



Te Kauwhata Water

Supply Water Safety Plan

Organisation and Supply Details:

Community Name	Te Kauwhata (TEK001)
Supply owner/organisation name:	Waikato District Council
Prepared by:	CH2M Beca Ltd and Waikato District Council staff
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Contents

1	Revision Details	5
2	Introduction	5
3	Supply Details	6
4	History of the Te Kauwhata Water Supply	7
5	Description of the Te Kauwhata Water Supply	7
	5.1 Intake.....	9
	5.2 Water Treatment Plant	10
	5.3 Reticulation	12
	5.4 Management	12
6	Photographs of the Te Kauwhata Water Supply	13
7	Flow Chart / Schematic of the Supply	34
8	Barriers to Contamination	35
9	Benefits of Proposed Improvements	36
10	Methodology	36
11	Risk Ranking Procedure	37
12	Improvement Schedule	40
13	Drinking Water Standards and Grading	52
14	Consultation	53
15	Contingency Plan	54
16	Risk Tables	58

List of Figures

Figure 1.	On-Demand and Restricted Supply Areas Overview.....	8
Figure 2.	Location of Te Kauwhata Water Treatment Plant and Reticulation.....	9
Figure 3.	Te Kauwhata Intake, Headworks and Arkal Filters Overview	10
Figure 4.	Te Kauwhata Treatment Plant Overview	12
Figure 5	Intake.....	13
Figure 6	Headworks.....	13
Figure 7	Arkal Filters.....	14
Figure 8	Raw Water Reservoir	14
Figure 9.	Raw Water pH and Turbidity Monitoring	15
Figure 10.	Pre-Caustic Dosing Equipment.....	16
Figure 11.	Alum Dosing Equipment.....	17
Figure 12.	PAC Dosing Equipment.....	17
Figure 13.	Coagulant and pH Dosing Monitoring Equipment	18
Figure 14.	Poly Dosing Equipment	19
Figure 15.	Clarifier Flocculation Tank, and Poly Dose Point.....	19
Figure 16.	Clarifiers.....	20
Figure 17.	Clarified Water Turbidity Meters	20
Figure 18.	Fluoride Dosing Equipment	21
Figure 19.	Filters.....	21
Figure 20.	Filter Turbidimeters	22
Figure 21.	Clarifier and Filter Waste Settling Ponds.....	23
Figure 22.	Post-Caustic Dosing Equipment	24
Figure 23.	UVT Monitoring Equipment	25
Figure 24.	UV Dosing Equipment	26
Figure 25.	UV Dosing Control and Monitoring Equipment.....	26
Figure 26.	Chlorine Dosing Equipment	27
Figure 27.	Filtered Water Quality Monitoring Instrumentation	28
Figure 28.	Backwash, and Treated Water Reservoirs.....	29
Figure 29.	Network Pumps.....	29
Figure 30.	Final Water Quality Monitoring Instrumentation 1.....	30
Figure 31.	Final Water Quality Monitoring Instrumentation 2.....	31
Figure 32.	Network Reservoir, Hall Road, Western B	32
Figure 33.	Network Reservoir, Springhill Road, Meremere	32
Figure 34.	Network Reservoir, Te Kauwhata Road, Te Kauwhata	33

List of Tables

Table 1.	Summary of Te Kauwhata Water Supply Details	6
Table 2.	Critical Points	35
Table 3.	Likelihood Scale	38
Table 4.	Consequence Scale	38
Table 5.	Risk Level Allocation Table	39
Table 6.	Capital and Significant Projects	42
Table 7.	Operational Improvements and Minor Projects	46
Table 8.	Summary of Compliance with DW SNZ	52
Table 9.	Risk Table: Catchment	58
Table 10.	Risk Table: Intake	61
Table 11.	Risk Table: Coagulation, Flocculation & Sedimentation / PAC Dosing	65
Table 12.	Risk Table: Filtration	72
Table 13.	Risk Table: pH Adjustment	75
Table 14.	Risk Table: UV Disinfection	76
Table 15.	Risk Table: Chlorine Dosing	77
Table 16.	Risk Table: Storage Reservoir and Lift Pumps	81
Table 17.	Risk Table: Reticulation	83
Table 18.	Risk Table: Storage Reservoirs	88
Table 19.	Risk Table: Other	90

1 Revision Details

This plan will be revised and submitted for approval before 31 January 2023.

Assessment of the Performance of the Plan

Assessment of the performance of the Water Safety Plan (WSP) will be undertaken annually. The assessment will consider any events, non-compliances, near misses and unexpected situations that have occurred, progress against the improvement schedule and any changes to any of the supply elements. Any matters requiring attention will be included into the Annual Plan, the Water Supply Activity Management Plan and if requiring significant capital funding, the Council Long Term Plan.

Reporting of the Plan

A brief report on the performance of the WSP, including information from the assessment of the plan will be provided by the Compliance and Income Team Leader to the Treatment and Services Team Leader in February of each year. The report will cover the items listed in the assessment of the performance of the plan, listed above. The Treatment and Services Team Leader will be responsible for ensuring that any matters requiring attention will be appropriately included into the Annual Plan or the Water Supply Activity Management Plan. If significant capital funding is required the Treatment and Services Team Leader will include the matter into the Council approval process and the Council Long Term Plan.

Links to other Quality Systems

This WSP will be linked to the Annual Plan, the Water Supply Activity Management Plan and the Long Term Plan.

2 Introduction

This Water Safety Plan (WSP) has been prepared for the Te Kauwhata water supply to identify potential events that present public health risks to the consumers of the drinking water supply. Waikato District Council (WDC) is committed to the WSP and to the future improvements to the supply identified in this WSP.

A Public Health Risk Management Plan (PHRMP) was first prepared by Opus International Consultants Ltd for the Te Kauwhata supply in early 2012. This WSP has been prepared using the original PHRMP as a starting point but including more up to date information following further consultation.

The Te Kauwhata drinking water supply is a small supply providing water to a population of approximately 2,149 people in Te Kauwhata, Hampton Downs and Meremere.

The water is sourced from the Waikato River before it undergoes conventional treatment at the Te Kauwhata Water Treatment Plant (WTP). It is then pumped from the treatment plant through the reticulation to three storage reservoirs.

The scheme is administered at the main WDC offices in Galileo Street, Ngaruawahia and managed by the Waters Manager.

The management, maintenance and operation of the Te Kauwhata water supply is the responsibility of:

- Waters Manager – Karl Pavlovich
- Treatment & Services Team Leader – Vacant
- Treatment Supervisor – David Kennington

- Compliance and Income Team Leader – Jaime Wara
- Water Planning Team Leader – Richard Pullar
- Six Treatment plant operators with expected qualifications of Level 4 Waters
- Five Reticulation serviceman and Two cadets with expected qualifications of Level 4 Waters

3 Supply Details

Table 1. Summary of Te Kauwhata Water Supply Details

Supply Details	
Supply Name	Te Kauwhata
WINZ Community Code	TEK001
Supply Owner	Waikato District Council
Population Served by Supply	2,149 (WINZ register June 2017)
Source Details	
Source Name	Waikato River for Te Kauwhata
Source WINZ Code	S00067
Type of Source	River
Depth of Bore	NA
Consent Expires	30 June 2024
Maximum Consented water take:	22,900 m ³ /day for whole of Te Kauwhata Irrigation Association
Grid Reference of Source (NZMG)	
Easting : 1750346.46	Southing : 372346.92
Treatment	
Location	Te Kauwhata
Treatment Processes	Coagulation; Filtration; UV; Chlorination
Average Daily Volume	1,713 m ³ /day
Peak Daily Volume	3,262 m ³ /day
Distribution – Zone 1	
Distribution Zone Name	Te Kauwhata / Rangiriri
Distribution Zone WINZ Code	TEK001TR
Distribution Zone Population	1,410 (WINZ register June 2017)
Distribution – Zone 2	

Distribution Zone Name	Whangamarino Rural / Meremere
Distribution Zone WINZ Code	TEK001WH
Distribution Zone Population	739 (WINZ register June 2017)

4 History of the Te Kauwhata Water Supply

The original Te Kauwhata water supply was established by the Te Kauwhata Irrigation Association (TKIA) primarily as an irrigation scheme supplying water to the rural areas of W hangamarino, Meremere, Te Kauwhata, and Rangiriri. Water was abstracted from the Waikato River and filtered through a bank of Arkal coarse filters, before being chlorinated to prevent the growth of algae and pumped to consumers.

In the 1980's, Waikato District Council established a community supply for Te Kauwhata and Rangiriri using water from the TKIA supply. At the Hall Road treatment plant, the chlorinated water destined for the Te Kauwhata township entered a control reservoir before passing through additional treatment processes. The pre-chlorination was found to be creating potentially harmful by-products, so the supply underwent a series of upgrades in 1996, 2000 and 2003.

Currently the supply still receives screened raw water from the TKIA intake, under the resource consent held by TKIA (Consent No. 109337). From the intake the raw water line goes to a shared reservoir, owned by the TKIA. The irrigation scheme is supplied with chlorinated water from this reservoir and a separate metered pipeline provides raw water from the reservoir to the Te Kauwhata water treatment plant. Treated water is then distributed to the two distribution zones of the supply.

The latest upgrade of the treatment plant in 2003 increased the capacity of the supply from 1,870m³/day to 3,080m³/day to cater for predicted future growth in the North Waikato region and to supply potable water to the new Spring Hill Corrections Facility. The Department of Corrections provided a significant contribution to the funding of this upgrade.

Significant investment has been made in recent years into dosing equipment, monitoring instrumentation, and process controls in order to improve and ensure the final water quality.

The Waikato River is known to sometimes contain cyanobacteria algal blooms during the warmer summer months. A powdered activated carbon dosing system is installed at the treatment plant to be used in the event of cyanotoxin contamination.

5 Description of the Te Kauwhata Water Supply

The Te Kauwhata water treatment plant is located just south of the Hampton Downs correction facility at Hall Road. The treatment plant is a conventional coagulation, clarification, filtration design with UV and chlorine disinfection and provides water for the domestic, commercial and industrial needs of the Te Kauwhata, Meremere and Hampton Downs communities. The supply has two distribution zones; Te Kauwhata / Rangiriri and W hangamarino Rural / Meremere. The Te Kauwhata / Rangiriri zone serves the town of Te Kauwhata whilst the W hangamarino Rural / Meremere zone serves the communities of Hampton Downs and Meremere. The zones have a mix of on-demand and restricted supplies, as shown in the following figure.

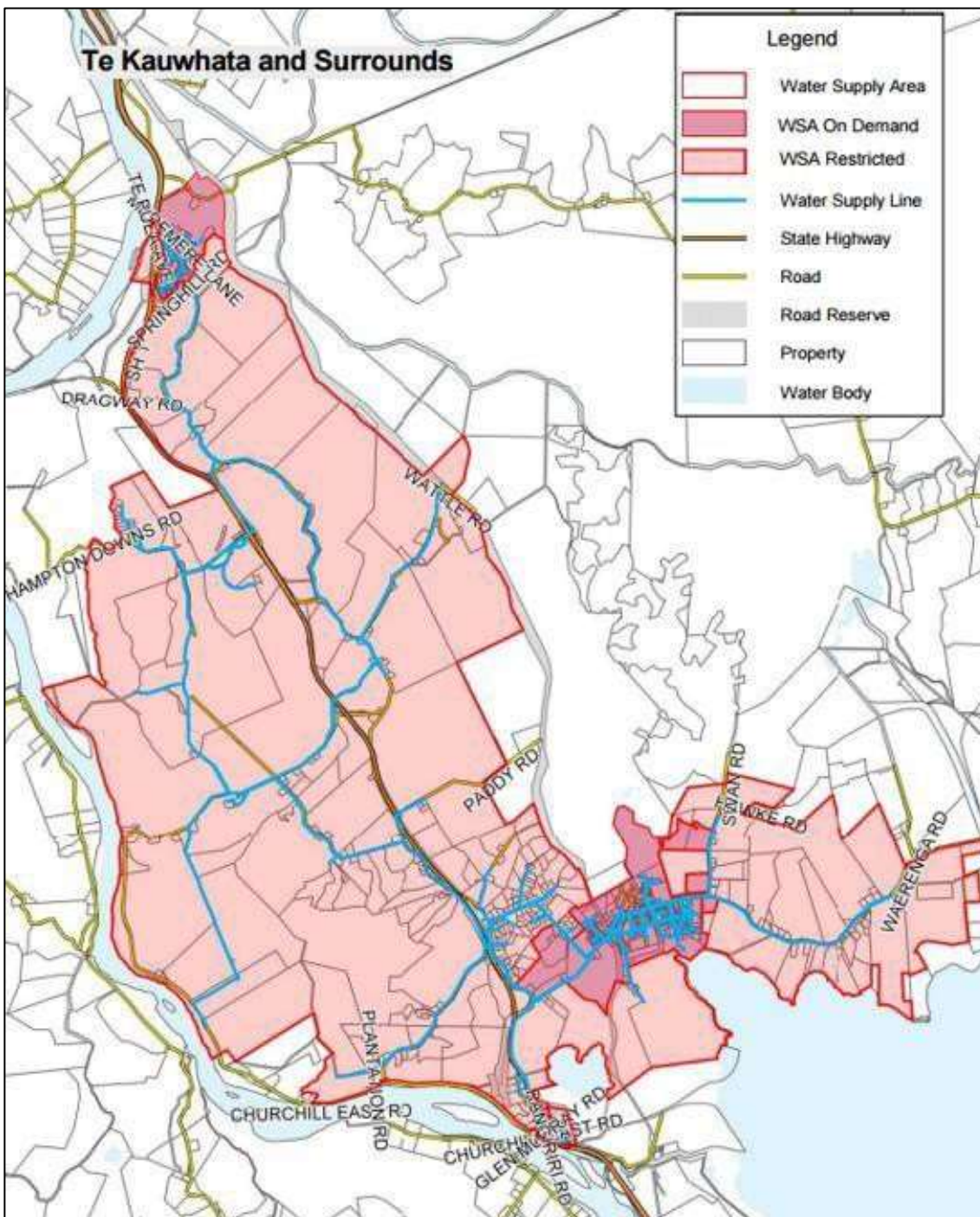


Figure 1. On-Demand and Restricted Supply Areas Overview

Because the Te Kauwhata WTP abstracts raw water from the Waikato River, the primary water quality concerns are microbiological - protozoa, bacteria / viruses and cyanobacteria. The Waikato River water is low in turbidity but reasonably high in colour. Quality is also relatively constant compared to most surface waters, being heavily influenced by Lake Taupo and hydro-electric impoundments along the river.

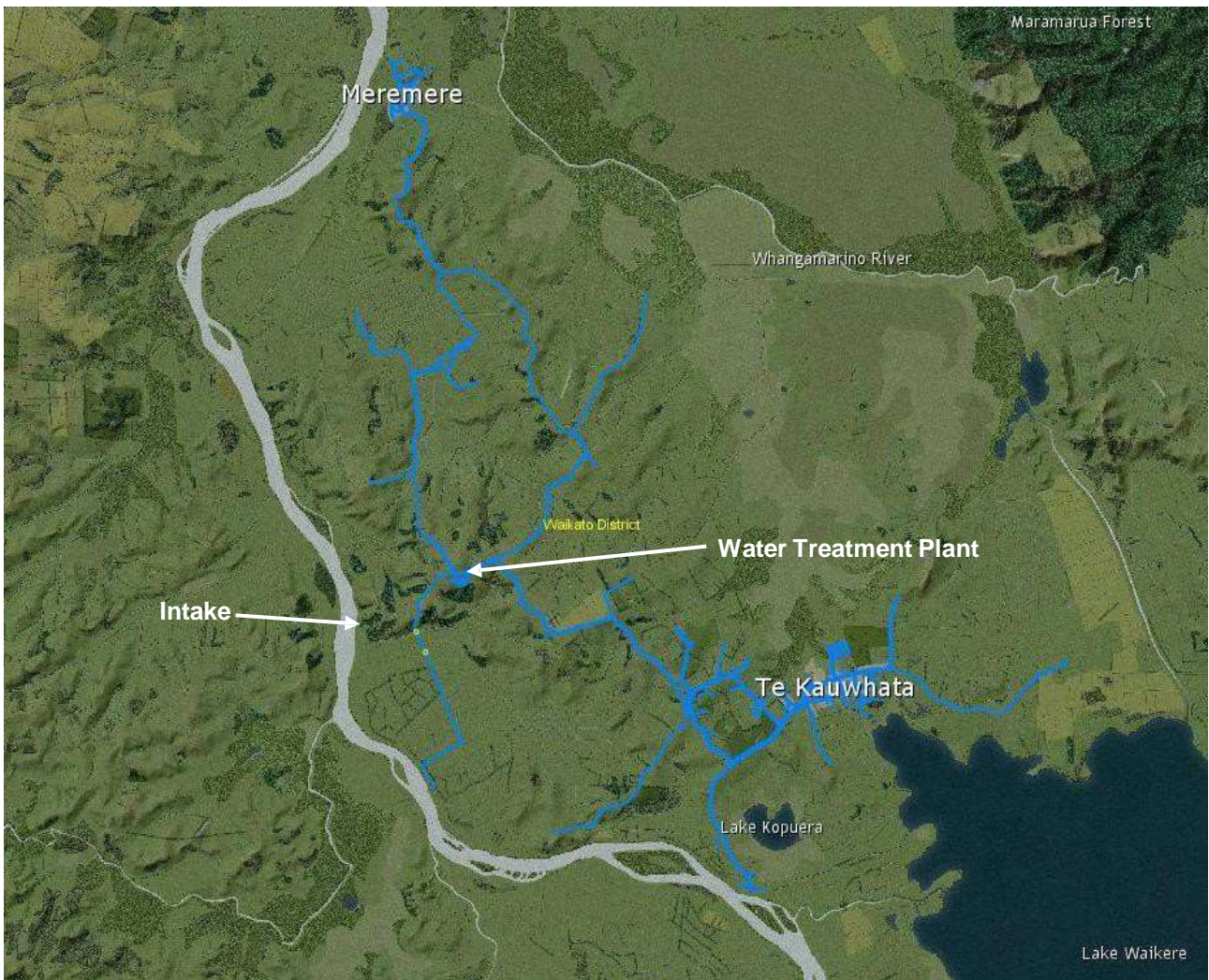


Figure 2. Location of Te Kauwhata Water Treatment Plant and Reticulation

5.1 Intake

Raw water is abstracted from the Waikato River at an intake off Churchill East Road. The water is drawn through 2.5 mm mesh size screens by a set of four pumps used in duty / assist configuration. A flow meter monitors the rate of abstraction.

The water passes through banks of 100 micron nominal Arkal filters before it is piped up to the raw water reservoir (Irrigation Reservoir) at the WTP. The raw water pumps are controlled by the raw water reservoir level transmitter.

The main from the intake to the raw water reservoir is largely made up of asbestos cement pipe. The pipe runs through farmland and is susceptible to damage from farm machinery and practices.

An electrical connection is provided for backup power generation using a portable generator.



Figure 3. Te Kauwhata Intake, Headworks and Arkal Filters Overview

5.2 Water Treatment Plant

Raw water turbidity and pH is continuously monitored.

Caustic and alum is dosed in a common main prior to the clarifiers, each having a single dose pump. Coagulated water pH is continuously monitored. The caustic and alum dose rates are set proportional to flow. A streaming current monitor is fitted but not currently operational. Council plans to investigate options for its reliable operation to automate the alum dose.

Powdered activated carbon for cyanotoxin removal is dosed prior to the clarifiers if required. Dose rate is set proportional to flow, using a single dose pump.

Polyelectrolyte is dosed into the flash mixer tank of each clarifier. Each clarifier has its own poly pump. The poly dose rates are set proportional to flow.

The plant has two upflow clarifiers acting as duty. To reduce flow shock to the clarifiers, which causes expansion of the sludge blanket, the raw water control is ramp restricted. Clarifier waste is discharged to settling ponds where supernatant is syphoned to a tributary of the Ngariohe Stream and settled sludge is discharged to the landfill. A turbidity meter provides monitoring of the clarified water for each clarifier.

The plant is equipped to dose fluoride pre-filters using a single dose pump. Dose rate is set proportional to flow. Fluoride is not being dosed at present.

Clarified water is filtered through two gravity sand filters. The filter media is a mixture of sand and pumice. Backwashing of the filters is carried out at regular time intervals but can also be triggered by high turbidity, headloss or manual intervention. Backwash air scour is provided by two blowers acting in duty / standby configuration. Backwash water is drawn from the backwash water tank utilising 1 of 2 pumps. Backwash waste is discharged to settling ponds where supernatant is syphoned to a tributary of the Ngariohe Stream and settled sludge is discharged to the landfill. The turbidity of filtered water leaving each sand filter is monitored by individual turbidimeters and a filter to waste facility is in place following filter backwash and if raised turbidity levels are detected.

The filtered water is dosed with caustic for pH correction, having a single dose pump.

A UVT meter measures the filtered water transmissivity prior to the UV reactors.

Two UV reactors, acting in duty / manual standby configuration, disinfect the filtered water.

The water is chlorinated post UV with chlorine gas using one chlorinator. Chlorine dosing is feedback controlled to a set point and automatically adjusted. The chlorine dosing system uses pressurised feed water and a venturi vacuum delivery. One 920kg drum and one 70kg cylinder, acting as duty / standby, are kept at the treatment plant. After chlorination the water enters the treated water reservoirs which provide 30 minutes contact time.

The filtered water is continuously monitored for chlorine, pH and fluoride.

Following disinfection the treated water flows to the treated water reservoirs. The default treated water flow setup under gravity is from Reservoir 1 to 2, then up to 40% level of Reservoir 3. The final water pump provides the facility to fill Reservoir 3 from 2.

The treated water reservoirs utilise two sets of pumps, acting in duty / standby configuration, which pump final water through the reticulation to the Western B / Meremere, and Te Kauwhata storage reservoirs.

The treated water is continuously monitored for chlorine, pH and fluoride using duplicate instrumentation.

The plant operation, performance, monitoring and alarm states are telemetered to the WDC office. All significant monitoring equipment is calibrated weekly and validated quarterly.

An electrical connection is provided for backup power generation using a portable generator.



Figure 4. Te Kauwhata Treatment Plant Overview

5.3 Reticulation

Two set of pumps provide the treated water supply to the Western B 360m³, Meremere 250m³ and Te Kauwhata 500m³ reservoirs. The reservoirs are alarmed for high and low water level, sending a message to the duty operator.

Much of the distribution network has been replaced over the years and it is now made up of PE, HDPE and PVC pipes. Approximately 600m of asbestos cement pipe remains in Te Puea and Heather Green Avenues, and is of very poor condition as reported in the 2016 Opus AC pipe report.

5.4 Management

WDC has a memorandum of understanding with TKIA regarding the maintenance and operation of the TKIA owned assets.

The intake screen is cleaned by WDC staff. The intake structure, pumps, Arkal filters, rising main and raw water reservoir are the property of the TKIA. All maintenance applied to these assets is the responsibility of the TKIA.

WDC owns and is responsible for the watermain from the raw water reservoir to the water treatment plant. TKIA is responsible for the irrigation scheme reticulated network. WDC owns and operates the chlorination equipment used to dose water supplied to the irrigation scheme.

The WDC owned treatment plant and downstream reticulation system are managed and operated by two different teams within WDC, being treatment and reticulation.

A treatment plant document titled “W hangamarino Water Treatment Plant, Operational Manual, Functional Description and P&ID” dated 15/9/2006 provides guidance on the operational and management of the plant.

All of the WDC owned Te Kauwhata water supply assets are managed using WDC's asset management system.

6 Photographs of the Te Kauwhata Water Supply



Figure 5 Intake



Figure 6 Headworks



Figure 7 Arkal Filters



Figure 8 Raw Water Reservoir



Figure 9. Raw Water pH and Turbidity Monitoring



Figure 10. Pre-Caustic Dosing Equipment



Figure 11. Alum Dosing Equipment



Figure 12. PAC Dosing Equipment



Figure 13. Coagulant and pH Dosing Monitoring Equipment



Figure 14. Poly Dosing Equipment



Figure 15. Clarifier Flocculation Tank, and Poly Dose Point



Figure 16. Clarifiers



Figure 17. Clarified Water Turbidity Meters



Figure 18. Fluoride Dosing Equipment



Figure 19. Filters



Figure 20. Filter Turbidimeters



Figure 21. Clarifier and Filter Waste Settling Ponds



Figure 22. Post-Caustic Dosing Equipment



Figure 23. UVT Monitoring Equipment



Figure 24. UV Dosing Equipment



Figure 25. UV Dosing Control and Monitoring Equipment



Figure 26. Chlorine Dosing Equipment



Figure 27. Filtered Water Quality Monitoring Instrumentation



Figure 28. Backwash, and Treated Water Reservoirs



Figure 29. Network Pumps



Figure 30. Final Water Quality Monitoring Instrumentation 1



Figure 31. Final Water Quality Monitoring Instrumentation 2



Figure 32. Network Reservoir, Hall Road, Western B

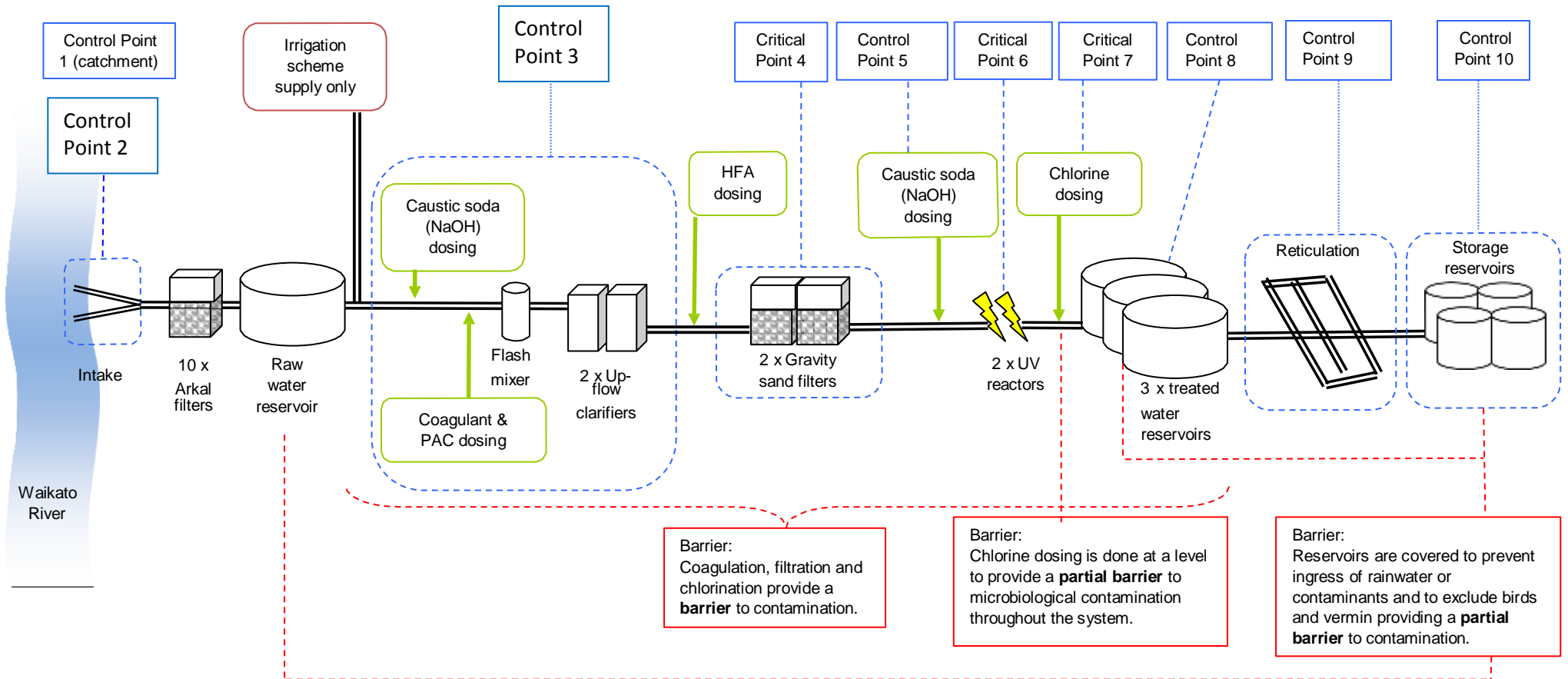


Figure 33. Network Reservoir, Springhill Road, Meremere



Figure 34. Network Reservoir, Te Kauwhata Road, Te Kauwhata

7 Flow Chart / Schematic of the Supply



8 Barriers to Contamination

Table 2. Control and Critical Points

Critical points where hazards can be eliminated, minimised or isolated include:

	Critical Point	Description
1.	Catchment	<i>Possible access point for contamination.</i>
2.	Intake	<i>Pump failure means eventual loss of supply.</i>
3.	Coagulant / flocculation / sedimentation / PAC dosing	<i>Failure will result in reduced natural organic matter, particle and pathogen removal in the clarification and filtration processes.</i> <i>Failure of PAC dosing will inhibit cyanotoxin removal.</i>
4	Filtration	<i>Failure will result in reduced natural organic matter, particulate and pathogen removal.</i>
5	pH adjustment	<i>Failure will result in compromised bacterial inactivation.</i> <i>Overdosing may exceed chemical MAV.</i>
6	UV disinfection	<i>Failure will result in reduced protozoa inactivation.</i>
7	Chlorine dosing	<i>Failure will result in compromised bacterial inactivation.</i> <i>Overdosing may exceed chemical MAV.</i>
8.	Storage reservoir and lift pumps	<i>Possible point for contamination.</i> <i>Pump failure means eventual loss of supply.</i>
9.	Reticulation	<i>Possible access point for contamination.</i> <i>Possible access point for contamination due to backflow.</i>
10.	Storage reservoirs	<i>Possible point for microbiological contamination.</i>
11.	People	<i>Prevention possible failures or contamination</i>

Existing barriers to contamination include:

1. Coagulation, Clarification and Filtration

The treatment plant uses the addition of coagulants to stabilise and flocculate contaminants to enable settling and filtration of the water removing microbiological organisms, organic material and suspended solids. PAC dosing provides removal of cyanotoxins when they are present in the source water. This process step **provides a barrier to pathogen and particulate and cyanotoxin contamination.**

2. UV Disinfection

The treatment plant uses UV disinfection to inactivate microbiological organisms that have not been removed by the filtration process. This provides a **barrier to microbiological contamination**.

3. Chlorination

The treatment plant uses chlorination to disinfect the water of non-protozoan microbiological organisms. As there is at least 30 minutes contact period before the chlorinated water is distributed to consumers, this provides a **barrier to bacterial and viral contamination**.

4. Prevention of Contamination of Treated Water while it is in the Network Reticulation

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

- Chlorine dosing is done at a level to ensure it is available to protect the water against microbiological contamination throughout the storage and reticulation.
- Hygiene procedures are documented and followed for all distribution system maintenance.
- Operators are trained and experienced.

5. Prevention of Contamination of Treated Water in Storage

The reservoirs are covered to prevent unauthorised access, ingress of rainwater or contaminants, and to exclude birds and vermin. The following measures contribute to provision of a **partial barrier against recontamination** of water following treatment.

The process control summaries for identified Critical Control Points (Critical Points) are stored in Council's Promapp process management online repository.

9 Benefits of Proposed Improvements

The proposed improvements will provide public health benefits by reducing the risk of adverse health outcomes associated with poor drinking water quality.

The treatment plant provides good quality water and can meet the Drinking Water Standards New Zealand (DWSNZ) requirements for 7-log protozoa removal. The standards require 4-log protozoa removal for the Waikato River catchment and upgrading the treatment process to 4-log will ensure compliance with the DWSNZ.

Improvements to the operation and management of the supply will further reduce the risk of poor quality water being provided to consumers.

10 Methodology

This WSP has been prepared in accordance with the approaches recommended by the Ministry of Health. Supporting documents include the WSP Guides and A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies, Ministry of Health (2014).

A qualitative risk assessment approach has been taken following the guidance notes in Appendix 2 of the "Framework" allowing the prioritisation of improvement needs and development of the Improvement Schedule.

Indicative cost estimates have been prepared for the required improvement measures. Implementation timeframes will be discussed and agreed between the Treatment Services Team Leader and the Treatment Supervisor at the start of the financial year. Implementation of the Improvement Schedule is ultimately subject to Council funding approval.

The Treatment and Services Team Leader is responsible for implementation of improvements, subject to community and WDC approvals, funding constraints and availability of resources. The Compliance and Income Team Leader is responsible for ongoing review and updating of the WSP and associated Improvement Schedule.

Contingency Plans have been prepared to provide guidance in event that control measures fail to prevent the occurrence of a risk event that may present acute risk to public health. The Treatment Supervisor is responsible for implementation of the Contingency Plans when monitoring has identified the occurrence of a risk event.

Separate risk tables have been prepared for:

- Catchment
- Intake
- Coagulation, Flocculation and Sedimentation / PAC Dosing
- Filtration
- pH Adjustment
- UV Disinfection
- Chlorine Dosing
- Storage Reservoir and Lift Pumps
- Reticulation
- Storage Reservoirs
- Other

11 Risk Ranking Procedure

The tables in this section identify the possible public health risks in each part of the supply. Each risk or possible 'event' which might occur has been evaluated based on the likelihood of the event occurring and the consequence (or outcome) if it occurs.

For the purposes of this WSP, categories for likelihood and consequence have been adapted from those in the 2014 MoH Guide, in order to make them more appropriate to this supply. These adapted ratings are given below in **Table 3** and **Table 4**. The overall risk estimate derived from the product of likelihood and consequence is provided in **Table 5**.

Table 3. Likelihood Scale

Likelihood	Description
Almost certain	Is expected to occur in most circumstances.
Likely	Will probably occur (once in 1 or 2 years).
Possible	Might occur at some time (once in say 5 years).
Unlikely	Might occur (once in 10 to 20 years).
Rare	Could occur (once in 50 to 100 years).

Table 4. Consequence Scale

Consequences	Description
Insignificant	<ul style="list-style-type: none"> - Insignificant impact. - Little disruption to normal operation. - Small increase in operation costs.
Minor	<ul style="list-style-type: none"> - Short disruption of service (<1 hour) to part of a zone. - Aesthetic water quality event for some consumers. - No reported illness. - Some manageable operation disruption. - Some increase in operating costs.
Moderate	<ul style="list-style-type: none"> - Disruption of service (<4 hours) to one or more zones. - Water quality event that requires flushing to clear. - Boil water notice for up to 3 days. - No reported illness. - Significant modification to normal operation but manageable. - Operation costs increased. - Increased monitoring.
Major	<ul style="list-style-type: none"> - Disruption of service (>4 hours) to two or more zones. - Prolonged boil water notice. - Probable illnesses. - Adverse publicity and loss of trust of consumers. - Systems significantly compromised and abnormal operation if at all. - High level of monitoring required.
Catastrophic	<ul style="list-style-type: none"> - Disruption of complete supply for one or more days. - Several instances of illness in the community or instance of death. - Prolonged boil water notice. - Significant negative national press and long term loss of trust of consumers. - Complete failure of systems.

Table 5. Risk Level Allocation Table

		Consequence			
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Moderate	High	Extreme	Extreme	Extreme
Likely	Moderate	High	High	Extreme	Extreme
Possible	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Rare	Low	Low	Moderate	High	High
Estimated Risk Level		Action Plan			
Low		No action required			
Moderate		Consider action if risk can be economically mitigated			
High		Action plan required			
Extreme		Action plan required, with higher priority to complete than for a "high" risk level			

12 Improvement Schedule

A significant factor for consideration of Te Kauwhata water supply improvements is residential development to accommodate the Auckland urban sprawl. Council has drafted high level ideas and costs associated with this development, which have been presented in the following table. A significant amount of investigation and planning is required to define these ideas. Improvement timelines will be enacted as per the improvement schedule adopted by The Waikato District Council Asset Management Plan 2017.

Project	Current Scope	Cost (estimated, \$)	Proposed New Scope	Housing Infrastructure Fund Sought (* denotes time value only request)
Water treatment plant	Design and first stage construction costs to upgrade the plant to produce additional capacity	3,734,924	With an additional 1,500 lots a new solution would be required to supply potable water to Te Kauwhata residents. These funds would be diverted for that purpose.	
Water treatment plant	Stage 2 construction of plant upgrade	2,236,813	With an additional 1,500 lots a new solution would be required to supply potable water to Te Kauwhata residents. These funds would be diverted for that purpose.	1,004,101*

Project	Current Scope	Cost (estimated, \$)	Proposed New Scope	Housing Infrastructure Fund Sought (* denotes time value only request)
Water treatment plant and trunk main infrastructure		12,300,000	Combine above projects (total investment \$5,971,737). Construction of a new water treatment plant (including clarifiers, filters, UV etc.) and reservoir, network to cater for Te Kauwhata: \$5,650,000 treatment plant \$1,350,000 reservoir	6,328,263 (net of current LTP projects)

The improvement schedule is derived from the risk tables that follow in Section 16. The improvement schedule outlines improvements that have been recommended for preventing, reducing or eliminating the identified public health risks in the Te Kauwhata drinking water supply. Possible improvements to the water supply have been identified in the ‘Additional Measures That Could Be Put in Place’ column of the risk tables. The most suitable option to improve the management of each unmanaged risk has then been included in the improvement schedule. Detail, further to that contained in Tables 3 and 4 can be found following the number in the Reference to Risk Table column. It should be noted that costs are estimates only. Each project is ranked according to the priority to which projects should be completed.

- TSTL – Treatment and Services Team Leader
- TS – Treatment Supervisor
- CITL – Compliance and Income Team Leader
- WPTL – Water Planning Team Leader

Table 6. Capital and Significant Projects

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
1	Extreme	Storage Reservoir and Lift Pumps, Storage Reservoirs	8.5, 10.5	Fit anti-surge baffles, to reduce probability of reservoir failure during earthquakes.	WPTL	Not quantified.	2022-23
2	Extreme	Other	11.14	Fit non-slip material to intake structure walking surface. Fit handrails to intake structure.	TS	\$15,000	2022-23
3	High	Other	11.11	Seismic structural review and implementation of seismic strengthening of existing water infrastructure where required. Preparation of an earthquake response plan.	WPTL	Not quantified	2020-21
4	High	Chlorine Dosing	7.3	Fitting of 2 nd dosing system to provide duty / standby arrangement.	TSTL / CITL / WPTL	\$10,000	2021-22
5	High	Catchment, Intake, Other	1.6, 2.6, 11.5	Increase treated water storage to provide at least 24hrs treated water storage.	WPTL	Not quantified	2020-21

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
6	High	Coagulation, Flocculation and Sedimentation / PAC Dosing	3.5	Fitting of 2 nd caustic dose pump to provide duty / standby arrangement.	TSTL / CITL / WPTL	\$10,000	2021-22
7	High	Other	11.10	Install computer hard drive process data storage capacity at the treatment plant as the primary data storage for the treatment plant.	TSTL / CITL / WPTL	\$10,000	2022-23
8	High	Other	11.5	Evaluation of required spares to be undertaken following asset criticality assessment.	WPTL	Staff time	2020-21
9	High	Intake	2.1, 2.2, 2.3, 2.6	Implement a contingency plan in case temporary floating pumping is required.	TS	Staff time	2019-20
10	High	Storage Reservoirs	10.1	Ensure all hatches and possible entry points for rainwater, plant matter, insects, birds, vermin etc. are secure against ingress or access. Implement routine inspection of the reservoirs.	WPTL	Staff time + \$3000	2021-22

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
11	Moderate	Coagulation, Flocculation and Sedimentation / PAC Dosing	3.1, 3.9	Fitting of 2 nd coagulant, and poly dose pump to provide duty / standby arrangement.	TSTL / CITL / WPTL	\$20,000	2022-23
12	Moderate	Coagulation, Flocculation and Sedimentation / PAC Dosing	3.10	Fitting of a 2 nd PAC dose pump to provide duty / standby arrangement.	TSTL / CITL / WPTL	\$10,000	2020-21
13	Moderate	Catchment, Intake, Coagulation, Flocculation & Sedimentation / PAC Dosing, Filtration, Storage Reservoir and Lift Pumps	1.3, 1.4, 2.5, 2.8, 3.7, 4.4, 8.1, 8.2, 8.3	Increase treated water storage to provide at least 24hrs treated water storage.	WPTL	Not quantified	2022-23
14	Moderate	pH Adjustment	5.1	Fitting of 2 nd caustic dose pump to provide duty / standby arrangement.	TSTL / CITL / WPTL	\$10,000	2022-23

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
15	Moderate	Other	11.1	Ensure sampling programme is reviewed by independent person. Ensure sample collection follows sampling programme.	CITL	Staff time	2019-20
16	Moderate	Intake, Coagulation / Flocculation / and Sedimentation / PAC Dosing, Filtration, Storage Reservoir and Lift Pumps	2.5, 3.7, 4.4, 8.2	Ensure WDC owned generators are serviced. Ensure generator supplier agreements are set up.	TS	Staff time	2020-21
17	Moderate	Storage Reservoirs	10.2	Restrict access to reservoir sites through construction of appropriate fencing and install alarms on reservoir access hatches.	TSTL	\$50,000	2021-22
18	Low	Filtration	4.5	Increase treated water storage to provide at least 24hrs treated water storage.	WPTL	Not quantified	2021-22

Table 7. Operational Improvements and Minor Projects

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
1	Extreme	Intake	2.9	Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	TSTL	Staff time	2020-21
2	Extreme	Reticulation	9.3	Review the process for planning and recording of preventative maintenance. Prepare a preventative maintenance plan for the treatment plant. Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	WPTL TS TSTL	Staff time	2021-22

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
3	Extreme	Reticulation	9.1	<p>Review and upgrade documentation procedures for pipe renewal and maintenance.</p> <p>Review the process for planning and recording of preventative maintenance.</p> <p>Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.</p>	<p>WPTL</p> <p>WPTL</p> <p>TSTL</p>	Staff time	2022-23
4	High	Other	11.7	<p>Provide ongoing annual training to maintain operator competence.</p> <p>Provide water treatment operator training.</p>	TSTL / TS	Staff time + \$15000	2021-22
5	High	Catchment, Reticulation, Other	1.1, 1.7, 2.2, 9.5, 9.6, 9.8, 11.4	<p>Review the process for planning and recording of preventative maintenance.</p> <p>Prepare a preventative maintenance plan for the treatment plant.</p> <p>Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.</p>	<p>WPTL</p> <p>TS</p> <p>TSTL</p>	Staff time	2021-22

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
6	High	Other	11.3	Set up documented inspection schedule, to ensure plant equipment and processes are checked to ensure correct operation.	TS	Staff time	2020-21
7	High	Catchment	1.2	Ensure the catchment assessment is undertaken, and that identified risks are addressed.	CITL	\$15,000	2022-23
8	High	Coagulation, Flocculation & Sedimentation / PAC Dosing	3.5	Fault find, and commission pH correction dosing.	TS	Staff time	2022-23
9	High	Catchment, Intake	1.1, 1.7, 2.2	<p>Review and upgrade documentation procedures for pipe renewal and maintenance.</p> <p>Review the process for planning and recording of preventative maintenance.</p> <p>Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.</p>	<p>WPTL</p> <p>WPTL</p> <p>TSTL</p>	Staff time	2021-22
10	High	Intake	2.6	Ensure TKIA has asset maintenance and renewal programmes in place that are effective, and are being followed.	WPTL	Staff time	2021-22

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
11	High	Storage Reservoirs	10.1	Implement routine inspection and cleaning of storage reservoirs.	TS	Staff time	2018-19
12	High	Catchment, Other	1.1, 11.6	Undertake a review of the operational manual and standard operating procedures for the treatment plant. Update, complete and finalise where necessary.	TS	Staff time	2019-20
13	Moderate	Coagulation, Flocculation & Sedimentation / PAC Dosing	3.1, 3.9	<p>Review the process for planning and recording of preventative maintenance.</p> <p>Prepare a preventative maintenance plan for the treatment plant.</p> <p>Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.</p>	<p>WPTL</p> <p>TS</p> <p>TSTL</p>	Staff time	2020-21
14	Moderate	Storage Reservoir and Lift Pumps	8.3	Prepare a preventative maintenance plan for the treatment plant.	TS	Staff time	2020-21

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
15	Moderate	Coagulation, Flocculation & Sedimentation / PAC Dosing	3.1, 3.9	<p>Review and upgrade documentation procedures for pipe renewal and maintenance.</p> <p>Review the process for planning and recording of preventative maintenance.</p> <p>Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.</p>	<p>WPTL</p> <p>WPTL</p> <p>TSTL</p>	Staff time	2020-21
16	Moderate	Storage Reservoir and Lift Pumps, Storage Reservoirs	8.1, 10.3	Implement routine inspection and cleaning of storage reservoirs.	TS	Staff time	2018-19
17	Moderate	Catchment	1.3, 1.4, 1.5	Undertake annual raw water chemical testing regime to test for contaminants in raw water.	CITL	\$1,000	2022-23
18	Moderate	Other	11.9	Undertake testing for aesthetic determinands and compare against DW/SNZ Guideline Values.	CITL	Staff time +\$4000	2019-20

Priority	Risk Level	Water Supply Area	Reference to Risk Table	Proposed Works	Person Responsible	Expected Cost	Timeframe
19	Moderate	Coagulation, Flocculation and Sedimentation / PAC Dosing	3.8	Check that supplier agreement states the quality to which the chemical has to meet.	TS	Staff time	2019-20
20	Low	Filtration	4.2	Plan regular checking of the condition and depth of the filter media.	TS	Staff time	2018-19
21	Low	Reticulation	9.7	Implement routine flushing programme for reticulation.	TSTL	Staff time	2018-19

13 Drinking Water Standards and Grading

At the time of writing of this report the Te Kauwhata water supply demonstrates an ability to fully comply with DWSNZ. Table 5 below shows a summary of the compliance with the drinking water standards to date.

The treatment plant at Te Kauwhata is currently not graded, the Te Kauwhata / Rangiriri zone and the Whangamarino Rural / Meremere zone are graded d.

These gradings are out of date and do not reflect the supply's current capability.

Table 8. Summary of Compliance with DWSNZ

Standards compliance assessed against.	DWSNZ 2005 (revised 2008).
Secure bore water.	NA
Bacterial compliance criteria used for water leaving the treatment plant.	Criterion 2A (continuously monitored chlorination).
Protozoa log removal requirement required for the supply.	Waikato River has been accepted as requiring 4-log removal.
Protozoa treatment process.	Coagulation, clarification, sand filtration and UV provides 7 log removal.
Compliance criteria 6A or 6B is used for water in the distribution zone.	Criterion 6A.
Bacterial compliance for water leaving the treatment plant has been achieved for the last 4 quarters.	Yes.
Protozoa compliance for water leaving the treatment plant has been achieved for the last 4 quarters.	Yes.
Bacteria compliance for water in the distribution zone has been achieved for the last 4 quarters.	Yes.
P2 determinands allocated to supply.	Fluoride.
Chemical compliance achieved for the last 4 quarters.	Yes.
Cyanobacteria identified in the supply.	Yes.
Cyanobacterial compliance has been achieved for the last 4 quarters.	Yes.

14 Consultation

A site visit was undertaken at the Te Kauwhata water supply by those involved in the preparation of the WSP. The WDC staff provided input into identifying the systems, procedures and practices that are currently in place to prevent, reduce and mitigate risks.

The plan was then modified to take account of required updates.

Subsequent to this consultation telephone discussions and email contact has been used to provide information necessary for the preparation of this WSP. The WSP was then reviewed by all divisions of the water team and signed off by the Waters Manager.

The information provided during this consultation has been used to compile the risk tables.

15 Contingency Plan

Te Kauwhata Water Supply Contingency Plan	
Type of Event	Required Contingency Action
<p>An earthquake may cause damage to the source, treatment plant or distribution system. The water supply may be shut down as a result.</p>	<p>Contact the Ministry of Civil Defence in the event of an earthquake emergency. (Keep a list of the contact details for the nearest Ministry office and of the Earthquake Commission).</p> <p>Check all structures associated with water storage, abstraction, treatment and distribution.</p> <p>If water supply structure is damaged so that water cannot be distributed, or cannot be distributed with a satisfactory quality, use alternative supply. Provide another source of potable water until water of acceptable quality can again be supplied.</p> <p>Advise Drinking Water Assessor (DWA).</p> <p>Keep customers informed and advise once regular service is restored.</p>
<p>Inadequate chlorination.</p> <p>Indicators: Low FAC (<1mg/L) or no FAC reported from treatment plant monitoring.</p>	<p>Inspect treatment plant to identify cause of problem and rectify as quickly as possible.</p> <p>Hand dose sodium hypochlorite to treated water reservoirs.</p> <p>Advise Drinking Water Assessor (DWA) and prepare to issue boil water notice if appropriate, i.e. if cannot reinstate adequate chlorination.</p> <p>Make arrangements for provision of emergency treatment or alternative water supply.</p> <p>Keep customers informed and advise once regular service is restored.</p>

Te Kauwhata Water Supply Contingency Plan	
Type of Event	Required Contingency Action
<p>Severe turbidity of source water and high turbidity in treated water for more than 1 minute.</p> <p>Indicators: Highly turbid water in the Waikato River or monitoring indicates treated water leaving the treatment plant exceeds 1 NTU for more than 1 minute.</p>	<p>Cease abstraction whilst source is turbid and supply from storage, or continue to operate treatment plant but filter water to waste until treated water turbidity is less than 1 NTU.</p> <p>Assess turbidity performance of individual clarifiers and filters to determine if problem is common to clarifiers or filters or specific to one or more clarifier or filter.</p> <p>Take filters with turbidity continuing to exceed 1NTU out of service.</p> <p>Monitor reservoir level. Monitor source water turbidity.</p> <p>If reservoir storage is low and effective treatment cannot be resumed then advise DW A and issue Boil Water notice while problem is resolved.</p> <p>Keep customers informed and advise once regular service is restored.</p>
<p>E. coli transgression in water leaving treatment plant or distribution zone.</p> <p>Indicators: E. coli transgression reported following routine monitoring.</p>	<p>Follow transgression response procedure in DW SNZ.</p> <p>Advise Drinking Water Assessor (DW A).</p> <p>Commence daily E. coli testing at WTP.</p> <p>Use an enumeration test method.</p> <p>Sample in distribution system.</p> <p>Investigate cause, inspect plant and source.</p> <p>Take remedial action.</p> <p>Continue to sample for E. coli until 3 consecutive samples are free of E. coli.</p> <p>If E. coli is found in repeat samples consult with DW A, intensify remedial action, increase disinfection, consider 'Boil Water' notice, and consider alternative supply.</p>

Te Kauwhata Water Supply Contingency Plan	
Type of Event	Required Contingency Action
<p>Severe microbiological contamination of source water (such that treatment is ineffective).</p> <p>Indicators: A contamination event in the catchment may be observed by or reported to WDC staff. May also be indicated by reported illness among consumers or positive E coli monitoring results.</p>	<p>Issue "Boil Water" notice.</p> <p>Advise Drinking Water Assessor (DW A).</p> <p>Inspect the river upstream of the intake to identify source of contamination and rectify problem as quickly as possible.</p> <p>Consider provision of emergency treatment or alternative water supply (e.g. tankers).</p> <p>Disinfect contaminated reservoirs and flush mains.</p> <p>Keep customers informed and advise once regular service is restored.</p>
<p>Chemical contamination of source water.</p> <p>Indicators: A contamination event in the catchment may be observed by or reported to WDC staff. May also be indicated by reported water quality concerns from consumers (taste, odour, and colour) or illness among consumers.</p>	<p>Advise Drinking Water Assessor (DW A).</p> <p>Assess situation and advise customers regarding use / treatment / disposal of contaminated water.</p> <p>Arrange emergency water supply (tankers) if necessary.</p> <p>Inspect the river upstream of the intake to identify source of contamination and rectify problem as quickly as possible.</p> <p>Flush contaminated reservoirs and mains.</p> <p>Keep customers informed and advise once regular service is restored.</p>
<p>Cyanobacteria / Cyanotoxin contamination of source water.</p>	<p>Implement cyanobacteria management plan.</p> <p>Advise Drinking Water Assessor (DW A).</p> <p>Dose powdered activated carbon.</p> <p>Monitor source water for cyanobacteria (Alert Level 1 weekly).</p> <p>Monitor water leaving the treatment plant for cyanotoxins.</p> <p>If cyanotoxins in water leaving the treatment plant exceed 50% of the MAV prepare to supply drinking water from tankers to the community.</p> <p>If cyanotoxins in water leaving the treatment plant exceed the MAV supply drinking water from tankers to the community.</p> <p>Keep customers informed and advise once regular service is restored.</p>

Te Kauwhata Water Supply Contingency Plan	
Type of Event	Required Contingency Action
<p>Insufficient water available for abstraction and treatment or loss of ability to take water from river.</p> <p>Indicators: Observed or reported low river levels.</p>	<p>Advise customers to conserve water.</p> <p>Implement demand management strategies as required.</p> <p>Arrange emergency water supply (tankers) if necessary.</p> <p>Keep customers informed and advise once regular service is restored.</p>
<p>Instrument fault resulting in non-compliance with Criterion 2A of the DWSNZ for continuously monitored chlorine disinfected water leaving the treatment plant.</p>	<p>Instigate a sampling schedule for FAC, pH, Turbidity and E coli as per Criterion 2B for non-continuously monitored chlorine disinfected water leaving the treatment plant supplying populations up to 5,000.</p> <p>If the bacterial compliance criteria cannot be met using 2B, perform the remedial actions in Section 4.3.9 of the DWSNZ.</p>
<p>Instrument fault resulting in non-compliance with Part 5.4 DWSNZ coagulation, sedimentation and filtration processes: treatment compliance criteria.</p>	<p>Remove filter from service until instrument is repaired.</p> <p>If the Coagulation, sedimentation and filtration processes: treatment compliance criteria cannot be met by the above action, perform the remedial actions in Section 5.4.3 of the DWSNZ.</p>
<p>Instrument fault resulting in non-compliance with Part 5.16 DWSNZ ultraviolet light disinfection: treatment compliance criteria.</p>	<p>Instigate a sampling schedule as per Table 5.7 Enhanced combined filter performance: treatment compliance criteria of the DWSNZ.</p> <p>If the protozoal compliance criteria requirements cannot be met by the above action, perform the remedial actions in Section 5.16.4 of the DWSNZ.</p>

16 Risk Tables

- TSTL – Treatment and Services Team Leader
- TS – Treatment Supervisor
- CITL – Compliance and Income Team Leader
- WPTL – Water Planning Team Leader

Table 9. Risk Table: Catchment

1. Catchment									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Microbiological Contamination	1.1	Surface runoff from farmland in the Waikato River catchment.	Extreme (Almost Certain x Major)	High raw water E. coli results. Turbidity in raw water. Illness in community.	Coagulation, filtration, UV and chlorination treatment.	Yes.	High (Rare x Major)	Ensure O&M manual is up to-date, and reflects any changes in operation or maintenance practices since the manual was written in 2006. Ensure treatment asset maintenance and renewal programmes are in place, are effective, and are being followed.	TS

1. Catchment									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Microbiological contamination	1.2	Discharges from community wastewater systems, dairy effluent ponds or septic tank systems.	Extreme (Almost Certain x Major)	High raw water E. coli results. Turbidity in raw water. Illness in community. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Coagulation, filtration UV and chlorination treatment.	Partially.	High (Unlikely x Major)	Ensure the catchment assessment is undertaken, and that identified risks are addressed.	CITL
Chemical contamination	1.3	Surface runoff containing chemical contaminants from agricultural activities. (E.g. pesticides, fertilisers etc.)	High (Possible x Moderate)	Taste and / or odour. Complaints or information provided by public about activities in catchment.	Coagulation and filtration treatment. PAC dosing.	Partially.	Moderate (Unlikely x Moderate)	Increase treated water storage to provide at least 24hrs storage. Undertake annual raw water chemical testing regime to test for contaminants in raw water.	WPTL CITL
Chemical Contamination	1.4	Chemical contamination from coal mining activities in the region. (E.g. leachate, acid mine drainage).	High (Possible x Moderate)	Reduction in visual quality of raw water. Taste and / or odour.	Coagulation and filtration treatment. PAC dosing.	Partially.	Moderate (Unlikely x Moderate)	Increase treated water storage to provide at least 24hrs storage. Undertake annual raw water chemical testing regime to test for contaminants in raw water.	WPTL CITL

Chemical Contamination	1.5	Naturally occurring chemical contaminants.	High (Likely x Moderate)	Arsenic is a known contaminant of the Waikato River due to geothermal activity around Lake Taupo.	Tributaries of the Waikato between Taupo and Ngaruawahia provide significant dilution to the contaminated water.	Partially.	Moderate (Unlikely x Moderate)	Undertake annual raw water chemical testing regime to test for contaminants in raw water.	CITL
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1. Catchment									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Chemical Contamination	1.6	Industrial chemical spill.	Extreme (Possible x Major)	Reduction in visual quality of raw water. Taste and / or odour. Complaints or information provided by public. Chemical tests if a problem is suspected.	PAC dosing. Relationship with Waikato Regional Council so that river pollution incidents are reported to WDC.	Partially.	High (Unlikely x Major)	Increase treated water storage to provide at least 24hrs storage.	WPTL
Chemical Contamination	1.7	Cyanobacteria growth in source water.	Extreme (Likely x Major)	Algal bloom in river – discolouration of water. Taste and / or odour complaints from consumers. Weekly visual inspection of river for evidence of algal growth and history of algal growth in the river triggers weekly sampling for cyanobacterial cells (cells / ml) in river in source water.	PAC dosing. Cyanobacteria / cyanotoxin management plan requires weekly visual inspection of river for evidence of cyanobacterial growth and provides for weekly cyanobacteria monitoring at Alert Level 1 and subsequent graduated alert and monitoring levels.	Partially.	High (Unlikely x Major)	Ensure treatment asset maintenance and renewal programmes are in place, are effective, and are being followed.	TSTL

Table 10. Risk Table: Intake

2. Intake									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	2.1	Intentional vandalism or accidental damage to intake structure by floating objects in river.	Extreme (Possible x Major)	Obvious signs of damage to structure. Reduced / no flow to treatment plant.	Intake structure is submerged and not likely to be accessible to vandals. Intake structure does not extend out into the river far. Temporary floating intake pumps can be installed if required. Screening is installed to mitigate damage by floating objects.	Partially.	High (Unlikely x Major)	Implement a contingency plan in case temporary floating pumping is required.	TS
Loss of Supply	2.2	Damage to intake support structure due to lack of maintenance.	Extreme (Likely x Major)	Obvious signs of damage to the structure. Reduced / no flow to treatment plant.	Intake structure is in good condition. Temporary floating intake pumps can be installed if required.	Partially.	High (Unlikely x Major)	Implement a contingency plan in case temporary floating pumping is required. Ensure treatment asset maintenance and renewal programmes are in place, are effective, and are being followed.	TS TSTL

2. Intake									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	2.3	Drought or extreme low flows in Waikato River making pumps ineffective.	Extreme (Possible x Major)	Low flows in river or prolonged drought conditions.	No current issues with low river level affecting abstraction. Temporary floating intake pumps can be installed if required.	Partially.	High (Unlikely x Major)	Implement a contingency plan in case temporary floating pumping is required.	TS
Loss of Supply	2.4	Mechanical failure of intake pump / s.	Moderate (Possible x Minor)	Reduced / no flow to treatment plant.	Four intake pumps in duty / standby. Replacement pumps can be readily sourced.	Partially.	Low (Unlikely x Minor)	None.	
Loss of Supply	2.5	Failure of pumps due to power outage.	High (Possible x Moderate)	No flow to treatment plant.	Alarm sent during power failure. Generator connection point fitted to treatment facility.	Partially.	Moderate (Unlikely x Moderate)	Increase treated water storage to provide at least 24hrs storage. Ensure WDC owned generators are serviced. Ensure generator supplier agreements are set up.	WPTL TS

2. Intake

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	2.6	Failure of intake pipe.	Extreme (Unlikely x Catastrophic)	Reduced / no flow to treatment plant.	Pipe in river is protected by wharf, pipe in ground is protected by river bank.	Partially.	High (Rare x Catastrophic)	<p>Increase treated water storage to provide at least 24hrs storage.</p> <p>Implement a contingency plan in case temporary floating pumping is required.</p> <p>Ensure irrigation scheme management have asset maintenance and renewal programmes are in place, are effective, and are being followed.</p>	<p>WPTL</p> <p>TS</p> <p>WPTL</p>

2. Intake									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of right to take Water	2.7	Consent to take water is not renewed or is declined by Regional Council.	Very High (Unlikely x Catastrophic)	No valid water take consent currently held by WDC.	Valid water take consent currently held by WDC until 30 June 2024.	Yes.	High (Rare x Catastrophic)	None.	
Loss of Supply	2.8	Intake blockage occurs because there is no screen to exclude debris.	High (Likely x Medium)	Reduced or restricted flow to treatment plant.	Intake screen fitted.	Partially.	Moderate (Unlikely x Medium)	Increase treated water storage to provide at least 24hrs storage.	WPTL
Loss of Supply	2.9	Substandard TKIA operation and maintenance practices.	Very High (Possible x Catastrophic)	Reduced or restricted flow to treatment plant.	Memorandum of understanding.	Partially.	Very High (Unlikely x Catastrophic)	Document (via an agreement with the TKIA) who has responsibility for irrigation scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	TSTL

Table 11. Risk Table: Coagulation, Flocculation & Sedimentation / PAC Dosing

3. Coagulation, Flocculation & Sedimentation / PAC Dosing									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Flocs not formed	3.1	Coagulant dose pump failure.	High (Likely x Medium)	No or poor floc formation. High turbidity in water leaving the clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Operator regularly visits plant. Telemetry displays dosing pump activity and turbidity. Turbidity or water from clarifiers is monitored. Turbidity alarmed at leaving the filters. Process will shut down prior to forfeiting compliance.	Partially.	Moderate (Unlikely x Medium)	Fitting of a 2nd coagulant dose pump to provide duty / standby arrangement. Ensure treatment asset maintenance and renewal programmes are in place, are effective, and are being followed.	TSTL / CITL / WPTL WPTL

3. Coagulation, Flocculation & Sedimentation / PAC Dosing

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Flocs not formed	3.2	Inappropriate dose rate of coagulant chemicals.	High (Likely x Medium)	No or poor floc formation. High turbidity in water leaving the clarifiers or filters. Chemicals exceeding MAVs. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Jar testing regime. Operator regularly visits plant. Dosing is flow proportional. Turbidity or water from clarifiers is monitored. Turbidity alarmed at 0.09NTU leaving the filters. Process will shut down prior to forfeiting compliance. Raw water turbidity and pH is continuously monitored. Coagulated water pH is continuously monitored.	Yes.	Moderate (Unlikely x Medium)	None.	

3. Coagulation, Flocculation & Sedimentation / PAC Dosing									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Flocs not formed	3.3	Inadequate mixing of coagulant.	High (Likely x Medium)	Poor floc formation. High turbidity in water leaving the clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Mixing energy calculated and adequate. Process will shut down prior to forfeiting compliance. Turbidity or water from clarifiers is monitored.	Yes.	Moderate (Unlikely x Medium)	None.	
Flocs not formed	3.4	Coagulant chemical supply exhausted.	High (Likely x Medium)	Poor floc formation. High turbidity in water leaving the clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Operators at plant twice weekly, have remote chemical storage monitoring, and aware when chemical supplies are getting low. Chemicals are held in bulk at treatment plant. Delivery of chemicals is usually 3 working days after ordering. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Unlikely x Medium)	None.	

3. Coagulation, Flocculation & Sedimentation / PAC Dosing

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Poor floc formation	3.5	Raw water pH too low for optimal coagulation	High (Likely x Medium)	<p>Poor floc formation.</p> <p>Floc carryover to the filters.</p> <p>High turbidity in water leaving the clarifiers.</p> <p><i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i></p>	<p>Raw water pH is suitable about 80% of the time.</p> <p>pH correction to provide optimum coagulation is fitted but not currently operable.</p> <p>Raw water turbidity and pH is continuously monitored. Coagulated water pH is continuously monitored.</p> <p>Turbidity or water from clarifiers is monitored.</p>	Partially.	Moderate (Possible x Medium)	<p>Fault find, and commission pH correction dosing.</p> <p>Fitting of a 2nd caustic dose pump to provide duty / standby arrangement.</p>	<p>TS</p> <p>TSTL / CITL / WPTL</p>

<p>Poor sedimentation</p>	<p>3.6</p>	<p>Poor flow distribution between clarifiers.</p>	<p>High (Likely x Medium)</p>	<p>Poor floc formation. High turbidity in water leaving the clarifiers or filters. Increased frequency in backwashing of filters required. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i></p>	<p>Clarifier inlet channels designed to balance incoming flow. Turbidity or water from clarifiers is monitored. Process will shut down prior to forfeiting compliance.</p>	<p>Yes.</p>	<p>Low (Rare x Medium)</p>	<p>None.</p>	
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3. Coagulation, Flocculation & Sedimentation / PAC Dosing

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
High turbidity passes clarifier	3.7	Power failure causes loss of water flow from intake and loss of sludge blanket.	High (Likely x Medium)	Turbidity in water leaving clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Alarm sent during power failure. Plant can run to waste if high turbidity is detected. Turbidity or water from clarifiers is monitored. Turbidity alarmed at 0.09NTU leaving the filters. Process will shut down prior to forfeiting compliance. Generator connection point fitted to treatment facility.	Partially.	Moderate (Unlikely x Medium)	Increase treated water storage to provide at least 24hrs storage. Ensure WDC owned generators are serviced. Ensure generator supplier agreements are set up.	WPTL TS

3. Coagulation, Flocculation & Sedimentation / PAC Dosing

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Flocs not formed	3.8	Inappropriate or poor quality chemicals used.	Moderate (Unlikely x Medium)	No or poor floc formation. High turbidity in water leaving the clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Product supplier provides a suitable grade of chemicals. Turbidity or water from clarifiers is monitored. Process will shut down prior to forfeiting compliance.	Partially.	Low (Rare x Medium)	Check that supplier agreement states the quality to which the chemical has to meet.	TS
Flocs not formed	3.9	Poly dose pump failure.	High (Likely x Medium)	No or poor floc formation. High turbidity in water leaving the clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Operator regularly visits plant. Telemetry displays dosing pump activity and turbidity. Turbidity or water from clarifiers is monitored. Turbidity alarmed at leaving the filters. Process will shut down prior to forfeiting compliance.	Partially.	Moderate (Unlikely x Medium)	Fitting of a 2nd poly dose pump to provide duty / standby arrangement. Ensure treatment asset maintenance and renewal programmes are in place, are effective, and are being followed.	TSTL / CITL / WPTL WPTL

Cyanobacteria not removed	3.10	PAC dose pump failure.	High (Likely x Medium)	<p>No or reduced cyanobacteria removal.</p> <p>Customer complaints regarding taste and odour.</p> <p>Illness in the community. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i></p>	<p>Operator regularly visits plant.</p> <p>Telemetry displays dosing pump activity.</p>	Partially.	Moderate (Unlikely x Medium)	<p>Fitting of a 2nd PAC dose pump to provide duty / standby arrangement.</p> <p>Ensure treatment asset maintenance and renewal programmes are in place, are effective, and are being followed.</p>	TSTL / CITL / WPTL WPTL
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Table 12. Risk Table: Filtration

4. Filtration									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Particles not removed	4.1	Assessment of filter performance is difficult due to inadequate turbidity information.	High (Likely x Minor)	High turbidity in water leaving the filter. Lack of information available on the performance of each filter. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Each filter has individual turbidity meter. High turbidity alarm at 0.09NTU. Process will shut down prior to forfeiting compliance.	Yes.	Low (Unlikely x Minor)	None.	

<p>Table 12</p> <p style="writing-mode: vertical-rl; transform: rotate(180deg);">Particles not removed</p>	<p>4.2</p>	<p>Risk Table: Filtration</p> <p>Media loss from excessive backwashing rate or deterioration of filtration media.</p>	<p>High (Likely x Medium)</p>	<p>High turbidity in water leaving the filter.</p> <p><i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i></p> <p>Increased frequency of backwashing required.</p>	<p>Filter media replaced as required.</p> <p>High turbidity alarm at 0.09NTU.</p> <p>The backwash rate is set, so as not to exceed optimum backwash flow rate.</p> <p>Filter performance is monitored through turbidity trending.</p> <p>Process will shut down prior to forfeiting compliance.</p>	<p>Yes.</p>	<p>Moderate (Unlikely x Medium)</p>	<p>Plan regular physical checking of the condition and depth of the filter media.</p>	<p>TS</p>
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4. Filtration

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Particles not removed	4.3	Failure of backwash air blowers.	Moderate (Possible x Minor)	High turbidity in water leaving the filter. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Standby blower installed. Filter to waste facility in place if high turbidity is detected. High turbidity alarm at 0.09NTU. Process will shut down prior to forfeiting compliance.	Yes.	Low (Unlikely x Minor)	None.	
Particles not removed	4.4	Inability to backwash effectively due to power outage.	High (Likely x Medium)	High turbidity in water leaving the filter. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Power failure stops water flow through the plant. Generator connection point fitted to treatment facility. Process will shut down prior to forfeiting compliance.	Partially.	Moderate (Unlikely x Medium)	Increase treated water storage to provide at least 24hrs storage. Ensure WDC owned generators are serviced. Ensure generator supplier agreements are set up.	WPTL TS

4. Filtration

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Particles not removed	4.5	Failure of filter modulating valves.	Moderate (Possible x Minor)	High turbidity in water leaving the filter. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Two filters available. High turbidity alarm at 0.09NTU. Process will shut down prior to forfeiting compliance.	Partially.	Low (Unlikely x Minor)	Increase treated water storage to provide at least 24hrs storage.	WPTL
Failure to Remove Protozoa	4.6	Existing filtration inadequate for removal of particles to log level required by DW SNZ.	High (Likely x Medium)	Coagulation, flocculation and filtration processes do not meet protozoa log removal requirements of DW SNZ. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Existing coagulation, clarification and filtration provides a barrier against protozoa (Log 4). Filter to waste facility in place if high turbidity is detected. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Unlikely x Medium)	None.	

Table 13. Risk Table: pH Adjustment

5. pH Adjustment									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
pH Adjustment too High or Low	5.1	Dosing system failure.	High (Possible x Medium)	pH of the water leaving the treatment plant is high or low. (<7 or >8.5)	pH continuously monitored in water leaving treatment plant. High and low pH alarms. Process will shut down prior to forfeiting compliance.	Partially.	Moderate (Unlikely x Medium)	Fitting of a 2 nd caustic dose pump to provide duty / standby arrangement.	TSTL / CITL / TS
pH Adjustment too High or Low	5.2	Incorrect dosing rate.	High (Possible x Medium)	pH of the water leaving the treatment plant is high or low. (<7 or >8.5)	pH continuously monitored in water leaving treatment plant. High and low pH alarms. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Unlikely x Medium)	None.	

Table 14. Risk Table: UV Disinfection

6. UV Disinfection									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Dose too Low	6.1	Dosing system failure.	High (Likely x Medium)	UV intensity readings low. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	100% duty / standby UV unit available. Dose continuously monitored. Low UV intensity alarm. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Unlikely x Medium)	None.	
Dose too low	6.2	Failure of pre-treatment processes.	High (Likely x Medium)	UVT readings high. Poor quality filtered water. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	UVT continuously monitored in water leaving filters. High UVT alarm. Process will shut down	Yes.	Moderate (Unlikely x Medium)	None.	

Dose too Low	6.3	Excessive colour or turbidity	High (Likely x Medium)	<p>UVT readings high.</p> <p>High turbidity in water leaving the filter.</p> <p>E. coli or aerobic bacterial spores is detected in 100 ml sample of water leaving the UV unit.</p> <p>Excessive turbidity or colour (sufficient to reduce the UV intensity to a level that is too low).</p> <p>Absence of maintenance records.</p> <p>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</p>	<p>UVT continuously monitored in water leaving filters.</p> <p>Five filters available.</p> <p>Install adequate filtration system. Regular replacement and maintenance of filters.</p> <p>Automatic wipe system for sleeves with routine inspections</p> <p>Filter to waste facility in place if high turbidity is detected.</p> <p>Process will shut down prior to forfeiting compliance.</p>	Yes.	Moderate (Possible x Medium)	None.	

Dose too low	6.4	Power supply failure	Moderate (Possible x Medium)	Activation of Alarm. No Power Water flow shut off.	An alarm to indicate power failure 8 hour supply of water Plant able to take portable generator Annual electrical maintenance program for plant and reticulation supply.	Yes.	Moderate (U x Medium)	None.	
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Table 15. Risk Table: Chlorine Dosing

7. Chlorine Dosing									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Inadequate Chlorination	7.1	Inadequate contact time during peak demand.	High (Likely x Medium)	E. coli detected in water leaving the treatment plant. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Contact tank and site reservoirs have greater than 30 minutes.	Yes.	Low (Rare x Medium)	None.	
Inadequate Chlorination	7.2	Chlorine gas supply exhausted.	Very High (Likely x Major)	Illness in community. FAC is less than 0.2 mg/L or E. coli detected in water leaving treatment plant.	Bulk (900kg) duty and standby chlorine gas tanks used. FAC continuously monitored. Process will shut down prior to forfeiting compliance.	Yes.	High (Unlikely x Major)	None.	

7. Chlorine Dosing

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Inadequate Chlorination	7.3	Dosing system failure.	Extreme (Likely x Major)	Illness in the community. FAC is less than 0.2 mg/L or E. coli detected in water leaving treatment plant.	FAC continuously monitored. Low chlorine alarm. Venturi vacuum system has low failure rate. Process will shut down prior to forfeiting compliance.	Partially.	High (Rare x Major)	Fitting of 2 nd dosing system to provide duty / standby arrangement.	TSTL / CITL / WPTL
Inadequate Chlorination	7.4	Chlorine dose rate incorrect.	Very High (Likely x Major)	Illness in the community. FAC is less than 0.2 mg/L or E. coli detected in water leaving the treatment plant.	FAC continuously monitored. Low chlorine alarm. Set point determined and adjusted automatically from FAC on-line monitoring. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Rare x Major)	None.	

7. Chlorine Dosing									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Inadequate Chlorination	7.5	Chlorine demand exceeds chlorine dose due to high raw water turbidity.	Very High (Likely x Major)	High turbidity in water leaving clarifiers or filters. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i> FAC is less than 0.2 mg/L or E. coli detected in water leaving the treatment plant.	FAC continuously monitored. Low chlorine alarm. High turbidity alarms and filter to waste available. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Rare x Major)	None.	
Inadequate Chlorination	7.6	Lack of chlorine due to pipe failure or leak.	Very High (Possible x Major)	FAC is less than 0.2 mg/L or E. coli detected in water leaving the treatment plant. Chlorine gas leak alarm.	FAC continuously monitored. Low chlorine alarm. Chlorine gas leak alarm installed. Process will shut down prior to forfeiting compliance.	Yes.	Moderate (Rare x Major)	None.	

7. Chlorine Dosing									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Over Chlorination	7.7	Dosing system failure.	High (Likely x Medium)	FAC level high. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i> Odour and taste complaints from consumers.	FAC continuously monitored. High chlorine alarm. Venturi vacuum system has low failure rate. Process will shut down prior to forfeiting compliance.	Yes.	Low (Rare x Medium)	None.	
Over Chlorination	7.8	Chlorine dose rate incorrect.	Moderate (Likely x Minor)	FAC is greater than 1 mg/L.	FAC continuously monitored. Set point determined and adjusted automatically from FAC on-line monitoring. Process will shut down prior to forfeiting compliance.	Yes.	Low (Rare x Minor)	None.	

Table 16. Risk Table: Storage Reservoir and Lift Pumps

8. Storage Reservoir and Lift Pumps									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	8.1	Problem or failure with treatment site storage reservoirs.	High (Likely x Medium)	Loss of flow from treatment plant.	The three reservoirs provide a degree of redundancy.	Partially.	Moderate (Unlikely x Medium)	Identify necessary storage requirements to achieve 24 hours' age, and the necessary infrastructure is added to the AMP. Implement routine inspection of the storage reservoirs.	WPTL TS
Loss of Supply	8.2	Pump failure due to power outage.	High (Likely x Medium)	No pump activity. Reduction in reservoir water level.	Telemetry alarms indicate no pump activity. Generator connection point fitted to treatment facility.	Partially.	Moderate (Unlikely x Medium)	Identify necessary storage requirements to achieve 24 hours' age, and the necessary infrastructure is added to the AMP. Ensure WDC owned generators are serviced. Ensure generator supplier agreements are set up.	WPTL TS
Loss of Supply	8.3	Pump failure due to mechanical failure.	High (Likely x Medium)	No pump activity. Reduction in reservoir water level.	Two pumps operate in duty / standby arrangement. Pumps are standard off the shelf models and easily replaceable.	Partially.	Moderate (Unlikely x Medium)	Identify necessary storage requirements to achieve 24 hours' age, and the necessary infrastructure is added to the AMP. Prepare a preventative maintenance plan for the treatment plant.	WPTL TS

8. Storage Reservoir and Lift Pumps

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	8.4	Failure of pump controls.	High (Likely x Medium)	Excessive or reduced pump activity.	Manual over-ride.	Yes.	Moderate (Unlikely x Medium)	None.	
Loss of Supply	8.5	Reservoir failure during earthquake	Very High (Possible x Catastrophic)	No pump activity. Reduction in reservoir water level.	N/A	No.	Very High (Possible x Catastrophic)	Fit anti-surge baffles, to reduce the probability of reservoir failure during earthquakes.	WPTL

Table 17. Risk Table: Reticulation

9. Reticulation									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	9.1	Pipe failure.	Very High (Likely x Major)	Complaints from consumers about loss of supply. Change in flow or pressure in reticulation.	WDC requires all work and materials used in WDC owned reticulation to meet the specifications determined by the Hamilton City Standard Technical Specifications (Vol. 3). Inspections and renewals are recorded in WDC's asset management system.	Partially.	Very High (Possible x Major)	Review and upgrade documentation procedures for pipe renewal and maintenance. Review the process for planning and recording of preventative maintenance. Document (via an agreement with the Te Kauwhata Irrigation Association) who has responsibility for Irrigation Scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	WPTL
Loss of Supply	9.2	Excessive demand in network or inadequate system capacity.	Moderate (Possible x Medium)	Complaints from consumers about low pressure or loss of supply. Change in flow or pressure in reticulation.	Network model can demonstrate the effect of high demand or future growth within the reticulation. Network model calibrated 2015.	Yes.	Moderate (Unlikely x Medium)	None.	

9. Reticulation									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Microbiological Contamination	9.3	Inadequate controls on maintenance and construction work.	Very High (Likely x Major)	Complaints from consumers about taste or odour. E. coli present in reticulation system. Inadequate FAC in reticulation. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Maintenance and replacement work is undertaken by trained staff on WDC owned reticulation. WDC requires all work and materials used in the WDC owned reticulation to meet the specifications determined by the Hamilton City Standard Technical Specifications (Vol. 3).	Partially.	Very High (Possible x Major)	Review and upgrade documentation procedures for maintenance. Review the process for planning and recording of preventative maintenance. Document (via an agreement with the Te Kauwhata Irrigation Association) who has responsibility for Irrigation Scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	WPTL TS TSTL

9. Reticulation

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Chemical or Microbiological Contamination	9.4	Backflow from consumer connections.	Moderate (Possible x Medium)	Illness in community. Contaminants present in the reticulation system. Taste or odour complaints from consumers.	Testable backflow devices are currently required in restricted supply areas, and non-testable devices are required at new domestic supplies and toby replacements. Testable devices required for industries. Backflow policy recently updated and adopted by WDC. FAC maintained at suitable levels throughout the reticulation.	Yes.	Moderate (Unlikely x Medium)	None.	

9. Reticulation									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Supply	9.5	Breaks or leaks in pipes.	High (Likely x Medium)	Contaminants present in the reticulation system. Taste, odour or sickness complaints from consumers. Reduced FAC in water. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Breaks and leaks repaired as a priority. WDC provides a water main location service and supervision of contractors GIS database reticulation asset management system, repairs are recorded in system for WDC owned reticulation.	Partially.	High (Possible x Medium)	Document (via an agreement with the Te Kauwhata Irrigation Association) who has responsibility for Irrigation Scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	TSTL
Chemical Contamination	9.6	Inappropriate materials used for reticulation pipes and fittings.	Very High (Possible x Major)	Contaminants present in the reticulation system. Taste, odour or sickness complaints from consumers.	WDC requires all work and materials used in WDC owned reticulation to meet the specifications determined by the Hamilton City Standard Technical Specifications (Vol. 3).	Partially.	High (Unlikely x Major)	Document (via an agreement with the Te Kauwhata Irrigation Association) who has responsibility for Irrigation Scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	TSTL

9. Reticulation

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Inadequate Supply	9.7	Silting build up within reticulation pipes.	Low (Unlikely x Minor)	Reduced flows in reticulation. Complaints from consumer about quality of water.	WDC undertakes flushing in response to consumer complaints.	Partially.	Low (Rare x Minor)	Implement routine flushing programme for the reticulation.	TSTL
Inadequate Supply	9.8	Poor planning of maintenance and construction work leaves consumers without water supply.	High (Likely x Medium)	No supply or reduced pressure in areas where upgrading is undertaken. Scheduled maintenance or renewals.	24 hours' notice is given for planned shutdowns of WDC owned network. Customer service is kept informed. Temporary alternative supply provided if shut down exceeds 8 hours.	Partially.	Moderate (Possible x Medium)	Document (via an agreement with the Te Kauwhata Irrigation Association) who has responsibility for Irrigation Scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	TSTL

Table 18. Risk Table: Storage Reservoirs

10. Storage Reservoirs									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Microbiological contamination	10.1	Leakage through reservoir roof or other parts of structure or access by birds or vermin.	Very High (Possible x Major)	E. coli in water leaving reservoir. Decreased FAC in water leaving reservoir. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Residual chlorine in water.	Partially.	High (Unlikely x Major)	Ensure all hatches and possible entry points for rainwater, plant matter, insects, birds, vermin etc. are secure against ingress or access. Implement routine inspection of the storage reservoirs.	WPTL TS
Microbiological contamination	10.2	Vandalism to reservoir.	Moderate (Possible x Medium)	E. coli in water leaving reservoir. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i> Decreased FAC in water leaving reservoir. Reports from the public.	Residual chlorine in water.	Partially.	Moderate (Unlikely x Medium)	Restrict access to the reservoir sites through the construction of appropriate fencing. Install alarms on reservoir access hatches.	TSTL

Table 18. Microbiological contamination	10.3	Risk Table: Storage Reservoirs Sediment accumulation within reservoirs.	Moderate (Possible x Medium)	Visible suspended matter in water exiting reservoir. Decreased FAC in water leaving reservoir. Complaints from consumers.	Residual chlorine in water.	Partially.	Moderate (Unlikely x Medium)	Plan routine inspection and cleaning of the storage reservoirs.	TS
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10. Storage Reservoirs									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Microbiological Contamination	10.4	Contamination through unsanitary maintenance or sampling procedures.	Moderate (Possible x Medium)	E. coli in water leaving reservoir. Decreased FAC in water leaving reservoir. <i>(Set points outlined in Managing Drinking Water Supply Critical Control Points WDC promapp)</i>	Residual chlorine in water. Access to reservoirs is restricted to trained staff.	Yes.	Moderate (Unlikely x Medium)	None.	
Loss of Supply	10.5	Reservoir failure during earthquake	Very High (Possible x Catastrophic)	Reduction in reservoir water level.	N/A	No.	Very High (Possible x Catastrophic)	Fit anti-surge baffles, to reduce the probability of reservoir failure during earthquakes.	WPTL

Table 19. Risk Table: Other

11. Other									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Sampling Failure	11.1	Inadequate sampling programme or sample collection error.	High (Likely x Medium)	DW SNZ compliance failure due to days of week, days between samples, insufficient samples, information gaps, positive results or sampling error.	Sampling programme prepared and checked against Standards. Relevant staff well trained and qualified.	Partially.	Moderate (Unlikely x Medium)	Ensure sampling programme is reviewed by independent. Ensure sample collection follows sampling programme.	CITL
Unrecognised Contamination	11.2	Inadequate sampling programme, sample collection error or response to transgression.	High (Likely x Medium)	Gaps in records from weekly testing regime.	Sampling programme prepared checked against Standards. Relevant staff well trained and qualified. Hills Laboratory does E. coli testing and inform WDC promptly if positive result is detected. Results recorded in WaterOutlook (WDC's operational and data reporting system for monitoring the quality of water).	Yes.	Moderate (Unlikely x Medium)	None.	

11. Other

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Unidentified Operational Failure of Treatment Plant	11.3	Treatment plant processes are not sufficiently monitored or alarmed.	Very High (Likely x Major)	Process failure not identified before supply is contaminated. Contamination identified in supply. Operational near miss identified.	Telemetry includes continuous FAC, pH and turbidity monitoring. Operators visit site twice weekly. Process will shut down prior to forfeiting compliance.	Partially.	High (Unlikely x Major)	Set up documented inspection schedule, to ensure plant equipment and processes are checked to ensure correct operation.	TS
Failure of Supply Equipment due to Inadequate Maintenance.	11.4	Supply equipment fails due to inadequate asset information and inadequate maintenance planning.	Very High (Almost Certain x Medium)	Unexpected plant equipment failure. Not having an asset register and maintenance programme. No formal supply agreement with Irrigation Scheme.	Some maintenance planned and undertaken on WDC owned assets including basic lubrication and greasing of pumps undertaken by operator. Specialist maintenance is contracted out as required.	Partially.	High (Likely x Medium)	Review the process for planning and recording of preventative maintenance. Prepare a preventative maintenance plan for the treatment plant. Document (via an agreement with the Te Kauwhata Irrigation Association) who has responsibility for Irrigation Scheme reticulation area maintenance, repairs and management including response times, material specifications, required qualifications and notifications.	WPTL

11. Other

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Failure of Supply due to Unavailability of Spare Parts	11.5	Inadequate spare parts held or spare parts unavailable.	Very High (Almost Certain x Medium)	Plant is out of operation due to not having spare parts available.	Spare parts are held for some things. Replacement spares parts are usually available overnight.	Partially.	Moderate (Possible x Medium)	Evaluation of required spares to be undertaken following asset criticality assessment. Identify necessary storage requirements to achieve 24 hours' age, and the necessary infrastructure is added to the AMP.	WPTL
Failure of Supply due to Inadequate Operating Procedures Loss of supply	11.6	Insufficient, inadequate, out of date or incorrect manual of operational procedures.	Very High (Almost Certain x Medium)	Operational manuals not used. Operational Manuals not up to date. Operational manual copies are not the same.	Operational manuals issued 2006 but require review. Standard operating procedures are incomplete.	Partially.	Moderate (Possible x Medium)	Undertake a review of the operational manual and standard operating procedures for the treatment plant. Update, complete and finalise where necessary.	TS
Operator Error or Mismangement	11.7	Inadequate training, professional development and up-skilling of operators.	Very High (Likely x Major)	Poor operation of plant. Plant compliance failure. Loss of supply. Poor score on question about level of supervision in supply grading.	The plant operator has a National Certificate in Water Treatment. Ongoing training and upskilling provided for operators	Partially.	High (Unlikely x Major)	Provide ongoing annual training to maintain operator competence. Provide water treatment operator training.	TSTL / TS

11. Other									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Security Breach	11.8	Inadequate security at treatment plant allowing theft or vandalism.	Very High (Possible x Major)	Obvious signs of break in, theft or vandalism.	Door security alarms telemetered. Treatment plant is fenced.	Partially.	High (Unlikely x Major)	None.	
Complaints of Poor Taste or Odour in Water	11.9	Poor aesthetic quality of water not identified.	High (Possible x Medium)	Taste and odour complaints. Aesthetic sampling identifies determinands which exceed the NZDWS Guideline Values for aesthetic determinands.	Complaints investigated.	Partially.	Moderate (Unlikely x Medium)	Undertake testing for aesthetic determinands and compare against DW SNZ Guideline Values.	CITL

11. Other

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Loss of Treatment Plant Connectivity or Loss of Process Data	11.10	Lightning strike or power surge affecting telecoms.	High (Likely x Medium)	Loss of telecoms connection between treatment plant and office. Incomplete recorded data set of treatment plant process information. DW SNZ compliance failure due to not being able to provide complete treatment plant data sets.	Data recorded on WaterOutlook system.	Partially.	High (Possible x Medium)	Install computer hard drive process data storage capacity at the treatment plant as the primary data storage for the treatment plant.	TSTL / CITL / WPTL
Failure of Supply Infrastructure due to Liquefaction	11.11	Earthquake reduces the strength and stiffness of soil supporting water supply structures, and subjects the structures and equipment to high accelerations.	Extreme (Unlikely x Catastrophic)	Unexpected plant structures and equipment failure. Loss of supply. Complaints from consumers about low pressure or loss of supply. Change in flow or pressure in reticulation.	Structural review of Priority 1 and 2 buildings currently being undertaken by WDC.	Partially	High (Rare x Catastrophic)	Structure review and seismic strengthening of existing water infrastructure where required. Preparation of an earthquake response plan.	WPTL

11. Other									
Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Too much fluoride	11.12	Incorrect dosing set point.	High (Possible x Medium)	Fluoride levels found to be high (>1mg/L).	Fluoride is continuously monitored in the clear water tank. Fluoride is continuously monitored in the final water, using duplicate instrumentation. Fluoride testing done weekly at treatment plant and in reticulation as required by DW SNZ.	Yes.	Moderate (Unlikely x Medium)	None.	

11. Other

Event	No.	Cause	Risk Without Preventative Measures	Indicators	Preventative Measures in Place	Controlled	Residual Risk	Additional Measures That Could be put in Place	Resp.
Too much fluoride	11.13	Failure of dosing system.	High (Possible x Medium)	Fluoride levels found to be high. (>1mg/L).	Fluoride is continuously monitored in the clear water tank. Fluoride is continuously monitored in the final water, using duplicate instrumentation. Fluoride testing done weekly at treatment plant and in reticulation as required by DW SNZ.	Yes.	Moderate (Unlikely x Medium)	None.	
Operator Injury	11.14	Fall	Extreme (Possible x Catastrophic)	Slip on intake structure due to lack of grip. Fall from intake structure due to absence of railing.	Identification and awareness of hazard.	Partially.	Extreme (Unlikely x Catastrophic)	Fit non-slip material to intake structure walking surface. Fit handrails.	TS