Ashburton DISTRICT COUNCIL

Hakatere Water Supply

Water Safety Plan

Hakatere Water Supply
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Version 2.2: August 2018

Authorised by: _____

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Drinking Water Assessor

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Document Control

Version No	Description	Authorised	Approval Date
V 1.0	For submission to DWA for approval	AG	March 2008
V 2.0	Revision to DWA for approval	AG	February 2017
V2.1	Revision for DWA Re-review	AG	March 2017
V2.2	Revision to include CCPs	CS	August 2018

Contents

1 Background

Ashburton District Council (ADC) own and operate the Hakatere drinking water supply. Under the Health (Drinking Water) Amendment Act 2007 (the Act) water suppliers have a duty to prepare and implement Water Safety Plans (WSP), formerly Public Health Risk Management Plans (PHRMP) [Section 69Z].

Under the Act Council has a responsibility to take all practicable steps to comply with the drinking water standards [Section 69V]. This requirement can be met in part by implementing the provisions of an approved Water Safety Plan that relate to the drinking water standards.

The purpose of a Water Safety Plan is to identify the public health risks associated with a drinking water supply. A Water Safety Plan includes a list of what could go wrong with a supply and what measures can be put in place to prevent or eliminate risk to public health.

Hakatere is classified as a small supply under the legislation and is required to be compliant with the Act by 01 July 2015. In 2009 the Ministry of Health (MoH) approved a PHRMP for Hakatere. The approved PHRMP expired in 2014. This WSP has been prepared to meet the requirements of section 69Z of the Act.

2 Implementation, Review and Reporting

2.1 Implementation of the Plan

The ADC Assets Manager is responsible for the implementation of the WSP within the timeframes indicated, subject to community and Council approvals, funding constraints and availability of resources. The Assets Manager is also responsible for the ongoing review and updating of the WSP and associated Improvement Schedule.

The document will be kept current through the following steps:

- Collating comments from those regularly using the WSP and making any required changes;
- Monitoring customer complaints and making any required changes;
- Incorporating any minor changes that have been made to the water supply;
- Updating the risk tables as required;
- Updating the improvements schedule.

2.2 Review Plan Performance

It is a requirement that the WSP be reviewed, revised and submitted for re-approval within five years of approval. During the five year period, the document will be kept current through the following steps:

- Collating comments from those regularly using the WSP and making any required changes;
- Monitoring customer complaints and making any required changes;
- Incorporating any minor changes that have been made to the water supply;
- Updating the risk tables as required;
- Updating the improvement schedule.

2.3 Duration of the Plan

This Plan shall remain in force for a period of up to five years following approval.

2.4 Revision and Re-approval of the Plan

It is a requirement that the Plan be reviewed, revised and submitted for re-approval within five years of approval. Revision processes are detailed above.

2.5 Links to other Quality Systems

This Plan will contribute improvement measures to the AMP for prioritisation and funding via the LTP.

3 Supply Details

Supply	
Supply Name	*Hakatere (Upper)*
WINZ Community Code	HAK001
Supply Owner	*Ashburton District Council*
Supply Manager	*Andrew Guthrie*
Supply Operator	*Ashburton Contracting Ltd – Robin Jenkinson (NZCE Civil, R.E.A.)*
Population Served by Supply	*110* (WINZ)
Supply Grading	*Ed (current)*
Source	
Source Name	Hakatere Upper Well
Source WINZ Code	G00231
Location	*River Road*
Map Reference of Source	NZTM 1504363 easting, 5122221 northing
Type of Source	*Bore* - ECan Ref: L37/0811
Depth of Bore	*29.7m*
Consent Number	CRC991485
Consent Expires	07 April 2034
Maximum Consented water take:	*5 L/s, 200 m^3/day*
Treatment Plant	
Treatment Plant Name	*Hakatere Upper*
Treatment Plant WINZ Code	*TP00340*
Location	*River Road*
Map Reference	NZTM 1504363 easting, 5122221 northing
Treatment Processes	Chlorination, UV, and water softening plant for iron and manganese removal
Consented Daily Volume	*200 m^3/day*
Peak Daily Volume	*97 m^3/day*
Distribution	
Distribution Zone Name	*Hakatere Upper*
Distribution Zone WINZ Code	HAK001HH
Distribution Zone Population	*110*

Regulatory Compliance	
Standards compliance assessed against	*DWSNZ 2005 (rev 2008)*
Laboratory undertaking analyses	*Ashburton District Council*
Secure bore water	*No*
Bacterial compliance criteria used for water leaving the treatment plant	*Criterion 1*
Bacterial compliance for water leaving the treatment plant has been achieved for the last four quarters	*Yes*
Protozoa log removal requirement required for the supply	*Yes*
Protozoa treatment process	*UV disinfection*
Protozoa compliance for water leaving the treatment plant has been achieved for the last four quarters	*No*
Compliance criteria used for water in the distribution zone	*Criterion 6A*
Bacteria compliance for water in the distribution zone has been achieved for the last four quarters	*Yes*
P2 determinands allocated to supply	*None*
Chemical compliance achieved for the last four quarters	*Yes*
Cyanobacteria identified in the supply	*No*
Cyano bacterial compliance has been achieved for the last four quarters	*N/A*
Identify any transgressions that have occurred in the last four quarters *Nil*	

3.1 Contact Information

Water Supply Owner:

Ashburton District Council
PO Box 94, Ashburton
Contact: Andrew Guthrie, Assets Manager
Phone: 03 307-7741

Water Supply Operator:

Ashburton Contracting Ltd
PO Box 264, Ashburton
Contact: Robin Jenkinson
Phone 03: 308-4039

4 Methodology

This WSP has been prepared with regard to "Small Drinking-water Supplies: Preparing a Water Safety Plan", Ministry of Health (2014).

A qualitative risk assessment approach based on the guidance notes in Appendix 2 of "A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies", Ministry of Health (2014), has been undertaken.

4.1 System Description

Within this WSP the water supply is described and a schematic diagram prepared to illustrate the key elements of the supply. Critical points and barriers to contamination are also illustrated.

4.2 Consultation

The WSP was drafted after consultation with Euan Cox, the compliance coordinator responsible of the Ashburton water supplies and Chris Stanley (asset management officer – utilities).
The document was reviewed and discussed with Andrew Guthrie, Assets Manager, Ashburton District Council, and Robin Jenkinson, Ashburton Contracting Ltd, prior to completion.

4.3 Risk Assessment

The qualitative risk assessment approach used allows for the prioritisation of improvement needs and the development of the Improvement Schedule.

Risk tables have been prepared to summarise:

a) what could happen that may cause drinking water to become unsafe,
b) what measures are in place to prevent this from occurring and whether this is sufficient,
c) the assessed level of risk, and
d) what could be done to eliminate, isolate or minimise the risks.

Potential public health risks have been evaluated using the Likelihood and Consequence scales tabulated below (tables 1-3) to determine a risk level from low to extreme.

The scales used have been adapted from those suggested in Appendix 2 of "A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies", Ministry of Health (2014). Changes have been made to achieve a better spread of risk level outcomes, and to ensure relativity between the risks assessed for supplies of varying sizes. This is necessary as it is intended that improvement schedule items from individual supplies can be consolidated into a master list for implementation.

Table 1, Table 2 and Table 3 detail the criteria used and their definitions.

Table 1 Likelihood Scale

Likelihood	Frequency	Description
Likely	More than once per year	The threat can be expected to occur
Quite Common	Once per 1-5 years	The threat will quite commonly occur
Unlikely	Once per 5-10 years	The threat may occur occasionally
Unusual	Once per 10-50 years	The threat could infrequently occur
Rare	Less than once per 50 years	The threat may occur in exceptional circumstances

Table 2 Consequence Scale

Consequences	Microbiologically contaminated water	Chemically contaminated water	Supply interruption	Poor aesthetic water quality
Negligible		Minor chemical contamination event	Unplanned supply interruption for up to 8 hours	Poor aesthetic water quality of nuisance value only
Minor	Microbiological contamination (<100 population)	Recurrent chemical contamination (<100 population)	Unplanned supply interruption for in excess of 8 hours (<100 population)	
Medium	Microbiological contamination (100-500 population)	Recurrent chemical contamination (100-500 population)	Unplanned supply interruption for in excess of 8 hours (100-500 population)	Ongoing poor aesthetic water quality (may lead consumers to obtain water from other sources)
Major	Microbiological contamination (500-5000 population)	Recurrent chemical contamination (500-5000 population)	Unplanned supply interruption for in excess of 8 hours (500-5000 population)	

Consequences	Microbiologically contaminated water	Chemically contaminated water	Supply interruption	Poor aesthetic water quality
Substantial	Microbiological contamination (>5000 population) OR high potential for loss of life or hospitalisation with life threatening or long-term consequences	Recurrent chemical contamination (>5000 population). OR high potential for loss of life or hospitalisation with life threatening or long-term consequences.	Unplanned supply interruption for in excess of 8 hours (>5000 population)	

Table 3 Risk Level Allocation Table

	Consequence				
Likelihood	**Negligible**	**Minor**	**Medium**	**Major**	**Substantial**
Likely	Low	Medium	Very High	Extreme	Extreme
Quite Common	Low	Medium	High	Very High	Extreme
Unlikely	Low	Medium	High	Very High	Very High
Unusual	Low	Low	Medium	High	Very High
Rare	Low	Low	Medium	Medium	High

4.4 Improvement Schedule

An Improvement Schedule has been derived from the Risk Tables and is prioritised according to the assessed level of public health risk associated with hazards that are not adequately controlled at present.

Improvement measures identified in this WSP will be carried forward to the next AMP and LTP for approval and inclusion in annual budgets following the statutory public consultation process. Implementation of the Improvement Schedule is ultimately subject to Council funding approval, and/or obtaining alternative funding.

4.5 Benefits of Proposed Improvements

The proposed improvements will provide public health benefits by reducing the risk of adverse health outcomes associated with drinking water quality. In particular, risks will be reduced by ensuring the new UV system is certified and validated to ensure compliance with the Drinking-water Standards for New Zealand.
Investigating the resilience of the plant to natural hazards and developing and adopting an emergency response plan would ensure the supply is managed in the occurrence of such events.

Similarly, installing a generator for power supply in case of emergency would ensure supply is not interrupted in such events. However, this should only be carried out if the community supports the installation. A genset was installed by Council in 2008 but later removed at the request of the community. The then community accepted the loss of water supply associated with disruptions to power.

Improvements could also be made by the installation of a chlorine analyser and high/low residual alarms.

Uncertainties over the condition of pipes and equipment pose a risk of unexpected leaks, breakdowns and variations in performance which may lead to undesirable outcomes. To address this, Council is implementing an asset management and information system (AMIS) which will assist with recording and programming maintenance and with performing criticality assessments to prioritise attention on the riskier elements of the infrastructure. It will also help to consolidate information about the plant and infrastructure. The maintenance tracking is likely to be implemented in 2017-2018.

4.6 Contingency Plans

Contingency plans have been prepared (section 13) to provide guidance in the event that control measures fail to prevent the occurrence of a risk event that may present acute risk to public health. The Water Supply Operator is responsible for implementation of the contingency plans when monitoring has identified the occurrence of a risk event.

5 General Description

The Hakatere community is served by two water supplies. The Hakatere Upper supply is owned and maintained by Ashburton District Council, and the other, the Hakatere Huts, remains private. The Hakatere Upper scheme supplies water to 58 connections, including a camp ground and public toilets, with a total population of approximately 110 persons, anecdotally increasing to about 200 persons during the summer holiday period.
The water abstraction is consented under CRC991485, which allows for a combined total of 5 L/s and 200 m^3/day from bore.

The average winter demand is approximately 15 m^3/day. This is an average of around 260 litres per property per day, or 135 litres per person per day. The average summer peak demand is approximately 80 m^3/day. This is an average of around 1380 litres per property per day, or 730 litres per person per day.

5.1 Location Map

Figure 1 - Location Map

5.2 Description of Source

The current source is groundwater from one bore, ECan number L37/0811 (see map above), drilled to a depth of 29.7m BGL in December 1998. The bore is 250mm in diameter and is located East of River Road, past the recycling station beside the pump shed and storage tanks.
Two fixed speed Lowara pumps (which deliver up to 5 L/s) are installed in the bore. The abstraction rate is monitored and recorded using SCADA telemetry. The operation of the bore pumps is directly controlled by an ultrasonic level transmitter mounted in the roof of Reservoir Tank 1.

5.3 Treatment and Distribution

The raw water is treated by direct injection of hypochlorite solution whenever a bore pump is running.

Iron and manganese are present in the raw water. Iron is present at concentrations sufficient to cause staining. This is not of health significance recent chemistry monitoring (January 2017) of the raw water has shown high manganese levels in the raw water well above the aesthetic guideline value and close to the maximum allowed value of 0.4mg/L. A water softener is used to reduce the iron and manganese levels in the treated water. Following the high manganese result monthly manganese samples (beginning April 2017) are to be collected from the plant in order to monitor softener performance.

Two new 30m^3 PE storage tanks and one 23m^3 concrete tank are positioned on site and are interlinked for balancing and constant water "turn over". Two booster pumps (duty and duty assist) supply the distribution zone and are controlled by pressure switches for a reduced number of starts. All pumping information is linked and recorded by SCADA.
A depiction of the Hakatere water supply process is included below in Figure 2.

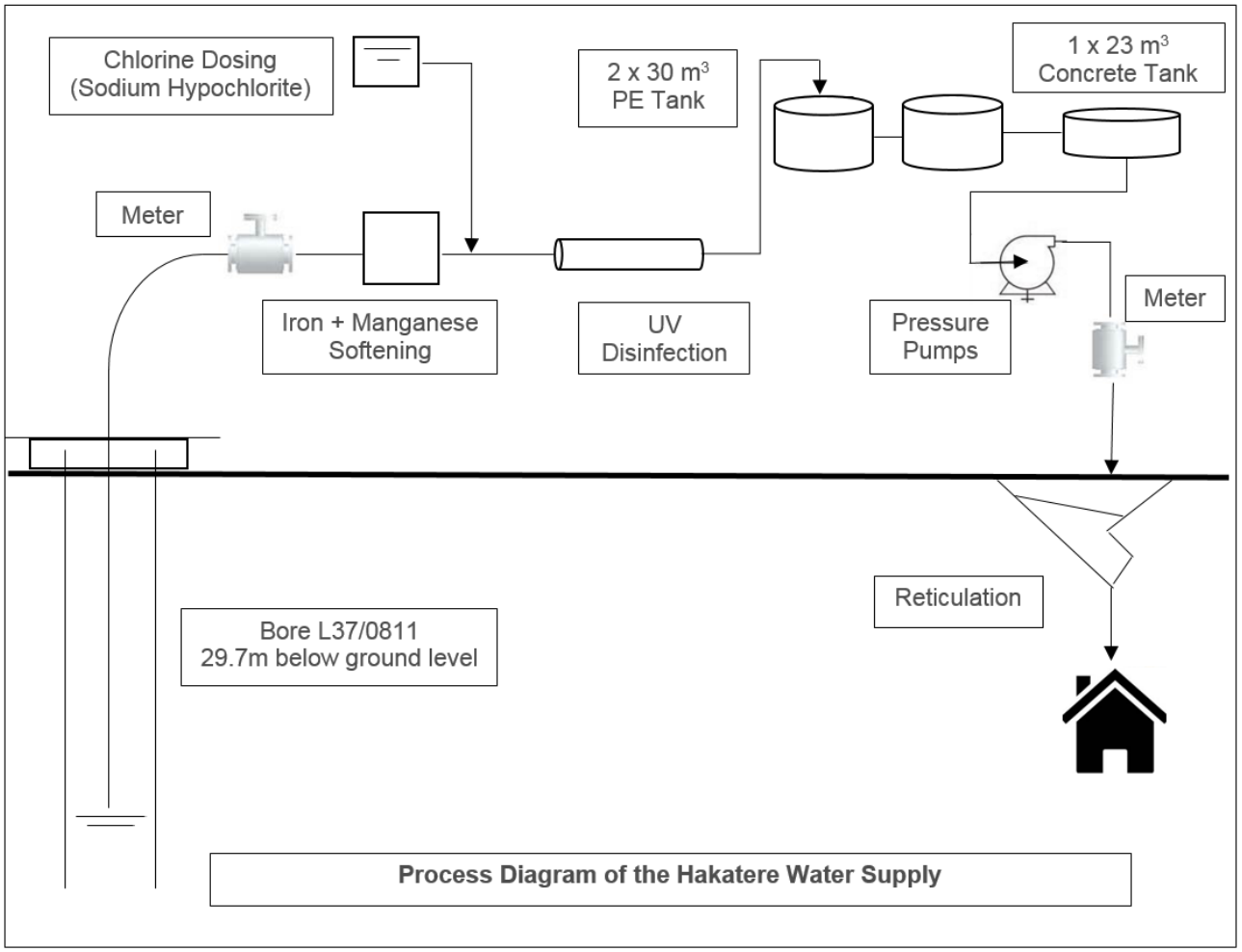

Figure 2 - Hakatere Water Supply Process Diagram

5.4 Monitoring and Alarms

All pumping information is linked and recorded by SCADA but there is no remote control functionality. The SCADA system is currently only used for data acquisition and remote monitoring purposes. It is not an integral part of the pumping or treatment plant control systems. The basic information recorded by SCADA includes:

- Cumulative bore flow volume
- Plant output volume
- Bore and treatment plant pump run hours
- Pressure information in service zone (which controls plant pump to supply)
- Service tank high level
- Alarms for low bore level, pump failure, high backwash tank level, high and low service tank levels, power failure, low service zone pressure and SCADA communication failure
- UV faults alarm

- Raw water turbidity monitoring

Regular inspections of the site are carried out by an ACL (Ashburton Contracting Ltd) staff member on a weekly basis. As part of the maintenance inspections, the staff take treated water samples for testing and carry out regular inspections of all plant, including chemical levels, any equipment faults signs of damage and “wear and tear”. A log is made of the inspection which includes details of any chemicals topped up, any irregularities and/or problems.
Currently water samples are collected weekly at the plant and monthly from the reticulation network, in accordance with bacterial compliance criterion 1 & 6A of the DWSNZ respectively. The samples are analysed by Ashburton District Council’s own facilities for post-treatment bacteriological levels. Manual readings are also taken for FAC, pH and turbidity. The manual readings are only used for process monitoring, not for compliance. Monthly Manganese samples are collected from the plant (beginning April 2017) to monitor the softener performance.
The list of monitored measures and alarms is shown below in Figure **3**.

State	Equipment Name	Point Name	Value	Units	Notes Available	Output	I/O Point Reference
NML	Backwash Tank	High Level Float	0				RDI 12
	Bore	Flow Today	15.5	m³			NAI 2
	Bore	Flow Yesterday	51.47	m³			NAI 3
	Bore	Flow Instantaneous	0	L/s			RAI 4
NML	Bore	Low Float	0				RDI 9
NML	Chlorine	Tank Low	0				
	Chlorine	Tank Level	88.8	L			RAI 6
	Outflow	Instantaneous (Derived)	0.25	L/s			
	Outflow	Today	11.8	m³			NAI 7
	Outflow	Yesterday	24.57	m³			NAI 8
	Pressure	Low SP	250	kPa			NAO 4
NML	Pressure	Low	0				NDI 2
	Pressure	Value	446.5	kPa			RAI 2
	Pump 1	HoursLast2	0.2				
	Pump 1	HoursLast24	3.1	Hours			
	Pump 1	StartsLast2	7				
	Pump 1	StartsLast24	67	Starts			
OFF	Pump 1	Run	0				RDI 1
NML	Pump 1	Fault	0				RDI 2
	Pump 2	HoursLast2	0.2				
	Pump 2	HoursLast24	1.7	Hours			
	Pump 2	StartsLast2	7				
	Pump 2	StartsLast24	69	Starts			
OFF	Pump 2	Run	0				RDI 3
NML	Pump 2	Fault	0				RDI 4
	Pump 3	HoursLast2	0				
	Pump 3	HoursLast24	7.4	Hours			
	Pump 3	StartsLast2	0				
	Pump 3	StartsLast24	0	Starts			
OFF	Pump 3	Run	0				RDI 5
NML	Pump 3	Fault	0				RDI 6
	Pump 4	HoursLast2	0				
	Pump 4	HoursLast24	1.5	Hours			
	Pump 4	StartsLast2	0				
	Pump 4	StartsLast24	1	Starts			
OFF	Pump 4	Run	0				RDI 13
NML	Pump 4	Fault	0				RDI 14
NML	Site	Comms Fail	0				
	Site	Comms Usage Today (%)	5.96	%			
	Site	Comms Usage Yesterday (%)	5.98	%			
	Site	Last Comms	2017-02-17 15:5..				
	Site	DLP Version	10				NAI 1
NML	Site	Phase Fail	0				RDI 11
	Storage Tank	Level High SP	95	%			NAO 3
	Storage Tank	Level Low SP	65	%			NAO 6
NML	Storage Tank	Level High	0				NDI 1
NML	Storage Tank	Level Low	0				NDI 4
	Storage Tank	Level	79	%			RAI 1
NML	Storage Tank	Low Float	0				RDI 10
	Turbidity	Raw Water Turbidity High Setpoint	2.5	NTU			NAO 5
NML	Turbidity	Raw Water Turbidity High Alarm	0				NDI 3
	Turbidity	Raw Water Turbidity	0.03	ntu			RAI 3
	UV	Intensity	0	W/m²			RAI 5
NML	UV	System Alarm	0				RDI 15
NML	UV	System Warning	0				RDI 16

Figure 3 **- Telemetry monitoring and alarms**

5.5 Maintenance and Administration

The Hakatere water supply is owned and managed by Ashburton District Council. Ashburton Contracting Ltd (ACL) are contracted to operate and maintain the water supply. The personnel involved in the day-to-day management and operation of the water scheme are adequately trained and qualified, and ACL staff undertake on-going training.

The reticulation comprises of approximately 150 m of DN 90 PE 80 pipes installed in 2010, and 800 m of DN 50 mm, or smaller, PE pipework initially constructed in 1984. No records have been kept of minor repairs in the general network.

6 History

The Hakatere water supply scheme was established in 1984 and the majority of the scheme reticulation dates from this time.

Major improvements to the scheme include:

- current water bore was drilled in 1998,
- second service tank added in 1999,
- iron and manganese removal plant was installed in 2004,
- an emergency generator was installed in 2008 and later removed (at the request of the community)
- a treatment plant upgrade in 2012

In 2009/2010, the rising main between the treatment plant and Hakatere Drive was upgraded. The upgrade consisted of replacing approximately 150 m of DN 50 HDPE with DN 90 PE 80. No other major reticulation upgrades have been carried out.

A PHRMP was prepared for this scheme in 2009 with a focus on identification of the most significant risks relating to water quality and reliability of supply.
The primary risks in 2009 were those with respect to:

1) Bore source and abstraction:
   - bacterial or protozoa contamination of the source
   - chemical contamination of the source
   - contamination of source water via well head
   - insufficient water available
2) Treatment:
   - inadequate disinfection
   - inadequate protozoa and iron and manganese removal
3) Storage and distribution:
   - Insufficient stored water
   - stored water quality deterioration
   - introduction of contaminants into the distribution system
   - loss of service
4) Other
   - system performance
   - Inadequate controls on construction and maintenance work.

Following a major upgrade programme which took place in 2012, the following significant risks have now been resolved:

- Contamination of source water via well head
- Inadequate disinfection
- Inadequate protozoa removal
- Insufficient stored water
- Stored water quality deterioration

6.1 Plant Upgrade

The bore head has been upgraded and secured, which addresses the risk of contamination of source water via the well head.
The existing treatment works building was extended and now provides a segregated chemical storage room which reduces the risk of pipe deterioration from the chemicals.
A UV treatment unit was installed, which provides disinfection and protozoa deactivation.
One of the existing booster pumps (SV804F22) was replaced with a new fixed speed Lowara pump (CA200/55), which improves the reliability of supply.
Two 30m^3 sealed PE tanks were installed, replacing one of the existing two 23m^3 concrete tanks. This improves water storage and reduces stored water quality deterioration.

7 Water Supply Distribution

7.1 Description of Storage

Two 30m^3 PE storage tanks and one 23m^3 concrete tank are positioned on site and are interlinked for balancing and constant water "turn over".

7.2 Description of Distribution

The reticulation comprises of approximately 150 m of DN 90 PE 80 pipes installed in 2010, and 800m of DN 50mm, or smaller, PE pipework initially constructed in 1984. No records have been kept of minor repairs in the general network.

7.3 Pump Systems

Two pumps (duty and duty assist) supply the distribution zone and are controlled by pressure switches to reduce the number of starts.

7.4 Power Supply Reliability

Power supply to the site is usually reliable but storm and snow events may result in localised or widespread power outages in this area. This would cause loss of supply in case of power outages.
The emergency standby generator was installed in 2008, then later removed at the request of the community.

7.5 Supply Pressure

The SCADA system records pressure information on the supply side of the pressure vessels in the plant, which controls the plant pump to supply. An alarm is set for low service zone pressure and SCADA communication failure.

7.6 Backflow Prevention

Properties served by this supply could pose a backflow contamination risk. There is also the risk of backflow contamination from all other connections if pressure was to drop significantly.

All new connections are examined against the ADC backflow prevention policy and as a minimum include a non-testable double check valve.

7.7 Maintenance

The supply is maintained by Ashburton Contracting Ltd (ACL), who are contracted to operate and maintain all ADC water supplies.

ADC is implementing an Asset Management and Information System (AMIS) to assist with programming, monitoring and tracking regular maintenance and inspection/monitoring tasks. This will also allow regular condition assessments and signal areas at increased risk.

8 Critical Points for Hazard Management

Figure 4 below presents a schematic of the water supply critical points and barriers to contamination. Critical points, where hazards can be eliminated, minimised or isolated are indicated in blue. Barriers to contamination are indicated in red.

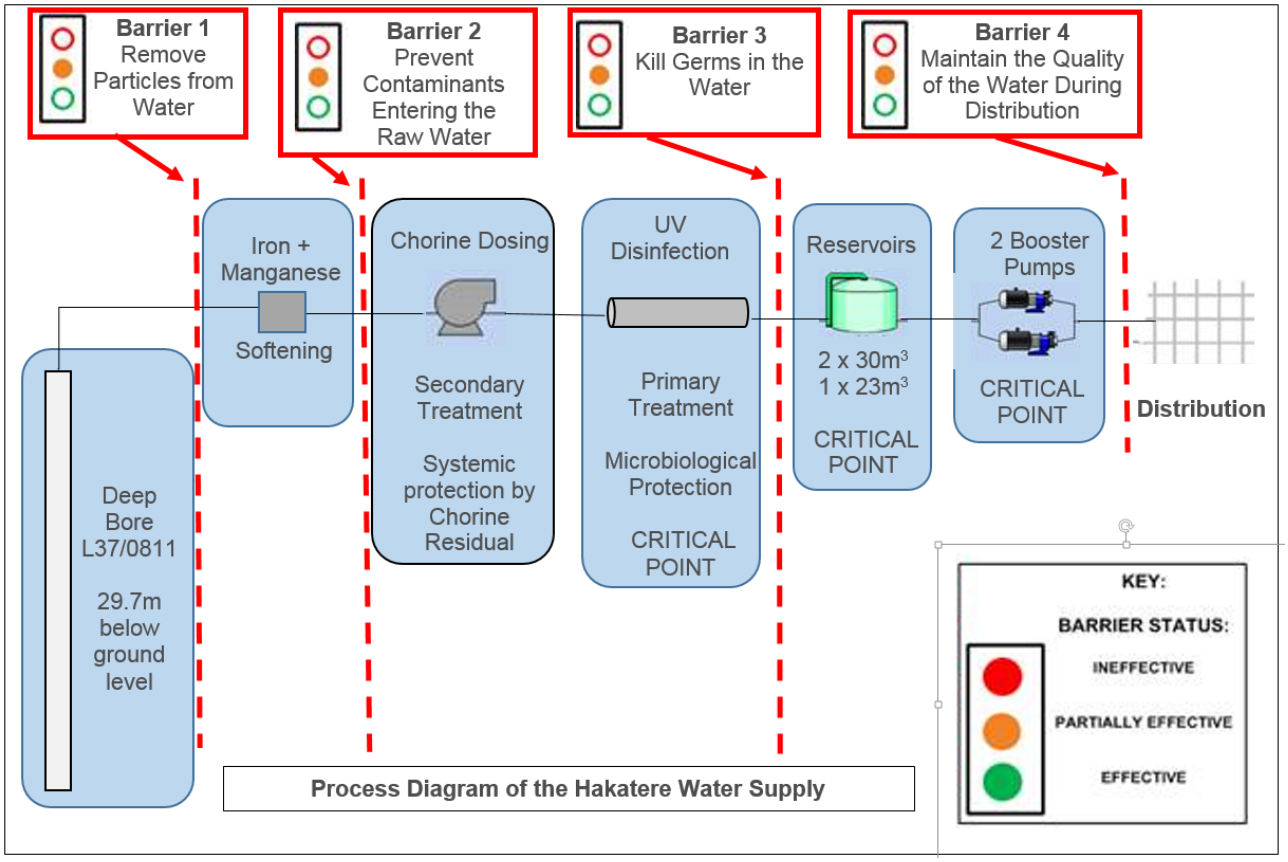

Figure 4 - Hakatere Water Critical Points and Barriers to Contamination

Critical points where hazards can be eliminated, minimised or isolated are tabulated below.

Critical Point	Description
Wellhead	*Possible point for microbiological and protozoa contamination (non-secure, river connection)* *Possible point for loss of supply*

Chlorine Dosing	*Overdosing may exceed chemical MAV* *Possible failure of chlorine dosing would result in loss of the systemic protection provided by the chlorine residual*
Treated Water Storage	*Possible point for microbiological contamination* *Possible point for loss of supply*
UV Disinfection	*Possible failure would result in loss of reliable microbiological and protozoa protection*
Pump Station	*Possible point for loss of supply*
Reticulation	*Possible point for microbiological contamination* *Possible point for loss of supply*

9 Barriers to Contamination

The following section discusses what barriers are in place to reduce the risk to public health from the Hakatere drinking water supply. A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies by the Ministry of Health (2014) states the barriers should:

- Prevent contaminants entering the raw water
- Remove particles from the water
- Kill germs in the water
- Maintain the quality of the water during distribution

9.1 Stop Contamination of Raw Water

The abstraction bore invert level is 29.7m below ground level approximately 300m from the Ashburton River. Currently, there is no definitive comment on whether the raw water is connected to the river water catchment or a separate aquifer. Until such time as necessary investigation and testing has been completed, this water source needs to be considered as a non-secure ground water source, potentially connected to the nearby Ashburton River.

Human and animal access to the Ashburton River catchment is not controlled and may contribute contaminants to the water source. Farming operations in the catchment may also affect water quality. There is no known industrial activity or significant potentially contaminating activities (eg mining, landfill) in the immediate catchment. There are four recorded discharge to land consents (ECan) in the immediate catchment

Some protection is provided by the Land and Water Regional Plan (LWRP), as the bore is regarded as a community drinking water supply under Section 16, Schedule 1. This means that a community drinking water supply protection zone applies, restricting and in some cases prohibiting some activities within a specified distance of the bore. This includes activities such as stormwater discharge, on-site wastewater treatment/disposal devices, and discharge of agrichemicals. The current protection zone assigned to bore L37/0811 is a provisional zone assigned by ECan without the use of any site specific information. A review of this protection zone will need to be undertaken following the catchment & aquifer investigations when the characteristics of the source are better understood.

The well head is constructed to prevent ingress of contaminants. It is housed in a sealed, locked chamber. A backflow prevention system at the wellhead prevents any flow of water back into the source. There is no history of E. coli in the raw water. Samples are collected monthly at the treatment plant and tested for Nitrates. Basic water chemistry sampling is also performed annually in January, where samples are collected for a suite of chemical tests including pesticides/herbicide residuals.

Overall, this barrier is considered to be a **partially effective barrier to contamination**.

9.2 Remove Particles from the Water

There is a softening plant provided to reduce iron and manganese levels in the raw water to achieve the aesthetic guideline value levels. The metal removal process involves the water passing through pressure tanks containing resin beads which "attract" the metals out of solution onto the bead surface. The beads are backwashed periodically using treated water and a brine solution.

There will also be a level of filtration as ground water passes through the gravels within the aquifer. This may aid in contaminant reduction.

Overall, this barrier is considered to be a **partially effective barrier to contamination**.

9.3 Kill Germs in the Water

Disinfection is provided by UV, which is an effective barrier for the removal or inactivation of protozoa. Additionally, chlorine dosing provides a secondary partially effective barrier to contamination.

Liquid sodium hypochlorite solution is injected into the water main upstream of the UV reactor prior to delivery into the storage tanks, primarily as a residual disinfection. The chlorine dosing pump system operates on a fixed dosing rate linked with the abstraction bore pumps. The increased storage consisting of the two new 30m^3 PE tanks and one existing 23m^3 concrete tank increases the chlorine contact time.

There is no on-line monitoring to confirm that the necessary Free Available Chlorine (FAC) is maintained under varying conditions. A turbidity monitor was added after the softener and before the UV to confirm that the water turbidity entering the UV reactor does not exceed the design limits of the drinking water standards.
The measured turbidity for the previous year (February 2016 to February 2017) satisfies the turbidity requirements in section 5.3.1 of the NZDWS.
No formal protozoa risk categorization has been performed on the bore. The plant operating procedures are not currently checked with the respect to the operation and calibration of the plant turbidity meter. The plant monitoring arrangements are not checked against the requirements of section 5.16.3 of the DWSNZ.
Overall, this barrier is considered to be a **partially effective barrier to contamination.**

9.4 Maintain the Quality of Water during Distribution

Disinfection

A chlorine residual is maintained in the reticulation to provide protection in the case of bacterial contamination after treatment. The FAC levels in the water are tested by ADC staff weekly post-treatment and monthly at one of two locations in the distribution zone. The ACL Plant Operator also carries out testing of FAC in the distribution zone.

Reservoirs

The tanks are normally connected in series to maximize contact time. Pipework allows tanks to be bypassed as required. The tanks are covered with screw lid access hatches to prevent unauthorised access, ingress of rainwater or contaminants. The air vents have rodent protection.

Pumpstation

Pressure is maintained in the network by two pumps (providing redundancy), reducing the risk of backflow contaminating the reticulation.

General

New connections are fitted with a backflow prevention device.

Maintenance procedures and hygiene practices, alongside trained and experienced operators, reduce the contamination risks associated with working on water mains. The building housing the treatment equipment and pump station is clean and locked. The area surrounding the building, reservoir and bore is fenced and locked.

The following measures contribute to provision of a **partially effective barrier against recontamination** of water following treatment:

- The tanks are covered/secured to prevent unauthorised access, ingress of rainwater or contaminants, and to exclude birds and vermin.
- Hygiene procedures are documented and followed for all distribution system maintenance.
- A disinfection residual is maintained within the distribution zone.

This barrier could be enhanced by:

- Assess risk of backflow from properties on the scheme and ensure current protection is appropriate / sufficient.
- Monitoring FAC leaving the plant.
- Adding a generator to maintain the supply in case of power outages.

10 Photographs of supply elements

Figure 5 - Wellhead

Figure 6 – Treatment Plant Building

Figure 7 - Two 30m^3 PE tanks and Wellhead Chamber

Figure 8 - 23 m^3 Concrete Tank

Figure 9 - Lowara Booster Pumps

Figure 10 - UV Treatment & Telemetry

Figure 11 - Chlorine Tank

11 Risk Tables

11.1 Risk Assessment Worksheet – Bore and Source Abstraction

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
B1	Microbiological contamination of source water	Contaminated source water – humans, livestock, septic tanks, agricultural activities, surface runoff, etc	Wellhead constructed to secure DWSNZ standards to prevent contamination from surface run-off. Chlorine & UV disinfection Community drinking water supply protection zone around the bore under LWRP Monitoring resource consent applications nearby for possible impacts on the bore Supply is from groundwater bore, which will provide some degree of filtration	Partial	Likely	Medium	Very High	Investigate bore catchment & aquifer characteristics. Obtain a formal protozoa risk categorisation. Assess the wellhead security against groundwater security criteria 2. Confirm validation and certification status of UV unit. Ongoing liaison with adjacent landowners to raise/maintain awareness of catchment protection. Encourage best practice agricultural activities and riparian management.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
B2	Chemical contamination of source water - general	Contaminated source water - agrichemicals, surface runoff, chemical spills	Wellhead constructed to secure DWSNZ standards. Wellhead is secured from casual access. Annual basic water chemistry testing undertaken. Community drinking water supply protection zone around the bore under LWRP Monitoring resource consent applications nearby for possible impacts on the bore Supply is from groundwater bore, which will provide some degree of filtration	Partial	Unlikely	Medium	High	Investigate bore catchment & aquifer characteristics. Ongoing liaison with adjacent landowners to raise/maintain awareness of catchment protection. Encourage best practice agricultural activities and riparian management. Use the Ministry of Health 'Priority 2 Determinand Identification Guide September 2012' to determine if there are any other chemical risks, e.g. disinfection by-products.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
B3	Contamination of source water	Contaminant entry via well head e.g. vandalism, flooding	The borehead is sealed at the surface and within a covered, locked enclosure. Treatment plant site is fenced but the gate is not locked, to allow access to a recycling drop off facility nearby.	Partial	Quite Common	Medium	High	Consider installing a fence to isolate the treatment plant from the nearby recycling drop off facility.
B4	Chemical contamination of source water – nitrates	Changing nitrate levels in the groundwater	Regular monitoring of nitrate-nitrogen at the plant and in the distribution zone. No records above MAV.	Yes				
B5	Contamination of source water	Catastrophic failure, e.g. seismic activity disrupting the aquifer confinement or wellhead protection	Inspection of facilities following a significant earthquake. Annual water chemistry profiles to determine that the water quality is relatively unchanged over time. Monthly monitoring of nitrate-nitrogen in abstracted water.	Partial	Unusual	Medium	Medium	Investigate resilience of plant to natural hazards. Develop Emergency Response Plan and implement if water supply cannot be maintained from this source.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
B6	Insufficient water available	Drought conditions will lead to lower groundwater levels Power supply interruption Bore pump failure	Monitoring resource consent applications nearby for possible impacts on the bore. New bores must be approved by ECan, therefore effects on ground water are assessed before new supplies are approved. Bore water levels are monitored through telemetry and alarmed.	Partial	Quite Common	Medium	High	Review need for increased demand management. Consult with community regarding installation of a generator for power supply in case of emergency. Regularly check bore pump records for any anomalies that may indicate a potential pump fault.

11.2 Risk Assessment Worksheet – Treatment

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T1	Inadequate primary disinfection	Protozoa Risk not formally assigned Uncertainty around UV unit validation and certification status. Uncertainty around plant monitoring arrangements Plant operating procedure not linked to the plant turbidity meter	UV disinfection system in place. Plant monitoring arrangements in place Manual UVT checks.	Partial	Likely	Medium	Very High	Obtain a formal protozoa risk categorisation. Confirm validation and certification status of UV unit. Check plant monitoring arrangements against DWSNZ requirements section 5.16.3 Check plant operating procedures with respect to operation and calibration of the plant turbidity meter

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T2	Inadequate primary disinfection	UV system malfunction, bulb/ballast failure, control system malfunction	Routine checks, inspections, cleaning and lamp replacement in accordance with manufacturer's recommendations. UV System SCADA alarms. UV Intensity recorded on SCADA Manual UVT checks.	Partial	Unlikely	Medium	Medium	
T3	Inadequate primary disinfection	High turbidity (low UVT).	High Turbidity SCADA Alarm Manual UVT checks.	Partial	Unlikely	Medium	Medium	

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T4	Inadequate secondary disinfection (not enough free available chlorine)	Dosing pump malfunction, control system malfunction, SCADA malfunction or inaccuracy	The chlorination process is aimed at disinfection in the reticulation network. Routine plant checks and inspections. Regular manual E. coli, FAC, pH and turbidity monitoring. A sample tap is available for testing on the pump station output.	Partial	Unlikely	Medium	High	Chlorine pump fail alarm. High/low chlorine residual alarm.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T5	Inadequate secondary disinfection (not enough free available chlorine)	Incorrect dose rate or solution strength too high/low. Chlorine solution runs out	Routine checks and inspections. Sodium hypochlorite solution supplied by regular and reputable supplier. Chlorine solution is diluted to reduce rate of decay while in storage. Instructions for refilling the chlorine solution are on site. Regular manual E. coli, FAC, pH and turbidity monitoring. Low chlorine tank alarm.	Partial	Rare	Medium	Medium	Install chlorine analyser. High/low chlorine residual alarms.
T6	Inadequate secondary disinfection (not enough free available chlorine)	High chlorine demand as a result of high turbidity	Regular manual E. coli, FAC, pH and turbidity monitoring. High turbidity alarm.	Yes				

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T7	Inadequate secondary disinfection	Short-circuiting through reservoir reducing contact time.	Reservoirs essentially joined in a series to increase contact time. Regular manual E. coli, FAC, pH and turbidity monitoring.	Yes				
T8	Over-chlorination (too much free available chlorine)	Dosing pump, control system or SCADA malfunction or inaccuracy.	Routine plant checks and inspections. Regular manual E. coli, FAC, pH and turbidity monitoring. The dosing pump only turns on when the bore pump is on. Chlorine tank level is monitored.	Partial	Unlikely	Negligible	Low	Considering installing telemetry alarms for chlorine dosing pump faults and chlorine dosing pump power failure. Consider installing chlorine residual high/low alarms.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T9	Over-chlorination (too much free available chlorine)	Incorrect dose rate or solution strength too high	Sodium hypochlorite solution delivered by regular and reputable supplier. Regular manual E. coli, FAC, pH and turbidity monitoring. Experienced and trained operators. Instructions for refilling the chlorine solution are on site. Calibration device for the dosing pump installed.	Partial	Unusual	Negligible	Low	Consider installing chlorine residual high/low alarms.
T10	Failure to remove other chemical contaminants from raw water	Treatment system inadequate	No known chemical contaminants in source water(ie no P2 determinands) Water chemistry profile carried out regularly.	No	Unusual	Medium	Medium	Cannot implement treatment based control measures to deal with all potential contaminants – control at source.
T11	Insufficient water available	Inadequate treatment plant capacity	Treatment capacity adequate for existing peak daily volume with reservoir storage to meet peak instantaneous flow rate.	Yes				

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T12	Insufficient water available	Damage to plant by natural hazard	Storage on-site in the event of damage to treatment plant. Contingency plans in place for alternative supply (e.g. tankers) if necessary.	Partial	Rare	Medium	Medium	Investigate resilience of plant to natural hazards. Develop Emergency Response Plan and implement if water supply cannot be maintained.
T14	Inadequate iron & manganese removal	Softening system malfunction, control system malfunction	Routine checks, inspections, of Softening system Softening Control is automated any detected fault results in softening unit shut down which stops water flow through plant. Routine Monitoring of Manganese in treated water (from April 2017)to monitor softener performance	Yes				

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk Event**
T15	Inadequate iron & manganese removal	Insufficient backwashing of resin beads	Automated system based on volume throughput and SCADA alarm system Routine Monitoring of Manganese in treated water (from April 2017)to monitor softener performance	Yes				

11.3 Risk Assessment Worksheet – Storage and Distribution

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
S1	Introduction of contaminants into the distribution system	Deliberate or accidental contamination via storage tanks	Storage tanks covered. Treatment plant site is fenced but the gate is not locked, to allow access to a recycling drop off facility nearby. Chlorine residual is maintained in the reservoirs.	Partial	Quite Common	Medium	High	Replace the existing reservoir hatches with lockable hatches. Consider installing a fence to isolate the treatment plant from the nearby recycling drop off facility.
S2	Introduction of contaminants into the distribution system	Backflow	All new connections have some level of backflow preventers, of the type indicated by the backflow prevention policy. A chlorine residual is maintained in the distribution zone. Two pressure booster pumps to provide redundancy.	Partial	Unlikely	Medium	High	Ensure existing connections are replaced in accordance with backflow policy when maintenance/ renewal works permit.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
S3	Introduction of contaminants into the distribution system	Operation and maintenance activities	Contractor has documented practices and procedures for working on water supplies. Contractor is experienced in working with water supplies. Chlorine residual is maintained in the distribution zone.	Yes				
S4	Introduction of contaminants into the distribution system	Pipe materials, age and condition, plumbosolvency	Lifecycle management plan for pipe maintenance and renewals. Relatively new infrastructure not nearing end of life.	Partial	Likely	Medium	Very High	Review and maintain Activity Management Plans and associated asset renewal programmes to minimise failures. Undertake a criticality analysis of the network to assist renewals planning.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
S5	Introduction of contaminants into the distribution system	Damage to distribution system by natural hazards	Pressure maintained will help prevent ingress of foreign material. PE pipe is more resilient against seismic activity. Damaged sections of reticulation can be isolated.	Partial	Rare	Medium	Medium	Develop Emergency Response Plan.
S6	Insufficient water available	Pump or power failure	There are two pressure booster pumps, providing redundancy. Alarms for pump faults are monitored on the telemetry system.	Partial	Likely	Medium	Very High	Consult with community regarding installation of a generator for power supply in case of emergency.
S7	Insufficient water available	Lack of storage	3 tanks on site providing a storage volume of 83 m^3.	Yes				

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
S8	Insufficient water available	Damage to storage or distribution systems, e.g. reservoir failure, water main failure, earthquake damage	The PE tanks and the concrete tank can be isolated separately. Damaged sections of the reticulation can be isolated. Ability to tanker water in to meet demand. ADC approval is required for third parties to work in the road corridor. Staff trained and skilled to repair water mains as required Reservoir level monitoring and SCADA alarms. Shutdowns are managed to avoid pressure surges e.g. water hammer and undue damage to the existing mains.	Partial	Unusual	Medium	Medium	Implement and use Asset Management System (AMS) for programming and monitoring regular maintenance and inspection/monitoring tasks. Undertake a criticality analysis of the network to assist renewals planning. Investigate resilience of plant to natural hazards. Develop Emergency Response Plan and implement if water supply/quality cannot be maintained.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Measures in Place to Control Risk Event**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
S9	Insufficient water	Vandalism or unauthorised access to storage tanks	Treatment plant site is fenced but the gate is not locked, to allow access to a recycling drop off facility nearby.	Partial	Quite Common	Medium	High	Fit a locking system to any taps that would allow unauthorised drain down of the tanks Consider installing a fence to isolate the treatment plant from the nearby recycling drop off facility.

11.4 Risk Assessment Worksheet – Other

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Additional Measures to Control Risk**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
O1	Incorrect water quality data used for supply management (failure to identify inadequate water quality)	Inappropriate/ inadequate/ incorrect sampling and reporting	Council have a sampling calendar for sampling compliance. Staff are trained to take samples and alternate personnel are available to cover for absences. Results are reported through the WINZ system to the Drinking Water Assessor. Sampling locations are clearly labelled. Annual IANZ accreditation for Council laboratory.	Yes				

O2	System does not perform as intended	Incorrect operation, inadequate maintenance.	Operators have sound knowledge of systems. There is an Operation and Maintenance manual. Key operation instructions are displayed permanently on site. An operations log is kept on site Plant records are copied and filed.	Partial	Unusual	Negligible	Low	Review and maintain activity management plans and associated asset renewal programmes to plan for regular maintenance and inspection/monitoring tasks. Ensure all plant records – including manuals, drawings, procedure instructions and emergency response plan are up to date and available at the plant. Council to place a requirement in the service provider to ensure Operation and Maintenance Procedure Manual is up to date and available at the plant. Implement and use Asset management System (AMS) for programming and monitoring regular maintenance and inspection/monitoring tasks.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Additional Measures to Control Risk**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
O3	System does not perform as intended	Inadequate skills or training.	Staff are skilled and experienced.	Partial	Unusual	Negligible	Low	Council to place a requirement on the service provider to provide staff with relevant training and skills.
O4	System damaged or contaminated by construction/ maintenance work	Inadequate controls on construction and maintenance work	All maintenance is undertaken by contractor's trained/authorised staff. Construction work is appropriately supervised. Carriageway Access Request (CAR) and Before You Dig used to permit maintenance and construction works.	Partial	Unusual	Medium	Medium	Maintain accurate as-constructed records and make readily available to all parties working on or in vicinity of system. Implement permit to work system for third parties wishing to work in vicinity of water supply assets. Inspect third party work to ensure water services are adequately protected.

List what could happen that may cause drinking-water to become unsafe (deterioration in water quality)			*Is this under control?*		*If not, judge whether this needs urgent attention. Urgent attention is needed for something that happens a lot and/or could cause significant illness.*			*What improvements could be made?*
Ref	**Risk Event**	**Potential Cause of Risk Event**	**Additional Measures to Control Risk**	**Controlled Yes/ No/ Partial**	**Likelihood of Risk Event**	**Consequences of Risk Event**	**Risk Level**	**Additional Measures to Control Risk**
O5	Inability to access site for operation/ maintenance/ emergency works	Flood, slip, bridge washout, snow fall or other hazard preventing vehicular access	Access roads are in good condition and are not generally vulnerable to natural hazards. Operations staff are equipped with suitable 4WD vehicles and given training in these use of these.	Yes				
O6	Loss of monitoring and alarm systems	Failure of SCADA system	Pumping and treatment control systems are independent of SCADA system so there will be no interruption to supply or treatment. SCADA operates from battery backup in event of power failure. Failure of remote SCADA equipment triggers alarm at central control centre prompting site attendance to investigate. All work on SCADA systems is undertaken by specialist telemetry contractor.	Yes				

12 Improvement Schedule

The Improvement Schedule is presented in two sections:

Part I: Major Projects and Capital Works

These projects will generally provide the greatest benefits in terms of addressing public health risks but typically require high levels of funding that may not be realistic for the community involved. It is noted that Council operate a targeted rating system such that costs associated with each water supply are borne by those ratepayers with connections to the supply. In many instances, major projects (e.g. new water source, additional treatment process) will require specific investigation and evaluation of options prior to confirmation of a suitable improvement solution. The Improvement Schedule may present a timetable for progressing such investigations, with the intention of incorporating specific upgrade projects in future versions of the WSP.

Part II: Management and Operational Improvements

These improvements will generally not provide the same degree of risk reduction as the proposed capital works upgrades but collectively they contribute to providing and maintaining effective barriers to contamination and can often be undertaken within existing operational budgets. These works are prioritised on the basis of the risk level identified and budget/resource availability.

Prioritisation

The priority for implementation is initially based on the identified risk level as follows:

Extreme risk	=	Priority 1
Very High risk	=	Priority 2
High risk	=	Priority 3
Medium risk	=	Priority 4
Low risk	=	Priority 5

Priorities have then been modified (generally elevated) where improvement items are related or need to be sequenced together.

Responsibility

The responsibility for implementation of specific improvement items is identified.

AM	=	Assets Manager
ACL	=	Ashburton Contracting Limited

Timeframes

The proposed timeframe for implementation reflects the assessed priority, anticipated funding arrangements and availability of resources. Some lower priority, low cost improvements may be completed at an earlier date where staff resources are available.

Compliance Timeframe

The Hakatere water supply falls in the category of a Small drinking water supply under the Health Act. This requires that all practicable steps are taken to comply with the Drinking Water Standards by 1 July 2015.

As Hakatere has not been granted secure groundwater status under Section 4.5 of DWSNZ, the Hakatere water supply is not compliant with the DWSNZ.

12.1 Part I: Major Projects and Capital Works

Hakatere Water Supply Improvement Schedule					Part I: Major Projects and Capital Works		
Priority	**Risk Level**	**Water Supply Area**	**Reference to Risk Tables**	**Details of Proposed Works**	**Person Responsible**	**Expected Cost**	**Intended date of Completion**
Given the recent upgrade no major projects or capital works are anticipated at this stage.							

12.2 Part II: Minor Projects and Operational Improvements

Hakatere Water Supply Improvement Schedule Part II: Minor Projects and Operational Improvements							
Priority	**Risk Level**	**Water Supply Area**	**Reference to Risk Tables**	**Details of Proposed Works**	**Person Responsible**	**Expected Cost**	**Intended date of Completion**
1	Very High	Source	B1, B2	Investigate bore catchment & aquifer characteristics for protozoa risk assessment and Drinking Water Protection Zone Review. Obtain a formal protozoa risk categorisation Assess the wellhead security against groundwater security criteria 2	AM	$1,000 + Staff time	31/3/2018
1	Very High	Source	B1, B2	Ongoing liaison with adjacent landowners to raise/maintain awareness of catchment protection. Encourage best practice agricultural activities and riparian management.	AM	Administration costs + staff time	Ongoing
1	Very High	Source	B6, S6	Consult with community regarding installation of a generator for power supply in case of emergency.	AM	Staff time	31/12/2020

Hakatere Water Supply Improvement Schedule Improvements				Part II: Minor Projects and Operational			
Priority	**Risk Level**	**Water Supply Area**	**Reference to Risk Tables**	**Details of Proposed Works**	**Person Responsible**	**Expected Cost**	**Intended date of Completion**
1	Very High	Source, Treatment	B1, T1	Confirm validation and certification status of UV unit. Check plant monitoring arrangements against DWSNZ requirements section 5.16.3 Check plant operating procedures with respect to operation and calibration of the plant turbidity meter	AM	Staff time	31/3/2018
1	Very High	Distribution	S4, O2	Review and maintain Activity Management Plans and associated asset renewal programmes to minimise failures.	AM	Staff time	Ongoing
1	Very High	Distribution	S4, S8	Undertake a criticality analysis of the network to assist renewals planning.	AM	Staff time	31/3/2018
2	High	Source	B2	Use the Ministry of Health 'Priority 2 Determinand Identification Guide September 2012' to determine if there are any other chemical risks, e.g. disinfection by-products.	AM	Staff time	Ongoing

Hakatere Water Supply Improvement Schedule Improvements				Part II: Minor Projects and Operational			
Priority	**Risk Level**	**Water Supply Area**	**Reference to Risk Tables**	**Details of Proposed Works**	**Person Responsible**	**Expected Cost**	**Intended date of Completion**
2	High	Treatment	T4,T8	Consider installing telemetry alarms for chlorine dosing pump faults and chlorine dosing pump power failure.	AM	$1,000 + Staff time	31/12/18
2	High	Treatment	T4,T5,T8, T9	Consider installing low/high chlorine residual alarms.	AM	$2,000 + Staff time	31/12/18
2	High	Distribution	S1	Replace the existing reservoir hatches with lockable hatches	AM	$5,000 + Staff time	31/12/18
2	High	Distribution	S9	Fit a locking system to any taps that would allow unauthorised drain down of the tanks	AM	$ 500 + Staff time	31/12/18
2	High	Source, Distribution	B3, S1, S9	Consider installing a fence to improve security of the treatment plant facility.	AM	$20,000	31/12/19
2	High	Distribution	S2	Ensure existing connections are replaced in accordance with backflow policy when maintenance/ renewal works permit.	AM	Staff time	1/7/2018 + Ongoing
2	High	Source	B6	Review need for increased demand management.	AM	Staff time	1/7/2018
2	High	Source	B6	Regularly check bore pump records for any anomalies that may indicate a potential pump fault.	AM	Staff time	Ongoing

Hakatere Water Supply Improvement Schedule Improvements				Part II: Minor Projects and Operational			
Priority	**Risk Level**	**Water Supply Area**	**Reference to Risk Tables**	**Details of Proposed Works**	**Person Responsible**	**Expected Cost**	**Intended date of Completion**
3	Medium	Source, treatment, distribution	B5, T12, S8	Investigate resilience of plant to natural hazards.	AM	Staff time	1/7/2019
3	Medium	Source, treatment, distribution	B5, T12, S5, S8	Develop and adopt an Emergency Response Plan.	AM	$5,000 + Staff time	1/7/2019
3	Medium	Treatment	T5	Install chlorine analyser	AM	$10,000 + Staff time	31/12/19
3	Medium	Distribution	S8, O2	Implement and use Asset Management System (AMS) for programming and monitoring regular maintenance and inspection/monitoring tasks.	AM	Staff time	1/7/2018 + Ongoing
3	Medium	Other	O4	Maintain accurate as-constructed records and make readily available to all parties working on or in vicinity of system. Implement permit to work system for third parties wishing to work in vicinity of water supply assets. Inspect third party work to ensure water services are adequately protected.	AM	Staff time	1/7/2019
4	Low	Other	O2	Ensure all plant records – including manuals, drawings, procedure instructions and emergency response plan are up to date and available at the plant.	ACL	Staff time	1/7/2020 + Ongoing

Hakatere Water Supply Improvement Schedule Improvements				Part II: Minor Projects and Operational			
Priority	**Risk Level**	**Water Supply Area**	**Reference to Risk Tables**	**Details of Proposed Works**	**Person Responsible**	**Expected Cost**	**Intended date of Completion**
4	Low	Other	O2	Council to place a requirement in the service provider to ensure Operation and Maintenance Procedure Manual is up to date and available at the plant.	AM	Staff time	1/7/2020
4	Low	Other	O3	Council to place a requirement on the service provider to provide staff with relevant training and skills.	AM	Staff time	1/7/2020
4	Low	Other	O2	Review and maintain activity management plans and associated asset renewal programmes to plan for regular maintenance and inspection/monitoring tasks. Ensure all plant records – including manuals, drawings, procedure instructions and emergency response plan are up to date and available at the plant. Council to place a requirement in the service provider to ensure Operation and Maintenance Procedure Manual is up to date and available at the plant. Implement and use Asset management System (AMS) for programming and monitoring regular maintenance and inspection/monitoring tasks.	AM	Staff time	1/7/2020 + Ongoing

13 Contingency Plan

The following contingency plan outlines appropriate responses to a range of potential situations where risk control measures fail to prevent a hazard event that may result in a situation of acute risk to public health.

The occurrence of a hazard, or risk event, may be indicated by monitoring systems, observed by ADC or ACL staff or reported by the public. Consumer complaints of illness or water quality issues may also indicate that a risk event has occurred.

The contingency actions identified are intended to provide a general guide and may need to be adapted to suit specific hazard situations.

13.1 Severe Microbiological Contamination of Source Water

Indicators	A contamination event in the catchment may be observed by or reported to ADC staff Reported illness among consumers Positive E. coli monitoring results
Actions	Issue "Boil Water' notice Advise Drinking Water Assessor (DWA) Inspect catchment and intake to identify source of contamination and rectify problem as quickly as possible Consider provision of emergency treatment or alternative water supply (e.g. reinstate decommissioned bore or use tankers) Disinfect contaminated reservoirs and flush mains Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.2 Chemical Contamination of Source Water

Indicators	A contamination event in the catchment may be observed by or reported to ADC staff Reported water quality concerns from consumers (taste, odour, colour) Illness among consumers Unexpected chemical presence in annual chemical testing
Actions	Advise Drinking Water Assessor (DWA) Assess situation and advise customers regarding use/treatment/disposal of contaminated water Arrange emergency water supply if necessary Inspect catchment and intake to identify source of contamination and rectify problem as quickly as possible Flush contaminated reservoirs and mains Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.3 Insufficient Source Water Available

Indicators	Observed or reported low ground water levels
Actions	Advise customers to conserve water Implement demand management strategies as required Arrange emergency water supply if necessary Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.4 Insufficient Water Available due to Leakage

Indicators	Observed or reported reduction in pressure or water availability
Actions	Advise customers to conserve water Implement demand management strategies as required Arrange emergency water supply if necessary Investigate system leakages Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.5 E. coli Transgression in Water Leaving Treatment Plant

Indicators	E. coli transgression reported following routine monitoring
Actions	Follow transgression response procedure in DWSNZ Advise Drinking Water Assessor (DWA) Commence daily E. coli testing at Water Treatment Plant Use an enumeration test method Sample in distribution system Investigate cause, inspect plant and source Take remedial action Continue to sample for E. coli until three consecutive samples are free of E. coli If E. coli is found in repeat samples consult with DWA, intensify remedial action, increase disinfection, consider 'Boil Water' notice, consider alternative supply
Responsibility	Assets Manager

13.6 Over-Chlorination

Indicators	Monitoring shows high FAC Complaints of strong chlorine taste/ smell from customers
Actions	Assess potential hazard to consumers and advise accordingly Inspect treatment plant to identify cause of problem and rectify as quickly as possible Flush system if necessary Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.7 Inadequate Disinfection

Indicators	Monitoring shows low or no FAC
Actions	Inspect treatment plant to identify cause of low or no FAC, or potential contamination and rectify problem as quickly as possible Assess the situation and consider issuing a precautionary boil water notice if deemed appropriate Notify DWA of situation and actions taken Consider provision of emergency treatment equipment or alternative water supply (e.g. tankers) Disinfect reservoirs and flush mains Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.8 E. coli Transgression in Water in the Distribution Zone

Indicators	E. coli transgression reported following routine monitoring
Actions	Follow transgression response procedure in DWSNZ (Figure 4.2 in 2008 version), and ADC response procedures Advise Drinking Water Assessor (DWA) Inspect plant/source Collect sample at plant for E. coli test, enumerate E. coli Resample distribution at original and adjacent sites Investigate cause and undertake remedial action If E. coli < 10 per 100mL consult DWA, resample distribution zone and enumerate for E. coli for three days, continue investigation of fault If E. coli > 10 per 100mL consult DWA, consider 'Boil Water' notice, continue investigation of cause, begin disinfection, consider flushing contaminated water to waste, intensify action, consider providing alternative supply Continue until fault is corrected and E. coli is absent for three consecutive days and DWA is satisfied that there is no remaining contamination
Responsibility	Assets Manager

13.9 Chemical Contamination of Water in Distribution Zone

Indicators:	Chemical contaminant in distribution zone (including over-chlorination)
Actions:	Advise Drinking Water Assessor (DWA) Assess situation and advise customers regarding use/treatment/disposal of contaminated water Arrange emergency water supply (tankers) if necessary Inspect catchment and intake to identify source of contamination and rectify problem as quickly as possible Flush contaminated reservoirs and mains If necessary Keep customers informed and advise once regular service is restored
Responsibility:	Assets Manager

13.10 Insufficient Water Available in the Distribution Zone

Indicators	Low pressure and flow in the distribution
Actions	Advise customers to conserve water Implement demand management strategies as required Arrange emergency water supply if necessary Keep customers informed and advise once regular service is restored
Responsibility	Assets Manager

13.11 Insufficient Water Available due to Unplanned Shutdown

Indicators	Unplanned shutdown will be reported to ADC staff by contractor
Actions	Keep customers informed and advise once regular service is restored Arrange emergency water supply if necessary
Responsibility	ACL and Assets Manager

14 Critical Control Points

14.1 Raw Water Turbidity

Process objectives:

- Provides a **raw water Quality Control Point** to help determine whether the UV treatment will provide the necessary log removal of protozoa.

Operational monitoring of control process:	
What	Raw water turbidity (NTU)
When	Continuous on-line SCADA monitoring
Where	Inside treatment plant, between the softener and the UV reactor
How	Hach 1720E Turbidimeter – online values and alarms to SCADA
Who	ACL Operator / ADC staff via SCADA
Records	SCADA data historian and plant log-book

Process performance criteria at the operational monitoring point:		**Correction if operating criteria are not met:**
Target Range:	< 1.0 NTU	No correction currently possible.
Action Limits:	NTU: > 1.0 NTU (for more than 5 minutes)	Duty Operator to respond by keeping a closer eye on the SCADA readings and weather conditions (high or constant rain) Duty Operator to notify Duty Supervisor and ADC Compliance Officer to monitor and prepare for Contingency Plan 13.7
Critical Limits:	NTU: > 2.0 NTU (for more than 3 minutes)	Duty Operator to notify Duty Supervisor and ADC Compliance Officer to monitor and prepare for Contingency Plan 13.7

Supporting programs:

- Monthly verification of the turbidimeter by the Operator.
- Three-monthly calibration of the turbidimeter by the Operator.
- Follow manufacturer's guidelines regarding further operation and maintenance of the turbidimeter.
- Monthly Operator check of accuracy of calibration standards and discarding of outdated calibration standards.
- Training and competency of Operator in the calibration, verification, operation and maintenance of turbidity instruments.
- Only utilise materials provided by the recognised supplier.
- Periodic in-depth servicing of instruments by a Hach Service Engineer, in accordance with the manufacturer's guidelines.

Periodic end-to-end testing of critical signals

14.2 UV Dose

Process objectives:

- Provides a **UV Dose Control Point** to help determine whether the UV treatment is providing the necessary log removal of protozoa.

Operational monitoring of control process:	
What	UV Dose
When	Continuous on-line SCADA monitoring
Where	Inside treatment plant, at UV reactor
How	UV reactor built-in instrumentation– continuous monitoring and alarms to SCADA
Who	ACL Operator / ADC staff via SCADA
Records	SCADA data historian and plant log-book

Process performance criteria at the operational monitoring point:		**Correction if operating criteria are not met:**
Target:	40 mJ/cm^2	No correction currently possible.
Action Limits:	*UV System Warning* alarm	Duty operator should keep a close eye on the SCADA readings and weather conditions (high or constant rain). Duty Operator to notify Duty Supervisor and ADC Compliance Officer to monitor and prepare for Contingency Plan 13.7.
Critical Limits:	*UV System Alarm* alarm	Duty Operator to notify Duty Supervisor and ADC Compliance Officer to follow Contingency Plan 13.7.

Note: The UV dose is not indicated explicitly on SCADA. The UV reactor monitors treatment parameters and calculates dose, and alarms are configured to indicate treatment insufficiency.

Supporting programs:

- Monthly verification of the UVT instrumentation by the Operator.
- Annual calibration (or replacement) of the UVT instrumentation by the supplier.
- Follow manufacturer's guidelines regarding further operation and maintenance of the UVT instrumentation.
- Training and competency of Operator in the calibration, verification, operation and maintenance of UVT instrumentation.
- Periodic calibration of the plant flowmeter by a suitable expert, in accordance with the manufacturer's guidelines.

Periodic end-to-end testing of critical signals.

14.3 Chlorine Disinfection - Plant

Process objectives:

- Provide **residual disinfection Quality Control Point** to help inactivate pathogens entering downstream of the dosing point.

Operational monitoring of control process:	
What	Free available chlorine (FAC) concentration in mg/L
When	Twice weekly (ACL) Weekly (ADC)
Where	Sample point inside the treatment plant
How	Hand-held pocket colorimeter with vendor-supplied reagents
Who	ACL Operator, ADC Environmental Monitoring Officer
Records	Plant log-book (ACL), Water Outlook (ADC)

Process performance criteria at the operational monitoring point:		**Correction if operating criteria are not met:**
Target Range:	FAC: 0.8-1 mg/L	Operator to adjust dosing system to achieve target range if noticed to be outside of target range during routine checking procedures
Action Limits:	FAC: < 0.7 mg/L > 1.2 mg/L	Duty Operator to respond by adjusting dosing to within target limits. Duty Operator to notify Duty Supervisor.
Critical Limits:	FAC: < 0.3 mg/L > 1.5 mg/L	Duty Operator to respond by adjusting dosing to within target limits. Duty Operator to notify Duty Supervisor. Duty Supervisor to contact ADC Compliance Officer. Contingency plan 13.6 (over -chlorination) or contingency plan 13.7 (inadequate disinfection) is to be followed.

Supporting programs:

- Monthly monitoring instrument checking and calibration by Operator as necessary.
- Monthly Operator check of accuracy of reagents and discarding of outdated reagents.
- Training and competency of Operator in free chlorination of drinking water.
- Only utilise potable water grade chlorine stock solution from approved supplier.

14.4 Chlorine Disinfection - Reticulation

Process objectives:

- Provide **residual disinfection Quality Control Point** to help inactivate pathogens entering downstream of the dosing point

Operational monitoring of control process:	
What	Free available chlorine (FAC) concentration in mg/L
When	ADC monthly ACL twice weekly
Where	ADC staff: Hakatere has two zone sample taps, located on Hakatere Drive North and at the public toilets. ACL operators: Sampling bollards as above
How	Hand-held pocket colorimeter with vendor-supplied reagents
Who	ADC Environmental Monitoring Officer and ACL Operator
Records	ACL: Plant log-book ADC: Water Outlook

Process performance criteria at the operational monitoring point:		**Correction if operating criteria are not met:**
Target Range:	FAC: 0.8-1 mg/L	Operator to adjust dosing system to achieve target range if noticed to be outside of target range during routine checking procedures
Critical Limits:	FAC: < 0.3 mg/L > 1.5 mg/L	ADC Environmental Monitoring Officer / ACL Operator to contact ADC Compliance Officer. Contingency plan 13.6 (over -chlorination) or contingency plan 13.7 (inadequate disinfection) is to be followed.