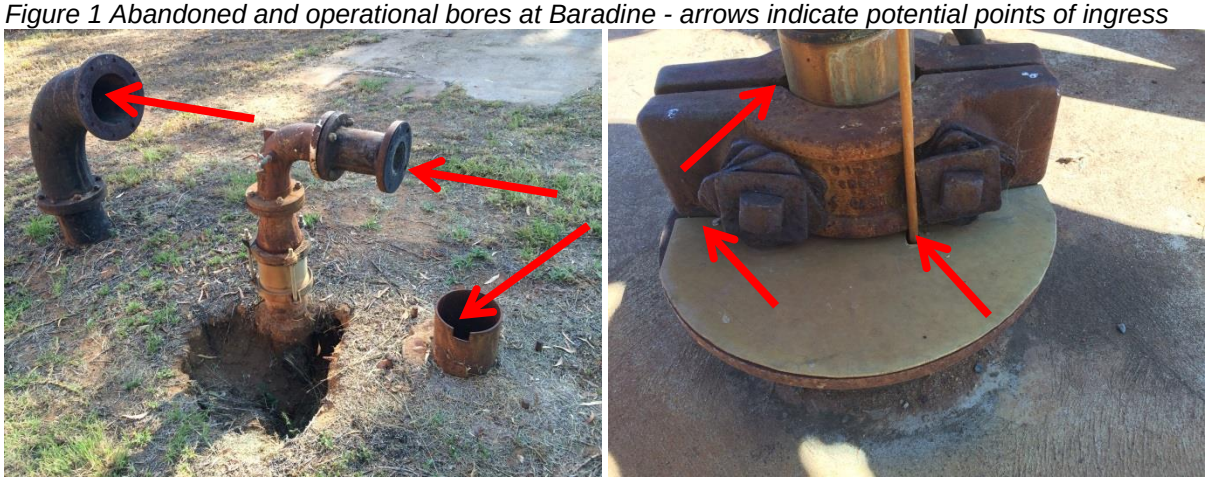
- Bore water
- Aeration
- pH adjustment
- Flocculation/ sedimentation
- Filtration
- Disinfection
- Fluoridation
- Distribution

Note: The System flow diagram for Baradine indicates that the reservoir is before treated water goes to the community. However, some residents receive water directly from the clear water tank. The process flow diagram should be adjusted accordingly.

2.1.1 Baradine bores

The Baradine bores are not fully sealed against ingress – however, as these bores undergo full treatment, including sedimentation and filtration which are open air processes, the sealing of these bores is a lesser priority than other systems. Nonetheless, it is best practice to minimise all sources of contamination, so these bores should still be sealed.

Figure 1 Abandoned and operational bores at Baradine - arrows indicate potential points of ingress



The piping configuration of the first image needs to be confirmed to ensure that the pipes are not connected to the drinking water system. The main point of ingress into the operational bore are around the clamp, but other holes should also be sealed.

2.1.2 Sedimentation tank

As the sedimentation tank has already been identified for an upgrade, this was not extensively reviewed. When a new clarifier is installed, the ideal outcome will be for online turbidity monitoring of both the clarifier and filters so that both processes can be operated as critical control points.

2.1.3 Filtration

The current filtration limits are as follows: Target <0.8 NTU, Action >0.9 NTU and Critical >1 NTU.

These limits are applied based on the daily plant measurement, and do not demonstrate that filtration provides a continuous barrier. This cannot be achieved until online turbidity meters are installed, and automated CCP actions implemented to ensure that filtration is effective 100% of the time.

As the water source is a ground water source, protozoa are less likely, and the prime consideration is effective disinfection. However, operationally, it was indicated that the plant is capable of achieving a much lower target, and as such, a target of < 0.2 NTU is appropriate.

Currently, the filters are backwashed on time, but without a water quality trigger. By establishing an appropriate action limit of 0.4 NTU, a backwash can then be initiated on water quality.

A critical limit of 0.8 NTU would ensure that disinfection remained effective.

2.1.4 Disinfection

Disinfection is currently operating at a target of 1.5 mg/L with action limits at <1.2 mg/L and a critical limit of <1 mg/L. Normally, these limits would be suitable, but for Baradine, the chlorine contact time is not sufficient (see below). Upper limits should also be established to minimise the risk of exceeding the chemical health guideline value.

An additional action limit of > 2 mg/L and a critical limit of > 4 mg/L should be included.

Chlorine contact time calculation (see Appendix A for detailed description)

The chlorine contact time was calculated for Baradine, based on the following assumptions:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum plant flow rate = 16 L/s (*estimated*)
- Clear water tank volume = 38250 L
  (*estimated based on room measurements*.)
- Clear water tank minimum operating level = 65%
- Baffling factor in clear water tank = 0.1 (no baffling)

- Reservoir volume = 1 100 000 L
- Reservoir minimum operating level = 60%
- Baffling factor in reservoir = 0.1 (no baffling)

Based on these assumptions the chlorine contact time from the chlorine contact tank is **2.6** min.mg/ L. If the baffling factor is increased to 0.3 on the basis that the clear water tank is rectangular, and this will provide some (still poor) baffling, the CT is calculated as **7.8** min.mg/ L, still significantly lower than the 15 mg.min/L required for effective disinfection.

Note: the Reservoir, at 1.1 ML provides an additional **68** min.mg/ L of chlorine contact time, but this is AFTER some of the community is provided water, so is not considered in the calculation.

2.1.5 Water Treatment Plant Building

The water treatment plant building is poorly maintained, and the site appears to pose WHS risks (not the subject of this project), as well as public health risks. For example

- There are significant holes in the walls, and under the metal doors that will allow small animal and bird access.
- Chemical tanks are not bunded, and a significant spill could leak into the clear water tank.
- The area is unsanitary with significant amounts of bird faeces visible.
- The clear water tank is under the floor of the WTP, but there are numerous large access holes where vermin can enter, contaminating the clear water tank.

Figure 2 Chemical tank showing evidence of a spill immediately adjacent to clear water tank hatch.

2.1.6 Clear Water Tank

The clear water tank is underground inside the WTP building, but has many significant points of ingress. There is a very high risk of animal ingress directly into the clear water tank.

The clear water tank should be sealed from ingress as a matter of urgency, and the WTP thoroughly cleaned.

Figure 3 Hole in the wall of the WTP adjacent to float level holes into clear water tank (note the extent of bird faeces immediately adjacent to the holes)

Figure 4 Further points of ingress into WTP building and into the clear water tank (under the floor)

As there is insufficient chlorine contact time in the clear water tank, and there are known areas where significant contamination may be present, Warrumbungle Shire Council should discuss the Baradine Water Treatment Plant with the local PHU and DPI Water as a matter of urgency.

Possible solutions:

Immediate

1) Discuss the need for a precautionary boil water alert or
2) Increase the chlorine concentration to 4 mg/L to maximise contact time (based on the calculations above, 4 mg/L will still only provide 10 min.mg/ L contact time assuming a baffling factor of 0.1.) There are likely to be customer complaints at this concentration, and the pre-emptive provision of information to customers would be critical.

Longer Term

3) Change the reticulation configuration so that all water must go through the reservoir prior to delivery to town, or
4) Install a new chlorine contact tank of sufficient size to provide adequate contact time (this will allow for the decommissioning of the current, potentially contaminated, clear water tank).

2.1.7 Baradine Reservoir

The following images are from the Aqualift report, and demonstrate that there are also significant points of vermin ingress into the reservoir.

Figure 5 Reservoir images, with arrows showing some of the vermin entry points

2.1.8 Recommendations for Baradine

Immediate

- Discuss disinfection and integrity issues with PHU and DPI Water to determine if they believe that a precautionary boil water alert is advisable in the absence of poor water quality results.
- Adjust the chlorine CCP to achieve a greater contact time depending on the advice received.

Short Term

- Take whatever steps are possible to establish integrity of the clear water tank to prevent contamination/ vermin ingress
- Seal the operational bore
- Repair the Baradine reservoir to prevent ingress of vermin
- Reduce the CCP limits for turbidity
- Initiate backwashes based on filtered water quality (the daily grab samples)
- Fix the holes in the WTP building to prevent vermin getting inside
- Thoroughly clean the WTP building to remove all bird faeces (care to be taken to not allow cleaning water to enter the clear water tank)
- Clean the Baradine reservoir to remove the ~1500 mm of sediment
- Ensure that all treated water passes through the reservoir prior to any customers to ensure appropriate disinfection.

Longer term

- Cap the abandoned bore
- Replace the clarifier (project to be commenced)
- Install online turbidity meters for filtration, (and sedimentation after the clarifier is upgraded)
- Install continuous online chlorine meters to ensure adequate disinfection.

2.2 Binnaway

The Binnaway WTP consists of the following

- Castlereagh River
- Flocculation
- Settling Lagoon
- Filtration
- pH adjustment
- Disinfection
- Fluoridation
- Distribution

2.2.1 Flocculation and Settling Lagoon

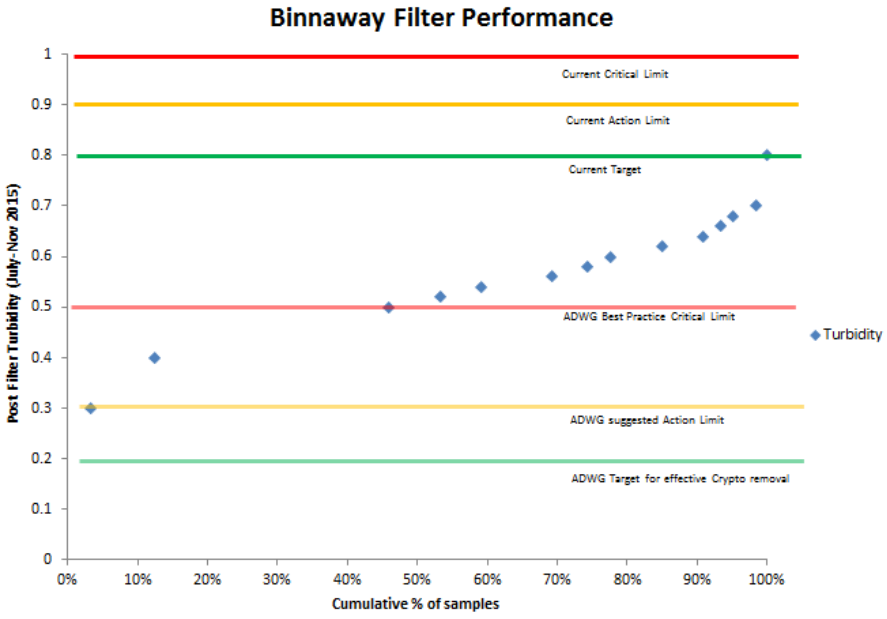
The settling lagoons generally result in good quality water of < 2 NTU turbidity. Ideally, an operational control point could be established to undertake jar tests and confirm the appropriate coagulant dose. The changeover from one settling lagoon to the other should also be based on outlet turbidity – for example, if the optimal coagulant dose is applied, and the turbidity does not reduce below a set point, that can be an indicator to switch lagoons.

2.2.2 Filtration

Filtration at Binnaway is currently operated at a target of 0.8 NTU, with action level at 0.9 NTU and a critical limit of 1.0 NTU. For a surface water scheme, this is not sufficient to provide a barrier against protozoa.

Operationally, the filtration performance at Binnaway is not as good as should be expected given the quality of water coming from the sedimentation lagoon.

Figure 6 Binnaway filtration performance (frequency distribution) July- Nov 2015.



At present, the current turbidity limits do not encourage the operator to take action to optimise filtration performance. These results are from daily grab samples, not online monitoring, so the performance may not actually even achieve this level on a continual basis.

Issues identified:

The filter performance is poor given that the settling lagoons are typically producing water less than 1.5 NTU. At this level entering the filter, best practice filter performance should be achievable for filtered water.

During discussions with the operator, several issues were raised. Firstly, it was noted that filter media is carried over to the lagoon during backwash cycles. In the case of Binnaway, backwash is by water only. This tends to indicate that the backwash flow rate is too high.

The operator also indicated that the backwash cycle uses approximately 40kL per filter, and that the water quality at the end of the backwash is “very clear”. This description raises suspicions that the backwash duration may be too long.

Filter backwash optimisation:

1) Observe the filter backwash cycle and if filter media is being carried over, reduce the flow rate for the backwash until filter media is no longer being lost, but adequate bed expansion and backwashing still occurs.
2) Once the backwash flow rate has been established, measure and plot the turbidity of the backwash water each minute or two throughout the backwash cycle.
   It should be expected that the turbidity will rapidly increase to very high levels (e.g. > 150 NTU) before reducing over the backwash cycle. Ideally, at the end of the backwash cycle, the turbidity will be around 10 NTU. If the turbidity is > 15 NTU, the backwash time should be extended, and if the turbidity is < 5 NTU the backwash time should be reduced to prevent over cleaning.
3) If optimisation of filtration as described is unable to result in a significant improvement in filter performance, the filter media likely needs replacement.
4) If filter media is to be replaced, the underdrains may also need refurbishment. It was noted that the two filters currently drain at different rates.

2.2.3 Disinfection

Disinfection is by chlorine gas, with a target of 2 mg/L, with an alert of 1.5 and a critical limit of 1 mg/L. These are appropriate, but additional high alert and critical limits are proposed to prevent a chemical health related incident.

Chlorine contact time calculation.

The chlorine contact time was calculated for Binnaway, based on the following assumptions:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum flow rate from reservoir = 10 L/s (*assumption*)
- Reservoir volume = 1 000 000 L
- Reservoir minimum operating level = 80%
- Baffling factor in reservoir = 0.1 (no baffling)

Based on these assumptions the chlorine contact time from the chlorine contact tank is **133** min.mg/ L, which ensures effective disinfection.

2.2.4 Fluoridation

The fluoridation plant at Binnaway operates according to the NSW Fluoridation Regulation. However, the CCPs at present have an alert level for fluoride leaving the water fluoridation plant at >1.5 mg/L.

The alert level range is recommended to be changed to <0.9 or > 1.2 mg/L so that operators intervene sufficiently rapidly to ensure that fluoride concentrations remain below the health guideline value. The Critical limits should also be adjusted such that a value >1.4 mg/L results in shutting off the fluoridation plant until the cause of the overdose is identified and rectified, and prior to overdosing.

The fluoridation plant is a saturator type plant, and a minimum volume of sodium fluoride powder is intended to be maintained in the saturator. However, there is a second unknown solid present in the saturator. The volume of the unknown solid is significant, and until it was determined that this solid was not in fact sodium fluoride, the operator was not adding bulk sodium fluoride to the saturator.

In order to attempt to meet the required fluoride dose, the operator turning up the fluoride dosing pump to 100% to try to maintain the correct final concentration. Nonetheless, the water fluoridation plant continued under-dosing. The water treatment plant records demonstrate that the dosing pump was at 100%, but do not provide further details of the issue.

The operator indicated that the problem was resolved when new sodium fluoride was added to the saturator. However, the unknown solid remains in the saturator.

Recommendation: The saturator tank will need to be emptied out and the contents disposed of appropriately. Ideally, the unknown solid should be analysed to determine if it is from a reaction with the source water, or whether it is due to the quality of the bulk chemical being used. Once the nature of the solid is known, appropriate management actions can be taken.

2.2.5 Reservoirs

The following images are from Aqualift. The arrows indicate potential areas for water ingress, or access by vermin.

Figure 7 Possible ingress points near access hatch, Binnaway reservoir

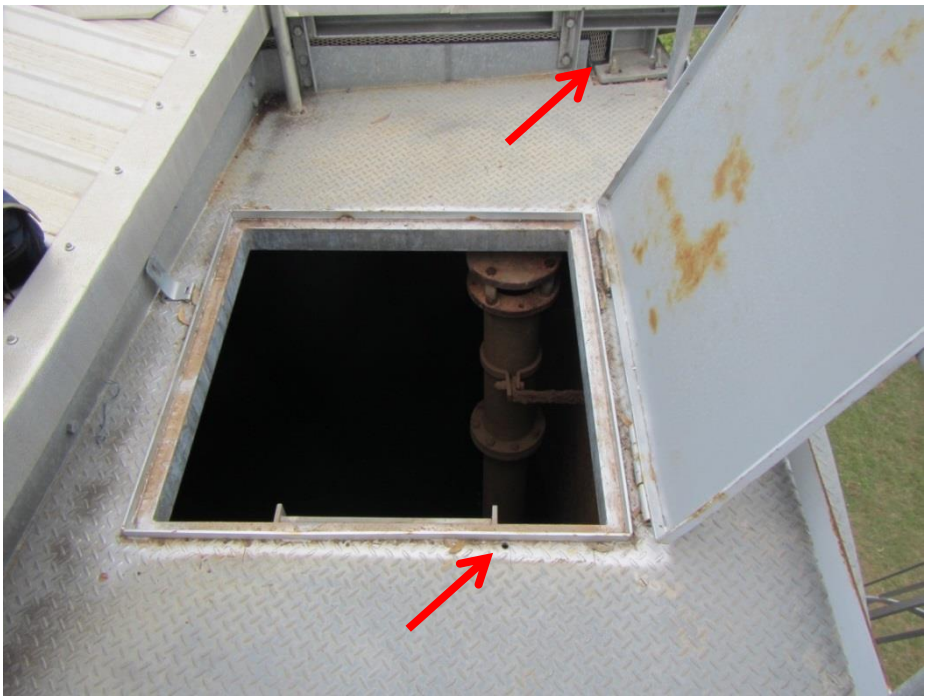
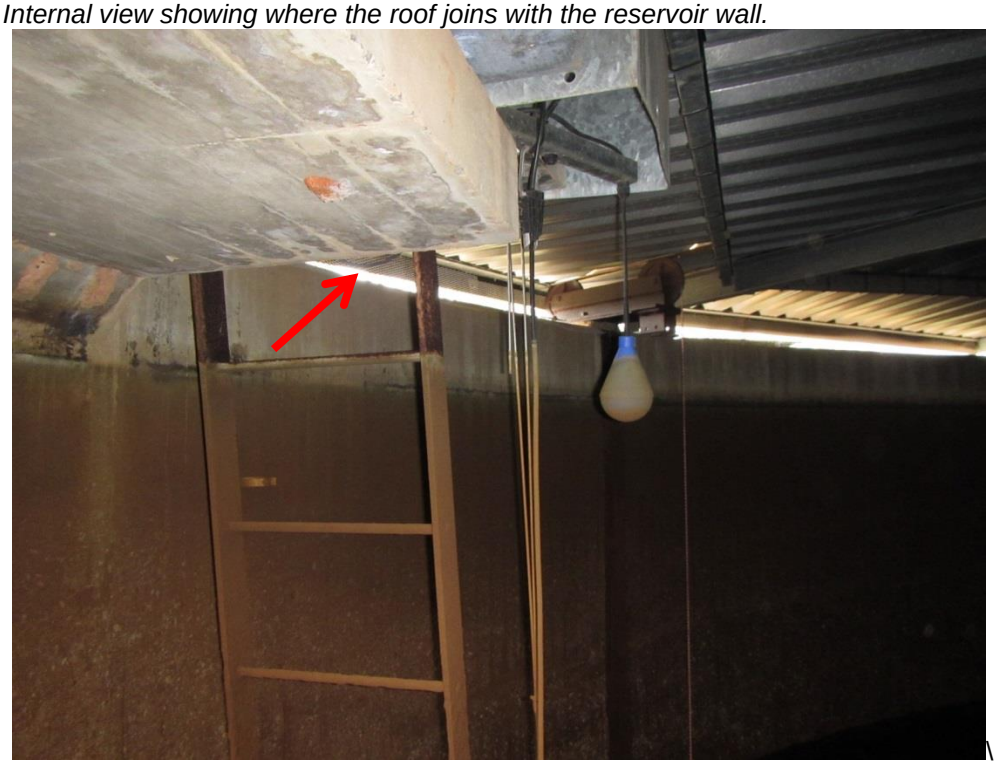
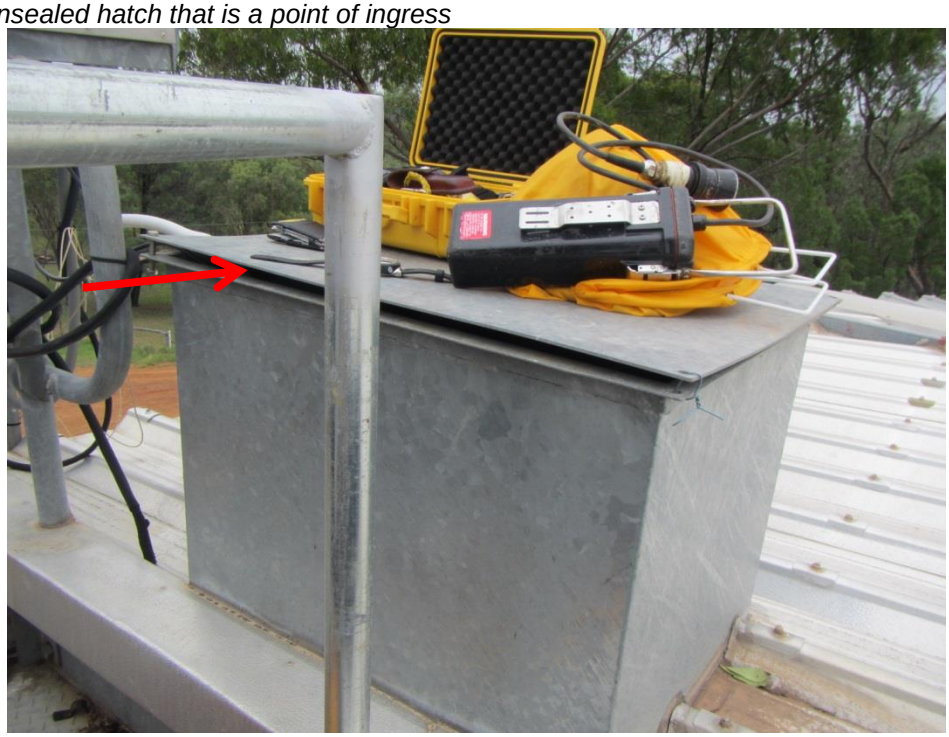


Figure 8 Internal view showing where the roof joins with the reservoir wall.



Note: there is significant light penetration in the image above, and it is not clear that there is adequate vermin proofing. This should be inspected to ensure that there are no points where birds or other vermin can gain entry.

Figure 9 Unsealed hatch that is a point of ingress



2.2.6 Recommendations for Binnaway

Immediate

Discuss fluoridation issues with PHU and/ or DPI Water.

Short term

- Set more challenging filtration CCP limits
- Optimise filtration by investigating backwash flow rate and backwash water quality
- Ensure that the reservoir is adequately sealed from vermin and rainwater cannot wash into reservoir.
- Arrange for cleaning of fluoride saturator (considering the hazardous nature of the material).
- Improve WTP record keeping so that any major plant changes or issues are recorded and can be reviewed at a later date.

Longer term

- Consider need to replace filter media
- Install online turbidity meters for each filter
- Establish an operational control point for the settling lagoon

2.3 Bugaldie

The Bugaldie scheme consists of a single bore that is dosed with sodium hypochlorite before distribution to the community.

2.3.1 Bugaldie Bore

The Bugaldie bore appears to be in a generally in good external condition, however, the underside of the bore cap should be sealed (for example with silicone) to definitively exclude vermin/ contamination.

Figure 10 Bugaldie bore

2.3.2 Chlorination

Chlorination of the Bugaldie scheme is by a single dosing pump, dosing sodium hypochlorite. Ideally, as the scheme is not monitored daily, there should be duty/standby dosing pumps to ensure that that chlorine is dosed continually when the bore is running, and online chlorine monitoring linked to CCP action and critical limits.

Figure 11 Chlorine dosing shed, Bugaldie

Chlorine contact time calculation.

The chlorine contact time was calculated for Bugaldie, based on the following assumptions:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum flow rate from reservoir = 5 L/s (*estimate*)
- Reservoir volume = 17 000 L
  (2 * 8500 L tanks, as stated in DWMS – may only be elevated reservoir.)
- Reservoir minimum operating level = 80%
- Baffling factor in reservoir = 0.3 (two circular tanks in series)

As the chlorination is initially into the ground level tank, and then water is pumped into the elevated tank, the baffling factor has been increased.

Despite the increased baffling factor, the chlorine contact time has been estimated at **13.6** min.mg/ L. This is lower than the required 15 mg.min/L. However if the bore was sealed, this should normally provide adequate disinfection. Note: the maximum flow rate is only an educated guess, and is higher than the 0.6 L/s estimated bore pump rate. If the maximum possible flow is higher, the contact time will be shorter.

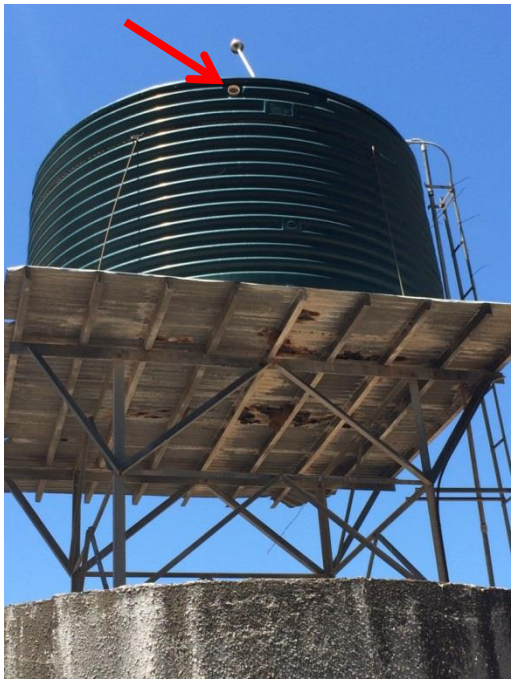
The configuration of the reservoirs should be confirmed as in series, and the volume and maximum flow rate determined. If only one reservoir is in use, the chlorine contact time will be inadequate.

2.3.3 Reservoirs

The Bugaldie elevated polytank gravity feeds to the community. Low water pressure is likely to be an issue in the community, and this can lead to ingress into the water mains at times of high demand. For example, there was an incident in Brisbane where fire-fighting demand led to negative pressures in the reticulation network, and fire-fighting foam was drawn into the reticulation. This example demonstrates the principal that if pressure becomes low enough, any (contaminated) water surrounding the mains can be entrained and distributed.

The elevated tank may not be secure from vermin contamination. For example, the overflow may not be covered, and the hatch and area surrounding the inlet pipe should be inspected. This tank was not a part of the Aqualift inspections, and no other reports are available.

Figure 12 Bugaldie elevated polytank - note the overflow.



2.3.4 Recommendations for Bugaldie

Short term

- Install duty/standby chlorinators
- Establish the maximum flow rate, and confirm chlorine contact times
- Inspect water tank(s), and ensure that they are vermin proofed
- Seal the bore

Long term

- Consider options to improve water pressure to limit risk of ingress into reticulation mains
- Install online chlorine monitoring to ensure chlorination is continuous

2.4 Coolah

The Coolah scheme consists of 2 bores that are chlorinated.

2.4.1 Bores

Figure 13 Abandoned bore – open and uncapped, with direct access to aquifer

Figure 14 Active bore - also unsealed

Figure 15 Bore 2 - well style, and unsecured from vermin access

The Coolah bores require immediate action to seal them and prevent vermin ingress. It is considered almost certain that all 3 bores access the same aquifer, and as such contamination of one will lead to contamination of all bores.

The abandoned bore should be decommissioned, and the active bores properly sealed. As there is no treatment other than disinfection, there is no other barrier to protozoa other than bore integrity.

2.4.2 Disinfection

Disinfection is via gas chlorination of the bore water. Disinfected water enters the rising main to Coolah where it is distributed both directly to consumers, and also to the Wentworth and Martin St Reservoirs.

The chlorination CCP is appropriate except that the chemical health guideline values need to be taken into consideration, and upper action and critical limits put in place.

Chlorine contact time calculation.

The chlorine contact time was calculated for Coolah, based on the reticulation pipework as customers receive water prior to the reservoirs:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum flow rate = 20 L/s (*estimate based on daily demand*)
- Rising main volume = 54 252 L (*2 132 m of 180 mm pipe)*
- Baffling factor = 1 (plug flow)

The chlorine contact time has been estimated at **45** min.mg/ L at the highway.

Note: The chlorine room at Coolah appears to have WHS issues associated with lifting chlorine cylinders into the chlorine room, securing cylinders when in the room. A safety shower is present alongside the chlorine cylinders, but in the event of a chlorine leak, would not be able to be used.

2.4.3 Reservoirs

The following figures are from the Aqualift report.

Figure 16 Martin St Reservoir - note the dead bats near points that are not sealed

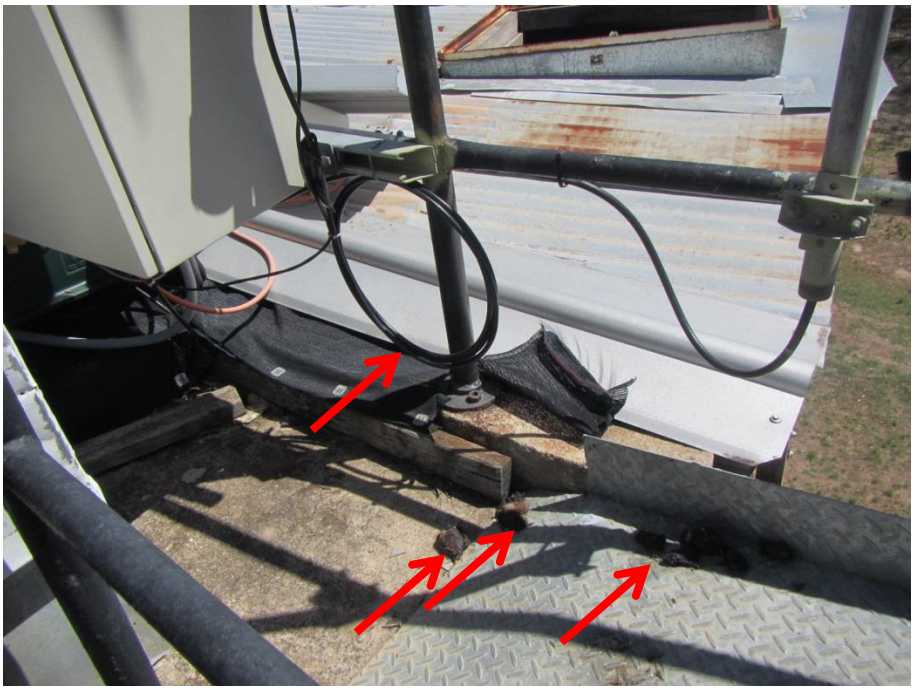


Figure 17 Martin St Reservoir - other points of ingress, and evidence of visible contamination

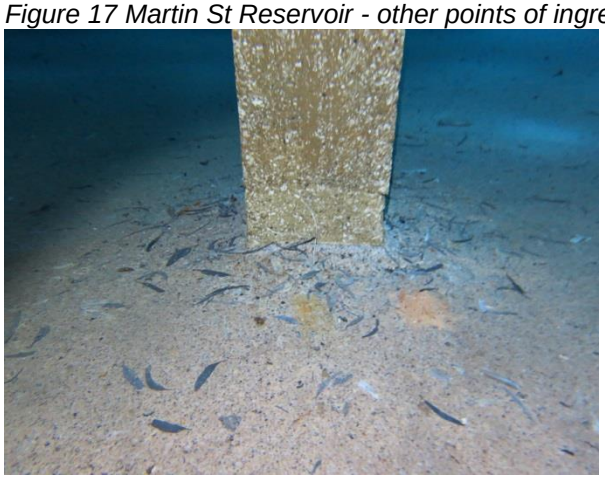


Figure 18 Wentworth Ave 2 Reservoir

Note: In this case, the hatch does not immediately appear compromised, yet, there is a live frog inside the reservoir. This demonstrates the level of rigour required to ensure that reservoirs are effectively vermin proofed.

2.4.4 Recommendations for Coolah

Immediate

- Seal the bores (including covering the abandoned bore)
- Adjust the CCPs to include high level alert and critical limits
- Confirm automatic changeover of chlorine gas cylinders

Short Term

- Decommission the abandoned bore
- Vermin proof the reservoirs
- Install online continuous chlorine monitoring to ensure continual effective disinfection

2.5 Coonabarabran

The Coonabarabran Water Treatment Plant consists of the following

- Surface Water (Timor Dam and Castlereagh River), Bore water backup
- pH adjustment
- Coagulation/Flocculation
- Sedimentation
- Filtration
- Disinfection
- Fluoridation
- Distribution

The Coonabarabran WTP is the largest WTP operated by Warrumbungle Shire Council. Whilst there are options for the water source, the predominant source is Timor Dam.

2.5.1 Sedimentation Lagoons

Raw water is dosed with lime, alum and polymer before entering into 1 of 2 sedimentation lagoons. The sedimentation lagoons are monitored daily for turbidity, but there is no documented control (for example, there is no documented action limit for undertaking jar testing and adjusting the alum dose). Further, other than ~18 months, there is no trigger for changing between lagoons.

Ideally, an operational control point should be developed for the operation of the sedimentation lagoons. This would introduce action limits on water quality that would require actions such as jar testing, optimising the alum and polymer dose rates, and for when to switch between lagoons.

2.5.2 Filtration

There are 2 sand filters at Coonabarabran WTP. These filters are not currently operated with a water quality trigger, rather based on time of operation. Backwash of the filters is based on time (30 hrs of run time) or headloss, with a trigger of 2.4m, but not on water quality. The filtration CCP should define a water quality backwash trigger that is appropriate for ensuring protozoan removal.

There is an online turbidity meter present on the combined filter outlet, but this is not currently visible in SCADA to provide turbidity readings to the operator. This instrument should be fully commissioned immediately.

The performance of the sedimentation lagoons and filters is plotted overleaf, along with the current CCP limits, and proposed improved CCP limits.

Analysis of water quality data:

1) There is a distinct step function in the data where both the settled and treated water turbidity have significantly reduced (between the 17th and 18th March 2014).
2) The CCP limits for filtration are well above what has been achieved for the past 3 years, with the current action limits only being exceeded in 2 events.
3) Based on data post 18 March 2014, an action limit of 0.3 NTU, which will improve operation to near best practice, can be achieved for > 85% of the time without impacting operations.

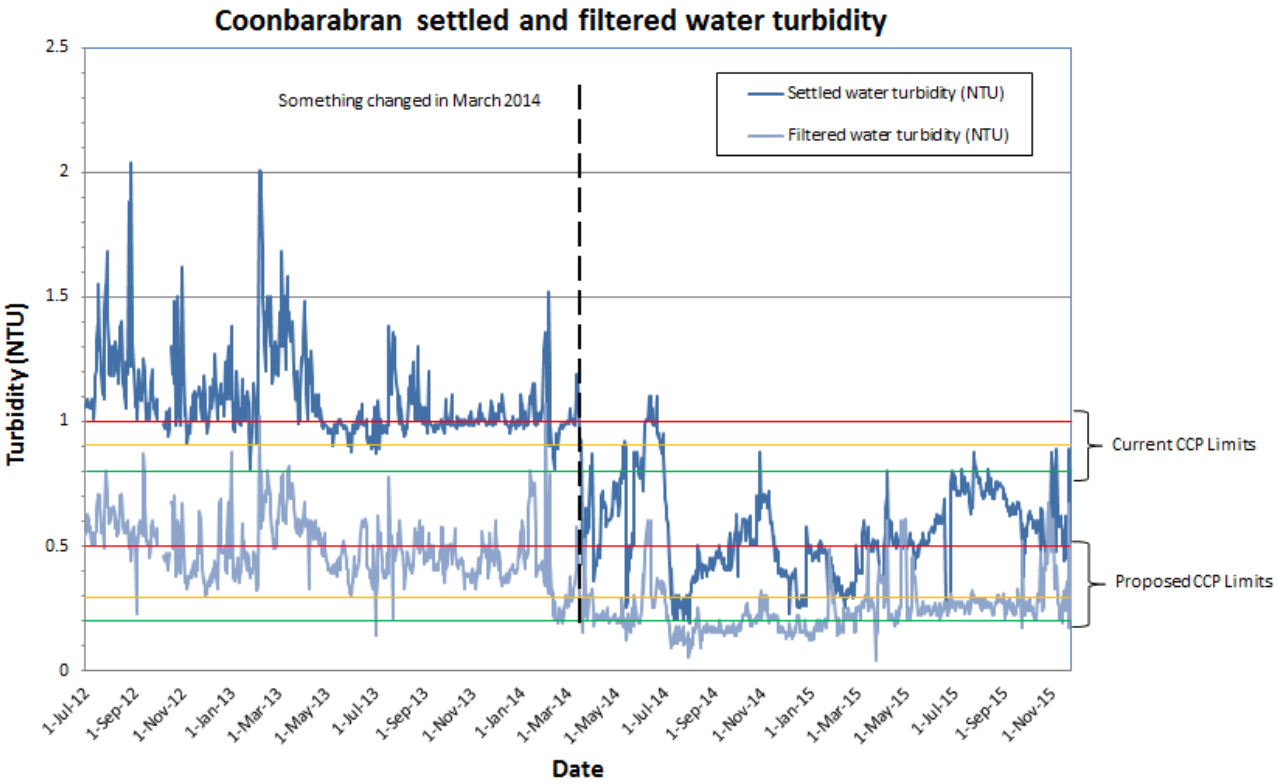
Note: The relevant Supervisor was requested to provide specific information regarding the change in operation that has resulted in the distinct change in turbidity between 17th and 18th March 2014, and it was suggested to Council that this may have been due to either a change in sedimentation lagoon, or

a calibration of the turbidity meter. No specific cause was identified, and it is not known when the lagoons were last switched.

However, as it is stated that the lagoons are switched approximately every 18 months, this is the working assumption used in the analysis below. It is further noted that plant records should have recorded the details of any change of such nature. Written records should identify all significant changes in operation as a matter of course. For example: when there was a change in turbidity meter, or when the lagoons were switched.

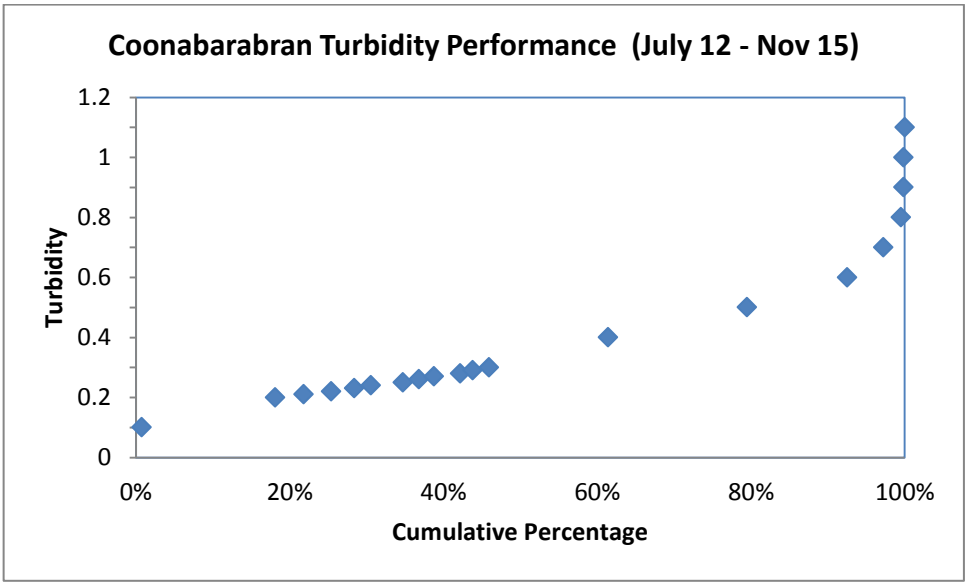
Assuming that the lagoons were switched, this demonstrates that when operating as designed, the sedimentation lagoons can achieve very high quality water. It is also noted that the general trend from January 2015 onwards is that the settled water turbidity is gradually increasing, probably indicating that the time to change lagoons is approaching.

Figure 19 Settled and filtered water quality data from plant records



Further analysis - Plant records should be examined in detail to identify specific changes. For example, when did jar tests take place, and are the changes in settled water quality reflective of changes in alum dose rate (it appears that this may possibly be the case around ~28 June 2014, 8 Nov 2014). If so, Figure 19 also demonstrates how better control of the sedimentation process could lead to better water quality outcomes.

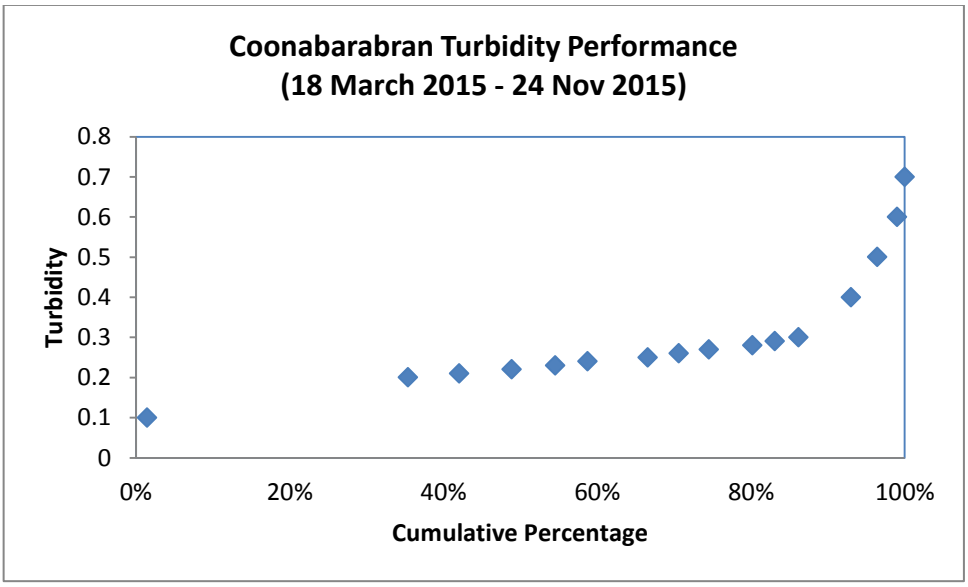
Figure 20 Frequency distribution of daily turbidity measurements – Full dataset



Note: At the current target limit of 0.8 NTU, *99.51% of all data points are below the target limit*.

It appears that the current filtration target is set so as to not require operator intervention based on water quality.

Figure 21 Frequency distribution of daily turbidity (restricted timeframe)



67% of all data since March 2015 are less than 0.25 NTU. A target of 0.2 NTU may be appropriate. 86% of results are below 0.3 NTU, indicating that a backwash initiated on water quality at 0.3 NTU may be appropriate.

A critical limit of 0.5 NTU would only have been exceeded in 3.6% of samples.

Note: The proposed limits are based off single daily grab samples, not online data demonstrating continuous plant performance. There is an online (combined) turbidity meter installed, but is not currently used to monitor plant performance.

Recommendation: The current combined turbidity meter should be brought online, and continuous data then analysed to determine appropriate filtration limits. The turbidity meter should subsequently be used for control of the CCP.

2.5.3 Disinfection

The current disinfection limits are set with a target of 2 to 5 mg/L. This ensures effective disinfection, but does not manage the chemical risk. There are currently no upper CCP limits, and this could result in chlorine overdosing.

The target limit should be adjusted to include an upper target, action and critical limits that are less than the health guideline value of 5 mg/L.

The chlorine contact time was calculated for Coonabarabran, based on the following assumptions:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum flow rate from reservoir = 95 L/s
- Reservoir volume = 2 500 000 L
- Reservoir minimum operating level = 75%
- Baffling factor in reservoir = 0.1 (no baffling)

The chlorine contact time has been estimated at **33** min.mg/ L, using the maximum plant flow, and minimum operating volumes, and lower critical chlorine concentration. Coonabarabran has sufficient contact time. However, as shown in Section 2.5.5 there are significant points of ingress near the town water pumps that could allow vermin to contaminate the clear water tank directly at the point where water is distributed.

2.5.4 Fluoridation

The fluoridation plant at Coonabarabran operates according to the NSW Fluoridation Regulation. However, the CCPs at present have an alert level for fluoride leaving the water fluoridation plant at >1.5 mg/L, potentially allowing a fluoride overdose.

The alert level range is recommended to be changed to <0.9 or > 1.2 mg/L so that operators intervene sufficiently rapidly to ensure that fluoride concentrations remain below the health guideline value. The Critical limits should also be adjusted such that a value >1.4 mg/L results in shutting off the fluoridation plant until the cause of the overdose is identified and rectified.

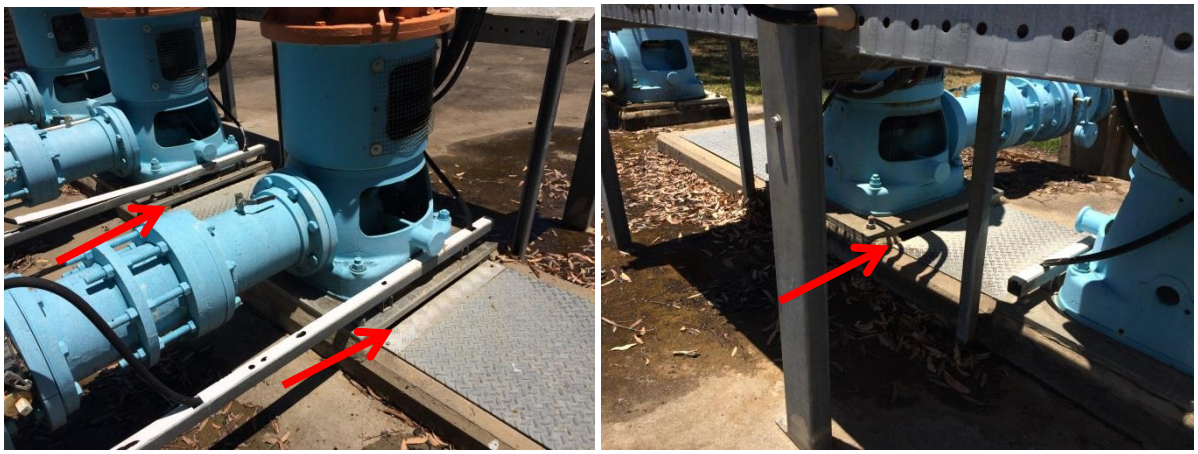
2.5.5 Clear Water Tank and Reservoirs

Treated water passes into the clear water tank where it is subsequently pumped to the Coonabarabran reticulation and reservoirs. The clear water tank is predominantly an underground tank, slightly elevated above ground level.

The clear water tank has multiple points of ingress, including the access hatch, and on the elevated platforms where the pumps are located. These points of ingress need to be sealed to prevent contamination of the treated water.

Figure 22 Entry hatch to clear water tank - unsealed.

Figure 23 Vermin access points near distribution pumps



Subsequent images are from the Aqualift report, and demonstrate that the Oxley Highway and Rifle Range reservoirs require actions to ensure that water is not contaminated.

Figure 24 Oxley Hwy Reservoir - hatch not properly sealed, debris ponding, and possible hole in vermin proofing

Figure 25 Rifle Range Reservoir 1

Note, a) there are gaps around the access ladder, b) there is evidence of ponding and possible holes in the vermin proofing near the hatch, c) there is significant leaf matter accumulating on the roof (poor draining off the roof is likely to lead to rust holes in the longer term), and d) the vermin mesh is not secured in all locations, and the ridges of the roof appear to allow access into the reservoir.

Figure 26 Rifle Range 2 – similar potential areas of ingress

Note the gaps where the section of roof capping is missing, and around the edges of the old access hatch.

2.5.6 Recommendations for Coonabarabran

Short Term

- Commission the turbidity meter to allow online monitoring of the filters
- Lower CCP limits for turbidity with water quality triggers
- Seal all points of ingress into the clear water tank
- Establish integrity of all reservoirs

Longer Term

- Establish an operational control point for the sedimentation lagoons
- Ensure continual chlorine monitoring is used to control the chlorination CCP.

2.6 Dunedoo

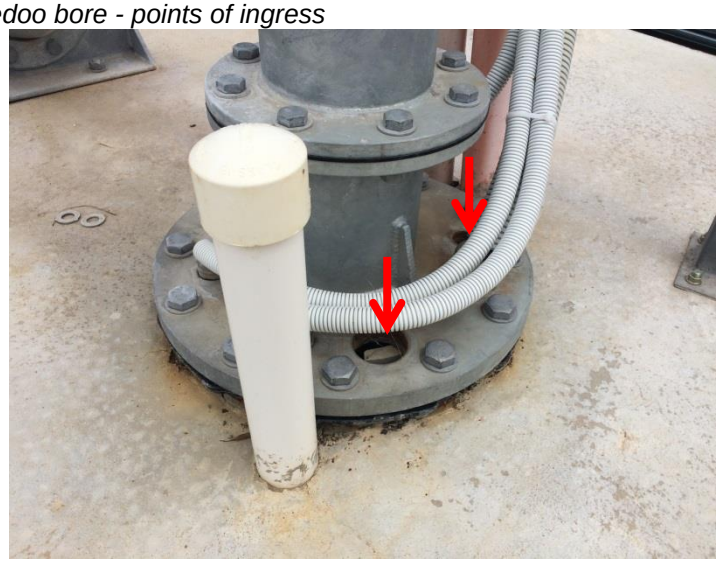
Dunedoo consists of 2 bores that are chlorinated prior to distribution.

2.6.1 Bores

The Dunedoo bores are not completely sealed.

Further, the original “well” in the WTP building is completely open, and is assumed to access the same aquifer. The “well” appears to be both a WHS issue as well as allowing direct contamination of the aquifer. Whilst it will be difficult to seal the well, failure to do so represents an unacceptable risk.

Figure 27 New Dunedoo bore - points of ingress



2.6.2 Disinfection

Disinfection at Dunedoo is via sodium hypochlorite using a single dosing pump with daily testing of chlorine residuals in the reticulation.

Chlorine contact time calculation.

The chlorine contact time was calculated for Dunedoo, based on the reticulation pipework as ~6 customers receive water prior to Bullinda St Reservoir:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum flow rate = 33 L/s (*estimate based on daily demand and pump hours*)
- Rising main volume = 44 532 L (*1750 m of 180 mm pipe)*
- Baffling factor = 1 (plug flow)

The chlorine contact time has been estimated at **22.5** min.mg/ L before the Bullinda St Reservoir. As the houses that take water from the rising main are located close to the reservoir, the contact time is considered adequate. Note, the reservoir itself, as it has a baffling factor of 0.1 only adds an additional 3 min.mg/L at this estimated maximum flow rate.

2.6.3 Reservoirs

The Bullinda St Reservoir has recently been re-roofed. In general the sealing is a vast improvement on the previous roof, but as the contractor has indicated his willingness to seal all access points, this should be undertaken. Each of the overlapping plates should be inspected to ensure that there are no points where water can wash in, or vermin could access the reservoir.

Figure 28 New Roof on Bullinda St Reservoir - some potential access points remain

The Rhodes St reservoirs require further attention. There is evidence of birds nesting, dead frogs, and faeces inside these reservoirs. There are clear access points for vermin to enter these reservoirs.

Figure 29 Rhodes St Reservoir #1

Figure 30 Rhodes St #2

2.6.4 Recommendations for Dunedoo

Short term

- Seal the bores
- Vermin proof the reservoirs
- Implement high level action and critical chlorine limits in the CCP
- Install duty/ standby chlorine dosing pumps

Longer Term

- Decommission the old well in the WTP building
- Install continuous online chlorine monitoring to ensure continual effective disinfection

2.7 Kenebri

The Kenebri scheme is similar to Bugaldie, as it is a single bore with chlorine disinfection.

2.7.1 Bore

The Kenebri bore is not sealed to prevent vermin or water runoff to enter the bore.

Figure 31 Kenebri Bore

2.7.2 Disinfection

Disinfection is achieved using sodium hypochlorite with a single dosing pump.

The chlorine contact time was calculated for Kenebri, based on the following assumptions:

- Minimum chlorine concentration (lower CCP limit) = 1.1 mg/L
- Maximum flow rate from reservoir = 5 L/s (*estimate only*)
- Reservoir volume = 22 000 L (2 * 11 000 L tanks)
- Reservoir minimum operating level = 80%
- Baffling factor in reservoir = 0.1 (if in parallel)

If the two tanks operate in parallel, the baffling factor is only 0.1, and the chlorine contact time has is only **6.4** min.mg/ L. Note: the maximum flow rate is only an educated guess. However, the flow rate would need to be <1 L/s to achieve an acceptable contact time.

An alternate solution would be to reconfigure the two tanks to operate in series. This could lead to a higher baffling factor (0.3) and the contact time would then be **19.4** min.mg/ L.

2.7.3 Reservoirs

The twin tanks on the elevated stand at Kenebri were not inspected as part of the Aqualift report. These tanks should be inspected to ensure that they are vermin proofed as it appears that parts of the roofs may not be secured completely, and the corrugations should be inspected to ensure that no vermin can gain access under the corrugations. In many other cases, access hatches and inlet pipework is not vermin proofed, so these items should also be checked. These are not visible from the ground.

Figure 32 Kenebri elevated water tanks

2.7.4 Recommendations for Kenebri

Short Term

- Seal the bore head to prevent ingress
- Inspect and secure the elevated tanks from contamination
- Determine the configuration of the tanks, and reconfigure to be in series if possible to increase chlorine contact time.
- Install duty/standby chlorine dosing pumps

Long Term

- Install online chlorine monitoring to ensure continual effective disinfection

2.8 Mendooran

The Mendooran water supply consists of the following:

- River water or Bore water (Bore not inspected)
- Flocculation
- Permanganate
- Sedimentation Lagoons
- Filtration
- Disinfection
- Distribution

2.8.1 Raw water

The Mendooran community uses septic systems, and it is believed that there have been some poor practices where some septic systems may have been emptied by drilling through to allow the effluent to seep into the aquifer. Some testing was undertaken in conjunction with NSW Health, but no final report has been prepared. Ideally the water quality data should be fully analysed, and the selection of raw water made an operational control point.

2.8.2 Chemical dosing

Raw water is dosed with permanganate and PACl to remove Mn and commence flocculation/ sedimentation. Dosing is by duty standby pumps, providing good redundancy.

2.8.3 Sedimentation Lagoons

The sedimentation lagoons appear to be producing good quality water, generally around 0.8 NTU. Nonetheless, the performance of the lagoons could be analysed and used to develop operational control point for enhanced management. For example, when to undertake jar tests, and when to change between lagoons.

2.8.4 Filtration

The filtration performance of the Mendooran treatment plant is currently producing very high quality water. There is online monitoring of the filtered water, but this signal is not used for control. Backwashes are currently initiated on time (~18 hours of run time), but should also be backwashed on a turbidity trigger.

It was described that a target of 0.2- 0.25 NTU is likely to be achievable currently; therefore, the best practice target of <0.15 NTU may also be possible with improvements to operational practice.

At present it is recommended to lower the target initially to <0.3 NTU, with an action limit (automated backwash) at 0.35 NTU. If this is able to be achieved with minimal change to operations, the tighter limits should be adopted.

The reason for not adopting the tighter limits immediately is that the current targets are based on daily measurements, not online continuous measurements. The change to continual online performance monitoring will subsequently identify whether the tighter limits are achievable.

2.8.5 Disinfection

Sodium hypochlorite is dosed using duty/ standby pumps from a batch tank. The bulk solution (2000L of bulk hypochlorite is diluted to 5000L), but currently there is poor mixing of the solution, leading to drifting concentrations for the first day after batching. A mixer for the sodium hypochlorite tank should resolve this issue.

The CCP limits for disinfection should also be amended to include upper chlorine limits to prevent chemical overdosing.

The chlorine contact time was calculated for Mendooran, based on the following assumptions:

- Minimum chlorine concentration (lower CCP limit) = 1 mg/L
- Maximum flow rate from reservoir = 10 L/s *(estimated plant flow)*
- Clear water tank volume = 100 000 L
- CWT minimum operating level = 80%
- Baffling factor in reservoir = 0.1 (no baffling)

The chlorine contact time has been estimated at **13** min.mg/ L, using the maximum plant flow, and minimum operating volumes, and lower critical chlorine concentration. This is low, but additional contact time will occur in the reticulation mains.

There are some customers that receive treated water directly from the water plant before the Coolabah reservoirs. These are the customers who receive water with the least contact time. There is additional contact time in the Coolabah and Standpipe reservoirs, and additional chlorination points described in the management plan (not inspected). These will ensure that customers after the distribution reservoirs have adequately disinfected water.

2.8.6 Reservoirs

The major issues at Mendooran relate to the potential for ingress of vermin into the clear water tank and reservoirs.

The clear water tank at the WTP has potential ingress points at each ridge, and the entry hatch should be inspected to ensure that nothing can enter.

Figure 33 Mendooran clear water tank roof

The following images are from the Aqualift report.

Figure 34 Standpipe Reservoir potential ingress points, and evidence of contamination

Figure 35 Coolabah Reservoirs 1-3 points of ingress and contamination evidence (animal bones)

Note the tree adjacent to the unsealed hatch on the reservoir, allowing easy access to vermin onto the reservoir.

2.8.7 Recommendations for Mendooran

Short Term

- Inspect the bore and ensure integrity
- Lower CCP limits for turbidity with water quality triggers for backwash
- Seal all points of ingress into the clear water tank
- Establish integrity of all reservoirs

Longer Term

- Establish an operational control point for the sedimentation lagoons
- Ensure continual chlorine monitoring is used to control the chlorination CCP.

3 CCP CHANGES

The Critical control points for all schemes were reviewed, and draft CCPs are included in Appendix B.

The primary changes to the CCPs include:

- Lowering turbidity targets and action limits to ensure filtration is operated as a barrier to protozoa.
- Inclusion of upper chlorine limits to ensure that the 5 mg/L health guideline for chlorine is not exceeded.
- Amendment of the fluoride limits so that corrective actions are taken prior to exceeding 1.5 mg/L.
- The reservoir CCP was amended to remove the action limit, and treat any potential point of contamination as a critical limit. The caveat to this is that at the current time, most reservoirs should be treated as critical as there are obvious points of ingress that need to be addressed as soon as possible.
- Inclusion of communication protocols into the CCP document to ensure that exceedances of action and critical limits are routinely informed to the Manager.

4 EMERGENCY RESPONSE PLAN

A draft Emergency Response Plan has also been provided to Council for consideration. The plan defines three levels that are linked to the CCP action and critical limits. A draft stakeholder list has been generated that needs to be populated by Council for each scheme so that key customers can be informed as soon as possible.

The stakeholder list includes key regulatory contacts, media contacts, vulnerable customers, chemical and equipment suppliers and scheme based tradespeople that can be engaged to rectify problems as required.

The NSW Health Protocols are included in the emergency response plan and define the actions that will be taken on detection of an incident.

Draft boil water alert and do not drink alert templates have been prepared and branded to Warrumbungle Shire Council so that they are as close as ready to be implemented as possible if they are required.

The ERP requires Council to complete contact details, and the draft is provided in Appendix C.

5 CONCLUSIONS

The primary risks to public health in Warrumbungle Shire relates to the bacterial, viral and protozoan hazards.

These can be summarised as follows:

- Bores are not sealed to prevent ingress of vermin/ contaminants
- Filtration limits are not stringent enough to ensure removal of protozoa from the source water.
- Chlorine contact times are not sufficient in all schemes that all customers receive water that is adequately disinfected.
- Reservoir integrity is poor, allowing contamination of treated water – there is evidence that birds, frogs and lizards enter into many reservoirs.

Whilst the chlorine residual in each scheme is generally maintained at suitable levels, the ongoing contamination of reservoirs is likely being masked.

The Department of Primary Industries issued Circular LWU 18 in June 2014 as a result of repeated *E. coli* detections across the state that related to breaches of integrity and failure to maintain adequate chlorine residuals. Utilities are required to meet the requirements of this circular.

Council has engaged Aqualift to inspect and report on the condition of the reservoirs and actions are being taken to seal hatches, and secure reservoirs from vermin. The priority of these actions should be increased, and all points of ingress sealed as an urgent requirement. Temporary actions such as expanding foam or silicone sealants should be used in the short term to seal bores and reservoirs ahead of any infrastructure solutions.

Note: The Baradine Clear Water Tank is significantly compromised.

Council should discuss the management of the Baradine Scheme with the local PHU on the basis that the clear water tank does not provide sufficient contact time for effective disinfection, and the likelihood of vermin entering the clear water tank is almost certain.

It is the opinion of Bligh Tanner that this scheme presents an unacceptable current public health risk.

Appendix A

Effective Disinfection

Disinfection is required to ensure that pathogenic viruses and bacteria are effectively inactivated.

Where a chemical disinfectant is used, the effectiveness is the product of the chlorine concentration and the time that the disinfectant has available to react. This is expressed mathematically as

$$c.t = [Cl] \times time$$

where [Cl] is the concentration of chlorine, and *c.t* is the contact time.

The Australian Drinking Water Guidelines (Information Sheet 1.2) references the World Health Organisation (2011) recommendation that a disinfectant concentration of 0.5 mg/L should be maintained for 30 minutes. In this case c.t > 15 mg.min/L is considered sufficient to deactivate bacterial and viral pathogens.

Note: DPI Water Circular LWU 18 also requires that providers ensure effective disinfection with a c.t of >15 mg.min/L.

Consider a reservoir (or clear water tank); the time that the disinfectant has to react depends on both the volume, and the flow rate through the reservoir.

$$t = \frac{volume}{flow\ rate}$$

However, this assumes that the water is evenly mixed throughout the reservoir, and that there is no short circuiting. In practice this is not true, and the USEPA provides guidance that the time T_{10} should be used. T_{10} is defined as the time it would take for a tracer to reach 10% of the initial concentration.

T_{10} can be determined using computerised flow dynamic modelling, measured using tracer studies, or an empirical baffling factor applied. In the case of Warrumbungle Shire, it is appropriate to use an empirical baffling factors.

Table 1. Baffle factor definitions (taken from *USEPA Guidance Manual for Disinfection Profiling and Benchmarking*).

Contact Tank Type	Tank Description	Baffle Factor
Un-baffled (mixed flow)	None, agitated basin, very low length to width ratio, high inlet and outlet flow velocities. Can be approximately achieved in flash mix tank.	0.1
Poor	Single or multiple un-baffled inlets and outlets, no intra-basin baffles.	0.3
Average	Baffled inlet or outlet with some intra-basin baffles.	0.5
Superior	Perforated inlet baffle, serpentine or perforated intra-basin baffles, outlet weir or perforated launders.	0.7
Perfect (plug flow)	Very high length to width ratio (pipeline flow), perforated inlet, outlet and intra-basin baffles.	1.0

When compared to tracer studies, these baffling factors are considered inaccurate, and often overestimate the baffling effect. With that in mind, where no specific baffling is known to have been incorporated into the chlorine contact tank (or reservoir) design, a baffling factor of 0.1 has been applied as a conservative estimate.

Further, it is necessary to consider the *worst case* disinfection scenario. Thus the c.t. calculation is made with the following assumptions:

[Cl] = the lower critical limit (i.e. the lowest allowable concentration)

Volume = the *lowest operating level* of the reservoir (e.g. 80% of physical volume)

Flow rate = maximum flow rate though the reservoir

$$c.t = critical\ [Cl] \times \left(\frac{minimum\ operating\ volume\ of\ reservoir}{maximum\ flow\ rate}\right) \times baffling\ factor$$

If the c.t is less than 15 mg.min/L then disinfection may be ineffective.

LWU Circular 18 provides some advice that protected groundwater may not require disinfection, and as such, Kenebri and Bugaldie *could* be considered exempt from the requirement to achieve a contact time of 15 mg.min/L.

In the opinion of Bligh Tanner, these groundwater sources are currently not sufficiently protected as the bores themselves are not properly sealed from water and/or vermin ingress, and effective disinfection is currently required to ensure the safety of these supplies.

Scheme	Calculated contact time (mg.min/L)
Baradine	**2.6**
Binnaway	133
Bugladie	**13.6**
Coolah	45
Coonabarabran	33
Dunedoo	22.5
Kenebri	**6.5**
Mendooran	**13**

Appendix B – Critical Control Points

Critical Control Points Reference Guide – Warrumbungle Shire Council

Baradine

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Baradine	BDN1	Filtration	All pathogens	Turbidity	<0.2 NTU	>0.4 NTU	>0.8 NTU
	BDN2	Disinfection (gas)	Chlorine sensitive pathogens	Chlorine	1.4 – 1.5 mg/L	<1.2 mg/L, >2.0 mg/L	<0.8 mg/L, >4.0 mg/L
	BDN3	Fluoridation	Fluoride	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	<0.9 mg/L or >1.1 mg/L (calculated daily concentration) OR <0.9 mg/L or > 1.2 mg/L measured concentration	>1.5 mg/L (calculated daily concentration) OR >1.4 mg/L (concentration leaving reservoir)
	BDN4	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	BDN5	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	0.8 mg/L	<0.5 mg/L, >2.0 mg/L	<0.2 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Baradine
CCP ID	BDN1
What is the control point?	Filtration
What are the hazards?	All pathogens
What is being monitored?	Turbidity
What will initiate response?	High turbidity reading (from grab sample)

Target <0.2 NTU	**Alert Level** >0.4 NTU	**Critical Limit** >0.8 NTU
Monitoring Systems Monitoring parameter: Turbidity Monitoring location: Outlet of filter Monitoring frequency: Daily grab sample • Backwashing filters (time based) • Visual inspection of filters (daily) • Hose down filter whilst backwashing (as required) • Pressure cleaning of filters (annually) • Calibration of turbidity meter (intervals) Associated routine checks: • Coagulation/clarification monitoring (daily) • Visual inspection of clarifier floc and inspection of the blowers (interval)	**Corrective actions** • Check filter operation (visual) • resample and test • if resample fails, instigate backwash • Check settled water turbidity - check PACl dosing - jar tests (as necessary) - adjust PACl/polymer doses accordingly • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Investigate cause (e.g. poor clarification) • Follow directions from Manager, such as - reduce flow rate through filters - check reticulation for chlorine residual and turbidity - adjust PACl rate if required - Microbiological sampling - Increase chlorine dose • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Consider instigating a boil water alert

Water Supply System	Baradine
CCP ID	BDN2
What is the control point?	Disinfection (gas)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 1.4 – 1.5 mg/L	**Alert Level** <1.2 mg/L, >2.0 mg/L	**Critical Limit** <0.8 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Leaving WTP Monitoring frequency: Daily • Daily chlorine residual testing (leaving plant) • Calibration of chlorine analyser (intervals) • Check rotameter • Check auto change over • Check bottles aren't empty • Arrange new bottle when duty is empty	**Corrective actions** • Check rotameter • Check for gas line leaks • Check bottles aren't empty • Manual change over (if required) • Check injector • Check service water and head unit • Increase/decrease chlorine dose - Re-check residual (after time) • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • If disinfection is compromised, consider need for a boil water alert

Water Supply System	Baradine
CCP ID	BDN3
What is the control point?	Fluoridation
What are the hazards?	Over or under-dose of fluoride
What is being monitored?	Fluoride concentration (daily sampling at WFP and reservoir, daily concentration calculation)
What will initiate response?	Low or high fluoride concentration

Target Leaving WFP, leaving reservoir and throughout distribution system =1.0 mg/L	**Alert Level** Calculated daily concentration <0.9 or >1.1 mg/L OR Measured Concentration <0.9 mg/L or >1.2 mg/L)	**Critical Limit** Calculated daily concentration >1.5 mg/L OR Concentration leaving reservoir >1.4 mg/L
Monitoring Systems Monitoring parameter: Fluoride Monitoring location: Monitoring out of the plant, out of the reservoir and throughout distribution system Monitoring frequency: Daily/weekly (as below) • Visual inspection of fluoridation system (interval) • Calibration of fluoride analyser (intervals) • Raw water testing as required • Daily measurement of volume treated and weight fluoride dosed with calculation of average daily fluoride concentration • Daily testing at outlet to water filtration plant and outlet from clear water storage reservoir • Weekly testing in distribution system	**Corrective actions** • Confirm calculations or re-sample and test • Conduct pump drop tests • Confirm current WTP flow rate and fluoride dosing rate • Test concentration leaving WFP more frequently • Consider temporarily shutting down fluoride dosing system • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, (via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Shut down fluoride dosing system. • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow directions from Manager - Refer to Emergency Response Plan - Test fluoride in reservoirs and reticulation - Identify cause & rectify problem • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453)

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Baradine
CCP ID	BDN3
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Baradine
CCP ID	BDN4
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 0.8 mg/L	**Alert Level** <0.5 mg/L or >2.0 mg/L	**Critical Limit** <0.2 mg/L or >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Bugaldie

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Bugaldie	BUG1	Disinfection (Hypo)	Chlorine sensitive pathogens	Chlorine	1.8 – 2.0 mg/L	< 1.3 mg/L >2.5 mg/L	< 1.0 mg/L, >4.0 mg/L
	BUG2	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	BUG3	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	1 mg/L	< 0.4 mg/L >2.5mg/L	< 0.2 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Bugaldie
CCP ID	BUG1
What is the control point?	Disinfection (hypo)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 1.8- 2.0 mg/L	**Alert Level** <1.3 mg/L, >2.5 mg/L	**Critical Limit** <1.0 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Off elevated reservoir outlet Monitoring frequency: Weekly • Chlorine residual testing • Calibration of instrument (intervals) • Check chlorine batch tank • Check pumps	**Corrective actions** • Check chlorine batch tank • Check pumps, dosing lines and point of injection • Check strength of hypochlorite tank - Order new hypo if strength is too low • Increase/ decrease chlorine dose - Re-check residual (after time) • Visual inspection of reservoir • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Microbiological sampling and testing • If disinfection is compromised, consider need for a boil water alert

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions to ensure integrity.

Water Supply System	Bugaldie
CCP ID	BUG2
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Bugaldie
CCP ID	BUG3
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 1.0 mg/L	**Alert Level** <0.4 mg/L or >2.5 mg/L	**Critical Limit** <0.2 mg/L or >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Binnaway

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Binnaway	BWY1	Filtration	All pathogens	Turbidity	<0.6 NTU	>0.8 NTU	>1.0 NTU
	BWY2	Disinfection (gas)	Chlorine sensitive pathogens	Chlorine	1.8 mg/L - 2.0 mg/L	<1.5 mg/L, >2.5 mg/L	<1 mg/L, > 4.0 mg/L
	BWY3	Fluoridation	Fluoride	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	<0.9 mg/L or >1.1 mg/L (calculated daily concentration) OR <0.9 mg/L or > 1.2 mg/L measured concentration	>1.5 mg/L (calculated daily concentration) OR >1.4 mg/L (concentration leaving reservoir)
	BWY4	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	BWY5	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	0.8 mg/L	< 0.5 mg/L, >2.5 mg/L	< 0.2 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Binnaway
CCP ID	BWY1
What is the control point?	Filtration
What are the hazards?	All pathogens
What is being monitored?	Turbidity
What will initiate response?	High turbidity reading (online or from grab sample)

Target <0.6 NTU	**Alert Level** >0.8 NTU	**Critical Limit** >1.0 NTU
Monitoring Systems Monitoring parameter: Turbidity Monitoring location: Outlet of filter Monitoring frequency: Daily grab sample • Backwashing filters (time based) • Visual inspection of filters (daily) • Hose down filter whilst backwashing (as required) • Pressure cleaning of filters (annually) • Calibration of turbidity meter (intervals) Associated routine checks: • Coagulation/clarification monitoring; visual inspection of floc in lagoon (daily) • Inspection of the blowers (interval)	**Corrective actions** • Check filter operation (visual) • resample and test • if resample fails, instigate backwash • Check settled water turbidity - check alum dosing - jar tests (as necessary) - adjust alum dose accordingly • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Investigate cause (e.g. poor clarification) • Follow directions from Manager, such as - reduce flow rate through filters - check reticulation for chlorine residual and turbidity - adjust alum dose if required - Microbiological sampling - Increase chlorine dose • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Consider instigating a boil water alert

Water Supply System	Binnaway
CCP ID	BWY2
What is the control point?	Disinfection (gas)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 1.8 – 2.0 mg/L	**Alert Level** <1.5 mg/L, >2.5 mg/L	**Critical Limit** <1.0 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Leaving WTP Monitoring frequency: Daily • Daily chlorine residual testing (leaving plant) • Calibration of instrument (intervals) • Check rotameter • Check auto change over • Check bottles aren't empty • Arrange new bottle when duty is empty	**Corrective actions** • Check rotameter • Check for gas line leaks • Check bottles aren't empty - manual change over (if required) • Check injector • Check service water and head unit • Increase/decrease chlorine dose • Re-check residual (after time) • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • If disinfection is compromised, consider instigating a boil water alert

Water Supply System	Binnaway
CCP ID	BWY3
What is the control point?	Fluoridation
What are the hazards?	Over or under-dose of fluoride
What is being monitored?	Fluoride concentration (daily sampling at WFP and reservoir, daily concentration calculation)
What will initiate response?	Low or high fluoride concentration

Target Leaving WFP, leaving reservoir and throughout distribution system =1.0 mg/L	**Alert Level** Calculated daily concentration <0.9 or >1.1 mg/L OR Measured Concentration <0.9 mg/L or >1.2 mg/L)	**Critical Limit** Calculated daily concentration >1.5 mg/L OR Concentration leaving reservoir >1.4 mg/L
Monitoring Systems Monitoring parameter: Fluoride Monitoring location: Monitoring out of the plant, out of the reservoir and throughout distribution system Monitoring frequency: Daily/weekly (as below) • Visual inspection of fluoridation system (interval) • Calibration of fluoride analyser (intervals) • Raw water testing as required • Daily measurement of volume treated and weight fluoride dosed with calculation of average daily fluoride concentration • Daily testing at outlet to water filtration plant and outlet from clear water storage reservoir • Weekly testing in distribution system	**Corrective actions** • Confirm calculations or re-sample and test • Conduct pump drop tests • Confirm current WTP flow rate and fluoride dosing rate • Test concentration leaving WFP more frequently • Consider temporarily shutting down fluoride dosing system • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, (via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Shut down fluoride dosing system. • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow directions from Manager - Refer to Emergency Response Plan - Test fluoride in reservoirs and reticulation - Identify cause & rectify problem • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453)

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Binnaway
CCP ID	BWY3
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Binnaway
CCP ID	BWY4
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 0.8 mg/L	**Alert Level** <0.5 mg/L or >2.5 mg/L	**Critical Limit** <0.2 mg/L or >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Coonabarabran

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Coonabarabran	CBN1	Filtration	All pathogens	Turbidity	<0.8 NTU	>0.9 NTU	>1.0 NTU
	CBN2	Disinfection (gas)	Chlorine sensitive pathogens	Chlorine	2.0 – 3.5 mg/L	<1.8 mg/L, >4.0 mg/L	<1.5 mg/L, >4.5 mg/L
	CBN3	Fluoridation	Fluoride	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	<0.9 mg/L or >1.1 mg/L (calculated daily concentration) OR <0.9 mg/L or > 1.2 mg/L measured concentration	>1.5 mg/L (calculated daily concentration) OR >1.4 mg/L (concentration leaving reservoir)
	CBN4	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	CBN5	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	0.6 - 3.5 mg/L	< 0.4 mg/L, >4.0 mg/L	< 0.2 mg/L, or >4.5 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Coonabarabran
CCP ID	CBN1
What is the control point?	Filtration
What are the hazards?	All pathogens
What is being monitored?	Turbidity
What will initiate response?	High turbidity reading (online or from grab sample)

Target <0.8 NTU	**Alert Level** >0.9 NTU	**Critical Limit** >1.0 NTU
Monitoring Systems Monitoring parameter: Turbidity Monitoring location: Outlet of filter Monitoring frequency: Daily grab sample • Backwashing filters (time based/headloss) • Visual inspection of filters (daily) • Hose down filter whilst backwashing (as required) • Pressure cleaning of filters (annually) • Calibration of turbidity meter (intervals) Associated routine checks: • Coagulation/clarification monitoring; visual inspection of floc in lagoon (daily) • Inspection of the blowers (interval)	**Corrective actions** • Check filter operation (visual) • resample and test • if resample fails, instigate backwash • Check settled water turbidity - check alum dosing - jar tests (as necessary) - adjust alum/polymer doses accordingly • Consider source water options if necessary • Notify Technical Officer (immediately on 0428 005 730) should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Investigate cause (e.g. poor clarification) • Follow directions from Manager, such as - reduce flow rate through filters - check reticulation for chlorine residual and turbidity - recirculate water to head of plant - adjust alum dose rate if required - Microbiological sampling - Increase chlorine dose • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Consider instigating a boil water alert

Water Supply System	Coonabarabran
CCP ID	CBN2
What is the control point?	Disinfection (gas)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 2.0 – 3.5 mg/L	**Alert Level** <1.8 mg/L, >4.0 mg/L	**Critical Limit** <1.5 mg/L, >4.5 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Leaving WTP Monitoring frequency: Daily • Daily chlorine residual testing (leaving plant) • Calibration of chlorine analyser (intervals) • Check rotameter • Check auto change over • Check bottles aren't empty • Arrange new bottle when duty is empty	**Corrective actions** • Check rotameter • Check for gas line leaks • Check bottles aren't empty • Manual change over (if required) • Check injector • Check service water and head unit • Increase/decrease chlorine dose - Re-check residual (after time) • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • If disinfection is compromised, consider need for a boil water alert

Water Supply System	Coonabarabran
CCP ID	CBN3
What is the control point?	Fluoridation
What are the hazards?	Over or under-dose of fluoride
What is being monitored?	Fluoride concentration (daily sampling at WFP and reservoir, daily concentration calculation)
What will initiate response?	Low or high fluoride concentration

Target Leaving WFP, leaving reservoir and throughout distribution system =1.0 mg/L	**Alert Level** Calculated daily concentration <0.9 or >1.1 mg/L OR Measured Concentration <0.9 mg/L or >1.2 mg/L)	**Critical Limit** Calculated daily concentration >1.5 mg/L OR Concentration leaving reservoir >1.4 mg/L
Monitoring Systems Monitoring parameter: Fluoride Monitoring location: Monitoring out of the plant, out of the reservoir and throughout distribution system Monitoring frequency: Daily/weekly (as below) • Visual inspection of fluoridation system (interval) • Calibration of fluoride analyser (intervals) • Raw water testing as required • Daily measurement of volume treated and weight fluoride dosed with calculation of average daily fluoride concentration • Daily testing at outlet to water filtration plant and outlet from clear water storage reservoir • Weekly testing in distribution system	**Corrective actions** • Confirm calculations or re-sample and test • Conduct pump drop tests • Confirm current WTP flow rate and fluoride dosing rate • Test concentration leaving WFP more frequently • Consider temporarily shutting down fluoride dosing system • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, (via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Shut down fluoride dosing system. • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow directions from Manager - Refer to Emergency Response Plan - Test fluoride in reservoirs and reticulation - Identify cause & rectify problem • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453)

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Coonabarabran
CCP ID	CBN4
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Coonabarabran
CCP ID	CBN5
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 0.6 – 3.5 mg/L	**Alert Level** <0.4 mg/L or >4.0 mg/L	**Critical Limit** <0.2 mg/L or >4.5 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system Monitoring frequency: Manual water quality testing (weekly) • WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (weekly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Coolah

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Coolah	CLH1	Disinfection (gas)	Chlorine sensitive pathogens	Chlorine	1.5 – 1.8 mg/L	<1.3 mg/L, >2.0 mg/L	<1.0 mg/L, >4.0 mg/L
	CLH2	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	CLH3	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	1.0 – 1.2 mg/L	<0.9 mg/L, >2.0 mg/L	< 0.5 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Coolah
CCP ID	CLH1
What is the control point?	Disinfection (gas)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Llow or high chlorine residual

Target 1.5 – 1.8 mg/L	**Alert Level** <1.3 mg/L, >2.0 mg/L	**Critical Limit** <1.0 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Leaving WTP Monitoring frequency: Daily • Daily chlorine residual testing (leaving plant) • Calibration of chlorine analyser (intervals) • Check rotameter • Check auto change over • Check bottles aren't empty • Arrange new bottle when duty is empty	**Corrective actions** • Check rotameter • Check for gas line leaks • Check bottles aren't empty • Manual change over (if required) • Check injector • Check service water and head unit • Increase/decrease chlorine dose - Re-check residual (after time) • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • If disinfection is compromised, consider need for a boil water alert

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Coolah
CCP ID	CLH2
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Coolah
CCP ID	CLH3
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 1.0-1.2 mg/L	**Alert Level** <0.9 mg/L or >2.0 mg/L	**Critical Limit** <0.5 mg/L or >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Dunedoo

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Dunedoo	DDO1	Disinfection (hypo)	Chlorine sensitive pathogens	Chlorine	1.5 – 1.8 mg/L	<1.2 mg/L, >2.5 mg/L	<1.0 mg/L, >4.0 mg/L
	DDO2	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	DDO3	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	1.0 – 1.5 mg/L	<0.9 mg/L, >2.5 mg/L	< 0.5 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Dunedoo
CCP ID	DDO1
What is the control point?	Disinfection (hypo)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 1.5 - 1.8 mg/L	**Alert Level** <1.2 mg/L, >2.5 mg/L	**Critical Limit** <1.0 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Outlet of Bulindah St Reservoir Monitoring frequency: Weekly • Chlorine residual testing • Calibration of instrument (intervals) • Check chlorine batch tank • Check pumps	**Corrective actions** • Check chlorine batch tank • Check pumps, dosing lines and point of injection • Check strength of hypochlorite tank - Order new hypo if strength is too low • Increase/ decrease chlorine dose - Re-check residual (after time) • Visual inspection of reservoir • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Microbiological sampling and testing • If disinfection is compromised, consider need for a boil water alert

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Dunedoo
CCP ID	DDO2
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Dunedoo
CCP ID	DDO3
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 1.0 – 1.5 mg/L	**Alert Level** <0.9 mg/L or >2.5 mg/L	**Critical Limit** <0.5 mg/L or >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Kenebri

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Kenebri	KBI1	Disinfection (hypo)	Chlorine sensitive pathogens	Chlorine	1.5 – 1.8 mg/L	<1.3 mg/L, >2.0 mg/L	<1.0 mg/L, >4.0 mg/L
	KBI2	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	KBI3	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	0.8 – 1.5 mg/L	< 0.5 mg/L, >2.0 mg/L	< 0.2 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Kenebri
CCP ID	KBI1
What is the control point?	Disinfection (hypo)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 1.5 - 1.8 mg/L	**Alert Level** <1.3 mg/L, >2.0 mg/L	**Critical Limit** <1.0 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Outlet of reservoir Monitoring frequency: Weekly • Chlorine residual testing • Calibration of instrument (intervals) • Check chlorine batch tank • Check pumps	**Corrective actions** • Check chlorine batch tank • Check pumps, dosing lines and point of injection • Check strength of hypochlorite tank - Order new hypo if strength is too low • Increase/ decrease chlorine dose - Re-check residual (after time) • Visual inspection of reservoir • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Microbiological sampling and testing • If disinfection is compromised, consider need for a boil water alert

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Kenebri
CCP ID	KBI2
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Kenebri
CCP ID	KBI3
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 0.8 – 1.5 mg/L	**Alert Level** <0.5 mg/L or >2.0 mg/L	**Critical Limit** <0.2 mg/L or >4 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Mendooran

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Target	Alert Level	Critical Limit
Mendooran	MDN1	Filtration	All pathogens	Turbidity	<0.3 NTU	>0.35 NTU	>0.5 NTU
	MDN2	Disinfection (hypo)	Chlorine sensitive pathogens	Chlorine	1.5- 2.5 mg/L	<1.2 mg/L, >3.0 mg/L	<1.0 mg/L, >4.0 mg/L
	MDN3	Reservoirs	All pathogens and all chemicals	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)		Breach of integrity identified
	MDN4	Distribution	Chlorine sensitive pathogens and all chemicals	Chlorine	0.8 – 1.2 mg/L	<0.4, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L

Target	This is where you want your system to be operating. Try to maintain levels equal to or greater quality the required value.
Alert Level	First indication your system may have a problem or a potential problem. Increase monitoring and refer to CCP management plans.
Critical Limit	At this limit you have lost control of your system. As a matter of urgency refer to CCP management plans and try to remediate problem.

Water Supply System	Mendooran
CCP ID	MDN1
What is the control point?	Filtration
What are the hazards?	All pathogens
What is being monitored?	Turbidity
What will initiate response?	High turbidity reading (online or from grab sample)

Target <0.3 NTU	**Alert Level** >0.35 NTU	**Critical Limit** >0.5 NTU
Monitoring Systems Monitoring parameter: Turbidity Monitoring location: Outlet of filter Monitoring frequency: Daily grab sample • Backwashing filters (time based) • Visual inspection of filters (daily) • Hose down filter whilst backwashing (as required) • Pressure cleaning of filters (annually) • Calibration of turbidity meter (intervals) Associated routine checks: • Coagulation/clarification monitoring; visual inspection of floc in lagoon (daily) • Inspection of the blowers (interval)	**Corrective actions** • Check filter operation (visual) • resample and test • if resample fails, instigate backwash • Check settled water turbidity - check PACl dosing - jar tests (as necessary) - adjust PACl dose accordingly • Consider source water options if necessary • Notify Technical Officer (immediately on 0428 005 730) should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Investigate cause (e.g. poor clarification) • Follow directions from Manager, such as - reduce flow rate through filters - check reticulation for chlorine residual and turbidity - recirculate water to head of plant - adjust PACl dose rate if required - Microbiological sampling - Increase chlorine dose • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Consider instigating a boil water alert

Water Supply System	Mendooran
CCP ID	MDN2
What is the control point?	Disinfection (hypo)
What are the hazards?	All pathogens
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high chlorine residual

Target 1.5- 2.5 mg/L	**Alert Level** <1.2 mg/L, >3.0 mg/L	**Critical Limit** <1.0 mg/L, >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Water treatment plant Monitoring frequency: Weekly • Chlorine residual testing • Calibration of instrument (intervals) • Check chlorine batch tank • Check pumps	**Corrective actions** • Check chlorine batch tank • Check pumps, dosing lines and point of injection • Check strength of hypochlorite tank - Order new hypo if strength is too low • Increase/ decrease chlorine dose - Re-check residual (after time) • Visual inspection of reservoir • Notify Technical Officer (immediately on 0428 005 730 should problem persist, otherwise, via weekly operating sheet) • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Sampling and testing within reticulation for chlorine residual • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing (low limit) • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Microbiological sampling and testing • If disinfection is compromised, consider need for a boil water alert

Reservoir CCPs can currently not be implemented due to lack in resources in implementing recommended actions (Aqualift report 2015) to ensure integrity.

Water Supply System	Mendooran
CCP ID	MDN3
What is the control point?	Reservoirs
What are the hazards?	All pathogens and All chemicals
What is being monitored?	Reservoir integrity
What will initiate response?	Any sign of reservoir integrity breach

Target No breach of reservoir integrity	**Alert Level**	**Critical Limit** Evidence of a breach of reservoir integrity
Monitoring Systems Monitoring parameter: Reservoir integrity Monitoring location: At reservoirs Monitoring frequency: Visual inspection (interval plus ad-hoc) • Check perimeter, fencing, gates, hatches, locks, netting, roofing - (refer to reservoir SOPs/ checklists that need to be developed) • Checklist from initial audit after integrity is re-established	**Corrective actions** **NOTE**: No Alert Level for reservoir breach. If there is a route of entry, assume the reservoir is contaminated.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Remove source of contamination • Rectify integrity breach • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Actions may include: - Consider instigating a boil water alert - Microbiological sampling - Dump water if appropriate, clean reservoir - Spot dose and check chlorine residual

Water Supply System	Mendooran
CCP ID	MDN4
What is the control point?	Distribution
What are the hazards?	All pathogens and all chemicals
What is being monitored?	Free chlorine residual
What will initiate response?	Low or high free chlorine residual

Target 0.8 – 1.2mg/L	**Alert Level** <0.4 mg/L or >3.0 mg/L	**Critical Limit** <0.2 mg/L or >4.0 mg/L
Monitoring Systems Monitoring parameter: Free chlorine residual Monitoring location: Sampling points in the distribution system • Monitoring frequency: WQ testing/monitoring program: - Technical Services (weekly by retic staff/ Technical Officer) - Regulatory Services (monthly) • Technical Officer: - Inform retic/ WTP staff of unusual results/ WQ observations - Enter data in spreadsheet • Regulatory Officer: - Inform Technical Officer of unusual results/ WQ observations - Record data in WQ monitoring spreadsheet	**Corrective actions** • Re-sample to check result • Technical Officer: Communicate results to retic staff to initiate flushing at location of low chlorine residual • As necessary communicate results to WTP operator to ensure that chlorine dosing is within limits • Sample and re-test to ensure effectiveness of corrective actions • Technical officer to log details, and inform Manager WW – Operations (0417 238 497) as required.	**Corrective actions** • Immediately notify Manager Warrumbungle Water (WW) – Operations (0417 238 497) • Follow all AL corrective actions • Check chlorine dosing at WTP is within limits and follow chlorination CCP. • Follow directions from Manager, such as - Shut down plant - Spot dose and re-sample - Microbiological sampling and testing • Manager WW – Operations call - PHU (0407 551 548), - Director Technical Services (0417 464 438) - Manager WW – Special Projects (0409 896 452) - DPI water (0458 268 453) • Where < 0.2 mg/L consider need for boil water alert

Appendix C – Draft Emergency Response Protocol

1 EMERGENCY RESPONSE PLAN

- Warrumbungle Shire Council has developed this incident and emergency response plan for water operations

Table 1 Management of incidents and emergencies

Alert Level	Description	Key management response(s)	Position(s) responsible
High: Disaster or Emergency	• Emergency Management Plan activated or natural disaster declared. Examples include flood, drought, bushfire and terrorism	External assistance requested to manage emergency or disaster Effective communication with community	General Manager
Medium: Incidents	• Exceedance of ADWG health guideline value • Outbreak of waterborne disease • Unable to provide treated water • Loss of water supply for >6 hours	Ensure all control measures identified in the DWMS are functioning effectively	Manager Warrumbungle Water - Operations
Low: Operational Action	• Exceed Action Limit for CCPs *Effectively managed by the water treatment operators undertaking actions in CCP document.*	Implement CCP actions to return to operational target Check and act upon operations and maintenance records and procedures Take appropriate actions to rectify situation	Treatment/reticulation Operators and Supervisors with guidance from Manager Warrumbungle Water - Operations

Table 2 Incident and emergency summary of actions

Alert Level	Key management response(s)	Brief summary of actions	Documented Plans & Procedures
High: Emergency or Disaster	External assistance requested to manage emergency or disaster	• Manager Warrumbungle Water – Operations to notify General Manager • Coordinate internal notification, investigation and response of water related aspects • Consider what community notification is needed e.g. do not drink alert, boil water alert or bottled/emergency water distribution • Liaise closely with NSW Health, DPI Water or other agencies to resolve issues	Business Continuity Plan, EMPLAN, DISPLAN
Medium: Incidents	Ensure all preventive measures are functioning effectively.	• Notify Manager Warrumbungle Water - Operations • Notify PHU • Ensure all control measures identified in the CCPs are functioning effectively • Commence investigation • Arrange for re-samples to be taken (where required) • Implement appropriate immediate remediation actions, (this may include manual dosing of reservoirs, flushing of mains, or isolation of affected areas) • Review associated laboratory reports and operational records • In case of customer complaints, coordinate investigation and resolution, including obtaining water samples where required • Determine if community notification required	Incident response plan (this document)
Low: Operational Action	Implement all CCP Alert level actions that are relevant.	• Notify Manager Warrumbungle Water – Operations as required in CCP. • Implement rectification actions immediately • Increase monitoring frequency to ensure issue is resolved	CCPs for each process Associated SOPs as identified in CCP.

1.1 Low - Operational Action

At the low alert level, operational actions are required to manage the issue and prevent escalation.

Issues at this level are normally identified by the water treatment plant operators or technical officer through operational monitoring.

Corrective actions will be taken to ensure processes are brought back to target levels, a note made in WTP diary (CCP exceedances) and the Manager Warrumbungle Water – Operations informed weekly, or escalated immediately if the problem cannot be rectified.

Note: Exceedances of upper and lower alarms are considered to be within the scope of normal operation of the management plan, and do not automatically escalate beyond “Low” unless the situation warrants. For example, a high chlorine alarm that is reacted to before the chlorine level exceeds the ADWG Health Guideline value is dealt with as a “Low” action.

If the ADWG Health Guideline values are exceeded, the issue is a “Medium” incident.

1.2 Medium - Incident

At the medium alert level, there is a potential for an adverse public health impact.

These issues are identified through either operational or verification monitoring of the processes and water quality, or where there has been a significant widespread treatment or reticulation network failure resulting in the loss (or likely loss) of water supply for a period >6 hours.

When identified, these issues are escalated in accordance with the escalation procedure.

A medium alert level incident is likely to be managed by the Manager Water - Operations. In most cases, it will be reported immediately to the local PHU.

Appropriate corrective actions will be identified, and implemented as soon as practicable to minimise the effect of the incident.

1.3 High – Emergency or Declared Natural Disaster

This level emergency or disaster requires coordination across departments and may require external resourcing and support from agencies, such as Department of Emergency Services, Department of Health, Department of Primary Industries and emergency responders.

In these cases the Council EMPLAN or DISPLAN will be activated.

2 RESPONSE PROTOCOLS

2.1 NSW Health Response protocol for the management of microbiological quality of drinking water.

This protocol is derived from the Australian Drinking Water Guidelines (the Guidelines) to guide Public Health Units (PHU) and water utilities in their joint response following rapidly changing source water quality, treatment failure, or microbial contamination.

Under Section 22 of the *Public Health Act* 2010, the Chief Health Officer has the power to issue advice, for the benefit of the public, concerning the safety of available drinking water and any possible risks to health involved in the consumption of that water. This may include a boil water alert. These powers are delegated to Public Health Unit Directors. A supplier of drinking water must issue to the public the advice provided under the Public Health Act, if so directed.

A regional water utility may issue a boil water alert of its own accord.

However, before issuing a boil water alert, the water utility should liaise with their local PHU to discuss the situation.

Testing drinking water for specific pathogens is impractical and can be unreliable. For this reason tests are carried out for bacteria, which are present in faeces and indicate contamination. The Guidelines recommend monitoring microbiological quality by testing for *Escherichia coli* (*E. coli*). *E. coli* is the most reliable and specific indicator of recent faecal contamination in drinking water. The presence of *E. coli* in drinking water indicates recent faecal contamination because the organism generally does not multiply in drinking water systems.

Testing for *E. coli* can help verify the adequacy of preventive measures. However, water utilities should not rely solely on end point testing. The implementation of a comprehensive risk-based drinking water management plan is the most reliable way to protect drinking water quality.

Total coliforms

NSW Health laboratory methods routinely provide total coliform as well as *E. coli* results. The Guidelines note that total coliforms are a poor indicator because they are normal inhabitants of soil and water, and can grow in water distribution systems. Total coliforms should generally not be detected in water sampled immediately after disinfection.

While total coliforms are not a reliable indicator of faecal contamination, their presence may suggest regrowth or possible ingress of foreign material. If detected, water utilities should check that disinfectant concentration is adequate, and that operation of the treatment plant and supply system is normal. Water utilities may set system specific targets for total coliform bacteria.

Further information on the microbiological quality of drinking water is available in the Guidelines (Chapters 5 and 10).

a) Action on the detection of E. coli or coliform bacteria

The water utility is responsible for carrying out all necessary investigation and re-sampling as specified in this response protocol.

1. The water utility and the Public Health Unit (PHU) should be notified of the contamination by the testing laboratory **(this must be immediate notification if *E. coli* is detected)**. Water utlities must record the chlorine concentration (free and total) and, if possible, pH and turbidity on the NSW Health sample label, must take a separate sample for these tests, must not use the microbiology sample, as it will become contaminated.

2. **<u>If total coliforms are detected</u>** (but not *E. coli*), the water utility should ensure adequate disinfectant concentration, check that the treatment plant and supply system are operating normally, and resume normal sampling. The next scheduled sample would normally be sufficient as follow-up. The water utility should consider system characteristics and analyse historical results when setting system specific targets for total coliforms.
3. **<u>If *E. coli* is detected</u>**, the water utility should immediately investigate possible sources of contamination and increase disinfection (if inadequate). Check disinfection, treatment, source and supply system are operating normally, rectify any parameters that are not normal. Sources of contamination might include a treatment breakdown or malfunction (including failure to meet turbidity targets), a mains break, interruption to the supply, surges in water or power supply, or deliberate or accidental contamination of the system. The investigation may include an inspection of the system and associated service reservoirs by trained personnel. When found, the source of contamination should be rectified.
   In some cases, *E. coli* may lodge in biofilm and be released at a later time. Flushing and re-sampling may be necessary to confirm whether contamination is persistent.
4. The water utility should re-sample at the same site using NSW Health Repeat Labels and record chlorine (free and total) and if possible pH and turbidity information. The sample should be submitted to a NSW Health Laboratory or other NATA accredited laboratory for analysis. Make sure that the laboratory knows that this is a repeat samples investigating possible contamination.
   Note: If immediate resampling is not possible the water utility and Public Health Unit should assess the situation and agree on the necessary actions.
5. **<u>If disinfection, treatment, source or supply system is not operating normally,</u>** consult PHU regarding boil water alert and rectification. For example, if treated water turbidity is >1 NTU disinfection may be ineffective. The PHU should consider the need for a boil water alert if the water utility cannot provide timely confirmation of normal operation, including an adequate disinfection concentration.
6. If *E. coli* is **not** detected in the repeat sample and no problem is found, resume normal sampling.
7. If *E. coli* is detected in the repeat sample and/or a problem is identified through the investigation, consult PHU regarding boil water alert and rectification. Confirm adequate disinfectant concentration, resample at same site and other sites in the distribution system, conduct full sanitary survey and assess need for boil water alert (Section d).
8. PHU Environmental Health Officers and Director should consult with the Water Unit and provide the findings of the water utility's investigation, when determining the need for a boil water alert. DPI water should also be advised.

b) Action in response to a failure in treatment or disinfection, or poor or rapidly changing source water quality

1. The water utility should immediately rectify the treatment or disinfection failure (i.e. failure to meet disinfectant or turbidity targets) and investigate possible cause of contamination. Additional operational or source water monitoring changes may be necessary.
2. The water utility should assess source water changes:
   a. Determine if there is rapidly changing raw water turbidity that cannot be improved (e.g. by changing the level of offtake or source).
   b. Determine if there has been a recent inflow of water from a contaminated source in the catchment (even if raw water turbidity is not rapidly changing).
3. If the treatment or disinfection failure cannot be corrected in a timely manner and there is not an adequate volume of treated water in storage, the water utility should contact the local

PHU and collect an additional microbiology sample of the drinking water using NSW Health Repeat/Additional Labels and record chlorine (free and total) and if possible pH and turbidity information. The sample should be submitted to a NSW Health Laboratory or other NATA accredited laboratory for analysis. Make sure that the laboratory knows that this is a repeat samples investigating possible contamination.

4. If the treatment or disinfection failure has been corrected and no *E. coli* is detected, resume normal sampling.
5. If the treatment or disinfection failure cannot be corrected and/or *E. coli* is detected in the repeat sample, consult the local PHU regarding boil water alert and rectification. Confirm adequate disinfectant concentration, resample at same site and other sites in the distribution system, conduct full sanitary survey, and assess need for boil water alert (Section d).
6. PHU Environmental Health Officers and Director should consult with the Water Unit and consider investigation/risk assessment outcomes in determining need for a boil water alert. DPI water should also be advised.

c) Corrective actions following the detection of contamination or treatment/disinfection failure:

Corrective action may include one, or more, of the following:

- Increase disinfection at the treatment plant
- Correct treatment failure if possible
- Optimise treatment processes at the treatment plant
- Increase/add chlorine at points in the distribution system
- Clean, flush, and disinfect mains

d) Contamination investigation and sanitary survey - assessing the need for a boil water alert.

The contamination investigation should aim to:

- Determine the origin of the contamination (e.g. is contamination present in water leaving the treatment plant or localised to one section of the distribution system?; is there evidence of pre- or post-treatment contamination?)
- Time and scale of contamination (i.e. the extent and likely recency of contamination)

The sanitary survey should consider whether barriers to contamination are adequate and whether treatment processes, including disinfection, are effective.

Barriers to the transmission of pathogenic microorganisms should include most, if not all, of the following:

- Selection of water sources which are protected from contamination by human and animal faecal material, and chemicals, and maintenance of an active catchment protection program
- Pre-treatment, such as detention and settling in reservoirs for sufficient time for pathogen die off

- Protection of water storages
- Extraction management
- Treatment (eg coagulation, settling, filtration)
- Disinfection of the water before it enters the distribution system
- Maintenance of adequate residual concentrations where chemical disinfection is used
- Security of the distribution system against re-contamination

Ensure the effectiveness of disinfectant concentration through particular attention to the following:

- Frequent (daily or continuous) monitoring of operational factors (e.g. pH, disinfectant residual, turbidity)
- No directly visible plant or animal material
- Minimum total chlorine residual of 0.5 mg/L after 30 min (if chlorination is used)
- Low turbidity, preferably <1 NTU
- pH optimised to suit the disinfectant used (subject to the need to minimise corrosion)
- Adequate maintenance of the reticulation system
- Frequent monitoring of disinfectant residual in the distribution system.
- If water temperature >30oC, monitor for amoebae

Factors to consider before issuing a boil water alert:

The PHU, Water Unit and/or Chief Health Officer will consider the following when determining the need for a boil water alert or an alternative supply:

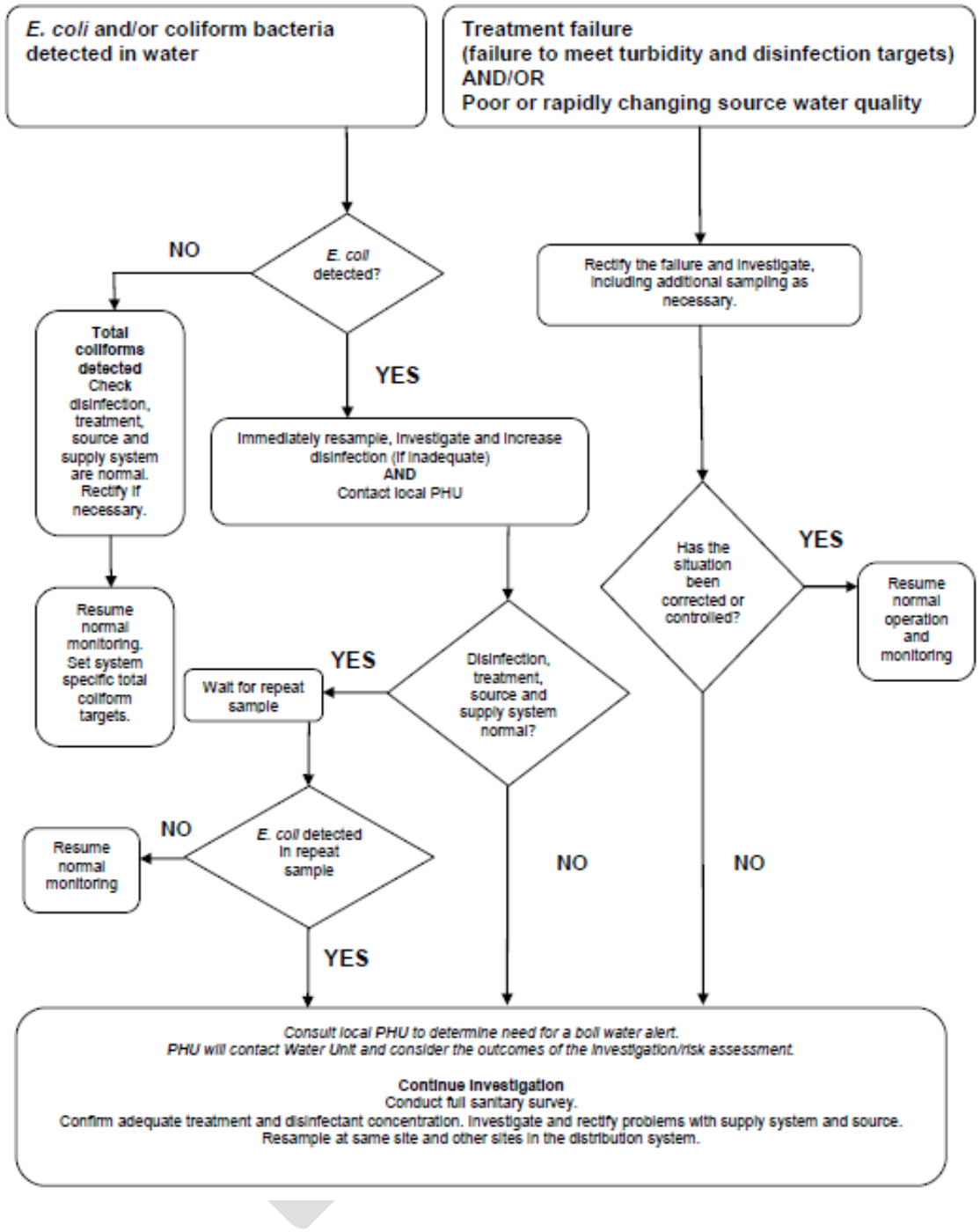
- Are people exposed to an ongoing risk that could be prevented with a boil water alert?
- The findings of the contamination investigation and sanitary survey
- The effectiveness of current disinfection
- Likelihood of identification and correction of the problem
- Evidence of increased illness in present or previous events. The PHU should consider the need for enhanced surveillance
- Exposure
- Estimate daily water consumption levels.
    - Determine if the samples are representative of water that is actually consumed?
    - Exposure duration and scale (how long and how many people been consuming the water?)
- Have there been any complaints about water quality or health?

- Are any vulnerable populations receiving the water? (i.e. dialysis patients, immunocompromised, etc.)
- Will rectification measures affect any vulnerable populations? (i.e. disinfection changes and dialysis patients)
- Whether proper sample collection and analysis techniques were used
- Whether a NATA accredited laboratory analysed the samples
- Availability of an alternative supply
- Notification of consumers that may receive carted water from the affected system.
- The need to communicate accurate and appropriate information to the public in a timely manner
- The best means to communicate the information
- The community impact of any public health action

e) Lifting a boil water alert

The PHU, Water Unit and/or Chief Health Officer will consider the factors listed in Section d as well as reviewing available test results. Where a water utility has issued a boil water alert it should consult the Public Health Unit about lifting the alert. DPI water should also be advised.

Figure 1 E coli response flow chart



2.2 NSW Health Response Protocol: For the Management of Physical and Chemical Quality Parameters

This protocol is derived from the Australian Drinking Water Guidelines (the Guidelines) to be used by Public Health Units (PHU) and water utilities to guide their joint response following the detection of physical and chemical water characteristics that exceed the Guidelines.

Under Section 22 of the Public Health Act 2010, the Chief Health Officer has the power to issue advice, for the benefit of the public, concerning the safety of available drinking water and any possible risks to health involved in the consumption of that water. This may include a recommendation for the provision of an alternative supply of water or a “do not drink” advice. These powers are delegated to Public Health Unit Directors. A supplier of drinking water must issue to the public the advice provided under the Public Health Act, if so directed.

The Australian Drinking Water Guidelines have set aesthetic and health related guideline values for physical and chemical characteristics. Aesthetic guideline values are set at the concentration that ensures water is aesthetically pleasing in terms of taste and odour, and can be used without causing corrosion of plumbing or staining. Health-related guideline values are set at the concentration that, based on current knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption.

Further information on the physical and chemical quality of drinking water is available in the Guidelines (Chapters 6 and 10). Where both aesthetic and health-related guideline values are exceeded, consider health related characteristics first and then aesthetic characteristics.

2.2.1 Action on the exceedance of guideline values

The water utility is responsible for carrying out all necessary investigation and resampling as specified in this response protocol.

1. The water utility and the Public Health Unit (PHU) should be notified of the contamination by the testing laboratory.
2. The water utility and the PHU should determine if a potential acute health risk exists. Consider the type of guideline value (health-related or aesthetic) exceeded, the concentration, and potential causes such as a major contamination event or treatment failure. Further information is available in the fact sheets for physical and chemical water quality in the Guidelines.
3. If a potential acute health risk exists, the water utility should consult with the PHU and the NSW Office of Water (NOW) regional inspector regarding immediate action such as rectification, alternative supply, public warnings, and investigation and sampling. The PHU should contact the Water Unit.
4. If no acute health risk is present the water utility should conduct an investigation, in consultation with the local PHU and the NOW regional inspector, to determine the possible sources of contamination. These might include a treatment breakdown or malfunction (e.g. chemical overdose), a mains break, corrosion, interruption to the supply, surges in supply, or deliberate or accidental contamination of the system. The investigation may include a visual inspection of the system and associated service reservoirs by trained personnel. When found, the source of contamination should be rectified.
5. The water utility should resample at the same site upon advice from the PHU using NSW Health Repeat Labels, unless specific project labels are issued. The sample should be submitted to a

NSW Health Laboratory or a NATA accredited laboratory for analysis. Make sure that the laboratory knows that this is a repeat samples investigating possible contamination.

6. If the repeat sample meets the guideline value resume normal sampling.
7. If the repeat sample exceeds the guideline value use available data to assess risk (see Risk assessment).
8. If the risk assessment does not indicate an ongoing risk, resume normal sampling.
9. If the risk assessment indicates an ongoing risk, the water utility should consult with the PHU and the NOW regional inspector regarding rectification (e.g. flushing, system maintenance, etc.), alternative supply, public warnings, and investigation and sampling. PHU Environmental Health Officers and Director should contact the Water Unit.

2.3 Risk assessment and considerations for public notification

2.3.1 Risk assessment

The Water Utility, PHU, and DPI water Regional Inspector should consider the following when conducting the risk assessment:

- Routine sampling frequency.
    - Water utilities that collect two routine chemistry samples per year for the affected supply system should discuss, with the PHU, the need for a sampling investigation either through a project or change in the routine sampling frequency.
- Statistical analysis of available data or sampling investigation results.
    - For health-related guideline exceedances, calculate the 95th percentile of results over (at least) the last twelve months.
    - For aesthetic guideline exceedances, calculate the mean of results over (at least) the last twelve months.
- Exposure.
- Estimate daily water consumption levels.
    - Determine if the samples are representative of water that is actually consumed?
    - Exposure duration (how long have people been consuming the water?
- Have there been any complaints about water quality or health?
- Are flow-on effects possible? Such as low pH causing lead and copper contamination through corrosion of plumbing.
- Are any vulnerable populations receiving the water? (i.e. dialysis patients, immunocompromised, infants, etc.)

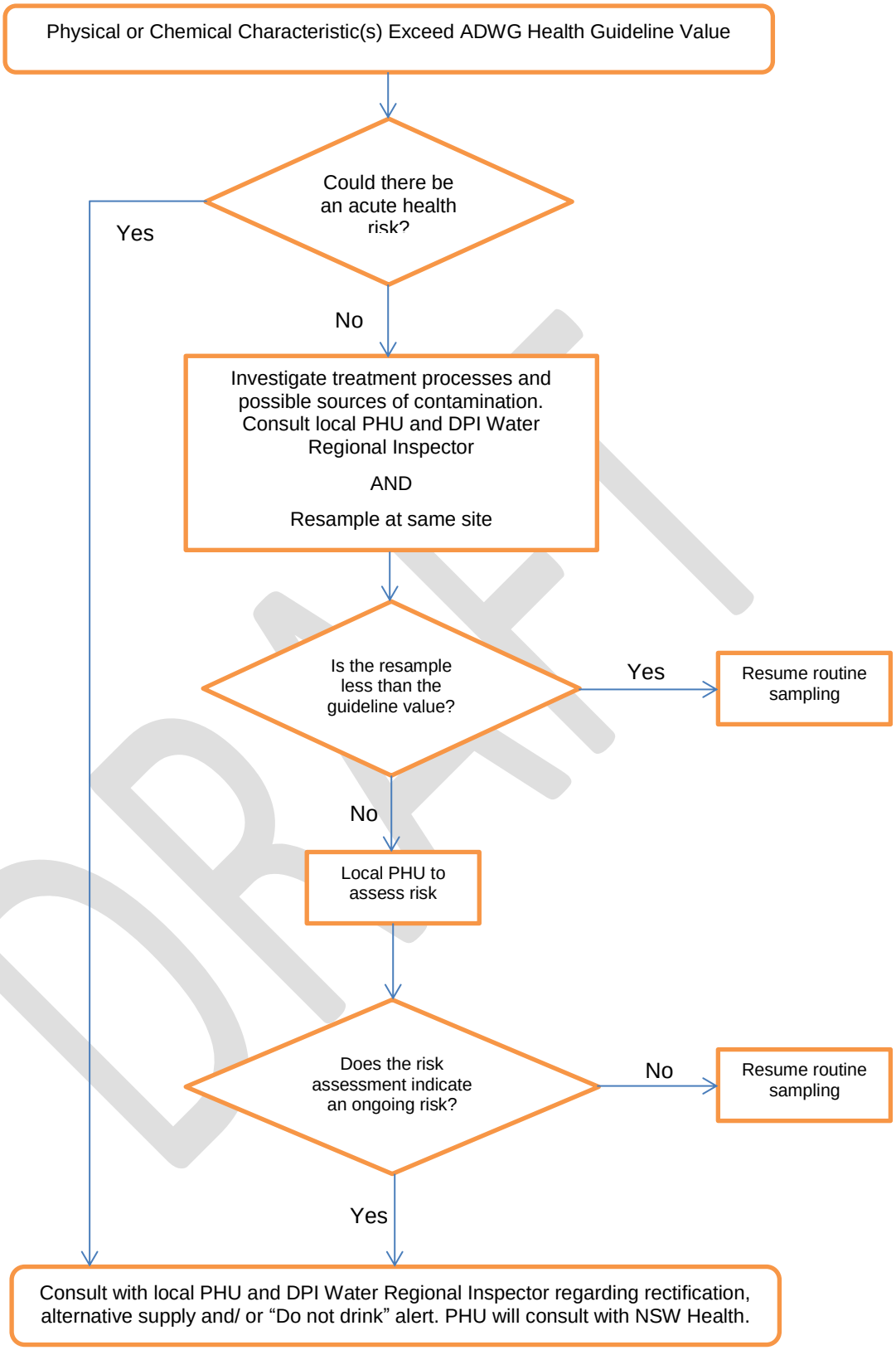
Further information on conducting health risk assessments is available in Section 3.2.3 of the Australian Drinking Water Guidelines and via enHealth's list of environmental health publications.

2.4 Public notification considerations

The PHU, Water Unit and/or Chief Health Officer will consider the following when determining the need for public notification, a do not drink advice, or an alternative supply:

- The outcomes of the risk assessment.
- Whether proper sample collection and analysis techniques were used
- Whether a NATA accredited laboratory analysed the samples
- Availability of an alternative supply
- Notification of consumers that may receive carted water from the affected system.

Figure 2 E. coli response flow chart



3 COMMUNICATIONS LISTS - GENERAL

Stakeholders List - Emergency Response

Regulatory

	Title	Person	Office	Mobile
Public Health Unit	Environmental Health Officer	Mark Nave	6809 8977	0407 551 548
NSW Health - Water Unit	Project Officer	Wendy Henderson	9391 9973	
Department Primary Industries Water	Regional Inspector, Western Region	Bruce Lamont	6841 7402	0458 268 453
EPA				

Media - Community wide communications

	Title	Person	Office	Mobile
ABC Western Plains (Dubbo)			6881 1811	
ABC New England North West (Tamworth)			6760 2411	
ABC Central West (Orange)			6393 2511	
Three Rivers FM			6375 1015	
2DU Dubbo			6882 7727	
2WCR FM			6842 5262	
Coonabarabran Times			6842 1844	
Coolah District Diary Dunedoo Diary			6377 1950 6377 1950	

3.1 Contacts - Baradine

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED – example below

Baradine				
Vulnerable Customers	**Title**	**Person**	**Office**	**Mobile**
Multi Purpose Service			6843 1909	
Doctors Surgeries				
Aged Care				
Dialysis patients				
Baradine Central School			6843 1805	
Child care facilities				
Key Suppliers	**Reason**	**Contact**	**Office**	**Mobile**
Company name				
	Coagulant (PACl)			
	Poly			
	Soda ash			
	Chlorine Gas			
	Fluoride			
	Pump Supplier			
	Electrician	C. Cormie		
	Online instruments			
Radtel	PLC/SCADA			
Essential Energy	Electricity		13 20 80	

3.2 Contacts - BINNAWAY

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

3.3 Contacts - Bugaldie

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

3.4 Contacts - Coolah

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

3.5 Contacts - Coonabarabran

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

3.6 Contacts - Dunedoo

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

3.7 Contacts - Kenebri

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

3.8 Contacts - Mendooran

INSERT CONTACTS FROM THE EXCEL TEMPLATE WHEN COMPLETED

4 TEMPLATES FOR BOIL WATER AND DO NOT DRINK ALERTS

The following pages include draft templates for boil water alerts and do not drink alerts.

The boil water alert template only requires editing to identify the location where customers need to boil their water, and a decision as to who is the appropriate contact.

The do not drink alert will require further information and input from NSW Health. This template may be used, for example, if there has been a significant contamination event in the catchment that has resulted in a contaminant being present at levels that present an immediate (acute) health risk.

Examples include pesticides, fuel, fire fighting foam etc.

As the public health impacts for each contaminant will vary, the advice in the do not drink template needs to be tailored to the specific incident.

Boil Water Alert – DD/MMM/YEAR
E. coli bacteria contamination

Warrumbungle Shire Council regularly monitors drinking water to ensure its safety. Regular monitoring has detected *E. coli* bacteria in the **<<DELETE TOWNS NOT AFFECTED – Baradine, Binnaway, Bugaldie, Coonabarabran, Coolah, Dunedoo, Kenebri, Mendooran >>** water supply. *E. coli* itself is generally not harmful but its presence in drinking water is associated with sewage and animal wastes. These bacteria indicate that the water may be contaminated with organisms that may cause gastrointestinal disease.

As a precaution you are advised that water used for consumption should be brought to a rolling boil. Water should then be allowed to cool and stored in a clean container with a lid and refrigerated.

Boiled or bottled water should be used for:
Drinking, cooking, washing uncooked foods (such as seafood or salads), making ice, personal hygiene, pet's drinking water, washing hands, cleaning teeth, gargling, face washing of young children, washing toys and children's utensils.

Dishes should be washed in hot soapy water or in a dishwasher. Children should take boiled or bottled water to school.

Warrumbungle Shire Council is working to alleviate the problem.

For further information contact: Council Contact Details

'Boil Water Alert' precautions for schools and child care centres

A “Boil Water Alert” has been issued for **<<DELETE TOWNS NOT AFFECTED – Baradine, Binnaway, Bugaldie, Coonabarabran, Coolah, Dunedoo, Kenebri, Mendooran >>**. Until further notice, children and employees should not consume water, ice or drinks made with water, or raw foods rinsed with water that has not been boiled or filtered.

When possible, parents and caregivers should provide their children with boiled or bottled water, bottled juices or juices prepared with boiled water from home.

Access to drinking fountains should be restricted or turned off where possible, so that students do not drink unboiled water by mistake.

Water should flow unrestricted to toilets and washrooms. Signs should be placed in the washrooms indicating that the water is not for drinking.

Students and staff are advised to thoroughly wash their hands with soap and running warm tap water after using the toilet and handling food. Hands should then be dried thoroughly.

For further information please contact: Council Contact Details

Boil Water Alert – DD/MMM/YEAR
Cryptosporidium and/or *Giardia* Contamination

Warrumbungle Shire Council has detected *Cryptosporidium* and/or *Giardia* in the **<<DELETE TOWNS NOT AFFECTED – Baradine, Binnaway, Bugaldie, Coonabarabran, Coolah, Dunedoo, Kenebri, Mendooran >>** water supply. This/These organisms may cause gastrointestinal disease.

Anyone in the identified area with symptoms such as diarrhoea, abdominal pain, slight fever or vomiting should contact their doctor. As a precaution you are advised that water used for consumption should be brought to a rolling boil.

Water should then be allowed to cool and stored in a clean container with a lid and refrigerated.

Boiled or bottled water should be used for:
Drinking, cooking, washing uncooked foods (such as seafood or salads), making ice, personal hygiene, pet's drinking water, washing hands, cleaning teeth, gargling, face washing of young children, washing toys and children's utensils.

Dishes should be washed in hot soapy water or in a dishwasher. Children should take boiled or bottled water to school.
Special care is advisable for certain consumers at this time, these include; people with severely weakened immune systems (the immunosuppressed), individuals receiving dialysis treatment, and aged individuals. Please contact your doctor or local Public Health Unit for more information.

The above precautions should be taken until further notice.

Warrumbungle Shire Council is working to alleviate the problem. For further information contact: Council Contact Details

Lifting of Boil Water Alert – DD/MMM/YEAR

Residents in **<<DELETE TOWNS NOT AFFECTED – Baradine, Binnaway, Bugaldie, Coonabarabran, Coolah, Dunedoo, Kenebri, Mendooran >>** no longer need to boil their drinking water.

Warrumbungle Shire Council advises that any residents that restricted their water usage run their kitchen and bathroom taps for 5 (or more?) minutes to flush any stagnant water from their household plumbing. THIS STATEMENT MAY NOT BE APPLICABLE – CHECK WITH MANAGER WATER PRIOR TO RELEASE.

Warrumbungle Shire Council apologies for the inconvenience, and thanks you for your cooperation.

Should you require further information on this topic please contact: Council Contact Details

DO NOT DRINK ALERT – DD/MMM/YEAR

Residents in the **<<DELETE TOWNS NOT AFFECTED – Baradine, Binnaway, Bugaldie, Coonabarabran, Coolah, Dunedoo, Kenebri, Mendooran >>** water supply area are advised not to consume drinking water until further notice.

Warrumbungle Shire Council is concerned that the water supply may be contaminated with <<Contaminant>> and that the water supply may not be safe for consumption.

Warrumbungle Shire Council is working closely with NSW Health to resolve the situation, and will provide bottled water at

LOCATION AND ADDRESS
TIME

Or: Alternate water supplies are available from

LOCATION AND ADDRESS
TIME

Updates will be provided as soon as possible.

For further information please contact: Council Contact Details

5 BLUE GREEN ALGAE

I presume that Council has a Blue Green Algae Management Plan for the Timor Dam. There should be a link to that document here.

6 CUSTOMER COMPLAINTS

Customers often provide the first indication that there is a problem with water quality. Any customer complaint that implies that there might be a problem should be immediately investigated, and WTP operations reviewed.

Each Council office reception area should be made aware of the importance of recognising public health concerns, and a procedure developed for immediately communicating water quality issues to the appropriate person. Suggestions include the Technical Officer - Water, or operational staff, but a record of the complaint should be kept, and the Manager Warrumbungle Water – Operations informed of complaints on a regular basis (e.g. at a maximum, weekly).

7 TRAINING AND AWARENESS

When adopted, the Emergency Response Plan needs to be understood by all personnel associated with the production or delivery of drinking water, including managers, and the Director Technical Services.

Ideally, over time, emergency scenarios should be developed, and practiced to ensure that all relevant staff are aware of their roles should an incident occur.